HALIFAX

P.O. Box 1749
Halifax, Nova Scotia
B3J 3A5 Canada

Item No. 12.1.1
Appeals Standing Committee
March 6, 2025

TO: Chair and Members of Appeals Standing Committee

FROM: Peter Duncan, Director, Engineering & Building Standards

DATE: February 26, 2025

SUBJECT: Appeal Report – BLAST-2024-09274 1190 Barrington Street, Halifax

ORIGIN

On January 21, 2025, Atlantic Road Construction & Paving Ltd. (ARCP) submitted a Notice of Appeal after Development Engineering issued Blasting Permit BLAST-2024-09274 for 1190 Barrington Street, Halifax with site-specific terms and conditions concerning a nearby Heritage Building.

MOTION FOR CONSIDERATION

In accordance with Section 58 of Administrative Order One, the motion before the Appeals Standing Committee is to allow the appeal.

RECOMMENDATION

It is recommended that the Appeals Committee uphold the Blasting Inspector's decision to add site-specific terms and conditions to the blasting permit and deny the appeal.

BACKGROUND

On November 22, 2023, Development Engineering received an application under HRM By-law B-600 Respecting Blasting from Atlantic Road Construction and Paving Limited (ARCP) to perform blasting at a development site located at 1190 Barrington Street (PID 00049965).

Development Proposal

The development at 1190 Barrington Street is on a 0.2-hectare property situated between Tobin Street and South Street. A Development and Building Permit has been approved for the construction of an eight-storey mixed-use building consisting of 95 residential units, ground-floor commercial area, and two levels of below-ground parking. The development site is near a heritage property located at 1222 Barrington Street, commonly known as Henry House.

The Henry House Heritage Property

The property at 1222 Barrington Street, known as the Henry House, contains a historic residence built circa 1834. The Henry House was built by mason John Metzler, and was once the home of William A. Henry, a lawyer, politician, Father of Confederation, and Judge of the Supreme Court of Canada. The house is constructed of ashlar granite blocks, with prominent corner quoins and local ironstone. The Henry House was municipally registered as a heritage property in 1981 and is located within the Old South Suburb Heritage Conservation District. The Henry House also holds provincial heritage registration and was designated a National Historic Site of Canada in 1969.

The heritage value of the Henry House includes, but is not limited to:

- Two-and-a-half storey, three-bay façade Halifax House style stone house with:
    - Asymmetrical portico-covered entrance;
    - Truncated gable roof with three attic windows at either end;
    - Rare freestone construction consisting of ashlar granite blocks with prominent quoins along the main façade, and gable walls in local ironstone with granite window surrounds; and,
    - Minimal setback from the street.

The Henry House stands as a rare example of an early 19th century stone residence. Many single-detached stone houses have been lost to redevelopment over the decades, and as a result, few remain. Stoddard House at 1359 Barrington Street (circa 1828, municipally registered heritage property) is one of the few comparable structures.

Locations of the development site and Henry House are shown on Map 1.

Blasting Permit Review
Initial blasting was permitted in April 2024 under Blasting Permit BLAST-2023-15291 based on the applicant meeting the requirements of the Blasting By-Law B-600; however, damage was subsequently reported at Henry House.

After the reported damage, the HRM Blasting Inspector issued written direction to immediately cease all blasting activities on-site until further notice from HRM. Blasting remained suspended until the applicant submitted a blasting mitigation plan and a condition review of Henry House. The applicant's geotechnical engineer, Mitchelmore Engineering Company Limited (MECO), prepared a report detailing the condition review of Henry House and blasting mitigation recommendations. This report is included in Attachment A.

HRM By-law B-600 establishes vibration limits to protect modern residential structures but does not include specific standards for heritage buildings. As a result, HRM hired WSP, an independent consultant with expertise in blasting near heritage properties, to conduct a peer review of the MECO recommendations, assess the suitability of the applicant's proposed blasting mitigation plan, and provide independent recommendations for blasting near Henry House. The WSP report is included in Attachment B.

A summary comparing the MECO and WSP report findings and recommendations is provided in Attachment C.

The MECO recommendations to support the continuation of blasting are stated below:

- *Blasting limits on air over pressure and ground vibrations at adjacent properties must comply with HRM Bylaw B600 at existing infrastructure. Blasting limits at Heritage properties are reduced by 50% or more for Heritage properties. Based on previous records of blasting in the Halifax Formation bedrock in the area and an assessment of adjacent infrastructure, blast operations can be mitigated to comply with HRM Bylaw B600 and factored limits for Heritage building in consideration of the following operating controls.*
    - *Blastholes should be spaced about one (1) metre with a maximum of three (3) rows of blastholes per blast.*
    - *The weight of explosives in each blast hole is governed by distance to Henry House and the amounts listed in Table 3.3.*
    - *Blast should only be taken after all muck from previous blast operations have been removed and an open face is free in front of the first line of blastholes.*
- *The inspection and condition review of Henry House indicated the interior and exterior was observed to be in Good to Fair condition for most areas, consistent with expectations for a well-*

maintained Heritage Building of similar age. Two areas are identified as in Poor condition, the entrance walkway and the exterior chimney, which are not consistent with expectations for well-maintained Heritage Building of similar age.

- *The opinion in the condition review was that these two areas, in particular, due to the current Poor condition, may experience some shift and/or dislodgement even if the PPV [ground vibration*] *is in compliance with the blasting limits for Heritage Properties. As discussed, the limits recommended for Henry House are similar to what will be experienced daily at the building for the current operation and the risk of damage can be reduced by halting vibration generating activities at the business during blasting. Further, providing a perimeter around the stone chimney inside and outside during blasts, as recommended in the structural report, are encouraged to protect the public from falling objects that may result from blasts.*

The WSP report provided an analysis of industry best practices near heritage properties and recommended a conservative approach to the blasting limits and additional monitoring measures for Henry House. Accordingly, in November 2024, the HRM Blasting Inspector added further terms and conditions to the blasting permit, which must be met by the applicant before blasting can resume. This was done in accordance with Section 21(1) of Blasting By-law B-600:

21. (1) The Inspector may impose terms and conditions on a Blasting Permit.
(2) No person shall carry out or cause to be carried out Blasting which contravenes any term or condition imposed under subsection (1).

Based on the recommendations from WSP, the following additional terms and conditions were added to the blasting permit in consideration of the potential impacts blasting could have to the heritage property:

- Vibration limits should adhere to the Swiss standard SN640 312a for historic structures and transient construction vibrations. The SN640 312a for historic structures and transient construction vibrations maximums are shown below: -Less than 30 Hz - 6 mm/s -30 to 60 Hz – 8 mm/s -Greater than 60 Hz - 12 mm/s. [*These limits range from 16% to 50% of the allowable limits in the by-law, which are designed to prevent cracking in newer construction*].
- For monitoring vibrations at Henry House use 2 seismographs, one installed on the foundation and one on the upper floor.
- Monitoring of crack widths allows for the monitoring of any lateral and/or shear displacement. Measurements of the monitoring device should be set up at selected cracks. During the blasting, records of the crack measurement should be taken at various times during the day to observe whether any change is visible.
- Secure areas where falling pieces of stone or mortar could occur as a result of vibrations given the altered state of certain areas.
- Optimize the design of the bench opening blasting to minimize the blast confinement.
- Optimize the firing sequence.
- Evaluate the possibility of using the electronic detonator in order to benefit from its precision and flexibility. The electronic detonator also allows to check the entire firing circuit before firing the blast. The firing console of the electronic system requires the response of each detonator to allow the initiation of the blast. This system thus allows the blaster to progressively follow the response of the firing circuit when laying the blast mats. In the presence of an anomaly, the blaster will be able to remove the mats and make any necessary corrections. In order to benefit from its precision and flexibility. The use of the electronic detonator also allows a complete check of the system before firing, thus avoiding misfires.
- Record each blast using a video camera for quality control.

A copy of BLAST-2024-09274 is found in Attachment D.

DISCUSSION

Blasting is a construction method used to excavate rock. HRM issues over 60 Blasting Permits annually to support development across the municipality. This method is commonly used for new subdivision development and projects requiring below-ground parking. Compared to mechanical methods like rock breakers, blasting is typically faster and more efficient for construction timelines.

The development site initially began blasting but was directed by HRM last spring to cease all blasting activities. While HRM reviewed appropriate blasting limits, the applicant continued rock excavation using a mechanical rock breaker. Due to the hardness of the rock, this method is expected to be a lengthy process.

The applicant has informed HRM that they are receiving numerous public complaints regarding the noise and vibration caused by rock breaking. They have also indicated that if blasting were permitted, it could significantly reduce the excavation timeline, potentially requiring only two to three additional blasts, whereas mechanical rock breaking would take considerably longer.

