Traffic Operation Improvements at the Pembina-Emerson Port of Entry

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ABSTRACT

Major land-based ports of entry (POE's) are key surface transportation assets that process high annual vehicle volumes and are an integral component of surface transportation networks that support the safe, secure and efficient movement of people and goods between Canada and the United States. Historically, POE facilities were often developed with minimal inter-agency or bi-national co-ordination. Although bi-national mechanisms for improved infrastructure coordination at POE's have recently emerged, the Pembina-Emerson POE was modernized in the late 1990's prior to these new collaborative processes. As a result of these less-than-desirably coordinated improvements, a number of traffic operation and related safety issues emerged almost immediately upon completion of the new POE facilities. In addition to the impact upon port efficiency and throughput, these issues also have broader safety and security consequences.

Although a bi-national project team was undertaking a long-range planning study to address POE requirements to the year 2035, it became evident that there was an opportunity for Manitoba Infrastructure and Transportation to implement a cost effective series of immediate improvements for the southbound (SB) direction of travel that would not preclude any long-range planning initiatives. The proposed suite of immediate SB improvements were intended to address a number of traffic operation and related safety issues that had emerged at the Pembina-Emerson POE, particularly during peak periods, as vehicles approached and manoeuvred through the port.

These improvements reflected improved advance notification, vehicle channelization and lane assignment strategies, as well as access management improvements at the existing duty free facility. These improvements were designed and constructed within a three year period for minimal cost and were expected to improve SB traffic operation and overall border plaza safety for a period of 5-10 years. These immediate SB improvements would be sufficient to address traffic operations at the POE until such time as the long-term improvements recommended in the POE concept plan were implemented. The SB improvements included as assessment of lessons learned regarding the modification of driver behaviour and regarding driver compliance with channelization and lane assignment strategies.

1.0 Introduction

The development or improvement of land-based ports-of-entry (POE's) facilities and road infrastructure has not always occurred in a highly integrated inter-agency planning and decision-making environment. Prior to the September 2001 terrorist attacks on the United States, many land-based POE improvement projects proceeded with very little inter-agency coordination and required other agencies to adapt to plans in which they had minimal involvement or influence. The Pembina-Emerson POE is an example of where both US-Customs and Border Protection (CBP) and the Canada Border Services Agency (CBSA) facilities were completely rebuilt in the late 1990's with very little inter-agency or bi-national consultation and coordination, particularly regarding highway infrastructure and traffic management considerations. Exhibit 1 illustrates the regional context of the Pembina-Emerson POE.

As a result, it is not surprising that a number of traffic operations issues became apparent immediately after these new POE facilities were opened. These traffic operations issues intensified as the post NAFTA (1994) environment lead to significant increases in both passenger vehicle and commercial vehicle traffic throughout the first decade of the new millennium (Exhibit 2). Having largely been excluded or ignored in the initial POE planning and development process, transportation agencies were then placed under significant pressure by the public and stakeholder groups to address traffic related operational issues which continued to intensify with the increased traffic volumes.

2.0 Policy Context

Land-based POE's are key elements of the surface transportation network connecting two countries. Delay and congestion at POE's add supply chain costs (time, financial, environmental) and have potential negative impacts on economic growth. The bi-national Beyond the Border declaration (February 4, 2011) signed by President Obama and Prime Minister Harper provides the over arching policy framework for moving toward "a shared vision for perimeter security and economic competitiveness" in North America. The Beyond the Border declaration recognizes the critical importance of land-based POE's in their dual role of sovereign security and North American supply chain efficiency.

The Pembina-Emerson POE is the fifth (5th) ranked land-based POE between Canada and the United States in terms of two-way truck based trade ($17B in 2011) and has the largest trade values for a POE west of Detroit-Windsor. The Pembina-Emerson POE is ranked eighth (8th) in terms of total bi-directional truck movements. Total two-way truck based trade at the Pembina-Emerson POE is projected to grow to $27.5 billion by 2035.

In 2012, total bi-directional movements exceeded 1 million vehicles with a 60-40 auto / truck split and 50-50 directional split by vehicle category. Total bi-directional traffic at the Pembina-Emerson POE is forecast to double and exceed 2 million vehicles by the year 2035. These projected volumes will retain the same 60-40 auto-truck and 50-50 directional vehicle split characteristics (Exhibit 3).

The trade significance of the Pembina-Emerson POE prompted Manitoba Infrastructure and Transportation (MIT) to initiate a planning study to develop a port improvement concept that would best address future requirements to the year 2035. This planning study was completed in 2012 in partnership with other transportation and border services agencies (North Dakota Department of Transportation-NDDOT, Canada Border Services Agency-CBSA, Customs and Border Protection-CBP and the General Services Administration-GSA) and recommended specific improvements to the southbound (SB) direction of travel by 2020 and northbound (NB) direction by 2025.

In the interim, MIT recognized that there were some immediate improvements that could be implemented to address the most pressing traffic operation issues in the SB direction for roadways under the jurisdiction of the Province of Manitoba. Initial stakeholder consultations conducted in 2009 during the terms of reference development process for the Pembina-Emerson POE planning study led MIT to develop a suite of SB improvements which would address advance notification, undesirable weaving, and intersection conflict issues. These immediate SB improvements were intended as cost-effective interim solutions to provide some relief to traffic operational issues prior to longer-term SB improvements being implemented in 2020.

