Niagara Escarpment Crossings Traffic Operations and Safety Study

Final Report
TPB186103

Prepared for:

Niagara Region
1815 Sir Isaac Brock Way, Thorold, ON

2/19/2019

Wood Environment & Infrastructure Solutions
a Division of Wood Canada Limited
3450 Harvester Road, Suite 100, Burlington, ON
www.woodplc.com

2/19/2019

Ms. Carolyn Ryall
Director, Transportation Engineering
Niagara Region
1815 Sir Isaac Brock Way
Thorold, Ontario
L2V 4T7

Dear Ms. Ryall,

Thank you for the opportunity to undertake this study. We understand that the crossings of the Niagara Escarpment in the Niagara Region are a requirement for access for residents and business. Residents expect these crossings to be available but also be safe for use by all road users. The businesses in the Niagara Region rely on these crossings for local deliveries and access to longer distance markets. The balance for quality of life for residents and economic viability for the businesses is a delicate balance when examining these Escarpment crossings.

Longer term we appreciate that the Region has been pursuing several new infrastructure initiatives including the NGHTA Corridor with the Ministry of Transportation Ontario, the Niagara Trade Corridor with the Federal Government, and a new escarpment crossing within the Niagara Region that provides access for goods to a provincial freeway facility. All of these initiatives have been discussed and studied for many years, yet no real infrastructure changes have occurred despite a common understanding that some or all of these longer-term initiatives are required.

In the interim, the Region continues to have operational concerns raised regarding these escarpment crossings. Many operational improvements have been considered and implemented in an attempt to address these concerns. However, the majority of these operational improvements have been perceived to only have limited impact and a more fulsome evaluation of potential interim solutions is required. This study was undertaken to evaluate the impacts of previous operational improvements implemented and an evaluation of more extensive policy and operational improvements for implementation.

Sincerely,

Wood Environment & Infrastructure Solutions
a Division of Wood Canada Limited

Lachlan Fraser, MPIA
Transportation Planner

Reviewed by:

John McGill, P.Eng., PTOE, RSP
Principal, Transportation Planning

MK/JMCG/LF

Niagara Escarpment Crossings Traffic Operations and Safety Study

Final Report
TPB186103

Prepared for:

Niagara Region
1815 Sir Isaac Brock Way, Thorold, ON

Prepared by:

Wood Environment & Infrastructure Solutions
a Division of Wood Canada Limited
3450 Harvester Road, Suite 100, Burlington, ON

2/19/2019

Copyright and non-disclosure notice

Third-party disclaimer

Executive Summary

Niagara Region has been actively increasing its traffic operations and controls across the Niagara Escarpment while developing strategies to improve the roadway designs for the north-south crossings. In an effort to ensure these strategies were supportable by evidence-based studies, Niagara Region undertook this Niagara Escarpment Crossings Traffic Operations and Safety Study.
The study area included four (4) of the key escarpment crossings in the west end of the Niagara Region including:

- Victoria Avenue (RR 24) between King Street (RR 81) and Fly Road;
- Mountain Street (RR 18) – Lincoln;
- Mountain Road (RR 12) – Grimsby; and
- Main Street-King Street – Grimsby.

There have been many concerns raised regarding the real and perceived safety of these escarpment crossings and of particular concern is the operations of trucks and goods movement across the escarpment. To ensure that there is a clear understanding of the existing traffic operations on the study area roadways, a significant amount of data was collected including a review of previously assembled data from sources such as the Niagara Escarpment Crossing Master Plan (2013) and from the Niagara Region's traffic databases. Additional field work was conducted for this study that updated traffic counts with and without schools in operation, video records of traffic operations across the study area crossings, and a limited number of consultation meetings with the local municipal staff.

Improvement plans were developed based on the study's assembled data and were sorted into five (5) separate categories:

- Operational and Design;
- Education;
- Network and Policy;
- Emerging Technologies; and
- Other Considerations.

These improvement plan options were evaluated based on several criteria and the resulting recommendations were once more sorted according to the appropriate time frame for implementation:

- Short Term Improvements
  - Consistent signs and markings on all crossings;
  - Implement traffic calming where appropriate;
  - Improved truck warning signage;
  - Lower speed limits;
  - Identify a preferred truck route;
  - Increased enforcement, either police presence or electronic enforcement;
  - Complete streets designs consistent with Niagara Region policies;
  - Continue to collaborate with local municipalities.

- Medium Term Improvements
    - Finalize the new escarpment study EA;
    - Create a Goods Movement Committee or Council;
    - Introduce minor design improvements on crossings; and
    - Develop a Niagara Region policy on electronic enforcement strategies such as red light cameras and speed enforcement.

- Long Term Improvements
    - Continue to pursue a Trade Corridor between Niagara Region and the City of Hamilton across the top of the Niagara Escarpment;
    - Strategic acquisitions of property at key locations such as the south-west quadrant of Mountain Street (RR 18)/King Street (RR 81) to facilitate the safer movement of heavy vehicles.

Table of contents

List of figures

List of tables

1.0 Introduction

Wood has been retained on behalf of Niagara Region for the provision of consulting services to complete an Escarpment Traffic Operations and Safety Study that focusses on the movement of goods across the escarpment to ensure that these goods movements are being carried out in a safely and in a manner that is consistent with the expectations of the surrounding communities. There have been several previous studies undertaken that examine the movement of goods across the escarpment and this study is not intended to replicate those studies, but rather build upon their findings and recommendations.

1.1 Study Area

The study area includes four specific locations/roads that either cross the escarpment or abut the escarpment. Each of the study locations should be considered unique in terms of their surroundings and geometry. However, they are all subject to a similar problem in that heavy vehicles frequently use these locations to cross the escarpment, either as a point of origin or destination. Given the shared problem, each location is not necessarily independent of the other locations, and any solutions proposed to solve a problem at one location may have a flow on effect at one, or more, of the other locations. The four locations to be investigated in this study include:

- Victoria Avenue (RR 24) between King St. (RR 81) and Fly Rd.
- Mountain Street (RR 18) (Beamsville)
- Mountain Road (RR 12) (Grimsby)
- Main/King St. (RR 81) (Grimsby-Vineland)

The locations are described in detail below.

1.1.1 Victoria Avenue (RR 24) between King St. (RR 81) and Fly Rd.

Victoria Avenue (RR24) connects the QEW in the north, and Chambers Corners in the south where it intersects Highway 3. Victoria Avenue is a four-lane road and transitions to two lane road south of Fly Road. The intersection of Fly Road and Victoria Avenue adjoins an aggregate quarry with an entrance and exit on both Fly Road and Victoria Avenue. The abutting land uses are primarily residential or commercial throughout. It has a posted speed limit of 50km/hr within the study area.

1.1.2 Mountain Street (RR 18) (Beamsville)

Mountain Street (RR18) between King St. (RR81) and Fly Rd. (RR73) connects Beamsville with Lincoln on the escarpment and provides a relatively direct route for vehicles travelling along the escarpment to access the QEW to the north.

Mountain St. is primarily a two-lane road and features steep grades, a variety of land uses including residential, educational, and places of worship, and also provides some active transportation facilities (sidewalks/on road cycle lanes). It has a posted speed limit of 50km/hr within the study area.

1.1.3 Mountain Road (RR 12) (Grimsby)

Mountain Road (RR12) connects Fly Rd. (RR73) to Elm St. and Main St. (RR81) in Grimsby. It is a two-lane road that cuts into the escarpment and follows a curved route along the escarpment rather than the other typically linear escarpment crossings. There are far fewer access points to any development along this section of Mountain Road given the steep grade and obvious associated constraints. It has a posted speed limit of 50km/hr within the study area.

1.1.4 Main St. / King St. (RR 81) (Grimsby-Vineland)

Main Street East / King Street (RR81) links Vineland with Grimsby and continues further west to Hamilton (Hwy. 8). It is primarily a two-lane road with occasional centre turning lanes to assist traffic movement. Main/King St. runs along the bottom of the escarpment and is a significant east-west connection for residents and heavy vehicles in the local area. It has a posted speed limit of 50km/hr within the study area.

1.2 Background

The escarpment crossings in Niagara Region serve several purposes and provides access across the escarpment for many road users such as passenger vehicles, trucks, pedestrians and cyclists. It is not uncommon to see children using the road right of way on sidewalks that are directly adjacent to the roadway that accommodates gravel trucks. This mix of uses, combined with the extreme gradients that these roads have to accommodate result in many complaints and concerns. These include:

- Volume of trucks
- Type of trucks
- Vehicle speeds
- Noise, vibration and air quality impacts
- Road geometry
- Intersection operations
- Signage, markings, and traffic control operations.

Figure 1 below illustrates where the key areas of concern are located.

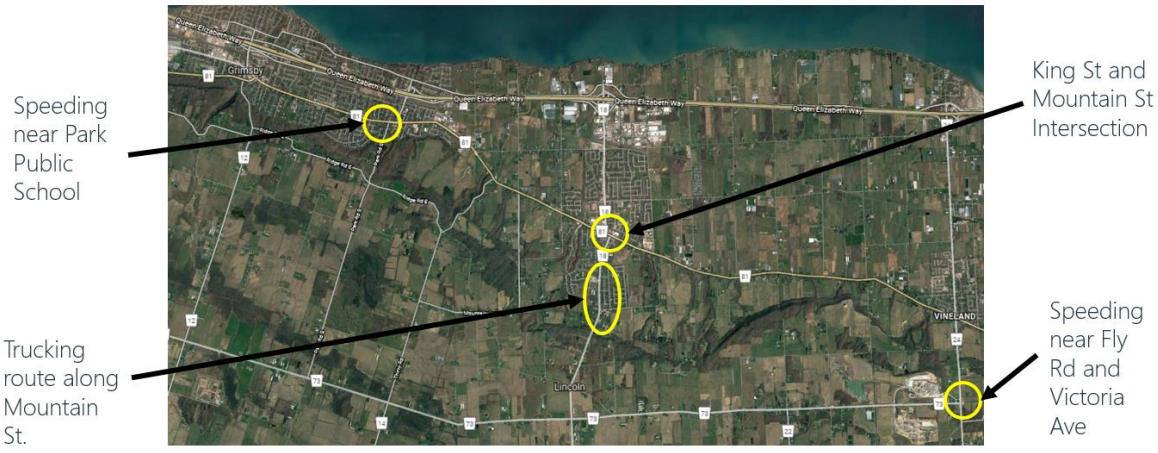


Figure 1: Focus Areas and Relevant Concerns

As such, a wide ranging and high-level analysis of the study area is required to better understand the factors that contribute to the problems as either a whole, or as individual components.

1.3 Trucking

Since the focus of this study is to examine the operations of trucks across the escarpment, it is important to recognize that trucking is a key economic contributor to the Niagara Region. The Regional Roads are presently available to all truck types throughout the year. There are presently no truck restrictions and as a result, there are many differing types of trucks that can be observed using these Regional Roads, including:

- Dump Trucks
- Cement Trucks
- Tractor-Trailers
- Dump Trucks with pups

These trucks carry goods that include: gravel from the nearby gravel pits, farm products, office supplies, and general commercial products. Trucks also return from making deliveries and these 'empty-load' trucks present additional challenges. An illustration of vehicles from Geometric Design Guide for Canadian Roads by Transport Association of Canada (TAC)-June 2017 is provided below for better understanding.