The Blasting By-law permits blasting when all requirements of the by-law have been met, including any additional conditions imposed by the Blasting Inspector. In this case, the applicant has met all standard by-law conditions, such as conducting pre-blasting surveys of affected properties and committing to the revised blasting plan. However, the applicant has stated that they have been unsuccessful in obtaining permission to access Henry House to place the additional monitors on the property and within the building, as well as securing the building's exterior, as recommended by the WSP report and required by the HRM Blasting Inspector in the November 2024 permit. HRM staff have not confirmed with the Henry House that they have refused the applicant entry to the property

A valid blasting permit was issued to the applicant in November 2024, requiring compliance with permit conditions related to Henry House. HRM staff do not support any further blasting unless all conditions of the blasting permit are met, including terms to protect public safety and minimize impacts on the heritage building.

Similar conditions were included on a blasting permit for a 114-unit mixed-use residential development at 5426 Portland Street, Halifax, adjacent to the registered heritage properties of Churchfield Barracks row house units (also known as the "12 Apostles") at 2046–2068 Brunswick Street. In such cases, the developer is required to work closely with the affected properties.

FINANCIAL IMPLICATIONS

There are no financial implications if the applicant complies with the terms and conditions stated on the blasting permit.

RISK CONSIDERATION

Reducing the terms and conditions of the blasting permit poses a significant risk to the registered heritage property and public safety in the vicinity of the Henry House. Easing these safeguards would increase the likelihood of structural damage or total loss of this municipally, provincially, and federally registered heritage property and create potential hazards for occupants, visitors, and the public. Strict adherence to the permit's conditions is essential to protecting both the integrity of the Henry House and the well-being of the public.

COMMUNITY ENGAGEMENT

Not applicable.

ENVIRONMENTAL IMPLICATIONS

No environmental impacts identified.

ALTERNATIVES

1) The Appeals Committee could choose to allow the appeal and permit blasting to take place without the additional monitoring measures being in place at the Henry House; or

2) The Appeals Committee could add other terms and conditions to the Blasting Permit.

LEGISLATIVE AUTHORITY

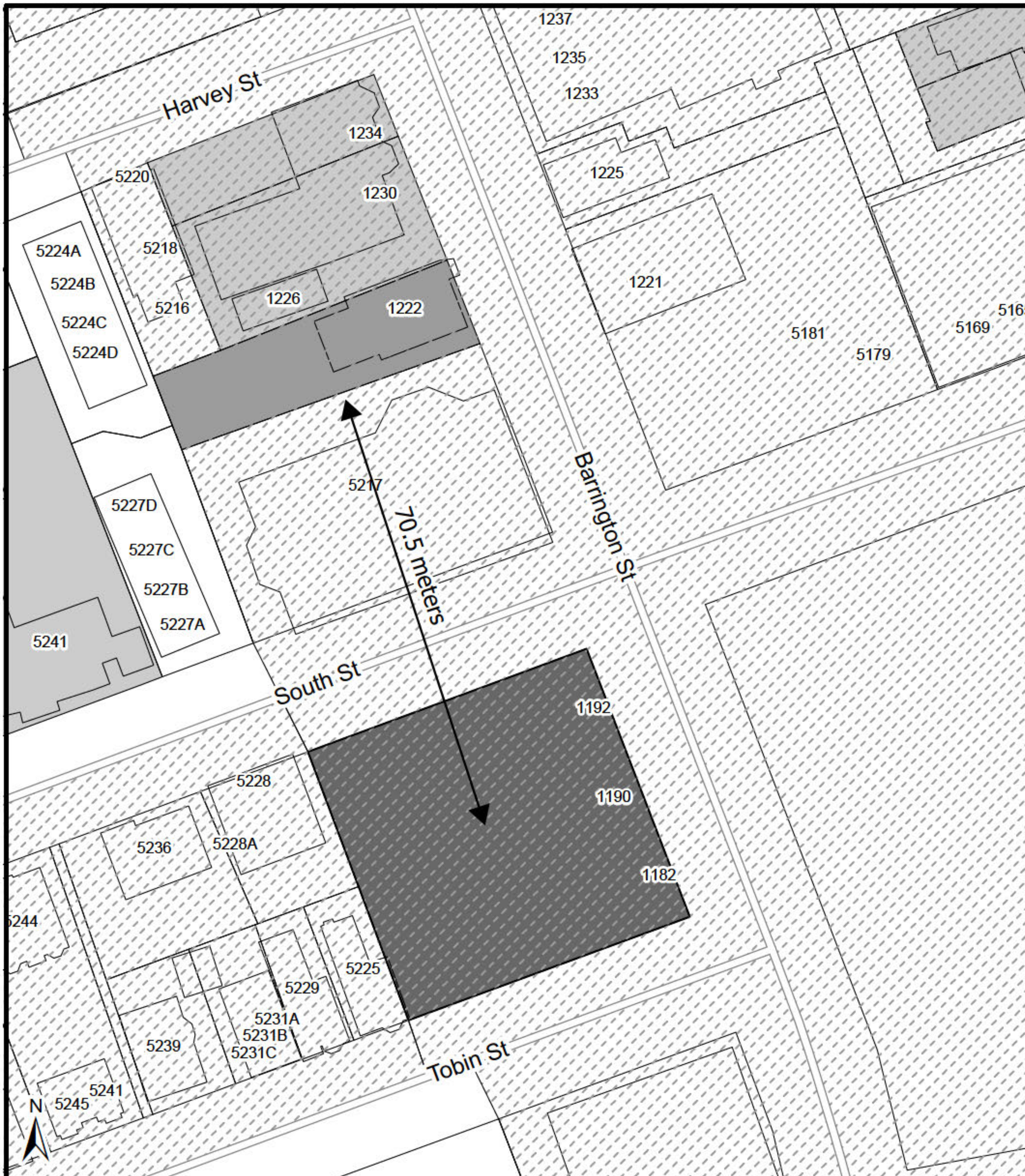
Section 44 of the Halifax Regional Municipality Charter, S.N.S., 2008 C39.

Blasting By-Law B-600

ATTACHMENTS

Map 1 – Location
Attachment A: MECO Report July 8, 2024
Attachment B: WSP Report November 8, 2024
Attachment C: Summary of the MECO and WSP Report Findings and Recommendations
Attachment D: Blasting Permit BLAST-2024-09274
Attachment E: Notice of Appeal
Attachment F: Appeal Notification Letter

Report Prepared by: Ashley Blissett, Manager, Development Engineering 902.476.7210



Map 1 - Development Site Location

1190 Barrington Street,
Halifax

Development Site

Registered Heritage Property

Barrington Street Heritage Conservation District

Henry House Heritage Property

HALIFAX

0 10 20 30

Meters

HRM does not guarantee the accuracy of any representation on this plan.

12 February 2025

Attachment A

BLASTING VIBRATION CONTROL PLAN

1190 Barrington Street Development

Halifax, NS

Updated on PPV Limits | Revision 2 | July 8, 2024

Meco Project Number: 10772

BLASTING VIBRATION CONTROL PLAN

1190 BARRINGTON STREET DEVELOPMENT

Prepared for

ATLANTIC ROAD CONSTRUCTION & PAVING

6 Belmont Ave.
PO Box 89
Dartmouth, NS B3G 1M7

REGISTERED PROFESSIONAL ENGINEER
8 Jul 2024
DATE
[redacted]
P. MITCHELMORE
7468
PROVINCE OF NOVA SCOTIA

Prepared by

MITCHELMORE ENGINEERING COMPANY LIMITED

109 Ilsley Avenue, Unit 14
Dartmouth, NS | B3B 1S8
Tel: (902) 444-3131
Fax: (902) 404-7777

Document Details

Meco Project No.:	10772	Date Submitted:	July 8, 2024
Issue Status:	Updated on PPV Limits	Revision No.:	2
Prepared By:	Perry Mitchelmore, P.Eng. PMP	[redacted]	
Reviewed By:	Anthony Lewis, P.Eng.		

Document Revision History

Issue Status:	Updated on PPV Limits	Revision Number:	2	Date:	July 8, 2024
Issue Status:	For Use & Implementation	Revision Number:	1	Date:	June 21, 2024
Issue Status:	For Review and Comment	Revision Number:	0	Date:	May 10, 2024
Issue Status:		Revision Number:		Date:	
Issue Status:		Revision Number:		Date:	
Issue Status:		Revision Number:		Date:	

Table of Contents

1 INTRODUCTION

Acting on the authorization of Atlantic Road Construction & Paving (ARCP), Mitchelmore Engineering Company Ltd. (Meco) has prepared a Blasting Vibration Control Plan for excavation at the 1190 Barrington Street Development, Halifax, NS.

The purpose of the plan is to provide guidance on controlling peak particle velocity (PPV) to achieve the requirements of HRM Bylaw B600, and specifically PPV experienced at Henry House, a designated Heritage Property.

