Integrated Transportation Corridor: Phase 1 Feasibility Study

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Province of Nova Scotia

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1 Introduction

1.1 Context

It is the desire of the Government of Nova Scotia to play a strategic role in the Province's development as a major international gateway. As part of this intent, this study was commissioned to examine the feasibility of introducing a roadway into the CN rail corridor on the Peninsula of Halifax to provide a highly efficient, free-flow route for trucks serving Halterm and nearby port services: effectively consolidating truck and rail freight movement related to these facilities into one corridor.

In addition to moving this component of truck traffic away from the public road network on the Peninsula, this Integrated Transportation Corridor (ITC) was conceived to allow the possibility of use of the facility by others including public transit and emergency services, all the while maintaining the rail connection.

The proposed ITC would become part of an already vital part of the regional economy. According to the Halifax Port Authority, direct and indirect employment related to the Port of Halifax in 2009 will be 9,000 jobs that generate an annual employment income in the order of 670 million dollars.

1.2 Project scope and approach

This is a technical and strategic analysis looking specifically at the rail corridor, and trucking demand was based on projections to the year 2026. This analysis horizon was chosen to be consistent with the ultimate planning year used in the recently released Halifax Regional Municipality (HRM) Regional Plan.

McCormick Rankin Corporation was engaged to undertake this study on behalf of the Province of Nova Scotia and our approach was based on the understanding that the study conclusions would have to rely on both quantitative and qualitative inputs. As a result, we took a highly technical approach to the analysis of economic impacts, design considerations, travel demand modelling, noise impacts, costing, traffic handling, and so forth.

At the same time, knowing the potential impacts that the corridor may have on port utilization and competitiveness, the potential support it offers to a number of HRM planning and transportation initiatives, the complex inter-relationships that exist between various container shipping, intermodal transfer, and transload activities that take place in the Port, and the related economic impacts of such considerations we have taken a consultative approach to our work by speaking with key stakeholders and potential users of the rail corridor. Recognizing the potential impacts on neighbourhoods and communities adjacent and in close proximity to the rail corridor, we have also considered input gathered by the Province from a consultative website struck for that purpose.

1.3 Building on past work

This study builds on a series of studies completed in recent years that discuss the potential of the CN corridor to provide an integrated, multi-modal facility for rail freight movement and trucking options, as well as other uses including public transit in various forms. We have not recreated this work. Rather, our methodology focused on exploiting portions of the findings of this past body of work that were relevant to the current review, assessing them with respect to their continued value and applicability, and using or adapting them for the purposes of our work. Of course in some cases, new research and analysis was required to supplement or replace findings that were no longer applicable.

This value-added approach was the key to meeting the very tight timeline set for this study. In addition, in some cases it provided multiple independent lines of evidence that helped the team address questions of data reliability and risk management in preparing the various analyses and recommendations.

1.4 The need for sensitivity analysis

Uncertainty is present in all planning and analysis efforts. In some cases it may arise from the quality of data available. In others, historical data may simply not be applicable to the analysis of future needs. Instances may even arise where reliable quantitative data is simply not available and expert opinion must provide the basis for a particular input value. Sensitivity analysis – the use of a range of values for various inputs instead of a single value – is invaluable in helping both specialist experts and decision makers to better understand the implications of various assumptions that underlie specific recommendations. Throughout our various analytical reviews we have used sensitivity analysis to help provide this type of guidance.

1.5 Report organization

This report is presented in eight sections. Section 1, of which this is part, offers the background to the study. Section 2 provides our forecast of marine cargo activity and truck traffic demand for the corridor out to our planning horizon of 2026. Section 3 discusses the peninsular roadway network that would be affected by the corridor changes, projected growth in traffic volumes, and what this means for trucks.

Section 4 provides a description and assessment of the potential use of the corridor and concludes with a preferred alternative. This section begins with consideration of the constraints imposed on the corridor – technical constraints such as structures; and operational constraints such as rail activity and connection points to the local transportation system. We then review various options considered by this study, outlining the process that was used to reduce a long list of options to a manageable few, and then the detailed analysis that was used to select the preferred option.

Section 5 discusses integration with the proposed Halifax Urban Greenway. Section 6 discusses the potential opportunities that exist in using the corridor to accommodate a bus-rapid-transit service. Section 7 provides a discussion of the benefit-cost analysis of the preferred alternative and the penultimate Section 8 examines the feasibility of that same alternative. Section 9 completes the report with our concluding thoughts.

2 Marine Cargo Forecast

2.1 Background

The primary intent of the ITC is to function as a consolidated multimodal corridor to handle container truck traffic that is generated by terminals in the south end of the Halifax peninsula. The volume of trucks generated by this south end terminal activity will depend on how much container traffic moves through this location over our planning period. This chapter provides a discussion of the marine cargo forecasts for the planning horizon year. It concludes with a discussion of the implications of those forecasts for truck demand on the corridor in 2026.

2.2 Challenges in forecasting container traffic

At the best of times, forecasting maritime general freight and container traffic is an uncertain matter. The United Nations report on Regional Shipping and Port Development Strategies notes:

> *The economic relationship between GDP and trade volume is considered useful in forecasting the development of the container sector, although the relationship is not considered a sufficient explanation of the growth. There are a wide range of factors that impact on the volume of container imports and exports, including exchange rate fluctuations, changes in economic structure etc. However, for forecasting purposes it is necessary to use very simplified relationships, because many of the causal variables are themselves even harder to predict than container volumes. Container imports and exports are, for instance, undoubtedly greatly affected by exchange rate movements. However, the uncertainties involved in estimating exchange rates are immense. The forecasting relationships used in this study in fact are simple, linear relationships between container volumes and GDP. In most cases, the regression analysis provided a surprisingly good fit for these simple relationships. Further testing indicated that this was not simply because both variables tended to rise over time.*[1]

Past studies in Halifax have appropriately employed sensitivity analysis to help overcome this difficult challenge. However, as global economic conditions continue to shift dramatically, these fundamental changes will most certainly affect the reliability of container traffic forecasts developed in the past. While we have used past work as a guide, we also carried out a research review of the likely effects of these changed global economic conditions on previous container traffic forecasts. This review provides a foundation for container traffic forecasts contained herein, and permits a commentary on critical risk issues that must be considered in their development and deployment as part of our analysis process.

[1] United Nations. “Regional Shipping and Port Development Strategies: Container Traffic Forecast”. Monograph Series on Managing Globalization. United Nations Economic and Social Commission for Asian and the Pacific. New York. 2005

2.3 Methodology

2.3.1 Research base

Five recent studies provide forecasts of marine cargo that touch upon activity in the Port of Halifax:

1. MariNova (2006), *Halifax Inland Terminal and Trucking Option Study*, for HRM/HPA, January, 2006
2. Transport Canada, *The Evolution of Canada's International Marine Trade (1990-2015)* by Transport Canada for National Marine Industries Council (NMIC), May 2006
3. Transcom (2006), *Gateway Strategy Development Initiative* for Nova Scotia Government
4. InterVista (2007), Atlantic Gateway Business Case, for Atlantic Canada Opportunities Agency
5. MariNova (2008), *Atlantic Gateway Distripark Plan Final Report*, for HRM and Partners

While these reports were not all centered on forecasts, they did provide some relevant data that were used to advantage in the present assignment. Because of the interests of the contractors who prepared them, the forecast data in the various reports are presented in different formats (e.g., tonnage vs. TEUs[2]). The geographic scope of the reports also varied, ranging from pan-Canadian international trade and ports, to regional studies, to a focus on the Atlantic coast as a whole, to more detailed studies of projects specific to the Port of Halifax.

A truck hauling a twenty-foot container out of Halterm. This is the basic container unit, though a majority containers in use today are twice as long, or two twenty foot equivalents.

The differing scope of the studies also generated different scenarios for the growth of trade. All of the studies' scenarios did posit growth, except one scenario in one study of the Port of Halifax that implied stagnation into the future.

2.3.2 Alternative projection methodologies

Trade projections are commonly developed around one of two assumptions: that trade will grow more or less along the average of the growth in port activity over a specified period in the recent past; or that trade will grow as the national GDP grows, assuming that the GDP figures contain both export and import demand components.

Both are logical ways of projecting trade behaviour and they have advantages and disadvantages. The 'trade growth' approach does lend itself to non-linear events, such as the movement of manufacturing from North America to China, which can change the amount of marine trade dramatically, irrespective of GDP growth. Conversely, infrastructure changes, such as the widening of the Panama Canal, and pricing changes, such as a common tariff for Atlantic ports, can work against the Port of Halifax regardless of world or North American GDP growth.

The 'GDP growth' approach tends to align itself with the more sophisticated tools used to project domestic economic conditions and may therefore be seen to be less prone to projections of boom and stagnation. As well, the GDP method may

[2] TEU = twenty foot equivalent units, the standard industry term for measuring container volumes.

be more useful for large, national studies, while the trade growth approach works best in geographically more restricted studies.

2.4 Application and rationale for this study

Both approaches can be seen in the studies noted in Section 2.3.1 of this report and described below, which means that simple comparisons of the studies' data could be misleading. The Transport Canada study uses the GDP growth method, while the MariNova (2008) study develops regression lines based on past activity in the Port of Halifax. Translations of data and scenarios can be done between the two approaches, as in the Transport Canada study, where national growth patterns in marine trade are applied to eastern and western ports based on their present (2003) shares.

In the case of forecasting traffic for this study, we have opted to work on a standard basis of 3 scenarios, high, medium, and low. Some of the 5 studies referenced use 4 scenarios. Our approach is a hybrid one that uses both approaches. The low scenario is related to the 'trade activity' approach employed in the MariNova (2008) study, which shows a regression line through the years preceding 2007 that is virtually flat. Our low scenario is therefore 0% compound annual growth rate (CAGR) in trade through the Port of Halifax. The medium scenario incorporates the effects, first, of an economic slowdown through 2010, followed, second, by growth constraints in GDP due to an increasingly tight labour market from 2011-12 and thereafter. This medium scenario is based on a 1.5% CAGR in GDP annually. Finally, our high scenario anticipates a resurgence of growth in Asia, partially due to a recovery in North American demand that stimulates Canadian exports and imports. The high scenario is built on an average 2.5% CAGR in GDP.

Trade activity based on these growth rates are seen as being commensurate with the growth rates in the overall economy. The rates used in this analysis are on the low side of the projections made (where done) in the 5 studies noted above. The studies' forecasts range from a worst-of-worst at 2.3% annual growth to an 8.5% best-of-best growth. In major part, the difference in projections ranges between our estimate and the referenced studies is due to the challenges facing the Canadian and US economies over the next seven years from the end of 2008 to the end of 2015 and then increasing demographic pressure on demand and production for export out to 2026. Neither the economic nor the demographic changes facing North America were readily apparent when the earlier projections were made.

2.5 Findings

We provide three marine cargo forecasts for the Port of Halifax - Best Case, Benchmark, and Low Case.

These forecasts were prepared based on a review of previous reports and regression analysis relating latest port marine cargo statistics to Canadian GDP, exports plus imports. The critical assumptions are as follows:

1. Best Case – The Canadian economy grows .09% in 2009, 1.28% in 2010, and 2.5% thereafter. Port activity responds to this growth.

2. Benchmark Case – Canadian economy grows .09% in 2009, and 1.28% in 2010 and thereafter.

3. Low Case – Port growth equals 0%, based on traffic regression 1997-2007. This forecast case is based on port activity rather than GDP growth.

The results are as shown in the following table.

Table 1 Marine Cargo Forecasts

Marine Cargo	2007	2026	%
Benchmark Case			
Containers 000's TEU's	550	729	32.6%
Break Bulk 000's Tonnes	153	181	18.6%
Bulk 000's Tonnes	7,613	7,084	-7.0%
Best Case			
Containers 000's TEU's	550	883	60.6%
Break Bulk 000's Tonnes	153	206	34.7%
Bulk 000's Tonnes	7,613	7,613	0.0%
Low Case			
Containers 000's TEU's	550	550	0%
Break Bulk 000's Tonnes	153	153	0%
Bulk 000's Tonnes	7,613	7,613	0%

2.6 What does this mean with regard to truck forecasts?

Obviously, the amount of truck traffic generated by the south end terminals will depend to a significant degree on the marine cargo passing through them. Our forecasts for future-year truck traffic are thus directly related to the forecasts outlined in Table 1.

In order to establish some form of relationship between truck volumes and south-end freight activity, we compared 2008 south-end marine cargo traffic activity to observed truck trip numbers taken at the gates of the various south end facilities. The results of this analysis provide the primary foundation for the development of our future year truck traffic forecasts for the south end marine terminals.

In using this approach, we note that in the course of our stakeholder consultations we found a general sentiment that the percentage of containers moved by truck (as opposed to rail) would increase in the future. The key factors behind this conventional wisdom included:

- A general increase in cargo moved by container as opposed to break-bulk.
- Attempts by the terminal operators to increase the percentage of local import/export container moves by truck, and
- An increase in the use of transload facilities (also referred to as cross-docking) by commercial retail companies.

Transloading is important to the Port of Halifax because it creates local jobs, adds value to imports, and provides a needed service. We note however, that transloading activities also have the potential to increase truck traffic. Transloading activity is expected to grow in the Port of Halifax in the future and land has been set aside for that purpose. Currently, there are two transloading facilities in the HRM operated by Fastfrate and Armour Transport in Burnside.

Floor of the crossdock at Fastfrate's new transloading facility in Burnside. Twenty and forty-foot containers, arriving at Halifax from overseas, are backed up to the doors on the right and the contents are transferred to 53 foot trailers through doors on the left. From there the goods are either trucked to destinations in the Maritimes or taken to CN's Intermodal Terminal where they are shipped by train to central Canada and beyond. Transloading is a key element of supply chain management used by the modern retailing industry.

These factors - in tandem with the variability of the current global economic situation - added complexity to the truck forecasting process that could not be dealt with explicitly. However, in our opinion, the range of marine cargo forecasts shown in Table 1 themselves embrace to some level this potential change in freight shipping practice. We thus chose to use these same ranges of growth, combined with the relationship we established between marine cargo activity and truck traffic for 2008 as the basis for our future year truck traffic forecasts. These forecasts are summarized in Table 2, below.

Table 2 Truck Traffic Forecasts

	2008	**2026 Horizon Year**		
	Baseline	**Low Case**	**Benchmark** [A]	**High** [A]
Growth Forecast [B]	~	0%	32.6%	60.6%
Daily Truck Trips [C]	480	480	640	800

Notes:

A – The daily truck trip values have been rounded.

B – Container growth forecasts taken from Table 1.

C – Daily truck trips represent the total of all truck moves. Therefore, the baseline volume of 480 trips is a total of 240 inbound trips and 240 outbound trips.

3 ITC Roadway Network Impacts

3.1 Background

Halifax Peninsula is the economic centre of Atlantic Canada, with 60,000 residents and nearly 80,000 jobs[3]. As a peninsula, getting into and out of this centre has always been difficult and today, this access is severely constrained. The table at left indicates the share of total road capacity offered by the seven routes serving the peninsula that comprise 26 lanes. The rail corridor offers an additional means of moving to and from the Peninsula, with 5 two-way VIA rail trips per week and one freight train per day.

In this section of the report we assess the impacts that truck traffic generated by the south end terminals will have on the roadway network with and without the ITC.

3.2 The importance of reliability and efficiency for freight movement

The concept of using the ITC to accommodate truck traffic flows to a significant degree from the potential reliability and efficiency benefits that result from such use, and the importance of those benefits for freight movement.

That attempts to achieve such benefits are important is in little doubt. The Federal Highway Administration (FHWA) in the United States reports that truck vehicle-kilometres nearly doubled between 1980 and 2000. The FHWA has also forecast that the tonnage of freight moved by truck will double between 1998 and 2020. These trends are reflected in Canada as well, and imply that trucks will continue to play an expanding and key role in moving freight across North America and logically, for the movement of container traffic to and from the port of Halifax. This is a reality.