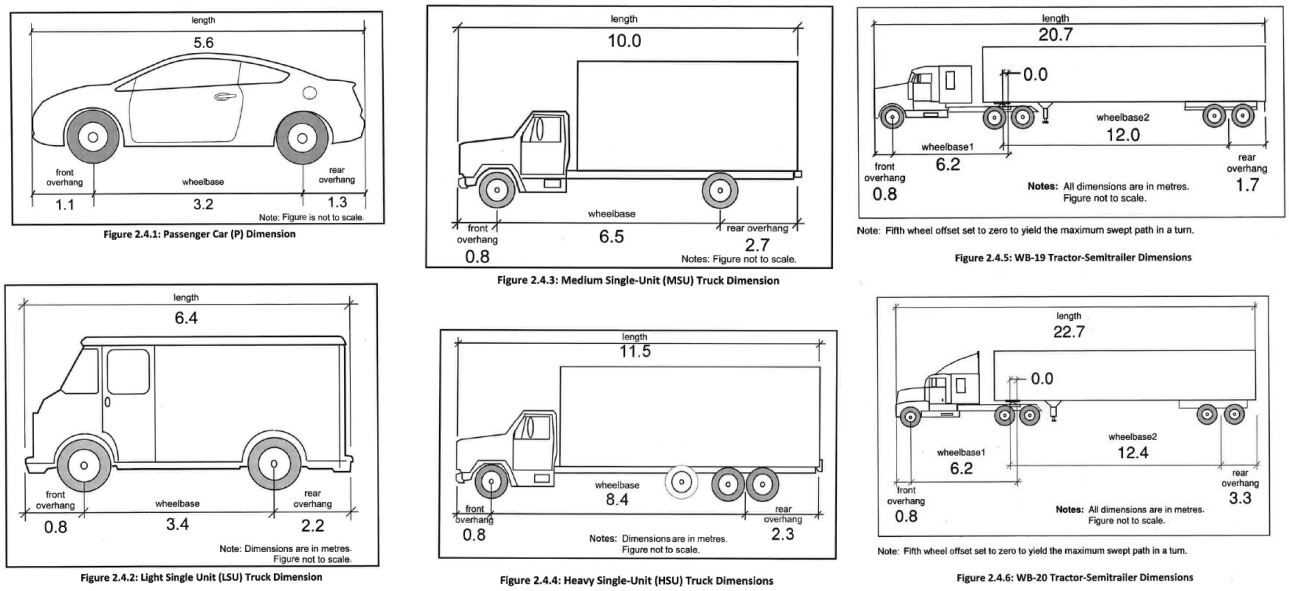


Figure 2: Design Vehicles and Related Dimensions

2.0 Data Assembly

There have been a number of previous traffic operations studies conducted in the Grimsby-Lincoln-Vineland area, which includes the current study area. These historical studies have created an adequate baseline to assist future studies with respect to data collection and recommended improvements. A summary of the most recent/significant studies can be found below.

2.1 Niagara Escarpment Crossing Study – Transportation Study Report – Hatch Mott MacDonald & Paradigm (2013)

The report prepared by Hatch Mott Macdonald (HMM) was commissioned to consider the need for a new or improved truck crossing of the escarpment and utilizes a variety of data collection methods to help assist their understanding and knowledge of the area. The data collected includes base traffic, topographical, environmental, and planning data, supplemented by traffic counts and roadside surveys.

The results of the traffic data and modelling analysis indicate that since 1997, truck volumes have increased on some routes and decreased on others. The main north – south crossings of the escarpment that carry significant truck volumes are Victoria Avenue (RR24) in Vineland, Mountain Road (RR12) in Grimsby and Mountain Street (RR18) in Beamsville.

Furthermore, approximately 48% of truck drivers indicated that they would not change their route, even if a new or improved route was provided. The study concluded that if a new or improved crossing suitable for trucks was provided there would still be a significant number of trucks using the existing crossings.

The study also found that all of the existing crossings have geometric features that make them unsuitable for use as truck routes. Steep grades were found to be the main constraining factor for truck movement. In addition, all of the routes have incompatibilities for continued movement of trucks such as the intrusion of trucks into residential areas and into areas of high pedestrian or cyclist activity.

Based on these findings and conclusions, the Project Team formulated the following Problem Statement to update the one contained in the 1997 study:

Significant local and through truck volumes are travelling on steep grades through communities, mixing with pedestrian and cyclist traffic, or passing incompatible land uses.

It was concluded that the preferred solution is to provide improved traffic management for truck movements using the existing crossings in the short term; and consideration of a new crossing in the longer term as a way of redirecting some of the truck traffic away from the urban areas. If impact from a new crossing is found to be unacceptable, further consideration can be given to improving the Park Road – Bartlett Avenue corridor to accommodate trucks. On the basis of these findings, it was recommended to Regional Council that since a single solution was not apparent and that a combination of solutions that involved both new and improved existing crossings, as well as improved traffic management would be required, a Master Plan approach be adopted to complete the study.

2.2 Niagara Commercial Vehicle Survey – Traffic Count & Vehicle Classification Summary – IBI Group (2013)

The report prepared by IBI Group was conducted as part of the Ontario Commercial Vehicle Survey (CVS) to serve as a supplemental document that will assist Niagara Region in understanding commercial vehicle movements within the Niagara area. IBI collected data at nine separate locations within Niagara Region, as seen below in Figure 2.

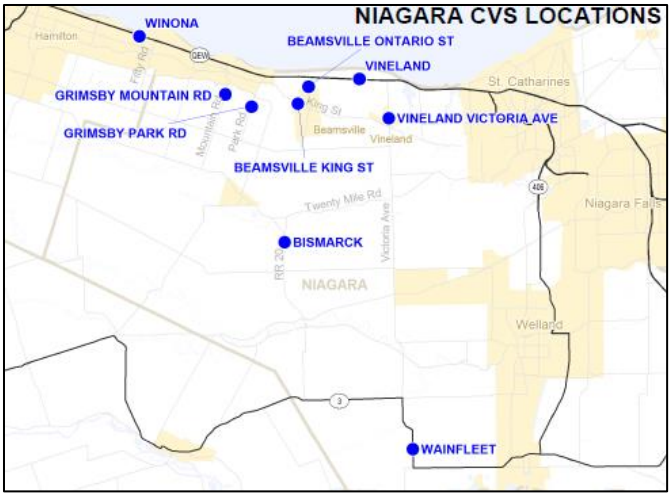


Figure 3: Niagara CVS Locations - IBI Group

Three-hour manual counts were conducted during the ATR classification count period. These manual counts provide very valuable information about the mix of large passenger vehicles – RVs and automobiles/light trucks with trailers – in the traffic mix, vehicles that any type of ATR equipment has difficulty distinguishing from commercial vehicles. A comparison between manual count data and corresponding ATR count data was used to inform the process of categorizing original vehicle classifications from the raw data into standard groupings for analysis: passenger vehicles, single-unit trucks, and multi-unit trucks.

The final traffic profiles generally show balanced passenger vehicle volumes by direction at each location, but some imbalance of truck volumes, which may be due to trucks diverting around the Victoria truck inspection station, which intercepts westbound trucks on the QEW. The QEW sites were found to still carry far more vehicles of all types than any of the other locations combined.

3.0 Data Collection and Field Observations

Following the summary of available material, it has been identified that there are gaps in the necessary components of data that are required to provide a complete and comprehensive assessment of the traffic operations and safety study. As a result, the following required data and associated data collection programs are outlined below.

Required Data	Data Collection Process
Turning Movement Counts at key intersections	Niagara Region provided most recent data
Volume and Speed Profiles at key locations	Engage traffic data collection specialist
Up to date video and photo materials	Engage Videographer to conduct field visits
Complaints Register	Request from Niagara Region
Crash/Collision information within the study area	Request from Niagara Region
Road Improvement & Construction Plans	Request from Niagara Region
Recent significant development applications	Request from Niagara Region

3.1 Turning Movement Counts

Turning movement counts were provided for the following intersections:

- King St. (RR81) and Ontario St. (RR18), Beamsville;
- King St. (RR81) and Mountain St. (RR18), Beamsville; and
- Victoria Ave. (RR24) and King St. (RR81), Vineland.

The provided data was collected at different intervals (Beamsville – Oct. 2016, Vineland – June 2017) and breaks down the intersection movements by both direction and classification (bike/car/truck). This information assists in verifying vehicle volumes and can provide some low-level indication of preferred trucking routes.

3.2 Volume and Speed Profiles

Volume and speed profiles were provided for the following locations:

- Main St. (RR81) west of Park Rd. South, Grimsby;
- Mountain Rd. (RR12) north of Ridge Rd., Grimsby;
- Mountain St. (RR18) south of Hillside Dr., Beamsville; and
- Victoria Ave. (RR24) north of Moyer Rd., Vineland.

The data was collected from August 1st, 2018 till August 8th, 2018 and breaks down the profile by direction, volume, vehicle length, and speed. Heavy vehicles are defined as vehicles 8.0m in length or over. Further analysis was completed by Niagara Region to provide the average speed of each vehicle classification at each of the above locations, as the initial data sorted vehicles separately by either speed or by classification, rather than by both.

3.3 Video and Photographic Observations

The videographer was requested to complete the following tasks:

- Video imagery for RR12, RR18, and RR24 in both directions, preferably following heavy vehicles;
- Aerial footage of three intersections of RR81 with RR12, RR18, and RR24;
- Aerial footage of RR12, RR18, and RR24.

This assists in providing a more thorough understanding of the challenges and problems in the area and may highlight some points of concern previously unknown to the Region staff or the project team. It also contributes towards a developing database of evidence regarding truck driver behaviour.

3.4 Complaints Register

The Region had initially indicated a register of the complaints received by local residents and/or business in the area could be made available, but only verbal information was shared in order to identify potential problem spots within the study area.

3.5 Collision Reports

Crash/collision records were requested for the following locations within the study area:

- Victoria Avenue (RR24);
- Mountain Street (RR18);
- Mountain Road (RR12);
- King Street (RR81);
- Ontario Street (RR18); and
- Fly Road (RR73).

The collision reports were provided for the past five years within the study area.

3.6 Road Improvement and Construction Plan

A list of the planned road improvements and construction dates that were scheduled for the short term was provided to assist in coordinating the traffic data collection program. This ensured that the collected data is unimpeded by any potential construction impacts on travel demand or travel patterns.

3.7 Review of Recent Significant Development Applications

The Region provided basic information for any development applications that met the below criteria:

1. Applications that are:

   a) Plans of subdivision/condominium; or

   b) Buildings greater than three storeys; or

   c) Commercial buildings larger than 100,000sqft; and

   d) Have been approved/constructed over the last 18 months in Beamsville or Grimsby.

2. Any other major buildings that recently completed construction over the past six months that could have increased heavy vehicle traffic in the area;
3. Recent or planned gravel pit expansions or significant farming expansions along the escarpment.

4.0 Traffic Operations and Safety Findings

The collected data provided insight into a variety of the problems to be addressed as part of this study. This section will discuss the collected data as it relates to each of the issues presented earlier in this report (Section 1.2).

4.1 Trucking – Volume, Behaviour, and Travel Routes

Truck volumes, behaviour, and the routes they take to traverse the escarpment have been the source of a number of complaints and are the primary focus of this study. To better understand current trucking volumes and the routes they take, the traffic data collected in September of 2018 was assessed in conjunction with the Origin-Destination survey conducted in 2013, and previous traffic volume data also collected in 2013. Trucking behaviour was primarily observed through video and photo evidence.

4.1.1 Volume

As seen in Table 1 below, a comparison of traffic volumes from 2013 to 2018 reveals a number of useful statistics. Most notably, that RR12 and RR24 carry the bulk of heavy vehicle trips both up and down the escarpment, whilst RR18 is currently only used for approximately 15% of all heavy vehicle trips within the study area.

Table 1: Weekly Traffic Volume Comparison (2013 vs. 2018)

Location	Direction	2013		2018		% Change		
		Passenger Vehicles	Heavy Vehicles	Passenger Vehicles	Heavy Vehicles	Passenger Vehicles	Heavy Vehicles	Total
Mountain Road (RR12)	NB	25766	1453	22861	1673	-11.27%	15.14%	-9.86%
	SB	26234	1185	23827	2210	-9.18%	86.50%	-5.04%
Mountain Street (RR18)	NB	12995	1135	13243	647	1.91%	-43.00%	-1.70%
	SB	13482	781	12626	825	-6.35%	5.63%	-5.69%
Victoria Avenue (RR24)	NB	29197	2209	32644	2099	11.81%	-4.98%	10.63%
	SB	28589	2885	30921	1994	8.16%	-30.88%	4.58%

Furthermore, heavy vehicle trips at each location within the study area make up, on average, 6.37% of total trips in each direction, well within acceptable limits (approx. 10%) for Regional Roads. This would indicate that the mixture of heavy vehicles as a total percentage of all vehicle trips is not unusually high, particularly on RR18, where heavy vehicles make up 4.7-6.1% of all vehicle trips.

In addition, the ability to compare the data from 2018 with the previously collected data in 2013 further reveals a change in the distribution of heavy vehicle trips across the observed locations within the study area. Whilst the number of heavy vehicle trips are down on RR24 (both in actual volume and as a percentage of all trips), RR12 has seen a significant increase in south-bound heavy vehicle trips. RR18 has also seen a significant drop in north-bound heavy vehicle trips during this time period.

Finally, when reviewing past development applications and combining this with a comparison of historical and current aerial imagery, it is not significantly apparent that local development projects have contributed to heavy vehicle trip generation. Although it should be noted, there are currently two projects

along the RR18 corridor in Beamsville that are likely to produce some heavy vehicle trips now and in the near future. It is noted that the heavy vehicle trips are within the acceptable limits for the area, mostly located on RR12 and RR24, and have increased on RR12 whilst declined on RR18.

4.1.2 Behaviour

Truck driver behaviour has been cited as a disruptive and dangerous presence in the received complaints. It is often difficult to build a complete picture of truck driver behaviour as the observation period is a limited window, and may not provide a comprehensive representation of each individual truck that travels through the study area. It should be noted however, that this does not indicate that unobserved trucks behave poorly or otherwise.

