TRANSPORTATION PLANNERS AND ENGINEERS

bunt & associates

Six Mile Road
Corridor Study

Final Report

Prepared for

Town of View Royal

Date

January 14, 2020

Project No.

04-19-0077

04-19-0077
January 14, 2020

John Rosenberg
Director of Engineering & Parks
Town of View Royal
45 View Royal Avenue
Victoria, BC
V9B 1A6

Dear John:

Re: Six Mile Road
Corridor Study

Bunt is pleased to provide the following Six Mile Road Corridor Study. The areas surrounding the Six Mile Corridor have encountered significant changes over the past 20 years. These changes require a reassessment of this important transportation corridor. The prioritized recommendations provided within this report were guided by a productive public engagement process. The resulting report outlines specific steps the Town of View Royal can take that we believe will strike the balance between various community objectives.

Yours truly,
Bunt & Associates

Jason Potter, M.Sc., PTP
Associate, Senior Transportation Planner

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EXECUTIVE SUMMARY

The Six Mile Road Corridor Study is intended to assess existing transportation conditions along the 1 km length corridor and recommend infrastructure priority projects that address community concerns.

The corridor is within the Town of View Royal; however, it is important to note that the corridor is owned by the Ministry of Transportation and Infrastructure (MOTI) and as such, alterations to the corridor require MOTI approval.

Objectives for the Study were defined by a comprehensive public engagement process. The community's objectives for the corridor were diverse, including a desire for reduced peak period vehicle delays, traffic calming during non-peak periods and safety improvements for all transportation modes.

Bunt prepared and analyzed various traffic model scenarios to evaluate the impacts of various potential mitigation options. Mitigation options were analyzed with respect to feasibility, the approximate costs to implement and their potential 'impact to objectives'. Recommended actions are prioritized based on public feedback, cost and 'impact to objectives' analysis. Recommendations include:

- Optimize traffic signal timing at the Island Highway & Six Mile Road intersection;
- Introduce a Radar Speed Reader, facing southbound traffic on Six Mile Road, located between Six Mile Road's Highway 1 Off-ramp and Chilco Road / Nursery Hill Drive intersections;
- Install a "No Exit" Sign at Damon Drive;
- Convert Chilco Road / Nursery Hill Drive & Six Mile Road intersection to 4 –Way Stop control;
- Remove road hatching at commercial driveways and current signage, introduce "No Left Turn" signs with time of day restriction (6 AM – 9 AM) tab for vehicles exiting commercial accesses;
- Introduce a roundabout at the Atkins Road & Six Mile Road intersection, with a sidewalk extension south from the roundabout to the existing sidewalk along Six Mile Road's west edge;
- Install "Use Roundabout Ahead for Turnaround" sign south of Damon Drive facing northbound Six Mile Road traffic; and,
- Alter corridor cross section to provide improved pedestrian and cycling amenities on Six Mile Road, with priority to area between Atkins Road and Chilco Road/ Nursery Hill Drive.

1. INTRODUCTION

Bunt & Associates (Bunt) was retained to conduct a Corridor Study for Six Mile Road in View Royal, BC. The location of Six Mile Road Corridor (referred herein as the Corridor) is shown in **Exhibit 1.1**.

As illustrated in **Exhibit 1.2**, the Corridor extends approximately 1 km from Thetis Lake at its north terminus to Island Highway. For the purposes of this study, the Corridor is described as extending north / south despite it curving towards the east as it approaches its intersection with Island Highway.

The study is in response to considerable changes to the Corridor over the past 15 years, including commercial and residential developments that are now complete and others that have been approved and are currently under development. This study provides a multi-modal review of the Corridor with inclusion of the approved developments.

- Section 2 describes the Corridor's multi-modal transportation networks.
- Section 3 describes the public engagement process and findings.
- Section 4 presents the traffic operations analysis and traffic related considerations.
- Section 5 presents key issues, analysis findings and recommendations for the Corridor on a segment by segment basis.
- Section 6 offers a summary of potential actions and approximate costs. Recommended actions are assigned a priority ranking.

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Exhibit 1.1
Site Location

Six Mile Road Corridor Study
04-19-0077 April 2019

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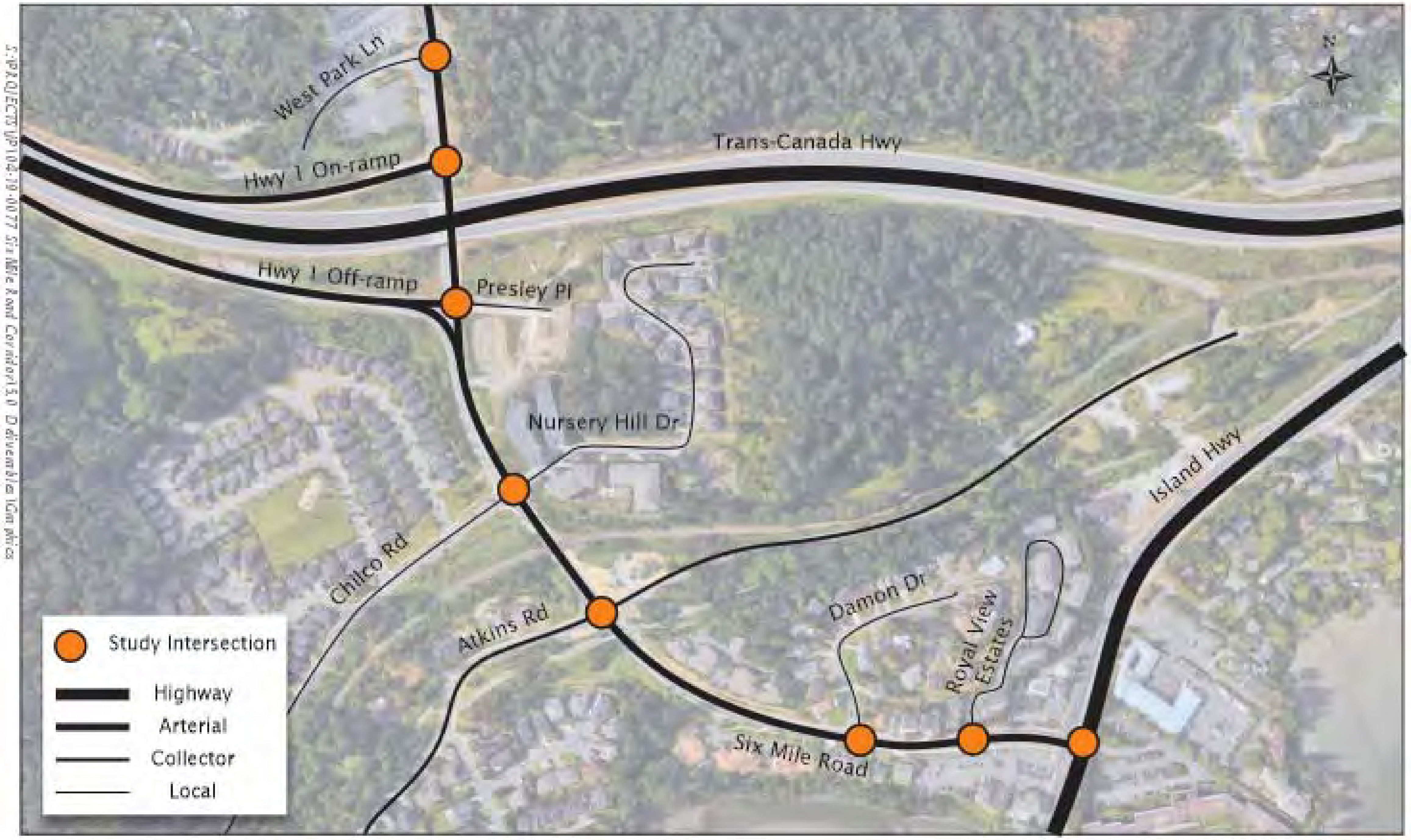


Exhibit 1.2

Study Road Network

Six Mile Road Corridor Study
04-19-0077 January 2020

2. EXISTING TRANSPORTATION NETWORK

This section presents background Corridor transportation information. It details the data collection process and describes the Corridor's road, pedestrian, cycling and transit networks.

2.1 Data Collection

Corridor traffic volumes were originally collected on Wednesday April 26, 2017 by Watt Consulting Group for their Thetis Lake Campground Transportation Impact Assessment (TIA). These weekday AM and PM volumes were confirmed and augmented with additional counts conducted by Bunt on:

- Saturday April 20, 2019;
- Tuesday April 23, 2019; and,
- Thursday May 23 2019.

Bunt collected supplemental traffic data at all Corridor intersections.

These datasets establish the peak hour periods as 7:30 to 8:30 AM and 4 PM to 5 PM.

These volumes are further supported by Ministry of Transportation and Infrastructure (MOTI) automatic count station data (location - P-11-47) which collects vehicle volumes on the Highway 1 Off-ramp to Six Mile Road.

The resulting 2019 vehicle volume dataset is illustrated in **Exhibit 2.1.**

2.2 Road Network

Six Mile Road is an Arterial Road under the jurisdiction of the Ministry of Transportation and Infrastructure with. Thetis Lake is at its north terminus and Island Highway at its south terminus. Six Mile Road connects through several intersections, including connections with Highway 1, Arterials Roads, Collectors, and Local Roads. **Exhibit 2.2** illustrates the Corridor's intersections, laning and traffic control.

2.3 Pedestrian and Cycling Networks

Sidewalks are inconsistent throughout the Corridor. Limited cycling amenities exist along the Corridor, however the Corridor is crossed (above grade) by the Galloping Goose Trail which is a major regional pedestrian and cyclist route. The Galloping Goose Trail connects to the Corridor just south of Atkins Road on the Corridor's east side. **Exhibit 2.3** illustrates the current pedestrian and cycling network.

2.4 Transit

The Corridor is serviced by BC Transit's 53 Route. Bus stops for Route 53 are located along Six Mile Road and Atkins Road.

In addition, there are six BC Transit routes that travel along Island Highway. Island Highway transit stops are located within 200m of the Island Highway and Six Mile Road intersection. These transit routes provide direct connections to Langford, the Langford and Colwood Exchange, Downtown Victoria, and Sooke.

Exhibit 2.4 illustrates the bus routes and stops within the study area, while **Table 2.1**summarizes their peak weekday and Saturday frequencies. It can be seen that transit routes on Island Highway are serviced frequently, particularly the routes to Downtown Victoria, which typically provide 15 minute headways.

Table 2.1: Corridor Bus Routes

BUS ROUTE NO.	DESCRIPTION	WEEKDAY AM PEAK FREQUENCY	WEEKDAY PM PEAK FREQUENCY	SATURDAY MID-DAY PEAK FREQUENCY
NORTH-SOUTH ROUTES ON ISLAND HIGHWAY				
39	Royal Roads / Camosun / Royal Oak/ UVic	30 min	30 min	n/a
46	Westhills Exch / Dockyard	30 – 40 min	30 – 40 min	n/a
48	Happy Valley / Downtown	55 min to Downtown(2)	30 min to Happy Valley(2)	n/a
50	Langford / Downtown	6 -15 min	6 – 10 min	15 min
51	Langford / UVic	30 min	(about 3 to Langford) n/a(1)	n/a
61	Sooke/ Langford/ Downtown	15 – 50 min	15 – 25 min	n/a
NORTH-SOUTH ROUTES ON SIX MILE ROAD				
53	Langford Exch / Colwood Exch	60 min(2)	60 min(2)	120 min

Note: (1) Only arrives once during this peak hour
Note: (2) Only arrives twice during this peak hour

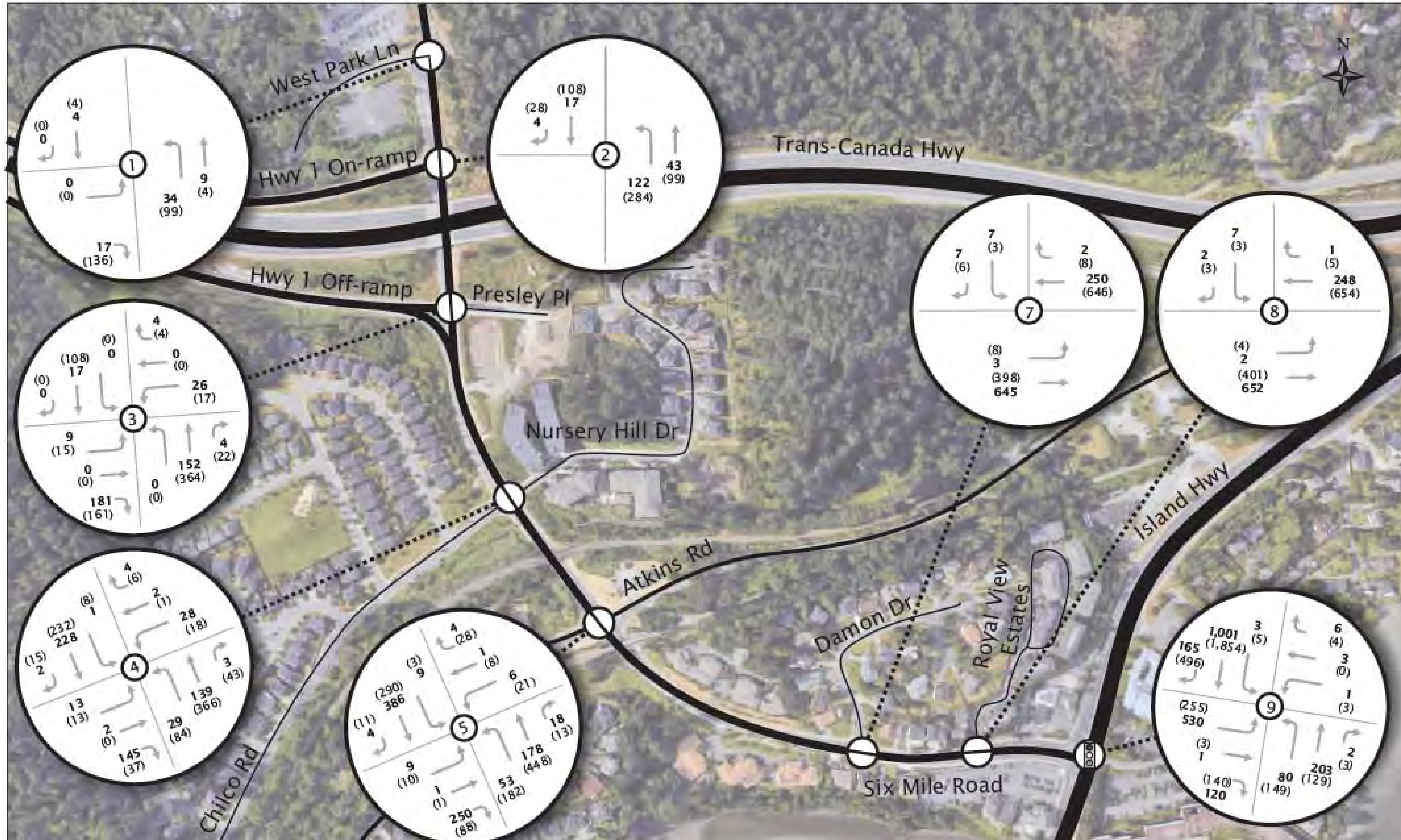
2.5 ICBC Accident Data

Five years of ICBC vehicle accident data is presented below in **Table 2.2**.

Table 2.2: ICBC Corridor Vehicle Accident Data 2013-2017

INTERSECTION	VEHICLE ACCIDENTS
Island Highway & Six Mile Road	65
Atkins Road & Six Mile Road	9
Presley Place & Six Mile Road	8
Highway 1 Off Ramp & Six Mile Road	8
Damon Drive & Six Mile Road	3
Chilco Road/ Nursery Hill Drive & Six Mile Road	1

In addition to the vehicle accidents presented in Table 2.2, the Corridor also experienced two cyclist accidents at the Island Highway & Six Mile Road intersection and one accident involving a pedestrain at the Chilco Road / Nursery Hill Drive & Six Mile Road intersection.



(00) Intersection #

000 AM (000) PM Intersection Volumes

Exhibit 2.1

Existing Weekday Peak Hour Traffic Volumes

Six Mile Road Corridor Study

04-19-0077 January 2020

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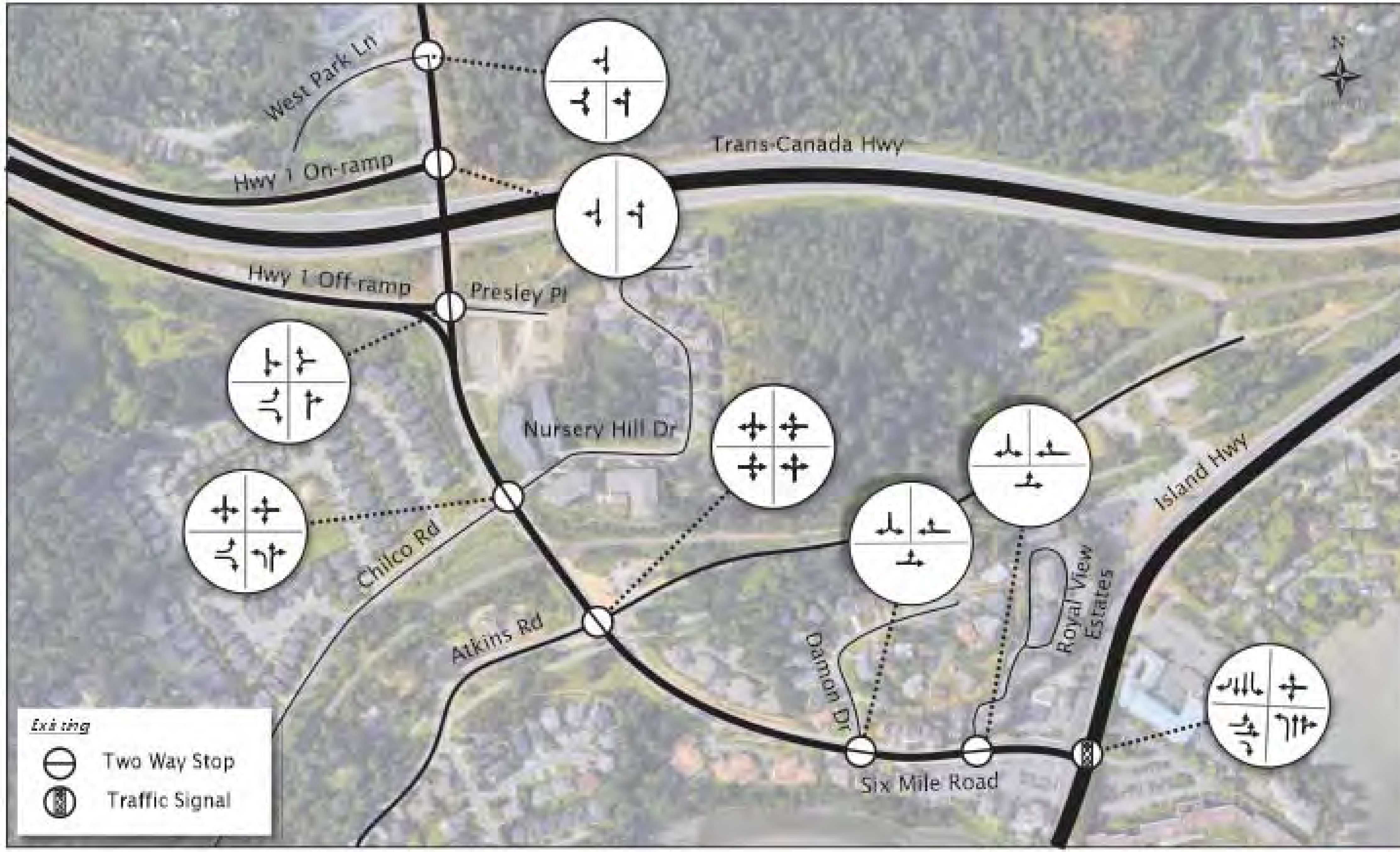