Facility	Lanes	% of capacity
Macdonald Bridge	3	19
MacKay Bridge	4	31
Quinpool	4	11
Chebucto	3	8
Mumford	2	5
Bayers	4	11
Bedford/Kempt	6	16
Total capacity	**26**	**100**

Assumes 600 vphpl (roads); 1450-1750 (bridges)
vphpl = volume/hour/lane

As the demand for freight movement by truck grows, concerns are raised about the reliability of the road system upon which these trucks will travel. Congestion and delay have a detrimental effect on freight movements: significant costs are associated with these delays – particularly freight with guaranteed delivery times. According to the FHWA, shippers and carriers have assigned cost estimates to freight delays that range from $25 to $200 per hour. Unexpected delays can thus result in substantial additional costs to both the trucker and the shipper, with a resulting loss in competitiveness – and possibly the viability - of any facility that must deal with such an environment on an ongoing basis.

[3] 2001 figures, *HRM Regional Plan* data.

3.3 Modelling approach

In relatively simple traffic or transportation studies with small study areas, the use of historical trend projections of travel demand is sometimes sufficient to provide a basis for a decision on a matter of relatively low importance. However, the specific question being examined in this study is both complex and of great importance. We have used the HRM Regional Transportation Demand Model as a tool of choice for modeling present and future year traffic patterns for this study. This model accounts for anticipated regional population and employment growth, committed changes planned in the Regional roadway network, and shifts in travel demand from private cars to public transit. It also allows for present-day and future year identification of congestion issues and bottlenecks, the examination of the potential effects of various corridor options on general traffic, specific truck travel times, potential transit and congestion relief benefits, and changes in emissions resulting from any new corridor option. This modeling approach eliminates any need for “opinion” or “trend” analysis, reduces the risks associated with such forecasts, and facilitates the use of sensitivity analysis in the examination of issues of particular concern.

Under the new HRM Regional Plan, the Halifax Peninsula is envisioned as the continued centre of economic and cultural life in the Region. Therefore, providing access to ensure the proper function and vitality of this important regional centre is both a challenge and a necessity.

3.4 Describing the situation

Using the model, a number of analyses were performed to develop an understanding of road system impacts with and without the ITC. The terms of reference for this study called for:

- An evaluation of the volume of trucks serving Halterm currently transiting the downtown, and the potential for re-routing them into the corridor.
- The identification of current and potential future bottlenecks for the present routes according to the traffic forecasts and the identification of potential bottlenecks that could be created by the re-routing of truck traffic into the corridor.

The following sections discuss these analyses and focus on an assessment of congestion and bottlenecks in the road system and the travel time implications of the ITC.

3.4.1 Road network congestion and bottlenecks

To begin, a review was carried out to determine the road network congestion or “bottlenecks” on the peninsula today. This process also helped to identify changes in network constraints over time, assuming no additional road capacity on the Peninsula, from the baseline scenario to the ultimate 2026 planning horizon.

The constraints on the Halifax peninsula road system have been identified in the following two figures. In both scenarios, the truck traffic uses the current downtown route to enter/exit the south end terminals. Figure 1 shows today’s conditions, and Figure 2 summarizes conditions forecast for the planning horizon year of 2026. This analysis reflects conditions during the critical afternoon peak hour of traffic.

Figure 1 Congestion on the Halifax Peninsula today

Network congestion is shown in Figures 1 and 2 using red and yellow lines on the maps. They indicate four main areas of congestion:

- The major downtown roadways;
- The Barrington Street corridor;
- The Robie Street corridor; and
- The Fairview interchange area.

Between today's conditions and those in the future, the tendency will be for this congestion to spread further in the network. Note also that the bridges both show increased congestion.

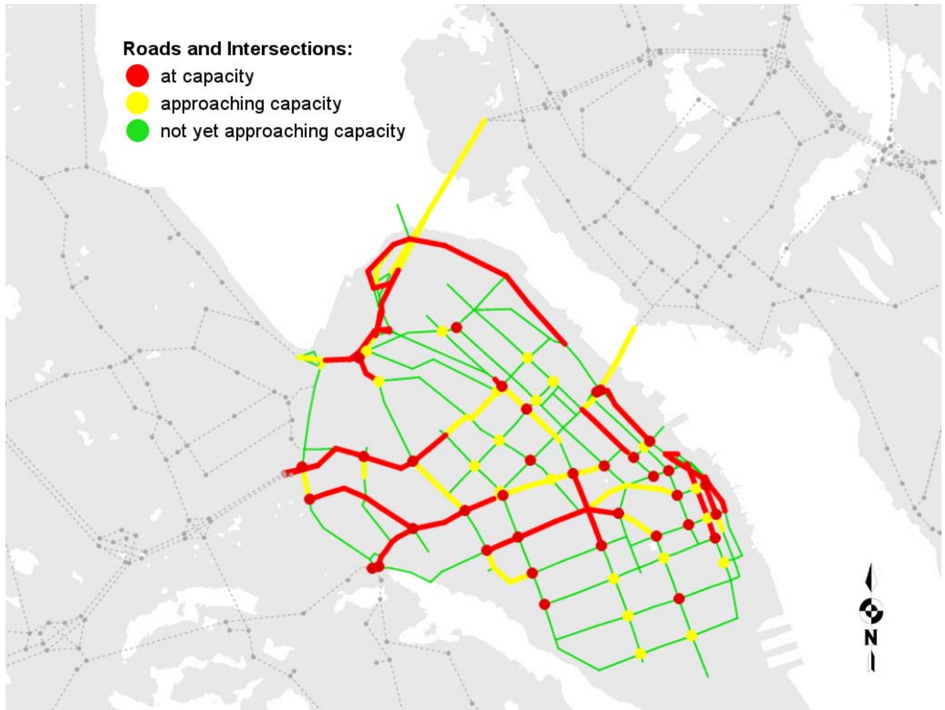
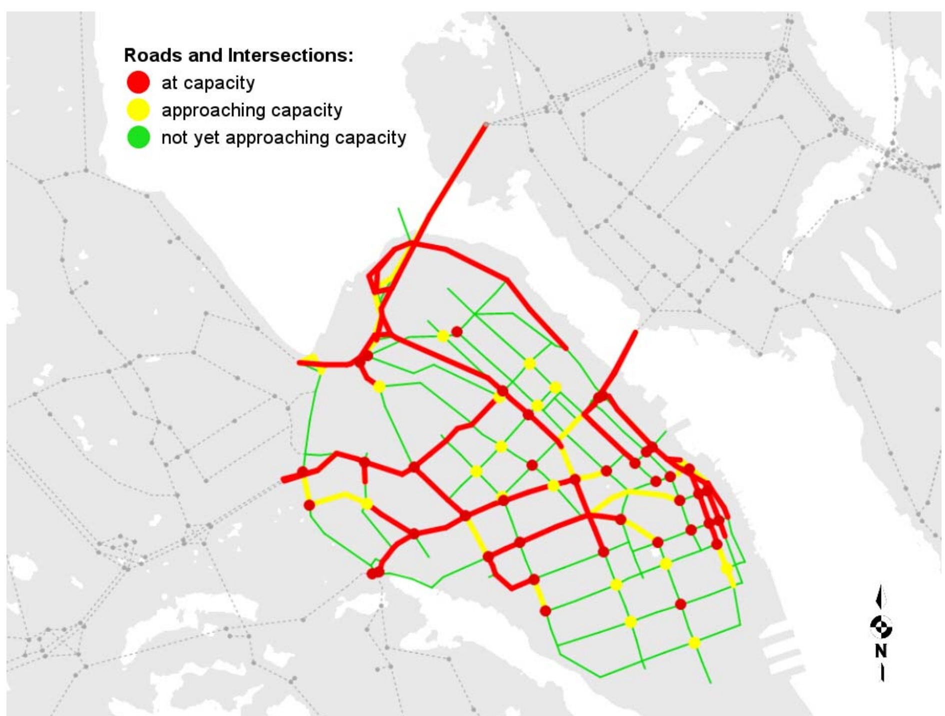


Figure 2 Forecast Peninsula Congestion in 2026

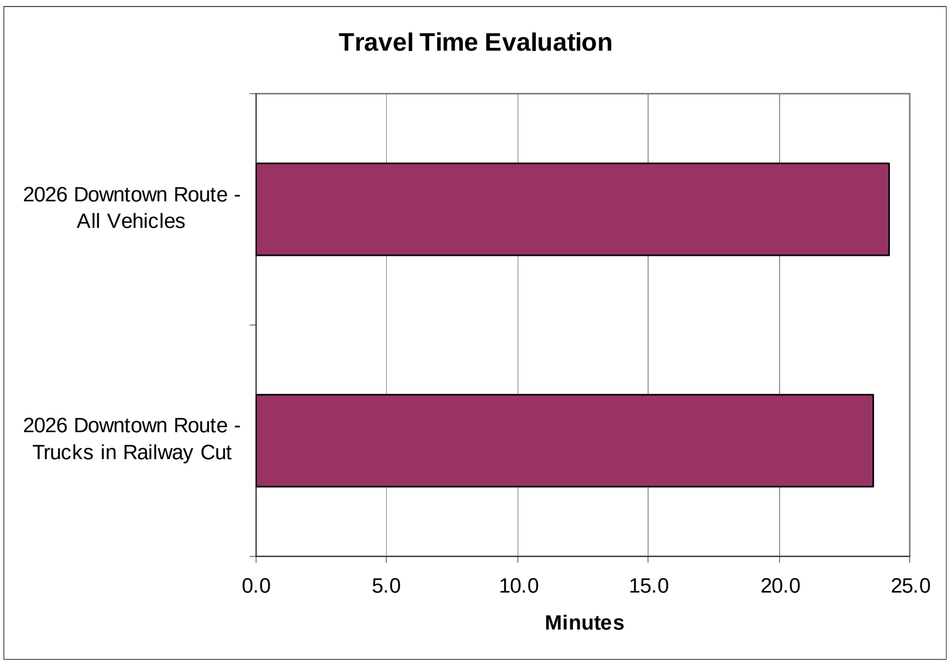


3.4.2 Trucking effects on downtown congestion

Travel times are a valuable way to measure a transportation system's general operating conditions as perceived by the people that travel upon it. In assessing this transportation system performance measure, we used the transportation demand model to extract information relating to vehicle and truck travel times on the peninsula. Our analysis addresses the specific question of whether the general traffic conditions in the downtown (i.e. delays due to congestion) will improve if trucks are removed from the current downtown route and diverted to the proposed ITC. The analysis deals specifically with traffic conditions during the critical afternoon peak hour of traffic.

Figure 3 summarizes the results of this analysis for the planning horizon year of 2026. In carrying out the analysis we first evaluated average travel times for all traffic on the specific downtown routes used by trucks going to and from the south end terminals without the ITC. We then compared the average travel times to those that would exist on these same downtown routes if the south end terminal truck traffic were diverted to the ITC.

Figure 3 Travel Time Impacts of Removing Trucks from Downtown Route



We concluded the following:

- Average travel times on the downtown roads used by truck traffic going to and from the south end terminals are expected to improve only very slightly if trucks are diverted to the proposed ITC; and
- In the downtown area, truck traffic going to and from the south end terminals does not appear to be a major contributor to the overall congestion and delay experienced during afternoon peak hour of traffic.

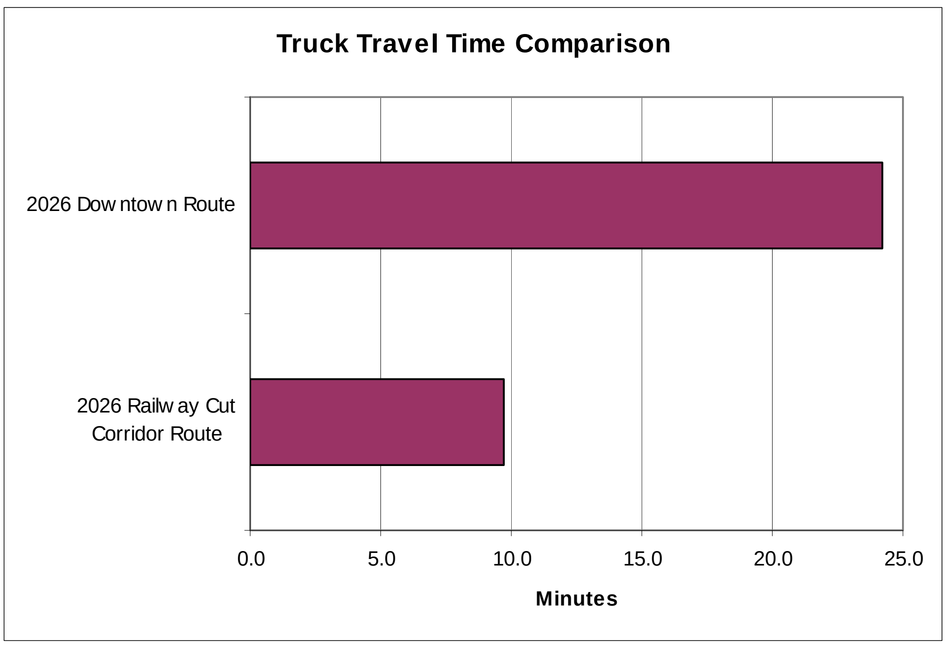
The results of this analysis were not unexpected given that truck trips going to and from the south end terminals on the downtown road network represent a very low percentage of the overall traffic on the downtown road network during the afternoon peak hour of traffic.

3.4.3 Truck travel time improvements

The next step in our evaluation process built on the travel time analysis for the downtown area, but specifically explored the question of the time savings (if any) that might result for trucks diverted to the proposed ITC.

In this comparative review we looked at the future 2026 truck travel times between the south end marine terminals and a common location where the two routes meet at the MacKay Bridge during the afternoon peak hour of traffic, via the downtown route versus the ITC. Only the results for the benchmark (midrange) 2026 truck forecasts have been reported as there was little difference in travel times and trends between the three future year truck forecast scenarios. The results of this analysis are summarized in Figure 4.

Figure 4 Truck Travel Time Comparison: Downtown Route vs. ITC (2026)



The comparison showed an approximate 15-minute travel time savings during the peak hour (in the peak direction) for truck trips that use the proposed ITC. This is a substantial time reduction.

3.4.4 An important postscript on reliability

As a road network approaches its limits of capacity, the reliability of the system deteriorates. Factors such as traffic incidents due to collisions, difficult driving conditions, power outages affecting traffic signal operations, or unusual surges in demand created by special events, can dramatically and suddenly increase congestion due to the inability of the road system to accommodate traffic loads when its effective capacity has been reduced by such influences.

We know from the discussion in Section 3.4.1 that the peninsular road network in Halifax today operates near capacity on several key links during peak hours of traffic. Experienced Halifax commuters are also very aware of the significant negative impacts of any incident on the road system.

We have already noted the substantial benefit in travel time savings for trucks moving to and from the south end terminals and using the ITC in the 2026 planning horizon. This is important, since the expected growing levels of congestion and the increasing number of "bottlenecks" on the Halifax peninsula public road system as we move forward, put into question the reliability and predictability of traversing the peninsula efficiently on that system in the future. In addition to improving travel times, the use of the ITC is expected to substantially improve the reliability of travel conditions for truck freight moving to and from the south end terminals on the Halifax peninsula. This is an important consideration for time sensitive freight and scheduling in the trucking industry.

3.5 Greenhouse gas emissions

In this analysis we examined the key differences in Greenhouse Gas (GHG) emissions that result from the two key planning scenarios in 2026:

- Retention of the current downtown truck route to service commercial vehicles going to and from the south end marine terminals (i.e. Hollis/Lower Water Street and Barrington Street); versus
- Use of the ITC route by that truck traffic.

