

**TRAFFIC OPERATION AND  
SAFETY REVIEW AT LEE  
ROAD AND HIGHWAY 19A  
PARKSVILLE, BC**



**INSURANCE CORPORATION OF BRITISH COLUMBIA  
MINISTRY OF TRANSPORTATION**

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# **TRAFFIC OPERATION AND SAFETY REVIEW AT LEE ROAD AND HIGHWAY 19A**

## **PARKSVILLE, BC**

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## EXECUTIVE SUMMARY

The traffic operations and safety at the unsignalized intersection of Lee Road and Highway 19A in Parksville have been the subject of concern in the community. Area residents and businesses have been requesting that the Ministry of Transportation (the Ministry) install a traffic signal at this intersection to facilitate movements into and out of Lee Road. There is a perception in the community that the intersection presents a high risk of crashes, and that it is operationally inefficient due to long delays for the Lee Road movements. Current conditions at the intersection are seen to be hindering the mobility of residents and customers.

An analysis of traffic crash records and collision claim records was conducted in 2005 by Insurance Corporation of British Columbia (ICBC) staff. The analysis indicated an average crash rate at the intersection, relative to intersections with a similar geometric and traffic control configuration. The requests for a traffic signal have nevertheless persisted. The Ministry and ICBC therefore further commissioned Opus Hamilton to conduct an independent traffic operation and safety assessment, to objectively review the performance of the intersection and develop recommendations for solution options that can be considered for implementation.

Based on the above findings from reviews and analyses of the physical, traffic and collision characteristics, several safety issues were identified as follows:

- The rear-end collisions for the right-turning movement on Lee Road westbound are most likely caused by drivers of the front vehicle slowing abruptly or stopping to wait for an adequate gap in merging, while drivers following closely did not expect the stop when coming up from the hill.
- Due to the uphill gradient and sharp turning on the Lee Road westbound approach, trucks and trailer vehicles which are entering the intersection at slow speeds may also result in high collision risk with the mainstream vehicles traveling on Highway 19A at high speeds. This speed differential may contribute to the left-turn crossing collisions.
- The long delays when exiting Lee Road westbound occurring at a particular instance could make some drivers become impatient and accept shorter gaps in making the manoeuvres, possibly resulting in higher left-turn crossing collision risks.

- The highway vehicles which are likely travelling faster than the posted speed limit increase the collision risk with the merging traffic from Lee Road.
- Drivers on Lee Road eastbound were not advised by any STOP ahead or intersection ahead warning sign, which could result in a higher collision risk at the intersection under poor visibility condition.
- Some drivers on Lee Road eastbound which travel faster than the posted speed limit may lose control of their vehicles when approaching the intersection due to the downhill gradient.
- Drivers from the northbound and southbound of the highway when making right turns onto Lee Road were not advised of the safe turning speed to navigate the sharp right-turn curve. Similarly, eastbound and westbound drivers approaching the curve east of the intersection on Lee Road were not advised of a safe driving speed to negotiate the curve.
- Due to the limited availability of lighting, drivers are having low visibility of the intersection at nights and in dark conditions, especially when approaching downhill on Lee Road eastbound.
- Roadside vegetation and the large ferry guide sign could block drivers' sightlines when approaching or exiting the intersection.
- The relatively high proportion of older drivers in the area and their longer reaction and comprehension times will exacerbate the above issues.

Various potential long-term mitigating measures have been examined and it is suggested that road realignments, including grade alterations on Lee Road and provisions of offset right-turn lanes on both northbound and southbound approaches of Highway 19A to improve sightlines, be considered.

The analysis also indicated that a traffic signal is unwarranted, and that the net safety benefits may be negligible. The provision of a traffic signal at this location is therefore not recommended at this time. However, the analysis indicates that the intersection may warrant a signal in the future. It is suggested that the Ministry re-evaluate the intersection in the near future, and possibly review up-to-date collision characteristics to assess the safety benefits.

Other possible safety improvements which could be treated as low cost and ready-to-implement options include the following:

- i. Provide advanced reduce speed limit warnings on both northbound and southbound of Highway 19A;
- ii. Repaint the faded pavement markings and turn arrows;
- iii. Install intersection ahead warning signs on Highway 19A approaches;
- iv. Conduct a lighting warrant analysis in order to assess whether additional lighting fixtures are deemed necessary, and if additional lighting is warranted, install additional lighting fixtures at the intersection;
- v. Provide painted broken white lines delineating the through traffic lanes on the exit legs of Highway 19A from the right-turn channelized lanes on Lee Road eastbound and westbound;
- vi. Provide advisory exit speed limit signs for the right-turn deceleration lanes on both Highway 19A northbound and southbound approaches and for both directions of the curve section of Lee Road east of the intersection (subject to confirming the curve radius, as well as possibly a safe curve speed survey using a properly calibrated vehicle to confirm the advisory speed in safely negotiating the curve section);
- vii. Provide additional stop signs on the left-side of Lee Road approaches;
- viii. Install a stop ahead warning sign on Lee Road eastbound;
- ix. Post a speed limit sign of 50 kilometres per hour on Lee Road eastbound;
- x. Provide animal crossing warning signs on all approaches;
- xi. Trim roadside vegetation; and
- xii. Relocate the large ferry guide sign on Highway 19A southbound further north or overhead in order to minimize the interference with the sight lines.

In order to reduce the collision risks and to ease the traffic from Lee Road merging onto the highway, it is also strongly recommended that the travel speed along the study corridor be monitored and enforced to encourage drivers to travel at the reduced highway speed of 60 kilometres per hour.

In addition, taking into account the high population of older drivers in the area, some specific measures to accommodate older drivers were recommended which include the following:

- a. Increase the size of the existing stop signs and street name signs on Lee Road approaches; and
- b. Provide wider pavement marking to clearly delineate the travel path for older drivers on all approaches to the intersection.

Economic evaluations of the proposed improvements at the study intersection are therefore conducted for the proposed two implementation plans as follows:

- |        |   |
|--------|---|
| Plan 1 | Implement only the ready-to-implement safety improvements and specific measures for older drivers; and,                                     |
| Plan 2 | Implement the ready-to-implement safety improvements and specific measures for older drivers plus the provision of offset right-turn lanes. |

The results of the economic evaluations including the improvement cost estimates, potential annual savings for ICBC, and potential ICBC funding are summarized in TABLE ES.1 for the two proposed implementation plans. A detailed breakdown of the improvement cost assumptions is included in APPENDIX C.

**TABLE ES.1 RESULTS OF ECONOMIC EVALUATION**

<b>PROPOSED IMPLEMENTATION PLAN</b>	<b>TOTAL ESTIMATED COSTS</b>	<b>POTENTIAL ANNUAL SAVINGS</b>	<b>POTENTIAL ICBC FUNDING</b>
PLAN 1	\$87,000	\$11,000	\$10,500
PLAN 2	\$327,000	\$13,700	\$15,000

The next steps will be for ICBC and the Ministry to consider the feasibility of implementing these proposed mitigating measures and to conduct a second round of public consultation with the stakeholders with regard to the two proposed implementation plans. With continued cooperation between the Ministry and ICBC, the study intersection can be made safer for all road users.

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## **1.0 INTRODUCTION**

### **1.1 Background**

The traffic operations and safety at the unsignalized intersection of Lee Road and Highway 19A in Parksville have been the subject of concern in the community. Area residents and businesses have been requesting that the Ministry of Transportation (the Ministry) install a traffic signal at this intersection to facilitate movements into and out of Lee Road. There is a perception in the community that the intersection presents a high risk of crashes, and that it is operationally inefficient due to long delays for the Lee Road movements. Current conditions at the intersection are seen to be hindering the mobility of residents and customers.

An analysis of traffic crash records and collision claim records was conducted in 2005 by Insurance Corporation of British Columbia (ICBC) staff. The analysis indicated an average crash rate at the intersection, relative to intersections with a similar geometric and traffic control configuration. The requests for a traffic signal have nevertheless persisted. The Ministry and ICBC therefore further commissioned Opus Hamilton to conduct an independent traffic operation and safety assessment, to objectively review the performance of the intersection and develop recommendations for solution options that can be considered for implementation.

### **1.2 Study Objectives**

The objectives of this study are to:

- Identify current traffic safety and operational concerns at the study intersection;
- Develop and evaluate mitigation measures that would reduce the risk of collisions and improve traffic efficiency at the study intersection; and
- Determine the potential for funding favourable mitigation measures from the ICBC Road Improvement Program and recommend an improvement strategy for the study intersection.

### 1.3 Study Location

The study intersection is along Highway 19A, a north-south highway linking various Vancouver Island communities along the Strait of Georgia coast. The intersection is under the jurisdiction of the Ministry located in between the communities of Parksville and Qualicum Beach. The study intersection provides the only access route to the French Creek Boat Harbour, which is about one kilometre to the east of Highway 19A. The French Creek Boat Harbour has a small park, a restaurant / pub, a fishery and pleasure craft market, a grocery store, and a passenger ferry to Lasqueti Island. The intersection also provides access to a Regional Park, a golf course and residential developments to the west of the highway. The intersection location is shown in FIGURE 1.1.