Exhibit 2.2

Existing Laning and Traffic Control

Six Mile Road Corridor Study
04-19-0077 January 2020

Exhibit 2.3

Pedestrian and Cycling Network

Six Mile Road Corridor Study

04-19-0077 January 2020

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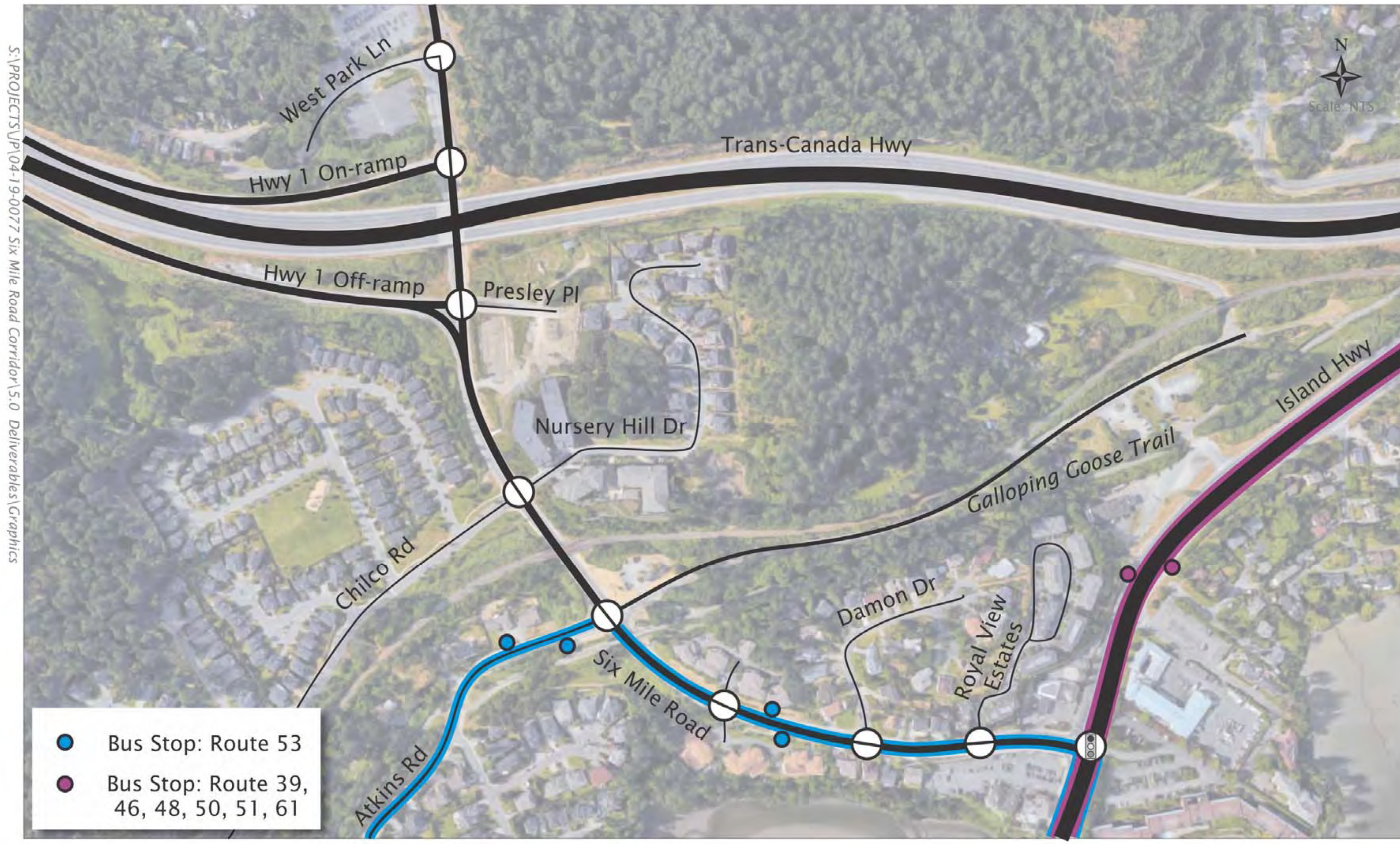

Exhibit 2.4

Transit Routes and Stops

Six Mile Road Corridor Study
04-19-0077 November 2019

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3. PUBLIC ENGAGEMENT

Project public engagement was organized and conducted by Bunt & Associates and the Town of View Royal. Bunt & Associates prepared graphics materials and attended two open house events to respond to questions and to record resident comments. Resident comments were reviewed to ensure the study considered all perspectives and opportunities. Town of View Royal staff provided the venue and outreach for the open houses as well as attending and facilitating the events. The Town maintained open channels of communication with the community throughout the study process.

3.1 Open House 1

Open House 1 was held at the Town of View Royal on May 1, 2019 from 5 PM to 7 PM. Existing condition analysis and conceptual intersection control options were presented in Open House #1.

Approximately 57 attendees were recorded. 47 comment forms were filled out either directly at the open house or submitted by using the Town provided on-line platform. The comment form is provided in **Appendix A**.

The comment forms had two key objectives. The first was to understand preferred outcomes and objectives for the Corridor. To quantify the results, respondents were asked to rank their most important objectives from the following options (with 3 being the most important and 1 being the third most important):

- Reduce vehicle travel time during morning and/or afternoon peak periods;
- Traffic calming along the Corridor or on adjacent streets in an effort to reduce unnecessary Corridor through traffic volumes;
- Improve safety for vehicles drivers (motorists feel there are unsafe conditions, such as difficult left turn movements);
- Improve pedestrian amenities/safety; and,
- Improve cycling amenities/safety.

The second part of the comment form was more open-ended allowing attendees to share their specific concerns and suggestions for the Corridor.

Respondents indicated a wide range of objectives. Travel time during the weekday AM peak period was the highest ranked concern, however issues such as traffic calming during non-peak periods and the safety and comfort of cyclists and pedestrians also factored high in the responses.

Responses are presented based on total points in **Figure 3.1** and by most first priority responses in **Figure 3.2**.

Figure 3.1: Objectives for Corridor – Total Point Percentage

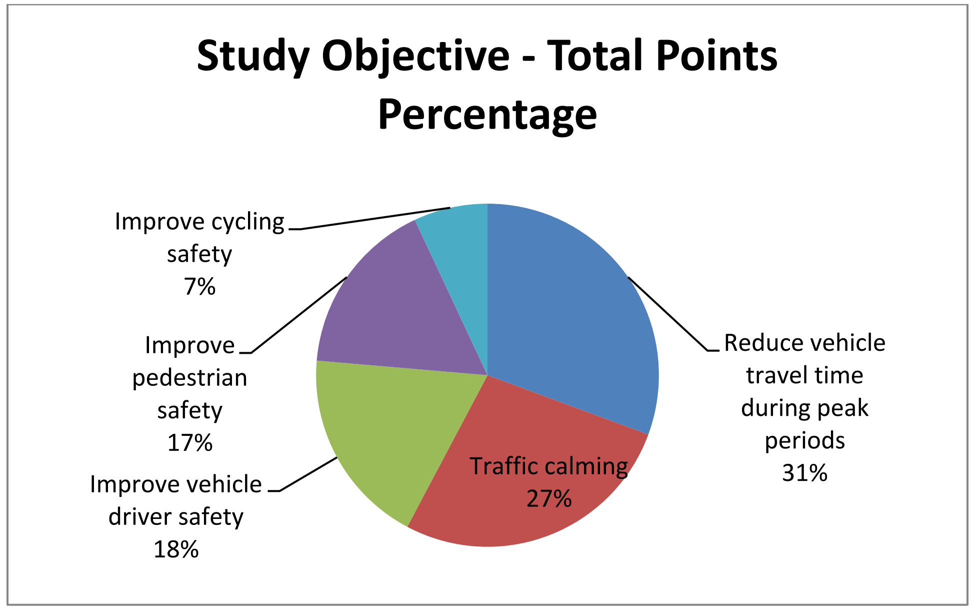
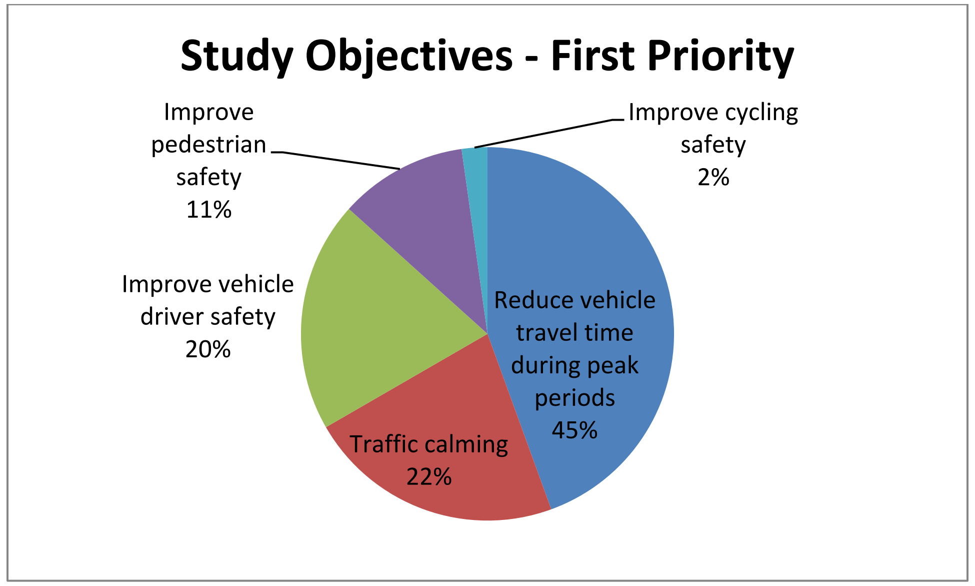


Figure 3.2: Objectives for Corridor - First Priority



The four options other than "reduce vehicle travel time during peak period" responses all have similarities of prioritizing safety of Corridor travelers over Corridor vehicle travel times. When these are combined, they represent 69% of the total points, this reinforces the notion that Corridor design should address traffic operational concerns but also address the comfort and safety of all transportation modes including pedestrians and cyclists.

Common themes provided in the open-ended component of the comment form, in no particular order included an interest in:

- Improved lighting;
- Improved pedestrian amenities including a buffer between the sidewalk and roadway;
- Traffic calming to reduce non-peak period vehicle speeds;
- Bike lanes and improved connections to the Galloping Goose Trail;
- Alternative connections to Highway 1;
- Sightline analysis at minor roadways such as Damon Drive;
- Analysis regarding left turn movements to and from the commercial parcels immediately adjacent to the Island Highway and Six Mile Road intersection;
- Increased transit service; and
- An expanded study area, in particular the Island Highway & Burnside Road West intersection.

The Exhibit Boards included a board for open house attendees to place a stick-it note comment onto a map. These comments are presented in **Exhibit 3.1**.

3.2 Open House 2

Open House 2 was held at the Town of View Royal on October 29, 2019 from 5 PM to 7 PM. Preliminary findings and recommendations were presented to the public for their review and comment.

Approximately 45 attendees were recorded. 29 comment forms were filled out either directly at the open house or submitted by using the Town provided on-line platform. The comment form is provided in **Appendix A**.

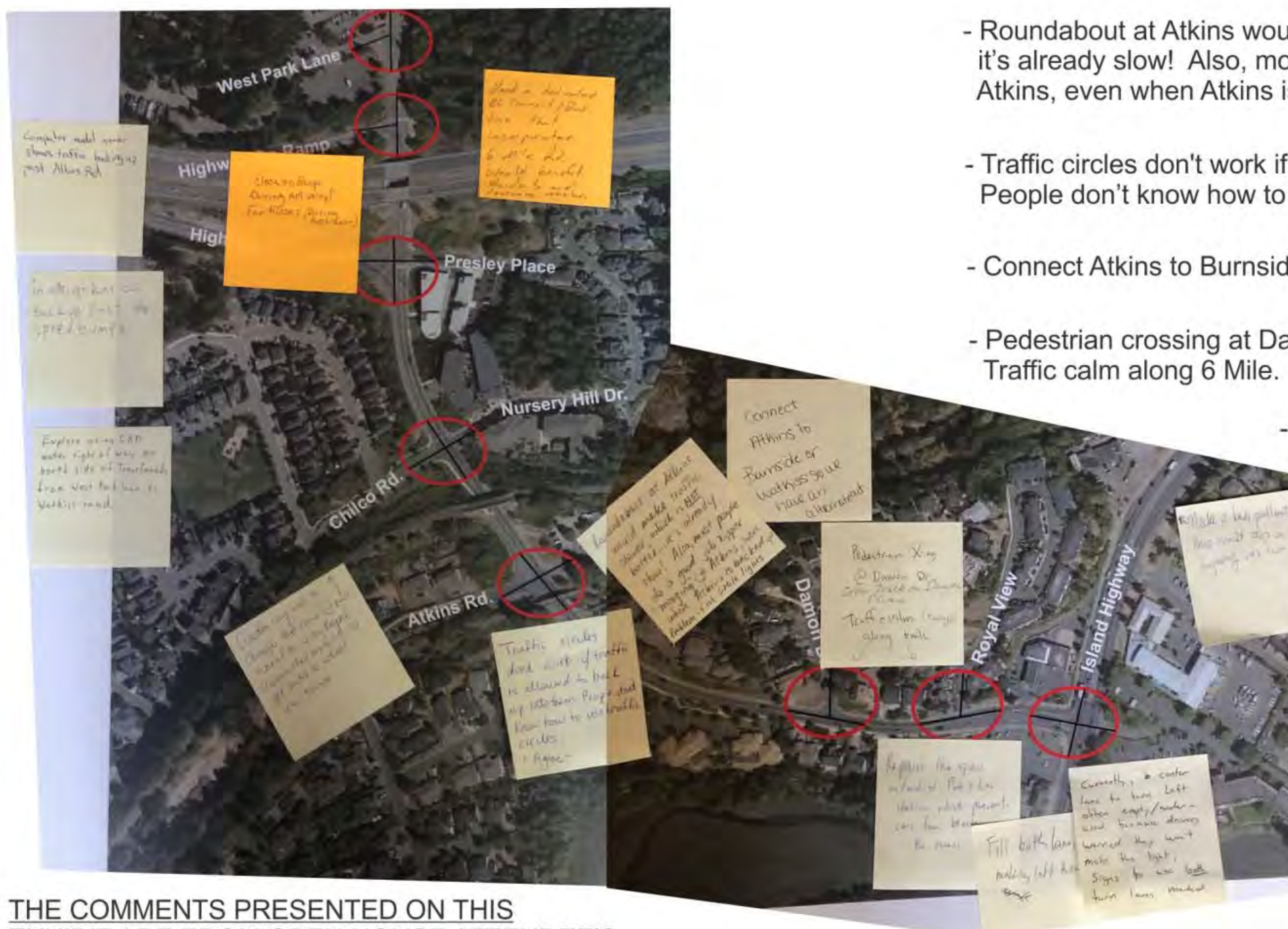
Similar to Open House 1, the Exhibit Boards included a board for open house attendees to place a stick-it note comment onto a map. These comments are presented in **Exhibit 3.2**.

Photo: Open House 2

- Computer model never shows traffic backing up past Atkins Road.

- In AM Atkins can backup past the speed bumps.

- Explore using CRD water right of way on north side of TransCanada from West Park Lane to Watkiss Road.



THE COMMENTS PRESENTED ON THIS EXHIBIT ARE FROM OPEN HOUSE ATTENDEE'S

- Close on-ramp during AM except for buses (during rush hour).

- Garden City had to change bus time at rail tunnel to View Royal about 20 minutes earlier to get kids to school in time.

- Need a dedicated BC Transit bus line that incorporates 6 Mile Road. Would benefit students and decrease vehicles.

- Roundabout at Atkins would make traffic slower, which is not better... it's already slow! Also, most people do a good job zipper "merging" at Atkins, even when Atkins is backed up. Problem is at 6 Mile lights.

- Traffic circles don't work if traffic is allowed to back up into them. People don't know how to use traffic circles.

- Connect Atkins to Burnside or Watkiss so we have an alternate route.

- Pedestrian crossing at Damon Drive. Cross walk on Damon please. Traffic calm along 6 Mile.

- Repaint the space in front of pub and gas station which prevents cars from blocking the access.

- Currently centre lane to turn left often empty/ under used because drivers worried they won't make the light; signs to use both turn lanes needed.

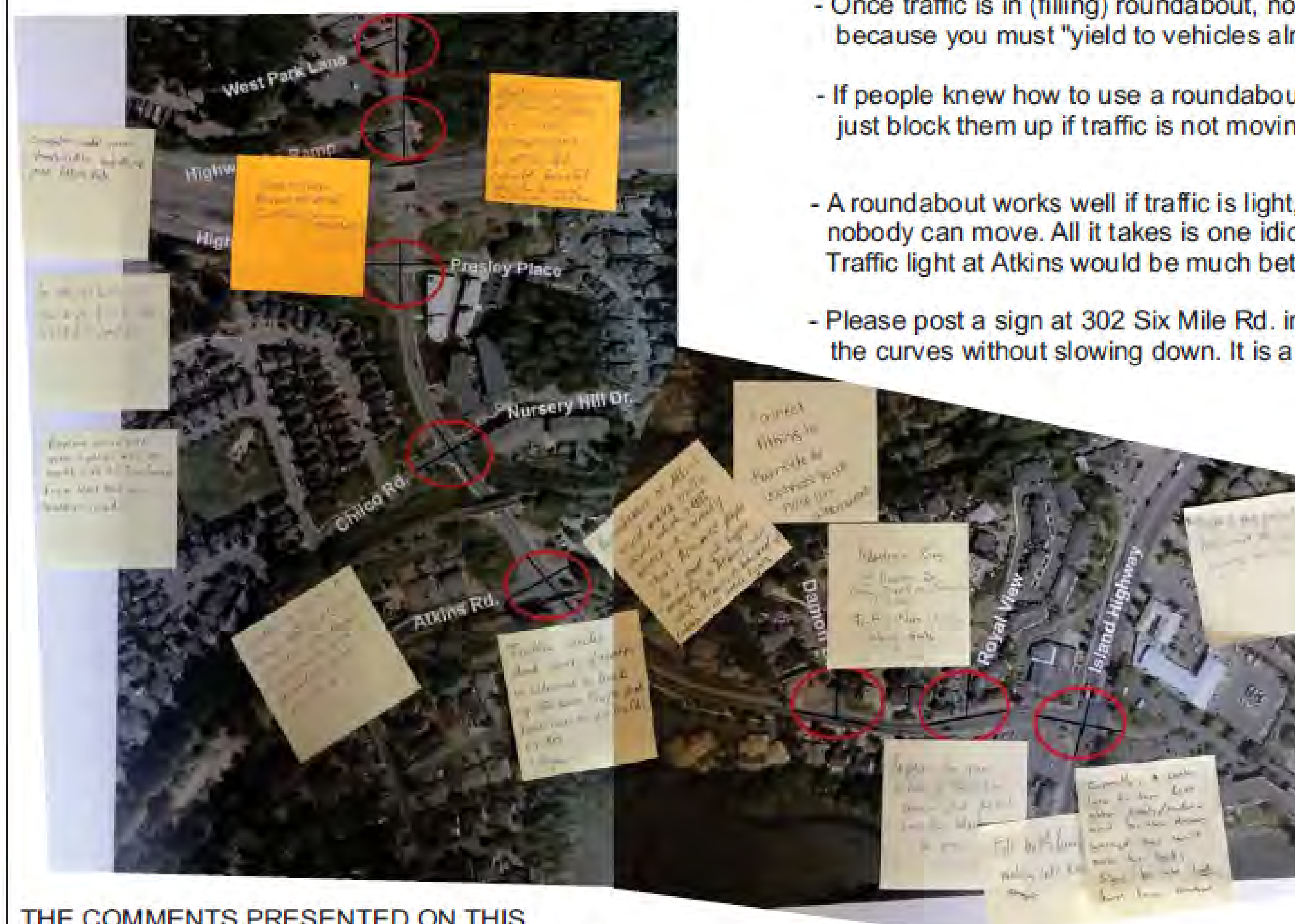
- Fill both lanes making left turns (at Island Highway intersection).

- Make a bus pullout, but must stop on (Island) Highway into town.

Exhibit 3.1

Open House #1 - Comment Board Summary

- Would love to see roundabouts at Chilco & Atkins.
- ITS close calls for accidents
- 6 mile pub bus need to be accessed by Rt turns only
- 6 mile pub needs the cross hatch reinstalled.
- We need cross walks at Damon & Atkins



- There is no mention of traffic control @ 300 Six Mile traffic doing double left 1770 Six Mile get stopped blockers Sooke Rd when green arrow is finished.
- On wet days/ nights on a regular basis traffic fishtails and accelerate dangerously up over a blind hill with a blind curve. There is no mention of any control to prevent this. I often call police when this occurs.
- Once traffic is in (filling) roundabout, no traffic can enter from "side streets" i.e. Atkins, because you must "yield to vehicles already in roundabout"
- If people knew how to use a roundabout it might help. Sadly, most people enter them & just block them up if traffic is not moving roundabout bad idea!
- A roundabout works well if traffic is light, but if traffic backs up into the roundabout then nobody can move. All it takes is one idiot that enters the roundabout when he can't exit. Traffic light at Atkins would be much better.
- Please post a sign at 302 Six Mile Rd. indicating Hidden drive ways. Can just speed around the curves without slowing down. It is a disaster waiting for an accident.
- Police services along six mile especially on wet days & nights is non existent.
- Roundabout at Atkins would reduce wait times for Chilco. I like that idea.
- Use Six Miles' parking lot to extend the right hand turn lane to lighten up traffic back up along Six Mile Road!
- Good that the intersection at Atkins & 6 Mile is noted to need improvement. Not sure a traffic circle will help those coming out of Chilco or at Nursery. Still think a traffic light would be better for all.

