KING'S WHARF DEVELOPMENT:

Access Risk Assessment and Options Analysis

Prepared by: Emergency Solutions International

13 March 2017

V1.1

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Version History

Version	Description	Date	Name	Signature
0.5	Initial Draft	20 Dec 2016	Sarah McLaughlin	[redacted]
0.6	Second Draft	11 Jan 2017	Bill Todd	[redacted]
0.7	Formatting and editing	27 Jan 2017	Mark Gillan	[redacted]
0.8	Final edits and Peer Review	6 Feb 2017	Mariann Patstone	[redacted]
0.95	Draft version submitted for review	8 Feb 2017	Mark Gillan Bill Todd	[redacted]
1.0	Final Review	1 Mar 2017	Mark Gillan	[redacted]
1.1	Detailed refinement	13 Mar 2017	Sean Day	Email dated March 9, 2017

Acronyms

CCTV	Closed Circuit Television
CN	Canadian National (Railway)
CROR	Canadian Rail Operating Rules
EMS	Emergency Medical Services
ESI	Emergency Solutions International
ESP	Emergency Service Provider(s)
GPS	Global Positioning System
HRM	Halifax Regional Municipality
MIACC	Major Industrial Accidents Council of Canada
NFPA	National Fire Protection Association
ROW	Right of Way

1.0 Introduction and Objectives

The King's Wharf Development is a multi-use project located on a 12.2-hectare site in Dartmouth N.S. The site was formerly the location of the Dartmouth Marine Slip, which ceased operations in 2007. Access to the site from Alderney Drive requires users to cross a railway line operated by Canadian National Rail (CN). Subject to a Development Agreement with the Halifax Regional Municipality (HRM), approved in 2009 the site currently contains four multi-storey buildings housing 354 residential units, a variety of office and commercial uses and below grade parking.

At its meeting on August 26, 2014, the Harbour East – Marine Drive Community Council approved the request of Fares Real Estate Inc. to amend the 2009 Development Agreement for the King's Wharf Development (HRM Case 19241). The amendment approval instituted a construction commencement date of April 01, 2017 for second access in the form of a grade separation to the site, crossing the CN railroad tracks located at the north side of the development. This amendment was in exchange for 54 more units.

In the fall of 2016, Fares Real Estate Inc., prompted by new information regarding the rationale for the requirement for the second access, engaged Emergency Solutions International (ESI) to facilitate, in conjunction with identified stakeholders, the examination of risk in relation to the interdependency between the existing rail crossing and the Kings Wharf Development. Specifically, ESI was requested to:

- identify and evaluate the level of risk associated with the current single at grade access to the King's Wharf project;
- identify and evaluate options for mitigating the level of risk identified, based upon an understanding of the expected project composition;
- provide a report that will assist Fares Real Estate Inc. in its discussions with HRM regarding the requirement for a second access.

ESI was not requested, nor is it the intent of this report to provide recommendations regarding the second access. Further, while the report will provide a limited qualitative risk assessment based upon the information available from various stakeholders, including CN, ESI was not requested to provide a full quantitative risk assessment.

It is believed that the analysis of risk and options presented within this document will form a foundation for stakeholders to re-examine the original requirement of a second access in the form of a grade separation.

2.0 Methodology

In developing this report, ESI has:

- Reviewed and used the available site development information as provided by Fares Real Estate Inc. and/or contained in the various HRM reports, including projections of site densities and occupancies;
- Researched and reviewed the various HRM Planning and associated reports, including the applicable Bylaws, Standards and Regulations;
- Researched and reviewed the various acts and regulations related to the operation and functioning of railroads and railway crossings in Canada;
- Requested and reviewed information provided by CN relative to the functions and activities of the railroad line between the Halifax AutoPort Terminal and the Dartmouth rail yards (portion of the Dartmouth Subdivision) as they may relate to the King Street rail crossing at Mile 12.99;
- Arranged and facilitated meetings with representatives of HRM Planning, Engineering and Parks;
- Arranged and facilitated a meeting with representatives of HRM Police, HRM Fire, Integrated Emergency Services and Emergency Medical Care Inc.;
- Created with ESP representatives above, planning scenarios utilized to discuss higher order consequence and probability for the site;
- Researched and reviewed various reports and studies regarding railroad crossing safety and operation in Canada and the U.S.;
- Had communication with Fire Chiefs from three other Canadian municipalities, where blocked rail crossings are of concern for emergency service providers;
- Based on the research, reviews and stakeholder input and provided information, defined site specific risk scenarios and completed a qualitative risk assessment; and
- Developed and evaluated various options for risk mitigation.

3.0 HRM Reports, Bylaws and Standards

In 2009, HRM approved a Stage 1 Development Agreement for the King's Wharf Development that gave conceptual approval to a master plan for a phased mixed used residential and commercial development that included the following elements:

- 12 buildings ranging in height from 5 to 32 stories.
- 2 new public streets including an extension of Prince Street with an overpass of the CN rail line.
- A maximum of 1500 residential units.
- A 200 room hotel.
- Up to 23,000 square feet of office and commercial space.
- Public parks and boardwalks and a marina.

In 2014 an amendment to the Stage 1 Agreement was requested and approved. The approval allowed for a slight change in the location of one building and a change in the proportion of small units. As well, approval was given to increase the number of residential units from 300 to 354 before requiring the construction of the second access and set a requirement that construction of the access be started by April 01, 2017.

The 2014 report addresses the rationale and purpose for the second access:

> ***HRM Design Guidelines & Street Access***
>
> *Both the existing Stage 1 and Stage 2 development agreements require that a second public street access be constructed from Alderney Drive at Prince Street before the development as a whole exceeds a total of 300 dwelling units. The specific number limitation of 300 units is derived from the Municipal Design Guidelines (the Guidelines[1]'), a set of engineering design specifications which set standards for the design and construction of municipal infrastructure. A key goal of the Guidelines is to ensure that two public street accesses are provided for new developments for every day convenience and service purposes, and to ensure that adequate emergency access can be provided in the event that one street becomes blocked. The Guidelines provide that a maximum of 100 dwelling units may be approved on a single public street access and, in cases where there is an approved phasing plan and agreement in place which confirm that a second street access will be provided within a specified timeframe, up to 300 dwelling units may be developed on a single access. Requests to exceed the 300-unit limit are not routine undertakings and are not typically entertained due to public safety concerns.*

[1] Often cited as the 'Red Book'

4.0 Rail Safety in Canada and the CN Dartmouth Subdivision

4.1 Rail Safety

The railway industry in Canada is highly regulated and controlled through various Acts and associated regulations related to railway safety and operations including:

- Railway Safety Act,
- Grade Crossing Regulations,
- Road/Railway Guide – Technical,
- Crossings Standards and Inspections Testing and Maintenance Requirements (RTD 10),
- Canadian Road/Railway Grade Crossing Detailed Safety Assessment Field Guide, and
- Canadian Rail Operating Rules (CROR).

A general overview of each these Acts/Regulation is provided in Appendix II.

The Canadian Rail Operating Rules – Section 103.1 (C) states:

> "*Speed on a non-main track over a public crossing at grade, equipped with automatic warning devices must not exceed ten (10) miles per hour from a distance of three hundred (300) feet until the crossing is fully occupied.*"

The Grade Crossing Regulations deal with the obstruction of grade crossing and the possible resultant need for access by an emergency vehicle:

- **97 (1)** It is prohibited for railway equipment to be left standing in a manner that causes the activation of the warning system at a public grade crossing other than for the purpose of crossing that grade crossing.

- **97(2)** It is prohibited for railway equipment to be left standing on a crossing surface, or for switching operations to be conducted, in a manner that obstructs a public grade crossing — including by the activation of the gate of a warning system — for more than five minutes when vehicular or pedestrian traffic is waiting to cross it.

- **98 (1)** If railway equipment is operated in a manner that regularly causes the obstruction of a public grade crossing, including by the activation of a warning system, and the municipality where the grade crossing is located declares in a resolution that obstruction of the grade crossing creates a

safety concern, the railway company and the road authority must collaborate to resolve the safety concern.

- **99** Despite section 97 and 98, if an emergency vehicle requires passage across a grade crossing, a company must take all necessary measures to immediately clear the grade crossing.

It is of note and of importance:

- that a train that is moving, however slowly, is not considered in violation of CROR 103.1 (C) and can block a level crossing for more than five minutes; and
- that depending upon its length, a train may block multiple crossings concurrently.

4.2 The Dartmouth Subdivision

CN owns and operates the Dartmouth Subdivision that runs from Windsor Junction to the Halifax AutoPort, a distance of about 16.25 miles. The Dartmouth rail yard is located at Mile 12.5 (see Appendix III for photos and Appendix III.I for map). Between the AutoPort and the Dartmouth yard there are about fifteen public and private rail crossings.

The crossing at King Wharf's is at Mile 12.99 and was installed in 2009 subject to an agreement between HRM, CN and Fares Real Estate Inc. which sets out conditions for the installation and maintenance of crossing infrastructure. The agreement contains a clause authorizing HRM and CN Rail to pursue the elimination of the use of the train whistle. (Access to the former marine slip was subject to a rail crossing at Prince Street.)

In 2015, HRM, at the request of Fares Real Estate Inc. initiated and completed the mandated process for 'whistle cessation' at the Mile 12.99 crossing. This process included the completion of a Grade Crossing Safety Assessment by Hatch Mott and MacDonald and the completion of some corrective/remedial actions by HRM, CN, and Fares Real Estate Inc. In addition, fencing was installed along the eastern boundary between the CN Right of Way (ROW) and the HRM property, to reduce trespassing on the rail ROW.

According to CN:[2]

- The line currently sees approximately eight (8) trains daily and eight (8) passages at the King's Wharf crossing distributed throughout daytime and nighttime.
- A considerable portion of goods carried on the railway line are automobiles, however, one must assume that any type of good that can be legally transported by rail can be carried on any segment of CN's network at any time.

[2] Raymond Beshro, Letter to ESI, *Request for Information from CN Rail re King's Wharf Project,* January 5, 2017, TS (see Appendix VIII for references.)