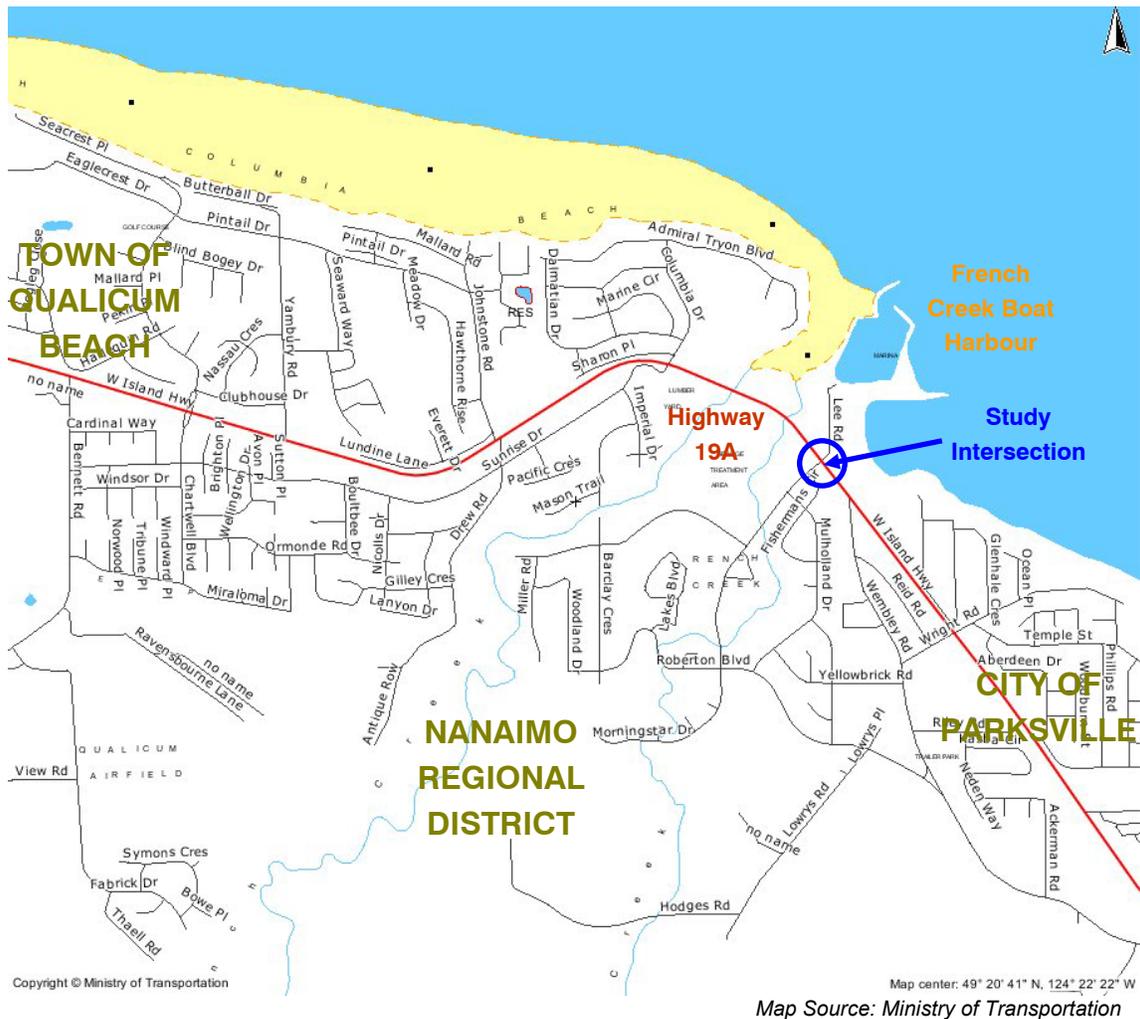


FIGURE 1.1 LOCATION OF STUDY INTERSECTION

Highway 19A in the vicinity of the intersection is oriented northwest-southeast. For clarity, Highway 19A for this study is assumed to be the north-south street, while Lee Road is assumed to be the east-west street.

## 1.4 Study Tasks

The following tasks were completed in this study:

- i. Site observations and traffic conflict analysis of the physical characteristics of the study intersection;
- ii. Review and analysis of the 2005 monthly and hourly traffic flow profiles of the area based on Ministry's traffic count data in the vicinity;
- iii. Review of the user characteristics of the study area;
- iv. Collection and review of traffic counts covering the peak hour periods for a typical weekday and weekend in August 2006;
- v. Review and analysis of Ministry's crash data and ICBC's collision claim records between January 2001 and December 2005;
- vi. Public consultation with the stakeholders in appreciating concerns, issues, and suggested solutions from the perspective of vulnerable road users;
- vii. Review and analysis of traffic characteristics and safety of the intersection including interactions with the road geometry, existing traffic control devices and other human factors that may affect the risk of collisions;
- viii. Road operation and traffic signal warrant analysis of the intersection taking into consideration of the vicinity traffic growth, alternative route choices, and adjacent intersection capacities;
- ix. Identification of safety issues and potential mitigating measures with consideration of both low cost / ready-to-implement options as well as higher cost improvement options;
- x. Evaluation of the various potential mitigating measures and estimation of potential level of ICBC investment to the suggested improvements; and,
- xi. Recommendation of improvement strategy to facilitate a second round of public consultation with the stakeholders.

## 2.0 INTERSECTION CHARACTERISTICS

### 2.1 Physical Characteristics

FIGURES 2.1 and 2.2 show respectively the photos and layout of the intersection. The general physical characteristics of the intersection are described below.

#### *Road Network*

- Highway 19A is a two lane provincial highway that connects the island communities of Parksville and Qualicum Beach, and has some characteristics of an urban arterial.
- Along Highway 19A, there are traffic signals at the major intersections, and minor cross streets are controlled by STOP and YIELD signs. There are also some driveways that provide direct access to private properties on both sides of the highway.
- Lee Road is a two lane paved roadway that provides the only access route to the French Creek Boat Harbour, which is about one kilometre to the east of the highway.
- Lee Road west of the highway is also a two lane paved roadway that provides access to a Regional Park, the Morningside Golf Course and surrounding residential developments. Alternate routes are available to the area from other access points on Highway 19A.

#### *Lane Configuration*

- The single traffic lane as provided in each direction of Highway 19A widens to become a three lane configuration with a left-turn bay, a through traffic lane, and a right-turn deceleration lane when approaching northbound and southbound to the study intersection.
- A dedicated left-turn lane, a through traffic lane, and a channelized right-turn lane are provided when approaching eastbound and westbound from Lee Road to the study intersection.

#### *Traffic Control Devices*

- At the study intersection, left-turn and through traffic from Lee Road eastbound and westbound are controlled by the STOP signs, and the right-turn traffic onto the highway are provided with YIELD signs. A small street name sign is placed above the stop sign for Lee Road westbound.

- Traffic signals are installed at the intersection of Wrights Road and Highway 19A (about 800 metres to the south of the study intersection) and at the intersection of Bennett Road and Highway 19A (about four kilometres to the north of the study intersection).

#### *Pavement Markings*

- Double-yellow centrelines are provided on the highway as well as on the Lee Road approaches.
- Stop lines are provided for the left-turn and through traffic lanes on Lee Road eastbound and westbound.
- Roadside delineation lines are marked on both sides of the highway.
- Some of the pavement markings and turn arrows are faded.

#### *Vertical and Horizontal Curvatures*

- On Highway 19A, there is a vertical curve at about 200 metres south of the intersection and a horizontal curve at about 100 metres north of the intersection.
- The northbound and southbound approaches on Highway 19A are generally level at the study intersection.
- The topography of Lee Road has a gradual downhill slope from the highway on the west to the harbour on the east. Lee Road has an uphill grade when approaching westbound and a downhill grade when approaching eastbound to the intersection.
- There is a sharp horizontal curve on Lee Road for access to or egress from the harbour. A review of aerial photographs indicates that the curve has a radius of approximately 50 metres. This generally indicates a design speed of about 40 kilometres per hour according to the Geometric Design Guidelines for Canadian Roads by the Transportation Association of Canada. The curve radius, as well as other features such as superelevation would need to be confirmed before determining the design speed.
- The channelized right-turn lanes from Highway 19A onto Lee Road appear to have a radius of about 50 metres, and would have a similar design speed.

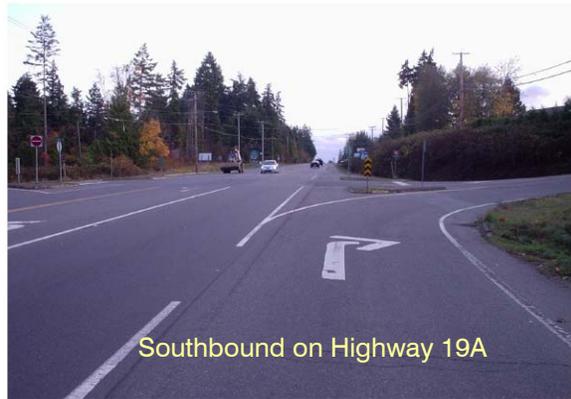
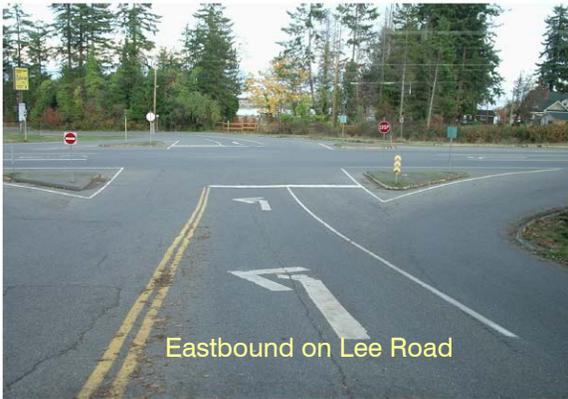
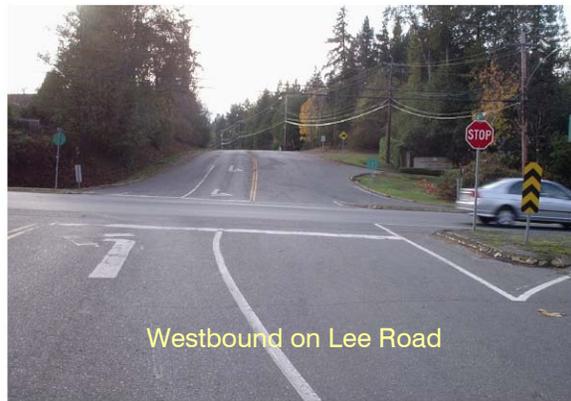
#### *Lighting*

- Two lighting fixtures are provided at the study intersection with one at about midway of the right-turn deceleration lane on Highway 19A northbound and the other located distant from the ditch at the north-west corner of intersection. In general, the intersection provides low lighting conditions.