<u>THE COMMENTS PRESENTED ON THIS EXHIBIT ARE FROM OPEN HOUSE ATTENDEE'S</u>

Exhibit 3.2

Open House #2 - Comment Board Summary

6 Mile Corridor

19-04-0077 January 2020

4. TRAFFIC OPERATION ANALYSIS

This section presents the Corridor's traffic operations including methods of analysis for existing and future conditions. The findings in this section lead to Section 5 where key issues, findings and recommendations are presented for the Corridor on a segment by segment basis.

4.1 Methods

4.1.1 Performance Thresholds

The existing operations of intersections along the Corridor were assessed using the methods outlined in the 2000 Highway Capacity Manual (HCM), using the Synchro 9 analysis software. The traffic operations were assessed using the performance measures of Level of Service (LOS) and volume-to-capacity (V/C) ratio.

The LOS rating is based on average vehicle delay and ranges from "A" to "F" based on the quality of operation at the intersection. LOS "A" represents optimal, minimal delay conditions while a LOS "F" represents an over-capacity condition with considerable congestion and/or delay. Delay is calculated in seconds and is based on the average intersection delay per vehicle.

Table 4.1 below summarizes the LOS thresholds for the six Levels of Service, for both signalized and unsignalized intersections as well as roundabouts.

Table 4.1: Intersection Level of Service Thresholds

LEVEL OF SERVICE	AVERAGE CONTROL DELAY PER VEHICLE (SECONDS)	
	SIGNALIZED	UNSIGNALIZED
A	≤10	≤10
B	>10 and ≤20	>10 and ≤15
C	>20 and ≤35	>15 and ≤25
D	>35 and ≤55	>25 and ≤35
E	>55 and ≤80	>35 and ≤50
F	>80	>50

Source: Highway Capacity Manual

The volume to capacity (V/C) ratio of an intersection represents ratio between the demand volume and the available capacity. A V/C ratio less than 0.85 indicates that there is sufficient capacity to accommodate demands and generally represents reasonable traffic conditions in suburban settings. A V/C value between 0.85 and 0.95 indicates an intersection is approaching practical capacity; a V/C ratio over 0.95 indicates that traffic demands are close to exceeding the available capacity, resulting in saturated conditions. A V/C ratio over 1.0 indicates a very congested intersection where drivers may have to wait through several signal cycles. In downtown and Town Centre contexts, during peak demand periods, V/C ratios over 0.90 and even 1.0 are common.

The performance thresholds that were used to trigger consideration of roadway or traffic control improvements to support roadway or traffic control improvements employed in this study are listed below:

Signalized Intersections:

- Overall intersection Level of Service = LOS E or LOS F;
- Overall intersection V/C ratio = 0.85 or greater;
- Individual movement Level of Service = LOS E or LOS F; and,
- Individual movement V/C ratio = 0.95 or greater.

Unsignalized Intersections and Roundabouts:

- Individual movement Level of Service = LOS E or LOS F, unless the volume is very low in which case LOS F is acceptable.

Roundabout analysis was conducted using SIDRA software. SIDRA is a specialized and a preferred method to provide HCM 2000 output for roundabouts.

In interpreting of the analysis results, note that the HCM methodology reports performance differently for various types of intersection traffic control. In this report, the performance reporting convention is as follows:

- For signalized intersections: HCM 2000 output for overall LOS and V/C as well as individual movement LOS and V/C is reported. 95th Percentile Queues are reported as estimated by Synchro or SimTraffic, the micro-simulation module of the Synchro software;

- For unsignalized two-way stop controlled intersections: HCM 2000 LOS and V/C output is reported just for individual lanes as the HCM methodology does not report overall performance. SimTraffic estimated queues and delays have also been reported, as the HCM 2000 methodology does not directly take into account the gaps afforded by adjacent signalized intersections;

- For unsignalized All-way Stop controlled intersections: HCM 2000 unsignalized LOS is reported for the overall intersection as well as by intersection approach LOS. The HCM 2000 methodology does not report an overall V/C ratio for All Way Stop controlled intersections. Degree of Utilization calculated with the HCM 2000 methodology is reported for individual movements in place of V/C, which is not part of the HCM 2000 report;

- For roundabouts: HCM 2010 Roundabout analysis output is reported since as HCM 2000 does not calculate LOS for roundabouts. Overall LOS, and LOS and V/C by movement are provided for roundabouts but no overall V/C ratio is provided for roundabouts in the HCM 2010 methodology.

The performance reporting conventions noted above have been consistently applied throughout this document.

The presented output observes the intersection in isolation, without spillback from other intersections. The Signal Timing Plan (STP) for the Corridor's one signalized intersection (Island Highway & Six Mile Road) was obtained from the Town of View Royal.

4.2 Existing 2019 Corridor Operations

Peak hour 2019 traffic operations for Corridor intersections is provided in **Exhibit 4.1** and **Exhibit 4.2** for the weekday AM and PM peak periods respectively.

As illustrated in Exhibits 4.1 and 4.2 the following two Corridor intersections currently exceed performance thresholds:

- Atkins Road & Six Mile Road; and,
- Island Highway & Six Mile Road.

4.2.1 Atkins Road & Six Mile Road

Regional traffic traveling east on Atkins Road encounters LOS D delays in the weekday AM and PM peak hour periods.

This intersection is also impacted by Island Highway & Six Mile Road intersection queue spillback during the weekday AM peak period.

4.2.2 Island Highway & Six Mile Road

The Island Highway & Six Mile Road intersection is shown to exceed threshold criteria in both the existing AM and PM peak hour periods.

Weekday AM peak period southbound queues on Six Mile Road were observed to exceed the model's forecasted 195m length. This discrepancy is believed to be partly due to the model not accounting for the existing hatching on Six Mile Road which removes left turn storage space as well as a driver preference for the inside left turn lane due to downstream lane preference.

During field observations it was noted in the spring of 2019 that 17 to 24 vehicles traveled through the Six Mile Road to Island Highway left turn phase per cycle. It was also noted that during the weekday AM peak period southbound queues extending from the Island Highway intersection commonly reach Atkins Road and sporadically reach as far as Chilco Road/ Nursery Hill Drive.

During the PM peak hour eastbound vehicles (on Island Highway) are shown to encounter V/C and LOS conditions that exceed threshold criteria.

Figure 4.1: SimTraffic Model Screen Cap

The screen capture image shown in **Figure 4.1** illustrates weekday AM peak period queue build up from the Island Highway & Six Mile Road intersection. The queue was observed during field visits to often reach and even exceed the Atkins Road intersection which represent queues greater than 400m.

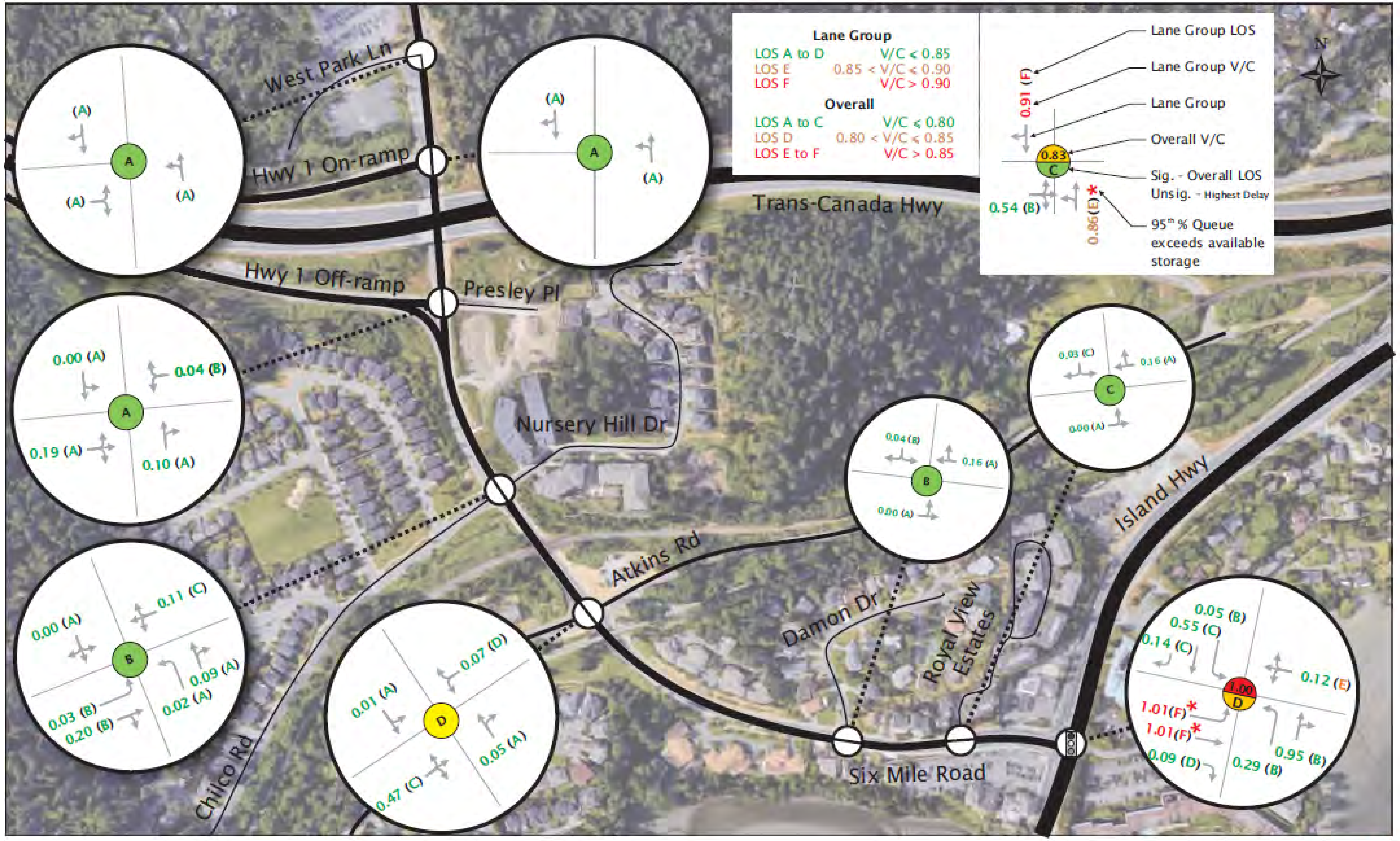


Exhibit 4.1
Existing Weekday AM Peak Hour Traffic Operations

Six Mile Road Corridor Study
04-19-0077 January 2020

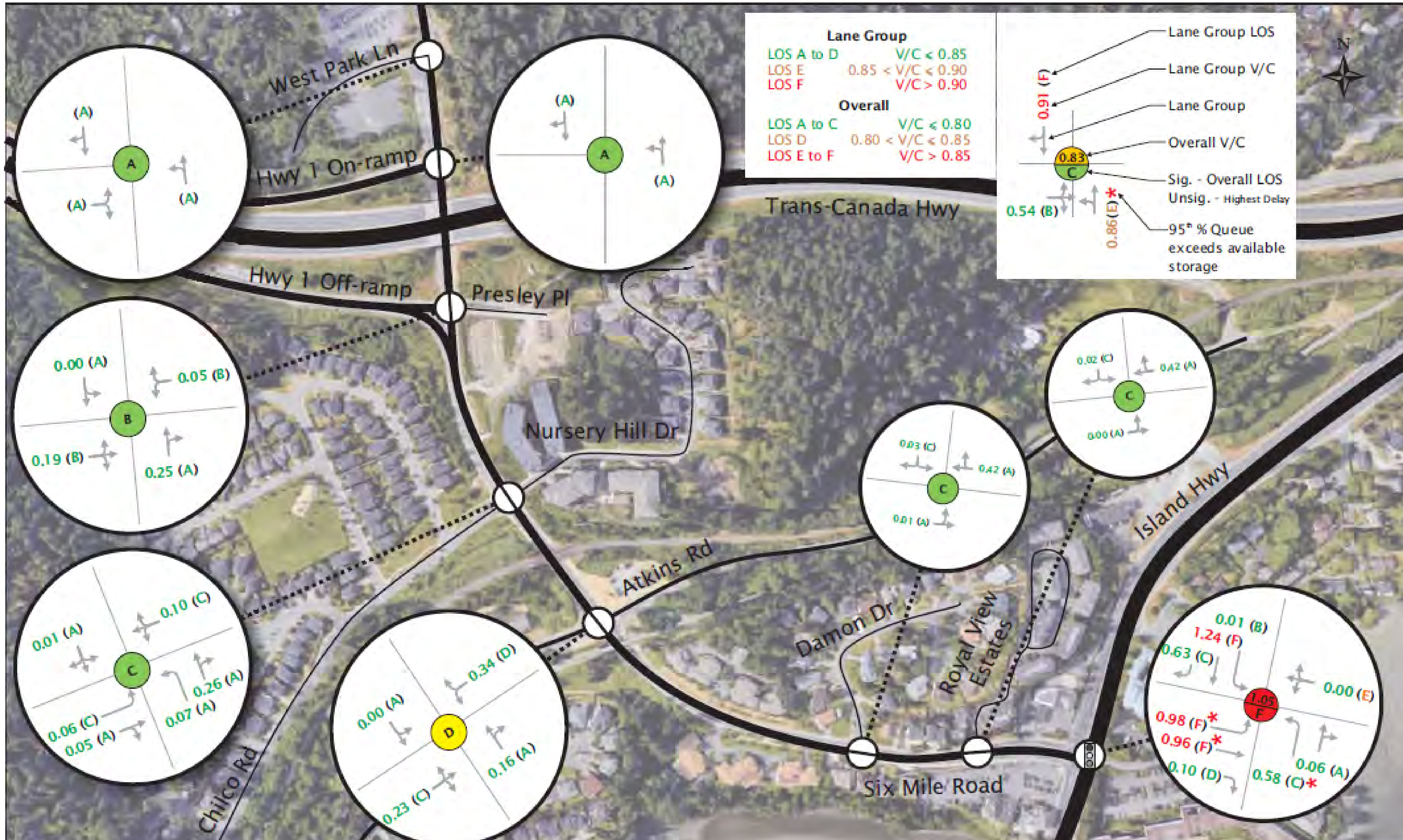


Exhibit 4.2

Existing Weekday PM Peak Hour Traffic Operations

Six Mile Road Corridor Study
04-19-0077 January 2020

4.3 Regional Impacts to Future Conditions

Future volume forecasts were calculated using growth patterns observed over the previous 10 - 15 years. These growth factors were applied to roadways that connect to the Six Mile Road Corridor such as Highway 1, Atkins Road and Island Highway. These forecasted volumes may however also be influenced by various other regional variables such as:

- Time savings and rerouting due to Highway 1 & McKenzie Avenue Interchange;
- Automatic Vehicles and related travel time savings; and,
- Private vehicle mode share decreases due to Transit service or cycling network improvements or alternative transportation options such as West Shore to downtown Victoria ferry service.

Quantifying the potential time savings of these regional factors is difficult. These factors that may decrease Corridor vehicle volumes are also countered by potential for above forecasted West Shore growth.

4.3.1 McKenzie Avenue & Highway 1 Interchange

A partial clover leaf interchange design is being implemented at the McKenzie Avenue & Highway 1 intersection with a target completion date of summer 2020.

McKenzie interchange project will allow Highway 1 vehicles to proceed through the intersection without stopping. This major Highway 1 intersection has been identified as a key bottleneck for southbound vehicles in the AM peak period that may discourage Highway 1 use, with some motorists instead using the Atkins Road route. According to McElhanney's May 2016 Traffic Analysis Report (Table 10), the eastbound and westbound movements along the Highway 1 may experience peak period time saving of almost 6 minutes and 8 minutes respectively on opening day. Forecasted time savings along Highway 1 may facilitate more Langford generated traffic to use the Langford Parkway to Highway 1 route rather than the Atkins Road route which is believed to be used to bypass Highway 1 traffic congestion.

4.3.2 Mode Share Shift

The July 2014 CRD Regional Transportation Plan has a transit mode share target of 12% for service within the Victoria Regional Transit System by 2030 and mode share targets of 25% for both cycling and walking in high density urban areas of the region by 2038. In 2011, only about 6% of mode share belong to transit while 3% cycled and 13% walked. However, the 2017 survey results indicate the mode share for transit, cycling, and walking increased to 8%, 5%, and 14%, respectively. These CRD mode share percentages are summarized in **Table 4.2**.

Table 4.2: CRD Mode Share – CRD Regional Transportation Plan (2014)

TRAVEL MODE	2001	2006	2011	2017	CRD 2030 TARGET
Auto Driver and Passenger	76%	78%	77%	72%	-
Transit	7%	7%	6%	8%	**12%**
Cycling	3%	4%	3%	5%	**25%**
Walking	12%	10%	13%	14%	**25%**
Other	1%	2%	1%	2%	-

*Trips within regional planning area and by population over 11 years of age.
**Source: 2017 CRD Household Travel Survey – Daily Travel Characteristics Report.
***Some variation from previous surveys is likely due to considerable methodological changes.

4.3.3 Regional Developments

Three residential developments along the Corridor have been approved or have been completed during the preparation of this study. The vehicle traffic associated with these developments was layered onto existing volumes to generate a future 2022 scenario which includes the developments. They are illustrated in **Exhibit 4.3** with regards to the number of residential units at each development.

4.4 Baseline 2022 Operations

Background vehicle volumes were factored up by percentages specific for key Corridor approaches. These applied growth rates along with the described approved regional developments are shown in Exhibit 4.3.

The resulting 2022 volume scenarios are considered more relevant than the existing condition scenarios since they include approved developments. This 2022 scenario was therefore used as the baseline condition. Comparison between 2019 and 2022 operations presents the net impact of the approved developments and the three years of applied background growth. **Exhibit 4.4** and **Exhibit 4.5** present the forecasted 2022 AM and PM peak hour traffic operations.

As illustrated in Exhibits 4.4 and 4.5 the same two intersections encounter capacity issues, they are the Atkins Road & Six Mile Road intersection and the Island Highway & Six Mile Road intersection. Generally, the issues found in the 2019 scenarios are still present and are slightly exacerbated by the growth factors.

4.5 Future 2032 Operations

Horizon 2032 scenarios were also created by applying the same annual growth rates provided on Exhibit 4.3. **Exhibit 4.6** and **Exhibit 4.7** present the forecasted 2032 AM and PM peak hour traffic operations.

As illustrated in Exhibits 4.6 and 4.7 by 2032 performance forecasts at the previously discussed Atkins and Island Highway intersections with Six Mile Road continue to deteriorate due to applied background growth rates. In addition, the Chilco Road/ Nursery Hill Drive & Six Mile Road intersection is shown to encounter LOS E delays during weekday AM and PM peak hour periods.