Truck behaviour was observed using footage provided by a third-party videographer. Generally, truck behaviour was observed to be appropriate and there were little-to-no instances where truck drivers behaved in a manner that endangered nearby vehicles, cyclists, or pedestrians. It is clear however, that given the constraints in road geometry, interactions between cyclists, pedestrians, and trucks are likely to occur and be perceived as dangerous or uncomfortable (see Figure 3 below). Truck driving behaviour also includes speed of the vehicle, and is discussed in Section 4.2 below.

Figure 4: Collage of Perceived Danger

In the collage above, the oversize load vehicle is stopped on the shoulder as it waits for a break in oncoming traffic to make a left hand turn into a construction site. Each of the other images have been included to help build a picture as to why heavy vehicles may be perceived as a problem in the study area. They are often travelling along constrained routes near to pedestrians or cyclists, or may be significantly oversized and this may be perceived as a danger or threat to other vehicles or pedestrians. Ultimately the observed heavy vehicles did not indicate any pattern of poor behaviour.

4.1.3 Travel Routes

As identified in Section 4.1.1 above, it has been observed that heavy vehicle trips along the escarpment are within the expected levels for a Regional Road and are distributed mostly on RR12 and RR24. However, individual turning movement counts conducted in 2016 were provided by Niagara Region to further assist the assessment of heavy vehicle movements.

Turning movement counts (8hr period) at the intersections of Victoria Avenue (RR24) and King Street (RR81), Ontario Street (RR18) and King Street (RR81), and at Mountain Street (RR18) and King Street (RR81), provide a small sample size to superficially review the travel routes of heavy vehicles as they reach the bottom of the escarpment.

The data provided by the Region has been summarized and is shown in the below graphic (Figure 4). A few conclusions can be drawn from the full dataset, which was collected in October 2016 and June 2017. Firstly, heavy vehicles using Victoria Avenue to traverse the escarpment typically remain on Victoria Avenue when they reach the intersection at King Street, 64% of north-bound trips continue along Victoria Avenue, and 82% of south-bound trips also stay on Victoria Avenue. Secondly, heavy vehicles tend to turn/continue west when arriving at the intersection of King Street and Mountain Street (RR18), and those trucks coming from the west, tend to favour turning south and heading up the escarpment. Finally, heavy vehicles at the intersection of Ontario Street and King Street also favour turning/continuing east-bound on King Street, whilst Ontario Street is the preferred route of choice (marginally) for heavy vehicles coming from the east.

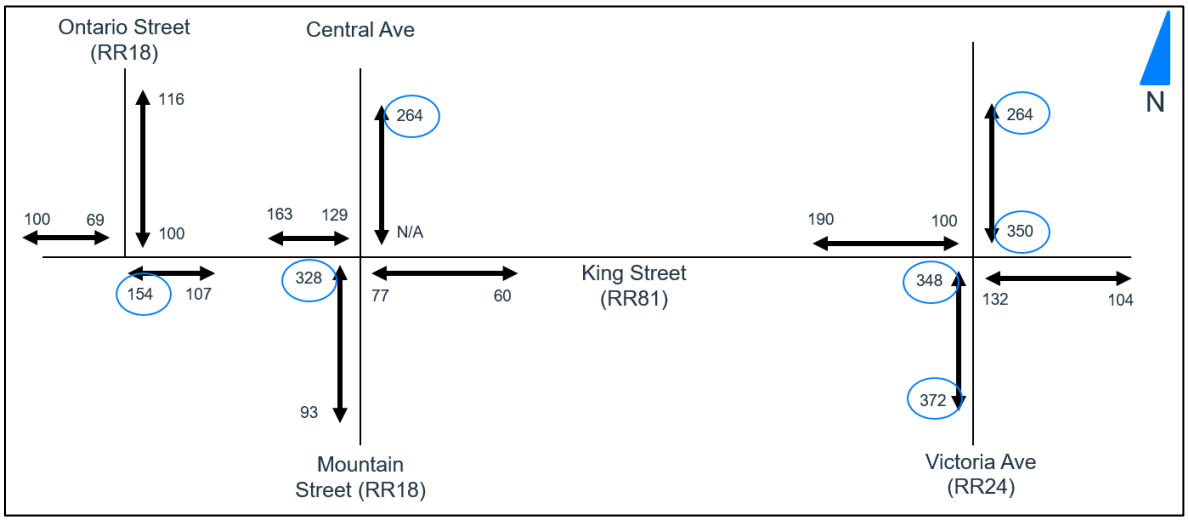


Figure 5: 8 Hour Movement Counts (In-Out) for Heavy Vehicles

When viewed as a whole, the turning movement counts indicate that the Mountain Street-to-Ontario Street is the favoured route for heavy vehicles using RR18, and that Victoria Avenue attracts and retains heavy vehicle trips. In addition to the turning movement counts, the previously completed studies conducted origin-destination surveys as part of their data collection program, and these were reviewed to provide further insight into heavy vehicle travel patterns within the study area.

A survey station was located on Mountain Road (RR12) and of the 518 heavy vehicles surveyed, most of the trips through this station originated in West Lincoln (137 trips), Hamilton-Wentworth Regional Municipality (94 trips), and Grimsby (58 trips). St. Catharines, Port Colborne and the GTA also contributed a combined 78 trip origins. The most common destinations for heavy vehicles at this station were for Grimsby (123 trips) followed by Hamilton-Wentworth Regional Municipality (114 trips) and West Lincoln (106 trips). Halton Region and Peel Region attracted another combined 69 heavy vehicle trip destinations.

Mountain Street (RR18) also featured a survey station, and most of the 261 total heavy vehicle trips surveyed originated in Lincoln (94 trips), West Lincoln (36 trips), and Hamilton-Wentworth Regional Municipality (24 trips). With respect to destinations, the highest number of trips were destined for Lincoln (92 trips), St. Catharines (35 trips) and West Lincoln (19 trips).

Victoria Avenue (RR24) was an additional location surveyed, and of the 798 total heavy vehicle trips, most trips originated in Lincoln (114 trips), Hamilton-Wentworth Regional Municipality (87 trips), and St. Catharines (73 trips). Whilst the highest number of trips were destined for Lincoln (177 trips), Hamilton-Wentworth Regional Municipality (81 trips) and St. Catharines (75 trips).

These stations were part of a wider network of survey stations that further extrapolates the patterns seen at the above-mentioned stations. Heavy vehicle trips from Grimsby, Lincoln, West Lincoln, and Hamilton-Wentworth Region account for around 43% of all origin locations, and just over 50% of all destination locations, making the four locations a significant source and attraction of heavy vehicle trips within the same area.

Furthermore, the significance of local heavy vehicle trips is established when looking at heavy vehicle trip distribution between these four locations. Table 2 below details the percentage breakdown of trips between the four locations, and shows that of all the origin trips from each location, around 60% of heavy vehicle trips from each origin point are destined for one of the four locations (including same origin-destination trips).

Table 2: Percentage of Origin Trip Distribution

Origins	Total Origin Trips	Destinations				Total
		Grimsby	Lincoln	West Lincoln	Hamilton Region	
Grimsby	157	31.85%	8.92%	22.29%	1.27%	64.33%
Lincoln	312	9.29%	37.18%	10.26%	6.73%	63.46%
West Lincoln	390	10.51%	13.33%	22.82%	12.82%	59.49%
Hamilton Region	347	4.90%	10.37%	17.00%	27.67%	59.94%

To confirm the implications of local heavy vehicle trips, Table 3 below details the breakdown of how significant the local trips are, when viewed as a percentage of all trips finishing at each location.

Table 3: Percentage of Local Trips to Each Destination

Destinations	Total Destination Trips	Origins				Total
		Grimsby	Lincoln	West Lincoln	Hamilton Region	
Grimsby	227	22.03%	12.78%	18.06%	7.49%	60.35%
Lincoln	400	3.50%	29.00%	13.00%	9.00%	54.50%
West Lincoln	417	8.39%	7.67%	21.34%	14.15%	51.56%
Hamilton Region	340	0.59%	6.18%	14.71%	28.24%	49.71%

A significant portion of heavy vehicles trips are made between the four key locations within/around the study area, and further still with regards to same Origin-Destination trips.

4.2 Vehicle Speeds

To ensure future decisions related to this study can be based on the most complete information available, speed data was collected to ensure that this component and the potential impact it may or may not have on the various complaints received can be better understood.

Speed profiles were collected as described in Section 3.2, and the raw data is presented below in Table 4, and the summarized data in Table 5. Each of the locations are subject to a posted speed limit of 50km/hr.

Table 4: Location Speed Profiles

Location	Direction	Vehicles per Speed Bracket (km/hr)										
		0-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	85-89	90-94	95-99
Mountain Road (RR12)	**NB**	17074	6007	1148	224	53	17	7	4	0	0	0
	SB	25447	491	64	18	6	5	3	3	0	0	0
Mountain Street (RR18)	**NB**	1436	3021	3142	2827	1834	930	432	185	83	0	0
	SB	1289	2885	2732	2845	1859	992	463	255	131	0	0
Victoria Avenue (RR24)	**NB**	4842	8227	7544	5744	4168	2225	1120	461	239	90	83
	SB	3357	4748	7605	7617	5334	2607	974	406	155	63	49
Main Street E (RR81)	**EB**	6908	13539	10306	6747	2839	1204	555	219	125	0	0
	WB	5362	10660	9824	6798	3522	1212	442	157	73	0	0

Table 5: Summarized Speed Profiles

Speed	Direction	% Exceeding Speed			
		Under	<10km/hr	10-20km/hr	>20km/hr
Mountain Road (RR12)	NB	69.59%	29.16%	1.20%	0.114%
	SB	97.73%	2.13%	0.11%	0.042%
Mountain Street (RR18)	NB	10.34%	44.37%	40.25%	11.735%
	SB	9.58%	41.76%	42.35%	13.687%
Victoria Avenue (RR24)	NB	13.94%	45.39%	34.93%	12.141%
	SB	10.20%	37.53%	47.27%	12.924%
Main Street E (RR81)	EB	16.28%	56.18%	25.42%	4.955%
	WB	14.09%	53.83%	30.31%	4.951%

The summarized data was grouped into four categories to assist in the review of data. These categories represent a variety of different 'mindsets' when it comes to speeding, as many individuals have varying levels of respect for a strict speed limit. Some people strictly adhere to them, others are comfortable with exceeding the limit marginally (less than 10km/hr over), whilst there are some individuals who are either unaware of the speed limit or disregard the limit and travel 10-20km/hr over or in excess of 20km/hr over the limit. By separating the data into these categories, decision makers can see the wider picture of the clearly evident, and significant, problem with speeding at the above locations (other than Mountain Road RR12).

The recorded speed profiles at both Mountain Road (RR12) and Victoria Avenue (RR24) are somewhat expected, given the geometry of each road (explored below in Section 4.3), as Mountain Road is a tight, two-lane, curved/windy road, and is not conducive to high speeds, whilst Victoria Avenue is a wide, four-lane, straight road, and is much more favourable for travelling at higher speeds.

In contrast, the speed profile collected for Mountain Street (RR18) is not what would typically be expected of a two-lane road in this area. Although this escarpment crossing is a common travel route for many vehicles, it is apparent that the posted speed limit is almost completely ignored (approx. 10% of all trips on RR18 are under the posted limit).

In addition, the excessive speeding recorded on Victoria Avenue is also of particular concern. Over the one-week data collection period, there were 285 instances of vehicles travelling more than 40km/hr over the posted speed limit. It would be expected or presumed that these particular cases would occur during the night, however there is still a reasonable portion that occur during the day (7AM-6PM).

Furthermore, the speed profiles recorded at Main Street East (RR81) in Grimsby indicate that although there are 53-56% of trips falling in the range of 50-60km/hr, there is a comparably more limited ability for vehicles to reach the excessive speeds seen at other locations.

In summary, the four locations where speed profiles were recorded shed light on a variety of problems, mostly indicating a need for speed reducing/limiting solutions at three of the four locations.

4.3 Road Geometry, Signage, Markings and Traffic Control

The previous studies completed provided a comprehensive review of the various roads within the study area. The prior studies are reviewed, compared to recent observations, and further assessed in this section as they pertain to the current study area.

Table 6 below provides a summary of the road geometry review from the 2013 Niagara Escarpment Crossing study prepared by HMM.