- Rail traffic on any given line is subject to change depending on CN's operational parameters, in customer's needs and economic conditions.
- A train exceeding about twenty-four (24) cars in length could potentially block the crossings at King's Wharf and the Alderney Ferry Terminal.
- With 8 trains per day multiplied by a calculated 1000 cars per day over the crossing, the current risk product[3] is 8000. This is well below the threshold where a grade separated access is identified as a solution to mitigate cross product risk by CN. Typically, the threshold is set at a minimum of 150,000 although there are no regulatory requirements. Consequently, if the current crossing geometry remains the same, no upgrades or changes would be required, even if traffic were to increase.

5.0 Stakeholder Consultation and Input

5.1 Overview

In addition to the appropriate representatives of the Fares Real Estate Inc. development team, ESI also met with various HRM department representatives in two group forums. CN representatives were offered the opportunity to participate in the two group forums, but declined. CN agreed, however, to receive and respond to written questions (Appendix V). These were received in January, after the December stakeholder meetings occurred. ESI also had communication with the Fire Chiefs from Canadian municipalities where the impact of blocked rail crossings on emergency response is an ongoing concern.

5.2 Objectives of the Meetings with HRM Representatives

There were five primary objectives for the meeting with the HRM representatives:

1. To understand the history and future plans of the King's Wharf development;
2. To be aware of and understand all relevant reports, past incidents (if any), studies, regulations, bylaws and standards;
3. To understand the rationale for the requirement of a second access, including public expectations;
4. To facilitate a discussion which leads to an understanding of risk in the context of King's Wharf, particularly as it relates to the consequences of response scenarios and response complexities; and
5. To explore options that result in meeting the acceptable risk tolerance while meeting public expectations.

[3] This cross product is also referred to the Road Exposure Index or Daily Crossing Exposures; some studies have used a minimum requirement of 200,000.

5.3 Meeting with HRM Planning, Engineering and Recreation/Parks

A meeting was held with representatives of HRM Planning, HRM Parks and Recreation and HRM Engineering. From that meeting:

- It was acknowledged that ESI was reviewing the appropriate documentation available from HRM, including reports, standards and bylaws;
- ESI's Risk Assessment and Options Analysis process was reviewed and discussed;
- Some possible risk scenarios were reviewed; additional past and potential future scenarios were offered and discussed;
- From a Transportation and Engineering perspective, there is no need for a second access to manage the flow of traffic to/from the site;
- For reason of aesthetics, costs, maintenance and connectivity, HRM Planning prefers not to have a grade separation provided the associated risks can be mitigated to the satisfaction of the First Responders;
- A sound rationale would be required to permit the elimination of the need for a second access from the Development Agreement;
- HRM has recently completed the upgrade of its street lighting to LED under the LED Streetlight Conversion Project. This upgrade includes telemetry capabilities that may support CCTV or other sensing technologies;
- First Responders were not consulted prior to the preparation of HRM Case 19241; and most importantly; and
- The second access requirement, as outlined in HRM Case 19241, was based upon HRM Municipal Design Guidelines, that were developed to address risk in rural settings.

5.4 Meeting with HRM Emergency First Responders

A meeting was held with representatives of HRM Police, HRM Fire, HRM Integrated Emergency Services and of Emergency Health Services. From that meeting:

- Participants were updated on the King's Wharf development and the outcomes from the earlier meeting with HRM Planning and others;
- ESI's Risk Assessment and Options Analysis process was reviewed and discussed;
- Some possible risk scenarios were reviewed; additional past and potential future scenarios were offered and discussed;
- Within the discussions around the risk planning scenarios it was recognized that the consequences of the hypothetical scenarios were the same as the existing risk at the King's Wharf and Alderney Ferry Terminal sites. Further, probability was agreed to be very low, given the lack of identifiable past

incidents and requirements such as non-combustible building construction and monitored detection and suppression systems;

- Although the high consequence risk scenarios were recognized as being low probability, and that the coincidental blockage of the rail crossing at King's Wharf further serves to decrease probability to a very low level, there is a need to provide procedures i.e. notification and communication, and any technological solutions that may serve to lower the probability of this occurrence further, or eliminate it altogether;
- It was observed by the Fire Service that CN brings hazardous materials back-and-forth along the Dartmouth waterfront, even though there is no destination for these products along this route. Elimination of this practice would eliminate a risk scenario;
- It was observed by the Fire Service that CN brings empty rail cars back-and-forth along the Dartmouth waterfront. This practice creates longer trains, thus increasing the probability of rail crossing blockages;
- The Emergency Service Provider's (ESP's) relationship with CN (in general) was discussed. It was noted that the relationship has, at times, been 'strained' due to differing priorities. It was also noted that the response to requests via the CN emergency phone number has been inconsistent. CN does not currently provide the ESP's with train manifests;
- If the entrance is blocked by a train during an emergency call, there is currently no established procedure in place;
- Police can perform a work-around, going over stationary rail cars or rely on their water-side response presence;
- Emergency Medical Services (EMS) indicated that they would not go through stationary cars. They might consider using the on-foot underpass (conceptual) depending on safety and timing of the incident;
- Fire would not pass, due to the size of its apparatus. It was noted the fire apparatus are driven over rail crossing and grade separations at the discretion of the driver; (some grade separations are not used due to safety concerns);
- The size of the largest piece of fire apparatus (aerial unit) will influence the scale of the grade separation based on the need to reflect current and future aerial unit centre line radius requirements; and
- Various alternatives to a grade separation were proposed. These are discussed in Section 7.0.

5.5 Request for Information from CN Rail

The following questions were provided to CN by letter in early November, 2016:

1. In regards to the rail crossing at the entrance to the King's Wharf development, can you confirm CN's understanding of the terms and conditions under which future phases of the project would proceed?
2. Can you provide details of the rail traffic that may currently use the King's Wharf crossing? Specifically:
    a. Type of cargo transported, including if the cargo includes petroleum products and/or hazardous materials.
    b. Frequency of use of the crossing – days per week, times per day; times during day.
    c. Average duration (in minutes) that crossing would be blocked.
    d. The possibility and frequency of the crossing at the Dartmouth Ferry Terminal and King's Wharf being blocked concurrently.
3. Are you able to project and share the information outlined in (2) for the next ten (10) years?
4. What is the process (policy and procedure) for a municipality to communicate with CN if a rail crossing is blocked and emergency service providers are unable to gain access to a site such as King's Wharf?
5. What is the process for a municipality to determine the potential for a crossing to be blocked during a specific time frame?
6. Can a municipality request that a train scheduled to be at a specific crossing, be delayed in its arrival at that crossing?
7. Can you share CN Emergency Response procedures, if a rail crossing becomes blocked due to an accident, derailment, etc.?
8. Does CN have plans to upgrade, change or improve the rail crossing at King's Wharf in the foreseeable future?
9. Are you able to assist with a discussion with the operators of the AutoPort facility regarding their current and future operations or should we contact them directly?

A response to the request was received in early January 2017. The information provided has been incorporated in the applicable sections of this report; the full response is included as Appendix V. It can be noted that many of the responses were general in nature.

In discussions with CN, a concern was expressed respecting any solutions which would impair business operations or set precedents with other municipalities. It is noted by ESI that CN is bringing the risk, at varying degrees, to the community.

5.6 Discussion with Municipal Fire Chiefs

Clearly, the Dartmouth waterfront is not the only area where this type of development issue has emerged. Across Canada, communities everywhere are grappling with the realities of the interface between development and rail. Winnipeg, MB; Saskatoon, SK; and Surrey, BC are examples of cities that have embraced a number of procedural and technological solutions to bring the probability of a coincidental rail blockage and high consequence event down to an acceptable level.

Surrey, BC for example, accepts that the Crescent Beach area which is home to 20,000 residents may be blocked by extended switching operations. Through partnership between the Municipality, Transport Canada, and the Rail Operator, procedures have been put in place to:

- shorten trains,
- improve communications between ESP communication centres and the Rail Operator Dispatcher, and
- provide a technological solution to ESP communication centres to view and time trains that are in switching operations.

Further, procedural assurances are in place to ensure that communication between the ESP communication centres and Rail Dispatch is immediate and that if necessary, a rail blockage may be prevented through the stoppage of the train, or minimized while responders are on route by the timely breakage of the train or expedient movement beyond the crossing. In the case of King's Wharf, the likelihood of this being necessary is very low.

6.0 Risk Background and Analysis

The planning and design for the next and future phases of King's Wharf is ongoing and continues to evolve and change to reflect market conditions and community expectations. Conceptually, it is anticipated that with the exception of the proposed 30+ floor tower that incorporates a hotel and residential units, the balance of the site will be developed with an "urban village design" – more human scale, mixed-use and well-designed places. It is not anticipated that the overall densities and population will differ significantly from those proposed in 2014.

When detailing the reasons for requiring a second grade separated access, HRM planning staff in HRM Case 19241 state:

> *" Further, in the case of King's Wharf, there are certain site-specific considerations that further exacerbate the provision of adequate vehicular access and egress. These include the following:*
>
> - *This mixed use development is surrounded on three sides by water and separated from the established public street system by an active rail line. This makes evacuation of residents and workers, or access by emergency services, a key concern as the site becomes more heavily populated as businesses are established.*
> - *The Municipality does not have the means to evacuate individuals in a situation where the only existing at-grade access is blocked by a train or another emergency event. This is a unique circumstance and not an issue in the case of most development sites.*
> - *The existing at grade public street rail crossing is located at an elevation which is amongst the lowest / closest to sea level in the surrounding area. In the case of a flood emergency, this single access would be amongst the first streets to be rendered inaccessible. A grade separated vehicular access spanning the CN rail line and connecting to Alderney Drive will provide an alternative route for all future phases of the development, this road would be less likely to be impacted by this type of event.* [4]

These concerns are addressed in the planning scenarios (Appendix I).

[4] Dickey, M. (2014). Case 19241, Non-Substantive Development Agreement Amendments for King's Wharf, Dartmouth (Report)

6.1 Methodology

Following a literature review and research pertaining to North American incidents involving rail and the urban interface, a list of ten (10) risk scenarios (Appendix I) were created by ESI in draft form. The risk scenarios fall into four categories of causation:

1. Human Accidental
2. Human Intentional
3. Technological failure
4. Natural

The ten (10) planning scenarios were reviewed by the HRM response agencies during a stakeholders meeting facilitated by ESI. Based upon the experience of the participants two scenarios were modified as follows:

1. A natural event involving strong storm surge flooding the site and affecting power supply requiring an evacuation; and
2. The derailing of one of the CN trains carrying hazardous materials, as was the case in a 2008 incident in Dartmouth.