*Posted Speed Limits and Other Traffic Signs*

- The posted speed limits are 60 kilometres per hour on Highway 19A and 50 kilometres per hour on Lee Road. The posted speed limit on Highway 19A is reduced to 50 kilometres per hour at about 500 metres to the south of the intersection when travelling on the southbound approach.
- A truck crossing / turning ahead sign is viewed on Lee Road when travelling to the west from the intersection.
- A curve ahead warning sign and an advisory speed sign of 60 kilometres per hour are provided on Highway 19A northbound and southbound for motorists to navigate the horizontal left-turn curve at about 100 metres north of the intersection.
- A large ferry guide sign is provided on Highway 19A southbound at about the beginning of the left-turn lane.
- Hazard markers to mark the start of the raised islands and no entry signs to warn the drivers from entering into the wrong traffic lanes are provided on all approaches to the intersection.



**FIGURE 2.1 PHOTOS OF THE STUDY INTERSECTION**

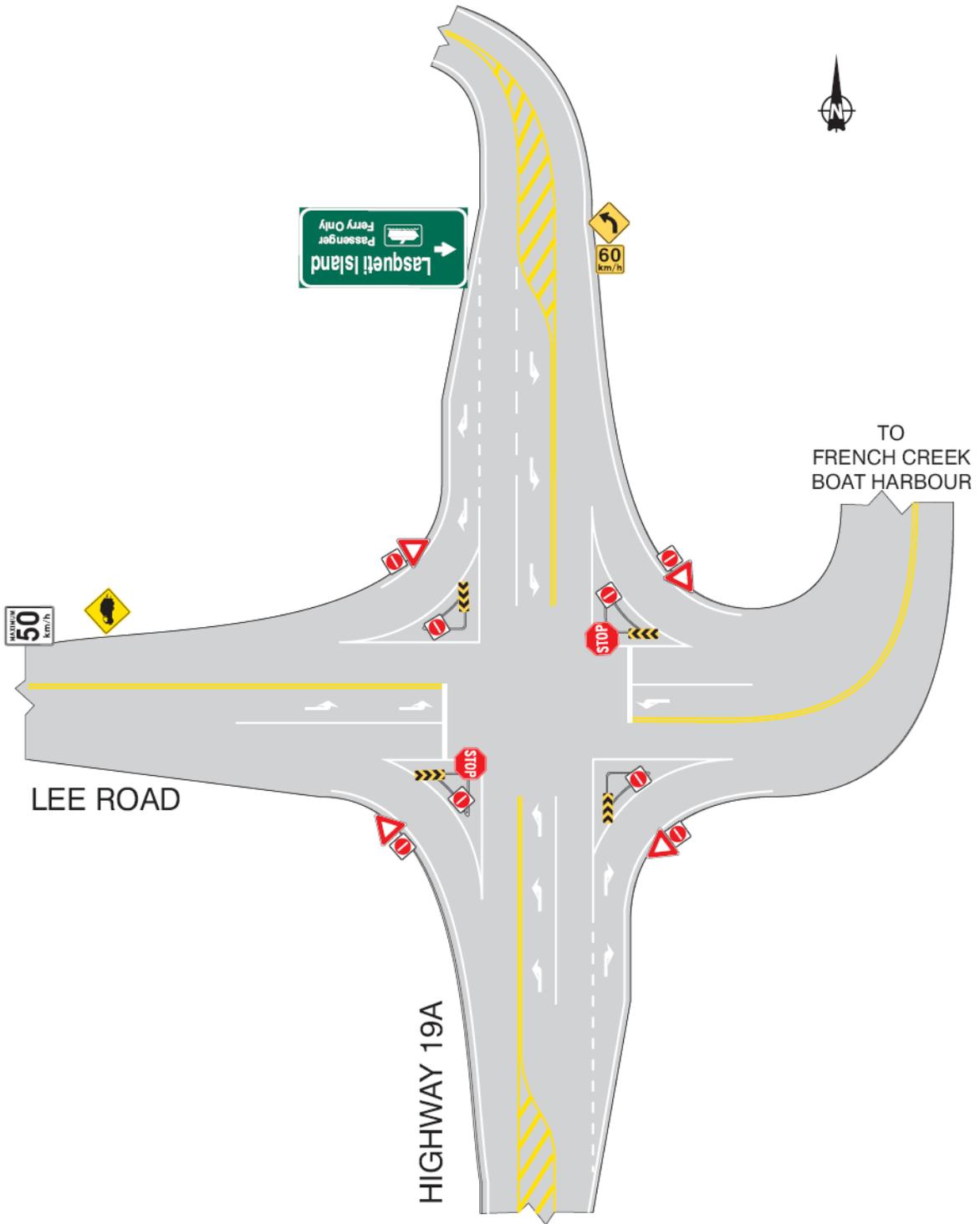


FIGURE 2.2 INTERSECTION LAYOUT

## 2.2 Intersection Sightlines

Traffic conflict analysis was carried out on-site to identify adequacy of sightlines for drivers when approaching the intersection from each arm. The following observations are noted:

### *Lee Road Traffic Approaching Highway 19A in Westbound Direction*

- The intersection and highway is generally visible when approaching uphill from the harbour on Lee Road westbound as shown in FIGURE 2.3.
- Vehicles from Lee Road westbound waiting at the stop line to merge into the mainstream highway traffic can be seen by approaching drivers in both northbound and southbound directions.
- The sightline distances, as shown in FIGURE 2.4, when looking south and north from the stop line on Lee Road westbound appeared to be adequate for drivers to enter or cross the highway with vehicles travelling at or near the posted speed limit. However, as is the case with many other intersections in the Province, if there are vehicles queuing in the left-turn lane on Highway 19A southbound or in the right-turn lane on Highway 19A northbound, the queues may block Lee Road drivers' views of through traffic approaching on the highway.



**FIGURE 2.3 APPROACHING HIGHWAY 19A FROM LEE ROAD WESTBOUND**



**FIGURE 2.4 SIGHTLINES FROM LEE ROAD WESTBOUND**

*Lee Road Traffic Approaching Highway 19A in Eastbound Direction*

- Due to the downhill slope on Lee Road eastbound, the stop line and auxiliary lanes only become visible as vehicles get closer to the highway. The highway and the intersection are visible as drivers approach the intersection as shown in FIGURE 2.5.
- The sightline distances when looking north and south from the stop line on Lee Road eastbound, as shown in FIGURE 2.6, are generally adequate for drivers to enter or cross the highway with vehicles travelling at or near the posted speed limit under good visibility conditions. However, sightlines to the north may become more critical when conditions are less than ideal as they are limited by the horizontal curvature and roadside vegetation. Also, as is the case with many other intersections in the Province, Lee Road drivers' views of through traffic approaching on the highway could be blocked by the left-turning queues on the northbound and right-turning vehicles on the southbound.



**FIGURE 2.5 APPROACHING HIGHWAY 19A FROM LEE ROAD EASTBOUND**



**FIGURE 2.6 SIGHTLINES FROM LEE ROAD EASTBOUND**

*Highway 19A Traffic Approaching the Intersection in Southbound Direction*

- The intersection first appears in the field of vision as drivers approach the horizontal curve section on Highway 19A southbound, as shown in FIGURE 2.7.
- The ferry guide sign may momentarily obscure drivers' visibilities of vehicles coming out from Lee Road eastbound at certain approach positions.



**FIGURE 2.7 APPROACHING THE INTERSECTION IN SOUTHBOUND DIRECTION**

*Highway 19A Traffic Approaching the Intersection in Northbound Direction*

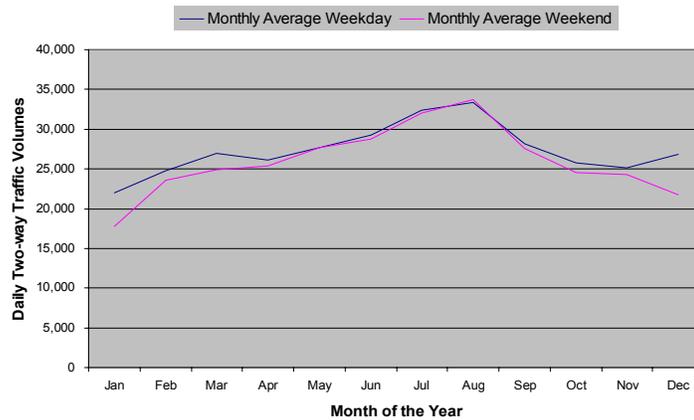
- Motorists when approaching the intersection in northbound direction, as shown in FIGURE 2.8, have good and unobstructed visibility of the intersection and vehicles coming out from Lee Road. However, the right-turn deceleration lane which leads to a sharp turn onto Lee Road is not clearly discernable.



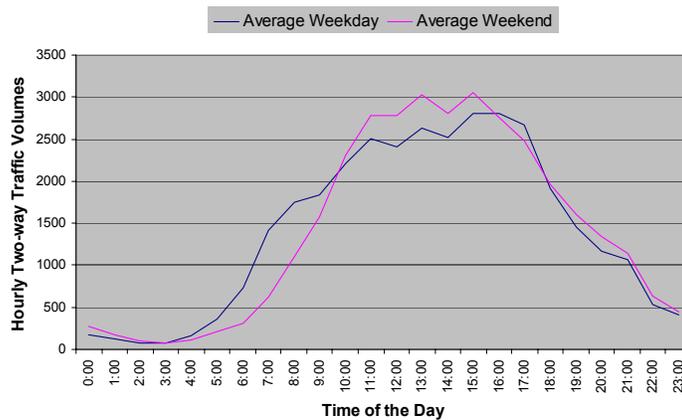
**FIGURE 2.8 APPROACHING THE INTERSECTION IN NORTHBOUND DIRECTION**

### 2.3 Traffic Characteristics and On-Site Observations

The 2005 annual traffic data as obtained from the Ministry traffic count station (P-14-1NS), which is located on Route 19 at about 2.1 kilometres south of Parksville, was selected for analysis of the monthly and hourly traffic flow characteristics in the area. The 2005 monthly traffic profiles by average weekday and weekend are illustrated in FIGURE 2.9. The graph represents a typical monthly traffic flow profile of the area, where the highest traffic flow volumes occur in August because the land uses in the area are related to summer activities. The 2005 August hourly traffic profiles by average weekday and weekend are therefore selected for analysis and are illustrated in FIGURE 2.10.