In carrying out our analysis, we considered peak hour vehicle-kilometres of travel for cars, trucks, and transit buses, the relative proportions of these vehicles in the traffic stream, and the classifications and operational characteristics of the roads used in each case. Our study area for this analysis was focused on the Halifax peninsula only, and included the geographic area of the current downtown truck route and the proposed ITC. The calculation of GHG emissions in each case uses the standard measure of direct greenhouse gases – CO_2e (carbon dioxide equivalents) – and follows Transport Canada's urban emissions calculation process.

Initially, we prepared a forecast of CO_2e emission estimates for the benchmark (midrange) 2026 truck forecast scenario. We then verified that the low and high truck traffic scenarios for the same year yielded the same comparative trend between the two routes and as a result only report the benchmark truck traffic results.

The findings from the analysis indicate that there is no net change in emissions achieved by diverting trucks out of the downtown to the ITC. In both cases, approximately 134,500 tonnes of CO_2e are produced annually This is not surprising given that the same number of truck trips are traversing the peninsula under both truck route scenarios, and that while operating conditions are smoother and travel times are faster on the ITC (less congestion, less emissions), the ITC route is actually about 1.5km longer.

In the course of our analysis, arguments were advanced that the ITC would result in some migration effects of localized GHG emissions from the downtown to the corridor, but lower overall exposure of individuals to those emissions. We take no viewpoint on this issue, since without detailed and very sophisticated atmospheric modeling such a contention is impossible to either support or quantify.

4 Engineering the ITC

4.1 Background

Earlier studies of the ITC recommended joint use of the rail corridor by using a shared lane facility, much as a tram shares a city street with automobiles. At certain times the rail corridor would be used by trains, and other times by trucks. An option that provided a one-way roadway separated from rail operations that alternated travel direction based on traffic demand was also proposed.

As explained in the 2004 Railway Cut Investigation Study (MMM Group for HRM), these scenarios would require marshalling yards to allow trucks to wait while train operations are completed or until the direction of one-way travel was changed. In developing these options, the focus was on working within the limits of the existing cut and keeping construction costs at a minimum.

Based on the comments received from our stakeholder consultations, operational and safety concerns dictate that a different approach is necessary – one that provides positive separation between the roadway and rail operations and operational flexibility. This section discusses the various technical challenges of developing an appropriate ITC design, presents a review of the corridor options developed to address these challenges, and summarizes the evaluation and selection of a preferred design alternative.

4.2 What do stakeholders think?

Prior to the development of any corridor options, we engaged key stakeholder agencies to obtain input of critical issues of concern associated with the integrated corridor. Stakeholders contacted included the Halifax Port Authority, Canadian National Railways, various representatives of the trucking industry, south end terminal operators, and the Halifax Regional Municipality. All of these interests had information and concerns to impart. Key among these high level concerns were the following issues:

- Maintain positive separation between rail and truck operations. This is essential to maintain operational flexibility and safety for both modes.
- It is critical to avoid measures that would hinder CN in its operations or that would prevent port terminal expansion.
- Understand the strategic importance of the south end terminals in the future of international shipping – the area offers deep water, rail and road-tied port facilities unencumbered by overhead structures such as bridges and wires: it is therefore uniquely positioned in Eastern Canada to service super post-Panamax ships over the long term.
- Avoid creating a facility that adds travel time for trucking; otherwise, it will not be used.

4.3 Constraints

There are a number of key physical, operational and safety constraints that were considered in developing the ITC. This section presents a summary of these constraints.

- Transmission line: Nova Scotia Power Incorporated (NSP Inc.) maintains a transmission line along the entire length of the rail corridor – from east of Young Avenue to Fairview Cove. Transmission lines are costly to relocate and in this particular case, there does not appear to be an alternative corridor for the service.
- Operational and design standards: In designing an integrated corridor, there are operational and safety considerations as well as national design standards that must be considered that impact the cross section and geometry of the facility.
- Stakeholder expectations: There is a need for operational flexibility and safe unencumbered passage along the corridor. Positive separation between truck and rail operations is a necessity.

4.4 Development of options

Against this background, and that of the transportation analysis discussed in Section 3, our next step was to identify a preferred cross section. It is clear that numerous potential options exist, but selecting a particular option that would be best from the point of view of meeting physical constraints and operational requirements, limiting social and economic impacts, and addressing long term service requirements was a substantive challenge. In response, we designed and undertook a multi-step approach that resulted in, first, a long list of candidate options and second, a short-list of potentially viable and appropriate candidate options. The remainder of this section details the steps involved and outcomes resulting from this process.

4.4.1 Long list

An expert panel was convened on December 15 and 16, 2008 to brainstorm preliminary concepts and to evaluate options. Participants included members of the study team from McCormick Rankin Corporation, O'Halloran Campbell, and MMM Group. There were nine participants in total.

Background documentation was compiled and provided to the participants prior to the session. These materials included:

- A context plan/constraints map
- A summary of past studies relevant to the corridor
- Summary findings of the stakeholder consultations
- A technical assessment of truck traffic growth projections.

The session began with an overview of the traffic demand and growth projections developed previously, together with a review of development and regulatory constraints.

The two-day session used brainstorming techniques to generate the long list of corridor options as shown in the table below.

Table 3 Long List of Corridor and Connection Options

Category	Option
Cross Section (Those carried forward are shown in **bold**)	**1A 2 Rail lines and a two-lane two-way road with urban drainage[4]**
	1B 2 Rail lines and a two-lane two-way road with rural drainage
	2A 1 Rail line and a two-lane two-way road with urban drainage
	2B 1 Rail line and a two-lane two way road with rural drainage
	3 1 Rail line and a three lane roadway (reversible centre lane)
	4 2 Rail lines and a three lane roadway (reversible centre lane)
	5 Accommodating light rail
	6 Shared track Option #1 – from 2004 Rail Cut Study
	7 Shared track Option #4A – from 2004 Rail Cut Study
	8 Shared track Option #4A Modified to include rural drainage
	9 Cut & Cover - rail and roadway in tunnel
North Connection	1 Intersection at Joe Howe Drive /Chester Spur
	1B Intersection at Joe Howe Drive Opposite Dutch Village Road
	2 Connection to Joseph Howe with connection to Dutch Village Ramp
	3 Extend corridor to Ceres Terminal
South Connection	**1 Marginal Road**
	2 Grade separate at tracks
	3 Reconfigure tracks to provide consolidated crossing on Marginal Road

4.4.2 Reducing the list

The long list includes a number of innovations. Obviously however, with 11 competing corridor options and seven connection options, there was a need to reduce the list to a manageable number for further evaluation. The expert panel concluded that three to four corridor options would be a reasonable number of alternatives with which to proceed. The concepts were discussed in detail by members of the expert panel, following which the long list was reduced to four corridor options and two connection options using a consensus-finding scoring technique.

Key factors considered in the elimination of various preliminary corridor options included:

[4] Urban drainage consists of curb and gutter and storm sewer. Rural drainage consists of a drainage ditch. Rural roads typically require a wider cross section than urban roads.

- **Obvious expense:**
    - Light rail. Light rail would require its own track system, maintenance/support facilities, and power source.
    - 1 Rail and 2 rail lines with 3 lane roadway A reversible lane would result in significant traffic control/monitoring system costs and potential safety concerns.
    - Cut and cover tunnel. Although this may be an option for the treatment of localized areas. It would be cost prohibitive to apply this treatment to long sections of the corridor

- **Failure to meet program intent:**
    - Shared track options #1 and 4A (These options do not provide the operational flexibility required by the corridor users. There are also safety and traffic control concerns associated with a shared facility.
    - 1 rail and 2 rail lines with a 3 lane roadway Although a reversible lane provides superior capacity, capacity is not a fundamental objective of this project

Key factors in the preliminary elimination of preliminary connection options included:

- **Network Disruption:**
    - Intersection at Joe Howe Drive /Chester Spur. On any street, the placement of signalized intersections in close proximity to one another presents unwanted delay and operational complexity to traffic flow. Since the Chester Spur connection is situated between the signalized Superstore entrance and the Dutch Village Road intersection, this would result in three sets of signals in tight sequence (225 m).
    - Connection with flyover on Dutch Village Road ramp. This configuration would result in increased congestion on Kempt Road. In addition trucks would be required to make several lane changes in a short distance to turn left to access the MacKay Bridge.

- **Vertical or horizontal geometry:**

    - Grade separation of roadway and rail at Marginal Road.

4.4.3 Short list

As a result of the scoring, four ITC options were carried forward for further development and evaluation. Theses options are illustrated in Figures 5 through 8:

Figure 5 2 Rail lines and a two-lane two-way road with rural drainage

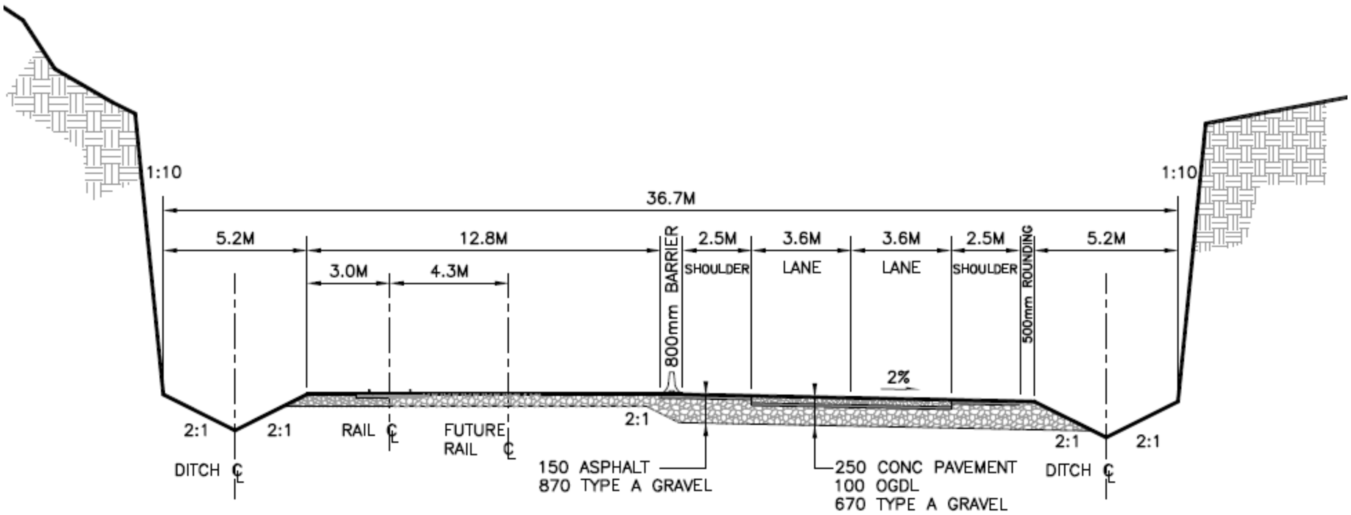


Figure 6 2 Rail lines and a two-lane two-way road with urban drainage

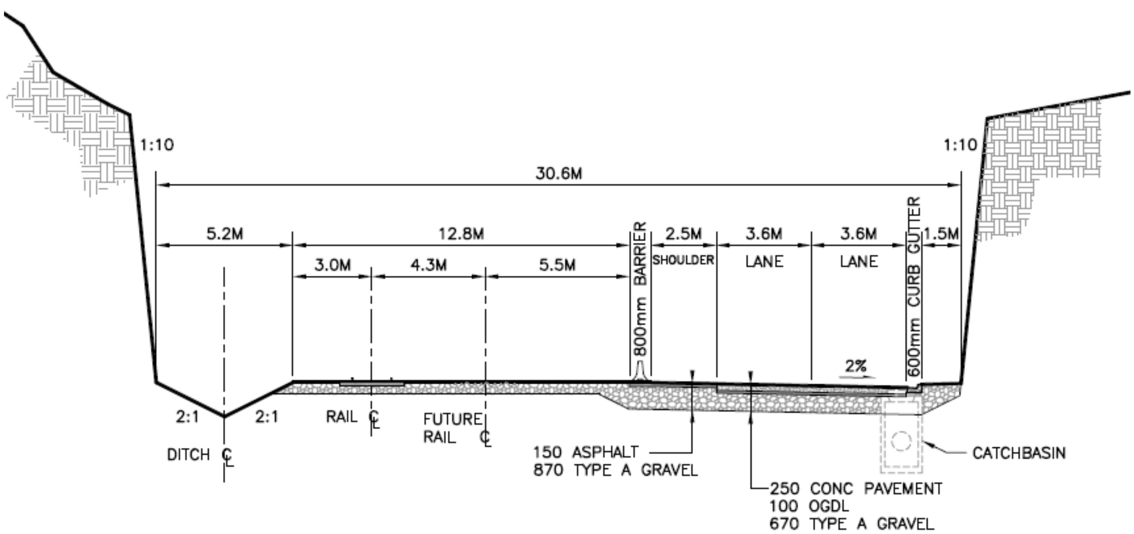


Figure 7 One rail line and a two-lane two-way road with rural drainage

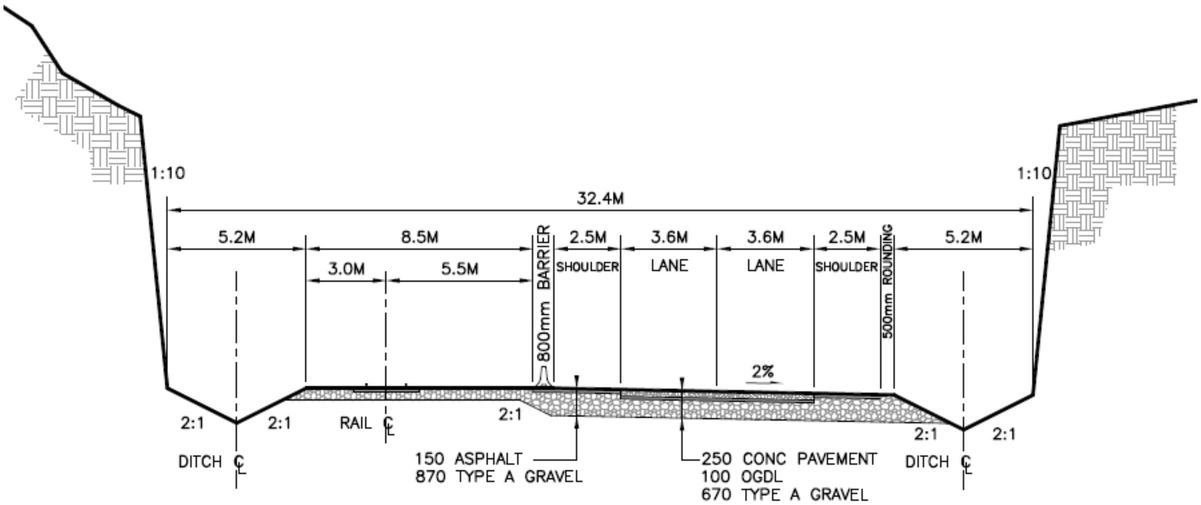
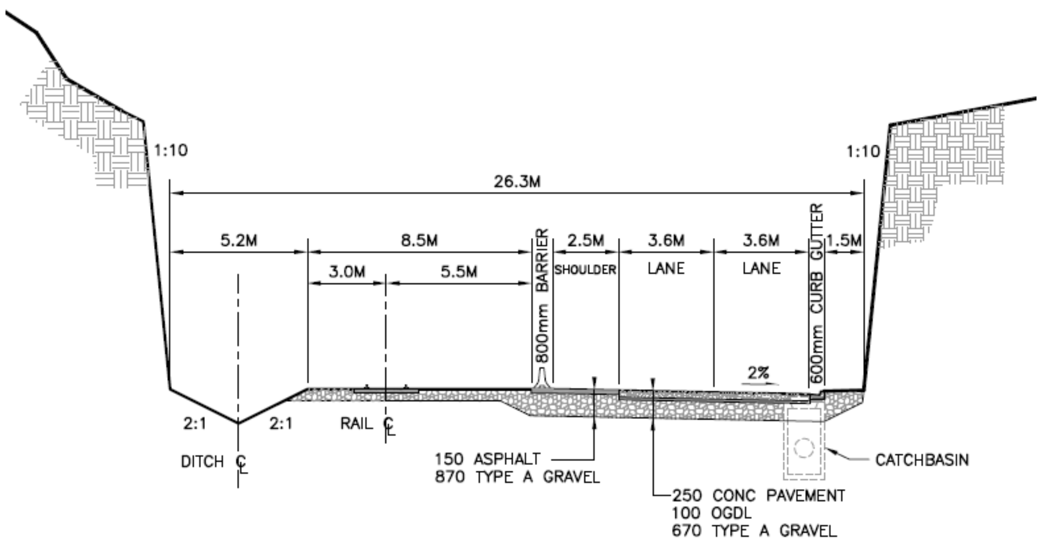


Figure 8 One rail line and a two-lane two-way road with urban drainage



The pros and cons associated with each of the shortlisted options are briefly described in Table 4 as they were understood at the time of the analysis.