Participants agreed upon the list of scenarios and utilized them to discuss detailed timings and interdependencies between the dispatching and response agencies. All scenarios were recognized as having a low to very low probability of occurring; however, with an added coincidental rail blockage these scenarios would have heightened consequence or impact. Participants discussed options to lower the probability of the scenarios with a view to managing risk to an acceptable level within the community.

Considering the discussion of the relative probabilities and perceived consequences of the planning scenarios, ESI populated numerical scores based on the following:

I. Probability/Likelihood
   a. Past Incidents
   b. Coincidental Rail Delay
   c. Number of Residents or invitees

II. Consequence/Impact
   a. Loss of Public Confidence
   b. Litigation
   c. Loss of Life/Injury
   d. Environmental
   e. Economic Loss

The sum of the Probability scores multiplied by the sum of the Consequence/Impact scores resulted in a scenario risk level (see Appendix I).

Risk Level = Probability multiplied by Consequence (or Impact)

It must be noted that while the information received from CN (see Appendix V) was not available for the HRM stakeholder meetings, the information was layered with the discussed scenarios, and the probability scores adjusted accordingly.

6.2 Probability

6.2.1 Increase in site population

Probability within the risk scenarios is a dynamic measurable. The higher the number of persons invited to the isolated side of the rail line, the more likely it is that there would be an incident, whether it be a heart attack, motor vehicle accident, fire, etc. While the exact change in the calculated probability based upon the increase of residents, workers and visitors is unknown, it is reasonable to assume that the probability of an incident rises as the population increases.

To study the incremental change to the probability of a planning scenario happening based upon the increase of population is very complex. Given that there have not been incidents stated in the planning scenarios that have actually happened in Dartmouth, it is not as simple as increasing the probability proportionally. It is recognized that a very low probability exists currently and is increased incrementally. The increase in probability is further minimized, however, due to the nature of the demographic which will occupy the development, the non-combustible building construction, and monitored detection and suppression systems. The developer also indicated at the meetings his intention to partner with each of the Emergency Service Providers to explore opportunities to reduce incident probability.

The model is further challenged as there must be a combination of an emergency incident response with the simultaneous occurrence of a train moving into the crossing. Again, there is a potential for this to occur, yet it is one of a very low probability combined with a second event (the emerging incident), also of a very low probability.

6.2.2 Rail Blockage – Timings and Scenarios

In order to study the time that the rail crossing may be blocked such that it may be applied to risk level components, several factors must be considered and are outlined below. (For ease of reading, the calculations are not detailed in the body of this document and have been placed in Appendix VII for reference.)

Moving Trains

CN Rail has provided conflicting information regarding the amount of time that moving trains block the rail crossing on a daily basis. Information was provided as follows:

1. "Trains are 1km in length, travel at 16km/hour, and traverse the crossing 8 times per day." This extends to a calculation that each crossing takes 3.75 minutes (or 3 minutes, 45 seconds), and the rail crossing is blocked for a total of 30 minutes per day.

2. The amount of time the crossing is blocked further increases by a 20-second delay created by the lowering and raising of the crossing arms (40 seconds in total). When the delay of the crossing arm is considered, the durations of each crossing increased to 4.41 minutes (or 4 minutes, 25 seconds), and the rail crossing is blocked for a total of 35.28 minutes per day.

3. In the same CN document, it was provided qualitatively that it takes 10 minutes per crossing; this is assumed to be inclusive of the lowering and raising of the crossing arm. This can be extended to determine a total of 80 minutes per day that the rail crossing is blocked.

Based on the differing pieces of information, it has been calculated that the time the tracks could be blocked by a moving train ranges between 4.41 - 10 minutes per crossing for a total of 35.28 – 80 minutes per day.

Stopped or Switching Trains

4. There is the potential for an instance of an emergency incident occurring at the same time as a train is fully stopped or in the process of switching in the crossing. Transport Canada legislation limits the duration a train may be stopped on the tracks for this purpose to a maximum of five (5) minutes. CN has not provided the frequency of this occurrence, so it is conservatively assumed to be one (1) of the eight (8) crossings noted above and it occurs once per day. Also to be considered is the time for slow-down (1 minute) and speed-up (1 minute) of the train.

Factoring in these additional times increases the duration of an individual blockage involving stopped or switching trains to fall within a range of 11.41 to 17 minutes, for a total time of blockage ranging between 42.28 to 87 minutes per day.

Fire Services and EMS often adopt response/deployment models that assist in the analysis of complex and dynamic risk. For the HRM Fire Service, NFPA 1710 would require a response to King's Wharf, within (eight) 8 minutes, 90% of the time[5]. HRM Fire demonstrate an initial engine arriving within (seven) 7 minutes 90 % of the time. Emergency Medical Care Inc. targets to have EMS arrive at King's Wharf within nine (9) minutes 90% of the time. While the worst-case scenario of a stopped or switching train delaying an emergency response time by 11.41 to 17 minutes clearly jeopardizes the successful achievement of the response model objective, the probability of this happening is very low.

It must be considered that there are some instances when an incident is called into the applicable ESP communication centre that, even if there is a train on the tracks, this will not affect emergency response time. Should the train be approximately 65% or more through the crossing when an incident is dispatched, the train will be clear of the crossing before the response vehicle has to pass. (See Appendix VII for calculation.)

Consideration then needs to be given to the instances when the train is less than 65% (approximately) through the crossing. The most serious event would be that the emergency response vehicle arrives just as the gate is coming down and the train is so close that it cannot be stopped.

In the worst-case scenario of a wait time of 17 minutes, there is an opportunity for a technological solution to assist in alleviating the severity of the situation. If through technology, the ESP communication centre was made aware of approaching or crossing trains, the request could be made that the engineer either "Hasten" or "Halt", i.e. speed up or slow down the train, as appropriate. In many of these potential occurrences, the crossing may be cleared simply by the ESP operator being aware of the situation at site and having a means of communication with the Rail Dispatcher.

Also for the planning scenarios cited, there is a reasonable opportunity for the train engineer to recognize there is an emergency and stop the train. For example, the worst planning scenario is the high rise fire which in many instances would be visible to the train engineer 500-700 metres away given the curvature of the tracks.

[5] NFPA 1710. (2016). Standard for the Organization and Deployment of Fire Suppression Operations, Emergency Medical Operations, and Special Operations to the Public by Career Fire Departments.

6.2.3 Probability Summary

Clearly the probability of a train causing a delay in the arrival of emergency equipment relies upon the coincident low probability planning scenarios combined with the low probability of a train about to pass for 42.28 to 87 minutes per day. The probability of this occurrence may be drastically reduced should the length of time the trains are on the crossing be reduced below the range of 42.28 to 87 minutes per day.
With proper technology and communication protocols it would seem it is highly possible to have the train halt or hasten within the approximate 6 to 9-minute response models. The key success factor for this lies in communication between the ESP or EMS communication centre and the CN Rail Dispatcher to the inbound train. A signal system activated through emergency dispatch could be an immediate indication for the engineer to speed up, break the train, or move on.

Within the models identified above, when HRM fire and/or police and EMS are dispatched for emergency response, they arrive at King's Wharf within 6 to 9 minutes, 90% of the time. Conversely, it may be suggested that – the ESP's acknowledge an acceptable level of risk that corresponds to 10% of the responses to incidents being delayed. It may further be considered that the 10% anomaly is representative of such instances as rail crossings on the Dartmouth waterfront.

There are no specific quantitative risk modeling frameworks recommended by Transport Canada.
In fact the traffic flow at King's Wharf is well below the Transport Canada threshold set in relation to risk and disruption for which they would require a grade separation. In relation to comparing this risk to other types of accepted risk in the community, Major Industrial Accidents Council of Canada (MIACC) Land Use Criteria sets range of the potential of Annual Individual Risk, or chance of a fatality in a given year when examining allowable land uses between industry and residential properties. "High density residential and commercial properties including places of continuous occupancy such as hotels and tourist resort" are often set at a level, by the community, of $1x10^{-6}$ or 1 in 1 million probability that a fatality will occur in a civilian context as a result of an industrial failure. To have a simultaneous occurrence of a very low probability incident align with the coincidental blockage of the rail crossing result in a delay of responders would be highly unlikely or at the lowest levels of the above MIACC probability criteria.

6. 3 Consequence (or Impact)

While the probability of an event occurring is increased by the introduction of more people and activity between the rail line and the waterfront, an increase to the level of consequence or impact from a potential event is considered to be negligible for the reasons outlined below.

Recent history indicates that it has been very rare that emergency response vehicles have been blocked by trains. Stakeholders were unable to reference an incident within HRM where there has been a notable

consequence stemming from an emergency response vehicle being blocked from crossing tracks due to the simultaneous presence of a train.

Stakeholders recognized that the community has, for a number of years, worked with CN to minimize incidents involving rail for the properties located on the waterside of the rail line. The residents and property owners have collaborated with the Halifax Regional Municipality (HRM) and CN to develop methods to manage, and work around, the risk and disruption caused by trains passing through the community as often as eight (8) times daily.

Currently, there are hundreds if not thousands of persons each day on the waterside of the tracks who are isolated for short durations of 4.5 to 10 minutes due to the passing or stoppage of trains. HRM has already agreed to accept a level of risk by allowing the development and operation of many businesses and homes on the waterside of the rail tracks. Notable sites and activity include the Alderney Ferry Terminal and park, the British Consulate, numerous office buildings, warehouse facilities and even the existing residential development on King's Wharf. The addition of more buildings, infrastructure and people will not increase the impact (or consequence) resulting from an emergency incident, beyond that which currently exists.

For the reasons cited above, the consequence scores for the planning scenarios explored within the risk assessment are thus, considered static. It was the opinion amongst the stakeholders that there will be no significant change in the level of Consequence (or Impact) by virtue of the proposed development and its resultant population increase.

6.4 Quantitative Risk Assessment

As noted in Section 1.0, a quantitative risk assessment is not within the scope of the review that ESI was requested to undertake. In order to complete such an assessment, significant data and information would be required from each of the stakeholders and then time allowed to compile and analyze it. From ESI's experience this is a time consuming and costly undertaking.