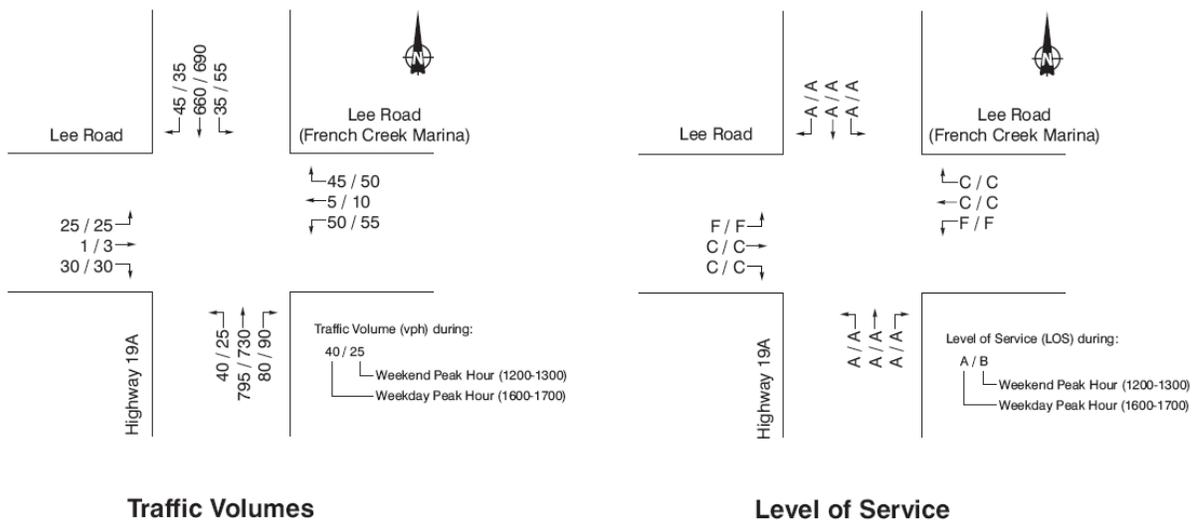
**FIGURE 2.9 2005 MONTHLY TRAFFIC PROFILES IN THE AREA**



**FIGURE 2.10 AUGUST 2005 HOURLY TRAFFIC PROFILES IN THE AREA**

FIGURE 2.10, which illustrates the general hourly traffic profile of the area in August 2005, suggests that the average weekday and weekend peak hour traffic volumes occur between 1200 and 1700 hours in the afternoon period. Vehicle turning movement counts covering the peak hour periods on Saturday, 12 August 2006 and on Wednesday, 16 August 2006 for the study intersection, which have also been provided by the Ministry for this study, were selected for analysis. Analysis of the traffic counts found that the peak hour vehicle turning movement volumes occurred from 1600 to 1700 hours during the weekday (Wednesday), and from 1200 to 1300 hours during the weekend (Saturday).

FIGURE 2.11 summarises the weekday and weekend peak hour traffic volumes of the study intersection. The existing operational performance of the study intersection was assessed in terms of Level of Service and was also shown in FIGURE 2.11.



**FIGURE 2.11 WEEKDAY AND WEEKEND PEAK HOUR TRAFFIC CONDITIONS**

The following traffic characteristics are generally noted:

- In general, the traffic volumes and distribution patterns are similar during weekday and weekend peaks with about 1,800 vehicles per hour using the intersection.
- The peak hour traffic volumes at the study intersection are dominant in the north-south direction on Highway 19A with about 1,460 and 1,420 vehicles per hour (two-way) during weekday and weekend.

- The east-west traffic volumes on Lee Road are relatively light as compared to that on Highway 19A.
- Lee Road westbound has two-way traffic volumes of about 220 to 260 vehicles per hour during the weekday and weekend peak hour periods and Lee Road eastbound has two-way traffic volumes of about 150 to 130 vehicle per hour during the weekday and weekend peak hour periods.
- The results of analysis indicate that the study intersection is currently operating at adequate Levels of Service on all approaches and movements except the eastbound and westbound left-turning movements from Lee Road. These movements are experiencing long delays and queues as indicated by the result of Level of Service F. Improvement measures should therefore be considered for these two left-turn movements.

The intersection performance analysis as presented in FIGURE 2.11 was conducted using the computer simulation software, Synchro, developed by Trafficware and based on the methods outlined in the Highway Capacity Manual issued by the Transportation Research Board in 2000. The estimated queue lengths from the Synchro analysis are summarised in TABLE 2.1 for the two critical left-turn movements on Lee Road eastbound and westbound. Maximum left-turn queue length was estimated to be about 39 metres (around six to seven vehicles) during the weekend peak hour.

**TABLE 2.1 LEFT-TURN QUEUE LENGTHS**

MOVEMENT	QUEUE LENGTH 95th (m)	
	WEEKDAY PEAK HOUR (1200-1300)	WEEKEND PEAK HOUR (1600-1700)
Left-turn on Lee Road Eastbound	16.1	16.5
Left-turn on Lee Road Westbound	34.9	39.0

Other site observations related to the existing traffic conditions and drivers' behaviour at the intersection were also noted as follows:

- Large trucks and vehicles with boat trailers are generated from the French Creek Boat Harbour. Due to the uphill gradient and sharp turning on Lee Road westbound, the trucks and trailers generally approach the intersection at slow speeds and the drivers sometimes experience difficulties in accelerating after a complete stop especially when they need to make a left-turn or cross the highway.
- Lee Road westbound left-turn or through drivers are delayed for a considerable length of time while waiting for a safe entry gap, and some drivers were observed to become impatient and accepted shorter gaps in making the manoeuvres, resulting in potentially unsafe movements.
- The delays in exiting Lee Road westbound become worse (some vehicles were observed to wait up to 10 minutes) when the Lasqueti Island ferry arrives and discharges passengers to their waiting vehicles at the same instance.
- Unlike Lee Road westbound, there is a downhill gradient on Lee Road eastbound. Some vehicles on Lee Road eastbound appeared to travel faster than the posted speed limit of 50 kilometres per hour and the approach, and could only come to a complete stop after the stop line at the intersection.
- The highway traffic was generally moving in platoons that were likely created by the traffic signals located upstream in both directions.
- Some vehicles are likely travelling faster than the posted speed limit of 60 kilometres per hour on the highway.
- Some drivers from the northbound highway traffic when making right turns onto Lee Road to the harbour appeared to travel much faster than a typical safe turning speed of 40 kilometres per hour around a channelized right-turn lane.

## 2.4 Road User Characteristics

According to the 2001 Canadian census, a high concentration of older residents was found in the areas of Qualicum Beach and Parksville. TABLE 2.2 shows the age profiles of the study area as compared to the entire province.

**TABLE 2.2 AGE PROFILES OF THE STUDY AREA**

AGE GROUP	PERCENT DISTRIBUTION		
	QUALICUM BEACH	PARKSVILLE	B.C. PROVINCE
0 – 4	2.1%	4.1%	5.3%
5 – 14	8.5%	11.4%	12.8%
15 – 19	4.8%	5.3%	6.9%
20 -24	2.6%	3.2%	6.2%
25 – 44	13.5%	20.1%	30.1%
45 – 54	14.0%	12.2%	15.3%
55 – 64	16.4%	12.9%	9.7%
65 – 74	20.9%	15.4%	7.3%
75 – 84	14.5%	11.8%	4.8%
85 and over	2.6%	3.6%	1.5%
Median Age of the Population	58.1	49.6	38.4

Source: 2001 Canadian Census

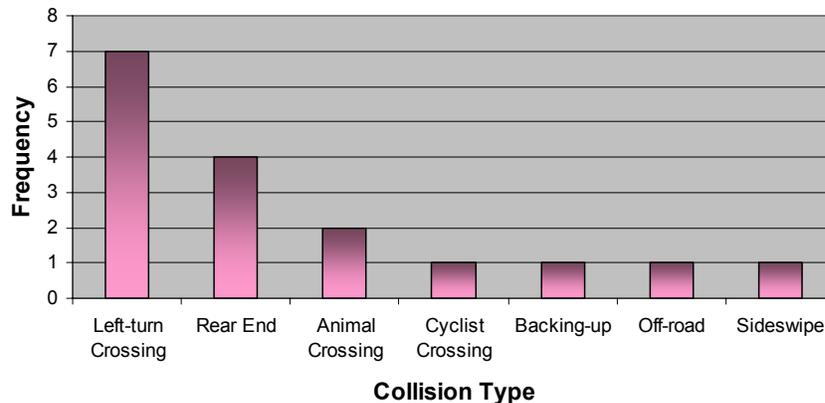
As can be seen from TABLE 2.2, both Qualicum Beach and Parksville have a high proportion of older residents (38 percent and 30.8 percent respectively) who are 65 and over as compared to that (an average of 13.6 percent) for the entire Province. The high concentration of older residents was also shown by the higher median age of 58.1 in Qualicum Beach and 49.6 in Parksville as compared to 38.4 for the entire Province. Older drivers tend to have more difficulty in seeing and recognizing signs, and may take longer in reading and comprehending textual information. They may also have slower physical reaction times that would increase the collision risk for all movements at this intersection.

### 3.0 COLLISION DATA ANALYSIS

#### 3.1 Severity and Types of Collisions

Ministry's crash data and ICBC's collision claim records between January 2001 and December 2005 were reviewed. A total of 14 collisions were reported in the Ministry's data and a total of 17 collisions were reported by the ICBC's claim records. For the collision analysis of this study, the ICBC's claim records were used.

Out of the 17 ICBC's claim records, 12 collisions (71 percent) involved property damage only, and 5 collisions involved casualty. No fatalities were reported from the 5-year collision data. FIGURE 3.1 summarises the types of collisions at the study intersection.