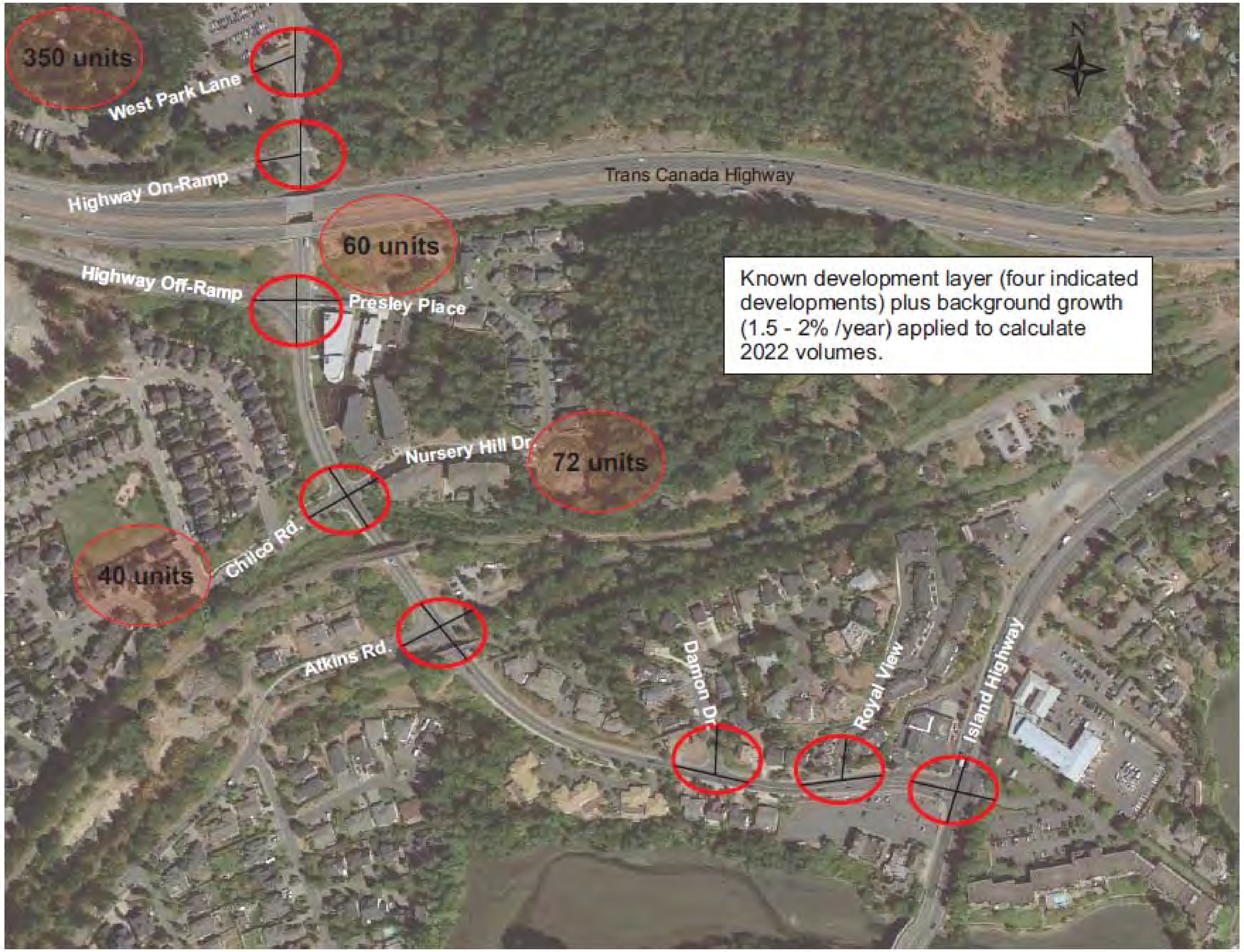


Exhibit 4.3
Approved Development Layer

Six Mile Road Corridor Study
04-19-0077 January 2020

bunt & associates

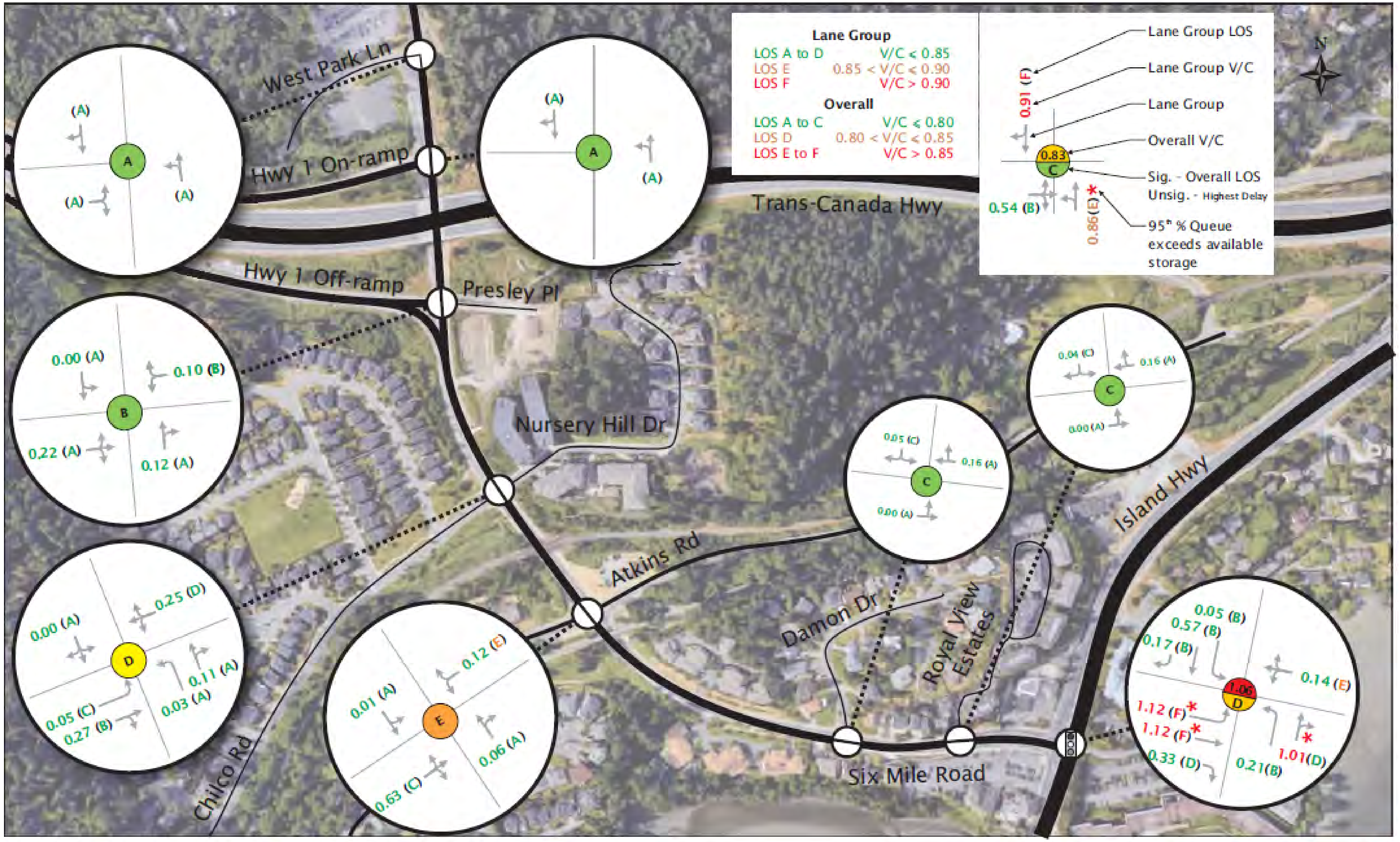


Exhibit 4.4

Total 2022 Weekday AM Peak Hour Traffic Operations

Six Mile Road Corridor Study
04-19-0077 January 2020

Exhibit 4.5

Total 2022 Weekday PM Peak Hour Traffic Operations

Six Mile Road Corridor Study
04-19-0077 January 2020

bunt & associates

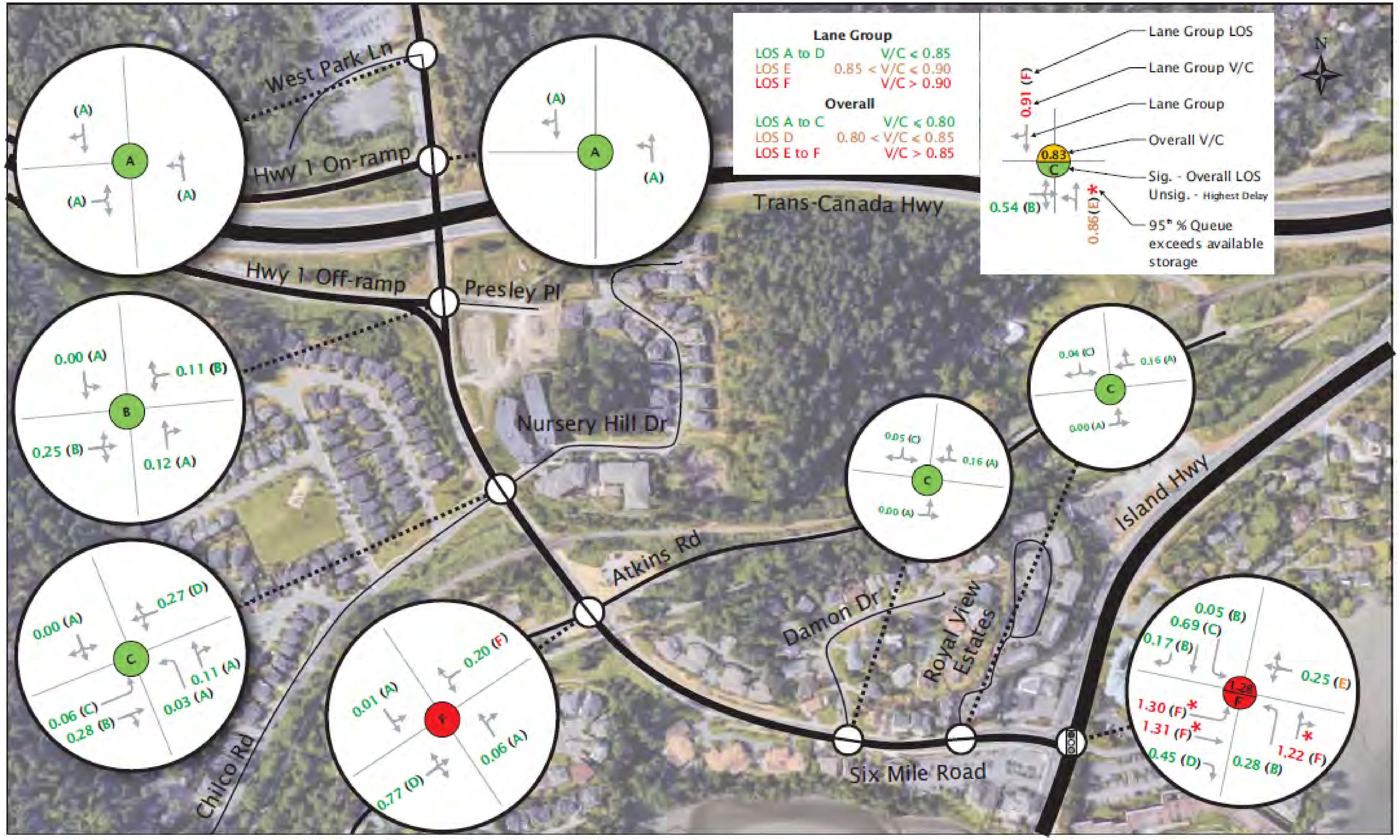


Exhibit 4.6

Total 2032 Weekday AM Peak Hour Traffic Operations

Six Mile Road Corridor Study
04-19-0077 January 2020

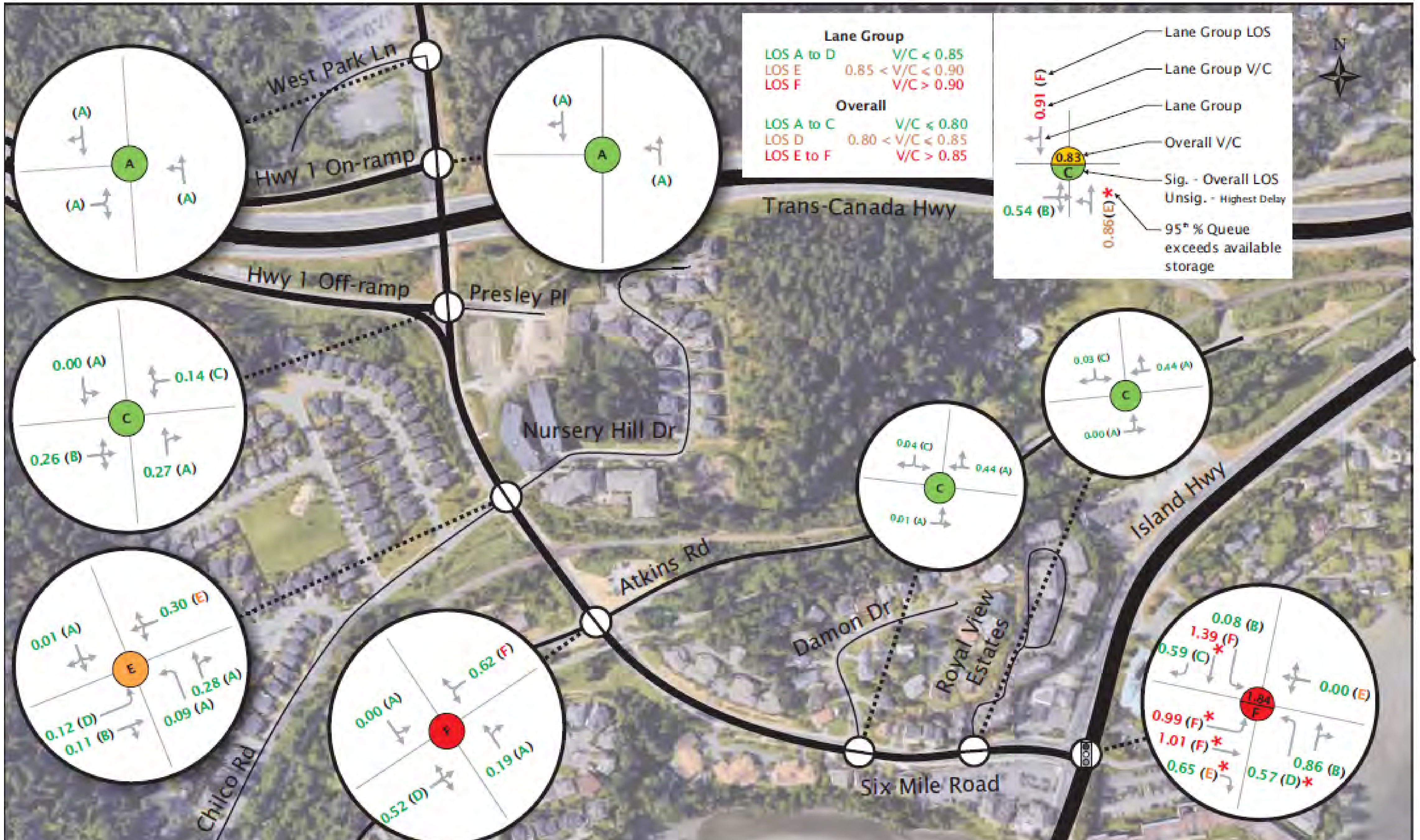


Exhibit 4.7

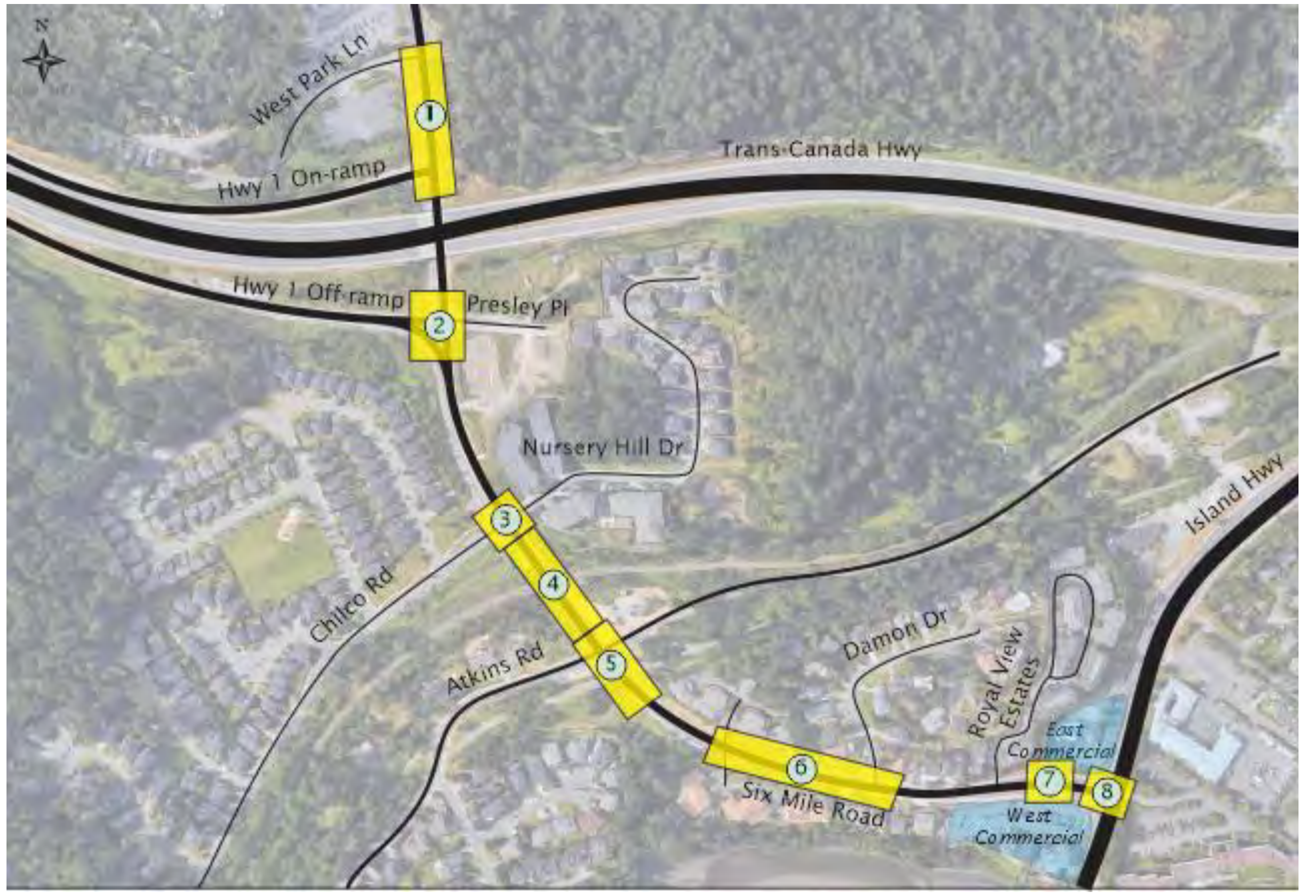
Total 2032 Weekday PM Peak Hour Traffic Operations

Six Mile Road Corridor Study
04-19-0077 January 2020

bunt & associates

5. CORRIDOR SEGMENTS

The Corridor was divided into eight segments. These segments are shown below.



For each Corridor Segment:

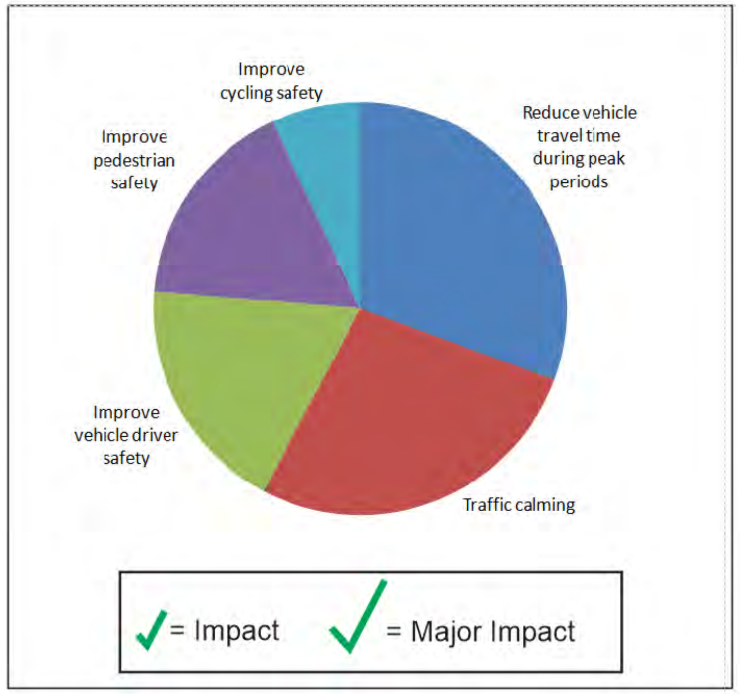
Issues identified by Bunt's traffic capacity analysis and the public engagement process are summarized,

Analysis and Findings are presented, and

Recommendations are provided.