2 BACKGROUND INFORMATION

The 1190 Barrington Street Development is located between Tobin Street and South Street and fronts onto Barrington Street. The site is flanked by apartment buildings with underground garage parking at 5206 Tobin Street to the east and 5217 South Street to the west. Henry House, located at 1222 Barrington Street, is located west of the apartment building at 5217South Street. A plan view of the area is contained in Appendix A.

2.1 HENRY HOUSE

Henry House, located at 1222 Barrington Street, is a two and a half story stone masonry building, designated as a National Historic Site and registered under the Heritage Property Act. A site visit to observe the interior and exterior of the building was completed June 1, 2024. A report documenting the condition is included in Appendix B.

In general, the interior of the building was observed to be in Good to Fair condition, consistent with expectations for a well-maintained Heritage Building of similar age. The exterior of the building was observed to be in Good to Poor condition. Two areas of Poor condition, the entrance stairway and the exterior chimney, are not consistent with expectations for well-maintained Heritage Building of similar age. The opinion in the condition review was that at these two areas, due to the current Poor condition, there is potential for loose stones and mortar to shift / dislodge for low levels of disturbance.

2.2 ADJACENT PROPERTIES

Adjacent properties fronting Barrington street include multi-level apartment building with underground parades. Both these building are likely founded on bedrock that may have also been blasted. Both buildings and others in the area appear to be well constructed modern buildings that can be regulated according to HRM Bylaw B600.

2.3 UTILITIES

Underground service utilities are located in Tobin Street, South Street and Barrington Street and include sanitary, water, combined sewer and a sanitary force main at Barrington Street, as well as gas lines in all streets. Underground utilities are regulated according to HRM Bylaw B600.

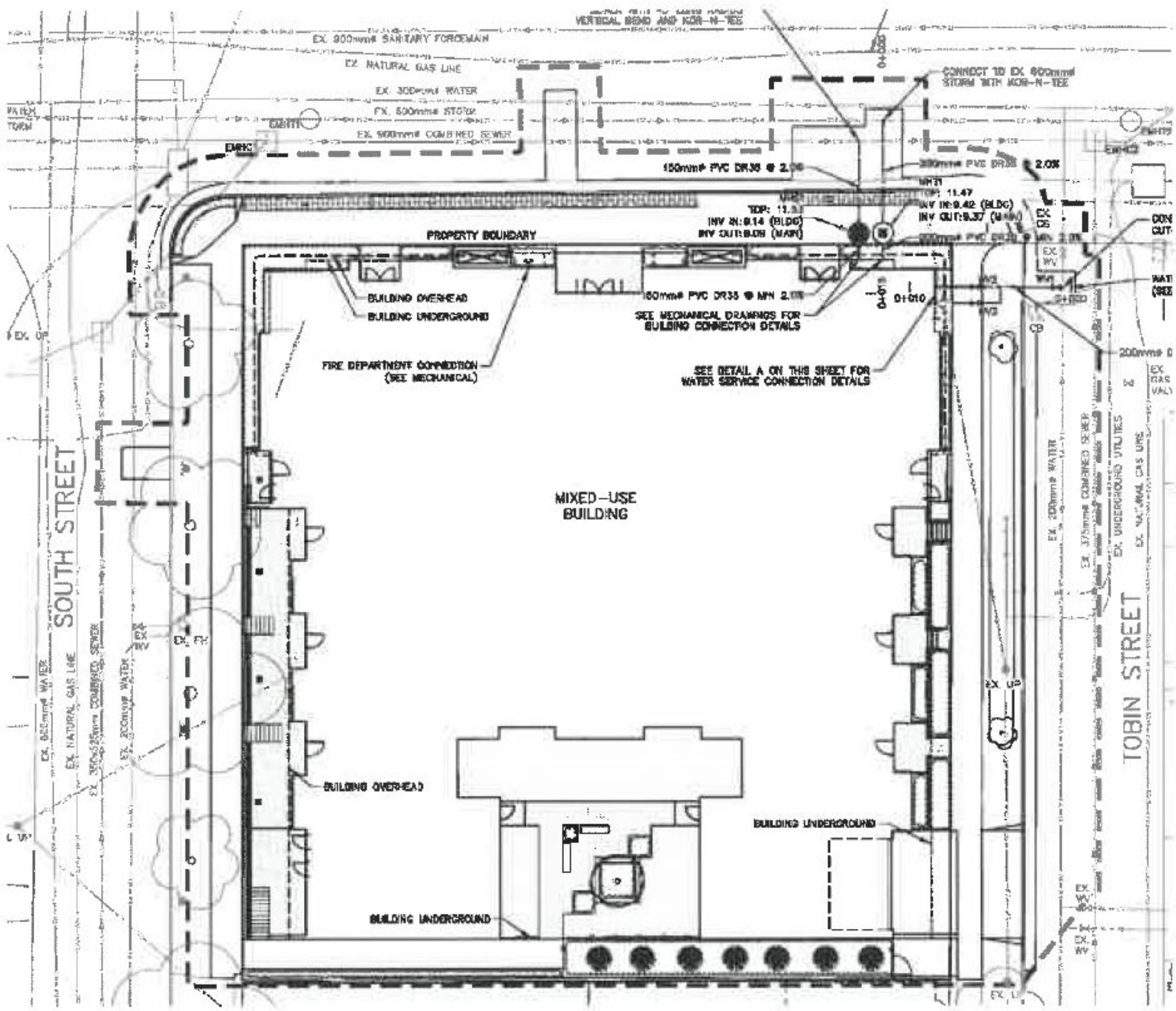


Figure 2.1 Underground Utilities

3 BLASTING PLAN

3.1 BLAST REGULATIONS

Halifax Regional Municipality regulates peak particle velocities (PPV) and air blast (db) pressures experienced at existing buildings and infrastructure that are generated from blasting in HRM Blasting Bylaw B600. The limits a frequency adjusted and apply to typical well-constructed buildings and infrastructure and are consistent with research performed by the United States Bureau of Mining (USBM) Standard RI 8507. Lower frequency PPV are more likely to cause displacements and damage to buildings which is reflected in the bylaws, which allow higher PPV limits for higher frequencies. Overpressure levels from air blasts for all blasting operations are limited to 128 decibels (db), or less.

3.1.1 HERITAGE PROPERTIES

Vibration limits to prevent threshold damage to typical buildings are relatively well known and accepted. However, there is no commonly accepted standard for vibration limits to protect historic buildings. A literature review identified four (4) primary standards for limits at historic buildings.

- United States Bureau of Mines (USBM) Standard RI 8507.
- British Standard BS 7385
- Swiss Standard SN 640 312
- German Standard DIN 4150

Key factors considered in each of the standards are the (1) building type and condition, i.e., sensitivity of a particular structure type to vibration, and fragility of a particular structure, pre-existing weaknesses or distress, etc. (2) vibration type, i.e., transient, e.g., blasting, sudden ground impacts, or continuous, e.g., vibratory pile driving, vibratory compaction, etc. and (3) importance factor. For the 1190 Barrington street development, the blasting regulations apply to short-term dynamic vibrations for blasting.

The standards approach to limiting PPV for heritage note that Heritage structures are not necessarily more vulnerable to vibration, but lower limits may need to be used based on professional judgment for individual cases where the structure may be structurally unsound, indicating a reduction of up to 50% for historic buildings may be appropriate. As similar approach was taken by HRM in 2019 related to the twelve apostles' Heritage buildings near the Trinity Development at Cogswell Road, with limits imposed as a function of frequency outlined in Table 3.1. At that time, HRM imposed a special reduction of 52% of the lowest limit up to a frequency of 30 hertz, then gradually increased the PPV limit to 96% of the lowest limit for frequencies of 60 hertz or greater.

Table 3.1 HRM Special Provisions for Heritage Properties (2019)

Frequency (hertz)	Heritage Building Maximum PPV (mm/sec)	HRM By-Law B600 Maximum PPV (mm/sec)
Less than 15		12.5
15 to 20		19
20 to 25		23
25 to 30		30.5
Less than 30	**6.0**	
30 to 35		33
35 to 40		38
30 to 60	8.0	
40 to 100		50
Greater than 60	12.0	

3.1.2 AMBIENT VIBRATIONS

The human body can perceive very low levels of vibrations as illustrated in Table 3.2. Steady-state vibrations will become noticeable to human occupants at approximately 1 mm/s, strongly noticeable at 6.0 mm/s, again dependent on frequency, with lower frequencies more noticeable. Thresholds of perception and annoyance for blast vibrations are somewhat higher.

Table 3.2 Human Perception of Vibrations (Australian Standard AS 2670.2-1990)

Vibration Level (mm/s)	Perception
.35	Barely Noticeable
1.0	Noticeable
2.2	Easily Noticeable
6.0	Strongly Noticeable

Ambient (background) levels of vibrations in buildings due to normal, day-to-day activities can range from about 0.5 mm/s to 2.5 mm/s, the upper level being something the occupant would easily notice. Ambient levels occur due to common activities, such as walking, occasional running, and closing doors, are often 1.0 – 1.5 mm/s, but may be as high as 3 to 6 mm/s. In one cited example in the literature, vibrations in excess of 2.5 mm/sec were recorded near workers taking down tables and chairs after an event at the Art Institute of Chicago. Vibrations from heel drops, a simulated activity similar to running or jumping, were recorded to be in the range of 1 to 5 mm/sec at the Saint Louis Art Museum. The literature indicates the proposed limits of blasting are comparable to a door slam, business activities, or even heavy traffic on Barrington Street.