Table 4 also discusses the pros and cons with various connection options at the north and southern ends of the ITC.

Table 4 Summary Table: Short List of Options (not prioritized)

	Pros	Cons
Cross Section Options		
1A **2 rail lines / 2 lane truck-way with rural drainage** **36.7m cross section**	▪ Use extra rail bed for rail maintenance ▪ Increased operational flexibility for rail ▪ Increased rail capacity ▪ Provides potential for commuter rail in the future ▪ Rock fall debris can collect in ditch line ▪ Wider shoulder provides improved accommodation of disables vehicle ▪ Increased snow storage space over urban section	▪ May need to pump storm drainage ▪ Additional rock excavation required for rural ditch ▪ Wider cross section than urban section. This is the widest of the four options carried forward ▪ Greatest property requirement ▪ Greatest visual impact ▪ Greatest impact on greenway
1B **2 rail lines / 2 lane truck-way with urban drainage** **30.6m cross section**	▪ Use extra rail bed for rail, maintenance lane ▪ Increased operational flexibility for rail ▪ Increased rail capacity ▪ Provides potential for commuter rail in the future ▪ Smaller cross section than rural drainage options ▪ Less visual impact, less property requirement than rural options ▪ Less impact on greenway	▪ May need to pump storm drainage ▪ No provision for rock fall debris ▪ Slightly reduced provision for disabled vehicles ▪ Less space for snow storage
2A **1 rail line / 2 lane truck-way with rural drainage** **32.4m cross section**	▪ Rock fall debris can collect in ditch line ▪ Wider shoulder provides improved accommodation of disables vehicle ▪ Increased snow storage space over urban section	▪ May need to pump storm drainage ▪ Reduced provision for rail maintenance ▪ No operational flexibility for rail ▪ No provision for increased rail capacity ▪ Reduced flexibility for commuter rail in the future ▪ Increased cross section width over urban drainage options
2B **1 rail line / 2 lane truck-way with urban drainage** **26.3m cross section**	▪ Smaller cross section than rural drainage options ▪ This is the narrowest cross section ▪ Least property requirement than ▪ Least visual impact ▪ Least impact on greenway	▪ May need to pump storm drainage ▪ No provision for rock fall debris ▪ Slightly reduced provision for disabled vehicles ▪ Less space for snow storage ▪ Reduced provision for rail maintenance ▪ No operational flexibility for rail ▪ No provision for increased rail capacity ▪ Reduced flexibility for

		commuter rail in the future
North Connection Option		
Intersection at Joe Howe Drive Opposite Dutch Village Road	▪ Access to three key arteries: Bicentennial Highway, Bedford Highway, MacKay Bridge ▪ Simple connection ▪ Compatible with transit function ▪ Easy access to bridge ▪ Eliminates offset intersections and consolidates into one intersection ▪ Operational strengths associated with four-way intersection ▪ Pedestrian benefits with one intersection	▪ Intersection spacing (Dutch Village Road) ▪ Does not bypass congestion at the Fairview Interchange ▪ Indirect connection to Ceres Terminal ▪ Public access – potential for violation ▪ At grade intersection (vs. flyover or direct connection) ▪ Indirect access to 100 series highways ▪ Purchase of property required to accommodate connection
South Connection Options		
Marginal Road	▪ Uses existing road infrastructure ▪ Low cost	▪ Conflicts with rail operations at rail crossings ▪ Potential for truck delays ▪ Rail crossing skew angle difficult to control
Reconfigure Tracks	▪ Substantially cheaper than grade separation ▪ Consolidate rail / truck interaction to one crossing	▪ Potential loss of rail switching flexibility

4.5 Preliminary construction cost estimates

Order-of-magnitude cost estimates were prepared for each of the four short listed corridor options listed above. The estimates, which include connection points, are as shown in Table 5. These costs do not include acquisition through lease or purchase from CN of the right to use the corridor, or any ancillary property acquisition required to widen the corridor.

Table 5 Order-of-Magnitude Cost Estimates

Option	Preliminary Cost Estimate
1A 2 rail lines / 2 lane truck-way with rural ditch	$270 M
1B 2 rail lines / 2 lane truck-way with urban drainage	$225 M
2A 1 rail line / 2 lane truck-way with rural ditch	$225 M
2B 1 rail line / 2 lane truck-way with urban drainage	$205 M

4.6 Selection of a preferred corridor option

To select a preferred option that would be carried forward to the feasibility analysis phase of this study, the study team conducted a matrix-based detailed scoring and evaluation of the four short listed corridor options. The evaluation was based on expert commentaries prepared to address each of the following criteria.

- **Container freight system:** Potential impacts on container terminals, shippers and shipping lines, existing and proposed intermodal and transload centres, and other port traffic.

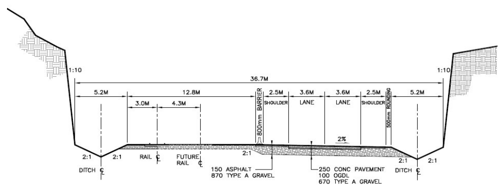
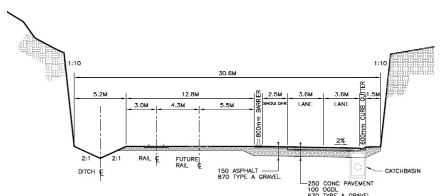
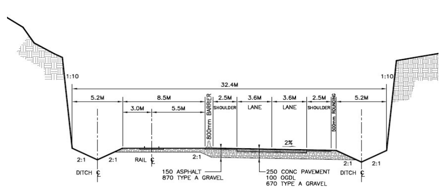
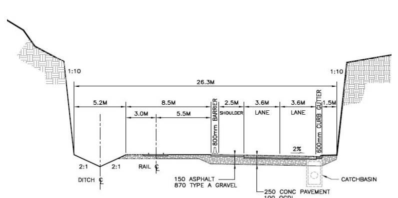
- **GHG Emissions:** The environmental impacts, including potential reductions in greenhouse gas emissions and fuel consumption.
- **Greenway:** The feasibility of providing green spaces and the potential use of the multi-modal corridor by pedestrians, cycling and other modes of active transportation.
- **Transit:** The potential impact on public transit, downtown parking and peninsular congestion associated with using the corridor as a commuter bus route.
- **Emergency Vehicles:** The impact of a direct and more secure route for emergency vehicles.
- **Corridor traffic:** The number of vehicles expected to use the corridor.
- Downtown congestion: The volume of trucks serving Halterm currently transiting the downtown, and the potential for re-routing them into the corridor, including:
- **Congestion improvement benefits** on traffic flows through the downtown corridor currently used by Halterm and other south end port facilities;
- **The National Highway System:** Assess the impact moving traffic off of designated National Highway routes will have on their designation and whether this designation can be transferred to the transportation corridor.
- **Exit/Entry Points:** The potential impact on traffic and roadways near the exit/entry points of the corridor and any modifications that might need to be considered.
- **Tourism:** The impact on tourism, particularly in the downtown waterfront areas
- **Urban planning:** the impact on the urban environment envisaged by “HRM by Design” an urban design policy initiative being undertaken by Halifax Regional Municipality.
- **Neighbourhoods:** Any and all potential impacts on residents, neighbourhoods and businesses whether located directly abutting the corridor, located on current truck routes or, located off the peninsula dependent on truck route analysis.
- **Noise:** The impact of noise emission along the corridor resulting from multi-modal usage.
- **Seasonal Maintenance:** Seasonal maintenance issues, including snow and ice removal as well as other safety and maintenance issues and provide recommendations as to best practices;
- **Road Safety:** Examination of all vehicle, rail, transit and highway safety and related issues associated with the operation of truck, rail and possibly transit and/or emergency vehicle traffic in the space available.
- **Tolling:** Evaluate the potential for tolling the corridor.
- **Technical Issues:** Technical issues associated with sharing the corridor with other modes other than rail.
- **Costing:** Provide a preliminary estimate of construction costs.

The following table (Table 6 - foldout) presents a summary of key evaluation points for each of the four corridor options. It then offers a brief discussion about how each concept performs in addressing each criterion. A subjective score (1 to 5) was applied based on our performance assessment. The values are also shown as symbols to allow the reader to more quickly scan the results.

Evaluation Matrix
Integrated Transportation Corridor

Criteria Least desirable — Most desirable

Symbol ○ ◔ ◑ ◕ ●

Option	Diagram	Description
1A		**Two rail lines with two-way truck/ transit lanes and rural ditch**
1B		**Two rail lines with two-way truck/ transit lanes and urban curb & gutter**
2A		**One rail line with two-way truck/ transit lanes and rural ditch**
2B		**One rail line with two-way truck/ transit lanes and urban curb & gutter**

Traffic and Logistics

Option		Container Freight System	Corridor Traffic	Downtown Congestion/ NHS	Exit-Entry Points	Technical Issues
1A		Two rails may offer more flexibility (capacity); improved travel time for trucks in peak hours/ direction; support from terminal operator. Solidifies position of south end terminals by removing conflict in downtown. Removal of dangerous goods from downtown streets.	All options accommodate freight, emergency vehicles, transit and trucks at similar levels.il.	Marginal benefit to downtown congestion. No effect on NHS. Perceived improvement in traffic flow due to removal of trucks.	Potential conflict between trucks and rail movements at south end terminals; LOS D or better at north end intersection, more conflict points at south end than single track option.	Positive separation between rail and road, reserved space for rail maintenance; maintains independence of operations for both trucks and rail; no requirement for marshalling yards.
1A	Rating	◕	◑	◑	◔	◑
1B		Two rails may offer more flexibility (capacity); improved travel time for trucks in peak hours/ direction; support from terminal operator. Solidifies position of south end terminals by removing conflict in downtown. Removal of dangerous goods from downtown streets.	All options accommodate freight, emergency vehicles, transit and trucks at similar levels.	Marginal benefit to downtown congestion. No effect on NHS. Perceived improvement in traffic flow due to removal of trucks.	Potential conflict between trucks and rail movements at south end terminals; LOS D or better at north end intersection, more conflict points at south end than single track option.	Positive separation between rail and road, reserved space for rail maintenance; maintains independence of operations for both trucks and rail; no requirement for marshalling yards.
1B	Rating	◕	◑	◑	◔	◑
2A		Single track offers less flexibility (capacity); improved travel time for trucks in peak hours/ direction. Solidifies position of south end terminals by removing conflict in downtown. Removal of dangerous goods from downtown streets.	All options accommodate freight, emergency vehicles, transit and trucks at similar levels.	Marginal benefit to downtown congestion. No effect on NHS. Perceived improvement in traffic flow due to removal of trucks.	Potential conflict between trucks and rail movements at south end terminals; LOS D or better at north end intersection	Positive separation between rail and road, reserved space for rail maintenance; maintains independence of operations for both trucks and rail; no requirement for marshalling yards.
2A	Rating	◔	◑	◑	◕	◑
2B		Single track offers less flexibility (capacity); improved travel time for trucks in peak hours/ direction. Solidifies position of south end terminals by removing conflict in downtown. Removal of dangerous goods from downtown streets.	All options accommodate freight, emergency vehicles, transit and trucks at similar levels.	Marginal benefit to downtown congestion. No effect on NHS. Perceived improvement in traffic flow due to removal of trucks.	Potential conflict between trucks and rail movements at south end terminals; LOS D or better at north end intersection	Positive separation between rail and road, reserved space for rail maintenance; maintains independence of operations for both trucks and rail; no requirement for marshalling yards.
2B	Rating	◔	◑	◑	◕	◑

Community

Option		Greenway	Tourism	Urban Environments	Neighbourhood Impacts
1A		All alternatives offer some opportunities to facilitate greenway. Any accommodation would have to be done at top of cut or with cut and cover structure. In fill situations, greenway would be outside ROW. Narrower alternatives provide an advantage.	Removing trucks from downtown improves pedestrian environment, may reduce actual safety risks and will reduce perceived safety risks. Reduces working port experience. Use of corridor by tour buses not recommended.	Presence of corridor offers significant advantages; supports HRM by Design objectives.	Removal of vegetation; regularization of encroachments by residents; land uplift opportunities with transit stations; crime shadow around transit stations; likely need to replace character structures. Visual impacts. Narrower alternatives provide an advantage.
1A	Rating	◔	◑	●	◔
1B		All alternatives offer some opportunities to facilitate greenway. Any accommodation would have to be done at top of cut or with cut and cover structure. In fill situations, greenway would be outside ROW. Narrower alternatives provide an advantage.	Removing trucks from downtown improves pedestrian environment, may reduce actual safety risks and will reduce perceived safety risks. Reduces working port experience. Use of corridor by tour buses not recommended.	Presence of corridor offers significant advantages; supports HRM by Design objectives.	Removal of vegetation; regularization of encroachments by residents; land uplift opportunities with transit stations; crime shadow around transit stations; likely need to replace character structures. Visual impacts. Narrower alternatives provide an advantage.
1B	Rating	◕	◑	●	◑
2A		All alternatives offer some opportunities to facilitate greenway. Any accommodation would have to be done at top of cut or with cut and cover structure. In fill situations, greenway would be outside ROW. Narrower alternatives provide an advantage.	Removing trucks from downtown improves pedestrian environment, may reduce actual safety risks and will reduce perceived safety risks. Reduces working port experience. Use of corridor by tour buses not recommended.	Presence of corridor offers significant advantages; supports HRM by Design objectives.	Removal of vegetation; regularization of encroachments by residents; land uplift opportunities with transit stations; crime shadow around transit stations; likely need to replace character structures. Visual impacts. Narrower alternatives provide an advantage.
2A	Rating	◑	◑	●	◔
2B		All alternatives offer some opportunities to facilitate greenway. Any accommodation would have to be done at top of cut or with cut and cover structure. In fill situations, greenway would be outside ROW. Narrower alternatives provide an advantage.	Removing trucks from downtown improves pedestrian environment, may reduce actual safety risks and will reduce perceived safety risks. Reduces working port experience. Use of corridor by tour buses not recommended.	Presence of corridor offers significant advantages; supports HRM by Design objectives.	Removal of vegetation; regularization of encroachments by residents; land uplift opportunities with transit stations; crime shadow around transit stations; likely need to replace character structures. Visual impacts. Narrower alternatives provide an advantage.
2B	Rating	●	◑	●	◑