3.0 Existing Conditions and Issues

3.1 Existing Geometric Conditions- PTH 75 Southbound

Provincial Trunk Highway (PTH) 75 is a 4 lane divided expressway with a posted speed limit of 110 km/h, an annual average daily traffic count of 3000 vehicles per day and is a significant component of the National Highway System (NHS) in Manitoba. PTH 75 transitions from a 110 km/h speed limit to a 50 km/h speed limit as the SB cross-section expands from 2 lanes to 3 lanes within 1 km of the border. Within this transition area there is a major 4 leg intersection serving the weigh scale site and Provincial Road (PR) 243, a major 3 leg intersection providing access to the Town of Emerson (PR 200), two left hand accesses serving the CBSA facility, and two right hand accesses serving the duty free shop. Given this context, the potential of driver confusion and undesirable weaving manoeuvres in close proximity to the POE is high.

3.2 Discussion of Issues

As noted in the introduction, the reconstruction of the POE in the 1990's was undertaken with very little inter-agency consultation. Furthermore, traffic operations upstream from the custom plaza were not considered during the planning, design and construction of these projects by border services agencies (CBSA, CPB, and GSA). As such, significant traffic operational issues for vehicles approaching the POE from both the north and the south emerged immediately after the new CBP (1997) / CBSA (1999) facilities were constructed. Ironically, poor planning and infrastructure coordination also created operational issues for both CBP and CBSA regarding the efficient use of staff and primary inspection lane (PIL) infrastructure.

For MIT, traffic operation problems on PTH 75 SB approaching the POE resulted in repeated requests for action or improvements from the Manitoba Trucking Association (MTA), the duty free shop operator and the public. The SB traffic operational problems revolved around three primary issues:

1. Inadequate advance notification and poor lane assignment strategies
2. Weaving manoeuvres and conflicts between passenger vehicles and commercial trucks
3. Intersection conflicts at the duty free shop

These issues are conceptually illustrated in Exhibit 4.

1. Inadequate advance notification and poor lane assignment strategies

Ideally, traffic approaching the POE should be able to select the appropriate travel lane based both on the desired destination, and the PIL booth servicing protocol. In the case of SB traffic approaching the POE, drivers have five primary destinations; the POE itself, the weigh scale at PR 243, the Town of Emerson at PR 200, the duty free shop located on the right hand side of the highway, and the CBSA facility located on the left hand side of the highway. Furthermore, the geometry of the POE dictates that all commercial traffic must approach the facility from the right lane while passenger vehicles and bus traffic must use the center and/or left lane.

A lack of communication during the POE development process meant that there was no opportunity to develop a comprehensive traffic management strategy to facilitate the orderly and efficient movement of traffic as it approached the POE. The legacy upstream signage (Exhibit 5) did not provide any information to facilitate the segregation of passenger and commercial vehicle traffic and was ineffective in allowing drivers to select the appropriate lane for any of the five above referenced destinations as they approached the border.

As a result, MIT received repeated complaints regarding inadequate lane assignment signage. The majority of these complaints were related to periods of peak commercial vehicle activity. During these periods commercial traffic queues in the right hand lane can extend several kilometres back from the POE, while the center and left hand lanes continue to operate at close to free flow conditions. The lack of appropriate signage often resulted in passenger vehicles joining the end of the commercial vehicle queue in the mistaken assumption that they should also be in that lane.

2. Weaving Manoeuvres

The impact of inadequate advance notification was also evident in reports of sudden weaving manoeuvres in the vicinity of the POE as poorly informed drivers made last second lane selection decisions. Fortunately, these weaving manoeuvres took place within the low speed (50km/h) section of the highway and collision reports were rare.

Undesirable weaving manoeuvres also occurred due to a lack of forethought in the POE design with respect to export check parking requirements. Vehicles may have a requirement to have an export check conducted by the CBSA prior to leaving Canada, however; no formal export check

parking facility was established when the POE was redeveloped. In the absence of dedicated export check parking facilitates drivers have used various ad-hoc parking options, each with its own set of difficulties.

Some drivers used the left hand slip parking lane adjacent to the CBSA facility. This parking spot was, however, frequently occupied by people wishing to visit the Duty Free Shop. When unoccupied this parking location worked well for passenger vehicles as it was adjacent to the appropriate through lane for passenger vehicles. Commercial vehicles would also use this slip lane when available; however, upon exiting these vehicles would be required weave across two lanes to re-enter the truck lane. This manoeuvre was particularly difficult to accomplish when there were truck queues present and would often result in a commercial vehicle blocking the passenger vehicle lanes.

Drivers also parked their vehicles on the right hand commercial lane shoulder, exited their vehicle and crossed 3 lanes of traffic to enter the CBSA facility. In addition to the obvious pedestrian safety concerns, this also resulted in passenger vehicles weaving across the commercial vehicle lane upon departure in order to access the appropriate PIL.