The USBM RI 8507 study, as well as several other studies, compared strains in walls produced by everyday activities (walking, running, closing doors, etc.) with those needed to cause threshold cracking. Results indicated that occupants of buildings commonly produce strains in walls similar to those produced by blasting vibrations of 2.5 to 12.5 mm/sec. Perhaps even more significantly, strains in walls caused by seasonal changes in temperature and humidity have been found to be several times those produced by blasting vibrations. These findings explain why wall finishes in buildings often exhibit hairline cracking in the absence of vibration exposure.

3.2 Blast Monitoring Experience – Ground Vibration

3.2.1 Local Geology

Bedrock in downtown Halifax consists of sedimentary rock belonging to the Halifax Formation, described as greenish-black to rust-brown slate with thin beds of minor black metasiltstone. The Formation is sometimes extensively fractured and weathered for two (2) metres or more and has well-developed fracturing. The Halifax slate is generally a poor-quality bedrock.

3.2.2 Previous Observations

Particle velocities from blasts propagate radially to the surrounding environment. The initial vibrations tend to be higher frequency particles that attenuate to lower frequencies as they propagate from the blast location. Within the immediate area, at distances between 50 and 100 metres, the range to Henry House from the site, historical records from within the HRM and in the Halifax Formation bedrock, indicate frequencies less than 30 Hz are possible, although the majority of monitored results will be greater than 30 Hz. That opinion is generated from a review of over 2,500 observations at different distances, as illustrated in the box in Figure 3.1.

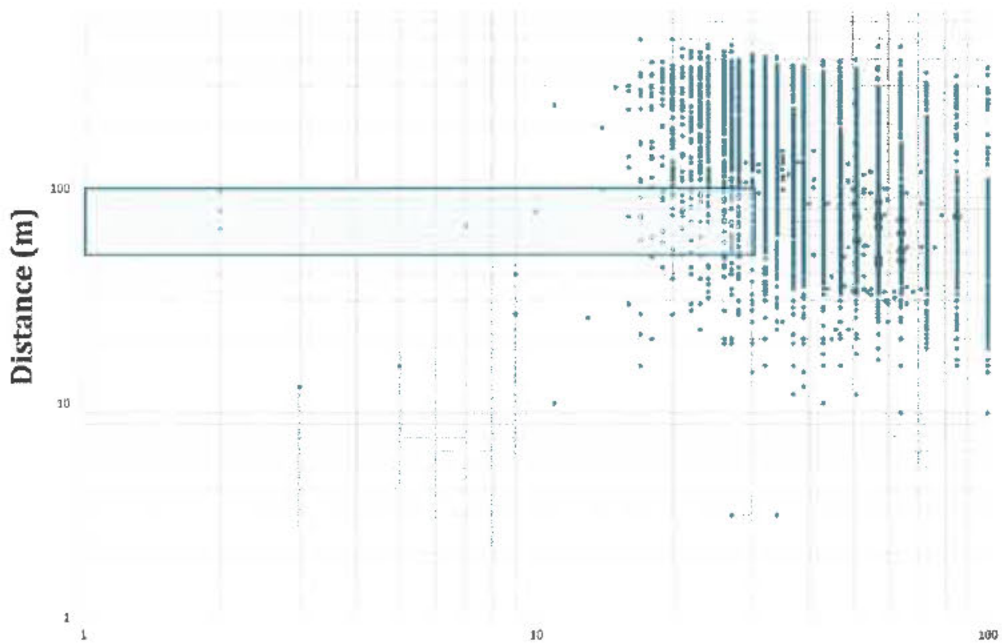


Figure 3.1 Frequency versus Distance, Construction Blasts, Halifax Formation

Based on the anticipated frequency for a specific blast area, the allowable load per delay in blast design is selected using a "scaled distance" variable, which is defined as a relationship between peak particle velocity and the ratio of distance to the square root of the load per delay. A representative plot of values from our records for the Halifax Formation is presented in Figure 3.2. The scaled distance is selected based on the allowable PPV and then the allowable load is selected based on distance.

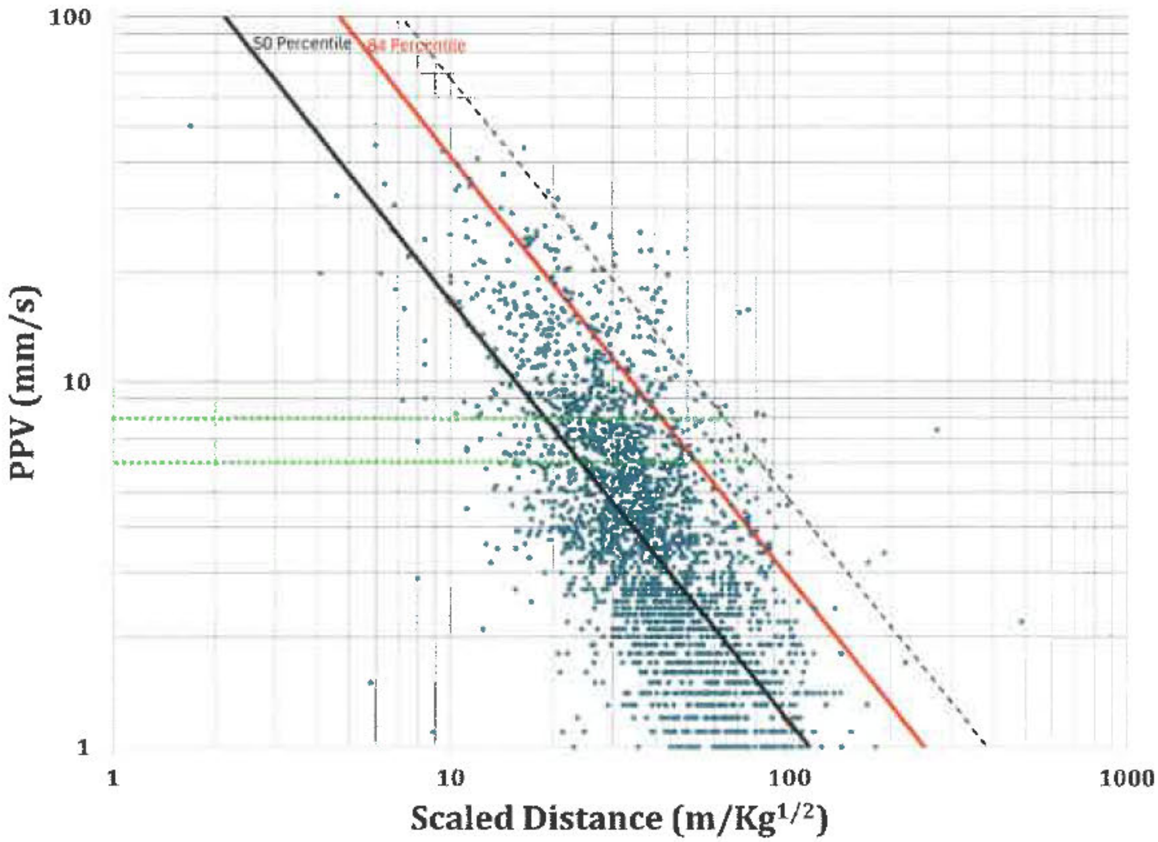


Figure 3.2 PPV versus Scaled Distance, Construction Blasts, Halifax Formation

3.2.3 Blast Control- Heritage Building

All construction blasting at the site will be between 50 and 100 metres distance from Henry House. At this range, initial blasts should be designed assuming potential for less than 30 Hertz, or a maximum peak particle velocity of 6 mm/s. Based on an anticipated lognormal distribution of PPV as a function of distance, two values are suggested for blast design.

- For confined blasts, defined as initial sinking blasts, or blasts that do not have an open face, the suggested scaled distance to guide blast loading is the 95th percentile value, approximately 80.

- For unconfined blasts, defined as production blasts that have one or more open faces, the suggested scaled distance to guide initial blast loading is the 84th percentile value, approximately 51.

The maximum load per delay is related to scaled distance and the distance from the infrastructure being monitored to the centre of the blast as follows, where distance is measured in metres and charge weight is measured as kilograms of explosive.

$$Charge/Delay = \left(\frac{Distance}{Scaled\ Distance}\right)^2$$

The recommended loading based on distance ranges (Measured as the shortest distance from the perimeter of the blast to the exterior wall of Henry House) to manage peak particle vibrations from construction blasting at Henry House is summarized in Table 3.3.