Other Modes and Environmental

Option		Transit	Emergency Vehicles	GHG Emissions	Noise
1A		Increasing transit reduces parking demand; use of BRT will help achieve HRM's aggressive transit goals, less congestion. Potential for commuter rail option.	No real benefit for emergency vehicles.	Marginal increase due to slightly longer travel distances and mixing of traffic at Fairview Interchange.	Removal of trucks from the downtown will reduce noise there; net increase in ambient noise in vicinity of rail cut. Mitigation could include berms and walls. Property acquisition typically much costlier than sound barrier mitigation.
1A	Rating	●	◑	◔	○
1B		Increasing transit reduces parking demand; use of BRT will help achieve HRM's aggressive transit goals, less congestion. Potential for commuter rail option.	No real benefit for emergency vehicles.	Marginal increase due to slightly longer travel distances and mixing of traffic at Fairview Interchange.	Removal of trucks from the downtown will reduce noise there; net increase in ambient noise in vicinity of rail cut. Mitigation could include berms and walls. Property acquisition typically much costlier than sound barrier mitigation.
1B	Rating	●	◑	◔	◔
2A		Increasing transit reduces parking demand; use of BRT will help achieve HRM's aggressive transit goals, less congestion.	No real benefit for emergency vehicles.	Marginal increase due to slightly longer travel distances and mixing of traffic at Fairview Interchange.	Removal of trucks from the downtown will reduce noise there; net increase in ambient noise in vicinity of rail cut. Mitigation could include berms and walls. Property acquisition typically much costlier than sound barrier mitigation.
2A	Rating	◑	◑	◔	◔
2B		Increasing transit reduces parking demand; use of BRT will help achieve HRM's aggressive transit goals, less congestion. Narrower cross section provides more space for terminal.	No real benefit for emergency vehicles.	Marginal increase due to slightly longer travel distances and mixing of traffic at Fairview Interchange.	Removal of trucks from the downtown will reduce noise there; net increase in ambient noise in vicinity of rail cut. Mitigation could include berms and walls. Property acquisition typically much costlier than sound barrier mitigation.
2B	Rating	◕	◑	◔	◑

Safety and Maintenance and Financial

Option		Seasonal/ Maintenance	Road Safety	Tolling	Cost
1A		More costly in the cut than open areas by a factor of 1.8. Would need to acquire additional fleet equipment. Little difference in cost of maintaining urban and rural section. Rural cross section provides for falling or thrown debris.	Little evidence for collision reductions: truck-involved collision history is minimal over past 5 years. Possible reduction in perceived risk for pedestrians and cyclists. No likely difference in safety performance from alternate cross sections. Designs incorporate appropriate clearances for transit and rail; hard separation present - rail/road. Laybys at transit terminals required. CCTV monitoring and control centre likely required - linked to HRM control centre. Potential for application of photo radar (speed management measure - asume 50 km/h operating speeds). Illegal pedestrian crossing activity at shopping centres requires control/mitigation.	Volumes are so low that tolling is not viable. Extra costs may place south end terminal at a disadvantage.	$ 270 million
1A	Rating	◑	◑	○	○
1B		More costly in the cut than open areas by a factor of 1.8. Would need to acquire additional fleet equipment. Little difference in cost of maintaining urban and rural section.	Little evidence for collision reductions: truck-involved collision history is minimal over past 5 years. Possible reduction in perceived risk for pedestrians and cyclists. No likely difference in safety performance from alternate cross sections. Designs incorporate appropriate clearances for transit and rail; hard separation present - rail/road. Laybys at transit terminals required. CCTV monitoring and control centre likely required - linked to HRM control centre. Potential for application of photo radar (speed management measure - asume 50 km/h operating speeds). Illegal pedestrian crossing activity at shopping centres requires control/mitigation.	Volumes are so low that tolling is not viable.	$ 225 million
1B	Rating	◔	◑	○	◑
2A		More costly in the cut than open areas by a factor of 1.8. Would need to acquire additional fleet equipment. Little difference in cost of maintaining urban and rural section. Rural cross section provides for falling or thrown debris.	Little evidence for collision reductions: truck-involved collision history is minimal over past 5 years. Possible reduction in perceived risk for pedestrians and cyclists. No likely difference in safety performance from alternate cross sections. Designs incorporate appropriate clearances for transit and rail; hard separation present - rail/road. Laybys at transit terminals required. CCTV monitoring and control centre likely required - linked to HRM control centre. Potential for application of photo radar (speed management measure - asume 50 km/h operating speeds). Illegal pedestrian crossing activity at shopping centres requires control/mitigation.	Volumes are so low that tolling is not viable.	$ 225 million
2A	Rating	◑	◑	○	◑
2B		More costly in the cut than open areas by a factor of 1.8. Would need to acquire additional fleet equipment. Little difference in cost of maintaining urban and rural section.	Little evidence for collision reductions: truck-involved collision history is minimal over past 5 years. Possible reduction in perceived risk for pedestrians and cyclists. No likely difference in safety performance from alternate cross sections. Designs incorporate appropriate clearances for transit and rail; hard separation present - rail/road. Laybys at transit terminals required. CCTV monitoring and control centre likely required - linked to HRM control centre. Potential for application of photo radar (speed management measure - asume 50 km/h operating speeds). Illegal pedestrian crossing activity at shopping centres requires control/mitigation.	Volumes are so low that tolling is not viable.	$ 205 million
2B	Rating	◔	◑	○	◕

4.6.1 Findings

As indicated in the cross section drawings, the general comparison was between options that offered an allowance for one track or two and whether a rural cross section was applied versus an urban cross section. These choices are critical as they can have substantially different impacts on the corridor width. That being said, certain criteria had a larger impact in separating one concept from another. Following is a brief discussion of some of the main elements which differentiate the options. Following is a brief discussion of key elements which differentiate the options.

4.6.2 Container freight system

While an allowance for a second track was not required by CN, concepts that showed this allowance were rated slightly higher by the study team since it offered greater flexibility (capacity) either to CN or for future options including commuter rail. In any case, the ITC improved travel time for trucks in peak hours direction. It was also viewed as potentially solidifying the position of south end terminals by removing the conflicts in the downtown. Removal of dangerous goods from downtown streets was also viewed as a benefit.

4.6.3 Entry-exit points

There are potential conflicts between trucks and rail movements at the south end terminals and there would obviously be more conflict points with a two track option versus a single track option.

4.6.4 Halifax Urban Greenway

All of the alternatives offer some opportunities to facilitate the proposed Halifax Urban Greenway. As currently proposed by HRM trails planning staff, accommodation would occur at the top of the cut. Obviously, narrower alternatives provide an advantage over wider options by potentially offering more space for the trail. At a few locations, it may be necessary to cantilever the trail over the cut for short distances. A cut and cover structure may be considered as an option. In fill situations, it is assumed that the greenway would be outside the right of way.

4.6.5 Neighbourhood impacts

Once again, narrow options offer an advantage over wider options by potentially maintaining more separation between the cut and properties. In all cases, the project would result in the removal of vegetation and related visual impacts. There would need to be a regularization of encroachments by residents (some parts of the right of way are encroached upon by outbuildings and gardens). If transit is implemented, all options also offer the potential for land value increases in the vicinity of transit stations; on the other hand, there is some potential for a crime shadow around transit stations and additional enforcement may be necessary. With widening of the rail cut, all of the bridges, which may be described as character structures, would need to be replaced.

4.6.6 Transit

Increasing effective transit services will reduce parking demand in the downtown and implementation of a Bus Rapid Transit service in the corridor could help to achieve HRM's aggressive transit goals, resulting in less congestion. Those options that maintain space for two rail lines offer the potential for future commuter rail.

4.6.7 Noise

All options result in the removal of trucks from the downtown, which will reduce noise there; at the same time there will be a net increase in the amount of ambient noise in the vicinity of the rail line. Mitigation could include berms and walls (in areas of cut, the walls of the cut are expected to be effective).

4.6.8 Seasonal maintenance

It is estimated that seasonal road maintenances will be more costly in the cut than open areas by a factor of 1.8. It would likely be necessary to acquire specialized or additional fleet equipment. There would however, be little difference in cost of maintaining urban and rural section. Options with a full rural cross section rate slightly better than urban sections since the ditches provide for falling or thrown debris.

4.6.9 Cost

Cost is a key variable, largely dictated by the width of the cut (rock excavation and removal is costly). Our preliminary estimates range from a low of $205 million for the narrowest option (with a single rail line and an urban cross section) to a high of $275 million for the widest option (two rail lines and a full rural cross section).

4.7 Preferred alternative

Based on the analysis shown in Table 6, the two highest scoring options were Options 1B (2 rail lines / 2 lane truck-way with urban drainage) and 2B (1 rail line / 2 lane truck-way with urban drainage). Option 2B scored slightly higher than option 1B mainly due to its lower cost.

The current rail corridor has been in place and operational for approximately 90 years. Clearly these types of facilities need to be planned for long term flexibility. As a result, Option 1B was selected as the preferred alternative to advance to the feasibility stage of this study due to the increased flexibility offered for the accommodation of future increases in rail freight or the provision of commuter rail.

The following illustration provides a three dimensional sketch of the preferred Option 1B corridor cross section.

Figure 9 Illustration of Preferred Alternative

This illustration shows the general arrangement of infrastructure in the rail cut under the preferred option. From left to right is the CN main line (it will be necessary to move the line from its present alignment); space reserved for a future rail line and CN maintenance, a central concrete barrier separating the roadway from the rail line, a shoulder breakdown lane, two travel lanes, and finally curb and gutter and a paved boulevard. The base of the cut would measure a nominal 30.6 metres wide. Note the power transmission line on the right.

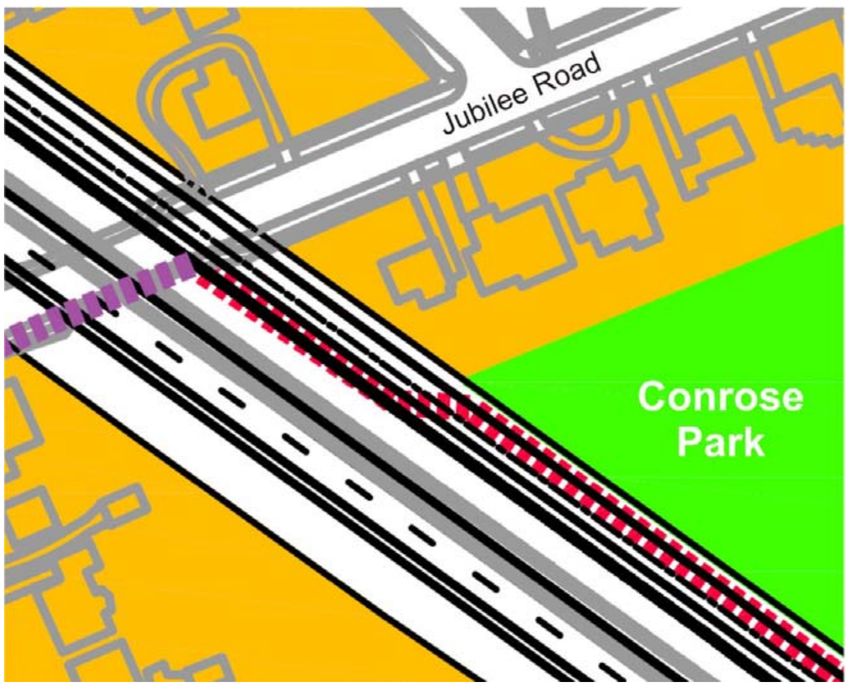
5 Accommodating the Halifax Urban Greenway

The Halifax Urban Greenway has been under consideration for several years. This would be a multi-use trail on the apron of the rail line, with expected users to include walkers, joggers, cyclists, and related modes. The most recent concepts, provided to the study team by HRM trails division, shows the trail routing back and forth across the rock cut to take advantage of available level land at the top of the cut. The crossings utilize many of the dozen bridges that cross the cut. In our analysis of the concept, it is possible to still accommodate the Greenway even as it is necessary to widen the cut. However, three locations will require some additional thought. These are as follows:

- **Jubilee Road (See Figure 10)** There is space within Conrose Park to move the proposed trail alignment to the east; however it may be difficult to bypass a house on Jubilee Road. Options include providing a cantilevered walkway structure or a cut and cover structure to reroute the trail around the property, or realigning the trail to Jubilee Road at Connaught Avenue.

Figure 10 Jubilee Road Greenway Constraint

In these maps, the dashed line indicates the current planned trail alignment. Where the line is purple, the proposed trail alignment has been maintained. Where the line is red there is insufficient right of way to accommodate the trail as planned, should the ITC be implemented.

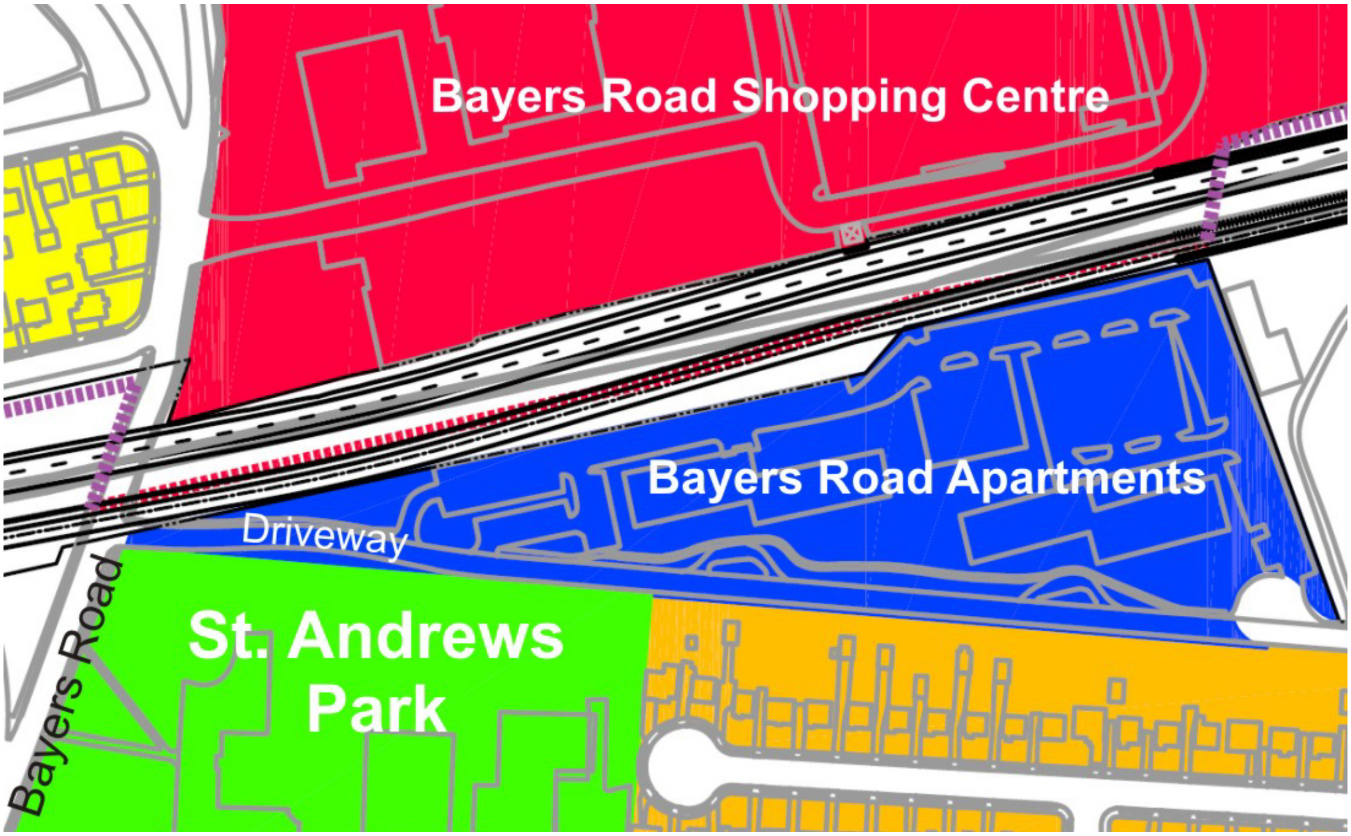


- **Roosevelt Street (See Figure 11)** There is a constriction at the north end of Flynn MacDonald Park next to Roosevelt Street. It may be necessary to run the trail within the HRM road right-of-way at this location.