Table 6: Summary of Road Geometry (2013)

Characteristic	RR12 (Grimsby Mountain Road)	RR 18 (Beamsville Ontario Street/Mountain Street)	RR 24 (Vineland Victoria Avenue)
Lane Configuration	2 lanes	2 lanes	4 lanes - north of Moyer Road & 3 lanes - 2 SB, 1NB south of Moyer Road.
Lane Widths	Approximately 3.5 m	Approximately 3.5 m	Approximately 3.5 m
Shoulder Widths	East side - sidewalk from north to ridge Rd. ~ 1.5 m, then ~1 m paved shoulder. Raised curb all thru. West side - paved shoulder, ~ 1 m. Rolled curb all thru	Approximately 1-1.5 m paved shoulders. 1.5m sidewalk starts north of Edelheim Rd on the east side. Crossing has approximately 1-2 m shoulder width	North of Moyer Rd. approximately 1.5 m sidewalk on east side, no shoulder on west side. Raised curb all thru South of Moyer Rd. approximately 1 m gravel shoulder on both east and west side. Rolled curb all thru
Grade (Max)	Approximately 6-7 % main incline at curves. Approximately 4-5 % straightaways.	Approximately 4-6 %	Approximately 4-6 % on the straightway
Horizontal/Vertical Curve Radii	1. North-most (South to East)curve approximately = 125 m 2. Second (East to South-East) curve = 250 m 3. South-most (South-East to South) curve = 180 m	1. Main curve @ Hillside Dr = 700 m	1. Straight, no turns
Lateral Clearance	Approximately 1-4 m clearance at crossing. 0.5 m to hydro poles on north end near Elm Street and northmost curve.	Approximately 1.5-5 m. 2 m clearance at crossing. Major Hydropoles Approximately 3-5 m on west side.	Approximately 2-5 m from edge of pavement.
Pavement Condition	Good - some cracking present	Good at Crossing. As you reach school area and intersection with King St to the north, the pavement becomes poor with many cracks.	Fair - many cracks filled with filler.
Intersection Control	1. Elm St @ Mountain: Signalized 2. Ridge Rd W.@ Mountain: Stop Control	1. King St @ Mountain: Signalized 2. Philp Rd @ Mountain: Stop Control	1. King St @ Victoria: Signalized 2. Fly Rd@ Victoria: Stop Control
Intersection Configuration	Intersections are stop controlled with right-of-way to Mountain St.	Edelheim Rd @ mid crossing, stop controlled with shared left, thru, right turn movement.	N/A

Advance Warning Signs	1. NB @ top of hill. Over-sized stop sign with red flasher. 2. NB just before Elm St. Flashing intersection ahead sign.	1. NB @ top of downhill portion. Truck use low gear with yellow flasher.	1. NB @ top of downhill portion. Truck use low gear, with yellow flasher. 2. NB @ bottom of downhill portion approaching intersection at King St. Intersection prepare to stop ahead warning, two yellow flashers.
Adjacent Land Use	Residential on north approach of crossing. As travel continues south to Ridge Rd. the residential use is predominantly on east side to Ridge Rd. West/East side has steep slope up/down escarpment. Major Hydro poles on west side, cross to east side @ Ridge Rd. W. Church on east side across from Ridge Rd W.	Residential use north of Hillside Dr. with school zone for school located on west side across from George St. Sparse residential use south of Hillside Dr. Retirement apartments/condos at Edelheim Rd and just north of Edelheim Rd on the east side with 3 residential properties across from Edelheim Rd on the west side. Agricultural use (winery/farm) across from Kinsmen Dr. on west side. Major Hydro Poles on west side north of Philp Rd.	Residential use north of Moyer Rd with very long driveways. Residential house on east side across from Moyer, close to curb. Agricultural (winery) on west side south of Moyer. Municipal water station at top of hill on east side. Major Hydro Poles on west side north of Moyer, and switch over to east side south of Moyer
Dwelling Set-Back	Approximately 10 m where housing is present.	No Dwelling at crossing. Greater than 10 m where housing is present.	Dwelling across from Moyer Road, on the east side is approximately 10 m or less from edge of pavement.
QEW Connection	Direct access approximately 1km north through Christie Street and highway ramp accesses	Access to north, through Ontario Street. Approximately 4.5km away. Must turn on King Street to get to Ontario Street.	Direct access approximately 4.5 km north along Victoria Avenue
Speed Limit	50 km/h, with 40 km/h speed reductions at bends	50 km/h with 80km/h south of Leonard Cres.	50 km/h

Given the above table is based on information collected in 2013, the table was reviewed and compared to recent observations. There are some, but a fairly limited number of changes to report on. Most notably, Mountain Street (RR18) has been improved and now features a partially complete cycle lane, additional flexi-barriers outside the school, and a repaired pavement near the King St. intersection.

Ultimately, a review of the existing conditions indicates that Victoria Avenue is the best suited route for heavy vehicle traffic as it provides additional lanes, large setbacks, and the surrounding land uses are considered to be more compatible with heavy vehicle traffic. Mountain Road (RR12) and Mountain Street (RR18) are both narrow corridors with either incompatible adjacent land uses, or constrained by either the road alignment or gradient, resulting in a less than ideal route for heavy vehicle traffic. Unfortunately, as both RR12 and RR18 are still completely traversable by heavy vehicles, and the apparently minor concerns regarding road geometry do not affect driver route choices, heavy vehicles continue to operate along each of the three crossings.

4.4 Intersection Operations

Given the conclusions drawn from the heavy vehicle travel patterns in Section 4.1.3, it is evident that the intersections at Ontario St. (RR18) and King St. (RR81), and at Mountain St. (RR18) and King St. (RR81), are likely to cause some vehicle conflicts given the close proximity of the two intersections. These two intersections have also been the source of pedestrian complaints, as some heavy vehicles are unable to complete a turning movement in the provided space and will occasionally 'roll-over' the curb. Based on the various complaints, and the likelihood of turning conflicts, aerial imagery was collected on site to further examine the intersection and assist in recommending a solution.

As seen below in Figure 5, when two tractor-trailer heavy vehicles attempt a manoeuvre whereby one vehicle turns west from Mountain Street, and the other turns south on to Mountain Street, there is a potential for the vehicles to conflict. Neither vehicle in the below image can complete their respective manoeuvre without assistance from the other driver. In this particular case, there is a vehicle parked illegally on King Street (circled in red), which is impeding the turning path of the west-bound vehicle.

Figure 6: Turning Conflict at Mountain St. and King St., Beamsville

However, even in the absence of illegally parked vehicles, some heavy vehicles (particularly those with one or more trailers) have difficulty making the right hand turn from King St. to Mountain St. (RR18) (see Figure 6 below). The vehicle in the image has 'rolled-over' the curb while making a right hand turn on to Mountain St. (RR18), and it is clear that this is not a rare instance, given the obvious presence of tire tracks across the pedestrian standing area. This is a noticeable area of concern, as there is already a limited

amount of space available for pedestrians to stand while waiting to cross either Mountain St. or King St., and for a heavy vehicle to mount the curb while pedestrians wait in this area, creates a potentially dangerous situation for pedestrians. It is evident that some changes need to be made at this intersection, either by physical realignment or making operational changes.

Figure 7: Turning Difficulties at Mountain St. and King St., Beamsville

Similar problems also exist at the intersection of Ontario St. and King St., where heavy vehicles (particularly those with one or more trailers) have some difficulty completing a turn without assistance from other vehicles. In Figure 7 below, a tractor-trailer is turning north from King St. on to Ontario St., and although the turning path does not significantly cross over the oncoming turning lane, had the nearest vehicle not provided additional space to accommodate the heavy vehicle, there would have likely been a conflict.

Figure 8: Intersection Conflicts at Ontario St. and King St., Beamsville

However, even with the provision of an additional buffer from the passenger vehicle, this is likely an uncomfortable scenario for both drivers. This is further confirmed in Figure 8 below, where the black pickup truck is stopped while waiting for the heavy vehicle to complete its turn on to Ontario St.

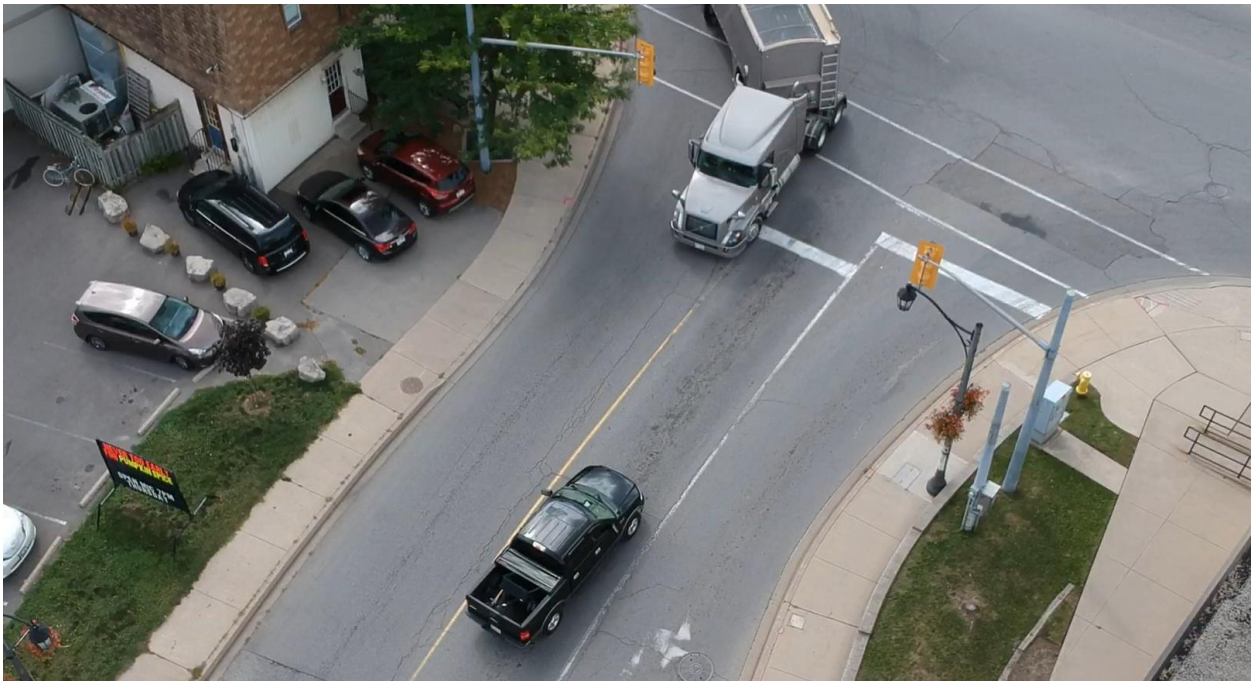


Figure 9: Turning Conflict at Ontario St. and King St., Beamsville

Ultimately, the movement of heavy vehicles through this corridor along RR18, combined with the difficulties presented by the two intersects, results in a situation where both pedestrians and vehicles are at risk of causing or being involved in a minor or major incident. Given that this corridor along King St. is considered to be 'downtown' Beamsville, there are aspirations to transform this area in to a highly walkable and desirable place for pedestrians, and the intersection designs and vehicle movements are likely to conflict with these aspirations.

4.5 Summary of Findings

Based on the previously available information from past studies, and the newly collected data and observations, there are a number of conclusions to be drawn. This includes:

- Heavy vehicle volumes are within the acceptable range for this area;
- Mountain Road (RR12) and Victoria Avenue (RR24) carry the majority of heavy vehicle traffic, while Mountain Street (RR18) sees far fewer trips;
- Heavy vehicle driver behaviour was observed to be appropriate;
- Origin-Destination Surveys revealed local trips are a significant contributor to heavy vehicle traffic in the area;
- Speeding and excessive speeding is a concerning problem at three of the four data collection points;
- Road geometry is inconsistent and varies both across each of the crossings and along the length of Mountain Street (RR18);

- The intersection of Mountain Street (RR18) and King Street (RR81) in Beamsville has the potential to lead to a variety of traffic conflicts where heavy vehicles are required to make tight turns; and
- Road signage and markings within the study area were observed to be under-maintained and inconsistent for each of the three escarpment crossings within the study area.

5.0 Improvement Options and Evaluation

The crossings of the Niagara Escarpment have been examined on several occasions and by many transportation specialists. As evidenced by fact that Niagara Region and the local municipalities have implemented many of the previous improvement recommendations, and many of their own, this listing of improvement options was intended to challenge the status quo and bring forward new and unique improvement plans that may not have been considered in the past. These improvement plans will be evaluated and assessed for their likely impacts and acceptability for implementation. For the purposes of this study, the various improvement plan options have been categorized into five (5) separate categories, being:

- Operational and Design
- Education
- Network and Policy
- Emerging Technologies
- Other Considerations

5.1 Operational and Design Options

For these options, the four (4) road sections that have been identified for consideration will be addressed individually.