Table 3.3 Recommended Loading Values to Limit PPV at Heritage Building

Distance to Infrastructure from Centre of Blast (m)	Confined Blast Max Load per Delay (Kg)	Unconfined Blast Max Load per Delay (Kg)
50 - 60	0.40 – 0.55	1.0 – 1.4
60 - 70	0.55 – 0.75	1.4 – 1.9
70 – 80	0.75 – 1.00	1.9 – 2.5
80 – 90	1.00 – 1.25	2.5 – 3.1
90 - 100	1.25 – 1.50	3.1 – 3.8

3.2.4 Blast Control- Other Infrastructure

For construction blasting where the distance to other infrastructure is less than 50 metres, which includes the adjacent apartment buildings and underground utilities in the streets, blast should be designed for the 25 to 30 Hertz range, or a maximum peak particle velocity of 30.5 mm/s. As with Heritage Buildings, a lognormal distribution of PPV as a function of distance is anticipated and two values are suggested for blast design.

- For confined blasts, defined as initial sinking blasts, or blasts that do not have an open face, the suggested scaled distance to guide blast loading is the 95th percentile value, approximately 20.
- For unconfined blasts, defined as blasts that have one or more open faces, the suggested scaled distance to guide blast loading is the 84th percentile value, approximately 12.

The recommended loading based on distance ranges to manage peak particle vibrations from construction blasting to other infrastructure are summarized in Table 3.4.

Table 3.4 Recommended Loading Values to Limit PPV to Infrastructure

Distance to Infrastructure from Centre of Blast (m)	Confined Blast Max Load per Delay (Kg)	Unconfined Blast Max Load per Delay (Kg)
<10	-	0.70
10 – 20	0.25 – 1.00	0.70 – 2.70
20 – 30	1.00 – 2.25	2.7 – 4.30
30 - 40	2.25 – 4.00	4.30 - 5.00
40 - 50	4.00 – 5.00	5.00
>50	5.00	5.00

3.2.5 Blast Monitoring to Date

There have been two (2) blast events at the site; (1) a sinking blast on April 24th and a production blast April 25th. The initial blast was monitored for PPV and air overpressure at three (3) locations and the second blast was monitored at the same three location and also at Henry House. Both blast events used a maximum load per delay of 3.2 kg. The initial blast had a total explosive weight of 259 kg in 80 holes compared to 38.4 kg in12 holes for the second blast. Results are tabulated in Blast Plan

ARCP indicates each blast pattern will consist of Fortel Pro packaged explosive with Pentex Booster and Handidet delay detonators. Blast holes will be drilled vertically parallel to the face with up to a maximum of three lines of holes per blast. Each blast hole will be loaded with explosive and a handidet detonator that provides for a 500 ms in-hole delay and 25ms delay between line holes with a 17ms delay across lines. The delay sequence will be designed to allow a minimum 8ms delay between any two blasthole detonations. Specifications for blast products are included in Appendix A. A typical blast layout is identified in Figure 3.3. Blasthole depth will be limited to less than three (3) metres and only one (1) lift is planned for the site.

Table 3.5 and plotted in Appendix C.

None of the blast observations were outside compliance with HRM Bylaw B600. The PPV results for the initial sinking blast, April 24th, are consistent with the blast plan plotting near the 95 percentile. The second blast, April 25th is between the 50th and 85th percentiles, consistent with expectation. The third plot in Appendix C is the monitored results at Henry House on April 25th which shows the PPV is within expectations.

The scaled distance for the first blast varied from 39.1 to 55.3, which is consistent with a sinking blast where the recorded PPV is 10 to 15 mm/s and, when compared with the scatter in Figure 3.2, all results plot around the 84-percentile expectation. The scaled distance for the second blast was in the 16.8 to 28.5 range, except for monitoring at Henry House, where the scaled distance was 47.5. When compared with the scatter in Figure 3.2 all results plot around the 50-percentile expectation.

3.3 Blast Plan

ARCP indicates each blast pattern will consist of Fortel Pro packaged explosive with Pentex Booster and Handidet delay detonators. Blast holes will be drilled vertically parallel to the face with up to a maximum of three lines of holes per blast. Each blast hole will be loaded with explosive and a handidet detonator that provides for a 500 ms in-hole delay and 25ms delay between line holes with a 17ms delay across lines. The delay sequence will be designed to allow a minimum 8ms delay between any two blasthole detonations. Specifications for blast products are included in Appendix A. A typical blast layout is identified in Figure 3.3. Blasthole depth will be limited to less than three (3) metres and only one (1) lift is planned for the site.

Table 3.5 Initial Monitored Results (1190 Barrington Street)

Location	Date	PPV (mm/s) [Frequency (Hz)]			Load (kg/delay)	Distance (m)	Scaled Distance
		Trans	Vert	Long			
5206 Tobin Street	24 Apr	2.4 [58]	15.8 [75]	8.6 [69]	3.2	85	47.5
	25 Apr	1.7 [57]	7.2 [57]	3.5 [64]	3.2	34	19.0
5225 Tobin Street	24 Apr	17.2 [75]	15.8 [75]	7.9 [69]	3.2	99	55.3
	25 Apr	15.6 [57]	11.1 [39]	6.3 [51]	3.2	30	16.8
5217 South Street	24 Apr	7.7 [68]	9.3 [70]	6.3 [67]	3.2	70	39.1
	25 Apr	2.5 [64]	2.5 [47]	2.3 [57]	3.2	51	28.5
1222 Barrington Street	25 Apr	4.2 [64]	2.9 [43]	2.8 [39]	3.2	85	47.5

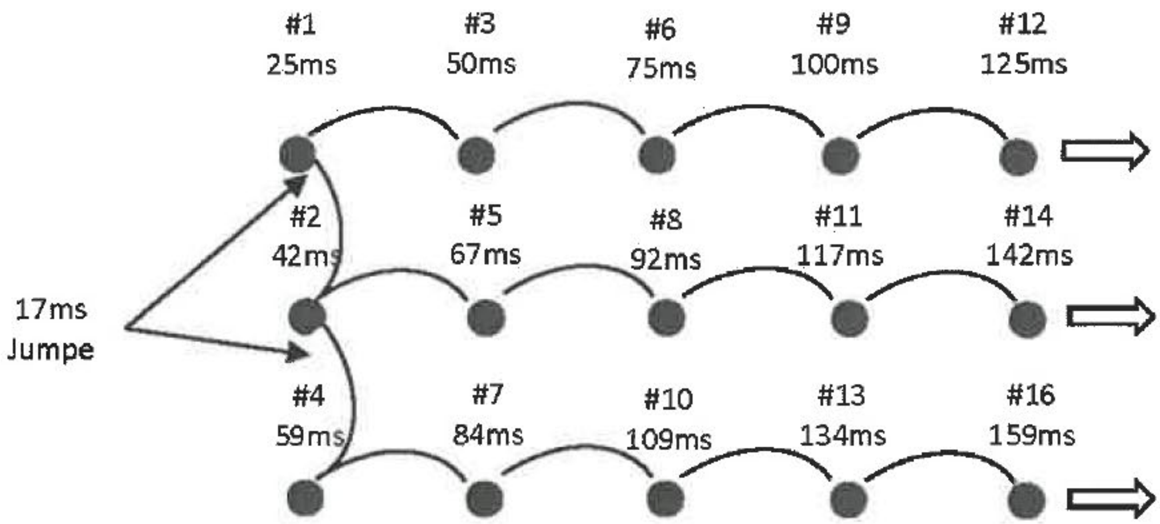


Figure 3.3 Typical Blast Layout

The objective of the blasting plan is to locate all sinking blasts away from the heritage site. Once the site is exposed such that future blasts will have at least one open face, blasthole loading should proceed using values in Table 3.3 for three to five blast events to monitor the response at Henry House. If monitoring verifies consistent response frequencies greater than 30 hertz, the scaled distance for design can be adjusted to the 20 to 40 range for the remainder of the project. In general, production blasts will progress away from the sinking blast radially.

- Phase 1 – open the quadrant furthest from the heritage house, with a series of blasts that have two (2) lines of six (6) holes each (12 in total) in the southeast corner of the site.
- Phase 2 – progress blasting from Phase 1 towards Barrington Street using similar size blasts or adjusted as appropriate based on monitoring results.
- Phase 3 – Progress blasting in a westerly direction towards South Street.

3.3.1 Blast Crew

Blasting will be supervised by Ted Drover, Blaster 1st Class, certificate #20046994, Ted is employed by Atlantic Road Construction and Paving.

3.3.2 Monitoring and Evaluation

Each blast will be monitored for peak particle velocity and air blast. A minimum of three (3) seismographs will be used for each blast, with one dedicated to Henry House.

4 CONCLUSIONS AND RECOMMENDATIONS

The 1190 Barrington Street Development is located between South Street and Tobin Street. The site is flanked by apartment buildings with parking garages and underground utilities in the adjacent streets. Henry House, a designated Heritage Building, is located between 50 and 100 metres from blast activities.