Figure 11 Roosevelt Street Greenway Constraint

- **Bayers Road (See Figure 12)** North of Bayers Road, it will be necessary to move the trail alignment further east – possibly beside the Bayers Apartments driveway next to St. Andrews Park – or to the west side of the rail line through the Bayers Road Shopping Centre parking area.

Figure 12 Bayers Road Greenway Constraint



6 The ITC and public transit[5]

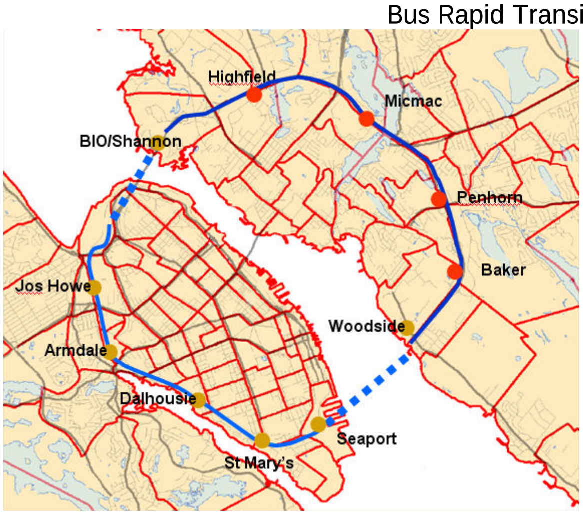
6.1 Background

The HRM Regional Plan sets out a critical role for public transit in servicing the future travel demand that results from planned growth. This is in keeping with international trends in transportation planning which necessarily focus on developing sustainable urban transportation systems that focus on preserving liveable communities and significantly enhancing opportunities for people to travel using alternatives to the private car.

In looking forward to their future year planning horizon, the HRM Regional Plan sets out an average transit use target (region-wide) by the year 2026 of 23 percent of all weekday afternoon peak hour trips. Achieving this 23 percent transit mode share target by 2026 is an ambitious initiative that will require very substantial investments in the public transit system and the infrastructure associated with deploying that fleet effectively.

We emphasize the ambitious nature of the HRM modal split targets not because they are not achievable: with suitable investments and aggressive travel demand management policies, there is some likelihood that they might be reached. However, it would be inappropriate not to consider the real possibility that – for a variety of reasons, and in particular because of the very substantial funding required to build a transit system capable of attracting and supporting such usage levels - the targets will not be achieved. Not achieving these targets means that new harbour crossing capacity may be required earlier – perhaps much earlier - than would be the case if future transit modal shares were consistent with those goals.

In our view, satisfying this aggressive transit modal split target will only be possible through the use of a sophisticated public transit system – most likely Bus Rapid Transit (BRT). BRT normally employs a combination of reserved bus lanes, exclusive busways, specialized terminal and station operations, park and ride facilities, and ancillary improvements to move passengers quickly and efficiently. Using the rail corridor to accommodate Bus Rapid Transit (BRT) could form an integral part of such a strategic initiative.



We note that the current rail corridor appears to be the only undeveloped linear corridor on the Peninsula that might be available for use by BRT. It is also strategically located, linking a number of key peninsular commercial and employment areas, and as a BRT route, has the potential to provide a congestion-free transit link between these areas and Highway 102.

[5] Portions of the discussion in this chapter have been drawn from the *Cross Harbour Traffic Needs Assessment Study* carried out by MRC for the Halifax Dartmouth Bridge Commission. That study also examined a potential transit use of this corridor.

In the longer term, using the rail corridor to accommodate BRT, and linking this to shoulder bus lanes on the Circumferential Highway, also provides an opportunity to create a complete Regional BRT circuit if a third harbour crossing were provided at the south end of the peninsula.

6.2 The implications of modal split targets

6.2.1 Overview

If the HRM cannot achieve the 2026 target modal split share to transit, other studies have shown that traffic congestion in the Region – and in particular on the Peninsula – will become intractable. Under such conditions and unless significant funds are invested in the expansion of road infrastructure in the region, commuters will suffer significant delay. Traffic congestion has also been shown to be a significant contributor to increased levels of CO_2e emissions. Of course, if access to the Peninsula area becomes difficult and time consuming, it is also unlikely that the planned employment and residential growth in this area of the HRM will be realized. This would represent a significant failure of the planning process which carries with it real and important financial and broader economic consequences.

It is unrealistic to suggest that the accommodation of BRT on the ITC would be the sole contributor to the achievement of the Region's modal split targets. Nonetheless it is our view, substantiated by quantitative analysis, that the corridor could play a key contributory role in this regard. In order to understand the potential benefits that accrue from the overall achievement of the 23% goal, we examined two of the three performance parameters noted above: avoidance of commuter delays, and reductions in greenhouse gas emissions.

6.2.2 Avoidance of commuter delays

To quantify the impact that a 23% transit modal share would have on travel times, the HRM transportation demand model was used to quantify the total person-hours of travel that take place on the road network under both a status – quo modal split scenario in 2026, and the achievement of the HRM 2026 target modal split to transit in the peak hour.

Our analysis indicated that the achievement of the HRM 2026 target modal splits would result in a reduction in total peak period[6] person hours of travel across the regional network in the order of 5,400 person-hours, if travel times on the transit system were identical to those of private motor vehicles on the street system.

However, if travel times on the transit system provided a significant advantage to peak period users over those achievable in a private motor car, then the total peak period savings in person hours of travel would be substantially greater.

Although this is a simplistic method of examining an extremely complex issue, the results of this analysis suggest that the potential travel time savings associated with a 23% transit modal share are significant.

[6] The term peak period refers to the 4 hour combined morning and evening 2-hour peak periods of traffic that are expected to exist in 2026.

6.2.3 Greenhouse Gas Emissions

Greenhouse Gas (GHG) emissions generated by vehicular traffic were quantified on a region-wide basis (all of HRM) for the peak traffic hours to determine the differences that result from the two key transit planning scenarios:

- An 18% transit use or low transit use scenario; versus
- A 23% transit use or high transit use scenario.

We applied the same calculation methodology discussed in Section 3 to calculate GHG emissions. Of course in this case, we were dealing with the entire HRM and not a subset of the road system as was the case in our Section 3 analysis. A summary of CO_2e emission estimates for the 2026 planning horizon is shown in Table 7 for the two different levels of transit usage. All units are metric tonnes produced during the peak traffic hours of a typical year.

Table 7 CO_2e emission savings with 23% transit modal split

2026 Horizon Scenario	Annual Peak Hour GHG Emissions (tonnes of CO_2e)	Percent Savings
Region-wide Low Transit Use (18%)	1,050,000	~
Region-wide High Transit Use (23%)	954,000	10%

The findings indicate that there is a general reduction in vehicle emissions if the HRM can achieve their transit use targets by the 2026 planning horizon. The 10% reduction in emissions is associated with reducing the number of cars on the road.

6.3 Concluding thoughts

While one can argue about the specific level of benefit that accrues to the HRM from the ability to use the ITC corridor for transit, it is our opinion that having access to the corridor for the long term use of a BRT system would be advantageous in helping the HRM to achieve its 2026 transit modal split targets as set out in the 2006 HRM Regional Plan.

Discussions with Metro Transit and communications with the HRM in respect of the potential use of the corridor for public transit confirmed their qualified level of interest in the possibilities that it offered to further the goals of the Region in achieving greater levels of transit use in the HRM. This qualified interest was predicated on any such corridor having appropriate transit stations and related operational features, as well as the need for the HRM to analyze alternative corridors in which bus rapid transit could be provided, in order to evaluate options more fully.

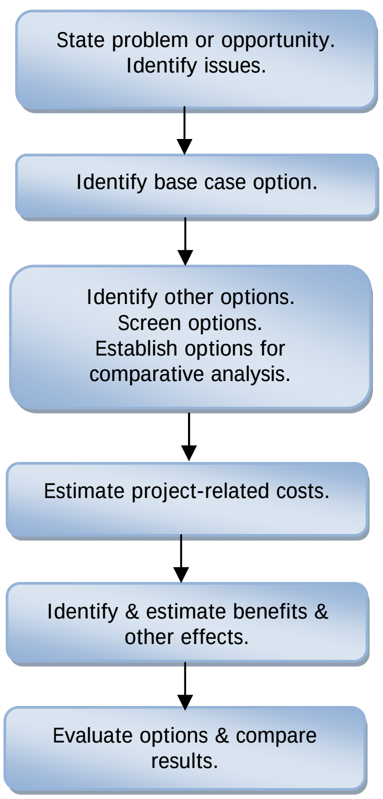
7 Benefit/Cost Analysis

7.1 Background

Benefit/cost analysis (BCA) is an evaluation approach that examines from the perspective of society at large the relative merits of alternative options for public investment. It is similar to investment analysis undertaken by a firm when it evaluates the profitability of a new investment. However, a BCA examines the merits from a broader perspective of various stakeholders impacted by the proposed investment.

Our approach to the benefit/cost analysis follows that outlined by Transport Canada (1994) and is summarized in Figure 13. The next part of this section provides a concise statement of the problem and options. It also provides the quantitative analysis of the various options. The remainder of this section discusses our conclusions.

Figure 13 Benefit/cost Analysis Approach



7.2 Atlantic Gateway context

An assessment of alternative transportation infrastructure options is ultimately linked to the perceived opportunities emanating from an Atlantic Gateway Development. An examination of the benefit/cost associated with alternative transportation options and selection of the best option improves the overall competitiveness of the Atlantic Gateway concept.

A successful Atlantic Gateway development will provide significant benefits to the Atlantic Region. A recent study provides estimates of the potential impact.[7] As shown in Table 8, the Atlantic Gateway has the potential to create 61,300 new jobs with $2,118 million in wages by 2025 given the growth assumptions. It should be noted that these figures are based on growth assumptions estimated in 2006 and do not necessarily reflect the impact of the current global economic situation.

Table 8 Potential Economic Impact of 2025 Atlantic Gateway Traffic Projections

Potential Economic Impact of 2025 Atlantic Gateway Traffic Projections in Atlantic Canada (in 2006 dollars)					
	Jobs	Person Years	Wages ($ M)	GDP ($ M)	Output ($ M)
Direct	54,000	45,100	2,073	3,244	7,440
Indirect	28,900	24,200	801	1,498	3,922
Induced	38,300	32,000	1,208	1,794	3,934
Total Impact on Atlantic Canada	121,200	101,300	4,082	6,534	15,296
Rest of Canada	12,400	10,400	602	975	1,841
Increase from Current Levels	+61,300(2) (+85%)	+51,300 (+85%)	+2,118 (+82%)	+3,434 (+83%)	+7,691 (+82%)

Source: InterVISTAS
(2)Figure slightly higher due to rounding.

[7] InterVISTAS Consulting Inc, MariNova Consulting Ltd. and TranSystems. 2007. *Atlantic Gateway Business Case*.

7.3 Analysis: Atlantic Gateway Perspective

7.3.1 Base case

The base case refers to the status quo – it is the existing transportation system that will prevail if the rail cut option does not proceed. We assume that the Atlantic Gateway Project will, under the base case, transport marine goods from the south end to their destinations using current routes, i.e. city streets. Hence, the various options that we examine are evaluated as the incremental benefit/costs to this base case. Travel time savings and other benefits are measured in terms of their savings relative to truck traffic etc., using existing routes. The time horizon year used is 2026.

7.3.2 Preferred alternative

As documented earlier in this report, an extensive review was conducted of various alternative options using the CN Rail system on the peninsula. The final option selected for detailed analysis (Option 1B) involves two rail lines with a two-way roadway and urban curb and gutter. The benefit cost analysis for this option is provided under three scenarios based on low, medium and high port marine cargo growth assumptions.

Under the low case, truck trips are held at existing levels – 240 truck round trips per day. Under the base case, truck trips are expected to grow from 240 to 320 round trips by 2026. Under the high growth case, truck growth is expected to increase from 240 to 400 round trips by 2026.

7.3.3 Construction and operating costs

Subsequent to the selection Option 1B as the preferred corridor alternative, the construction cost estimate was further refined through the technical road design process. Table 9 provides a breakdown of this refined cost estimate.

Table 9 Option 1B – Construction Cost Breakdown (2009$)

Option 1B – Construction Cost Breakdown (2009$)	
One rail line with future 2nd rail, and two-way Truck/Transit lanes and Urban curb and gutter	$ 126,000,000
Bridge Demolition (all)	$ 5,650,000
Supply and Install by-pass temporary bridges	$ 2,800,000
Bridge Replacement (Incremental cost only-for additional length required beyond the existing bridge lengths)	$ 13,800,000
Access road from CN Yard @ Halterm to Transit Route.	$ 2,000,000
Access road from CN Yard to Joseph Howe Drive.	$ 2,000,000
Allowance for Storm Water System Lift/Pump Station & Outfall.	$ 10,000,000
Property Acquisition. (Allowance)	$ 7,000,000
Sub-Total	**$ 169,250,000**
Contingency 20 %	**$ 33,850,000**
TOTAL	**$ 203,100,000**
SAY:	**$210,000,000**

ITEMS NOT INCLUDED IN THIS ESTIMATE:

1. The Active Transportation (AT) trail and any special structures needed to accommodate the trail or any resolution to already existing AT constraints.
2. Environmental, design, survey, P.M., geotechnical, etc.
3. NSPI Transmission line relocation or modifications.
4. Transit Terminals.
5. Corridor purchase/lease costs.

It should be noted that this construction cost estimate only includes the incremental difference in the bridge replacement costs resulting from the widening of the rail cut. This approach was used as the existing bridges across the rail cut are nearing the end of their design life and will require replacement in the foreseeable future regardless of whether the ITC project proceeds or not.

Seasonal maintenance operating costs are estimated at $155,200 per year.

7.3.4 Benefits

The major benefits to society can be classified into two major categories:

- Travel time savings benefits: The benefit of transportation alternatives is the time travel savings of the proposed alternative to the base case. For work related trips, time savings represent an opportunity cost for employees. For pleasure trips, time savings represent an opportunity cost for foregone leisure. For the purposes of this study we distinguish two types of benefits – trucking and commuters and business trips by cars.
- Social cost savings benefits: Savings from the social costs caused by transportation systems. In this study, we focus on two major social costs, greenhouse gas emissions (GHG) and accidents.

There is also an incremental operating cost savings associated with reducing the wear and tear of heavy truck traffic on downtown streets and placing them on a concrete pavement specifically designed to accommodate heavy loads. The table below provides a breakdown of the benefits and costs for the preferred alternative, presented for the low, base and high truck traffic forecasts.

Table 10 Benefit / Cost Breakdown for Option 1B

Benefit - Cost Breakdown - Option 1B		
Benefits Module 1		***Present Value 2010-2026***
Travel time savings trucks railway cut	low	$5,461,012.04
	medium	$6,651,166.34
	high	$7,548,912.03
Travel time savings cars existing route	low	$1,163,233.15
	medium	$1,163,233.15
	high	$1,163,233.15
Incremental operation cost savings railway cut	low	$347,873.34
	medium	$409,073.02
	high	$470,273.27
Social benefit greenhouse gas savings	low	$0.00
	medium	$0.00
	high	$0.00
Social benefit accidents savings	low	$0.00
	medium	$0.00
	high	$0.00
Costs Module 1		
Incremental construction costs railway cut		$210,000,000.00
Operation costs		$1,328,431.09
Corridor purchase or lease costs		$0.00
Property values		$0.00

Table 10 does not include any corridor purchase or lease cost. At the time of the preparation of this report no final determination had been made in respect of this item, and as a result, we have not included this cost in the final calculation of the benefit/cost analysis results.