3. Intersection Conflicts at the Duty Free Shop

The largest source of complaints directed to MIT came from the operator and customers of the duty free shop. By virtue of its location, immediately north of the POE on the right hand side of the road, the entrance and exit were frequently blocked by truck queues during periods of high commercial vehicle activity. Efforts were made to address this issue through the use of "Do Not Block Driveway" signs, however; driver compliance was poor. As a result, drivers wishing to enter the Duty Free Shop were faced with a choice of either joining the back of the commercial vehicle queue (which would frequently extend 1-2 km back from the duty free shop entrance) or stopping in the center lane and making an attempt to force their way between stopped commercial vehicles to access the duty free shop entrance. Drivers exiting the duty free shop were forced to exit between closely spaced trucks in the commercial vehicle lane. In addition to the negative impact on duty free operator's business, this was also a serious safety concern due to the lack of adequate sight distance for both the exiting driver and for the through traffic in the center lane.

4.0 Alternative Development and Recommended Solution

4.1 Alternative Development

Through a functional design process, MIT was able to identify a suite of measures that could be implemented at a relatively low cost without negatively impacting any future long-term improvements. In the development of alternatives stage of the functional design process, three alternative short-term plans ranging from minor enhancements to the construction of an entirely separate commercial truck lane located to the west of the existing highway were prepared. It was felt that the alternatives developed encompassed a range of viable solutions under the short term-

scenario that would address some of the operational issues that could be resolved by infrastructure improvements. Exhibit 6 illustrates the three alternatives described below.

Alternative 1 – Enhanced Status Quo

This alternative was considered to be the minimum enhancement capable of addressing the two key issues impacting traffic operations at the POE. This alternative consisted of two key components:

1. Improved lane assignment signing on the approach to the POE.
2. Vehicle queue detection technology at the duty free accesses linked to enhanced signage flashing beacons) to warn truck drivers not to block the driveways.

Alternative 2 – Narrow Median and Traffic Signals

This alternative was an enhanced interim solution which would address the need for improved lane assignment well in advance of the POE, the elimination of access (entrance and exit) blockages at the duty free shop, enhanced visibility at the duty free shop, and flexible lane assignment immediately north of the border compatible with future smart border initiatives. The key components of this alternative were:

1. Improved static lane assignment signing well in advance of the POE.
2. Flexible lane assignment signing immediately north of the POE in the form of an overhead variable message sign.
3. The construction of a median to separate commercial truck and passenger vehicle traffic in the vicinity of the duty free shop and the installation of traffic signals to safely accommodate the crossing of passenger vehicle and commercial truck traffic at the duty free shop access.
4. The use of vehicle queue detection technology at the duty free shop access linked to the traffic signals to eliminate the blockage of the access by commercial truck queues.

Alternative 3 – Wide Median

This alternative was considered a "high-end" solution and was similar to one of the long-term alternatives that were developed in the planning study. This alternative relied on improved signage and significant geometric enhancements to improve operations in the SB direction of travel. The key components of this alternative included:

1. Improved static lane assignment signing well in advance of the POE.
2. Flexible lane assignment signing immediately north of the POE in the form of an overhead variable message sign.
3. The construction of an entirely separate truck lane approximately 30m to the west of the existing highway to resolve the operational issues related to the interaction of passenger vehicles and commercial trucks in the vicinity of the duty free shop and the CBP facility.

4. The reconfiguration of the duty free shop parking lot to a single access point and the provision of separate commercial truck and passenger vehicle parking at the duty free shop.
5. The installation of vehicle queue detection technology at the duty free shop access linked to enhanced signage (flashing beacons) to warn commercial truck drivers not to block the access.

Although Alternative 3 was the most effective in addressing the key operational issues at the POE, it was determined that it was not feasible in the short term due to the limited room available to manoeuvre large commercial vehicles in the vicinity of the existing duty free shop. As a result this alternative was eliminated as a candidate for the short-term enhancement of the Pembina-Emerson POE.

4.2 Evaluation and Recommended Alternative

Following the development of the three alternatives and an initial screening by key departmental staff, an evaluation of all alternatives was carried out based on both design criteria and implementation criteria. The results of this evaluation showed that Alternative 2 was the preferred alternative, Alternative 3 was ranked second and Alternative 1 ranked third. As noted earlier, Alternative 3 was determined to be non-viable in the short-term and only Alternative 2 and Alternative 1 were carried forward for cost estimates. Alternative 2 was selected as the preferred alternative and is illustrated in Exhibit 7.

5.0 IMPLEMENTATION

The SB improvement strategy was phased in over three (3) years. In 2010, the GSA constructed pavements on the US side (CBP SB plaza approach) that would tie in with future MIT work. In 2011 fixed panel ground mount and overhead signs as well as an overhead Variable Message Sign (VMS) were installed to improve advance notification. In 2012 the pavements, intersection improvements, and a detection system were completed.

5.1 Improved Signage (2011)

The signage improvements were aimed at segregating commercial and private vehicles into their appropriate lanes well in advance of the POE. This initiative involved the installation of series of ground mounted and overhead mounted signs ($50K) beginning 3 km in advance of the POE as well as the overhead VMS ($525K) under a 50-50 cost sharing arrangement with the federal government (under the Border Information Flow Architecture pilot project). These signage improvements are illustrated in Exhibit 8.

A unique feature of the VMS was that, in addition to providing advance notification of lane assignment by vehicle type (truck / auto), there was also the capability to assign private vehicles to either the left or center lanes to accommodate future smart border initiatives such as RFID and NEXUS document holders. By providing the flexibility to incorporate smart boarder initiatives in the longer term, the VMS has the added benefit of allowing MIT to provide real time

messages on any related border or downstream highway conditions (i.e. delay information, road closures due to weather or flood related conditions) through the MIT Operations Center. Communication protocols have been established between MIT, CBSA, CBP, and NDDOT to allow the partner agencies to request message changes to reflect conditions as required.