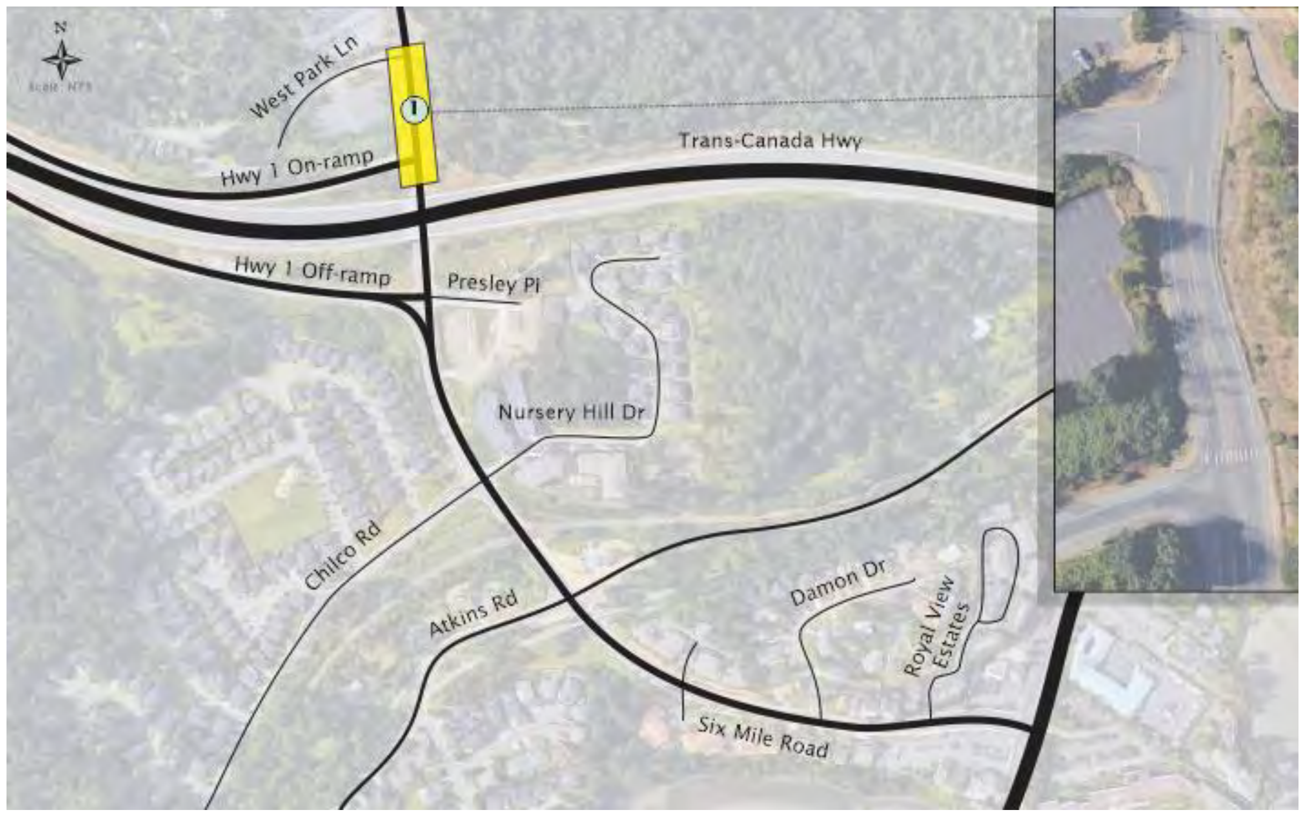
Recommended mitigation or actions are evaluated with a Priority Check

The Priority Check evaluates the action against the public engagement derived study objectives. Objectives are subjectively given either a check mark for having an impact or a larger checkmark for an anticipated major impact.



Approximate costs of recommended actions as well as corresponding ranked priority actions are presented in Section 6.

5.1 Segment 1: Six Mile Road North of Highway 1



5.1.1 Issues

- Pedestrian safety, particularly during summer months when Thetis Lake parking lot overflow results in vehicles parking along Six Mile Road.
- Substandard pedestrian amenities along Six Mile Road between Highway 1 Off-Ramp and Thetis Lake parking lot area.

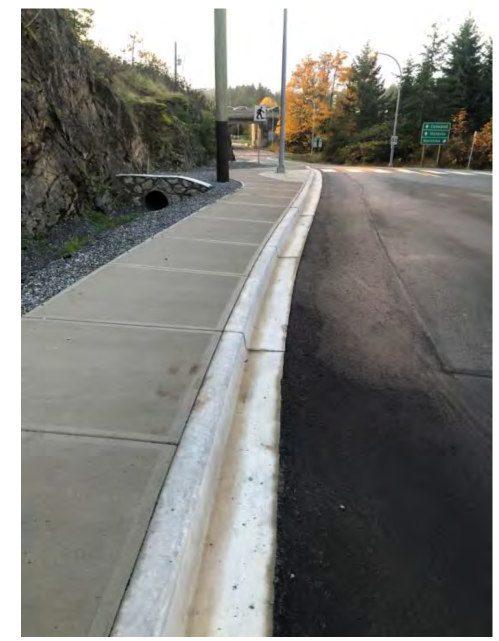
5.1.2 Analysis & Findings

No traffic capacity issues forecasted at Highway 1 On-ramp & Six Mile Road intersection in existing or future scenarios.

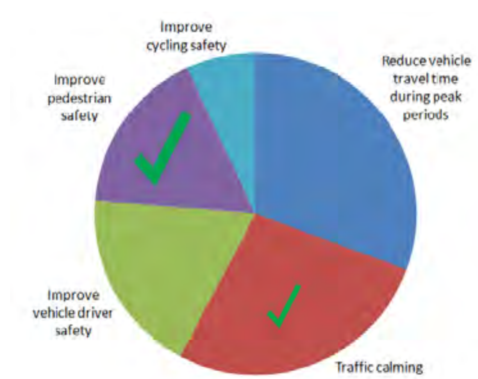
5.1.3 Recommendations

1. Improve pedestrian amenities along Six Mile Road's east edge.

Status: Sidewalk added to Six Mile Road's east edge in summer of 2019 as part of West Park Lane development.



Photos: New sidewalk was introduced in summer of 2019. Photos taken near West Park Lane, facing south.



Priority Check

5.2 Segment 2: Six Mile Road & Highway 1 Off-Ramp Intersection

5.2.1 Issues

- Pedestrian safety during peak summer periods: crosswalk on intersection's south leg could be upgraded to a Special Crosswalk with pedestrian activated buttons.
- No traffic capacity issues forecasted.

5.2.2 Analysis & Findings

Vehicles exiting Presley Place are not anticipated to encounter delays requiring mitigation as they turn onto Six Mile Road, according to Synchro model analysis.

Pedestrian Crossing options include:

> A Signed and Marked Crosswalk: *Pedestrian crossing is permitted at marked and signed crosswalks. Marked crosswalks are installed to draw a driver's attention to a crossing location and to indicate to pedestrians that the location is a good place to cross the road.*
>
> A Special Crosswalk: *Special crosswalks also draw a driver's attention to the needs of the pedestrians at the crosswalk. They are push button operated and usually reserved for more complex locations where a driver's attention may be difficult to obtain with a signed and marked crosswalk.*

Pedestrian Crossing Warrant

The Pedestrian Crossing Control Manual for British Columbia (Ministry of Transportation and Infrastructure) was used to examine pedestrian crossings. The warrant takes into account crossing time measured by crossing distance, crossing opportunities, which is a product of conflicting vehicle volumes, and forecasted pedestrian crossing demands. They also take into account stopping sight distances for approaching vehicles, proximity of adjacent traffic or pedestrian signals or crosswalks, and road geometry.

The existing pedestrian crossing has low pedestrian volumes during regular periods, however this increases during peak Thetis Lake periods. The two-lane profile of Six Mile Road with existing traffic volumes provides approximately 160 crossing opportunities per hour based on the future forecasted 2032 traffic volumes. The crossing opportunity value of 160 crossing opportunities indicates that the crossing does not warrant a more robust crossing with push-button or overhead lights. TAC Pedestrian Crossing Warrant Charts are provided in **Appendix B**.

5.2.3 Recommendations

- Upgrading the pedestrian crossing to a Special Crosswalk is not warranted due to low volumes of pedestrians crossing at this location and the relatively low volume of vehicle traffic.
- Not a desired crossing location due to lack of pedestrian infrastructure on Six Mile Road's west edge and potential conflicts with vehicles exiting Highway 1 Off Ramp.
- No recommended changes.

5.3 Segment 3: Chilco Road / Nursery Hill Drive & Six Mile Road Intersection

5.3.1 Issues

- Chilco Road and Nursery Hill Drive approach vehicles experience significant delays as they turn onto Six Mile Road.
- Pedestrian safety concerns due to the intersection being a key Six Mile Road pedestrian crossing point location and high conflicting Six Mile Road vehicle speeds, particularly in the southbound direction as vehicles enter the Corridor from the Highway 1 off-ramp.

5.3.2 Analysis & Findings

Four potential traffic control options at the Chilco Road & Six Mile Road intersection were examined:

- o Existing, 2-way stop control;
- o 4-way stop control;
- o Traffic signal (semi-actuated, uncoordinated); and
- o Roundabout.

Table 5.1: Chilco Road & Six Mile Road Operation Comparison –2022

SCENARIO	MOVEMENT	UNSIGNALIZED 2-WAY STOP (EXISTING)			4- WAY STOP			TRAFFIC SIGNAL			ROUNDABOUT		
		LOS	V/C	95TH Q (M)	LOS	V/C	95TH Q (M)	LOS	V/C	95TH Q (M)	LOS	V/C	95TH Q (M)
AM	*OVERALL*	*A*	-	-	*B*	-	-	*A*	*0.32*	-	*A*	*0.26*	-
	EBL	C	0.05	0	A	0.04	15	B	0.09	5	-	-	-
	EBTR	B	0.27	10	A	0.28	15	B	0.12	10	B	0.20	10
	WBLTR	D	0.25	5	B	0.11	10	B	0.28	10	A	0.05	5
	NBL	A	0.03	0	A	0.07	15	A	0.06	5	-	-	-
	NBTR	A	0.11	0	A	0.31	20	A	0.12	15	A	0.15	5
	SBLTR	A	0.00	0	C	0.58	30	A	0.34	25	A	0.26	10
PM	*OVERALL*	A	-	-	C	-	-	A	0.41	-	A	-	-
	EBL	D	0.10	0	A	0.03	15	B	0.09	5	-	0.36	-
	EBTR	B	0.08	0	A	0.09	15	B	0.03	0	A	0.08	5
	WBLTR	D	0.23	5	B	0.08	10	B	0.22	5	B	0.05	0
	NBL	A	0.10	5	C	0.19	15	A	0.15	10	-	-	-
	NBTR	A	0.33	0	C	0.81	30	A	0.43	35	A	0.36	20
	SBLTR	A	0.01	0	C	0.61	30	A	0.30	20	A	0.29	15

Table 5.1 suggests the Chilco Road / Nursery Hill Drive & Six Mile Road intersection could operate within threshold criteria during AM and PM 2022 peak hour periods. It is however noted that delays from Nursery Hill Drive and Chilco Road were observed to exceed the modeled output, this is due to observed sporadic queue spillback on Six Mile Road to Chilco Road / Nursery Hill Drive from the Island Highway intersection and also vehicles exiting Nursery Hill Drive needing to compete with the high volume of right turning vehicles from Chilco Road, particularly in the weekday AM peak period.

Table 5.2: Chilco Road & Six Mile Road Operation Comparison –2032

SCENARIO	MOVEMENT	UNSIGNALIZED 2-WAY STOP (EXISTING)			4- WAY STOP			TRAFFIC SIGNAL			ROUNDABOUT		
		LOS	V/C	95TH Q (M)	LOS	V/C	95TH Q (M)	LOS	V/C	95TH Q (M)	LOS	V/C	95TH Q (M)
AM	*OVERALL*	*A*	-	-	*B*	-	-	*A*	*0.35*	-	*A*	*0.28*	-
	EBL	C	0.06	0	A	0.04	15	B	0.09	5	-	-	-
	EBTR	B	0.28	10	A	0.29	15	B	0.12	10	A	0.20	10
	WBT	D	0.27	10	B	0.11	10	B	0.28	10	A	0.05	0
	NBL	A	0.03	0	A	0.07	15	A	0.06	5	-	-	-
	NBTR	A	0.11	0	A	0.31	20	A	0.18	15	A	0.15	5
	SBLTR	A	0.00	0	C	0.63	30	A	0.37	30	A	0.28	10
PM	*OVERALL*	A	-	-	C	-	-	A	0.41	-	A	0.36	-
	EBL	D	0.12	5	A	0.04	10	B	0.09	5	-	-	-
	EBTR	B	0.11	5	A	0.12	20	B	0.03	0	A	0.09	5
	WBT	E	0.30	10	B	0.10	20	B	0.22	5	B	0.05	0
	NBL	A	0.09	0	C	0.16	10	A	0.15	10	-	-	-
	NBTR	A	0.28	0	A	0.73	35	A	0.43	35	A	0.36	20
	SBLTR	A	0.01	0	C	0.73	30	A	0.30	20	A	0.34	15

Queue lengths are rounded to the nearest 5m.

Table 5.2 illustrates that the Chilco Road / Nursery Hill Drive & Six Mile Road intersection is anticipated to exceed threshold criteria during PM 2032 peak hour period with westbound (from Nursery Hill Drive) delays of LOS E. It is again noted that minor leg delays may in fact exceed our modeled output as vehicles exiting Nursery Hill Drive compete with the high volume of right turning vehicles from Chilco Road in the AM peak period.

5.3.3 Mitigation Options

Retain Existing 2 Way Stop Control

Current traffic control could be retained since the intersection is shown to not exceed threshold criteria until the 2032 scenario.

4-Way Stop Control

Conversion to 4-way stop control was examined. It was found to result in traffic operation improvements for the minor leg delays. A 4 –Way Stop would increase northbound and southbound delays; however they remain within performance thresholds and can act as a traffic calming measure for vehicles traveling on Six Mile Road.

Supplemental southbound queue analysis was conducted to examine southbound Six Mile Road queues. This is with respect to potential concerns that southbound Six Mile Road queues may extend back towards the Highway 1 Off-ramp. Queues shown in Tables 5.1 and 5.2 were Synchro software generated. Our SimTraffic analysis indicates 95th percentile southbound peak hour queues in 2032 may reach 35 m if the intersection were converted to 4-way stop control, and 29 m during the PM peak hour. This length of queues, which is approximately equivalent to five vehicles, is generally consistent with the Synchro model output and are not anticipated to impact Highway 1 Off-Ramp movements since the Off-Ramp connection with Six Mile Road is approximately 130 m north of the Chilco Road/ Nursery Hill Drive intersection.

Traffic Signal

Introduction of a traffic signal at this location would decrease minor leg peak period delays (to LOS B) without significant impact to the major north / south movements (they remain at LOS A). However, a traffic signal is not warranted at this location using forecasted 2022 and 2032 pedestrian and vehicle volumes.

Table 5.3 presents the Transportation Associates of Canada (TAC) traffic signal warrant results which indicate a traffic signal is not warranted based on 2022 and 2032 forecasted traffic and pedestrian volumes (total score of 100 required for a traffic signal to be warranted). The 2022 versus 2032 results illustrate the impact of 10 years of background vehicle growth. Changes to nearby commercial land uses could result in a more impactful change to the pedestrian score. TAC traffic signal warrants are provided in **Appendix C**.

Table 5.3: TAC Traffic Signal Warrants

INTERSECTION/ TIME PERIOD	VEHICLE SCORE	PEDESTRAIN SCORE	TOTAL SCORE	WARANTED
Chilco 2022	56	25	**81**	**NO**
Chilco 2032	58	25	**83**	**NO**

Introduction of a traffic signal at this location is anticipated to cost $300,000 to $500,000 depending on design elements. This is substantial cost considering mitigation is not technically needed until 2032 according to operation thresholds and a signal is not warranted using common traffic signal warrants.

Roundabout

The Sidra analysis indicates that if the Chilco Road & Six Mile Road intersection is converted to a roundabout, it can be anticipated to operate within performance thresholds. Generally, traffic operations of a roundabout are shown to function similar to a traffic signal.

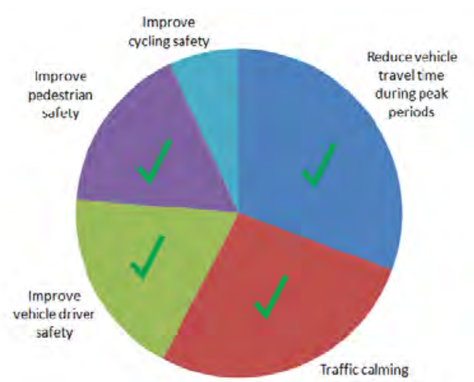
Like a traffic signal, the introduction of a roundabout at this intersection would require significant resources including space for an increased intersection footprint.

5.3.4 Recommendations

1. Convert traffic control to 4 Way Stop control. Conversion to 4 Way Stop control is preferred due to its relative low costs and anticipated benefits to reduce minor leg peak period delays, without significantly impacting Six Mile Road north/ south through traffic. This would assist with traffic calming, pedestrian safety and assist minor leg peak period delays. Importantly, conversion to 4-way Stop control is shown to not result in problematic queues on Six Mile Road that would extend towards the Highway 1 off-ramp. This should be supported with "Stop Ahead" signs (W-11) on Six Mile Road approaches to the intersection. Initially the new traffic control at the intersection should also be supported with "New" (W-329) and "Traffic Control" (W-12) or the Ministry's "Prepare to Stop" (C-29) sign.

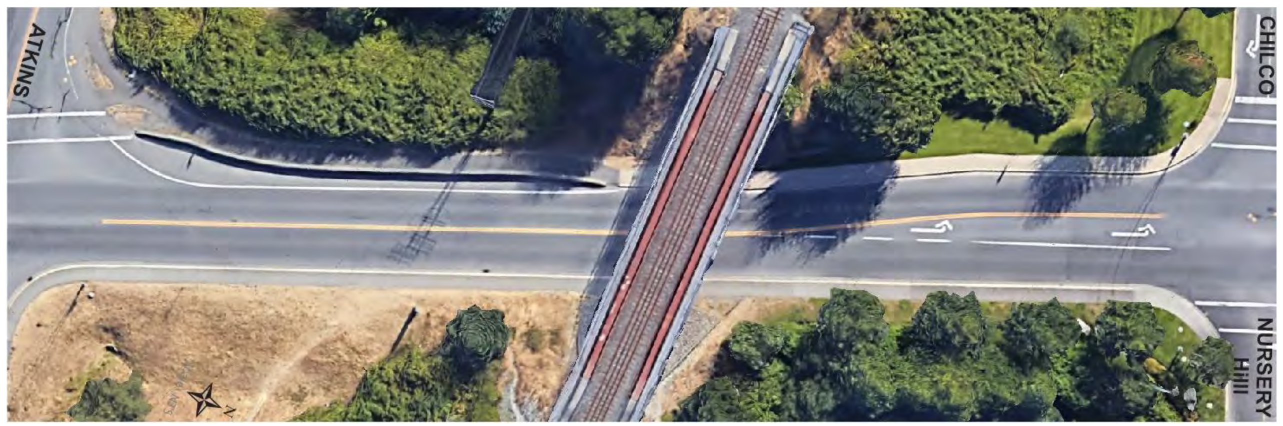
   Consideration can be given to the installation of a pedestrian crossing upgrade including road narrowing and/ or a central refuge median, along the intersection's north leg. This would assist with traffic calming and pedestrian safety.

2. In addition to traffic control alterations, the installation of a Radar Speed Reader for southbound vehicles, located north of Chilco Road is recommended to reduce southbound vehicle speeds as they approach the Chilco Road/ Nursery Hill Drive intersection.



Priority Check

5.4 Segment 4: Between Chilco Road & Atkins Road



5.4.1 Issues

- Current cross section with vehicle and bicycle shared lanes present safety concerns for cyclists.
- Six Mile Road under Rail Bridge narrows approximately to a **13.2 meter** cross section.

Figure 5.1: Existing Cross Section at Rail Bridge

5.4.2 Analysis & Findings

- This area of the Corridor is a key active transportation mode link between the Galloping Goose Trail and Chilco Road/ Nursery Hill Drive residential areas.
- With current bridge structure, there is not adequate width for minimal width travel lanes, sidewalks and bikes lanes.

5.4.3 Recommendations

1. Reduce travel lane width to improve sidewalk/ cycling widths. Priority corridor location for cross section alterations is between Chilco Road and Atkins Road.
    - Prioritize barrier separating vehicles from sidewalk.
    - Prioritize Six Mile Road's east edge, due to higher active mode volumes.
    - Coordinate cross section alterations with potential alterations at the Atkins Road & Six Mile Road intersection.
    - Examine feasibility of expanding Corridor right of way by reducing rail bridge support infrastructure.

Figure 5.2: Preferred Cross Section Option

East edge alteration, one shared use sidewalk/ trail.