When we examine each of the truck growth forecasts individually, the quantifiable benefits are significantly lower than costs. Normally, such an outcome implies a rejection of proceeding with the project based on the quantifiable benefits. The following tables summarize the benefits and costs for each truck growth forecast. They also provide findings from a sensitivity analysis that increases the project life to thirty years.

Table 11 Low Case Benefit-Cost Summary

Low Case Benefit-Cost Summary		
	Net Present Value	
	2010-2026 (Millions 2009$)	2010-2039 (Millions 2009$)
Benefits	6.972	9.088
Costs	211.328	211.732
Benefit/Cost ratio	0.03	0.04

Table 12 Medium Case Benefit-Cost Summary

Medium Case Benefit-Cost Summary		
	Net Present Value	
	2010-2026 (Millions 2009$)	2010-2039 (Millions 2009$)
Benefits	8.233	10.999
Costs	211.328	211.732
Benefit/Cost ratio	0.04	0.05

Table 13 High Case Benefit-Cost Summary

High Case Benefit-Cost Summary		
	Net Present Value	
	2010-2026 (Millions 2009$)	2010-2039 (Millions 2009$)
Benefits	9.182	12.460
Costs	211.328	211.732
Benefit/Cost ratio	0.04	0.06

7.4 Other benefits

The benefit/cost analysis outlined in the previous section deals with those benefits and costs associated directly with the gateway function of the project. Notwithstanding this fact, it is evident that there are potential benefits that could arise from this project that relate to a broader perspective. We outline some of these potential benefits below.

7.4.1 Potential reductions in CO_2e emissions

As indicated in Section 6 of this report, the rail cut corridor has the potential to form part of a Bus Rapid Transit (BRT) system that could help in achieving the 2026 transit modal share targeted in the HRM Regional Plan (23%).

Under this high transit modal share scenario there are major savings in social costs as commuters move from cars to buses. One such saving is a reduction in CO_2e emissions, and our model simulations estimate that such GHG savings could amount to 96,000 tonnes equivalent of CO_2 yearly.

This projected reduction in CO_2 equivalent GHG emissions results in annual savings of $3.0 million using the average CO_2 equivalent value of $30.00 estimated by Transport Canada. This in turn represents $25.8 million (2009$) in net present value terms. Obviously, only some portion of this benefit could be attributed to the presence of the ITC corridor, and then only if the corridor were actually used to accommodate public transit.

7.4.2 Potential travel time savings

In Section 6.2.2, we already noted that if the 2026 HRM Transit Modal Split of 23% was achieved in the horizon year, this could result in reductions in total network person hours of travel that would represent an overall societal saving. In the conservative analysis presented in that section we estimated the potential daily savings in this regard to be in the order of in the order of 5,400 person-hours, if travel times on the transit system were identical to those of private motor vehicles on the street system. Translated into economic terms, this represents annual savings of about $12 million or $103 million (2009$) in net present value terms. Again, we note that only some portion of this benefit could actually be attributed to the presence of the ITC corridor, and then only if the corridor were actually used to accommodate public transit.

7.4.3 Delaying a third harbour crossing

Our model simulations also suggest that if the Region is successful in achieving the high transit option in 2026, this has the potential to delay a $1.1 billion expenditure for a third harbour crossing. If – as other studies suggest - a third harbour crossing is required by 2016 under the base case, and the ITC corridor plays a role (through a provision to accommodate transit) in helping to achieve the target modal splits set by the HRM, the building of the new harbour crossing may be delayed to 2026. The benefit of such a delay may be expressed quantitatively as the present value of the harbour crossing in 2016 less the present value of the harbour crossing in 2026. This amounts to $297 million (2009$). We note again that only some portion of this benefit could actually be attributed to the presence of the ITC corridor, and then only if the corridor were actually used to accommodate public transit.

7.5 Key finding of B/C analysis

A benefit cost analysis reveals that the benefit cost ratio of the selected option is significantly below one and hence results in a recommendation not to proceed. On the other hand, our sensitivity analysis suggests that a high transit use for the rail corridor has significant benefits to cost relative to the base case. Of course, if the high transit option can be achieved under an option other than the rail corridor these benefits would be significantly reduced.

8 Feasibility and Risk Management

8.1 Background

This project is very complex. If it proceeds to implementation, the factors that will affect its ultimate performance either as a gateway project, or as a contribution to the broader Regional transportation system, are far reaching and problematic to quantify. There is little doubt that from a strictly technical standpoint, the preferred alternative can be built and can provide for the intended simultaneous movement of trains, trucks, and – if desired - transit. This however, can be regarded as a necessary but not sufficient achievement in terms of defining whether or not the project is "feasible".

Even the question of whether or not the project can meet some defined quantitative cost-effectiveness threshold may or may not be the appropriate measuring stick to assess the feasibility of the project. Governments regularly invest in projects whose cost-effectiveness may not be quantifiable: the provision of community centres, skating rinks, and other similar amenities provide good examples of such expenditures. In such cases, decisions are often reached on the basis of a broader set of societal considerations, and the need to balance perceived strengths, weaknesses, threats, and opportunities in the context of societal values and needs.

In these cases, feasibility cannot be measured. Rather, clearly assessing and understanding the risks of realizing the various potential combinations of project impacts – both negative and positive – becomes a more realistic means of assessing project feasibility. It is our view that this project is one of those whose value and feasibility is best assessed using this kind of risk analysis approach. Our assessment of feasibility thus concentrates on providing a carefully considered risk commentary that identifies key risk issues and their potential consequences, discusses the likelihood of those risks being realized, and outlines the factors that contribute to that likelihood. Where possible, mitigating measures that might help reduce risk are also discussed.

8.2 Some thoughts on risk and risk management

8.2.1 What is risk?

Risk is attendant to all aspects of our lives. We do not always think about it, or even clearly understand the different levels of risk we accept in our day-to-day activities. Individuals, governments, businesses, academic institutions, and others are all engaged in the business of taking risks that may affect themselves, or some cases thousands or millions of others. MacCrimmon and Wehrung provide a clear and substantive definition of risk that is at the same time illuminating and precise:

> *The main definition of the verb "risk" in the Oxford English Dictionary is "to expose to the chance of injury or loss." …It is worthwhile to reflect upon various aspects of the definition. First, it is necessary that there be a potential loss of some amount (we will use "loss" as a general expression to include "injury"). Second, there must be a chance of loss. A sure loss is not a risk. Third, the notion "to expose" means that the decision maker can*

take actions that can increase (or decrease) the magnitude of or chance of loss. Therefore "to risk" implies the availability of choice. This exposure may be to the person making the risky decision or to other persons or groups in the environment.[8]

8.2.2 What is risk management?

When we talk about managing risk, we refer to the fact that the decision maker can take actions that can change the magnitude or chance of a loss taking place. Implementing risk management actions implies active behaviour involving attempts to adjust the components of the risky situation. To attempt such actions requires a fundamental understanding of the components of the risky situation and their relative influences on possible outcomes under different circumstances.

MacCrimmon and Wehrung enunciate a model of risk management that has five phases:

- Recognizing and structuring the risks;
- Evaluating the risks and deciding whether to act or not;
- Adjusting the risks more in line with what is desired;
- Choosing among the risky actions;
- Tracking the outcomes.

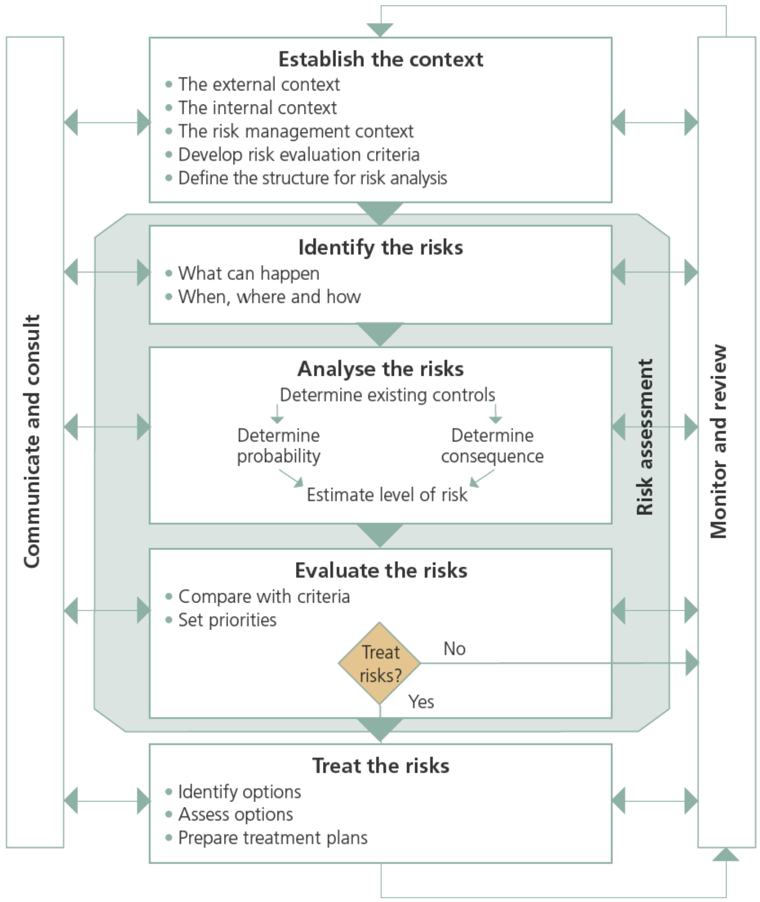
In any report dealing with risk management the primary aim is to provide information that will help decision makers to recognize and evaluate the risks, evaluate alternative actions, and to choose from among those actions. What is important to recognize is that the actions themselves are risky, and although our understanding of their potential impacts may be based on the best available information, there is no absolute certainty as to the outcome that will occur. In this context, recommendations regarding the tracking of outcomes (the fifth phase of the risk management process) are fundamental and must be considered an integral part of any plan of actions implemented as a result of a risk management review.

8.2.3 The risk analysis process

The risk management process consists of a series of steps that, when undertaken in sequence, enable continual improvement in decision-making. Figure 14 summarizes this process.

[8] MacCrimmon, KR, Wehrung, DA. "The Management of Uncertainty: Taking Risks". The Free Press. New York, N.Y. 1986

Figure 14 Risk Management Process[9]



This is the process that we followed in our risk analysis of the preferred alternative. The work was carried out in a one-day workshop attended by key project team technical specialists. In the course of the day, the context for the analysis was assessed, and key risks were identified and evaluated from the standpoint of their likelihood of occurrence, and their potential impact if they did occur. A relatively simple, standardized matrix typical of this type of analysis, and shown in Figure 15, was used to estimate the level of risk for each identified risk element based on the probability and impact values.

Figure 15 Risk Estimation Matrix

Impact	Likelihood		
	Likely	Possible	Rare
Significant	High	High	Medium
Major	High	Medium	Low
Minor	Medium	Low	Low

[9] "The Risk Management Process: Australian/New Zealand standard AS/NZS 4360"

Using the matrix in Figure 15, each risk element could be evaluated for its likelihood and consequence, and these two values could then be used to determine a “risk level” of Low, Medium, or High. For instance, if a given element was considered to have a likelihood of “Rare”, combined with a possible “Significant” impact, the risk level obtained from Figure 15 was “Medium”. The process is quite simple, but helps to standardize the discussion among those doing the rating, and thus provides a framework that enforces consistency in the way in which the ratings are obtained.

Risks were also classified as “positive” or “negative”. Positive risks were elements which had the potential to yield a positive gain. Negative risks were of the more traditional type, and had some risk of loss associated with them. Of course in both cases, there was a level of doubt about whether or not the outcome would be realized.

The risk ratings themselves were used as the basis for the evaluation of the risks into two broad categories:

- High Risk elements: if rated as negative these elements were regarded as factors which might prevent the project or some significant benefit related thereto, from being realized. In these instances, carefully structured measures would be required to avoid a significant threat to the project. If rated positive, it meant that these factors had a significant potential to advance the goals of the gateway corridor project. These instances were regarded as candidates for proactive measures to advance the realization of the corridor goals, if not the corridor itself.
- Low and Medium risk elements: in both these cases, some decision had to be made regarding the acceptability of the risk being incurred. In essence, to advance the project further required some understanding and acceptance of the risks that were present – whether positive or negative.

Potential risk mitigation measures were identified for each risk element. Such mitigating measures could include a variety of generic options including:

- Avoiding the risk: the do nothing option. Of course, on negative high risk elements, such an option would essentially amount to abandoning the project.
- Change the likelihood of occurrence: either through engineering measures, the initiation of ancillary offsetting action within the community, or through collaboration with stakeholders to reduce the risks.
- Change the impacts: in some cases, mitigating measures could help to reduce the severity of consequences flowing from a potential risk.
- Sharing the risk: teaming with a partner or reducing exposure through insurance;
- Retain the risk: in some instance, risk levels may be present but acceptable.

8.3 Results of the risk analysis

To help initiate and set a framework for our discussions, we first identified both the internal context and the external context for this review. Table 14 summarizes this context.

Table 14 Risk Assessment Context

The Internal Context	The External Context
Stakeholders:	**The operating environment:**
CN	*Corridor neighbours*
HRM	*Developers*
TIR	*Downtown Business*
Developers	*Ceres*
Halterm and Ocean Terminals	*CN Intermodal*
Trucking firms	*HRM*
Different cultures, interests and objectives.	**The world freight market**
	Environmental impacts

Developing an understanding of this context also helped to frame the discussions during the risk analysis process.

Tables 15, 16, and 17 present the results of our risk analysis in summary form for each of the elements of high, medium, and low risk respectively.

Table 15 Risk Elements Rated "High"

Risk Element	Positive or Negative	Prioritization			Potential Mitigation or Proactive Measure
		Likelihood	Impact	Risk	
Local community objection to rail cut	N	Likely	Significant	High	On going stakeholder consultation; community integration plan
Corridor land lease costs too high	N	Possible	Significant	High	P3 mechanism (HDBC, HRM, CN); shadow tolls
Perceived environmental impacts generate objections	N	Likely	Significant	High	Community integration plan; carbon offsets
Halterm closes	N	Possible	Significant	High	Improve access to Halterm - implement project
Implementation of third harbour crossing - gateway impact	N	Possible	Significant	High	Implement truck restrictions or premium tolling on truck harbour crossing; delay need for crossing with TDM
Implementation of third harbour crossing - transit impact	P	Possible	Significant	High	
Change in political will - provincial	N	Possible	Significant	High	Build a business case to get support from private sector
Lack of HRM political will	N	Possible	Significant	High	Build a business case to get support from private sector; Provincial incentives
Loss of federal funding support	N	Possible	Significant	High	P3 mechanism
HRM By Design advocates - support	P	Likely	Major	High	Stakeholder consultation; project briefing; encouraged to support
HRM transit modal split not achieved	N	Possible	Significant	High	Implement TDM measures; transit use incentives
Project costs prohibitive	N	Likely	Significant	High	P3 mechanism
CN not responsive	N	Likely	Significant	High	Political response
Blasting in residential area - community perception	N	Likely	Major	High	On-going consultation program, liaison
Potential for crime shadow at transit stations	N	Likely	Major	High	Safety conscious design, security measures, CPTED
Increase in ambient noise	N	Likely	Major	High	Integration plan, cut & cover at sensitive locations, on-going consultation

Table 16 Risk Elements Rated "Medium"

Risk Element	Positive or Negative	Prioritization			Potential Mitigation or Proactive Measure
		Likelihood	Impact	Risk	
Trail advocates support rail cut	P	Possible	Major	Medium	Trail integration plan and funding
Fuel cost rise	P	Likely	Minor	Medium	
CN abandons cut - transit perspective	P	Rare	Significant	Medium	P3 mechanism (HDBC, HRM); shadow tolls
CN abandons cut - Gateway perspective	N	Rare	Significant	Medium	P3 mechanism (shortline)
Northwest Passage open year round	P	Possible	Major	Medium	Marketing and operations plan to put Halifax at the forefront.
Property values increase with high transit and stations	P	Likely	Minor	Medium	Land uplift capture plan required
Shipping price system to North America changes	P	Rare	Significant	Medium	Partnership between CN, port authorities and shippers
Construction cost estimates too low	N	Possible	Major	Medium	Inflation induced cost factors, report construction costs in current dollars for year of construction
Changes in vehicle technology (LCV)	P	Likely	Minor	Medium	Increases efficiencies on corridor only; Ensure design criteria accommodate LCV design vehicle
Metro Transit supports rail cut	P	Possible	Major	Medium	Stakeholder consultation; project briefing; encouraged to support (union briefing)

Table 17 Risk Elements Rated "Low"

Risk Element	Positive or Negative	Prioritization			Potential Mitigation or Proactive Measure
		Likelihood	Impact	Risk	
Freight forecasts incorrect	N	Possible	Minor	Low	Apply a sensitivity analysis to the review; adjust project timing until trends are obvious;
Vehicle traffic forecasts too high	N	Possible	Minor	Low	Apply a sensitivity analysis to the review; adjust project timing until trends are obvious;
Property values decrease - no transit	N	Rare	Minor	Low	Community integration plan
Road safety: Trespassing, Bus / truck interaction, Intersections	N	Possible	Minor	Low	Safety conscious design, security measures, photo radar
Operating costs higher than anticipated	N	Possible	Minor	Low	Detailed review and study
Loss of NHS designation	N	Rare	Minor	Low	Business case
Constructability - not able to maintain service on existing rail line	N	Rare	Major	Low	Careful planning and design
Availability of property for trail - off CN ROW	N	Possible	Minor	Low	Property/financial offsets; pedestrian structures (cut & cover)
Hazardous material incident	P	Rare	Major	Low	Incident management/response plan

In addition to these results, the risk analysis workshop also carried out a risk analysis of the potential consequences if the ITC corridor does not proceed. Table 18 presents the findings of that evaluation.