5.2 Geometric Improvements (2012)

Detailed design of the proposed SB geometric improvements started in March 2011 and was completed in September 2011. The project was tendered and awarded in October 2011 with construction work beginning in July 2012 and completed in October 2012. The total contract value of the construction works for the geometric improvements (including the queue detection system described in 5.3 below) was approximately $1.2 million. At the south limit of project (the Canada/US border) the raised median and the truck lane tied seamlessly into the construction works that GSA (on behalf of CBP) had completed during the autumn of 2010.

The geometric improvements included a commercial lane and channelization in the form of a narrow raised median to separate commercial truck and passenger vehicle traffic in the vicinity of the duty free shop, in order to further aid vehicle segregation downstream of the signage improvements. The design of the narrow raised median also included a channelized right-turn lane to accommodate drivers in passenger vehicles wanting to access the duty free facility.

To address the absence of a formal export check facility for commercial operators, a truck export check parking lane was constructed on the west side of the truck lane between the duty free entrance and exit.

At the exit from the duty free shop, a median opening was provided for passenger vehicles exiting from the duty free to continue south to the CPB facility. The median opening also allows drivers to return back through the CBSA PIL booths. A right-turn cut-off and separator island was constructed to channelize commercial trucks exiting from the duty free shop to continue south into the U.S. using the dedicated truck lane.

5.3 Queue Detection (2012)

In addition to the geometric roadway improvements, a set of traffic signals was also installed at the entrance intersection to the duty free shop (Exhibit 9). The signal installation was designed to serve three functions:

1. Operate as a queue detection system designed to keep the duty free shop entrance clear of stopped truck traffic. This system uses video detection technology to determine when downstream commercial vehicles queues are beginning to encroach on the duty free shop driveways. The detector is programmed activate the traffic signals to hold approaching commercial vehicles short of the duty free access until there is sufficient room to allow for them to move forward without blocking the entrance.
2. Allow passenger vehicles to safely enter the duty free shop from the center lane. Detection loops in the center lane right turn slot are activated by vehicles waiting to turn

right. Upon activation these vehicles are given a protected right turn arrow indication, while conflicting commercial traffic in the right lane is held by a red light.

3. The traffic signals are also equipped with pedestrian signals allowing a person crossing from the commercial export check parking spot to the CBSA facility to do so safely while all southbound traffic is held by a red light.

6.0 Post Implementation Results and Lessons Learned

The immediate program of SB improvements were intended as an interim measure to address the most pressing traffic operations and safety related issues that MIT had been monitoring for approximately 10 years until such time as longer-term solutions developed under the Pembina-Emerson POE study could be implemented. The following subsections provide an overview of some of the results and lessons learned from the planning and immediate post-implementation period for this project.

6.1 Traffic Operations and Safety Assessment – Post Implementation Field Observations

Following the completion of the SB improvements, a series of three separate field observations were conducted over a 6 month period to obtain an understanding of how drivers were responding to the changes and to assess how well the previous operational and safety issues had been mitigated. These observation sessions were each 1 hour long and were timed to coincide with the commercial vehicle peak as this period was associated with the reported operational problems. The observations were timed as follows and the results are summarized below:

- Immediately following completion of interim improvements October 2012
- 4 months following completion of interim improvements February 2013
- 6 months following completion of interim improvements April 2013

Improved Advance Notification

The addition of the advance lane assignment signage (both ground mounted and overhead) along with the installation of the overhead VMS sign appears to have been a complete success in achieving the goal of segregating commercial vehicles into the right lane and passenger vehicles into the left and center lanes. In all three field observation sessions, 100% of traffic destined for the USA border was observed to be using the appropriate lane. There was no occasion on which a passenger vehicle destined for the POE was observed to enter into the back of the commercial vehicle queue as had been reported in the past.

Weaving Manoeuvres

The occurrence of unnecessary weaving manoeuvres on the approach to the POE has been dramatically reduced due to a combination of factors:

1. The improved advance notification signage has eliminated driver confusion relating to appropriate lane assignment.

2. The establishment of formalized and signed export check parking spots for both commercial and passenger vehicles. In particular, commercial vehicles now exclusively use the new parking slip lane constructed adjacent to right lane thereby eliminating the problems associated with commercial vehicle stopping in the left hand slip lane and then attempting to weave across two lanes to re-enter the commercial vehicle queue.
3. The construction of a raised median in the immediate vicinity of the duty free shop provides a physical barrier to minimize any weaving between private vehicles and commercial vehicles on the final approach to the CBP plaza.

Duty Free Access

An evaluation of the operation of the duty free access /egress post implementation produced the following results:

1. The operation of the traffic signals in queue detection mode was excellent. During the 3 separate observation periods the duty free entrance and exit were only blocked on three occasions. In all instances the blockage was caused by a commercial vehicle pulling into the intersection on amber light.
2. It was observed that drivers of passenger vehicle were initially having difficulty understanding that they could use the center lane to bypass the commercial vehicle queue to access the duty free shop. During the initial observation session immediately after opening in October 2013, only 10% of passenger vehicles wishing to access the duty free shop were doing so at the traffic signals from the center lane right turn slot while 90% were using the commercial vehicle lane to gain access the duty free shop. This was likely occurring for three reasons; first the use of the center lane to turn right is a significant violation of driver expectation; second, initial duty free access signage placements were unintentionally directing motorists to the commercial lane; and third, the majority of passenger vehicle drivers crossing the border are repeat visitors who had been habituated to entering the duty free shop from the right lane.