Blasting limits on air over pressure and ground vibrations at adjacent properties must comply with HRM Bylaw B600 at existing infrastructure. Blasting limits at Heritage properties are reduced by 50% or more for Heritage properties. Based on previous records of blasting in the Halifax Formation bedrock in the area and an assessment of adjacent infrastructure, blast operations can be mitigated to comply with HRM Bylaw B600 and factored limits for Heritage building in consideration of the following operating controls.

- Blastholes should be spaced about one (1) metre with a maximum of three (3) rows of blastholes per blast.
- The weight of explosives in each blast hole is governed by distance to Henry House and the amounts listed in Table 3.3.
- Blast should only be taken after all muck from previous blast operations have been removed and an open face is free in front of the first line of blastholes.

The inspection and condition review of Henry House indicated the interior and exterior was observed to be in Good to Fair condition for most areas, consistent with expectations for a well-maintained Heritage Building of similar age. Two areas are identified as in Poor condition, the entrance walkway and the exterior chimney, which are not consistent with expectations for well-maintained Heritage Building of similar age.

The opinion in the condition review was that these two areas, in particular, due to the current Poor condition, may experience some shift and/or dislodgement even if the PPV is in compliance with the blasting limits for Heritage Properties. As discussed, the limits recommended for Henry House are similar to what will be experienced daily at the building for the current operation and the risk of damage can be reduced by halting vibration generating activities at the business during blasting. Further, providing a perimeter around the stone chimney inside and outside during blasts, as recommended in the structural report, are encouraged to protect the public from falling objects that may result from blasts.

Appendix A

Plan Map of the Area

GENERAL SITE ARRANGEMENT PLAN

Scale: 1:500

LOCATION

NOTES

REVISION	DESCRIPTION	DATE
A	PRELIMINARY/DRAFT	2024-05-15

PRELIMINARY/DRAFT

Innovation | Reliability | Performance

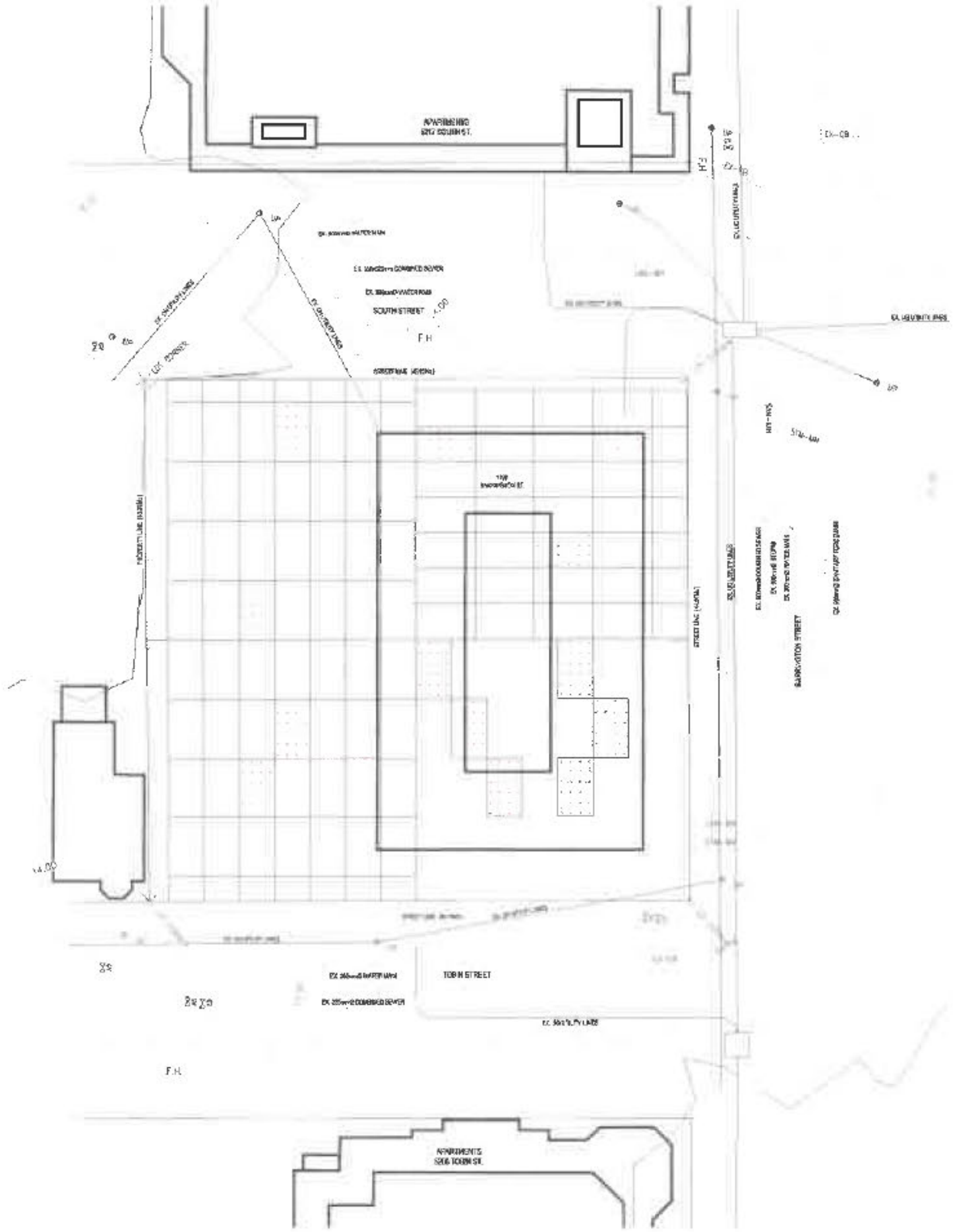
CLIENT

WWW.ARCP.CA

PROJECT

TITLE

DESIGNED BY: D.M.	APPROVED BY: P.R.
DRAFTED BY: J.R.R.	MANAGER: A.L.
DATE: 2024-04-30	SCALE: AS SHOWN
PROJECT #: 10772	DRAWING #: C-101



BLAST DESIGN SITE PLAN

Scale: 1:200

NOTES:

REVISION	DESCRIPTION	DATE
A	PRELIMINARY DRAFT	2024-05-13

PRELIMINARY DRAFT

Meco
Innovation | Reliability | Performance

STAMPS

//ATLANTIC
WWW.ARCP.CA

PROJECT:

TITLE: BLAST DESIGN SITE PLAN

DESIGNED BY: D.M.	APPROVED BY: P.M.
DRAFTED BY: J.W.M.	SHEET SIZE: A1
DATE: 2024-04-30	SCALE: AS SHOWN
PROJECT #: 10772	DRAWING #: C-102

Appendix B

Henry House Condition Review

HENRY HOUSE

CONDITION REVIEW

Final | Revision 1

July 8, 2024

KEYJAY

Henry House

Condition Review

July 8, 2024

Prepared For:

Mitchelmore Engineering Company
Attn: Anthony Lewis, CET
109 Ilsley Avenue, Unit #14
Dartmouth, NS | B3B 1S8

Prepared By:

KeyJay Inc.
Rebecca Legre, P.Eng.
84 Solaris Ridge
Porters Lake, NS | B3E 0E9
rebecca@keyjay.ca

TABLE OF CONTENTS

1.0 INTRODUCTION

KeyJay Inc. was retained to provide a structural opinion on the condition of a historical building, located at 1222 Barrington Street, in the downtown core of Halifax, Nova Scotia. The owner of the building reported damages resulting from blasting in the vicinity of the property. In response, the Halifax Regional Municipality (HRM), required an existing condition review be completed on the building.

This report documents the findings of the existing condition review, based on the findings of an on-site visual inspection.

2.0 BACKGROUND

The current building, more commonly known as Henry House, is a two and a half story historic masonry building. Built in 1834 as a sailor's residence, the building underwent major renovations in the late 1960s to early 1970s to repurpose the building for use as a restaurant. Due to its age and historical significance, Henry House is designated as a National Historic Site and is both Provincially and Municipally registered under the Heritage Property Act.

The building's exterior walls are approximately 2 feet (610 mm) thick composed of masonry stone walls. The building has a traditional gable roof with granite façades and iron stone. During the recent blasting activities, the Owner of Henry House claimed several areas of the exterior masonry walls and brick chimney were damaged, triggering the need for a condition review. The condition review is primarily focused on the condition of the building exterior and masonry walls.

3.0 SITE REVIEW

On June 1, 2024, a visual inspection of Henry house was completed by Rebecca Legere from KeyJay, accompanied by Anthony Lewis from Mitchelmore Engineering Company (Meco). The inspection consisted of an interior visual view of all exposed masonry walls on the basement, main floor, second floor and third floor levels. A visual inspection of the exterior was completed at ground level with the use of a drone was used to obtain video and photographs of the upper areas of the building's exterior.