5.1.1 Victoria Ave. (RR 24)

From an operational perspective, Victoria Ave. is the most attractive of the road sections studied that could accommodate trucking across the escarpment. However, there are some issues that could be addressed through operational improvements that could include: traffic calming, increased enforcement, improved signage and markings, and reduced speed limits. Each of these operational improvements are all options that the Region has previously considered and assessed.

With respect to the geometrics of this crossing, there exist a few non-standard design features that are in place in recognition of these unique geometrics. For example, at the intersection of Victoria Ave. and King St., the southbound lanes transition from a single through lane on the north-side approach to two departure lanes on the south approach. This results in a slightly offset alignment of the through lanes through the intersection which may cause some confusion. However, the justification for this misalignment is a result of the introduction of a truck climbing lane going southbound across the escarpment from King St. to Fly Rd.

Another unusual arrangement is the extended left-turn lane for northbound traffic approaching the intersection of King St. This extended left-turn lane has been introduced such that traffic can better align themselves where a vertical curve in Victoria Ave. restricts visibility of the queues at the intersection. Our study attempted to revisit the restriping options that could be considered for the purpose of introducing a centre left turn lane in one option, and the introduction of a cycle lane in another. These restriping options can be reviewed in **Appendix A**. These restriping options were not considered viable options as Victoria Ave. is best suited for trucking operations and the current striping is considered a better option for safety reasons when considering its purpose.

Table 7 below summarizes the evaluations of these options and the recommendations to carry any options forward for further consideration.

Table 7: Victoria Avenue (RR24)

OPERATIONAL/DESIGN OPTIONS	Effectiveness	Time Frame	Capital Cost	Operational Cost	Policy Changes	Infrastructure Planning	Comments
Traffic Calming	Reduced Speeding	Short	Low	No	No	Low	Do Not Carry Forward
Enforcement	Reduced Speeding	Short	Low	Police	No	No	**Carry Forward**
Signage/Markings	Improved Behaviour	Short	Low	No	No	Low	**Carry Forward**
Reduced Speed Limit	Reduced Speeding	Short	Low	No	No	Low	Do Not Carry Forward
Restriping	Improved Access	Medium	Medium	Maintenance	No	EA Required	Do Not Carry Forward
Realign Intersection	Improved Operations	Medium	Medium	Maintenance	No	EA Required	Do Not Carry Forward

5.1.2 Mountain St. (RR 18)

The Mountain Street provides a north-south connection within the study area. It comprises both rural and urban cross-sections with challenging road geometrics. Most concerning is north of Leonard Crescent, where existing road gradient is steep and advisory warning signs are in place to alert drivers. This section also provides urbanized geometrics with concrete curb and gutter and dedicated bike lanes on both sides. Several inconsistent design elements are observed within this road section. For instance, a sidewalk is only provided on the east side of the roadway, with wider boulevard south of Hillside Drive, whereas the offset between sidewalk and the roadway becomes narrower immediately north of Hillside Drive.

South of Cassandra Drive, sidewalks are provided on both sides up to King Street. Approximately 120m north of Elizabeth Street all the way to King Street, the sidewalks on both sides are provided adjacent to concrete curb within residential area, with a narrow concrete killstrip only on the east side. Similar inconsistency is observed with bike lanes along Mountain Street. The bike lanes are marked as dedicated lanes south of Hillside Drive and carried as a paved shoulder with varying width immediately north of Hillside Drive intersection without having proper signage. With inconsistences in road geometrics, a consistent pavement markings and lane designations could potentially provide a similarity throughout the corridor. This measure should be considered as a medium-term improvement when more information for planned development for adjacent land is available. If the traffic demand warrants, road improvements such as widening could be further investigated undertaking Class Environmental Assessment process.

In terms of traffic operations, the Mountain Street (RR18) sees an overall reduction in heavy vehicle demand within five years and sees lesser trips when compared to Mountain Road (RR12) and Victoria Avenue (RR24) which carry majority of heavy vehicle traffic within the study area. It is observed that speeding is a real concern along Mountain Street, where the majority of vehicles are observed exceeding the posted speed limit (50km/hr). On a broader scale this could potentially be a result of reduction in heavy vehicle traffic along the corridor, providing opportunity for passenger vehicles to drive faster without being impeded by slow moving heavies. No evidence of heavy vehicles exceeding speed limits were found during site visits and normal driving behavior of heavy vehicle drivers was observed. However, recent speed profile indicates speeding is a real issue which suggest implementation of traffic calming measures along the corridor supplemented by enforcement. Evaluations of options discussed above and

potential recommendations to carry any options forward for further consideration are summarized in **Table 8** below.

Table 8: Mountain Street (RR18)

OPERATIONAL/DESIGN OPTIONS	Effectiveness	Time Frame	Capital Cost	Operational Cost	Policy Changes	Infrastructure Planning	Comments
Traffic Calming	Reduced Speeding	Short	Low	No	No	Low	**Carry Forward**
Enforcement	Reduced Speeding	Short	Low	Police	No	No	**Carry Forward**
Restriping	Improved Operations	Medium	Medium	Maintenance	No	EA Required	**Carry Forward**
North Lane routing	Improved Operations	Medium	Medium	No	No	EA + Upgrade to RR	Investigate Further
Widening	Improved Operations	Medium	Medium	No	No	EA Required	Investigate Further
Active Transport Striping	Increased AT Participation	Short	Low	Low	No	EA Required	**Carry Forward**
Signage/Markings	Improved Behaviour	Short	Low	No	No	Low	**Carry Forward**
Parking Restrictions	Improved Operations	Short	Low	Existing	No	No	**Carry Forward**

5.1.3 Mountain Rd. (RR 12)

Similar to the parallel running Mountain Street, the Mountain Road also posses challenging road geometrics such as steep gradient and restricted sightlines at horizontal curves. Immediately north of Ridge Road West, the advisory warning sign for steep gradient are in place. The corridor is provided with asphalt sidewalk adjacent to road with standard concrete curb and gutter on east side, and a paved shoulder on with mountable concrete curb and gutter is available on west side. An electronic advisory speed check is also in place with flashing speed limit. At sharp horizontal curve between Oak Street and Elm Street, the speed is reduced to 40km/hr. Signage and Markings where found deficient or inconsistent could be addressed in short term to enhance traffic safety. One of potential location is the intersection of Oak Street at Mountain Road. The Oak Street is a single westbound right turn lane with stop control intersecting at Mountain Road with sharp entry radius on a horizontal curve. This creates a situation where drivers on either road have limited sightlines. Adequate warning signs should be provided to alert drivers of oncoming traffic.

Another potential area of improvement is just south of Elm Tree Road where the posted speed limit changes from 70km/hr to 50km/hr (heading north) and vice versa within 200m distance. Based on the speed profile, a vast majority of drivers are obeying speed limits while 29% travelled less than 10km/hr above posted limit. Traffic Calming measure such as electronic speed check is advised to be monitored on regular basis along with enforcement.

Significant increase in heavy traffic demand has been noted while comparing 2013 and 2018 traffic data, however heavy vehicles still represent less then 10% of total traffic. Considering low traffic demand, existing geometric constraints and limited Right-of-Way, neither restriping nor road widening is deemed warranted at this time of the study. Parking Restrictions are found on both sides of roadway under existing condition and should be maintained in future. Evaluations of options discussed above and potential recommendations to carry any options forward for further consideration are summarized in **Table 9** below.

Table 9: Mountain Road (RR12)

OPERATIONAL/DESIGN OPTIONS	Effectiveness	Time Frame	Capital Cost	Operational Cost	Policy Changes	Infrastructure Planning	Comments
Traffic Calming	Reduced Speeding	Short	Low	No	No	Low	**Carry Forward**
Enforcement	Reduced Speeding	Short	Low	Police	No	No	**Carry Forward**
Signage	Improved Behaviour	Short	Low	No	No	Low	**Carry Forward**
Parking Restrictions	Improved Operations	Short	Low	Existing	No	No	**Carry Forward**

5.1.4 Main St./King St. (RR 81)

The section of Main Street/King Street between Grimsby and Vineland is primarily a 2-lane road having diversified rural and urban cross sections. This includes provision of sidewalk as active transportation facility, a single lane roundabout as traffic calming measure, efficient traffic operations and aesthetic feature, a central two-way left turn lane at certain locations. Majority of adjacent fronting properties are agricultural lands, while medium density residential developments are present at major crossing streets such as but not limited to Victoria Avenue, Mountain Street, Ontario Street, and Mountain Road.

For the purpose of this study, more focus to King Street was given at section between Mountain Street and Ontario Street. This short section represents challenges with respect to heavy vehicle maneuvers. The benefit of an Ontario Street interchange at QEW provides a convenient access to all traffic including heavy vehicles heading south and vice versa. However, the disconnect between Ontario Street and Mountain Street is linked by short section of King Street, which portrays serious issues related to heavy vehicles which are forced to make tight turns at the intersections. These issues have been observed during site visits and documented using aerial videography as part of this study. To overcome this problem, a few alternative routing options via North Lane were developed to provide truck by-pass, are described in later section of this report. As previously mentioned, the intersection of Mountain Street (RR18) and King Street (RR81) in Beamsville has the potential to lead to a variety of traffic conflicts where heavy vehicles are required to make tight turns.

Along Main/King Street, excessive speeding has been observed as a valid concern and traffic calming measures such as a reduced speed limit should be considered along with enforcement. In general, it will likely be enforcement that plays a vital role in speed reduction when implemented on regular basis.

Since the cross section along the corridor varies significantly, options for geometric improvements such as road widening, provision of dedicated bike lanes, and restriping are not suggested at this time. Warrants for such improvements are dependent on planned future developments and should be monitored on regular basis. However, the Region is advised to ensure signage and markings are consistent and meet current design standards. Evaluations of options discussed above and potential recommendations to carry any options forward for further consideration are summarized in **Table 10** below.

Table 10: Main St. E./King St. (RR81)

OPERATIONAL/ DESIGN OPTIONS	Effectiveness	Time Frame	Capital Cost	Operational Cost	Policy Changes	Infrastructure Planning	Comments
Traffic Calming	Reduced Speeding	Short	Low	No	No	Low	**Carry Forward**
Enforcement	Reduced Speeding	Short	Low	Police	No	No	**Carry Forward**
Complete Streets	Improved Behaviour/ Increased AT	Medium	Medium	Maintenance	No	EA Required	**Carry Forward**
Signage	Improved Behaviour	Short	Low	No	No	Low	**Carry Forward**
Reduced Speed Limit	Reduced Speeding	Short	Low	No	No	Low	Do not implement without increased enforcement

5.2 Education

The local communities that rely on the escarpment for its economic livelihood, and those that reside adjacent to these escarpment crossings all have a vested interest in how these crossings perform. Regular communications with this local community may be a useful way to discuss Regional initiatives, local operating concerns, development opportunities, and investment plans.

At present, there many ways in which the Region reaches out to its communities. These include the Niagara Region web site, Twitter feeds, and Facebook updates. These can clearly be used to share information regarding goods movement in the Region. For the most part, this could get the message out to the community, but not a great method to create a meaningful dialogue with the community. Even so, these tools presently exist, and the Region should be encouraged to send out messages regarding goods movement across the escarpment using these social media tools. In addition, a regular newsletter on goods movement could be considered as an additional tool for communicating with the community, but this may be best developed and distributed by the local municipalities.

There are many commercial entities that operate transportation services across the region. These could be categorized in many ways, but could include:

- Business Improvement Areas (BIAs)
- Agricultural communities
- Quarry and Landfill Operators
- Other Commercial Entities.

Coordinating the operations and initiatives of these entities could be very beneficial for both these operators and the Region. Presently there are a few forums for goods movement discussions including:

- Niagara Region Agricultural Policy and Action Committee: This committee includes membership from the Ontario Federation of Agriculture, Niagara South Federation of Agriculture, and West Niagara Agricultural Society. This committee meets only a few times per year and focuses on policy issues and issues that may affect the agriculture industry in Niagara.
- Niagara Region Transportation Steering Committee: This committee meets on a regular basis and reports to the Public Works Standing Committee. Its focus is on strategic initiatives that presently include initiatives such as the Transportation Master Plan, the NGTA, the GO expansion program, Mobility Hubs, and Intermunicipal Transit.

- Regional Niagara Active Transportation Subcommittee: This subcommittee meets regularly and has a very active membership that has promoted active transportation in such a way that several infrastructure, policy, and operational improvements have been initiated in the Region.
- Downtown Beamsville Business Improvement Area (or Downtown Bench BIA): This BIA is focussed on the commercial entities in Beamsville with concerns related to King St. from Ontario St. to Academy St.
- Humberstone Landfill Site Public Liaison Committee and the Niagara Road 12 Landfill Site Citizens Liaison Committee: Both of these committees are now defunct but illustrates the concept of creating a forum for both the public, the government, and the commercial operators to meet and discuss common issues.