Based on the initial field observations, a number of measures were taken to address the need to better inform the driver of how the new duty free shop entrance was intended to operate. These included:

1. Changes to the VMS overhead messaging to indicate that the center lane should be used for duty free shop access, and to indicate the right lane was for “trucks only”.
2. Additional and modified static signage to better indicate lane assignment and duty free shop access in advance and in the immediate vicinity of the raised dividing island.
3. The duty free shop operator was asked to communicate the proper use of the entrance to his customers

The impact of these measures were reflected in a progressive improvement in driver comprehension during the second and third set of observations taken 4 months and 6 later. Those observations showed that compliance improved to 50% and 70% respectively for passenger vehicles using the appropriate center lane when the right lane was occupied by commercial vehicle queue. It was noted that there was a definite driver preference to use the

right lane when commercial vehicles were not present, however; as this was not an operational or safety concern, no measures have been taken to try to change driver behaviour in this regard. A summary of field observations is presented in Exhibit 10. The results in terms of driver behaviour have generally been positive in terms of addressing the traffic operations and safety issues identified at the start of the project:

1. The confusion over lane assignment on the approach to the POE has been completely rectified with 100% of commercial traffic approaching the POE in the right lane and 100% of private vehicle traffic approaching the POE in the left and center lanes.
2. Weaving between commercial and private vehicle lanes on approach to the POE has been virtually eliminated.
3. The duty free shop access operation has been significantly improved. The traffic signals and queue detection system are effective in keeping the driveways clear of commercial vehicles. The installation of a median between the commercial lane and the passenger vehicle lanes provides a refuge for vehicles exiting the duty free shop and ensures that they have adequate sight distance to safely re-enter PTH 75 traffic. Traffic entering the duty free shop can now bypass long commercial vehicle queues and enter from the center lane safely at a traffic signal controlled intersection.

6.2 Demonstrating the Value of an Integrated Planning Process

The SB improvements were also seen as a means to develop credibility with other key transportation (NDDOT, Transport Canada), border service (CBP, CBSA) and public works (GSA) agencies regarding the value of engaging in a coordinated bi-national, multi-agency planning process. The SB improvement planning process served as a pilot project to demonstrate that effective solutions for addressing the operational concerns of various agencies could be developed and implemented in a fairly compressed time frame. Successful implementation of the SB improvements helped to develop credibility for undertaking a planning process of any type and was an important factor in securing a much higher level of bi-national agency commitment to the long-term Pembina-Emerson POE planning study.

6.3 Project Leveraging

The SB improvements initiated and completed by MIT provided an opportunity to develop better project coordination practices among bi-national agencies (MIT / GSA on pavements) as well as acting as a catalyst for a program of similar improvements in the northbound (NB) direction that were subsequently undertaken by NDDOT. MIT began their process of investigating options for SB improvements in 2009 and completed them in 2012 at a total cost of $1.7M. NDDOT began looking at NB improvements in 2010 and are scheduled to complete a suite of projects in 2013 at a cost of $1.3M. A further $300K in pavement tie-in work on the approach to the CBSA plaza will be done by MIT in 2013 to coordinate with the NB improvements being constructed by NDDOT.

6.4 Stakeholder Feedback

The SB improvements were well received by two key stakeholder groups, namely the Manitoba Trucking Association (MTA) and the duty free shop operator.

The MTA has recognized that while the SB improvements are interim measures, they have nonetheless been effective in improving channelization of vehicle types and reducing both intersection conflicts between trucks and autos as well undesirable and unsafe weaving manoeuvres.

The duty free shop operator is extremely pleased with the effort made by MIT to address long-standing access / egress issues and is very supportive of the results regarding improved access / reduced intersection blockages.

In completing the SB improvements, MIT has developed a much higher level of credibility with both the MTA and the duty free shop operator regarding POE operations. Both stakeholders are now highly committed to the longer-term planning process and the recommended concept plan that emerged from this initiative.

EXHIBIT 1: Pembina – Emerson POE

Traffic Type	2005	2006	2007	2008	2009	2010	2011
Southbound							
Autos	235,011	276,415	308,031	324,458	265,210	326,445	317,750
Trucks	198,843	200,541	228,455	224,512	189,393	202,438	208,509
Buses	1,744	1,624	1,593	1,481	1,280	1,357	1,095
Total SB Traffic	***435,598***	***478,580***	***538,079***	***550,451***	***455,883***	***530,240***	***527,354***
Northbound							
Autos	228,091	236,993	276,027	280,429	259,747	318,769	324,578
Trucks	199,642	187,007	197,516	205,525	162,738	167,771	177,216
Buses	1,537	1,480	1,439	1,306	1,082	1,146	1,155
Total NB Traffic	***429,270***	***425,480***	***474,982***	***487,260***	***423,567***	***487,686***	***502,949***
Bi-Directional							
Autos	463,102	513,408	584,058	604,887	524,957	645,214	642,328
Trucks	398,485	387,548	425,971	430,037	352,131	370,209	385,725
Buses	3,281	3,104	3,032	2,787	2,362	2,503	2,250
Total Traffic	***864,868***	***904,060***	***1,013,061***	***1,037,711***	***879,450***	***1,017,926***	***1,030,303***