Table 18 Risk evaluation if the corridor does not proceed

Risk Element	Positive or Negative	Prioritization			Potential Mitigation or Proactive Measure
		Likelihood	Impact	Risk	
Public intolerance of trucks in down town	N	Likely	Major	High	Provide alternate connection - third harbour crossing, inland terminal, rail cut; relocate marine terminal
HRM By Design can not be fully achieved	N	Likely	Major	High	Provide alternate connection - third harbour crossing, inland terminal, rail cut; relocate marine terminal
Unable to achieve HRM transit targets - No BRT route	N	Likely	Significant	High	Implement aggressive TDM measures, transit use incentives
Earlier need for third harbour crossing	N	Possible	Significant	High	Implement aggressive TDM measures, transit use incentives
Increased travel time for truck freight	N	Likely	Major	High	Provide alternate connection - third harbour crossing, inland terminal, rail cut; relocate marine terminal
Increased congestion in downtown core as a result of not achieving transit goals	N	Likely	Significant	High	Provide alternate connection - third harbour crossing, inland terminal, rail cut; relocate marine terminal
Port/City/Provincial image deteriorates - loss of competitiveness	N	Possible	Significant	High	Other gateway initiatives
Freight movement shifts from truck to inland terminal (rail) - public opinion	P	Likely	Major	High	
Freight movement shifts from truck to inland terminal (rail) - stakeholders	N	Likely	Major	High	P3 mechanism (shortline)
Risk Element	**Positive or Negative**	**Prioritization**			**Potential Mitigation or Proactive Measure**
		Likelihood	**Impact**	**Risk**	
Halterm is less viable	N	Possible	Major	Medium	Provide alternate connection - third harbour crossing, inland terminal, rail cut
Tourism impacts - trucks in downtown, Pier 21	N	Likely	Minor	Medium	Time of day restrictions for trucks, reconfiguration of roadway network in terminal area
CN abandons cut - transit perspective	P	Rare	Significant	Medium	P3 mechanism (HDBC, HRM); shadow tolls
CN abandons cut - Gateway perspective	N	Rare	Significant	Medium	P3 mechanism (shortline)
Northwest Passage open year round	N	Possible	Major	Medium	Marketing and operations plan to put Halifax at the forefront.
Shipping price system to North America changes	N	Rare	Significant	Medium	Partnership between CN, port authorities and shippers
Changes in vehicle technology (LCV)	N	Likely	Minor	Medium	Inland terminal alternative
Hazardous materials transported in a more dense urban area	N	Rare	Significant	Medium	Incident management/response plan
Risk Element	**Positive or Negative**	**Prioritization**			**Potential Mitigation or Proactive Measure**
		Likelihood	**Impact**	**Risk**	
Risk of increased collision frequency on city streets	N	Possible	Minor	Low	Improved accommodation of pedestrians, road safety review of truck routes
Potential bottleneck resulting from proposed developments along current truck route	N	Possible	Minor	Low	Provide alternate connection - third harbour crossing, inland terminal, rail cut; relocate marine terminal
Potential delay of trail construction	N	Possible	Minor	Low	
Alternative facility is more costly - inland terminal / new marine facility	N	Possible	Minor	Low	Cost standpoint
Defer structure replacement - public safety	N	Rare	Major	Low	Structural replacement program

8.4 Key observations on risk analysis related to corridor proceeding

In this section, we provide a series of observations regarding the results of this risk analysis.

- Sixteen high level risk factors were identified. Of these, two were regarded as potential "showstoppers": risk elements whose nature either precluded mitigating action, or made such action highly speculative. The two "showstoppers" were:
  - There is a lack of political will at the HRM level;
  - There is a change in political will at the Provincial level.

- Consultation and collaboration programs and community action plans were listed as potential mitigating or proactive countermeasures in five cases for the high level risk factors. It is evident that community will is a key factor that must be considered in a positive and proactive way if the project is to proceed under any conditions. Such programs can be expected to involve collaboration on the development and implementation of mitigating technical measures (cut and cover sections for the corridor, noise mitigation, compensatory planning or community measures to restore or enhance valued community features etc.);

- Various types of P3 mechanisms are suggested as proactive countermeasures for five of the high level risk factors. This is not surprising since such mechanisms constitute risk-sharing propositions, and will usually only go forward once the risk/return ratio of a project has been proven to be of sufficient magnitude to be of interest to private sector parties. In the short term, such propositions are likely to be difficult to assemble given the state of the global economy.

- There are ten factors that have been rated as medium risks. Interestingly, eight of these involve positive risks. They include:
  - Trail advocates support rail cut: providing additional community incentive for the project to proceed;
  - Fuel cost rise: likely to provide additional incentive to provide access to the rail cut for both trucks and transit;
  - CN abandons cut: from a transit perspective the abandonment of the rail line within the cut opens new and perhaps affordable opportunities for use of these lands for public transit;
  - Northwest Passage open year round: may provide an opportunity for Halifax to function as the entry, exit, and servicing gateway to this potentially critical shipping route;
  - Property values increase with high transit modal split and stations: if public transit stations are placed along the corridor, experience in other cities has clearly shown the potential for such installations to have a positive effect on property values and development levels;
  - Shipping price system to North America changes: at present, trans-Atlantic shipping pricing schedules dictate uniform pricing for cargo crossing from Europe to any port on the eastern seaboard or inland to Montreal. Such a policy puts Halifax in a weak competitive position. If pricing schedules were to become more closely related to distance, then Halifax's position as one of

  the closest ports to Europe could become a competitive advantage.
  - Changes in vehicle technology (LCV): the ability to accommodate long combination vehicles within the rail cut could provide some competitive advantage to the south end marine terminals;
  - Metro Transit supports rail cut: proactive support from Metro Transit could provide additional impetus to moving the ITC forward.

- All of the low risk elements noted in the risk assessment appear to be able to be readily dealt with using relatively straightforward and cost-effective measures. In two cases, the measures adjusting project timing until various key trends become more evident. In four others, careful planning and design processes and community consultation measures are seen as potentially effective strategies.

8.5 Key observations on risk analysis related to corridor not proceeding

The risk analysis panel felt strongly that an assessment of the consequences of not proceeding should be examined as a logical counterpoint to the preceding analysis. This view was based on the fact that a number of positive opportunities were associated with the implementation of the ITC corridor, particularly with respect to enhancing – to varying degrees - the potential for HRM to achieve a number of key regional planning and community goals including, but not limited to:

- Reaching the target modal splits set out in the HRM Regional Plan;
- Supporting the goals of the “HRM by Design” project, which actively promotes and requires heavy truck traffic to be minimized in the downtown;
- Supporting the goals of the Greenway concept for a series of trails and paths along the current corridor.

Of the nine high level risk elements cited in this review, five would result in a greater need for a third harbour crossing. These include:

- Public intolerance of trucks in down town: could be mitigated by the provision of a third harbour crossing which would provide a logical connection across the harbour from the south end terminals for trucks destined to Burnside or to external highway connections on the Provincial highway system;
- HRM By Design can not be fully achieved: similar to the point immediately above, the provision of a third harbour crossing would help reduce considerably or eliminate downtown truck traffic generated by the south end terminals;
- Earlier need for third harbour crossing generated by the difficulty of achieving target modal splits set for the regional plan;
- Increased travel time for truck freight: If truck freight cannot move efficiently in the downtown, and the competitive position of the port is negatively affected, a third harbour crossing – while perhaps not justifiable in itself to deal with this matter – could provide some additional motivation to consider early implementation of such a connection that could handle trucks.

- Increased congestion in downtown core as a result of not achieving transit goals: in a manner similar to the point just made above, the early implementation of a third harbour crossing could help alleviate general traffic congestion on the downtown peninsula.

A critical risk element if the project does not move forward involves the status of Halifax as a port city. From a gateway standpoint, failure of the port to be able to refine or even maintain its competitive position in the global market due to a declining ability to service the south end terminals, could jeopardize the reputation of the port as an effective gateway to North America.

Six of the high risk elements involve some aspect of relocation of the marine terminal or the eventual construction of an inland terminal.

9 Concluding Thoughts

This study has examined a broad range of issues within a highly complex and developing urban context. Nonetheless, there are a number of key observations and findings that merit highlighting in this concluding section of the report. Following are our concluding thoughts.

With respect to the role of the Port in the regional economy

- The Port of Halifax is a vital part of the regional economy, employing 9,000 persons and generating an annual employment income in the order of 670 million dollars.

With respect to forecasting future marine cargo traffic and truck traffic

- The cargo forecasts prepared for this study reflect a diminishing expectation in the rate of growth in cargo traffic at the south end terminals within the planning horizon. In a major part the difference in projection ranges between our estimate and past studies is due to the challenges facing the Canadian and US economies over the next seven years from the end of 2008 to the end of 2015.

- Truck traffic forecasts for the south end marine terminals track the expected rate of growth of marine cargo traffic at that location. By the planning horizon year, in the highest growth scenario, daily truck trips are expected to almost double from 2008 volumes to a level of approximately 800 truck trips.

- Truck traffic generated by the south end terminals represents a very small portion of the overall traffic volumes using the Barrington/Hollis/Lower Water Street corridor.

With respect to the impact of the ITC on the existing roadway network

- As the demand for freight movement by truck grows, concerns are raised about the reliability of the road system upon which these trucks will travel. Congestion and delay have a detrimental effect on freight movement that can reflect on the viability of a port’s operations. The goal of the ITC project is to help address this concern and thus support the position of the Port of Halifax as a major gateway to the North American market.

- If truck traffic from the south end terminals is diverted to the ITC corridor, travel times on the portions of the public road systems previously used for this activity will change only very marginally. This is largely due to the fact that this truck traffic represents only a very small component of the overall volumes using these facilities.

- The ITC corridor provides significant reductions in truck travel times for the truck traffic generated by the south end marine terminals. A one-way trip in the peak hour direction of traffic flow in 2026 reduces from 25 minutes to 10 minutes. This represents a substantial efficiency for both trucking and port operations.

- The increasing number of "bottlenecks" on the Halifax Peninsula public road system as we move forward to the 2026 planning horizon, put into question the reliability and predictability of traversing the peninsula efficiently. In addition to improving travel times for trucks, the use of the ITC is expected to substantially improve the reliability of travel conditions for truck freight moving to and from the south end terminals. This is an important consideration for time-sensitive freight and scheduling in the trucking industry.

- There is no net change in emissions achieved by diverting trucks out of the downtown to the ITC. This is not surprising given that the same number of truck trips is traversing the peninsula under both truck route scenarios, and that while operating conditions are smoother and travel times are faster on the ITC, the ITC route is actually 1.5km longer.

With respect to the preferred design alternative for the ITC

- The preferred alternative for the ITC consists of two rail lines physically separated from a two-lane, two-way roadway with urban drainage. Although CN have indicated that they do not require a second rail line, we have provided space for a possible second line in the cross section should it be needed in the future.

- The current rail cut corridor has been in place and operational for approximately 90 years. Clearly, these types of facilities need to be planned for long term flexibility. The preferred alternative was selected partly because of the flexibility it offered for the accommodation of future increases in rail freight or the provision of commuter rail.

With respect to the accommodation of the Halifax urban greenway

- In general, the Halifax urban greenway can be accommodated as part of the ITC.

With respect to the ITC and public transit

- If the HRM cannot achieve the target modal split of 23% to transit by 2026, other studies have shown that traffic congestion in the Region, and in particular on the peninsula, will become intractable. Under such conditions, and unless significant funds are invested in the expansion of road infrastructure in the Region, commuters will suffer significant delay.

- In our view, having the ITC present for transit use would be advantageous to the HRM as it strives to achieve its Regional Plan target modal split to transit of 23% by 2026. Satisfying this aggressive transit modal split target could be facilitated through the use of a sophisticated bus rapid transit system that can in part be accommodated within the ITC corridor. The fact that the corridor traverses adjacent to major peninsula employment centres including commercial, university, hospital and downtown office areas represents a significant advantage in this respect.

- While one can debate the specific level of benefit that accrues to the HRM from the ability to use the ITC corridor for transit, it is our opinion that having access to the corridor for the long term use of a BRT system would be advantageous in helping the HRM to achieve its 2026 transit modal split targets as set out in the 2006 HRM Regional Plan.

With respect to the benefit/cost analysis of the preferred alternative

- From a gateway perspective alone the quantifiable benefits associated with the ITC are significantly lower than costs. More specifically, benefits are less than 10% of costs. Normally, such an outcome implies a rejection of proceeding with the project based on the quantifiable benefits alone.

- While the gateway perspective provides the foundation for this study, it is evident that potentially substantial benefits accrue to the HRM as a political body, and as a society, from the perspective of supporting several major planning and community development initiatives launched by the Region in the last few years.

- Regardless of how it is achieved, a conservative estimate suggests that reaching the objective of a 23% target transit modal split in 2026 should reduce peak hour GHG emissions region-wide by approximately 10%. This reduction in GHG emissions has been valued at $25.8 million ($2009) in net present value terms.

- Regardless of how it is achieved, a conservative estimate suggests that reaching the objective of a 23% target transit modal split in 2026 should result in a saving of approximately 5,400 person hours of travel per day in the planning horizon year of 2026. These travel time savings have been valued at $103 million ($2009) in net present value terms.

- Achieving the target modal splits may also allow the delay of a $1.1 Billion expenditure for a third harbour crossing. This amounts to a $297 million ($2009) saving.

With respect to the feasibility of the project

- A complex and detailed risk analysis was carried out to evaluate the potential feasibility of the project. The analysis indicated that the question of proceeding with the ITC is a double-edged sword in that there are substantive risks for all stakeholders involved either if the project proceeds, or does not proceed.

- Our risk analysis identified two key “showstopper” risk factors. These two elements were regarded as showstoppers because their nature either precluded mitigating action or made such action highly speculative.
    - There is a lack of political will at the HRM level.
    - There is a change in political will at the Provincial level.