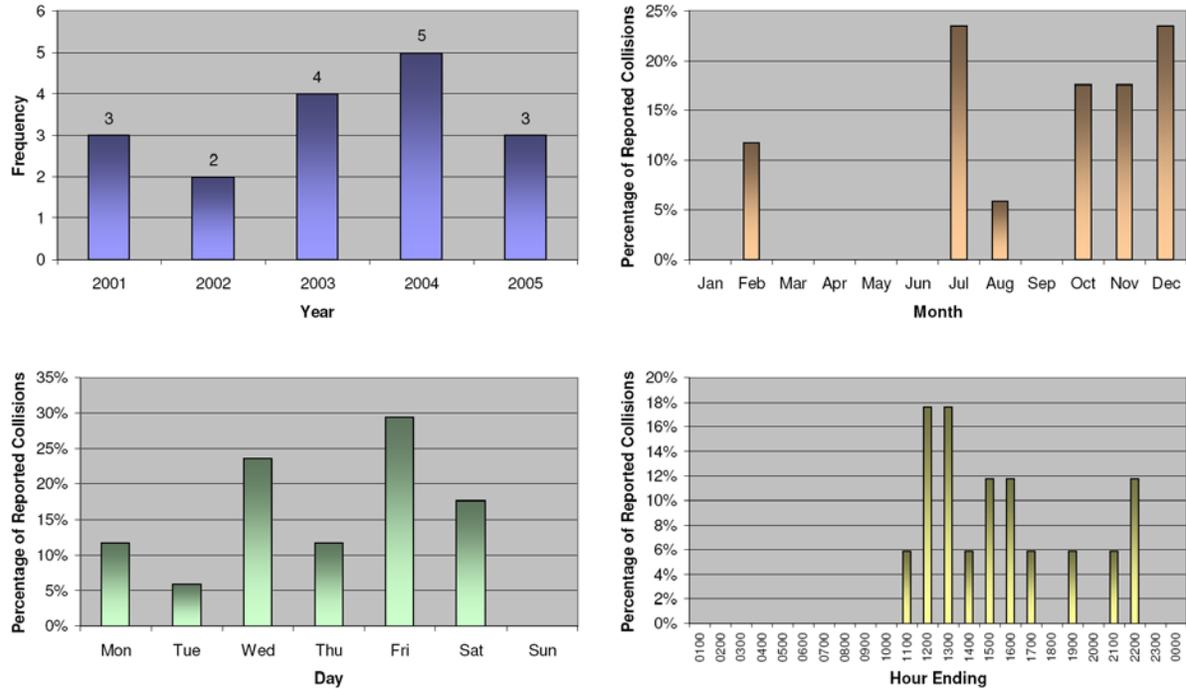


**FIGURE 3.1 DISTRIBUTION OF COLLISION TYPE**

As can be seen from FIGURE 3.1, left-turn crossing collisions were dominant (7 out of 17) at the study intersection followed by rear-end collisions (4 out of 17). Most of these left-turn crossing and rear-end collisions are related to vehicles exiting from the French Creek Boat Harbour on Lee Road westbound. Other collision claims involved animals and a cyclist crossing in the vicinity of the study intersection, backing-up for a sweeper truck when making a right-turn onto Lee Road, losing control of vehicle due to the icy road condition, and sideswiping when pulling out from side of the highway.

### 3.2 Temporal Distribution of Collisions

The temporal distributions of the collisions were also analyzed to establish the relationship between time and collision frequency. The temporal distributions of collisions by year, month, day of the week, and time of the day are illustrated in FIGURE 3.2.



**FIGURE 3.2 TEMPORAL DISTRIBUTIONS OF COLLISIONS**

The annual frequency of collisions varies from two to five collisions during the study period. An examination of the collision rate in the area of the study intersection has been conducted by ICBC staff in 2005. This previous examination indicated that the collision rate at the study intersection was close to the average collision rate for similar roadways on a rural conventional highway, and was far below the critical accident rate. As a further check, it is estimated that the intersection has an average collision rate range of between 0.27 and 0.68 collisions per million entering vehicles per year. This estimated average collision rate is 10 to 60 percent lower than the typical collision rate of 0.75 collisions per million entering vehicles per year for an unsignalised intersection in the Lower Mainland area.

A random fluctuation of collisions in the temporal patterns of year, month, and day is also noted. Moreover, due to the low collision frequency at this intersection, the temporal patterns as presented in FIGURE 3.2 do not contribute any significant meaning in terms of collision trends. However, the collision distribution by hour ending which indicated that collisions were most likely occurred during the afternoon and late evening hours, probably corresponded to the time periods with high traffic volumes. These collision clusters at the time periods with high traffic volumes also suggest that the operational capacity of this intersection could be a contributing cause of those left-turn crossing and rear-end collisions when exiting from the French Creek Boat Harbour on Lee Road westbound.

### 3.3 Spatial Distribution of Collisions

The reported 17 collisions at the study intersection during the study period were plotted spatially and are shown in FIGURE 3.3. However, some of the incident descriptions as contained within the given set of ICBC claim records are vague and incomplete; hence, some logical assumptions on the approaches, orientations, and types of collisions were made by Opus Hamilton in plotting out the data.

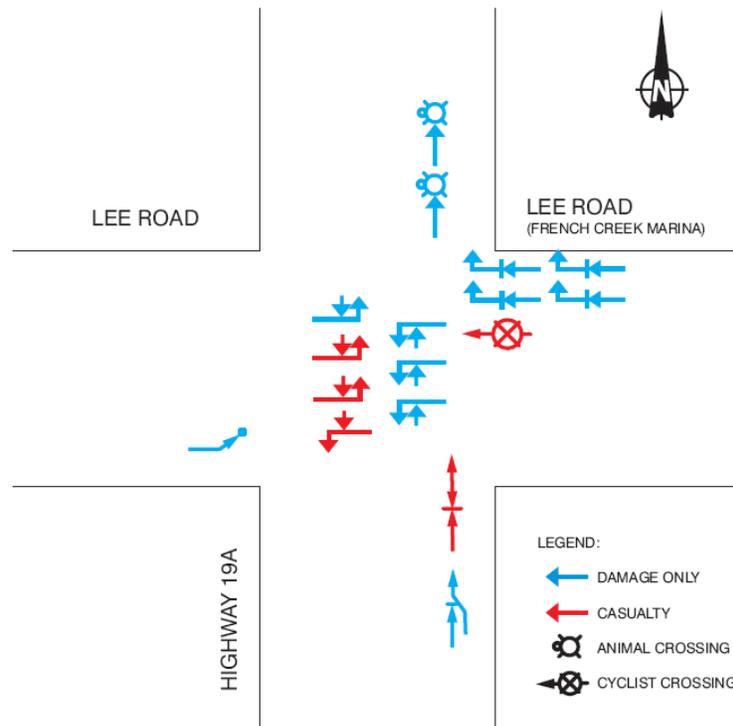


FIGURE 3.3 SPATIAL DISTRIBUTIONS OF COLLISIONS

#### 4.0 STAKEHOLDER CONSULTATIONS

A public consultation was conducted with the various stakeholders in the vicinity of the study intersection. In addition to the Ministry and ICBC, the consultation includes the French Creek Boat Harbour management and the French Creek Residents Association. The stakeholders' opinions or comments on what they perceived to be the current operational and safety problems when using the study intersection were sought.

The major comments that were mentioned are summarized below:

- Delays for eastbound and westbound left-turn movements can be long, especially during the afternoon and during summer daytime periods. Waits of more than five minutes were common.
- Vehicle speeds on Highway 19A can be high.
- Long delays result in residential traffic using the Wrights Road intersection, which is signalized.
- A traffic signal at the study intersection is desirable and felt to be needed.
- Nobody can recall any collisions occurring at the study intersection, but all mention various close calls, mainly involving vehicles turning left and "cutting it close". This was especially prevalent when delays were long and drivers were impatient.
- Sight distances and grades did not seem to be a concern, although it was noted that the uphill grade from the Marine may result in slower acceleration.

## 5.0 SAFETY ISSUES AND PRELIMINARY IMPROVEMENTS

### 5.1 Safety Issues

Based on the above findings from reviews and analyses of the physical, traffic and collision characteristics, several safety issues were identified as follows:

- The rear-end collisions for the right-turning movement on Lee Road westbound are most likely caused by drivers of the front vehicle slowing abruptly or stopping to wait for an adequate gap in merging, while drivers following closely did not expect the stop when coming up from the hill.
- Due to the uphill gradient and sharp turning on the Lee Road westbound approach, trucks and trailer vehicles which are entering the intersection at slow speeds may also result in high collision risk with the mainstream vehicles traveling on Highway 19A at high speeds. This speed differential may contribute to the left-turn crossing collisions.
- The long delays when exiting Lee Road westbound occurring at a particular instance could make some drivers become impatient and accept shorter gaps in making the manoeuvres, possibly resulting in higher left-turn crossing collision risks.
- The highway vehicles which are likely travelling faster than the posted speed limit increase the collision risk with the merging traffic from Lee Road.
- Drivers on Lee Road eastbound were not advised by any STOP ahead or intersection ahead warning sign, which could result in a higher collision risk at the intersection under poor visibility condition.
- Some drivers on Lee Road eastbound which travel faster than the posted speed limit may lose control of their vehicles when approaching the intersection due to the downhill gradient. A detailed speed survey would have to be done by the Ministry in order to confirm vehicle speeds.
- Drivers from the northbound and southbound of the highway when making right turns onto Lee Road were not advised of the safe turning speed to navigate the sharp right-turn curve. Similarly, eastbound and westbound drivers approaching the curve east of the intersection on Lee Road were not advised of a safe driving speed to negotiate the curve.
- Due to the limited availability of lighting, drivers are having low visibility of the intersection at nights and in dark conditions, especially when approaching downhill on Lee Road eastbound.

- Roadside vegetation and the large ferry guide sign could block drivers' sightlines when approaching or exiting the intersection.
- The relatively high proportion of older drivers in the area and their longer reaction and comprehension times will exacerbate the above issues.