This investment is not warranted, as it is expected that the outcomes would not be different from the qualitative assessment contained herein.

7.0 Options Identification and Evaluation

HRM had previously stipulated that the development of future phases of the King's Wharf project will require a second vehicular access. While the requirement is based upon current HRM standards, it has been acknowledged that the primary rationale for the requirement is related to the possible delays that may be encountered by emergency First Responders. This concern has not been the subject of a detailed evaluation prior to the completion of this report.

In proposing and evaluating options that would eliminate or reduce the impact on emergency first responders, it is necessary to balance the impact: on the operations of the railway, for the successful development of the King's Wharf project and for the adjacent neighbourhood and community.

Consideration should be given to options that include: infrastructure change, improvements and enhancements; technological solutions; and policies and procedures.

7.1 Infrastructure Improvements and Enhancements

1. Elimination of the Rail Crossing

The at grade rail crossing – as it currently exists – was constructed subject to an agreement between HRM, CN and Fares Real Estate Inc. This crossing is one of approximately fifteen between the AutoPort and the Dartmouth Marshalling Yards. Access to other lands and buildings along the rail line are also affected by the rail operations – particularly at Alderney Ferry Terminal and the adjacent lands.

Issues with access to the lands affected by the rail activity could be eliminated if the rail operations were to cease or be re-routed. There does not appear to be any immediate or short term plans for either.

Note however Downtown Dartmouth Secondary Planning Strategy Policy T-11:

> *The municipality should investigate through partnerships with CN and the private sector, financial strategies to relocate the CN marshalling yards off of the waterfront as well as alternative uses for the waterfront rail line, including opportunities for tourist or commuter rail service to Woodside, and continued service to the Dartmouth Cove marine business area (refer to waterfront policies). The municipality should investigate through partnerships with CN and the private sector, financial strategies to relocate the CN marshalling yards off of the waterfront as well as alternative uses for the waterfront rail line, including opportunities for tourist or commuter rail service to Woodside, and continued service to the Dartmouth Cove marine business area (refer to waterfront policies)*[6]

[6] Downtown Dartmouth Secondary Planning Strategy, October 05, 2013, Page 67

2. Grade Level Separation

The construction of a grade separation that allows for vehicular and pedestrian access is often considered the most effective solution to dealing with delays at grade crossings. Conceptual options for constructing a grade separation structure were provided by Fares Real Estate Inc. as part of the HRM development approval processes in 2009 and 2014 (see Appendix VI). Because of the proposed location, in each case the proposed structure would require unique and innovative engineering and construction practices, while potentially negatively impacting the adjacent neighbourhoods and communities. Further, there is recognition that the cost of maintenance of such a structure would be borne by HRM.

As noted in Section 4, the current cross product of the rail traffic per day (eight) and the estimated daily vehicle traffic (1000, as provided by the Fares Real Estate Inc. Traffic Study[7]) or 8000 is well below the capacity where a grade separation option is identified as an alternate solution to mitigate cross product risks. Further, the adjacent land uses significantly restrict the benefits of the grade separation to the King's Wharf development only – it would not overcome the access issues that may be encountered at other crossings along the Dartmouth Subdivision.

3. Second At-Grade Access

The opportunity to develop a second at grade access to the development site is limited to the addition of a rail crossing at the intersection of Alderney Drive and Prince Street. This access would be about approximately 95 metres from the current access. Adding this access would require the approval of HRM and CN; CN has indicated that they would not support this.

4. Emergency Vehicle Access

The level and timing of a response to an incident by an Emergency Service Provider (ESP) is determined by the type, location and severity (emergency/non-emergency). For example, the majority of responses by a fire department involve both equipment and personnel, while EMS and police responses may involve personnel only. An emergency vehicle access to the site would have to accommodate the largest piece of fire apparatus as per the building code.

While the access would be primarily for emergency vehicle access, it could also be used as a secondary pedestrian access in daily and emergency situations.

[7] Greg O'Brien, P. Eng., Manager, Traffic and Transportation – Dartmouth, WSP Canada Inc. Trip Generation Estimates, Various Land Use Scenarios, Kings Wharf, Dartmouth. (20 May 2014)

Conceptually, and based upon the findings of the risk assessment, an option may be to develop a second access that would be an active transportation trail that permits passage of emergency vehicles. While beyond the scope of this review, it appears that a second access could be developed from the Alderney Ferry Terminal area over the HRM owned park to join to the King's Wharf development.

5. Pedestrian and Responder Access and Egress by Foot

In some situations, as noted, responses to some incidents will/could involve ESP personnel only, depending upon the incident type and location. As well, there may be incidents that may require the evacuation of citizens from the King's Wharf development. While the design is outside the scope of this report, observations indicate that there may be an option to develop a pedestrian link from Alderney Drive – either under or over the rail tracks (see Appendix III.II).

6. Use of EHS LifeFlight Helicopter

There was a gap in the stakeholder meeting in that the capability of air ambulance, EHS LifeFlight, as a possible mitigation measure was not addressed. EHS LifeFlight could be utilized to overcome the very low probability of any sort of incident identified in the risk assessment. The air ambulance capability could serve to mitigate an incident of high probability, i.e. a medical event (heart attack) or a low probability event, i.e. a fire where Command staff could be moved to the other side of the train.

It is currently unknown whether the present configuration of the site would permit the use of the EHS LifeFlight. The current cul-de-sac turnaround area may be studied as a possible location to receive a helicopter and mitigate current risk. If it is determined that there are risk scenarios that may be minimized by the use of this option, King's Wharf development staff could consider setting aside an area that would be large enough to receive the helicopter. Similarly, consideration to proceduralize coordination between the operator on site and the emergency responders coming to land at the incident would be necessary. (http://www.ehslifeflight.ca/Pages/home.aspx)

7.2 Technological Solutions

There are in excess of 250,000 rail crossings in North America of which over 30,000 are in Canada. The issue of blocked crossings and the impact for emergency service providers has and is the subject of concern, review and evaluation nationwide. With the evolving and progressive advances in the availability and capability of various technologies, there has been a growing interest in their use in aiding ESP's and citizens alike in dealing with blocked rail crossings. As in most cases, the use of technologies has to be accompanied by the supportive policies and practices. It must be noted that these emerging technologies have not as of yet been certified by Transport Canada, but given the issues across Canada, there is a level of urgency to ensure these opportunities are developed and implemented.

1. CN Rail

One alternative approach is a monitoring system that provides real-time blockage information to emergency dispatchers so they can plan an alternative route that avoids the blocked crossing. Using Global Positioning Systems (GPS) CN monitors the position of their locomotives on a real-time basis using a built-in GPS device. Ideally, railway companies would simply release their real time train positioning data to ESP's who would then plan their routes accordingly. Unfortunately, security (i.e. terrorism) is a major issue and makes railway companies extremely hesitant to share real time train positioning data with possibly thousands of ESP's across North America.[i]

2. Closed Circuit Television Cameras

Closed Circuit Television Camera (CCTV) systems are used to provide security, surveillance and information, in a variety of settings and situations, by individuals, organizations, businesses and government. CCTV can allow for real time audio and video information to be available to ESP's in fixed and mobile positions.

Cameras strategically placed along the Dartmouth Subdivision could allow ESP's to view the status of trains in relation to specific rail crossings and based upon established policies and procedures adapt their incident response accordingly or in communication with Rail Dispatch hasten or hold passage of the train. As noted, Surrey, BC utilizes this technology in this manner and as well to ensure the Rail Operator complies with the Transport Canada Regulation that switching operations are limited to less than five minutes in duration.

It is understood that HRM has recently completed the installation of new LED street lighting. This lighting network includes the opportunity to layer other technologies, such as CCTV – additional evaluation and review of this opportunity is required.

3. Grade Crossing Monitoring and Information Systems

For many years, organizations like the Texas Transportation Institute and the U.S. Federal Railroad Administration have facilitated or undertaken studies and reviews related to the use of various technologies to monitor and gather information regarding grade level crossings. The purpose of these studies have included options for reducing accidents to improving access for emergency first responders. As technologies have evolved, a number of new applications have resulted that allow for collection of data on trains – including length, and speed.

One example of available system is that used in Sugar Land, Texas, known as the Sugar Land Rail Monitoring System. The system monitors real-time train presence, speed, length, direction and gate closure for a 6.4-mile

rail corridor, determines train status and projects downstream crossing closing and clearance times.[8] According to the City of Sugar Land website – '*the main benefit of the monitoring system is that first responders can quickly check the train traffic before travelling to an emergency call'* [9]

In Canada, MORR Transportation Consulting Ltd. has patented its TRAINFO solution –`*that provides real-time grade cross blockage notifications and predicts the location and duration of future blockages. TRAINNFO uses various roadside technologies (primarily acoustic sensors) to detect trains. TRAINNFO sensors are pole-mounted next to the track; they can be installed off rail property. The elapsed time between TRAINFO detecting a train and sharing the information is two (2) seconds or less.* The system is currently in use in the City of Winnipeg. Additional information is included as Appendix IV.

Given that each of the Emergency Service Providers have an established set of measures and metrics around response time, i.e. six to nine minutes in 90% of responses, should there be technological solutions that create situational awareness and link ESP Dispatchers to Rail Dispatchers, there is approximately six to nine minutes to notify and communicate the necessity to halt, hasten, or break the train that is, or will be, blocking the crossing.

7.3 Policies and Procedures

7.3.1 Improved and Enhanced Communications – Emergency Service Provider and CN

From our discussions with the ESP representatives in HRM, there does not appear to be a regular process of communications with representatives of CN. Where there has been a concerted effort between the Municipality and the Rail Operator (i.e. Surrey, BC), there has been a noted improvement in relation to the confidence of Municipal Officials as to the speed at which communication may be established between the ESP Dispatcher and the Rail Dispatcher.

7.3.2 Pre-Location of Equipment and Situational Awareness

During the meeting with the Emergency Service Providers, the possibility of pre-locating certain equipment and devices at the King's Wharf project was discussed. The purpose would be to reduce the impact of an increased response time caused by the blocked rail crossing by pre-locating Automatic Defibrillators (AED) and possibly staged, housed, and unstaffed fire apparatus on the site.