Since Goods Movement is a vital component of a community's economic viability, other municipal governments have established Standing Committees, or Subcommittees, to regularly discuss Goods Movement within their municipality. A good example is Peel Region that has embraced the concept that goods movement is important to their community. They have established the Peel Goods Movement Task Force whose mandate is to:

- develop a common vision for goods movement in the Peel area
- provide a forum to bring together key public and private sector stakeholders to guide future improvements to the goods movement system
- facilitate the exchange of information and to develop common messages on issues affecting goods movement; to monitor, review and provide input and feedback to regional, provincial and federal initiatives related to goods movement
- develop an action plan, with the required partnerships, for the implementation of short, medium and long-term improvements to the goods movement network in Peel.

Establishing an ongoing forum to discuss goods movement in Niagara may be extremely beneficial for the Region. It could embrace all of the entities mentioned above including the BIAs, the Agricultural industries, the Quarries and Landfill operators, and other commercial operators. Formalizing this as an Advisory Committee or Subcommittee reporting through Public Works Standing Committee should be considered. To implement, its creation would require support from Regional Council and would require a staff member to be responsible for writing terms of reference, establishing membership, and creating ongoing agendas and meeting minutes.

Table 11 below summarizes the education and communications considerations and evaluations resulting from this study.

Table 11: Education and Communications Options

EDUCATION & COMMUNICATIONS	Effectiveness	Time Frame	Capital Cost	Operational Cost	Policy Changes	Infrastructure Planning	Comments
Newsletters	Improved Behaviour	Short	No	Staff Assignment	Work with local municipalities	No	**Carry Forward with Local Municipalities**
Advisory Committees	Ongoing Communications	Medium	No	Staff Assignment	Council Support and Terms of Reference	No	**Carry Forward**
Social Media Blasts	Ongoing Communications	Short	No	Staff Assignment		No	Ongoing
BIAs	Raised Awareness	Medium	No	Staff Assignment		No	With Advisory Committee
Agricultural Associations	Ongoing Communications	Medium	No	Staff Assignment		No	With Advisory Committee
Quarries	Ongoing Communications	Medium	No	Staff Assignment		No	With Advisory Committee
Commercial Entities	Ongoing Communications	Medium	No	Staff Assignment		No	With Advisory Committee

5.3 Network and Policy

Niagara Region's recently approved Transportation Master Plan (TMP) includes a chapter on Goods Movement. It states, "Improving the movement of goods through and within the Region is vital to Niagara's economic development." Always a key consideration for the movement of goods is ready access to freeway facilities that connect industry with markets. In Niagara, the only freeway facility is the QEW which runs along the east and north portions of the region. However, due to the Niagara Escarpment's exaggerated geographic features, it becomes a significant barrier for QEW access.

Acknowledging that trucking across the Niagara Escarpment is not desirable, but at present a necessity, the Region has included several recommendations in their TMP as noted in Figure 9 below.

25	Work with MTO to identify a short-term solution to provide network redundancy through an alternate Provincial route parallel to the QEW that can accommodate longer-distance, inter-regional travel and goods movement, including a Role and Function study of Hwy 20/Regional Road 20 and a study to address the Smithville Bypass.
26	Advocate and work with MTO for capacity improvements to accommodate inter-regional and international travel demand, including: widening of QEW, implementing the NGTA East corridor and extension of Highway 406; and building a new Niagara-Hamilton trade corridor.
27	Undertake and/or complete EA for Niagara Escarpment Crossing and South Niagara East-West Arterial Road,

Figure 10: Niagara Region Transportation Master Plan Action Items

The Niagara to GTA corridor has been the subject of several studies and at present is not an active project for the province. Nonetheless the need for a new trade corridor that is an alternative to the QEW is clear (see Action Item #26 above). A Niagara-Hamilton Trade Corridor that connects Niagara Region at Highway 406 to the City of Hamilton in the vicinity of the Hamilton International Airport/Highway 403 would address the demands of moving goods across and through the Niagara Region and significantly reduce the need for trucking to cross the Niagara Escarpment. It is our understanding that the Region is actively pursuing support from other municipalities, the provincial government, and the federal government.

While a new trade corridor is being pursued, the Region has also recommended that they work with the province to identify a short-term solution for the need for another east-west route that creates network redundancy and an alternate route to the QEW (see Action Item #25 above). The recommendation from the TMP is for the Province and the Region undertake a Regional Road 20/Highway 20 Role and Function Study. This study would define the role and corridor opportunities that are possible for crossing Niagara above the Niagara Escarpment. Figure 10 below is taken from the TMP (Map 7) illustrates some opportunities for the Interim Trade Corridor and a possible implementation strategy.

As far back as 1997, an Escarpment Crossing (EA) Study was initiated as Phases 1 and 2 of the EA process. That study was guided by the following problem statement:

"Significant local and through truck volumes are travelling on steep grades through communities, mixing with pedestrian and cyclist traffic, or passing incompatible land uses."

In 2016, the Regional Council approved funding for the Phases 3 and 4 of the EA process for the Escarpment Crossing Study. The recommendations included discussions regarding short-term improvements (many of which have been implemented), medium-term improvements, and long-term improvements. These recommendations culminate in a recommendation for a new escarpment crossing corridor that would be designed to readily accept trucking demands across the escarpment. These recommendations are considered very valid and should be pursued at the Region's earliest convenience.

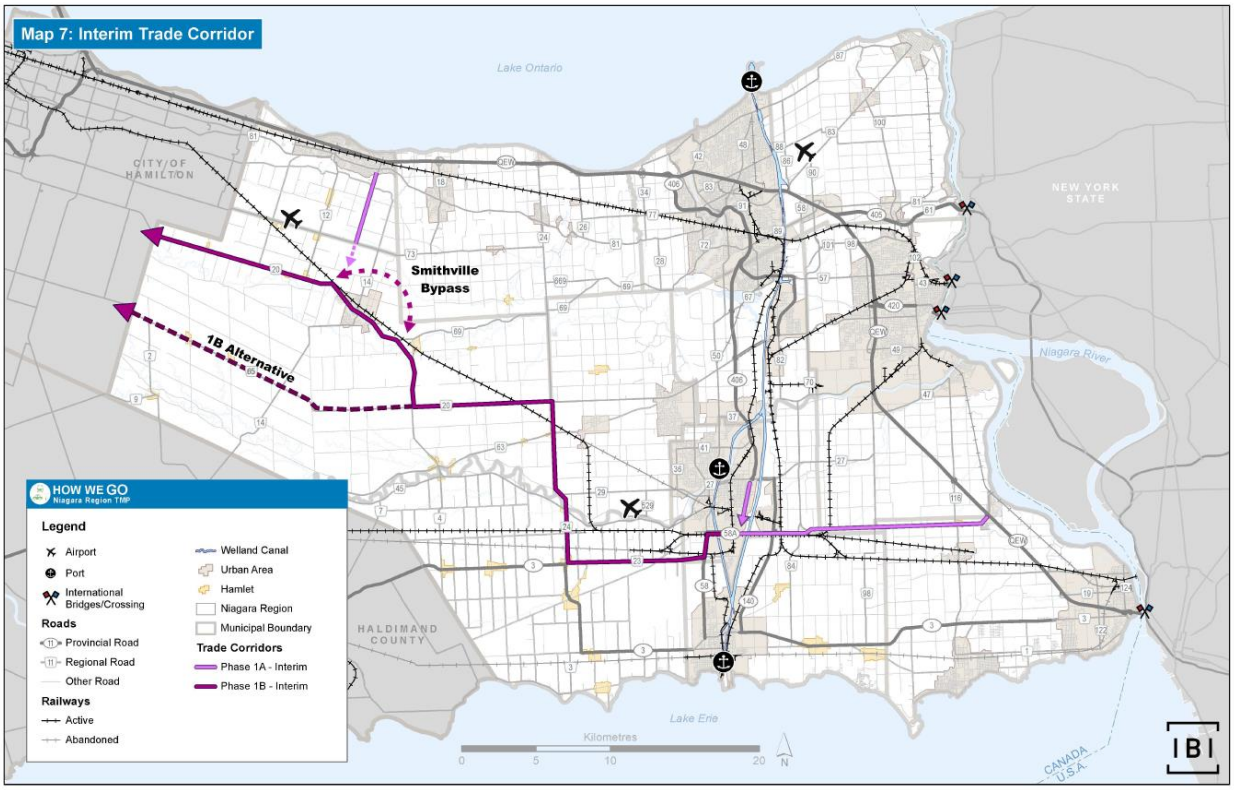


Figure 11: Interim Trade Corridor (TMP Map 7)

An existing alternative to crossing the escarpment in Niagara is to utilize the Fly Road/Mud Street corridor which would connect Victoria Ave. in the east to the Red Hill Parkway/Lincoln Alexander in the west. Our study examined the travel time and distance associated with each route as noted in Figure 11 below.

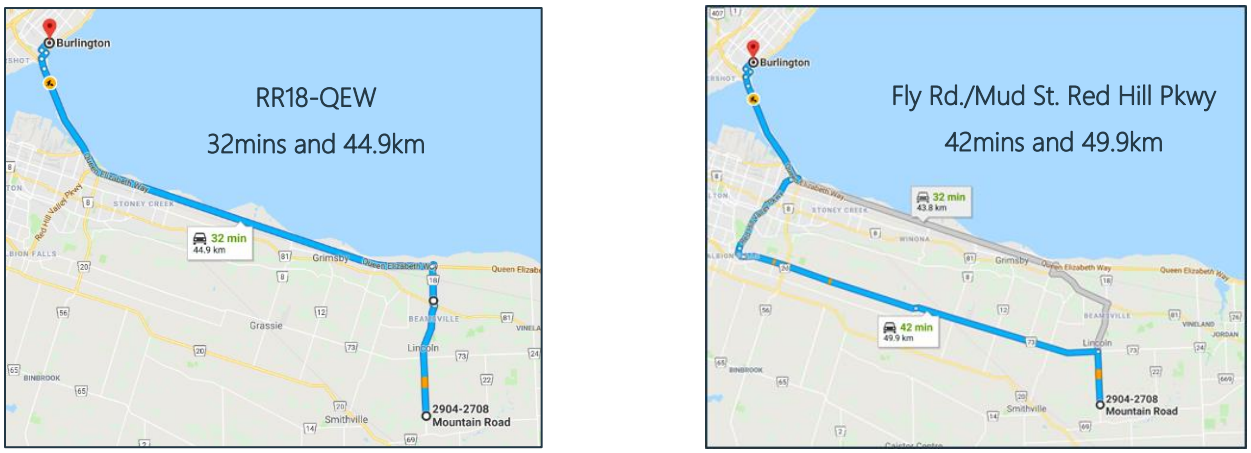


Figure 12: Fly Road/Mud Street Travel Time Comparison

This route change would require restricting truck movements across the escarpment, which is not desirable as many trucks still have origins or destinations that would require access to the escarpment crossings, it creates a longer travel time and distance for trucking, and it sends more trucks through some residential communities along that route that already have traffic calming treatments. In addition, there would be significant costs to upgrade this corridor to accommodate trucking as a preferred route and cooperation with the City of Hamilton to use Mud St. and the Red Hill/Lincoln Alexander Parkway. Due to these concerns, the Region is better served focusing on the Interim Trade Corridor initiative as noted above.

In Hamilton, the City undertook a Goods Movement Master Plan. Within it they examined in detail the possibility of creating time of day restrictions and "specified users" classification. Both of these initiatives are achievable by implementing a local by-law. However, the City does not endorse either of these due to the onerous requirement to enforce and the inequitable treatment that it imposes on certain road users. Based on these considerations, this study does not recommend that the Region implement either.

These network and policy options are summarized and evaluated in Table 12 below:

Table 12: Network and Policy Options

NETWORK AND POLICY	Effectiveness	Time Frame	Capital Cost	Operational Cost	Policy Changes	Infrastructure Planning	Comments
New Trade Corridor	Reduced cross-escarpment trucking to local deliveries only	Very Long	Very High	No	Supports TMP	Individual EA and funding	**Requires external support**
New Escarpment Crossing	Reduced cross-escarpment trucking to local deliveries only	Long	Very High	No	Supports Area Master Plan	EA Phases 3 & 4 and funding	**Initiate Phases 3 and 4 of the EA process.**
Fly/Mud Alternate Goods Route	Reduced cross-escarpment trucking	Medium	Low	Low	Defined Trucking Routes	No	Do not carry forward
Time of Day Restrictions	Limits cross-escarpment trucking	Short	Low	Enforcement	Bylaw	No	Do not carry forward
Specified User Permits	Limits cross escarpment trucking	Short	Low	Enforcement and Staffing	Bylaw	No	Do not carry forward

5.4 Emerging Technologies

As stated in the Region's TMP, "There are several emerging technologies that will play both a supportive and disruptive role in goods movement and manufacturing sectors. These technologies present opportunities to improve the efficiency of goods movement and potentially reduce the demand for transporting goods on Region's road network."