## 5.2 Traffic Signal Warrant Analysis

It is understood that residents and businesses of the area have been requesting that the Ministry install a traffic signal at this intersection to improve the safety and facilitate movements into and out of Lee Road. It is widely perceived that installation of traffic signals will improve safety at an intersection, in particular with respect to collisions involving right-of-way conflicts. A traffic signal at the study intersection would therefore reduce motorist discomfort at rural high-speed on Highway 19A and provide safety for the minor movements to or from Lee Road.

However, research also indicates that traffic signals could introduce other safety problems at an intersection. Rear-end and sideswipe collisions (especially on the previously uncontrolled approaches) usually increase after a signal is introduced. Moreover, the installation of unwarranted signals at intersection with relatively low traffic volumes on the side roads may create situations where the overall waiting time at the intersection is increased, and may in turn create aggressive driving behaviours and tempt drivers on the main highway to violate red light signals.

As such, a preliminary traffic signal warrant analysis for the study intersection has therefore been conducted following the methodology outlined in Section 402.3 of the Electrical and Traffic Engineering Design Guidelines issued by the Ministry of Transportation, Engineering Branch in December 2003, and the results are shown in APPENDIX B and C. The "Requirements of the Warrant Analysis" suggest that a signal may be installed if one or more of the warrants are met. The analysis was conducted for the highway's posted speed limit 60 kilometres per hour. Based on the analysis, a signal was about 90 percent warranted, but still not warranted. For sensitivity assessment, the analysis was performed with a posted speed limit of 80 kilometres per hour, the intersection would warrant a signal under both Warrant 2 – "Interruption of Continuous Traffic" and Warrant 9 – "Peak Hour Volume".

It should be noted that a large proportion of vehicles on the minor roads were right-turn vehicles. When carrying out the Ministry's signal warrant analysis in the past, right-turn vehicles were excluded as they did not get actuation loops. At present, loops are sometimes provided for the right-turn movements where volumes or vehicle type warrant it. For example, if a significant number of the right-turn vehicles are large trucks, provisions of signals would be deemed necessary as large trucks usually require longer gaps to merge into the mainstream traffic.

As in this case, all right-turn movements were included in the preliminary warrant analysis since a fair amount of trucks and large vehicles with boat trailers were observed during the site visit. However, if the majority of right-turn vehicles are found to be passenger cars throughout the rest of the day, these right-turn volumes should be excluded from the warrant analysis as they could easily fit into the gaps of the oncoming Highway 19A traffic. With this consideration the traffic signal would be less warranted.

The provision of a traffic signal will provide adequate gaps for eastbound and westbound left-turn and through traffic, and is expected to reduce the left-turn crossing collision frequency, as well as the angle collision risk. However, it will also increase the rear-end and sideswipe collision risks on the Highway 19A approaches, as mentioned above. The net benefits of providing a traffic signal are difficult to quantify, and may be negligible. Based on the above analysis, the provision of a traffic signal at this location is not recommended at this time. However, the analysis indicates that the intersection may warrant a signal in the future. It is suggested that the Ministry re-evaluate the intersection in the near future, and possibly review up-to-date collision characteristics to assess the safety benefits.

### **5.3 Alternate Intersection Configurations**

As a traffic signal is not warranted at the study intersection, it is suggested that other possible safety improvements for the study intersection, including alternative forms of traffic control or design and operational modifications to the existing intersection should also be considered. These other possible safety improvement measures include:

i. *Turn Restrictions from Lee Road Eastbound and Westbound*

In eliminating the left-turn crossing collisions at the intersection, traffic should be restricted from turning left or crossing Highway 19A by relocating the existing raised islands at the intersection to provide a right-out only configuration for Lee Road eastbound and westbound traffic. This proposed turn restriction scheme could also improve the operational efficiency of the intersection as well as to provide better turning sweep paths for Lee Road traffic merging onto the highway and for the right-turning traffic from Highway 19A onto Lee Road. The disadvantage of this scheme is that the banned left-turn and crossing vehicles would have to access their destinations via alternate detouring routes which may cause infiltration of traffic onto local neighbourhood streets and to the other intersections on Highway 19A. Traffic turning at other intersections on Highway 19A would experience similar delays and frustrations as at Lee Road. This simply relocates the issue and is thus not recommended.

ii. *Modification of the Intersection into a Roundabout*

The provision of a roundabout for the study intersection would help to eliminate the left-turn crossing collisions, provide a U-turn facility on Highway 19A, as well as to improve the operational efficiency of the intersection. Based on the 2006 summer peak traffic conditions and preliminary capacity analysis, the intersection would have an acceptable level of service when modified into a roundabout. Advance roundabout ahead warning signs would be needed when approaching the roundabout. However, an at-grade roundabout is not commonly seen in any other rural highways of the Province and it may create other safety impacts along the highway. Moreover, it may not be favourable to have a roundabout where traffic flows are heavily unbalanced or the approach legs are not on level ground. An unneeded delay of high, through traffic volumes on Highway 19A will result from the installation of a roundabout and thus a roundabout is not recommended for this intersection.

iii. *Provision of Offset Right-turn Lanes and Grade Alterations*

Provision of offset right-turn lanes on both northbound and southbound approaches of Highway 19A has also been considered. The offset lanes would provide a longer deceleration distance for drivers turning right onto Lee Road, and would position these decelerating vehicles further right to reduce interference with sightlines between through traffic on the highway and drivers entering the highway (turning either left or right). Better sightlines would help reduce the risk of potential left-turn crossing collisions. Road realignments, including grade alterations on Lee Road to improve sightlines, could also be considered as part of this scheme. A potential disadvantage of installing offset right-turn lanes is that drivers initially may be confused by the change in road markings, particularly in areas where offset right-turn lanes have not been used previously. This can be minimized by the effective use of advance guide signing and pavement markings. No research has been conducted on offset right-turn lanes to determine their safety effectiveness. However, safety effectiveness is likely to depend upon the traffic volumes of the conflicting turning and through movements and the amount of offset between the right-turn lanes at the intersection. FIGURE 5.1 shows photographs of these offset right-turn lanes.



**FIGURE 5.1 EXAMPLES OF OFFSET RIGHT-TURN LANES**

Among the above three alternate intersection configurations that have been considered, the provision of offset right-turn lanes seems to have the least impact to the existing operation of the highway and adjacent intersections. As such, it has been selected as an alternate option for economic evaluation and comparison with the benefits of installing a traffic signal at the intersection.

#### **5.4 Other Ready-to-implement Safety Improvements**

Other possible safety improvements which could be treated as low cost and ready-to-implement options to address partially the existing operational and safety issues of the intersection include the following:

- j. Provide advanced reduce speed limit warnings on both northbound and southbound of Highway 19A;
- ii. Repaint the faded pavement markings and turn arrows;
- iii. Install intersection ahead warning signs on Highway 19A approaches;
- iv. Conduct a lighting warrant analysis in order to assess whether additional lighting fixtures are deemed necessary, and if additional lighting is warranted, install additional lighting fixtures at the intersection;
- v. Provide painted broken white lines delineating the through traffic lanes on the exit legs of Highway 19A from the right-turn channelized lanes on Lee Road eastbound and westbound;
- vi. Provide advisory exit speed limit signs for the right-turn deceleration lanes on both Highway 19A northbound and southbound approaches and for both directions of the curve section of Lee Road east of the intersection (subject to confirming the curve radius, as well as possibly a safe curve speed survey using a properly calibrated vehicle to confirm the advisory speed in safely negotiating the curve section);
- vii. Provide additional stop signs on the left-side of Lee Road approaches;
- viii. Install a stop ahead warning sign on Lee Road eastbound;
- ix. Post a speed limit sign of 50 kilometres per hour on Lee Road eastbound;
- x. Provide animal crossing warning signs on all approaches;
- xi. Trim roadside vegetation; and

- xii. Relocate the large ferry guide sign on Highway 19A southbound further north or overhead in order to minimize the interference with the sight lines.

In order to reduce the collision risks and to ease the traffic from Lee Road merging onto the highway, it is strongly recommended that the travel speed along the study corridor be monitored and enforced to encourage drivers to travel at the posted speed limit of 60 kilometres per hour. Enforcement should be conducted during various times of the day, particularly during peak hours through an ICBC / RCMP speed campaign. It is noted that similar speed campaign has previously been carried out in other parts of the island. However, since speed enforcement is not included as part of the Road Improvement Program, the economic evaluation of it will not be conducted.

## **5.5 Specific Measures for the Older Drivers**

The visual and cognitive limitations of older drivers generate a need for signings and pavement markings that are legible, clear, and unambiguous. Possible measures at the study intersection that can be considered to accommodate older drivers include:

- a. Increase the size of the existing STOP signs and street name signs on Lee Road approaches; and
- b. Provide wider pavement marking to clearly delineate the travel path for older drivers on all approaches to the intersection.

TABLE 5.1 suggests the dimensions for the signs, text sizes, and pavement widths in order to compensate for older drivers' visual limitations.

**TABLE 5.1 SUGGESTED MEASURES FOR OLDER DRIVERS**

MEASURE	DIMENSIONS	
	CURRENT STANDARD	SUGGESTED STANDARD TO ACCOMMODATE OLDER DRIVERS
Size of Stop Signs	600 mm	900 mm
Size of Yield Signs	750 mm	900 mm
Size of Warning Signs	750 mm	900 mm
Text Height on Ground-mounted Street Name Signs	75 to 125 mm	150 to 200 mm
Pavement Width	100 mm	150 mm

## 5.6 Implementation Plans

ICBC has indicated that funding may be available through the Road Improvement Program if favourable investment opportunities exist to reduce the number of motor vehicle collisions and the associated claims costs. Economic evaluations of the proposed improvements at the study intersection are therefore conducted for the proposed two implementation plans as follows:

- Plan 1      Implement only the ready-to-implement safety improvements and specific measures for older drivers; and,
  
- Plan 2      Implement the ready-to-implement safety improvements and specific measures for older drivers plus the provision of offset right-turn lanes.

TABLE 5.2 summarizes those ready-to-implement safety improvements and specific measures for older drivers that are considered to be applicable for the proposed three implementation plans.