EXHIBIT 2: Bi-Directional Annual Traffic (2005-2011)

Traffic Type	2012 Total Volume	2015 Total Volume	2020 Total Volume	2025 Total Volume	2030 Total Volume	2035 Total Volume
Southbound						
Autos	356,684	390,907	470,513	546,619	646,746	774,602
Trucks	218,213	232,271	255,983	278,725	301,167	324,068
Total Traffic	574,897	623,178	726,496	825,344	947,913	1,098,670
Growth from Preceding Column in Table:		8.4%	16.6%	13.6%	14.9%	15.9%
Northbound						
Autos	335,564	368,291	449,904	520,985	622,201	733,445
Trucks	179,348	193,088	216,990	242,513	272,297	305,167
Total Traffic	514,912	561,379	666,894	763,498	894,498	1,038,612
Growth from Preceding Column in Table:		9.0%	18.8%	14.5%	17.2%	16.1%
Bi-Directional						
Autos	692,248	759,198	920,417	1,067,604	1,268,947	1,508,047
Trucks	397,561	425,359	472,973	521,238	573,464	629,235
Total Traffic	1,089,809	1,184,557	1,393,390	1,588,842	1,842,411	2,137,282
Growth from Preceding Column in Table:		8.7%	17.6%	14.0%	16.0%	16.0%

EXHIBIT 3: Bi-Directional Traffic Forecast (2012-2035)