5.4.1 Autonomous and Connected Vehicles

The freight and logistics industries are poised to be one of the early adopters of autonomous and connected vehicle technologies. Driverless truck technology is advancing rapidly and could provide substantial benefits to freight companies and efficiencies for the road network. They include:

- Driverless and connected trucking will significantly eliminate human error and drastically improve road vehicle safety and reduce delays caused by accidents
- Driverless trucks have the potential to allow for overnight driving and faster long-haul delivery times as driver rest periods will not be required
- Driverless and connected trucks would improve fuel efficiency and increase vehicle throughput by decreasing following distances and increasing traffic density

In 2016, Ontario launched a ten-year pilot program to allow the testing of automated vehicles on Ontario's roads. In response to advances in Automated vehicle (AV) technology, the program was updated on January 1, 2019 to allow for the testing and sale of more innovative technologies. At present, only Level 3 driverless vehicles are permitted. Level 3 is defined below by the Society of Automotive Engineers (SAE) International:

"Level 3 - Conditional Automation: *The vehicle becomes a co-pilot. The vehicle manages most safety-critical driving functions, but the driver must be ready to take control of the vehicle at all times."*

According to the Region's TMP, the Region has the opportunity to lay the groundwork for allowing these vehicles to effectively operate in Niagara Region through strategic initiatives and policy. This includes fostering the testing of these vehicles and maintaining the Region's infrastructure, such as pavement markings and signage, at a level that ensures the effective operation of these vehicles. To ensure readiness for these technologies, the Region should monitor technology advances and the introduction of regulations to allow for these technologies as they may have positive impacts for the reduction of trucking across the escarpment.

5.4.2 Commercial Drone Delivery

Although rail and marine transportation networks are possible alternatives for goods movement, they are not realistic options for goods movement across the escarpment. However, commercial drone delivery is becoming a reality with recent technology and regulation pilot studies being undertaken. Drone delivery has the potential to alleviate demand on the road network and potentially reduce the number of delivery trucks on the road. As seen in other regions in Canada, Niagara Region can prepare itself to be a testbed for these technologies to take advantage of the opportunities that this technology can provide.

5.4.3 Incentives

As with truck use restrictions, financial incentives are intended to encourage freight operators to shift truck traffic off specific roadways that have either congestion or safety issues, to more desirable routes. Any financial incentives provided must also recognize that the companies where the freight originates, or is received, must also benefit financial from any route shift, or time shift. The manner in which financial

incentives could be created is if a business case were developed that illustrated the cost trade-offs that could be achieved. Ideally, such a business case would create a scenario where the private sectors companies would undertake this program themselves with minor assistance from the public sector. If the private companies cannot be convinced that there is a financial benefit that would result in voluntarily adjusting their delivery routes, or if they cannot convince all companies to participate, then this private sector financial incentive program would not achieve desired results.

Another approach to incentivizing the freight industry to adjust their delivery routes could be an incentive program operated by the public sector. However, this would require a significant effort to establish the program administration and enforcement required for such a program. This program would require the public sector to establish the financial incentives that could be offered to freight operators that might cover many costs such as additional workers, longer trucking delivery times, increased maintenance costs, and possibly increased overtime labour costs.

There have been a few attempts to create financial incentive programs for the freight industries, but most have been associated with special events such as the Olympics, PanAm Games, and other like events. These special events typically have a defined time frame when implemented and the financial benefits accrued for the private business comes from reduced delivery times from avoiding congestion routes or time periods.

Due to the limited known benefits of a financial incentive program and recognizing the significant administrative effort that would be required to establish such a program, this program is not recommended for consideration in Niagara.

5.4.4 Electronic Enforcement

Electronic enforcement is becoming more prevalent in the transportation industry. It can eliminate the need for costly police enforcement at sites where there are operating issues. They can operate 24 hours a day if desired and generate fees that offset costs. One downfall of electronic enforcement is that there is a privacy issue in Ontario which restricts the identification of drivers and passengers of vehicles. As a result, it is the owner of the vehicle that gets impacted by improper driver behaviour rather than the actual driver committing the offense. As a result, many owners simply add the costs of electronic enforcement fees to the operating costs of their business.

In Ontario, there are three electronic enforcement programs available. One of these programs is the Red Light Camera Program which many Ontario municipalities participate in. However, red light violations are not the focus of this study and as a result, the Red Light Camera Program is not considered further.

- Automated Speed Enforcement (ASE): Photo radar was introduced to the Province of Ontario in the early 1990s for application on the provincial highways. However, it was subsequently scrapped when the government of the day changed. Recently, the City of Toronto has initiated a pilot program to introduce photo radar in Community Safety Zones which are typically implemented around schools. In this instance, normal speed fines would be doubled and the tickets mailed to the owner of the vehicle, who may not be the offending driver. Demerit points and licence suspension mandated by the Highway Traffic Act for drivers caught speeding would not apply.

  There are many requirements that will need to be considered prior to this ASE program get approved by the province and expanded to other municipalities. Cameras must take photographs of the offending vehicle which are then collected and reviewed at a central processing centre. This centre will be similar to the Red Light Camera Processing Centre operated by the City of Toronto, and supported financially by other participating municipalities. Trained officers must review every

picture to verify vehicle information and ensure the vehicle is in violation. Tickets are then mailed to the vehicle owner, regardless of who was driving the vehicle.

As this ASE program is presently a pilot program being run by the City of Toronto, it would be prudent for the Region to monitor the progress of this pilot such that should it be approved as a permanent program, and available to other municipalities, it could be a valuable tool in reducing speeding on their roadways.

- Road Tolls: In 1998 the Ministry of Transportation, Ontario introduced the Highway 407 Act which allowed the collection of tolls on the Highway 407 only. In February, 2017, the Ministry expanded the toll program to include the newly constructed Highway 412 which connected Highway 407 to Highway 401 in Durham Region. There has been no other program established that would permit local or regional municipalities to introduce a road tolling program.

  There are several examples of other municipalities in the United States that have introduced tolling programs. Although most of these toll programs were established to offset public sector maintenance or roadway expansion costs, some of these were established in an effort to reroute trucking operations away from these tolled roads. Most research shows that the trucking industry does try to avoid tolls if possible, but that is highly dependent on the rate of the tolling and how that tolling is collected. Establishing a toll rate that is fair to all road users, yet affects a trucking route diversion, would be a challenging exercise.

  As the Province of Ontario does not presently allow the collection of tolls on municipal roadways, this program is not available to Niagara Region. However, should the Province consider a change in the future, then the Region could reconsider its position with respect to tolls across the escarpment roadways and what purpose would the tolls be collected for.

5.5 Other Considerations

In a study progress meeting, a discussion ensued with respect to the Town of Lincoln Transportation Master Plan which is presently underway. A meeting with the Town staff focussed our discussions on the possible treatments at the intersection of Mountain St. (RR 18) at King St. (RR 81) and a proposed truck routing scenario.

5.5.1 Mountain St. (RR 18) at King St. (RR 81) Intersection

Video evidence has shown that large trucking vehicles have significant difficulty making turns at this intersection both southbound and northbound destinations of the escarpment. The eastbound to southbound right turn results in a significant number of large trucks overtracking the pedestrian waiting area of the sidewalk. In the northbound direction, illegally parked vehicles block large truck turning areas resulting in unnecessary on-road adjustments by the larger trucking vehicles to avoid colliding with these parked vehicles.

Several alternatives were considered to alleviate the trucking operations at this intersection including:

- Purchase the building/property on the south-west corner when available to reconstruct the intersection with improved turning radii;
- Install Bollards at south-west corner to provide safety to pedestrian waiting to cross and restrict larger vehicles driving over the curb and sidewalk platform;
- Restripe the south leg of the intersection to eliminate any possible use of the gore area by left-turning vehicles mistakenly considering it an exclusive left-turn. Many of the large trucks making

the eastbound to southbound right turn need to overrun that gore area to avoid overtracking on the pedestrian sidewalk; and

- Further restrict curbside parking on the north side of King St. just west of this intersection.

5.5.2 North Lane

North Lane in the Town of Lincoln has been examined on several occasions for its proposed use. At present it is primarily an access road to parking behind the commercial businesses along King St. It runs as a two-way operation and a connection between Ontario St. and Central Ave. Central Ave. north of the Mountain St. (RR 18) at King St. (RR 81) intersection is a one-way roadway running northbound only.

As one of the main concerns with trucking operations in the Town of Lincoln is the use of a short section of King St. between Mountain St. and Ontario St. by the trucking community. They use this section because it is presently the only direct route connection between the escarpment crossing of Mountain St. and the QEW.

Although North Lane is local access road with significant commercial potential for the local businesses in terms of parking and café style sitting facilities, it has a wide right-of-way. For the purpose of this study, it was examined to determine if it could be utilized as a bypass of King St. and a proposed trucking route. Turning templates and turn lanes were proposed to confirm that large trucks could negotiate North Lane as a possible truck route. These plans are shown in **Appendix B**.

Although the plans show that large trucks could negotiate North Lane as a trucking route, and modifying a portion of Central Ave. to accommodate two-way traffic between King St. and North Lane, our study has determined that the use of a local roadway as a large truck bypass route would not be in keeping with the intended use of a local roadway. Significant infrastructure improvements would be required along Ontario St. and at Central Ave. to implement this change, not to mention the significant amount of signing required to ensure large trucks are aware of this bypass. Although North Lane could be a truck bypass route between Mountain St. and the QEW, it would not solve the issue of large trucks coming from other directions other than the north. These large trucks would still have issues negotiating the Mountain St. and King St. intersection.

In conclusion, it was determined that the use of North Lane as a possible truck bypass route is not feasible nor recommended.

5.5.3 Proposed Truck Routing

Recognizing that the short stretch of King St. between Ontario St. and Mountain St. is not ideal for trucking operations due to its urban setting and abutting commercial establishments, the Town is considering proposing a preferred truck route connecting the QEW to Mountain St. The route would include Ontario St. at the QEW ramps, the South Service Rd. between Ontario St. and Bartlett Rd., Bartlett Rd. between the South Service Rd. and King St., and King St. between Bartlett Rd. and Mountain St. This route is illustrated in Figure 12 below:

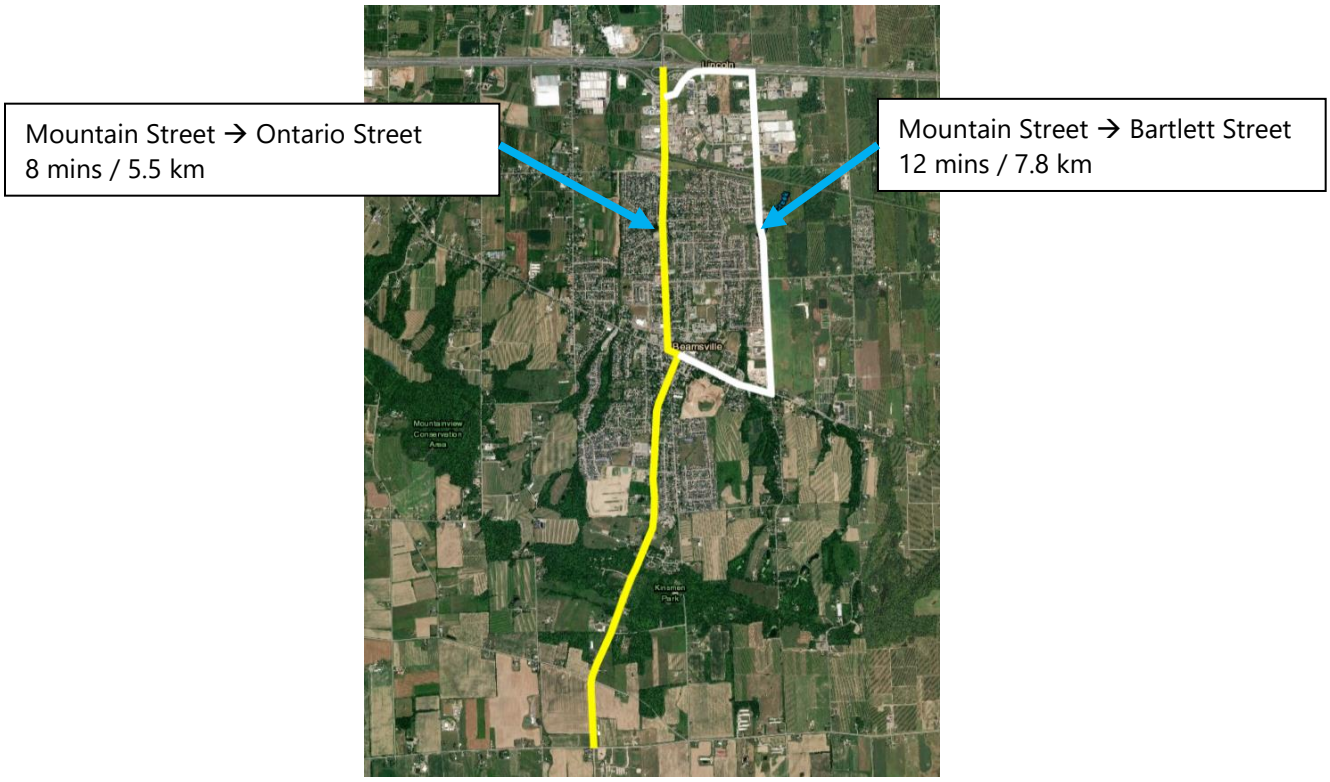


Figure 13: Town of Lincoln Possible Truck Route Option

This proposed truck route would not restrict trucks from continuing along Ontario St. and King St., but would instead be a voluntary preferred trucking route following some infrastructure improvements along that route. Although the route is approximately 2.3km. longer than the Ontario St. to King St. route, it may be more desirable as it avoids difficult operational issues for trucks, and avoids possible congested areas in the urban section of King St.