Strategically locating AED equipment throughout the development is warranted irrespective of other issues. This has become common practice in many jurisdictions. As well, in discussion with the HRM Police Service,

[8] Goolsby, M E et al. Evaluation of a railroad grade crossing monitoring system for first responders. (Oct 2004)
[9] Retrieved from: http://www.sugarlandtx.gov/index.aspx?NID=1134, 10 January 2017

any proactive community policing or tactical pre-planning between the Police Service and Development representatives is welcomed and will be fully supported by Fares Real Estate Inc. These types of options can serve to prevent or minimize the incidents studied above, and should be considered in the context of the ESP's operating guidelines and other procedural and technological options that may be considered.

7.3.3 Relationship with Emergency Service Providers

The King's Wharf development has, and will be, constructed to meet the requirements of all current building and associated codes and will ensure the safety and security of its residents, occupants and users.

During the meetings with the emergency service providers, the HRM Police representatives expressed an interest in greater interaction with Fares Real Estate Inc. both during the design of future phases, to discuss operational factors and to outline police practices. Similar interests were also expressed by the EMS and Fire representatives.

Pro-active initiatives such as these can reduce risk, enhance public safety and enhance community relationships. Fares Real Estate Inc. is committed to any of these types of ongoing relationship building forums.

8.0 Conclusions and Next Steps

Governments and organizations across North America continue to demonstrate a high level of understanding of the importance of safe and secured operations of railroads within urban environments, including the impact of blocked rail crossings. In Canada, the Federal Government has made significant changes to the Rail Safety Act and its regulations in response to concerns and issues encountered by communities who are affected.

The risk associated with blocked crossings is not isolated – it exists in most North American urban areas, particularly where the economy integrates with, and depends upon, effective railroad operations; there are numerous cases where residential and commercial communities are dealing with scenarios that have potential impacts greater than those at King's Wharf. Similar to the King's Wharf development, the rail interface with the Dartmouth Alderney Ferry Terminal experiences the same level of probability of an incident and coincidental blockage, as well as consequence should this low probability incident occur.

Our review has established that a blocked crossing at Mile 12.99 may, under a variety of emergency scenarios, have a very low probability, but high consequence for the King's Wharf Project, its occupants and for Emergency Service Providers. The probability and consequence of risk scenarios that may be encountered at King's Wharf, currently exist along each crossing that are part of the Dartmouth Subdivision. The level of probability considers the potential for an Emergency Service Provider (ESP) to be responding to an incident concurrent with a train blocking the rail crossing. Analysis based upon the information provided by CN, indicates that the maximum duration of moving trains will be in the range of between 4.41 to 10 minutes per crossing, 8 times a day, for a total of 35.28 to 80 minutes per day.

Developing and implementing alternatives to deal with blocked crossings requires HRM to consider the balance between an economic and efficient railroad operation and the communities within which rail operates. This is the balance that has to be considered when reviewing and evaluating options for dealing with the rail crossing at Mile 12.99 of the Dartmouth Subdivision. Current and future risk could immediately be lowered through measures such as: eliminating needless train cars travelling back-and-forth to shorter trains; elimination of trains carrying cargos of hazardous materials, and ceasing of switching operations that block King's Wharf and other crossings.

It is acknowledged that the construction of a grade separation is the most operationally effective option for mitigating what is a very low probability of coincidental response and occurrence of a risk incident. The grade separation provides the highest likelihood that ESP's will gain access to the development if they encounter a blockage. There is however, a very low probability that this constructed grade separation also becomes blocked or disabled, similarly preventing access by ESPs. It is recognized that a grade separation is the costliest solution, both for construction, ongoing maintenance and operation as well as creating the most community impact, i.e. affecting pedestrian flow, and obstructing views. Given the location and layout of the development

area, proposed grade separation, as well as, adjacent lands, there are very limited options for providing an unimpeded second grade level access.

One area for consideration for a secondary grade level access at Alderney Gate would have to be combined with the construction of Ferry Park Trail. Cleary, this option would serve to provide reciprocal benefit in relation to the existing risk at Alderney Gate, if combined with other identified technological options.

Across North America there continues to be an interest in identifying and using technology to mitigate the issue of blocked rail crossings. The exponential growth in the capacities and capabilities of integrated technologies provides many opportunities for solutions that alleviate the need for physical infrastructure investments; an option that should be considered for the King's Wharf project, and one that may be able to leverage the progressive investment that HRM has made in LED street lighting technologies with telemetry capabilities. These opportunities have to be evaluated concurrently with the consideration of required changes and improvements in the policies and procedures of the Emergency Service Providers in conjunction with CN. For example, given the response times of the ESPs, there is adequate time for communication procedures, aided by technology between the ESP communication centres and Rail Dispatch to halt or hasten a train prior to a responder's arrival.

Unlike the earlier processes that led to the decision to require a second access to King's Wharf, the evaluation and development of a possible alternative requires the active and constructive involvement of all stakeholders, including HRM, all emergency first responders, CN, Transport Canada and Fares Real Estate Inc. This is the approach contemplated by the Rail Safety Act and its Regulations.

CN is required to be part of the process that generates a solution that is acceptable and workable for all parties. This is particularly critical in that it recognizes that CN is the party that is creating the risk in the community. CN must be held to a measure of accountability that is commensurate with the level of risk their operation is creating. It has been acknowledged that a second access would not be a consideration if the rail crossing was not present. Whatever the final agreed upon solution – infrastructure, technological, policy and procedures or one that incorporates all three – the operational practices of CN and their contributions to reducing risk probabilities to the lowest level, must be included.

In summary, our review indicates that:

- Fares Real Estate Inc. is committed to proceeding immediately with the next phases of its $300+ million-dollar development.
- The potential risk level presented by having a single access to the King's Wharf project is an opportunity for HRM and Fares Real Estate Inc. to collaboratively explore and evaluate, in a timely fashion, alternatives to the construction of a grade separated access.

- Given the advances in technology and communications since the original requirement for a second access was placed on the development in 2009, together with the established risk profile, there is merit to all stakeholders, through a facilitated and coordinated stakeholder process, collaboratively reviewing and evaluating a combination of alternatives that could achieve the same objective.
- The alternatives agreed upon through this recommended process should concurrently provide financial, functional and operational benefits to all parties and other crossings throughout HRM.

It is proposed that Fares Real Estate Inc. should:

1. Immediately share a copy of this report with all stakeholders including the applicable HRM departments, Emergency Service Providers, CN, and Transport Canada.

2. Within thirty (30) days following release of the report on proceedings and recommendations, meet with individual stakeholders to review, discuss and receive feedback and to establish interest in participating in a stakeholder group; engaging representatives of Transport Canada and CN early in the process should be considered a priority.

3. Within forty-five (45) days meet with all stakeholders, in a facilitated forum, to collaboratively:

    - review and discuss the report and the feedback provided at the individual meetings;
    - establish a process, schedule, and required resources necessary to carry out a comprehensive evaluation of selected options; and
    - identify immediate opportunities, that could reduce risk and enhance ESP response.

4. Within one hundred and eighty (180) days, collaboratively select the preferred option(s) and establish the process, including target dates for appropriate development and implementation.

APPENDIX I: KING'S WHARF PLANNING SCENARIOS, RISK ASSESSMENT AND HEAT MAP

Appendix I.I King's Wharf Draft Planning Scenarios

King's Wharf Development:

Emergency Access Risk Assessment

Draft Planning Scenarios

Risk Category		Risk Description	Rail Complication
Operational	Fire	Fire on the top floor of developed building – request for 6 pieces of Fire apparatus, EMS, and Police.	1km train on tracks at 0.5km mark
	Police	Brawl at the Marina.	1km train on tracks at 0.5km mark
	EMS	Collapse of staging resulting in a 12 person medical incident.	Train due in 4 minutes
Natural		Blizzard causing train to de-rail in front of the development.	
		With climate change and the increasing frequency and severity of storms, storm surge floods the King's Wharf car garages. Potential for required evacuation.*	
Technological		Failure of Engine on rail system leaving train on tracks for a long period of time (2+ hours). Failure of crossing signals.	
Human Accidental		Collision between car and train, 1+ hour time period to investigate and clear.	
		Two petroleum cars are derailed at the King's Wharf crossing.*	
Human Intentional		Disgruntled worker commits arson at the adjacent Dominion Diving Dock resulting in the need to evacuate King's Wharf occupancies.	
Other		Failure of on-site water supply during a fire – need to stretch water service line across the rail tracks.	

Planning Assumptions:

- Population as defined in development documents (Case 19241)
- Static frequency, length, and manifest of rail traffic
- Historical incidents at similar crossings throughout HRM (holistic experience rate)

*** King's Wharf Risk Assessment and Options Analysis Forum**

- These scenarios have been adopted to examine the reasonable, worst-case scenario risks for the site and adjacent areas for the foreseeable future, as per the First Responders and the HRM Planners, Parks, and Infrastructure Departments.