5.5 Segment 5: Atkins Road & Six Mile Road Intersection

5.5.1 Issues

- Intersection exceeds capacity thresholds during 2022 AM and PM peak periods.
- There is no street level pedestrian crossing of Six Mile Road at the Atkins Road intersection.
- There is a missing pedestrian link between Six Mile Road's west edge sidewalk and the Galloping Goose Trail.

5.5.2 Analysis & Findings

Four potential traffic control options at the Atkins Road & Six Mile Road intersection were evaluated, they are:

- o Existing, 2-way stop control;
- o 4-way stop control;
- o Traffic signal (semi-actuated, uncoordinated); and,
- o Roundabout.

Operation results are presented in **Table 5.4** and **Table 5.5** for 2022 and 2032 volumes respectively.

Table 5.4: Atkins Road & Six Mile Road Operation Comparison - 2022

SCENARIO	MOVEMENT	EXISTING 2 WAY STOP			4 WAY STOP			SIGNAL			ROUNDABOUT		
		LOS	V/C	95TH Q	LOS	V/C	95TH Q	LOS	V/C	95TH Q	LOS	V/C	95TH Q
AM	*OVERALL*	*A*	-	-	*D*	-	-	*A*	*0.51*	-	*A*	*0.39*	
	EBLTR	C	*0.63*	35	B	*0.49*	35	B	0.39	20	A	0.34	20
	WBLTR	E	0.12	5	B	0.03	10	B	0.03	5	A	0.01	0
	NBLTR	A	0.06	0	B	0.50	15	A	0.33	30	A	0.20	10
	SBLTR	A	0.01	0	E	0.90	55	A	0.56	60	A	0.39	20
PM	*OVERALL*	*A*	-	-	F	-	-	A	0.68	-	A	0.44	
	EBLTR	D	*0.44*	15	B	0.22	25	C	0.21	15	A	0.13	5
	WBLTR	F	0.52	20	B	0.12	10	C	0.28	15	A	0.08	5
	NBLTR	A	0.18	5	F	1.22	45	A	0.73	115	A	0.44	25
	SBLTR	A	0.00	0	C	0.69	25	A	0.32	30	A	0.4	20

Table 5.5: Atkins Road & Six Mile Road Operation Comparison - 2032

SCENARIO	MOVEMENT	EXISTING 2 WAY STOP			4 WAY STOP			SIGNAL			ROUNDABOUT		
		LOS	V/C	95TH Q	LOS	V/C	95TH Q	LOS	V/C	95TH Q	LOS	V/C	95TH Q
AM	*OVERALL*	*B*	-	-	*E*	-	-	*B*	*0.55*		*A*	*0.42*	
	EBLTR	D	*0.77*	50	C	0.59	40	B	0.50	25	A	0.40	20
	WBLTR	F	0.20	5	B	0.03	10	B	0.03	5	A	0.01	0
	NBLTR	A	0.06	0	C	0.53	20	A	0.33	30	A	0.20	10
	SBLTR	A	0.01	0	F	**0.99**	65	A	0.57	70	A	0.42	20
PM	*OVERALL*	*A*	-	-	F	-	-	A	0.66		A	0.45	
	EBLTR	D	*0.52*	20	B	0.26	30	C	0.22	15	A	0.16	5
	WBLTR	F	0.62	25	B	0.15	10	C	0.30	15	A	0.09	5
	NBLTR	A	0.19	5	F	1.35	55	A	0.71	105	A	0.45	30
	SBLTR	A	0.00	0	D	0.85	30	A	0.39	35	A	0.44	20

Higher modelled delays at the intersection's westbound approach over the higher volume eastbound approach are due to the delays being average delays per vehicle and hence independent of volume as well as a higher proportion of left turning vehicles.

5.5.1 Mitigation Options

Existing 2 Way Stop Control
With the existing 2-way stop control configuration, the intersection is anticipated to operate with westbound delays in excess of threshold criteria during both weekday AM and PM peak hour periods in the post-approved development 2022 (LOS E in AM, LOS F in PM) and future 2032 scenarios.

4 Way Stop control
4-Way Stop control was deemed not appropriate due to the resulting output exceeding various performance thresholds, particularly for southbound vehicles on Six Mile Road during the weekday AM peak period and northbound vehicles during the weekday PM peak hour period.

Traffic Signal
The introduction of a traffic signal would reduce problematic westbound delays to LOS B delays -10-15 seconds while maintaining northbound and southbound Six Mile Road Corridor LOS A delays.

Transportation Associates of Canada (TAC) traffic signal warrants were conducted for the Atkins Road and Six Mile Road intersection. **Table 5.6** presents the results which indicate a traffic signal is warranted based on both 2022 and 2032 forecasted traffic and pedestrian volumes. The intersection warrants a traffic signal according to TAC warrants.

Table 5.6: TAC Traffic Signal Warrants

INTERSECTION/ TIME PERIOD	VEHICLE SCORE	PEDESTRAIN SCORE	TOTAL SCORE	WARANTED
Atkins 2022	104	34	**138**	**YES**
Atkins 2032	123	35	**158**	**YES**

The pedestrian scores in **Table 5.5** reflect pedestrian volumes of 40 pedestrians per peak hour at each of the intersection's west, east and north legs. These are theoretical volumes as the Atkins intersection does not currently have a marked pedestrian crossing point at either its north of south legs.

Roundabout
Roundabout results are shown to also reduce problematic minor leg delays, while maintaining northbound and southbound Six Mile Corridor LOS A delays. A roundabout results in superior vehicle operations over a traffic signal.

A roundabout was found to have similar peak period Corridor travel time impacts as a traffic signal.

It is anticipated that annual maintenance costs for a roundabout are lower than a traffic signal as they are limited to maintaining landscaping features and the additional asphalt surface.

Other benefits of a roundabout at the Atkins Road intersections include:

- o Lower traffic speeds reduce crash frequency and crash severity for all users;
- o Drivers have more time to enter a gap in a roundabout circulating traffic; and
- o Vehicle emissions are reduced through reduced stops and delays.

Disadvantages of roundabouts, applicable to potential Atkins Road application include:

- o Greater space is required for the larger footprint of a roundabout to accommodate an acceptable outside diameter; and
- o Can be disadvantageous to pedestrian movements as they are pushed away from the intersection and hence may not align with adjacent sidewalks.

A conceptual roundabout design is provided below and in **Appendix C**. The TAC Canadian Roundabout Design Guide (2017) was used as design references.

5.5.2 Recommendations

A traffic signal and a roundabout were both shown to improve traffic operations.

1. A roundabout is favored at this location as it is anticipated to result in:
    - Minimal Six Mile Road Corridor travel time impacts;
    - Lower vehicle approach speeds on Six Mile Road which increases overall safety for all users; and,
    - Prioritizes pedestrians and provides improved connection with the adjacent Galloping Goose trail.

Figure 5.3: Conceptual Design of Atkins Road & Six Mile Road Intersection

2. Improvement of the sidewalk extending south from the intersection along its west edge. As shown in the Photo below, the sidewalk extending from Atkins Road towards the south on the west side of Six Mile Road is at road grade. It is recommended that this sidewalk be elevated to connect from the proposed roundabout to the existing sidewalk located approximately 55 meters south of the intersection.

Photo: Sidewalk area along Six Mile Road's west edge south of Atkins Road. Photo faces south.

Priority Check

5.6 Segment 6: Minor Road Residential Accesses Onto Six Mile Road

5.6.1 Issues

- Delays for vehicles turning from minor roads onto Six Mile Road, particularly during weekday AM.
- Vehicles using minor roads for turnaround movements.
- No pedestrian crossings across Six Mile Road in this segment. Controlled pedestrian crossings at Galloping Goose and Island Highway are approximately 480 m apart. This equates to an approximate 5 minute walk. NACTO suggests that rerouting over 3 minutes is problematic as it often leads to jaywalking. BC Transit bus stops along each edge of Six Mile Road.

5.6.2 Analysis & Findings

Vehicles from exiting minor roads do not warrant traffic signal installation due to low vehicle volumes.

A logical location for a potential mid-block crossing would be approximately 50 m north of Damon Drive as this is the approximate mid-point between the adjacent crossings and is near bus stops. Pedestrian Crossing Options include:

> A Signed and Marked Crosswalk: *Pedestrian crossing is permitted at marked and signed crosswalks. Marked crosswalks are installed to draw a driver's attention to a crossing location and to indicate to pedestrians that the location is a good place to cross the road.*
>
> A Special Crosswalk: *Special crosswalks also draw a driver's attention to the needs of the pedestrians at the crosswalk. They are push button operated and usually reserved for more complex locations where a driver's attention may be difficult to obtain with a signed and marked crosswalk.*

Pedestrian Crossing Warrant

The Pedestrian Crossing Control Manual for British Columbia (Ministry of Transportation) was used to examine pedestrian crossings. The warrant takes into account crossing time measured by crossing distance, crossing opportunities, which is a product of conflicting vehicle volumes, and forecasted pedestrian crossing demands. They also take into account stopping sight distances for approaching vehicles, proximity of adjacent traffic or pedestrian signals or crosswalks, and road geometry.

The two-lane profile of Six Mile Road with existing traffic volumes provides approximately 62 crossing opportunities per hour based on the future forecasted 2032 traffic volumes. This suggests if the mid-block demand was greater than 15 people per hour a Signed and Marked Crosswalk would be warranted. Low bus stop service demand. Crossing demand is anticipated to be less than 15 pedestrians per hour.

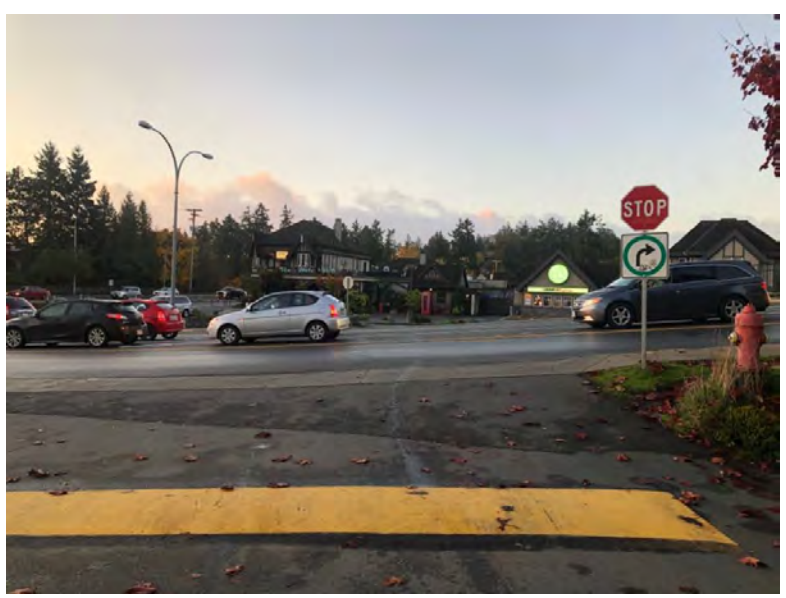
A mid-block pedestrian crossing near Damon Drive would have minimal impact to vehicle travel times during peak periods. Rationale for not implementing a crossing are to do with a forecasted lack of crossing demand rather than impacts to vehicle travel times.

5.6.3 Recommendations

No recommended changes as the anticipated crossing demand is less than the required 15 pedestrians per peak hour.

5.7 Segment 7: Six Mile Road / Commercial Accesses

Above Photo: Access from West Commercial. Below Photo: Access from East Commercial



5.7.1 Issues

The current configuration with road hatching on Six Mile Road presents sightline and safety concerns for vehicles entering and exiting the commercial sites with left turn movements to and from Six Mile Road. Vehicles entering the West Commercial (Six Mile Pub) site from northbound Six Mile Road must travel over three southbound lanes including two left turn storage lanes to enter the site. Furthermore. southbound Six Mile road vehicles that queue behind the hatched area in the left turn lanes block sightlines between vehicles turning left into the pub parking area and vehicles in the right curb side lane that may travel through the hatched area to turn right at the Island Highway intersection.

This issue is exacerbated by the close proximity (approximately 25m) of these commercial accesses to the Island Highway and Six Mile Road intersection. The access points are in fact within the functional area of the Six Mile Road & Island Highway intersection with the southbound left turn lanes extending past the accesses.

Clearing an area with road hatching on a multi-lane roadway, within the functional area of an intersection creates a safety concern, especially when left turning vehicles must traverse multiple lanes through sightline compromising vehicle queues.

This hatched area may also negatively impact the southbound left turn movement as it removes left turn storage area.

Existing control condition is inconsistent for West and East Commercial sites. The West Commercial approach is signed with a Stop sign. While the East Commercial site (Shell Gas) also has a “Turn Right” sign.

5.7.2 Analysis & Findings

Restricting left turn movements to and from these commercial sites will impact vehicle accessibility to these businesses. In particular, vehicles traveling eastbound on Island Highway wishing to enter the West Commercial site or vehicles wishing to exit the West Commercial site and travel north on Six Mile Road will need to use other nearby minor roads to perform turnaround manoeuvres.

> *You may **turn left**— including **turning left over a solid double yellow line**— if you do this carefully and safely and don't impede other traffic, and there are no signs prohibiting such **turns**.*
>
> - **Understanding intersections - ICBC**

Various control options were considered involving a mix of potential restrictive or left turn protecting measures such as:

- Major road hatching to facilitate left turn movements;
- Major road "Do Not Block Intersection" signs;
- Minor road "No Left Turn" signs;
- Minor road "Right Turn Only" signs; and,
- Major road centre median to physically block left turn movements.

Factors that are unique to this location were considered; the four most impacting factors are:

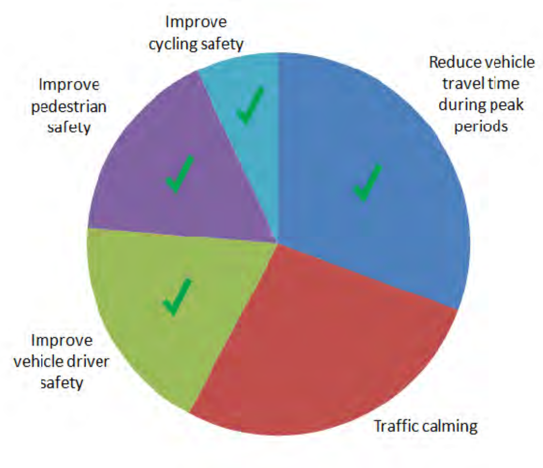
- Safety and accident prevention are the paramount considerations;
- Transportation Association of Canada (TAC) guidelines and the Ministry of Transportation and Highway's *Manual of Standard Traffic Signs & Pavement Markings* do not provide road hatching as an option for preservation of commercial access, rather just the preservation of emergency vehicle access;
- Consideration of grandfathering left turn access is given due to no alternative access configuration being feasible and corresponding impact to site access; and,
- Recognition that high vehicle volumes and queues on the southbound approach of Six Mile Road occur specifically during the weekday AM period, when demand to enter the west commercial area is low.

5.7.3 Recommendations

1. Bunt recommends removing/ not replacing the road hatching on Six Mile Road. Retain Six Mile Road's double yellow lines. Remove existing "Right Turn" sign from East Commercial Approach. Introduce "Left Turn Prohibited" (R-15L) signs on both the east and west minor leg approaches with a time period tab sign reading 6 AM – 9 AM. Remove "Do Not Block Business Access" intersection signs from Six Mile Road's southbound approach.

   Bunt believes this represents a compromise solution; left turn movements are not encouraged with hatching to comply with industry best practice however the left turns are not physically blocked and are only restricted during the weekday morning period when Six Mile Road queues are typically the longest and low levels of activity are anticipated at the West Commercial area.

2. Town of View Royal to create policy stipulating intersection clearing road hatching is only to be used to protect emergency vehicle access.



Priority Check

5.8 Segment 8: Island Highway & Six Mile Road Intersection

5.8.1 Issues

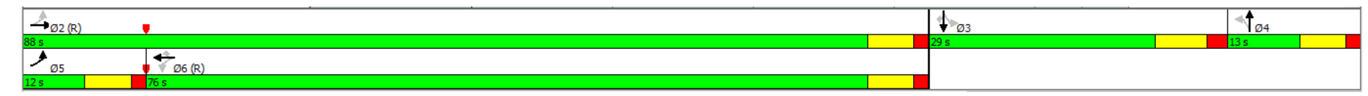
The Island Highway & Six Mile Road intersection demonstrates significant north leg (Six Mile Road approach) delays and corresponding queues in the existing weekday AM peak period. Due to property lines and in consideration of the existing dual left turn lanes, this intersection is considered built out in terms of lanes and geometric alternatives.

Figure 5.4: Screen Capture of AM SimTraffic Model Queues

5.8.2 Analysis & Findings

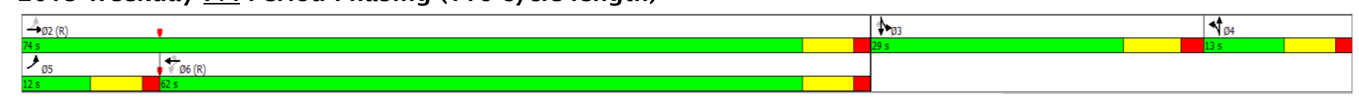
- Optimizing the AM period signal timing plan can reduce delays for southbound vehicles while still allowing the opposing Island Highway's eastbound movement to be under capacity thresholds.
- Optimizing the PM period signal timing plan can increase westbound through capacity while still allowing the opposing Six Mile Road southbound phase to be under capacity thresholds.
- Existing Six Mile Road commercial access hatching displaces left turn storage queue space. The hatching is estimated to result in approximately 150 fewer vehicles being able to travel through intersection (southbound left turn movements) per weekday AM peak hour (calculated at approximately five vehicles per signal cycle).

2019 Weekday AM Period Phasing (130 cycle length)

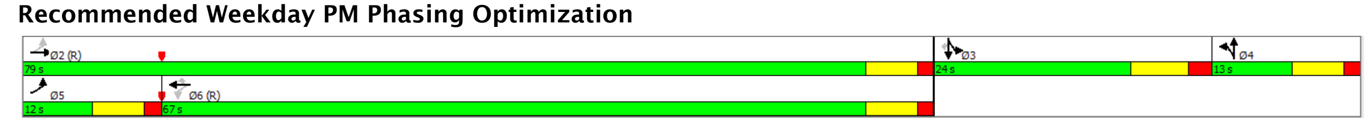


Recommended Weekday AM Phasing Optimization

2019 Weekday PM Period Phasing (116 cycle length)



Recommended Weekday PM Phasing Optimization

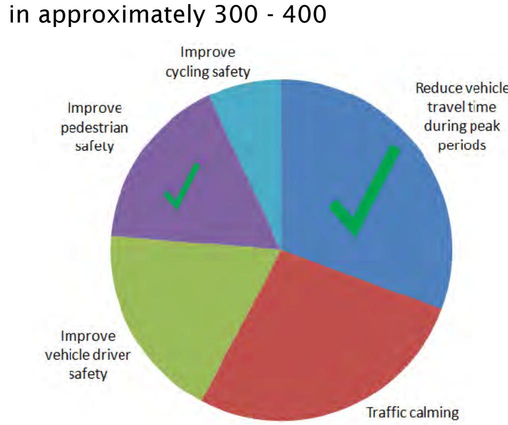


5.8.3 Recommendation

1. Traffic signal optimization is considered the most practical and impactful mitigation measure. Analysis suggests extending the southbound left turn phase by six seconds in the weekday AM period. Correspondingly the westbound and eastbound phases should be reduced by three seconds and the northbound movement (from Water's Edge) should be reduced by three seconds. 6-10 more vehicles anticipated to travel through each signal cycle or approximately 160 to 260 vehicles per peak hour. This also extends pedestrian walk phase. Combined with the recommended Six Mile Road hatching removal may therefore result in approximately 300 - 400 additional vehicles traveling through the intersection in a weekday AM peak hour.

   Our analysis suggests the traffic signal can also be improved during the PM peak hour period by extending westbound phase by five seconds. Correspondingly, the southbound phase should be reduced by five seconds.

   This is a low-cost item compared to the anticipated impact and can be implemented in short term.



Update: These signal timing changes were implemented on October 18th, 2019. Subsequent observations have noted reduced queues on Six Mile Road and negligible impact to Island Highway operations.

6. PRIORITY ACTIONS

Recommendations were examined in terms of approximate monetary costs to implement (**Appendix E**) over an evaluation of anticipated impact (or benefit) with regards to the three objective groups as determined by the public engagement process.