As this truck route proposal is being considered as part of the Town of Lincoln Transportation Master Plan, the Region should be an active participant in the consideration of this route as a realistic option for reducing the instances of truck problems at the intersection of King St. and Mountain St.

6.0 Recommended Improvement Plan

Based on the variety of potential causes listed in the previous section, a desktop preliminary research task was undertaken to explore a number of solutions. These improvements could potential be implemented in three stages and categorized accordingly into short, medium and long-term solutions given their level of complexity, funds availability, degree of public and business owner engagement, planned future developments, support to/from neighbouring municipalities and regions. These solutions are summarized as follows:

6.1 Short-Term:

The short-term represent relatively low-cost solution that could be implemented fairly quickly, such as:

- **Consistent Signs and markings on all crossings** should be provided where found deficient to elevate existing conditions to current standards.
- **Traffic Calming** measures should be provided within residential areas for traffic safety including pedestrians and cyclist.
- **Additional Truck Route Signing** similar to '*Preferred Truck Route*' sign at top of Mountain RR 18 to be provided. This effort will guide truck drivers to choosing alternative routes and potentially distribute heavy vehicle demand evenly within the study area.
- **Lower Speed Limit for Trucks where existing road gradient is greater than 6%** as allowed by Highway Traffic Act (shown below) to be carried as a pilot study at one location and monitored. The study should document before and after conditions to understand if permanent implementation of speed reduction is worth considering.

Rate on grade
(6.1) The council of a municipality may by by-law,

(a) designate a portion of a highway under its jurisdiction that includes a grade of 6 per cent or higher; and

(b) prescribe for any class or classes of motor vehicles a rate of speed, when travelling down grade on that portion of the highway, that is 10 or 20 kilometres per hour lower than the rate of speed otherwise prescribed under subsection (1) or (2) for that portion of highway, but not lower than 40 kilometres per hour. 2002, c. 18, Sched. P, s. 29 (3-5).

Same
(6.2) The portion of a highway designated under clause (6.1) (a) shall not include more than 500 metres on either side of the portion of the highway where the grade is 6 per cent or higher. 2002, c. 18, Sched. P, s. 29 (3).

- **Preferred truck route** using Bartlett Road (Town of Lincoln) could be established in view of Town of Lincoln Transportation Master Plan. Work to be collaborated with Town to determine viability.

- **Additional Enforcement** should be considered on a regular basis for effectiveness. It can be supplemented with many solutions identified under short-term implementation program, such as traffic calming, preferred truck route, lower speed limits.

- **Complete Streets Treatment** for King between Mountain Street and Ontario Street could be considered to deter trucks movement within this section.

- **Continue to collaborate with local municipalities** as they develop their transportation master plans and other improvement plans.

6.2 Medium-Term:

The following medium-term solutions represents options with mid-range capital investment having moderate operational and maintenance cost:

- **New Escarpment Crossing** will provide and additional alternative route, which could provide relief on major corridors within the study limits. If and When a new crossing is implemented, education to road user would be of prime importance and key to success. A Class Environmental Assessment undertaking for Phase 3 and 4 could be initiated for new crossing.

- **Goods Movement Standing Committee** will require dedicated staff to oversee operation and logistic matters on a continuous basis. The allocation of man power and resources will not only develop and review implementation strategy, but it will also be helpful in monitoring benefits provided through improvements.

- **Infrastructure improvements on existing crossings** would potentially enhance traffic safety and driving experience, which could result in traffic diversion to available alternative routes. This may include but not limited to providing active transportation facilities for consistency and continuity, resurfacing where pavement shows visible sign of deterioration, improved road geometrics.

- **Monitor Electronic Enforcement Advances** such as Tolling, Photo Radar may prove to be an efficient way of deterring heavy vehicle traffic off residential areas and utilizing alternative routes. However, this solution should be considered in conjunction with enforcement.

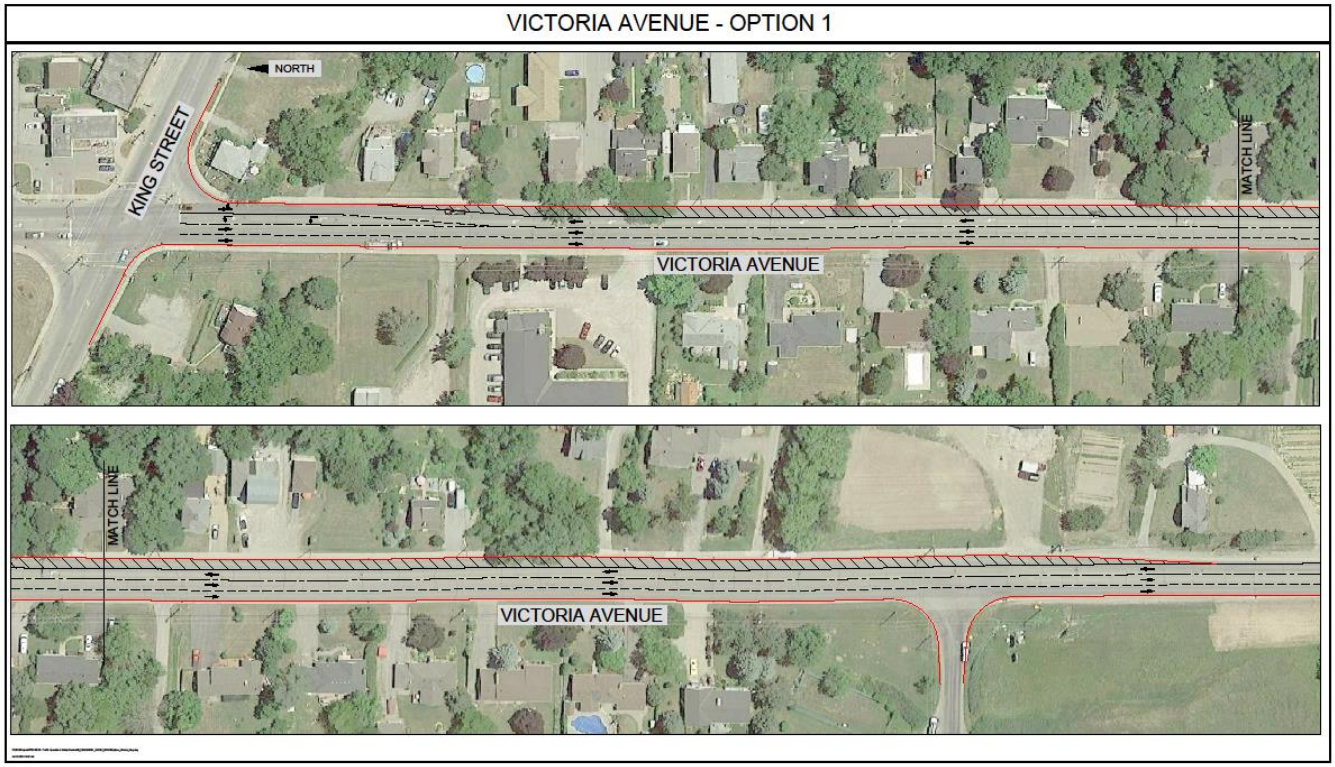
6.3 Long-Term:

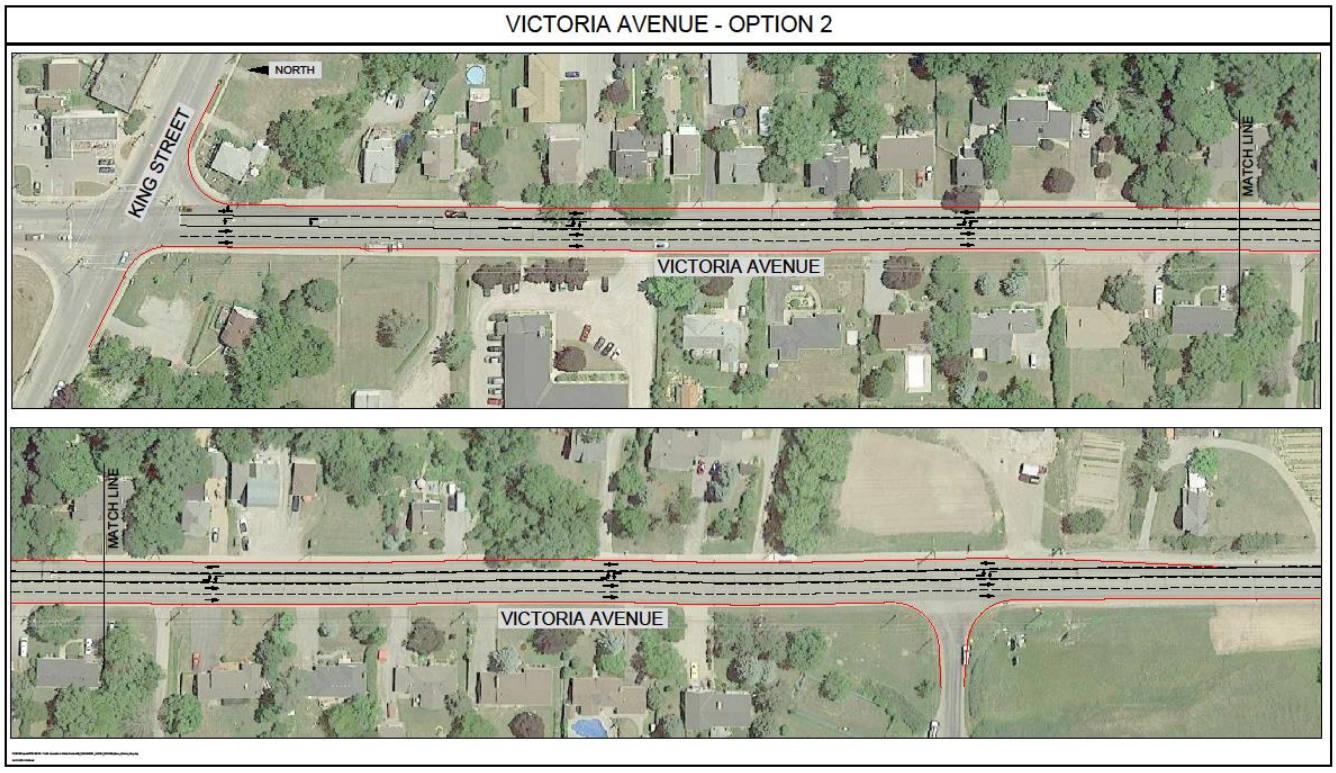
The long-term solution for goods movement is a Trade Corridor between Niagara and Hamilton across the escarpment. This will require tremendous effort to gather a consensus amongst municipalities, Regions and stakeholders to fund, implement and maintain. Where this long-term solution will provide greater connectivity, it is also subject to major capital investment, environmental assessment, property acquisitions, design and build challenges.

Furthermore, strategic property acquisition should be considered where required, especially at south-west quadrant of Mountain Street (RR18) / King Street (RR81) intersection to facilitate safer and wider turning of heavy vehicles.

Appendix A

Appendix A: Victoria Ave. (RR 24) Restriping Options





VICTORIA AVENUE - OPTION 3

VICTORIA AVENUE - OPTION 4

Appendix B

Appendix B: North Lane Design Options

NORTHBOUND TRUCKS - OPTION 1

NORTHBOUND TRUCKS - OPTION 2

SOUTHBOUND TRUCKS - OPTION 1

SOUTHBOUND TRUCKS - OPTION 2