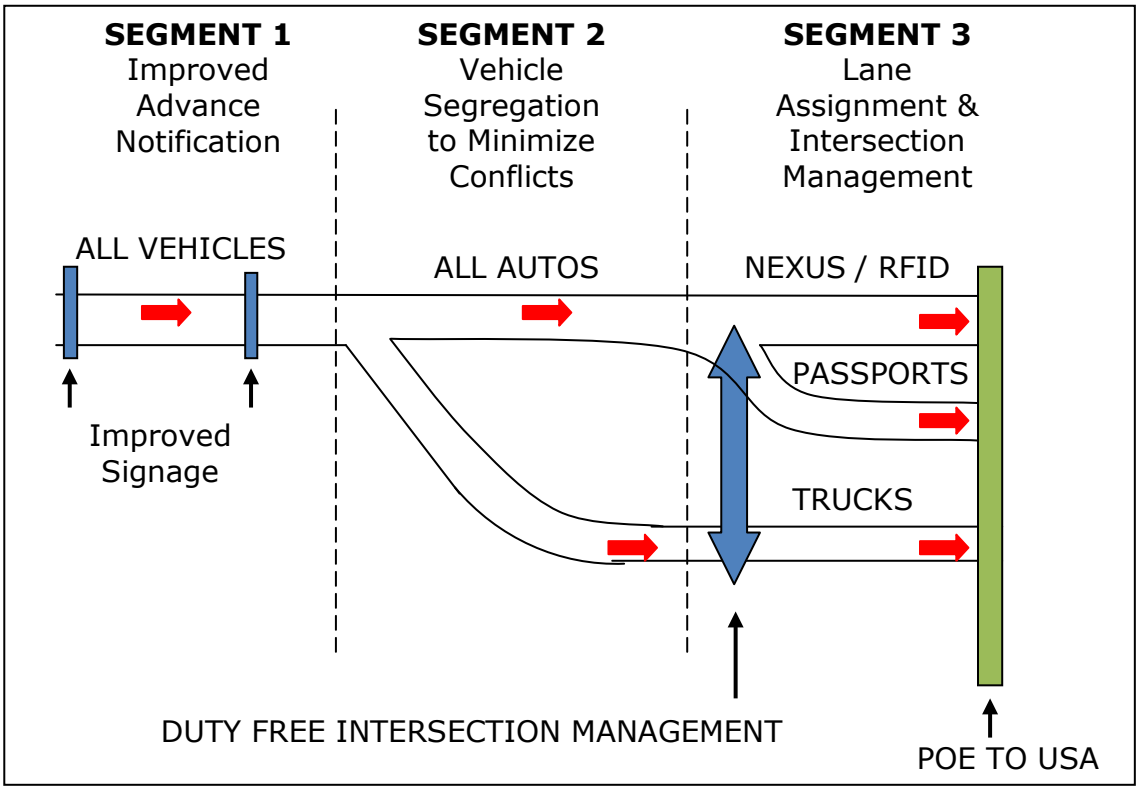

EXHIBIT 4: Conceptual Illustration of POE Traffic Operations Issues

EXHIBIT 5: Legacy Signage – 1 km North of POE

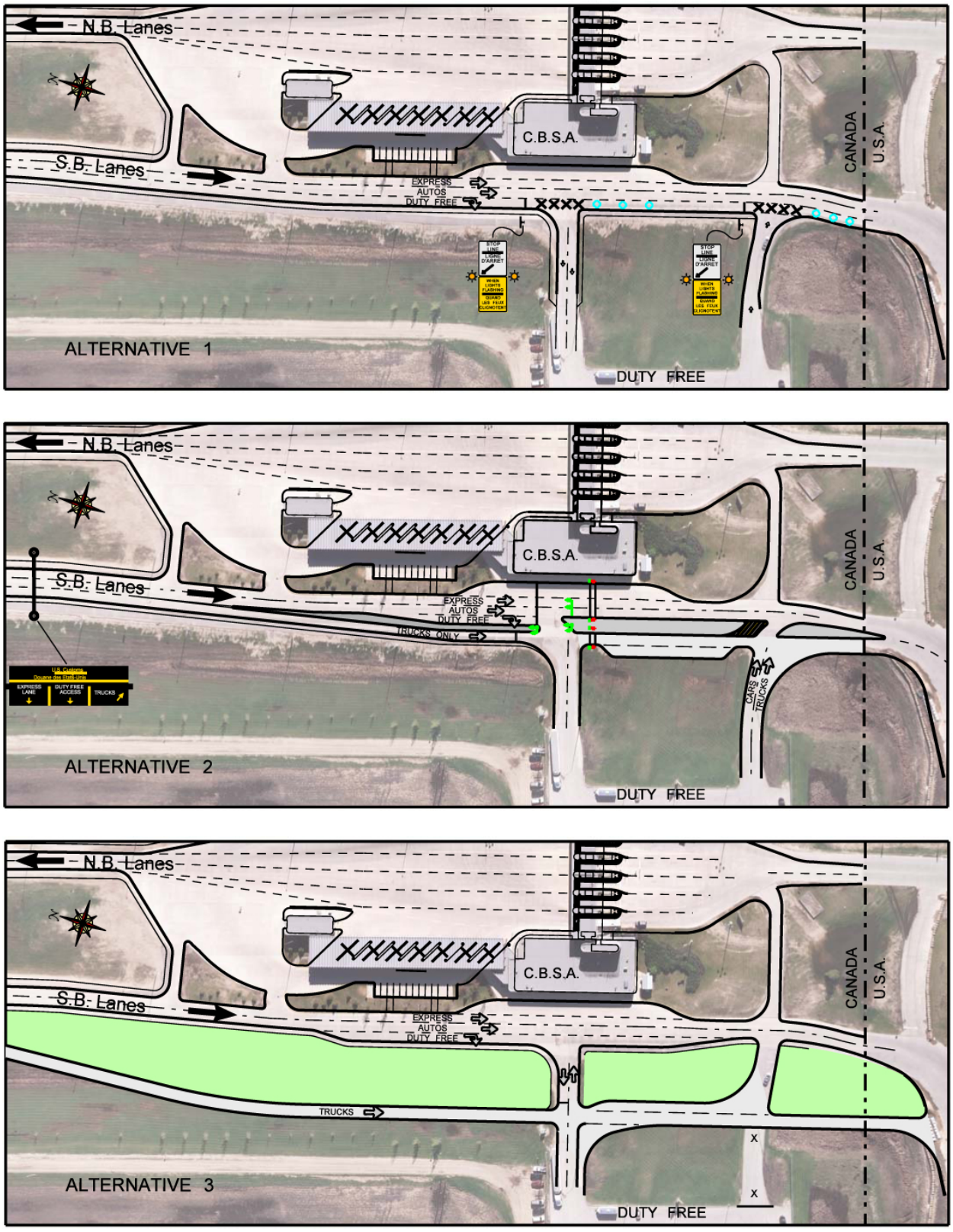

EXHIBIT 6: Functional Design Alternatives

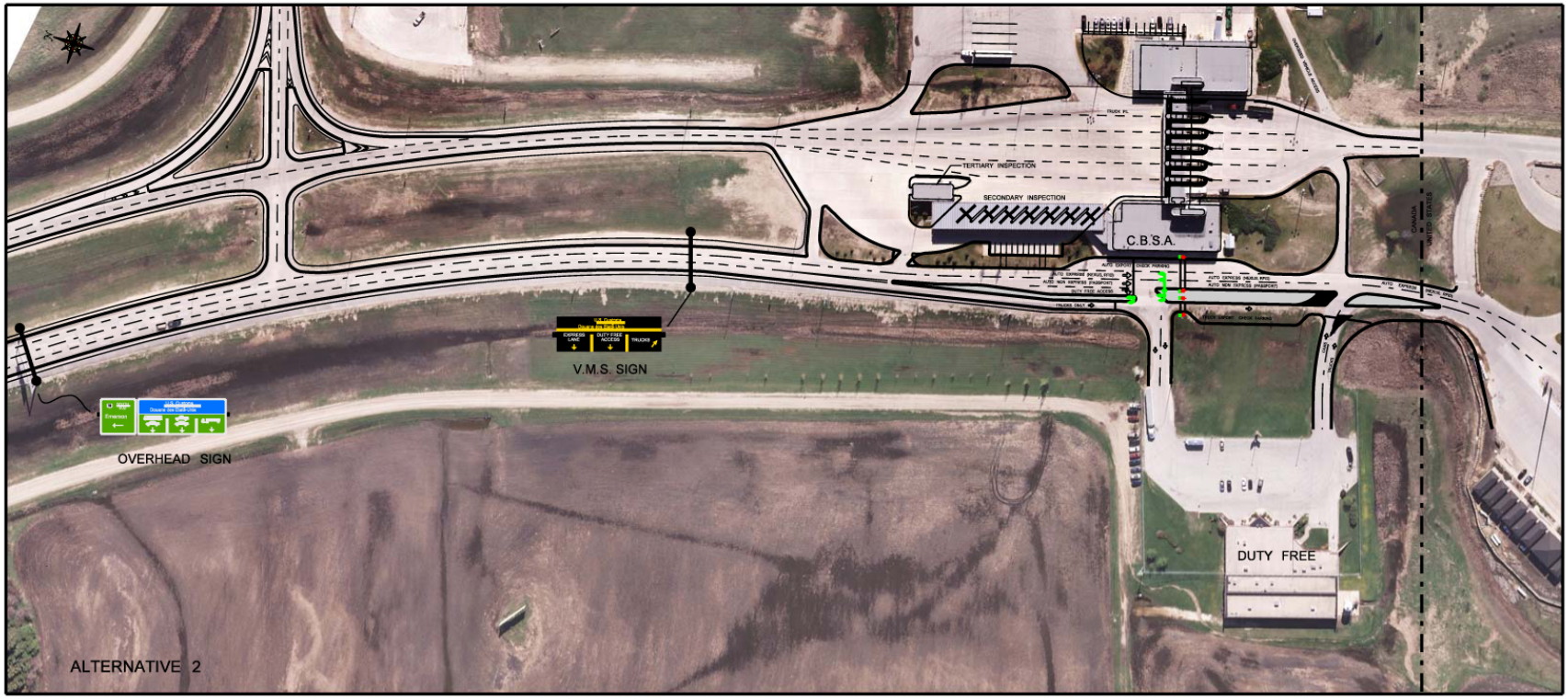

EXHIBIT 7: Preferred Functional Design Alternative – Narrow Median

VARIABLE MESSAGE SIGN
500 m NORTH OF
PORT-OF-ENTRY

OVERHEAD SIGN STRUCTURE
1 km NORTH OF
PORT-OF-ENTRY

GROUND-MOUNT
1.5 km NORTH OF
PORT-OF-ENTRY