Impact score-were calculated by assigning a score between 1-5 with 5 being the highest perceived impact to address the following key objective categories:

- Points (out of 5) for improvement to traffic flow during peak periods;
- Points (out of 5) for traffic calming impact; and,
- Points (out of 5) for improvement to nonvehicle transportation mode impact.

The lowest Cost/ Impact values therefore represent best returns from a cost perspective. These values presented in **Table 6.1** are intended to be used as general guidance and for comparative analysis.

Table 6.1: Cost/ Impact Analysis of Described Options

CORRIDOR SEGMENT	LOCATION	ACTION	COST	IMPACT VEH, CALM, NON-VEH	COST (1,000)/ IMPACT
2 / 3	Between Hwy Off Ramp and Chilco Rd.	1) Southbound Radar Speed Reader	$5,000	0, 4, 1 =5	1
3	Chilco/ Nursery & Six Mile Rd.	2) Convert to 4-Way Stop Control	$60,000	4, 5, 3 =12	4
3	Chilco/ Nursery & Six Mile Rd.	3) Introduce Traffic Signal	$545,000	4, 3, 3 = 10	55
3	Chilco/ Nursery & Six Mile Rd.	4) Improve Existing Pedestrian Crossing	$30,000	0, 3, 3 =6	5
4	Corridor Cross Section	5) One Curb Alteration per 100m	$260,000	0, 3, 4 =7	37
4	Corridor Cross Section	6) Two Curb Alteration per 100m	$565,000	0, 3, 5 =8	71
5	Atkins & Six Mile Rd.	7) Introduce Roundabout	$700,000	4, 4, 3 =11	64
5	Atkins & Six Mile Rd.	8) Introduce Traffic Signal	$545,000	2, 3, 3 = 8	68
6	At or near Damon	9) Special Pedestrian Crossing	$60,000	0, 2, 2 =4	13
6	At or near Damon	10) Bus Stop Improvements	$25,000	0, 0, 2 =2	13
6	South of Damon	11) "Use Roundabout Ahead for Turnaround" sign	$1,000	0, 1, 0 =1	1
6	At Damon Drive	12) "No Exit" sign.	$1,000	0, 1, 0 =1	1
7	Commercial Driveways	13) Two "No Left Turn" signs plus time tabs	$1,000	1, 0, 0 =1	1
8	Island Highway & Six Mile Rd.	14) Traffic Signal Timing Plan Optimization	$5,000	4, 0, 1 = 5	1
ALL	Corridor	15) Improve Corridor Lighting per 100 m	$40,000	0, 1, 4 =5	8

6.1 Action Plan

An Action Plan is provided in **Table 6.2** with priority ranking that are based on the analysis presented in Table 6.1. Some options presented in Table 6.1 are not in Table 6.2, since an alternative action is recommended for that location or no action is recommended based on the analysis.

Table 6.2: Priority Actions

PRIORITY	CORRIDOR SEGMENT	LOCATION	ACTION (# = TABLE 6.1 REFERENCE)	COST	NOTE
1	8	Island Highway & Six Mile Rd.	14) Traffic Signal Timing Plan Optimization	$5,000	Complete
2	2 / 3	Between Hwy Off Ramp and Chilco Rd.	1) Southbound Radar Speed Reader	$5,000	-
3	6	At Damon Drive	12) "No Exit" sign.	$1,000	-
4	7	Commercial Driveways	13) Remove existing signs, Add two "No Left Turn" signs plus time tabs.	$1,000	Preference would be removal of hatching (+$9,000), alternative is to not replace hatching.
5	3	Chilco/ Nursery & Six Mile Rd.	2) Convert to 4-Way Stop Control	$60,000	-
6	5	Atkins & Six Mile Rd.	7) Introduce Roundabout	$700,000	-
7	6	South of Damon Drive	11) "Use Roundabout Ahead for Turnaround" sign	$1,000	-
8	ALL	Corridor	15) Improve Corridor Lighting per 100 m	$40,000	-
9	4	Corridor Cross Section	5) One Curb Alteration per 100m	$260,000	Priority section is between Atkins Road and Chilco Road/ Nursery Hill Drive as this is a key active transportation link.
10	6	At or near Damon Drive	10) Bus Stop Improvements	$25,000	

*****

APPENDIX A

Open House Public Comment Forms

Feedback Sheet
Six Mile Corridor Traffic Study

1. Name & Address:

____

____

2. What is your preferred outcome for Six Mile Road solutions?

   Rank your top 3 choices, with **3 being your most important** preferred outcome. If you only have one concern place a 3 beside your concern, leaving the others blank.

   Solutions
   3/2/1

	Reduce vehicle travel time during morning and/or afternoon peak periods
	Traffic calming along the corridor or on adjacent streets in an effort to reduce unnecessary corridor through traffic
	Improve safety for vehicles and vehicle drivers
	Improve pedestrian amenities/safety
	Improve cycling amenities/safety

OVER --→

3. Describe your concerns regarding the Six Mile Road corridor:

4. Describe your suggestions regarding the Six Mile Road corridor:

Thank you for taking the time to attend the Open House and provide your written feedback.

Feedback Sheet
Six Mile Corridor Traffic Study

1. Name & Address:

2. Of the recommended changes, please list your preferred top two solutions:

3. Is there anything that wasn't recommended you would like to see occur?

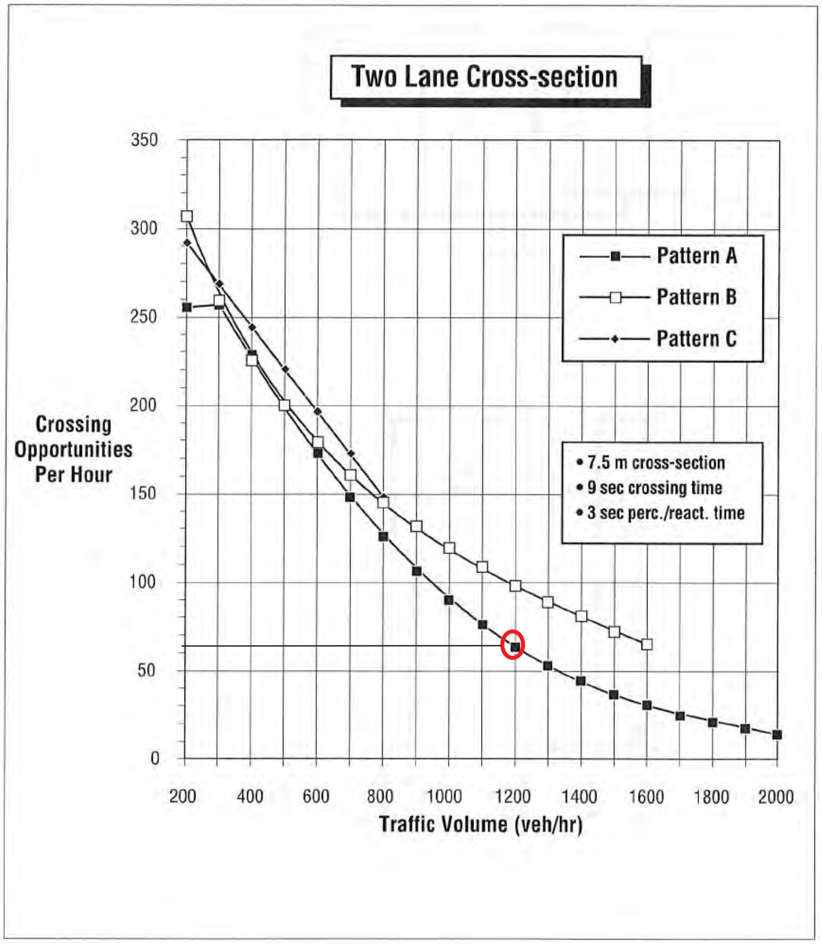
Thank you for taking the time to provide your written feedback.
Please email your completed form to engineering@viewroyal.ca
or drop it off at Town Hall by Friday, November 1, 2019.

OVER --→

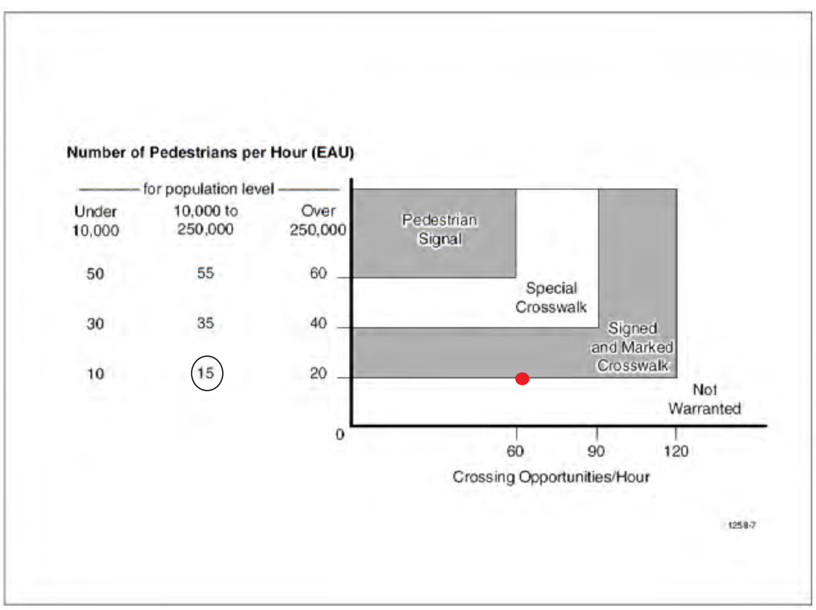
Additional comments:

APPENDIX B

Pedestrian Crossing Warrants



3.5A Estimated Crossing Opportunities for a 2 Lane Cross-Section



APPENDIX C

TAC Traffic Signal Warrants

View Royal, MOTI - Traffic Signal Warrant Analysis

Main Street (name)	6 Mile Corridor		Direction (EW or NS)	NS	Road Authority:	View Royal, MOTI
Side Street (name)	Chilco		Direction (EW or NS)	EW	City:	View Royal
Quadrant / Int #	2022 Total	Comments			Analysis Date:	2019 Apr 01, Mon
for Warrant Calculation Results, please hit 'Page Down'	CHECK SHEET				Count Date:	1905 Jul 10, Mon
					Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
6 Mile Corridor	NB	1				1			1
6 Mile Corridor	SB				1				1
Chilco	WB				1				
Chilco	EB		1				1		

Are the Chilco WB right turns significantly impeded by through movements? (y/n) y

Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	25,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
6 Mile Corridor	NS	50	5.0%	y	
Chilco	EW		2.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
press 'Set Peak Hours' Button to set the peak hour periods	35	168	9	2	333	2	47	2	5	18	2	166	40	40	40	0
	33	160	9	2	316	2	45	2	5	17	2	158	38	38	38	0
	28	136	7	2	269	2	38	2	4	15	2	134	32	32.3	32.3	0
	90	395	49	8	338	15	36	1	7	18	1	58	40	40	40	0
	86	375	47	8	321	14	34	1	7	17	1	55	38	38	38	0
	73	319	40	6	273	12	29	1	6	15	1	47	32	32.3	32.3	0
Total (6-hour peak)	**345**	**1,552**	**160**	**28**	**1,850**	**47**	**229**	**8**	**33**	**99**	**8**	**618**	**221**	**221**	**221**	**0**
Average (6-hour peak)	**57**	**259**	**27**	**5**	**308**	**8**	**38**	**1**	**6**	**17**	**1**	**103**	**37**	**37**	**37**	**0**

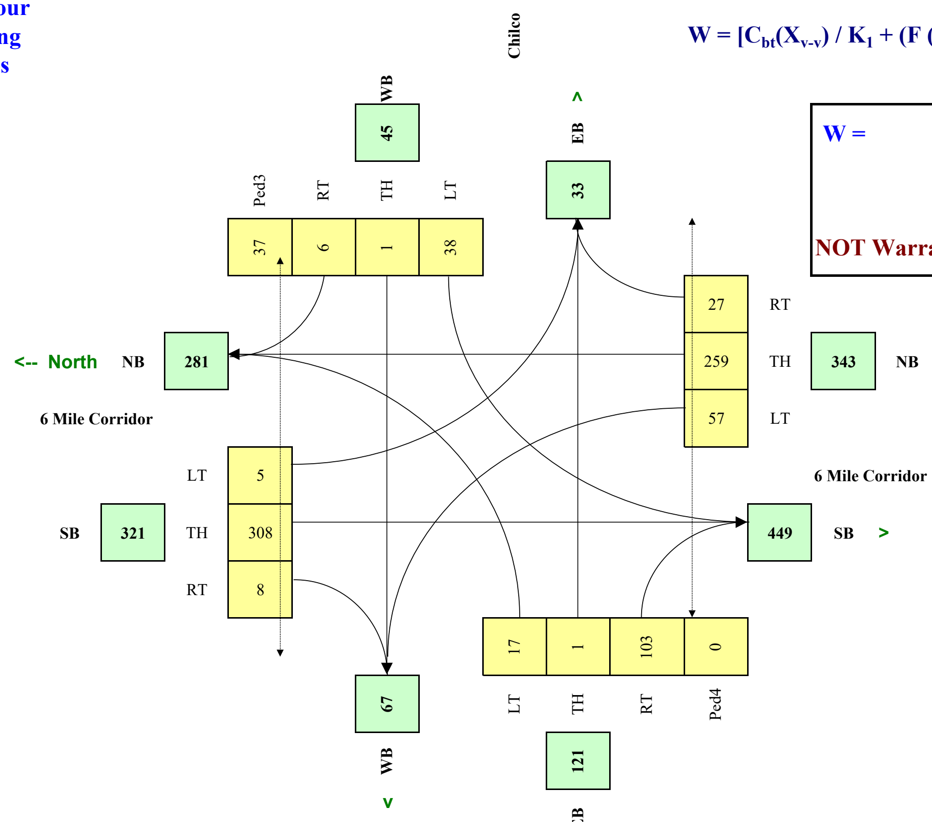
Average 6-hour Peak Turning Movements

$$W = [C_{bt}(X_{v-v}) / K_1 + (F (X_{v-p}) L) / K_2] \times C_i$$

W =	81	56	25
		Veh	Ped

NOT Warranted

RESET SHEET



Traffic Signal Warrant Spreadsheet - v3H © 2007 Transportation Association of Canada

View Royal, MOTI - Traffic Signal Warrant Analysis

Main Street (name)	**6 Mile Corridor**	**Direction (EW or NS)**	**NS**	**Road Authority:**	**View Royal, MOTI**
Side Street (name)	**Chilco**	**Direction (EW or NS)**	**EW**	**City:**	**View Royal**
Quadrant / Int #	**2032 Total**	**Comments**		**Analysis Date:**	**2019 Apr 01, Mon**
for Warrant Calculation Results, please hit 'Page Down'	**CHECK SHEET**			**Count Date:**	**1905 Jul 10, Mon**
				Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
6 Mile Corridor	NB	1				1			1
6 Mile Corridor	SB				1				1
Chilco	WB				1				
Chilco	EB		1				1		
Are the Chilco WB right turns significantly impeded by through movements? (y/n)							y		
							n		

Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	25,000
Central Business District	(y/n)	n

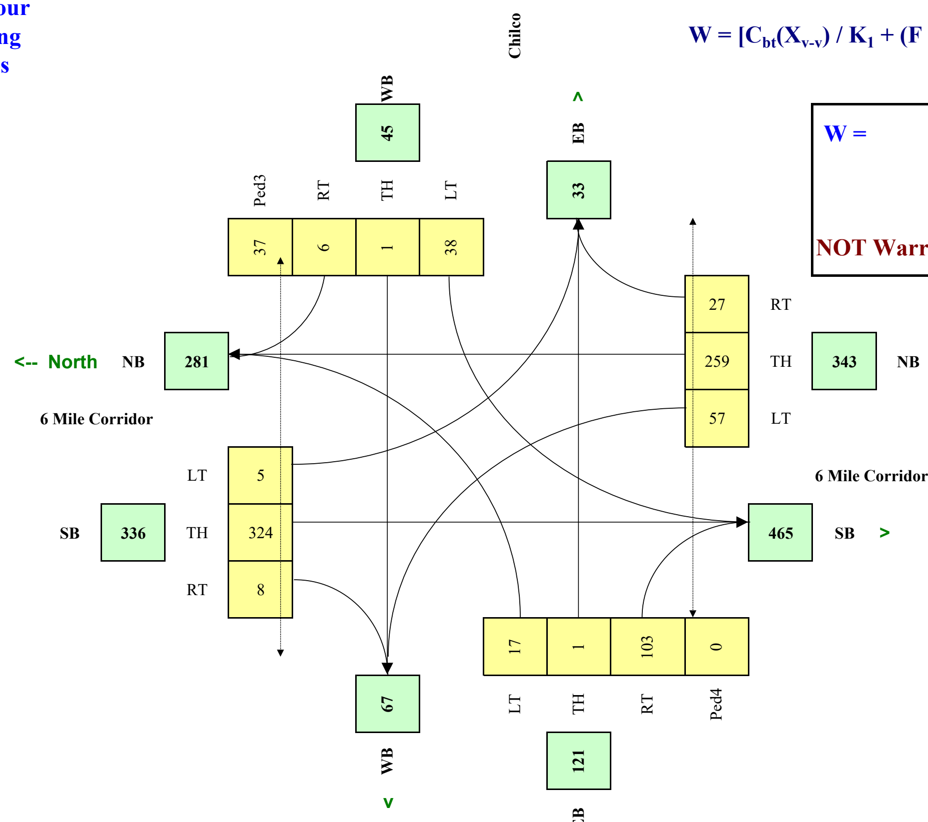
Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
6 Mile Corridor	NS	50	5.0%	y	
Chilco	EW		2.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
	35	168	9	2	366	2	47	2	5	18	2	166	40	40	40	0
	33	160	9	2	348	2	45	2	5	17	2	158	38	38	38	0
press 'Set Peak Hours' Button to set the peak hour periods	28	136	7	2	296	2	38	2	4	15	2	134	32	32.3	32.3	0
	90	395	49	8	338	15	36	1	7	18	1	58	40	40	40	0
	86	375	47	8	321	14	34	1	7	17	1	55	38	38	38	0
	73	319	40	6	273	12	29	1	6	15	1	47	32	32.3	32.3	0
Total (6-hour peak)	**345**	**1,552**	**160**	**28**	**1,941**	**47**	**229**	**8**	**33**	**99**	**8**	**618**	**221**	**221**	**221**	**0**
Average (6-hour peak)	**57**	**259**	**27**	**5**	**324**	**8**	**38**	**1**	**6**	**17**	**1**	**103**	**37**	**37**	**37**	**0**

Average 6-hour Peak Turning Movements

$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F (X_{v\text{-}p}) L) / K_2] \times C_i$$



W =	**83**	**58**	**25**
		Veh	***Ped***

NOT Warranted

RESET SHEET

Traffic Signal Warrant Spreadsheet - v3H © 2007 Transportation Association of Canada

View Royal, MOTI - Traffic Signal Warrant Analysis

Main Street (name)	6 Mile Road	Direction (EW or NS)	NS	
Side Street (name)	Atkins	Direction (EW or NS)	EW	
Quadrant / Int #	2022 Total	Comments		
for Warrant Calculation Results, please hit 'Page Down'	CHECK SHEET			

Road Authority:	View Royal, MOTI
City:	View Royal
Analysis Date:	2019 Apr 01, Mon
Count Date:	1905 Jul 10, Mon
Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
6 Mile Road	NB				1				1
6 Mile Road	SB				1				1
Atkins	WB				1				
Atkins	EB				1				

Are the Atkins WB right turns significantly impeded by through movements? (y/n) y

Are the Atkins EB right turns significantly impeded by through movements? (y/n) y