Appendix I.II King's Wharf Risk Assessment

Summary of Risks:	
# of Low Risks	4
# of Medium Risks	2
# of High Risks	3
# of Very High Risks	1
Total # of risks	**10**

Risk Register & Heat Map

Risk assessment for: King's Wharf
Date of last update: 13-Mar-17

Risk #	Risk Category	Risk	Description (With coincidental rail delay)	Existing Controls	Probability Score: Past Incidents *	Probability Score: Coincidental Rail Delay**	Consequence (or Impact) Score: Loss of Public Confidence	Litigation	Loss of Life/ Injury	Environ-mental	Economic Loss	Total	Resulting Risk Level	Estimated Cost ($ Millions)	Mitigative Options/ Treatment Plan
R1	Operational Risks	Structural Fire	Fire on the top floor of developed building – request for 6 pieces of Fire apparatus, EMS, and Police.	Detection and Supression equipment, monitored alarm	3	✔	2	3	1	N/A	2	8	24		Alternate access, communication to hasten or halt train
R2	Operational Risks	Police	Brawl at the Marina.	Site community based planning relationships	2	✔	1	1	0.5	N/A	1	3.5	7		Alternate access, communication to hasten or halt train
R3	Operational Risks	EMS Mass Casualty	Collapse of staging resulting in a 12 person medical incident.	OSHA requirements	2	✔	2	3	1	N/A	1	7	14		Alternate access, communication to hasten or halt train
R4	Natural Risks	Derailment (Haz Mat)	Blizzard causing train with petroleum cars to de-rail in front of the development.	Lessons Learned from Halifax incident	3	✔	N/A	N/A	N/A	3	1	4	12		Haz Mat could be eliminated with a CN procedure
R5	Technological Risk	Rail System Failure	Failure of Engine on rail system leaving train on tracks for a long period of time (2+ hours). Failure of crossing signals.	CN system maintenance, ability requirement to break train in 5 min	0.5	N/A	N/A	N/A	0.5	N/A	1	1.5	0.75		Shorter train - probability lessened
R6	Human Accidental Risk	Vehicle accident	Collision between car and train, 1+ hour time period to investigate and clear. (suicide)	Gates, lights	1	N/A	N/A	N/A	1	N/A	1	2	2		Break train
R7	Natural Risks	Storm surge, flood	With climate change and the increasing frequency and severity of storms, storm surge floods the King's Wharf car garages. Power failure ensues. Potential for required evacuation.	Engineering currently built-in to development to minimize impact: lowest levels (P2) are set at approx. 1.8 metres above normal high tide, each building has a monitored fire alarm system, full sprinkler system, and non combustible materials.	0.5	✔	1	1	0.5	1	1	4.5	2.25		Hold trains until evacuation complete
R8	Human Intentional Risk	Evacuation	Disgruntled worker commits arson at the adjacent Dominion Diving Dock resulting in the need to evacuate King's Wharf occupancies.	Engineer trained not to enter area with smoke	0.5	✔	1	1	N/A	1	1	4	2		Monitor guns for hydrants to direct smoke, delay in evacuation until train has passed.
R9	Operational Risks	Water supply	Failure of on-site water supply – need to station water service line across the rail tracks.	3 hydrants in proximity to King's Wharf, tanker capability, drafting capability	2	✔	1	1	N/A	N/A	1	3	6		Hold or hasten train. Dry hydrant system. Engineer trained not to enter incidents.
R10	Operational Risks	Motor Vehicle Collision	Haz mat incident at the King's Wharf/ intersection - a carrier is overturned.	Technician response capability, ERAP assistance	2	N/A	N/A	1	N/A	3	1	5	10		Traffic calming strategy (Dartmouth)

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Probability Score

* Past Incidents are based on National data, not King's Wharf specifically.

A probability score on Past Incidents:
0.5 a highly unlikely scenario that could possibly happen in 20+ years
1 is a reflection of a highly unlikely scenario that has occurred some where / some time, not at the site, nor in HRM , but could happen within 20 years
2 foreseeable that this incident could occur in the next 10 years
3 type of incident has occurred in HRM regularly

** Coincidental Rail Delay a) train in transit at crossing, max. 10-minute delay (CN), b) Training incoming 5 minutes, c) training stopped at crossing, 5 minutes total (TC).

The Coincidental Rail Delay factor is based upon the train blocking the King's Wharf entrance for 10 minutes 8 times a day, totaling 80 minutes a day.

Consequence (or Impact) Score

Loss of Public Confidence in:
Municipal Government, Responders, Developer
1 minor, 2 moderate, 3 high

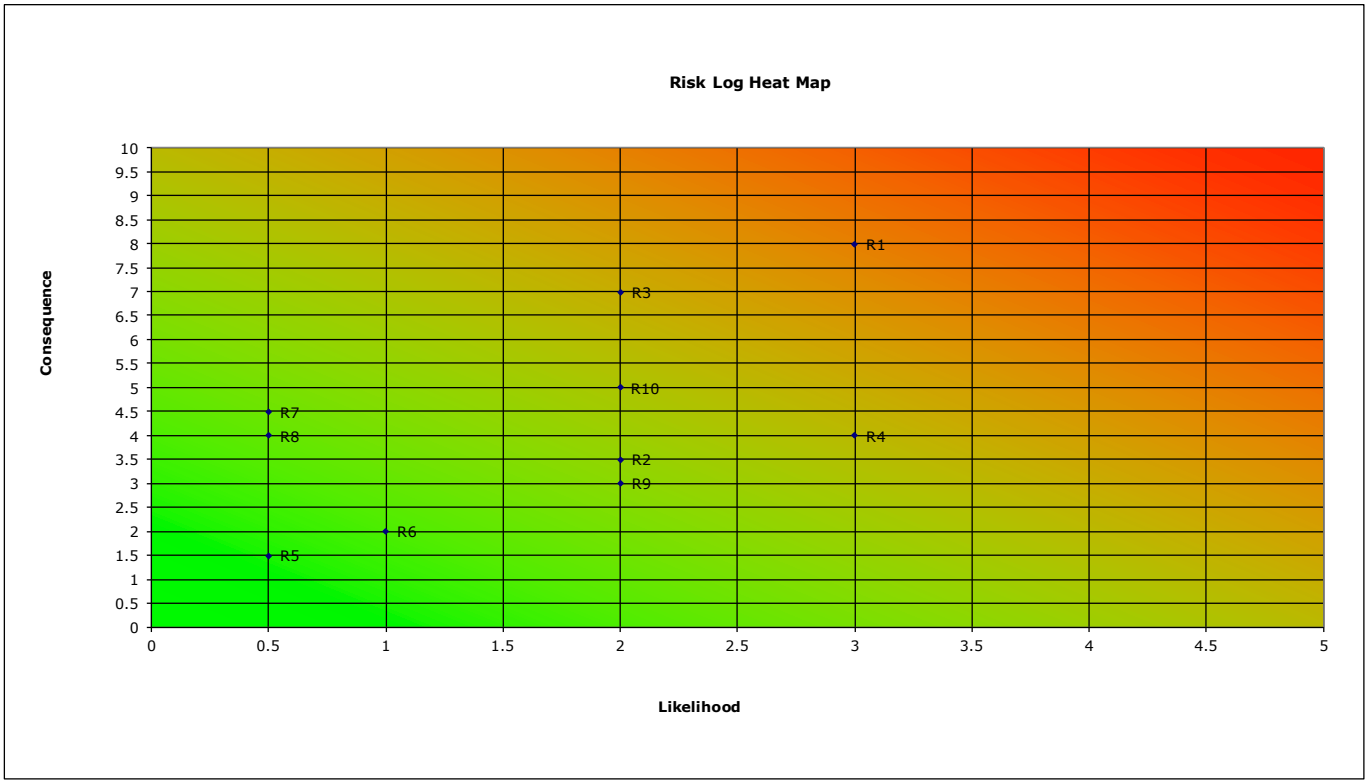
Litigation
1 minor, 2 moderate, 3 high

Loss of Life/Injury
0.5 1-9 deaths, >10 injuries
1 >10 deaths, <10 injuries

Environmental
3 Local specialized environmental response, short fire, damage, and significant clean up

Economic Loss
1 <10M $
2 >10M $

Appendix I.III King's Wharf Heat Map



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APPENDIX II: SUMMARY OF ACTS AND REGULATIONS

ACT/REGULATION	PURPOSE
Railway Safety Act	Objectives The objectives of this Act are to • **(a)** promote and provide for the safety and security of the public and personnel, and the protection of property and the environment, in railway operations; • **(b)** encourage the collaboration and participation of interested parties in improving railway safety and security; • **(c)** recognize the responsibility of companies to demonstrate, by using safety management systems and other means at their disposal, that they continuously manage risks related to safety matters; and • **(d)** facilitate a modern, flexible and efficient regulatory scheme that will ensure the continuing enhancement of railway safety and security.

Grade Crossing Regulations	These Regulations apply in respect of public grade crossings and private grade crossings.
	3 (1) Unless otherwise specified in an order of the Agency or in an agreement filed with the Agency under subsection 101(1) of the *Canada Transportation Act*, in the case of a public grade crossing,
	• **(a)** a railway company must ensure compliance with the requirements of these Regulations respecting
	  ○ **(i)** a Railway Crossing sign, a Number of Tracks sign and an Emergency Notification sign,
	  ○ **(ii)** the maintenance of a Stop sign that is installed on the same post as a Railway Crossing sign,
	  ○ **(iii)** a warning system,
	  ○ **(iv)** a crossing surface, other than its design, and
	  ○ **(v)** sightlines within the railway right-of-way and over land adjoining the railway right-of-way, including the removal of trees and brush that obstruct the sightlines; and
	• **(b)** a road authority must ensure compliance with the requirements of these Regulations respecting

ACT/REGULATION	PURPOSE
	○ **(i)** the design, construction and maintenance of a road approach, ○ **(ii)** traffic control devices, except for the maintenance of a Stop sign that is installed on the same post as a Railway Crossing sign, ○ **(iii)** the design of a crossing surface, and ○ **(iv)** sightlines within the land on which the road is situated and over land in the vicinity of the grade crossing, including the removal of trees and brush that obstruct the sightlines. **Information** • **4 (1)** A railway company must provide a road authority, in writing, with the following information in respect of a public grade crossing: ○ **(a)** the precise location of the grade crossing; ○ **(b)** the number of tracks that cross the grade crossing; ○ **(c)** the average annual daily railway movements; ○ **(d)** the railway design speed; ○ **(e)** the warning system in place at the grade crossing; ○ **(f)** an indication of whether a Stop sign is installed on the same post as the Railway Crossing sign; and ○ **(g)** an indication of whether or not whistling is required when railway equipment is approaching the grade crossing. • **8** An existing grade crossing that is a public grade crossing must meet the standards set out in Part B of the Grade Crossings Standards.
Road/Railway Guide - Technical	This Guide contains advice and technical guidance that stakeholders (road authorities, private authorities and railway companies) need to determine the minimum sightlines required at grade crossings.
Crossings Standards and Inspections Testing and Maintenance Requirements (RTD 10)	The Grade Crossings Standards are mandatory engineering standards that improve safety at crossings and are referenced in the Grade Crossings Regulations.
Canadian Road/Railway Grade Crossing Detailed Safety Assessment Field Guide	The purpose of this document is to guide individuals through a safety assessment of road/railway grade crossings. It provides an overview of the safety assessment objectives and process, guidelines for selecting an assessment team and developing a program, and methodologies for conducting crossing assessments.
Canadian Rail Operating Rules (CROR)	The CROR rules are intended to enhance railway safety. The rules cover employee responsibilities, signaling equipment, procedures for safe train movement, dealing with accidents and other topics that directly and indirectly affect railway safety.