Details of the site findings are provided in the sections below. All referenced photographs can be found in Appendix A.

3.1 BASEMENT LEVEL

The basement level includes a large open seating and bar area at the front of the building, with washrooms and storage areas at the rear. The main open area has the majority of the original stone walls exposed while the rear areas are finished with no exposed stone.

The front wall is in overall good condition (Photo 1 and Photo 2). Several areas of medium to wide mortar cracks (Photo 3) were noted with some areas of previously repaired cracks (Photo 4). The front wall appeared to be stable with no evidence of loose stones or mortar.

The exposed portion of the north wall also appeared to be in good condition with no notable areas of concern. The stairways leading to the main floor and exterior of the building (Photo 6) are also located on the north side of the building. General minor defects such as narrow vertical mortar and stone cracks were observed within the stairwells and on the exposed areas of the north wall.

The south side of the basement includes a brick fireplace (Photo 7) and oven. The south walls are parged with partially exposed areas of the stone masonry walls. Similar to the north and east walls, the exposed areas of the south walls were in good condition with minor masonry defects.

The brick fireplace is in fair condition with general deterioration due to age, some areas of mortar loss between the bricks on the outer hearth (Photo 8), as well as minor brick abrasions and chips on the bricks composing the interior of the fireplace. The owner claims portion of the brick mortar and chimney stones detached from the interior walls of the fireplace (Photo 9).

The stone oven on the south wall was in fair condition with general wear and a wide transverse crack through the base of the stone oven (Photo 10).

3.2 MAIN FLOOR

The main floor includes the main entrance foyer and a large open dining area in the front with a bar and kitchen in the rear. The majority of the main floor was finished and not visible for inspection. The only visible areas of the walls were on the south wall in the main dining area.

The south wall of the main floor includes two fireplaces and is exposed for the majority of the dining area. The wall is in fair condition with narrow to medium cracks through both the mortar joints and bricks (Photo 11 and Photo 12), deterioration and mortar loss (Photo 13). A wide separation between the rear fireplace and south wall was also noted (Photo 14). Similarly to the basement level, the owner also noted debris from separated mortar and/or stones in both of the second-floor fireplaces.

3.3 SECOND FLOOR

The second-floor layout contains a small dining area, bathroom and bar. The front, south and rear walls are exposed in the dinning area.

All three walls on the second floor are in good to fair condition with minor mortar cracks, loose stone and some cracks in the bricks (Photo 15, Photo 16, Photo 17 and 18). The wall appears stable with no loose stones or areas of concern. The timber lintels above the windows are in fair condition with wide splits and general wear (Photo 19).

3.4 THIRD FLOOR

The third floor is finished with no exposed brickwork. Several of the rooms did have cracks in the plaster but it is unclear if these are a result of general age of the structure or if they were a result of the blasting (Photo 20 and Photo 21). An assessment of the building condition based on these cracks would require further investigation and removal of portions of the plaster.

3.5 Exterior

The original front and side faces of the building's exterior are exposed, while the rear portion has a more recent addition. The exposed exterior faces all have notable weathering, mortar loss and cracks, deterioration and cracks through the stone blocks (Photo 22, Photo 23 and Photo 24). Several areas of recent chips in the granite blocks were noted (Photo 25 and Photo 26). Based on comments from the owner, these chips were a result of damage from the previous blasting.

On the front of the building, a walkway leading up to the main entrance is composed of stone stairs supported by masonry blocks. The front stairway is in fair to poor condition with severe mortar loss, unstable rubble foundation and evidence of movement in the granite blocks (Photo 27 and Photo 28). Based on weathering patterns on the stones, active continued movement of the blocks is suspected.

The brick chimney on the south side of the building in is poor condition with wide vertical cracks through both the mortar joints and bricks (Photo 29 and Photo 30). Due to the height of the chimney and its close proximity to the driveway along the side of the building, falling pieces of the chimney pose a significant concern to the safety of pedestrians and vehicles using the driveway.

4.0 Summary

In general, the interior face of the basement walls were observed to be in good condition with no significant defects or areas of concerns. General mortar cracks and chipped brickwork were observed but these defects would be expected for the age of the building. The interior face of the main and second floor walls are in good to fair condition with evidence of general wear and deterioration.

The exterior faces of the building are in fair condition with several areas considered to be in poor condition. The front step and brick chimney are in a state of disrepair with loose stones and mortar loss. Due to their condition, the chimney and front stairway are likely to be more susceptible to damage during any future blasting events.

To mitigate potential blasting impacts, a blasting plan completed by Meco, dated May 14, 2024, was prepared and will be implemented for any future blasting activates. The blasting plan submitted by Meco will reduce the risk of peak particle vibrations exceeding HRM by law B600, with the recommended reductions for Heritage properties. Due to their poor condition, the potential for loose stones and mortar to shift and/or dislodge from the building at the chimney and walkway locations is possible, even if peak particle vibrations remain within acceptable recommended limits for heritage properties.

It is recommended that continual monitoring of any future blasting activities be completed to verify conformance with Meco's May 14th blasting plan. Additionally, for protection against any falling objects, the driveway adjacent to Henry House should be closed to pedestrian and vehicular traffic for the full duration of all blasting events.

5.0 CLOSURE

Should you have any further comments or questions, please do not hesitate to contact the undersigned.

Sincerely,

KeyJay Inc.

Prepared By:

Rebecca Legere, P.Eng.
Structural Engineer

REFERENCES

Canadian Commission on Building and Fire Codes. (2015). *National Building Code of Canada.* National Research Council of Canada.

Canadian Commission on Building and Fire Codes. (2015). *Structural Commentaries (User's Guide - NBC 2015: Part 4 of Division B).* National Research Council of Canada.

Policy, Planning & Standards Division, Engineering Standards Branch. (2018). *Ontario Structure Inpsection Manual* . Ministry of Transportation Ontario.

APPENDIX A

Site Photographs

Photo 1 North side and front basement wall at bar location

Photo 2 Front basement wall

Photo 3 Cracks in the front basement wall

Photo 4 Previously repaired cracks in the front basement wall

Photo 5 Wall in stairwell leading to the main floor

Photo 6 Wall in basement stairwell to the exterior

Photo 7 Basement fireplace

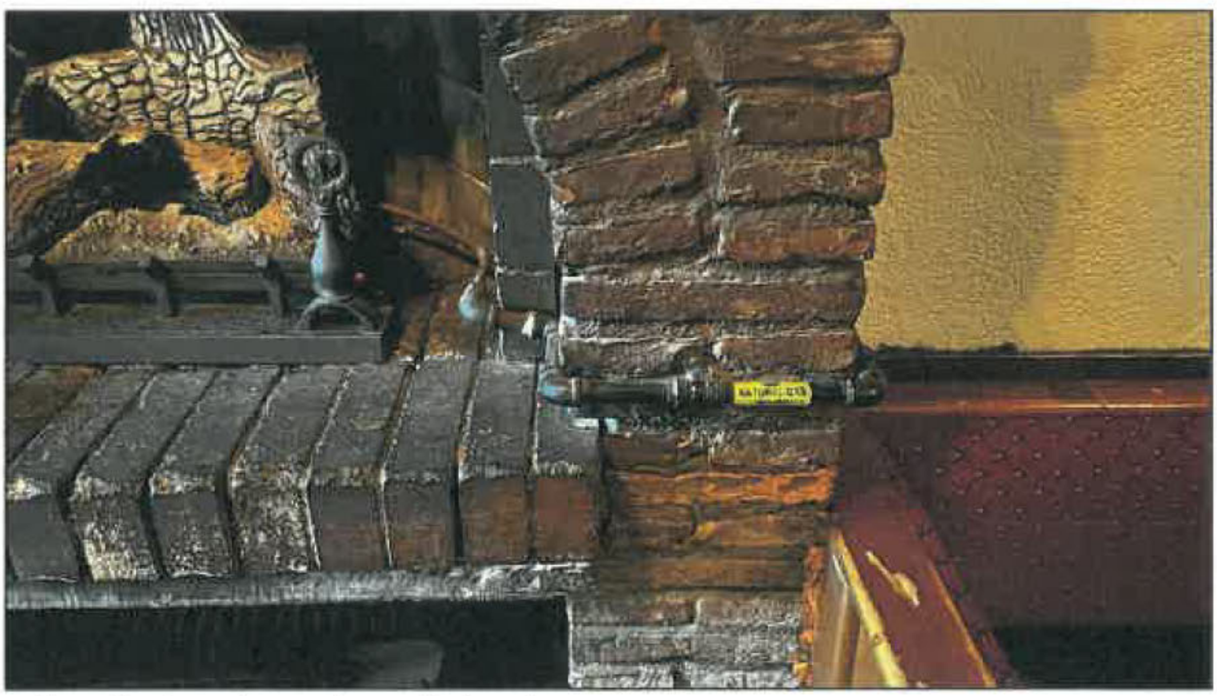


Photo 8 Loss of mortar in exterior hearth

Photo 9 Debris found in chimney after blasting

Photo 10 Crack in stone oven base

Photo 11 Vertical and mortar step cracks on the second floor south wall

Photo 12 Cracks on the main-floor south wall

Photo 13 General deterioration and mortar loss in south main floor wall

Photo 14 Separation between wall and main floor fireplace

Photo 15 Vertical cracks in rear second story wall

Photo 16 Vertical cracks in south second story window well

Photo 17 Vertical cracks in rear second story wall

Photo 18 Mortar cracks and deterioration on the southeast corner of the second floor