**TABLE 5.2 APPLICABLE MEASURES FOR THE IMPLEMENTATION PLANS**

MEASURES	PLAN 1	PLAN 2
Provide offset right-turn lanes and grade alterations	NA	Applicable
Ready-to-implement measures:		
Reduce speed limit to 50 km/h on the highway	Applicable	Applicable
Repaint the faded pavement marking and turn arrows	Applicable	Applicable
Install intersection ahead warning signs on the highway approaches	Applicable	Applicable
Install additional lighting fixtures	Applicable	Applicable
Provide painted broken white lines for the right-turn channelized lanes	Applicable	Applicable
Provide a southbound curve warning sign	Applicable	Applicable
Provide advisory exit speed limit signs for the right-turn lanes on the highway	Applicable	Applicable
Provide additional stop signs on Lee Road	Applicable	Applicable
Install a stop ahead warning sign on Lee Road eastbound	Applicable	Applicable
Post a speed limit sign of 50 km/hr on Lee Road eastbound	Applicable	Applicable
Provide animal crossing warning signs on the highway approaches	Applicable	Applicable
Trim roadside vegetation	Applicable	Applicable
Relocation of the ferry guide sign	Applicable	Applicable
Specific measures for older drivers:		
Increase size of stop signs	Applicable	Applicable
Increase size of yield signs	Applicable	Applicable
Increase size of warning signs	Applicable	Applicable
Increase text height of street name signs	Applicable	Applicable
Increase pavement width	Applicable	Applicable

## 5.7 Economic Evaluation

According to ICBC's New Funding Criteria for Road Improvement Projects (August 2005), it requires that ICBC investments in projects are based on achieving a minimum of 50 percent Internal Rate of Return over either a 2-year or 5-year post implementation period.

The benefits for economic evaluation are related to collision characteristics such as severity and frequency, the average ICBC claims costs, and the collision reduction potential of the suggested improvements. Section 3 has discussed the collision characteristics for the study intersection. The average claim costs which are provided from ICBC are summarized in TABLE 5.3.

**TABLE 5.3 AVERAGE ICBC CLAIM COSTS**

SEVERITY OF CLAIM	AVERAGE CLAIM COST
Fatality	\$241,000 per collision
Injury	\$26,000 per collision
Property Damage Only	\$3,000 per collision

Source: ICBC, 2007

The collision reduction estimates for individual improvement measure are adopted from those used in safety review studies that Opus Hamilton has previously conducted for ICBC. As the safety benefits of individual improvement measure may overlap, the collision reduction factors therefore need to be modified to avoid double counting.

Modified collision reduction factors were calculated by applying collision reduction factors only to collisions that might remain after the reduction effects of a previous countermeasure have been considered. The individual and modified collision reduction factors for improvement measures in the two proposed implementation plans are summarised in TABLES 5.4 and 5.5 respectively. TABLES 5.4 and 5.5 also show the related collision types and movements that may be affected by each improvement measure.

**TABLE 5.4 COLLISION REDUCTION FACTORS FOR PLAN 1 IMPROVEMENTS**

PROPOSED IMPROVEMENTS	RELATED COLLISION TYPES AND MOVEMENTS	ORIGINAL COLLISION REDUCTION FACTORS			MODIFIED COLLISION REDUCTION FACTORS		
		Low Estimate	Most Likely	High Estimate	Low Estimate	Most Likely	High Estimate
Repaint the faded pavement marking and turn arrows	All	10%	15%	20%	10%	15%	20%
Install intersection ahead warning signs	Left-turn crossing and right-turn	10%	15%	20%	9%	13%	16%
Install additional lighting fixtures	All night-time collisions	15%	20%	25%	14%	17%	20%
Provide painted broken white lines for the right-turn channelized lanes	Right-turn when exiting Lee Road	5%	10%	15%	4%	7%	10%
Provide advisory exit speed limit signs for the right-turn lanes on the highway	Backing up and weaving	30%	35%	40%	24%	25%	26%
Provide additional stop signs on Lee Road	Cyclist crossing and off-road	3%	5%	7%	3%	4%	6%
Install a stop ahead warning sign on Lee Road eastbound	Off-road	20%	25%	30%	17%	20%	22%
Post a speed limit sign of 50 km/hr on Lee Road eastbound	Off-road	5%	8%	10%	3%	5%	5%
Provide animal crossing warning signs	Animal crossing	10%	15%	20%	9%	13%	16%
Trim roadside vegetation	Left-turn crossing and right-turn	3%	5%	7%	2%	4%	4%
Relocation of the ferry guide sign	Eastbound left-turn crossing and right-turn	5%	10%	15%	4%	8%	11%
Increase Size of Stop Sign	Cyclist crossing and off-road	5%	8%	10%	3%	4%	5%
Increase Size of Yield Sign	Right-turn	5%	8%	10%	4%	5%	5%
Increase Size of Warning Sign	Left-turn, animal crossing, and off-road	5%	8%	10%	4%	5%	6%
Increase Text Height of Street Name Sign	na	na	na	na	na	na	na
Increase Pavement Width	Weaving	5%	8%	10%	5%	7%	8%

Note: Blue cells denote ready-to-implement measures, and green cells denote older driver-related measures

**TABLE 5.5 COLLISION REDUCTION FACTORS FOR PLAN 2 IMPROVEMENTS**

PROPOSED IMPROVEMENTS	RELATED COLLISION TYPES AND MOVEMENTS	ORIGINAL COLLISION REDUCTION FACTORS			MODIFIED COLLISION REDUCTION FACTORS		
		Low Estimate	Most Likely	High Estimate	Low Estimate	Most Likely	High Estimate
Provide offset right-turn lanes and grade alterations	All	15%	20%	25%	15%	20%	25%
Repaint the faded pavement marking and turn arrows	All	10%	15%	20%	9%	12%	15%
Install intersection ahead warning signs	Left-turn crossing and right-turn	10%	15%	20%	8%	10%	12%
Install additional lighting fixtures	All night-time collisions	15%	20%	25%	11%	14%	15%
Provide painted broken white lines for the right-turn channelized lanes	Right-turn when exiting Lee Road	5%	10%	15%	3%	6%	7%
Provide advisory exit speed limit signs for the right-turn lanes on the highway	Backing up and weaving	30%	35%	40%	21%	20%	19%
Provide additional stop signs on Lee Road	Cyclist crossing and off-road	3%	5%	7%	2%	3%	4%
Install a stop ahead warning sign on Lee Road eastbound	Off-road	20%	25%	30%	15%	16%	17%
Post a speed limit sign of 50 km/hr on Lee Road eastbound	Off-road	5%	8%	10%	3%	4%	4%
Provide animal crossing warning signs	Animal crossing	10%	15%	20%	8%	10%	12%
Trim roadside vegetation	Left-turn crossing and right-turn	3%	5%	7%	2%	3%	3%
Relocation of the ferry guide sign	Eastbound left-turn crossing and right-turn	5%	10%	15%	4%	7%	8%
Increase Size of Stop Sign	Cyclist crossing and off-road	5%	8%	10%	3%	4%	4%
Increase Size of Yield Sign	Right-turn	5%	8%	10%	3%	4%	4%
Increase Size of Warning Sign	Left-turn, animal crossing, and off-road	5%	8%	10%	3%	4%	4%
Increase Text Height of Street Name Sign	na	Na	na	na	na	na	na
Increase Pavement Width	Weaving	5%	8%	10%	4%	5%	6%

Note: Blue cells denote ready-to-implement measures, and green cells denote older driver-related measures

The results of the economic evaluations including the improvement cost estimates, potential annual savings for ICBC, and potential ICBC funding are summarized in TABLE 5.6 for the two proposed implementation plans. A detailed breakdown of the improvement cost assumptions is included in APPENDIX C.

**TABLE 5.6 RESULTS OF ECONOMIC EVALUATION**

PROPOSED IMPLEMENTATION PLAN	TOTAL ESTIMATED COSTS	POTENTIAL ANNUAL SAVINGS	POTENTIAL ICBC FUNDING
PLAN 1	\$87,000	\$11,000	\$10,500
PLAN 2	\$327,000	\$13,700	\$15,000

## 5.8 Overview

Based on the findings of this report, installation of a traffic signal at the study intersection is demonstrated to be not warranted under the current situation. Other than installing a traffic signal, this study has also considered alternate forms of intersection layout design and operational modifications, as well as some ready-to-implement safety improvements and specific measures for older drivers. Two implementation plans have been proposed and the associated potential ICBC fundings have also been calculated.

The next steps will be for ICBC and the Ministry to consider the feasibility of implementing these proposed mitigating measures and to conduct a second round of public consultation with the stakeholders with regard to the two proposed implementation plans. With continued cooperation between the Ministry and ICBC, the study intersection can be made safer for all road users.

**APPENDIX A**  
**LIST OF STAKEHOLDERS**

**TABLE A.1 LIST OF STAKEHOLDERS**

Insurance Corporation of British Columbia  
Ministry of Transportation  
French Creek Boat Harbour  
French Creek Residents Association

**APPENDIX B**

**TRAFFIC SIGNAL WARRANT ANALYSIS FOR 80 KILOMETRES PER HOUR  
SPEED LIMIT**

TRAFFIC OPERATION AND SAFETY REVIEW AT LEE ROAD AND HIGHWAY 19A  
PARKSVILLE, BC

**WARRANT NO.2 Interruption of Continuous Traffic**

Number of Incoming Lanes on Approach		Rural or Large Urban Areas with population > 10,000				Small Urban Areas with population <10,000	
		Major Street Speed (Posted or 85th Percentile Speed)					
		≤ 70 km/hr		> 70 km/hr			
Major	Minor	Major	Minor	Major	Minor	Major	Minor
1	1	750	75	525	50	525	50
2 or more	1	900	75	630	50	630	50
2 or more	2 or more	900	100	630	70	630	70
1	2 or more	750	100	525	70	525	70

Existing Scenario to be Considered			
Number of Incoming Lanes on Approach		Minimum Volumes	
Major	Minor	Major	Minor
2 or more	2 or more	630	70

Existing Traffic Volumes on Highway 19A					Existing Traffic Volumes on Lee Road				
Time Period	Northbound	Southbound	Combined total of both directions	Higher than Minimum?	Time Period	Eastbound	Westbound	Higher of the two directions	Higher than Minimum?
0800-0900	399	583	982	Yes	0800-0900	65	32	65	No
0900-1000	491	624	1115	Yes	0900-1000	62	52	62	No
1000-1100	582	665	1247	Yes	1000-1100	60	72	72	Yes
1100-1200	674	705	1379	Yes	1100-1200	57	91	91	Yes
1200-1300	765	746	1511	Yes	1200-1300	54	111	111	Yes
1300-1400	793	748	1541	Yes	1300-1400	49	103	103	Yes
1400-1500	821	750	1571	Yes	1400-1500	45	96	96	Yes
1500-1600	849	752	1601	Yes	1500-1600	40	88	88	Yes
1600-1700	915	738	1653	Yes	1600-1700	52	99	99	Yes
1700-1800	781	581	1362	Yes	1700-1800	41	93	93	Yes

Warrant is Satisfied? Yes

Reason: 8 hours of traffic volume exceed the minimum vehicular volume criteria.