ACT/REGULATION	PURPOSE
Railway Safety Act	The objectives of this Act are to • **(a)** promote and provide for the safety and security of the public and personnel, and the protection of property and the environment, in railway operations; • **(b)** encourage the collaboration and participation of interested parties in improving railway safety and security; • **(c)** recognize the responsibility of companies to demonstrate, by using safety management systems and other means at their disposal, that they continuously manage risks related to safety matters; and • **(d)** facilitate a modern, flexible and efficient regulatory scheme that will ensure the continuing enhancement of railway safety and security.
Grade Crossing Regulations	These Regulations apply in respect of public grade crossings and private grade crossings. **3 (1)** Unless otherwise specified in an order of the Agency or in an agreement filed with the Agency under subsection 101(1) of the *Canada Transportation Act*, in the case of a public grade crossing, • **(a)** a railway company must ensure compliance with the requirements of these Regulations respecting ○ **(i)** a Railway Crossing sign, a Number of Tracks sign and an Emergency Notification sign, ○ **(ii)** the maintenance of a Stop sign that is installed on the same post as a Railway Crossing sign, ○ **(iii)** a warning system, ○ **(iv)** a crossing surface, other than its design, and ○ **(v)** sightlines within the railway right-of-way and over land adjoining the railway right-of-way, including the removal of trees and brush that obstruct the sightlines; and • **(b)** a road authority must ensure compliance with the requirements of these Regulations respecting ○ **(i)** the design, construction and maintenance of a road approach, ○ **(ii)** traffic control devices, except for the maintenance of a Stop

ACT/REGULATION	PURPOSE
	sign that is installed on the same post as a Railway Crossing sign, ○ **(iii)** the design of a crossing surface, and ○ **(iv)** sightlines within the land on which the road is situated and over land in the vicinity of the grade crossing, including the removal of trees and brush that obstruct the sightlines. **Information** • **4 (1)** A railway company must provide a road authority, in writing, with the following information in respect of a public grade crossing: ○ **(a)** the precise location of the grade crossing; ○ **(b)** the number of tracks that cross the grade crossing; ○ **(c)** the average annual daily railway movements; ○ **(d)** the railway design speed; ○ **(e)** the warning system in place at the grade crossing; ○ **(f)** an indication of whether a Stop sign is installed on the same post as the Railway Crossing sign; and ○ **(g)** an indication of whether or not whistling is required when railway equipment is approaching the grade crossing. • **8** An existing grade crossing that is a public grade crossing must meet the standards set out in Part B of the Grade Crossings Standards.
Road/Railway Guide - Technical	This Guide contains advice and technical guidance that stakeholders (road authorities, private authorities and railway companies) need to determine the minimum sightlines required at grade crossings.
Crossings Standards and Inspections Testing and Maintenance Requirements (RTD 10)	The Grade Crossings Standards are mandatory engineering standards that improve safety at crossings and are referenced in the Grade Crossings Regulations.
Canadian Road/Railway Grade Crossing Detailed Safety Assessment Field Guide	The purpose of this document is to guide individuals through a safety assessment of road/railway grade crossings. It provides an overview of the safety assessment objectives and process, guidelines for selecting an assessment team and developing a program, and methodologies for conducting crossing assessments.
Canadian Rail Operating Rules	The CROR rules are intended to enhance railway safety. The rules cover employee responsibilities, signaling equipment, procedures for safe train movement, dealing with accidents and other topics that directly and indirectly affect railway safety.

APPENDIX III: SITE PHOTOS

Appendix III.I: Dartmouth Rail Yard at Mile 12.5 and King's Wharf at Mile 12.99

Appendix III.II: King's Wharf Access Option

Entrance to access under rail as it crosses outflow of Shubenacadie Canal from Kings Wharf Approach

1. View from Shubie Canal Side

2. Shubie canal side from further back

3. View climbing back up to parking lot level at Shubie Canal

APPENDIX IV: TRAINFO SOLUTION


TRAINFO SERVICES
COMMUTERS
TRAINFO will notify motorists of blocked rail crossings where and when they want.
TRAFFIC MANAGEMENT CENTRES
TRAINFO integrates seamlessly into Traffic Management Centres through GIS systems, XML files and numerous other means to allow TMCs to reduce the impact of blocked rail crossings.
EMERGENCY SERVICES
TRAINFO can be integrated onto the GIS of dispatch software to help responders avoid rail crossing delays that can cost lives.
LOGISTICS
TRAINFO can be layered into fleet dispatch software GIS, provided as a standalone GIS, or downloaded into on-board apps to navigate around railway crossing blockages.
MEDIA
TRAINFO can enhance traffic alert services and attract listeners by providing broadcasters and other media companies with custom rail crossing information.

TRAINFO

Quantifying Railway Crossing Delays
Winnipeg, Manitoba, Canada

ABOUT TRAINFO™

TRAINFO is a product of MORR Transportation Consulting. It uses innovative technology and patented algorithms to detect blocked train crossings and predict when future blockages will occur. TRAINFO collects, analyzes, and shares this information in real-time using various dissemination methods.

CASE STUDY BACKGROUND

Our study took place in Winnipeg, which has a population of 700,000. Being at the junction of Canada's main rail lines, Winnipeg has approximately 220 at-grade railway crossings with over 50 through-trains per day.

We quantified travel delay caused by train blockages at one of the major crossings. This study was important because Marion St is a major east-west arterial and key commuter corridor into downtown Winnipeg. More than 30,000 vehicles use Marion St each day including many commercial, public transit, and emergency vehicles. Delay incurred as a result of train blockages translates into significant economic and productivity losses to road users.

METHODOLOGY & APPROACH

We estimated train crossing delays using two methods:

- Traditional
- TRAINFO

Traditional method → relied on publicly-available data from the City of Winnipeg and Transport Canada and equations frequently used in railway crossing delay studies.

TRAINFO method → relied on actual train crossing data, Bluetooth sensors, and pneumatic road tubes that directly measured train crossing impacts on travel delay.

We collected travel time and train crossing data for 44 weekdays. TRAINFO collected train crossing blockage information including blockage time and duration. Bluetooth sensors collected travel time on Marion St between two points 1.1 km apart. We also used pneumatic road tubes to collect hourly traffic volumes on Marion St.

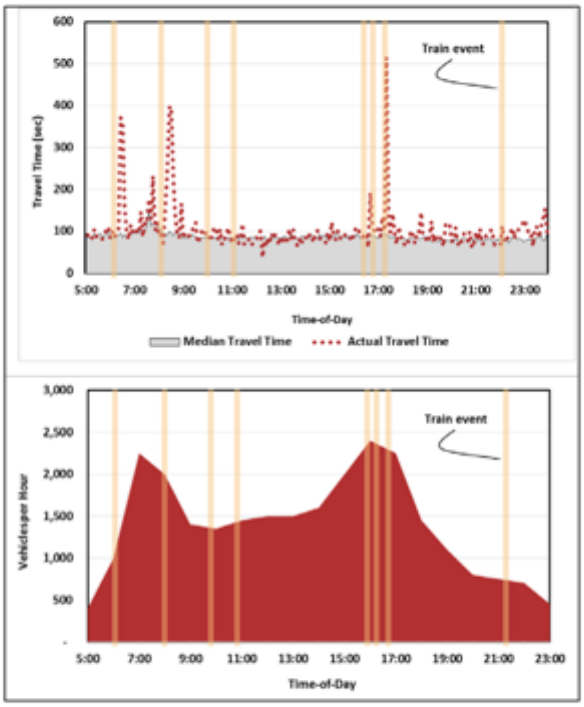
We calculated baseline travel time along Marion St without a train and compared it to travel time when a train blockage occurred. We also calculated how many vehicles experienced these delays using the tube counts.

Data Collection Configuration

RESULTS

- The impact of train crossing blockages usually takes between 15 and 30 minutes to dissipate after the crossing clears.
- The typical travel time for vehicles traversing the 1.1 km segment is around 100 seconds but certain train crossing events can increase travel time by 500%.
- Each train crossing event lasts about 5 minutes.
- The traditional method underestimates the number of vehicles delayed by the blockage by 400%
- The traditional method underestimates the total person-cost per year of these delays by over 100%.
- TRAINFO, along with Bluetooth sensors and hourly traffic volume data, provides accurate information about the impact of train crossing blockages.

	TRAINFO Method	Traditional Method	% Difference
Gate down time per train	5.2 minutes	3 minutes	72%
Average daily train volume	6.5 trains per day	4 trains per day	63%
Vehicles delayed per day	1,364	271	404%
Total vehicle-delay per day	20.8 hr	8.9 hr	133%
Total person-cost per year	$184,296	$87,128	112%



Hourly Traffic Volumes on Marion St & Train Crossing Events at CP Emerson Crossing for February 23, 2016

Travel Time on Marion St & Train Crossing Blockage Duration at CP Emerson Crossing for February 23, 2016

For more information visit www.trainfo.ca.

APPENDIX V: CN RESPONSE

CN

www.cn.ca

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By Email

January 5th, 2017

Bill Todd
Emergency Services International (ESI)
btodd@nbnet.nb.ca

Subject: REQUEST FOR INFORMATION FROM CN RAIL RE KING'S WHARF PROJECT

Mr. Todd,

The following is in response to your letter addressed to CN, dated November 9th 2016. Please find attached the 9 questions you addressed to CN, and CN's response in blue font following each question.

If you have further questions, do not hesitate to contact the undersigned. CN anticipates the opportunity to read your report and its conclusions.

Regards,

[redacted]

Raymond Beshro, MOUQ, MCIP

CC:
Sean Day, Fares Inc.
sean@faresinc.com

Peter Duncan, Halifax Regional Municipality
duncanp@halifax.ca

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January 5, 2017
Page 2

Question 1: In regards to the rail crossing at the entrance to the King's Wharf development, can you confirm CN's understanding of the terms and conditions under which future phases of the project would proceed?

Response: For Phase 1 of the project, CN initially authorized the project's developer to gain access to the development lands via an existing private grade crossing. CN then authorized the developer and HRM under the October 29 2012 agreements to widen the crossing surface and install a warning system to bring it up to public crossing standards. It was understood that any additional requirements stemming from population and traffic increase or emergency vehicle access would require a grade-separation as a means to gain a second access across the railway corridor. We understand this condition was captured by the development agreement between the developer and Halifax Regional Municipality, for obvious reasons linked to safety, emergency access and traffic fluidity.