GROUND-MOUNT
3 km NORTH OF
PORT-OF-ENTRY

EXHIBIT 8: Improved Signage

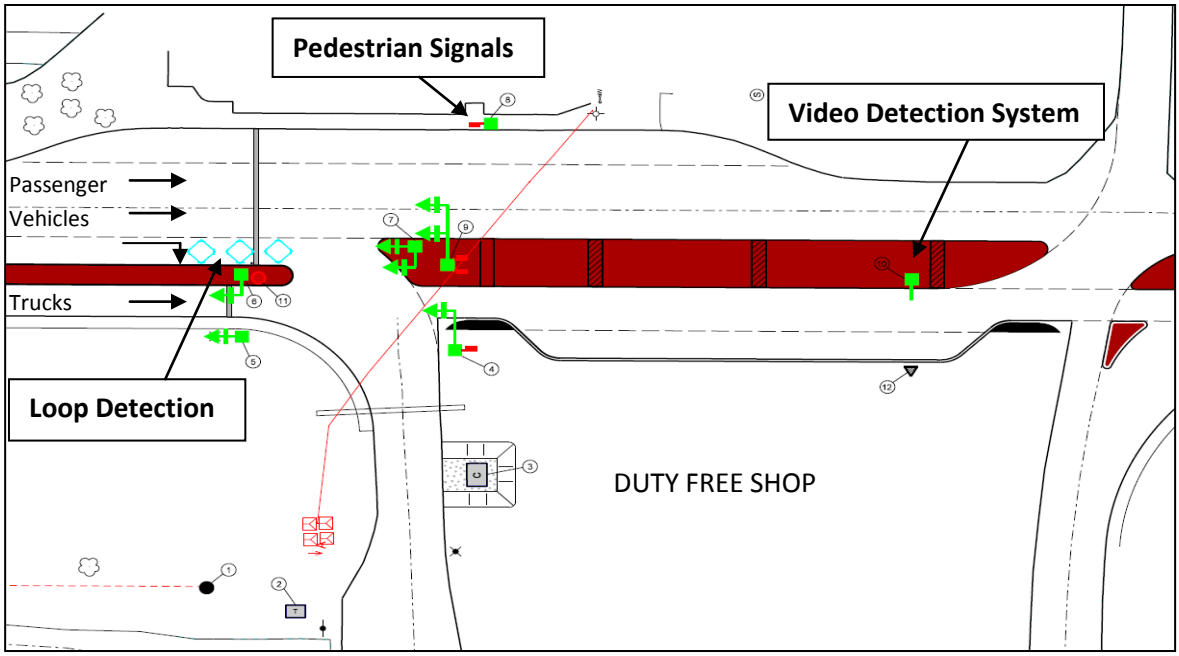

EXHIBIT 9: QUEUE DETECTION SYSTEM

	Driver Behaviour Index		
Traffic Operation Issue	October 2012 Poor | Fair | Good	February 2013 Poor | Fair | Good	April 2013 Poor | Fair | Good
Advance Notification Lane Assignment	**Good**	**Good**	**Good**
Weaving Control	**Good**	**Good**	**Good**
Duty Free Operation	**Poor**	**Fair**	**Good**

EXHIBIT 10: SUMMARY OF POST IMPLEMENTATION FIELD OBSERVATIONS