Note: Traffic volumes from 0900 to 1200 and from 1300 to 1500 are estimated based on the general traffic profile of the area.

**WARRANT NO.9 Peak Hour Volumes**

Location Type	Major Street Speed (Posted or 85th Percentile Speed)	
	≤ 70 km/hr	> 70 km/hr
Rural	Figure 3	Figure 4
Large Urban (>10000 pop.)	Figure 3	Figure 4
Small Urban (<10000 pop.)	Figure 4	Figure 4

Existing Scenario to be Considered	
Location Type	Figure
Rural with Major Street Speed > 70 km/hr	Figure 4

x

Peak hour traffic volumes on Highway 19A					Peak hour traffic volumes on Lee Road				
Time Period	Northbound	Southbound	Combined total of both directions	Higher than Minimum?	Time Period	Eastbound	Westbound	Higher of the two directions	Higher than Minimum?
1200-1300	765	746	1,511	Yes	1200-1300	54	111	111	Yes

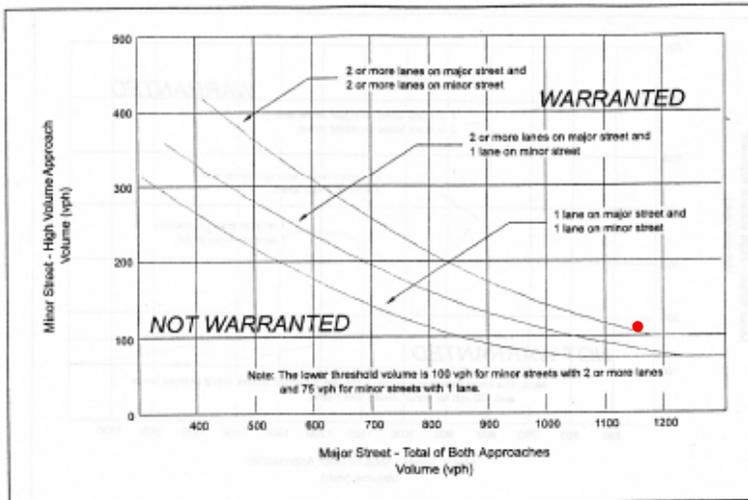


Figure 4. Warrant 9: peak hour volumes 2

Warrant is Satisfied? Yes

Reason: The peak hour traffic volume on the minor street exceeds the required threshold.

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**APPENDIX C**

**TRAFFIC SIGNAL WARRANT ANALYSIS FOR 60 KILOMETRES PER HOUR  
SPEED LIMIT**

**TRAFFIC OPERATION AND SAFETY REVIEW AT LEE ROAD AND HIGHWAY 19A  
PARKSVILLE, BC**

**WARRANT NO.2 Interruption of Continuous Traffic**

Number of Incoming Lanes on Approach		Rural or Large Urban Areas with population > 10,000				Small Urban Areas with population <10,000	
		Major Street Speed (Posted or 85th Percentile Speed)					
		≤ 70 km/hr		> 70 km/hr			
Major	Minor	Major	Minor	Major	Minor	Major	Minor
1	1	750	75	525	50	525	50
2 or more	1	900	75	630	50	630	50
2 or more	2 or more	900	100	630	70	630	70
1	2 or more	750	100	525	70	525	70

Existing Scenario to be Considered			
Number of Incoming Lanes on Approach		Minimum Volumes	
Major	Minor	Major	Minor
2 or more	2 or more	900	100

Existing Traffic Volumes on Highway 19A				Existing Traffic Volumes on Lee Road					
Time Period	Northbound	Southbound	Combined total of both directions	Higher than Minimum?	Time Period	Eastbound	Westbound	Higher of the two directions	Higher than Minimum?
0800-0900	399	583	982	Yes	0800-0900	65	32	65	No
0900-1000	491	624	1115	Yes	0900-1000	62	52	62	No
1000-1100	582	665	1247	Yes	1000-1100	60	72	72	No
1100-1200	674	705	1379	Yes	1100-1200	57	91	91	No
1200-1300	765	746	1511	Yes	1200-1300	54	111	111	Yes
1300-1400	793	748	1541	Yes	1300-1400	49	103	103	Yes
1400-1500	821	750	1571	Yes	1400-1500	45	96	96	No
1500-1600	849	752	1601	Yes	1500-1600	40	88	88	No
1600-1700	915	738	1653	Yes	1600-1700	52	99	99	No
1700-1800	781	581	1362	Yes	1700-1800	41	93	93	No

Warrant is Satisfied? No

Reason: 7 hours of traffic volume does not exceed the minimum vehicular volume criteria no both roads

Note: Traffic volumes from 0900 to 1200 and from 1300 to 1500 are estimated based on the general traffic profile of the area.

TRAFFIC OPERATION AND SAFETY REVIEW AT LEE ROAD AND HIGHWAY 19A  
PARKSVILLE, BC

**WARRANT NO.9 Peak Hour Volumes**

Location Type	Major Street Speed (Posted or 85th Percentile Speed)	
	≤ 70 km/hr	> 70 km/hr
Rural	Figure 3	Figure 4
Large Urban (>10000 pop.)	Figure 3	Figure 4
Small Urban (<10000 pop.)	Figure 4	Figure 4

Existing Scenario to be Considered	
Location Type	Figure
Rural with Major Street Speed > 70 km/hr	Figure 4

x

Time Period	Peak hour traffic volumes on Highway 19A				Higher than Minimum?	Time Period	Peak hour traffic volumes on Lee Road			
	Northbound	Southbound	Combined total of both directions	Higher than Minimum?			Eastbound	Westbound	Higher of the two directions	Higher than Minimum?
1200-1300	765	746	1,511	No	1200-1300	54	111	111	No	

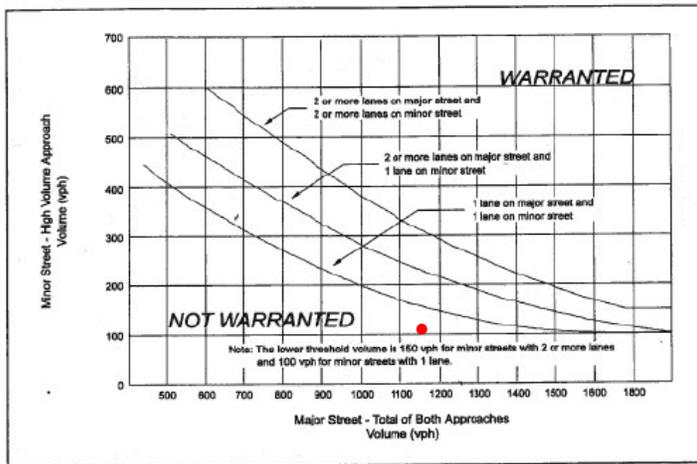


Figure 3 Warrant 9: peak hour volumes 1

Warrant is Satisfied? No

Reason: The peak hour traffic volume on the minor street does not exceed the required threshold.

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## APPENDIX D

### DETAIL BREAKDOWN OF IMPROVEMENT COST ASSUMPTIONS

**TABLE D.1 IMPROVEMENT COST ASSUMPTIONS**

MEASURES	UNIT	COST PER UNIT	NO. OF UNITS	TOTAL ESTIMATED COSTS
Provide offset right-turn lanes and grade alterations	Square metre	\$100	100m(length) x 4 m(width) x 6 lanes	\$240,000
Ready-to-implement measures:				
Repaint the faded pavement marking and turn arrows	Line or Arrow	\$1,000	24	\$24,000
Install intersection ahead warning signs on the highway approaches	Sign and support	\$2,000	2	\$4,000
Install additional lighting fixtures	Lighting	\$10,000	2	\$20,000
Provide painted broken white lines for the right-turn channelized lanes	Line	\$1,000	2	\$2,000
Provide advisory exit speed limit signs for the right-turn lanes on the highway and the curve on Lee Road	Sign	\$500	4	\$2,000
Provide additional stop signs on Lee Road	Sign and support	\$2,000	2	\$4,000
Install a stop ahead warning sign on Lee Road eastbound	Sign and support	\$2,000	1	\$2,000
Post a speed limit sign of 50 km/hr on Lee Road eastbound	Sign and support	\$2,000	1	\$2,000
Provide animal crossing warning signs on the highway approaches	Sign	\$500	2	\$1,000
Trim roadside vegetation	Square metre	\$50	100m(length) x 1 m(width) x 4	\$20,000
Relocation of the ferry guide sign	Sign and support	\$1,000	1	\$1,000
Specific measures for older drivers:				
Increase size of stop signs	Sign	\$500	2	\$1,000
Increase size of yield signs	Sign	\$500	4	\$2,000
Increase size of warning signs	Sign	\$500	2	\$1,000
Increase text height of street name signs	Sign	\$500	2	\$1,000
Increase pavement width	NA	NA	NA	Cost included in repainting



## OPUS HAMILTON

- Traffic Operations
- Transportation Planning
- Road Safety Engineering
- Transit and Sustainability
- Asset Management
- Project Management