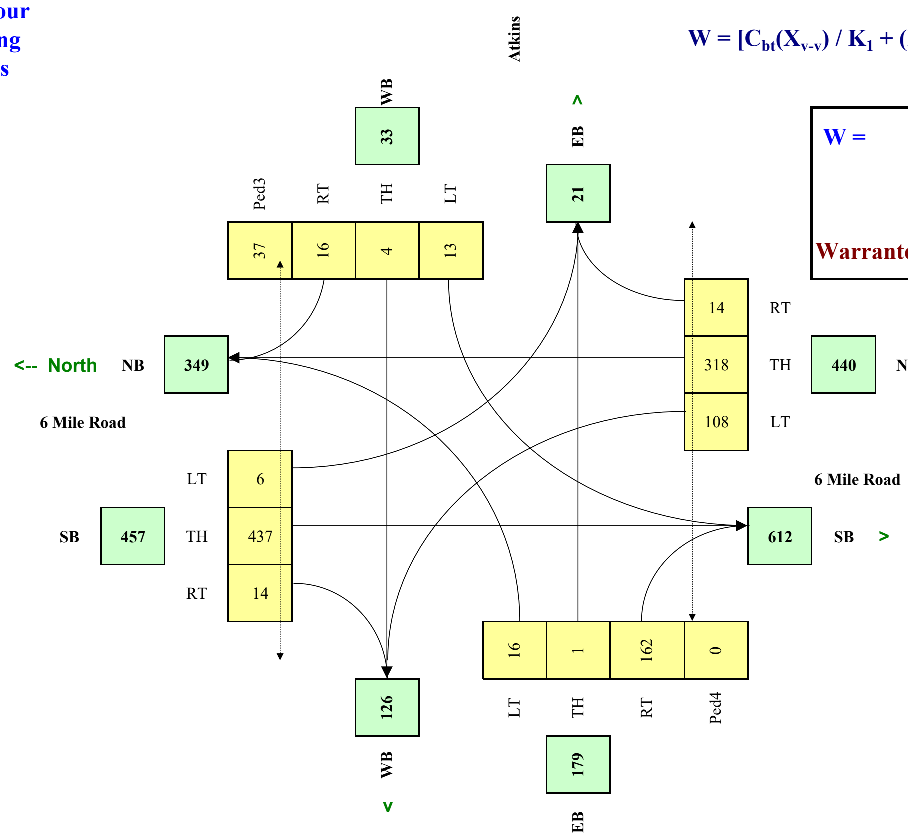
Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	25,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
6 Mile Road	NS	50	5.0%	y	
Atkins	EW		2.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
press 'Set Peak Hours' Button to set the peak hour periods	53	210	18	9	524	12	6	1	5	17	1	261	40	40	40	0
	50	200	17	9	498	11	6	1	5	16	1	248	38	38	38	0
	43	170	15	7	423	10	5	1	4	14	1	211	32	32.3	32.3	0
	182	481	13	3	427	19	22	8	29	18	1	92	40	40	40	0
	173	457	12	3	406	18	21	8	28	17	1	87	38	38	38	0
	147	388	10	2	345	15	18	6	23	15	1	74	32	32.3	32.3	0
Total (6-hour peak)	**648**	**1,905**	**85**	**33**	**2,622**	**85**	**77**	**25**	**94**	**97**	**6**	**973**	**221**	**221**	**221**	**0**
Average (6-hour peak)	**108**	**318**	**14**	**6**	**437**	**14**	**13**	**4**	**16**	**16**	**1**	**162**	**37**	**37**	**37**	**0**

Average 6-hour Peak Turning Movements



$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F\ (X_{v\text{-}p})\ L) / K_2] \times C_i$$

W =	138	104	34
		Veh	*Ped*

Warranted

RESET SHEET

Traffic Signal Warrant Spreadsheet - v3H © 2007 Transportation Association of Canada

View Royal, MOTI - Traffic Signal Warrant Analysis

Main Street (name)	6 Mile Road		Direction (EW or NS)	NS	Road Authority:	View Royal, MOTI
Side Street (name)	Atkins		Direction (EW or NS)	EW	City:	View Royal
Quadrant / Int #	2032 Total	Comments			Analysis Date:	2019 Apr 01, Mon
for Warrant Calculation Results, please hit 'Page Down'	CHECK SHEET				Count Date:	1905 Jul 10, Mon
					Date Entry Format:	(yyyy-mm-dd)

Lane Configuration		Excl LT	Th & LT	Through	Th+RT+LT	Th & RT	Excl RT	UpStream Signal (m)	# of Thru Lanes
6 Mile Road	NB				1				1
6 Mile Road	SB				1				1
Atkins	WB				1				
Atkins	EB				1				

Are the Atkins WB right turns significantly impeded by through movements? (y/n) y

Are the Atkins EB right turns significantly impeded by through movements? (y/n) y

Demographics		
Elem. School/Mobility Challenged	(y/n)	n
Senior's Complex	(y/n)	n
Pathway to School	(y/n)	n
Metro Area Population	(#)	25,000
Central Business District	(y/n)	n

Other input		Speed (Km/h)	Truck %	Bus Rt (y/n)	Median (m)
6 Mile Road	NS	50	5.0%	y	
Atkins	EW		2.0%	n	

Set Peak Hours

Traffic Input	NB			SB			WB			EB			Ped1 NS	Ped2 NS	Ped3 EW	Ped4 EW
	LT	Th	RT	LT	Th	RT	LT	Th	RT	LT	Th	RT	W Side	E Side	N Side	S Side
press 'Set Peak Hours' Button to set the peak hour periods	53	210	18	9	557	12	7	1	5	19	1	303	40	40	40	0
	50	200	17	9	529	11	7	1	5	18	1	288	38	38	38	0
	43	170	15	7	450	10	6	1	4	15	1	245	32	32.3	32.3	0
	182	481	13	3	475	19	25	9	33	20	1	107	40	40	40	0
	173	457	12	3	451	18	24	9	31	19	1	102	38	38	38	0
	147	388	10	2	384	15	20	7	27	16	1	86	32	32.3	32.3	0
Total (6-hour peak)	**648**	**1,905**	**85**	**33**	**2,846**	**85**	**88**	**28**	**105**	**108**	**6**	**1,131**	**221**	**221**	**221**	**0**
Average (6-hour peak)	**108**	**318**	**14**	**6**	**474**	**14**	**15**	**5**	**17**	**18**	**1**	**188**	**37**	**37**	**37**	**0**

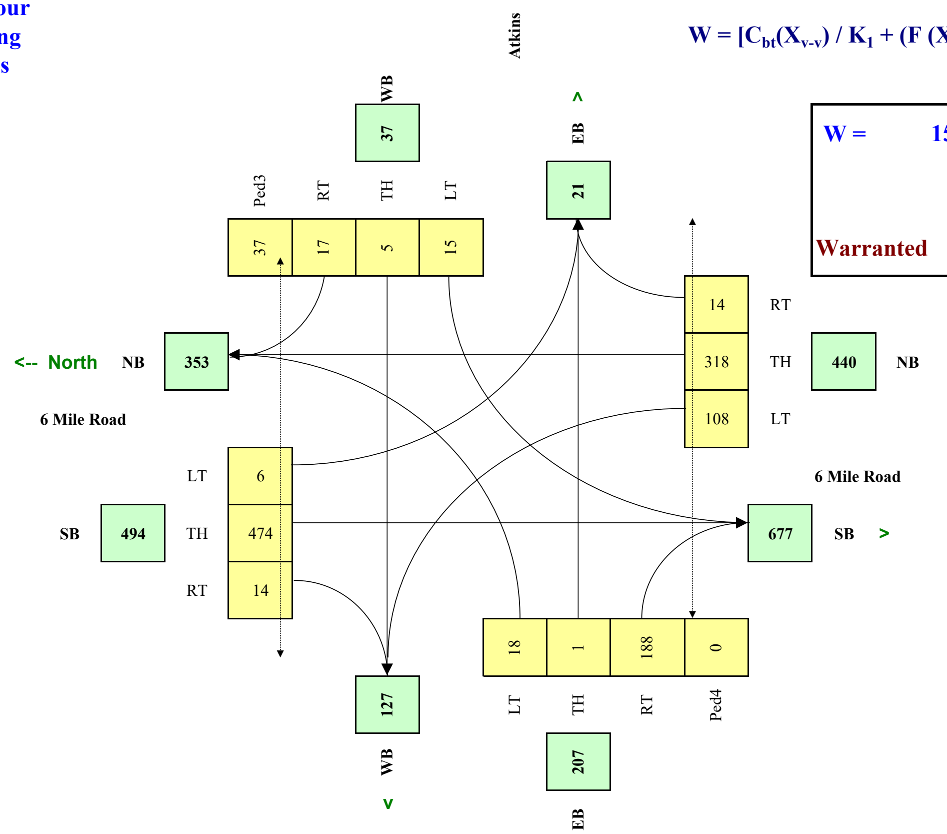
Average 6-hour Peak Turning Movements

$$W = [C_{bt}(X_{v\text{-}v}) / K_1 + (F\ (X_{v\text{-}p})\ L) / K_2] \times C_i$$

W =	158	123	35
		Veh	Ped

Warranted

RESET SHEET



Traffic Signal Warrant Spreadsheet - v3H © 2007 Transportation Association of Canada

APPENDIX D

Conceptual Roundabout Design – Atkins Road & Six Mile Road

S:\PROJECTS\P04-19-0077 Six Mile Road Corridor\4.0 Analysis & Design\ACAD\20191021_04-19-0077_6mile_Roundabout_V02.dwg
2019/10/22 11:29, Plotted by Caitlyn Quach

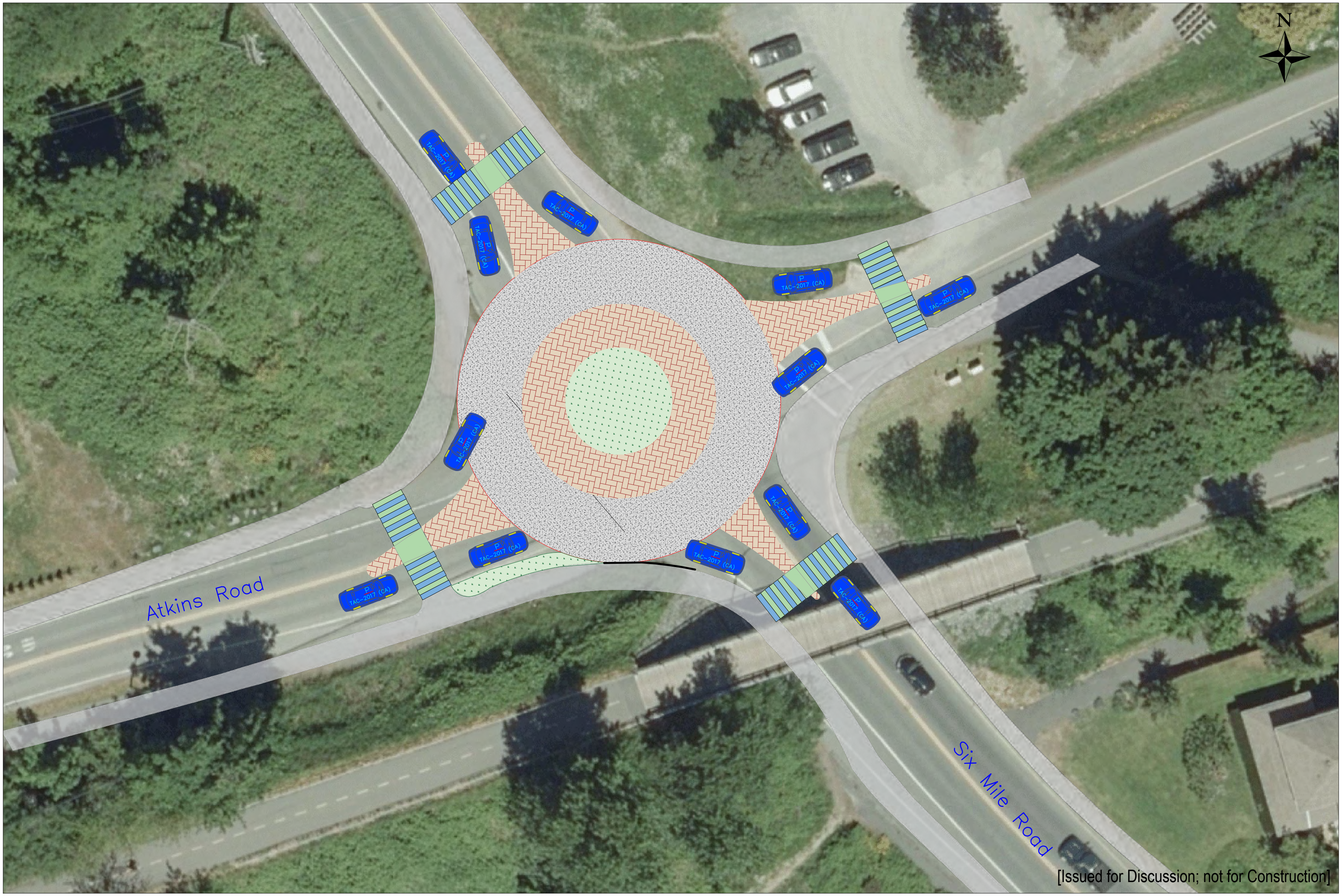


Exhibit Atkins

Conceptual Roundabout Design
Atkins Road and Six Mile Road

Six Mile Road Corridor

04.19.0077 October 2019 Scale 1:500 on Letter Prepared by CQ

bunt & associates

APPENDIX E

Conceptual Level Costing of Infrastructure Recommendations

Conceptual Design Estimate

Bunt & Associates Engineering Ltd.

Project: Six Mile Corridor			Job No:	04-19-0077
Roundabout at Atkins			Date:	1-Nov-19
			By:	JP
Notes: Includes sidewalk connecting			Sheet:	1 of 1

Item			**Approximate Quantity**	**Unit**	**Unit Price**	**Amount**
1.00	**REMOVALS/ DISPOSAL**					
	1.01	Asphalt	800	m^2	$80	$64,000
	1.02	Earth/Gravel/Top Soil	1	lump sum	$25,000	$25,000
		Subtotal				**$89,000**
2.00	**NEW CONSTRUCTION**					
	2.01	Subgrade Prep	800	m^2	$25	$20,000
	2.02	Misc Granular and Top Soil	1	lump sum	$10,000	$10,000
	2.03	Misc Earth Excavation	1	lump sum	$5,000	$5,000
	2.04	Waterworks (stormwater)	1	lump sum	$50,000	$50,000
	2.05	Roadway Asphalt	800	m^2	$160	$128,000
	2.06	Concrete Curb & Gutter	280	m	$160	$44,800
	2.07	Concrete Sidewalk (2m width)	40	m	$180	$7,200
	2.08	Letdowns, Angled	4	each	$4,000	$16,000
	2.09	Tactile Warning Strips	10	m^2	$400	$4,000
	2.10	Pavement Marking	6	each	$110	$660
	2.11	Street Lights + Electrical	122	m	$50	$6,100
	2.12	Supply and Install New Signage	12	each	$800	$9,600
	2.13	Colored Asphalt (Aprons, Islands)	100	m^2	$200	$20,000
	2.14	Thermoplastic	100	m^2	$80	$8,000
		Subtotal				**$329,360**
			450			
3.00	**MISCELLANEOUS**					
	3.01	Traffic Control	1	lump sum	$30,000	$30,000
	3.02	Tree Protection	1	lump sum	$3,000	$5,000
	3.03	Environmental Protection	1	lump sum	$8,000	$8,000
		Subtotal				**$43,000**
		Total				$461,360
		Contingencies		30%		$138,408
		Sub total				**$599,768**
		Engineering and Administration		15%		$89,965
		TOTAL				**$689,733**
		City Inspection		2%		$13,795
		GRAND TOTAL				**$703,528**
					SAY	**$704,000**

Notes:

*Prices, quantities and items are approximate, no not include all line items and are for discussion purposes only.

*This estimate does NOT include applicable taxes.

*No underground utilities have been confirmed as part of this estimate.

*Roadway material not determined.

Conceptual Design Estimate

Bunt & Associates Engineering Ltd.

Project: Six Mile Corridor		Job No:		04-19-0077
Chilco & Six Mile 4 Way Stop		Date:		1-Nov-19
		By:		JP
Notes: Does not includes improved lighting		Sheet:		1 of 1

Item			**Approximate Quantity**	**Unit**	**Unit Price**	**Amount**
2.00	**NEW CONSTRUCTION**					
	1.01	Concrete Curb & Gutter, Letdowns	80	m	$180	$14,400
	1.02	Tactile Warning Strips	10	m^2	$400	$4,000
	1.03	Pavement Marking	8	each	$500	$4,000
	1.04	Supply and Install New Signage	8	each	$1,000	$8,000
		Subtotal				**$30,400**
			450			
3.00	**MISCELLANEOUS**					
	2.01	Traffic Control	1	lump sum	$2,000	$2,000
	2.02	Environmental Protection	1	lump sum	$2,000	$2,000
		Subtotal				**$4,000**
		Total				$34,400
		Contingencies		30%		$10,320
		Sub total				**$44,720**
		Engineering and Administration		5%		$2,236
		TOTAL				**$46,956**
		City Inspection		2%		$939
		GRAND TOTAL				**$47,895**
					SAY	**$48,000**

Notes:

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*This estimate does NOT include applicable taxes.

*Prices, quantities and items are approximate, no not include all line items and are for discussion purposes

Conceptual Design Estimate

Bunt & Associates Engineering Ltd.

Project: Six Mile Corridor	Job No:	04-19-0077
Cross Section 1 Curb	Date:	1-Nov-19
	By:	JP
Notes: Per 100 meters, lighting excluded	Sheet:	1 of 1

Item			**Approximate Quantity**	**Unit**	**Unit Price**	**Amount**
1.00	**REMOVALS/RELOCATIONS**					
	1.01	Asphalt (driveways)	200	m^2	$80	$16,000
	1.02	Earth/Gravel/Top Soil	1	lump sum	$30,000	$30,000
		Subtotal				**$46,000**
2.00	**NEW CONSTRUCTION**					
	2.01	Roadway Asphalt	200	m^2	$160	$32,000
	2.02	Concrete Curb & Gutter	100	m	$160	$16,000
	2.03	Concrete Sidewalk (2m width)	100	m	$180	$18,000
	2.04	Concrete Median Barrier	100	m	$270	$27,000
	2.05	Pavement Marking	200	m	$15	$3,000
	2.06	Supply and Install New Signage	4	each	$800	$3,200
	2.07	Repainting Road Lines	200	m	$10	$2,000
		Subtotal				**$69,200**
3.00	**MISCELLANEOUS**					
	3.01	Traffic Control	1	lump sum	$30,000	$30,000
	3.02	Tree Protection	1	lump sum	$5,000	$5,000
	3.03	Environmental Protection	1	lump sum	$20,000	$20,000
		Subtotal				**$55,000**
		Total				$170,200
		Contingencies		30%		$51,060
		Sub total				**$221,260**
		Engineering and Administration		15%		$33,189
		TOTAL				**$254,449**
		City Inspection		2%		$5,089
		GRAND TOTAL				**$259,538**
					SAY	**$260,000**

Notes:

*Prices, quantities and items are approximate, no not include all line items and are for discussion purposes only.

*This estimate does NOT include applicable taxes.

*No underground utilities have been confirmed as part of this estimate.

*Roadway material not determined.

Conceptual Design Estimate

Bunt & Associates Engineering Ltd.

Project: Six Mile Corridor	Job No: 04-19-0077
Cross Section 2 Curb Alteration	Date: 1-Nov-19
	By: JP
Notes: Per 100 meters, lighting excluded	Sheet: 1 of 1

Item			**Approximate Quantity**	**Unit**	**Unit Price**	**Amount**
1.00	**REMOVALS/RELOCATIONS**					
	1.01	Asphalt (driveways)	400	m^2	$80	$32,000
	1.02	Earth/Gravel/Top Soil	1	lump sum	$50,000	$50,000
		Subtotal				**$82,000**
2.00	**NEW CONSTRUCTION**					
	2.01	Roadway Asphalt	400	m^2	$160	$64,000
	2.02	Concrete Curb & Gutter	200	m	$160	$32,000
	2.03	Concrete Sidewalk (2m width)	200	m	$180	$36,000
	2.04	Concrete Median Barrier	200	m	$270	$54,000
	2.05	Pavement Marking	400	m	$15	$6,000
	2.06	Supply and Install New Signage	8	each	$800	$6,400
	2.07	Repainting Road Lines	400	m	$10	$4,000
		Subtotal				**$202,400**
3.00	**MISCELLANEOUS**					
	3.01	Traffic Control	1	lump sum	$50,000	$50,000
	3.02	Tree Protection	1	lump sum	$5,000	$5,000
	3.03	Environmental Protection	1	lump sum	$30,000	$30,000
		Subtotal				**$85,000**
		Total				$369,400
		Contingencies		30%		$110,820
		Sub total				**$480,220**
		Engineering and Administration		15%		$72,033
		TOTAL				**$552,253**
		City Inspection		2%		$11,045
		GRAND TOTAL				**$563,298**
					SAY	**$563,000**

Notes:

*Prices, quantities and items are approximate, no not include all line items and are for discussion purposes only.

*This estimate does NOT include applicable taxes.

*No underground utilities have been confirmed as part of this estimate.

*Roadway material not determined.