Question 2: Can you provide details of the rail traffic that may currently use the King's Wharf crossing? Specifically:

- Type of cargo transported, including if the cargo includes petroleum products and/or hazardous materials.

Although a considerable proportion of goods carried on this railway line is automobiles, one must assume that any type of good that can legally be transported by rail can be carried on any segment of CN's network at any time. CN is subject to legal common carrier obligations, and must carry the goods that are presented to it for transportation.

- Frequency of use of the crossing – days per week, times per day; times during day.

The line currently sees approximately 8 trains daily, and 8 passages at the King's Wharf crossing, distributed throughout daytime and nighttime. Rail traffic on any given line is subject to change depending on CN's operational parameters, on customer needs and on economic conditions. The safest assumption is that rail traffic will grow over time, as will the local and regional economy (see response to Question 3).

- Average duration (in minutes) that crossing would be blocked.

An important distinction needs to be made between a blocked crossing and an occupied crossing. CN may not leave equipment standing or execute switching operations in a manner that obstructs the crossing or activates the warning system for more than five minutes. However, CN is allowed to cross and occupy the crossing for more than five minutes if the train is simply crossing without doing switching operations.

- The possibility and frequency of the crossing at the Dartmouth Ferry Terminal and King's Wharf being blocked concurrently.

Response: There is a 1200 feet separation between both crossings. Therefore, any train longer than this distance may occupy both crossings at the same time. The distance is equivalent to 24 rail cars, and potentially less, considering that automobile transporter cars are longer than 50 feet. For this reason, a new crossing at Prince Street would not be appropriate as a means to maintain two emergency routes to the development because there would only be a 300 feet separation. It is very likely that a new crossing surface at Prince Street would also be obstructed, if the crossing at Kings Wharf Place were to be blocked or occupied, in the case of an emergency.

Question 3: Are you able to project and share the information outlined in a (2) for the next ten (10) years?

Response: Things can change quickly in the railway industry, and we are not in a position to provide any kind of meaningful projection for the time being. For the purpose of preparing acoustic studies, consultants would typically apply a 2.5% annual growth rate over 10 years, in the absence of detailed information on the evolution of railway activities in a particular location.

Question 4: What is the process (policy and procedure) for a municipality to communicate with CN if a rail crossing is blocked and emergency service providers are unable to gain access to a site such as King's Wharf?

Response: CN has a toll-free Emergency phone number (1-800-465-9239) which connects callers to the CN Police Communications Centre, who in turn has the ability to reach Rail Traffic Control and local first responders. However, as you may know, a train may need considerable distance and time to come to a complete stop, so altering train speeds or schedules is not an acceptable emergency planning measure. As previously clarified with numerous stakeholders, CN cannot adapt its operations to specific requirements for each new residential development project, as this would not only be untenable on our transcontinental network, but it would certainly compromise the safety and efficiency of railway operations.

Question 5: What is the process for a municipality to determine the potential for a crossing to be blocked during a specific time frame?

Response: While there is no specific regulatory process for this, CN is committed to maintaining strong lines of communication with local emergency services in order to continuously improve the safety of communities and of railway operations. When the CN Police Communications Centre is advised of a blocked crossing anywhere on our network, they immediately advise local emergency services so that they can plan the appropriate detour until such time as the crossing is cleared.

Question 6: Can a municipality request that a train scheduled to be at a specific crossing, be delayed in its arrival at that crossing?

Response: No. See detailed response to question #4.

Question 7: Can you share CN Emergency Response procedures, if a rail crossing becomes blocked due to an accident, derailment, etc?

Response: CN'S Emergency Plan is shared with HRM Fire and Police, but cannot be disseminated beyond.

Question 8: Does CN have plans to upgrade, change or improve the rail crossing at King's Wharf in the foreseeable future?

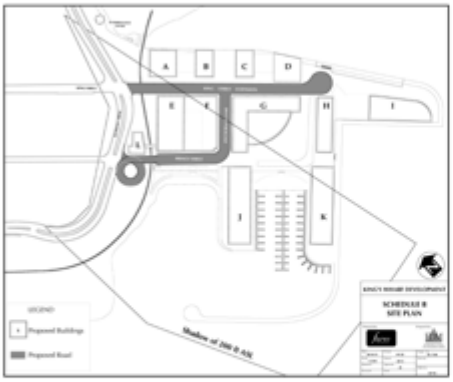
Response: Since the reconstruction of the crossing, CN and HRM collaborated in order to achieve anti-whistling at this crossing. The intervention required certain upgrades to compensate for the safety impacts of removing the train whistle. Based on recent information provided by HRM such as current traffic volume (1000 vehicles per day), design vehicle (Medium Single-unit Trucks), departure time (11 seconds) and traffic signal preemption (15 seconds) no further upgrades or changes are anticipated by CN for the crossing to remain compliant with the *Grade Crossing Regulations*. However, CN is scheduled to inspect this crossing in 2017 to confirm that no additional modifications are required for some aspects of *Grade Crossing Regulations* that only come in effect in 2021. The current cross product of 8000 (1000 vehicles x 8 trains) is well below the capacity where a grade separation option is identified as an alternate solution to mitigate cross product risks. Typically, this threshold is set at a minimum of 150000 vehicles-trains although there are no regulatory requirements defining it. Consequently, if the current crossing geometry remains the same no upgrades or changes would be required even if traffic were to increase.

Question 9: Are you able to assist with a discussion with the operators of the AutoPort facility regarding their current and future operations or should we contact them directly?

Response: Your contact would be my colleague Shaun Gallant, Terminal Manager at Autoport: 902-465-6050; shaun.gallant@cn.ca.

APPENDIX VI: PROPOSED GRADE LEVEL SEPARATION

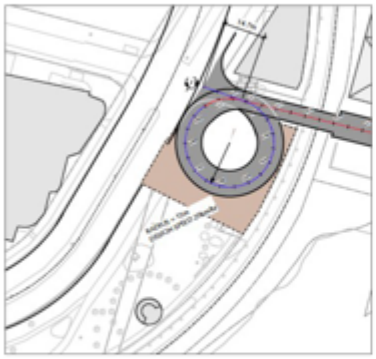
SECOND ACCESS

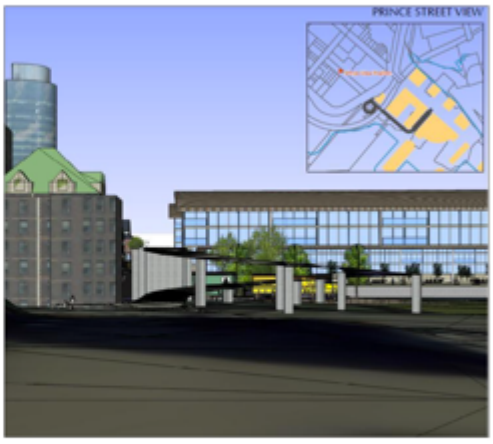


Existing

KING'S WHARF fares EDM

SECOND ACCESS





KING'S WHARF fares EDM

APPENDIX VII: CALCULATIONS SUPPORTING SECTION 6.2.2 Rail Blockage – Timings and Scenarios

Moving Trains

1) "Trains are 1km in length, travel at 16km/hour, and traverse the crossing 8 times per day." This extends to a calculation that each crossing takes 3.75 minutes, and blocks the rail crossing for a total of 30 minutes per day.

   Calculation of the duration (low end) of an individual blockage, assuming the train is moving:
   The train occupies the tracks 1/16 of an hour (60 minutes), 8 times each day or
   1/16(60) = 3.75 minutes (3 minutes, 45 seconds) per crossing

2) The amount of time the crossing is blocked further increases by a 20-second delay created by the lowering and raising of the crossing arms (40 seconds in total).

   Calculation of the range of a moving train including the 40 second delay caused by the lowering and raising of the crossing arm:
   40 seconds = .66 of a minute
   3.75 minutes per crossing + .66 = 4.41 minutes (4 minutes, 25 seconds)

   Calculation of the total time (low end) the crossing is blocked per day assuming the train is moving:
   4.41(8) = 35.28 (35 minutes, 17 seconds) minutes total blockage of the crossing per day

3) CN Rail provided qualitatively that it takes 10 minutes per crossing; this is assumed to be inclusive of the lowering and raising the crossing arm. This can be extended to determine a total of 80 minutes per day that the rail crossing is blocked.

   Calculation of the duration (high end) of an individual blockage, assuming the train is moving:
   Given at 10 minutes per crossing

   Calculation of the total time (high end) the crossing is blocked per day, assuming the train is moving:
   10 minutes per crossing x 8 crossing = 80 minutes total blockage of the crossing per day

The range of time that the rail crossing may be blocked per crossing by a moving train is between 4.41 – 10 minutes.
The range of time that the rail crossing may be blocked per day by a moving train is between 35.28 – 80 minutes.

Stopped or Switching Trains

4) Factoring in the 5 minutes permitted for train stoppage, the time for slow-down (1 minute) and speed-up (1 minute) increases the time of blockage from 35.28 – 80 minutes per day to 42.28 - 87 minutes per day.

   Calculation of the range of duration of an individual blockage, assuming the train is stopped/switching:

   4.41+5+1+1 = 11.41 minutes (11 minutes, 25 seconds) per crossing
   10+5+1+1 = 17 minutes per crossing

   Calculation of the range of total number of minutes the rail crossing is blocked per day, assuming the trains are stopped/switching once per day:

   4.41(7 times per day) + 11.41(1 time per day) = 42.28 minutes
   10(7 times per day) + 17(1 time per day) = 87 minutes

Therefore, the worst-case scenario involves a stopped or switching train and would delay an emergency response time by anywhere between 11.41 minutes and 17 minutes.

Calculation for determining the percentage of the train not through the rail crossing after factoring out the acceptable response time of the emergency:

17.33 minutes – total number of minutes (worst case) that the rail crossing is blocked
6 minutes – acceptable level of response time to reach the crossing
17.33 – 6 = 11.33 minutes (the amount of time remaining for the train to complete the crossing)
11.33/17.33 = 65%

APPENDIX VIII: REFERENCES

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