Photo 19 Splits in second story timber lintels

Photo 20 Cracks in third floor plaster

Photo 21 Cracks around front window on third floor

Photo 22 Crack over basement window on exterior face of north wall

Photo 23 Cracks through exterior stone

Photo 24 General wear, mortar loss and cracks on exterior masonry face

Photo 25 Recent chips in exterior granite blocks

Photo 26 Recent chip at corner of exterior granite block

Photo 27 Shifted and unstable front entrance stairway

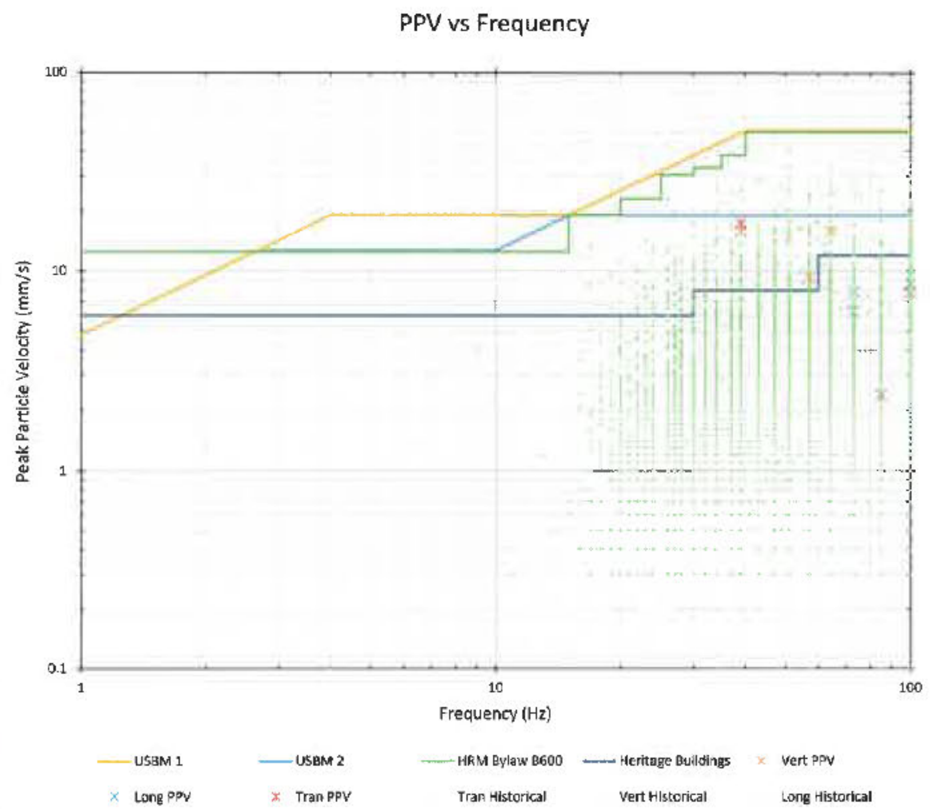
Photo 28 Mortar loss and unstable stairway foundation

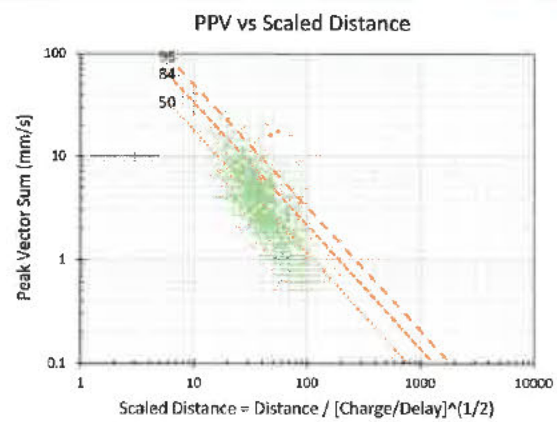
Photo 29 Chimney deterioration, cracks and mortar loss

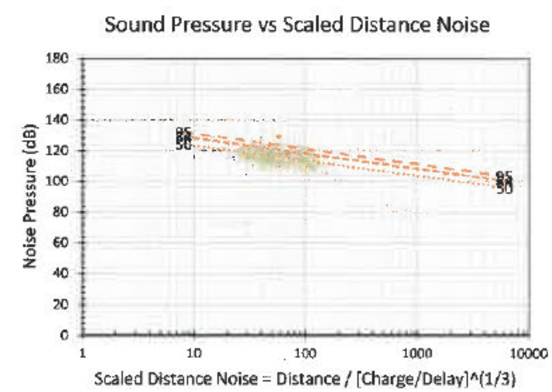
Photo 30 Side view of chimney

Appendix C

Blast Monitoring Results

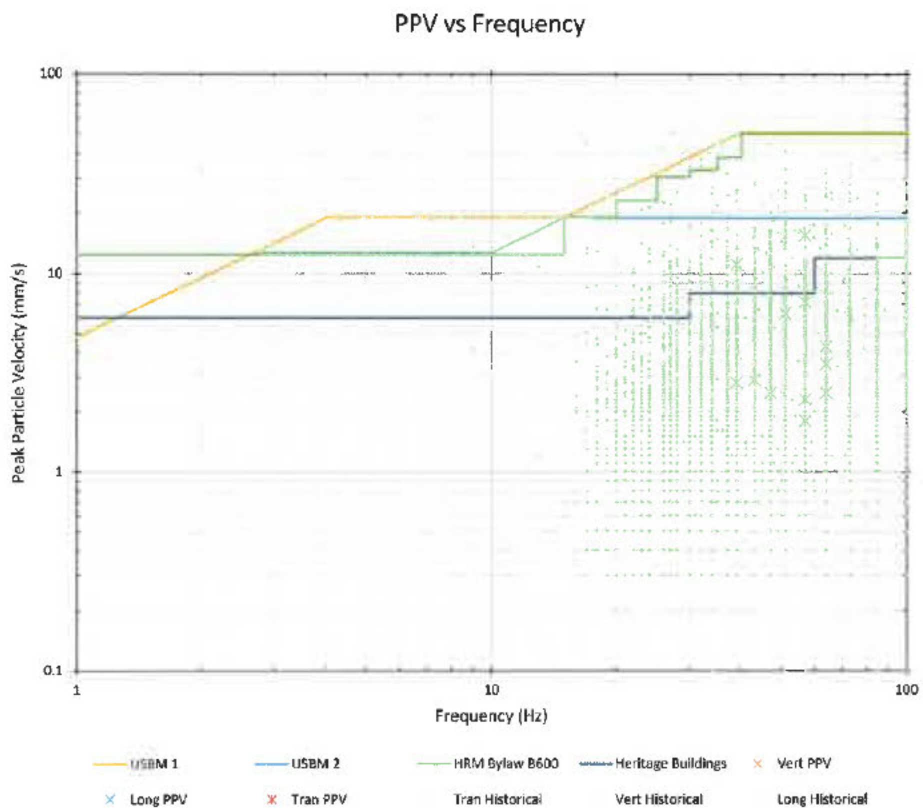

PPV vs Frequency
Peak Particle Velocity (mm/s)
100
10
1
0.1
1
10
100
Frequency (Hz)
USBM 1
USBM 2
HRM Bylaw B600
Heritage Buildings
Vert PPV
Long PPV
Tran PPV
Tran Historical
Vert Historical
Long Historical

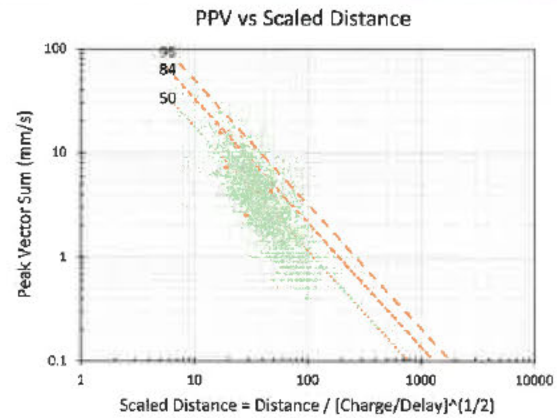

PPV vs Scaled Distance
Peak Vector Sum (mm/s)
100
10
1
0.1
84
50
1
10
100
1000
10000
Scaled Distance = Distance / [Charge/Delay]^(1/2)

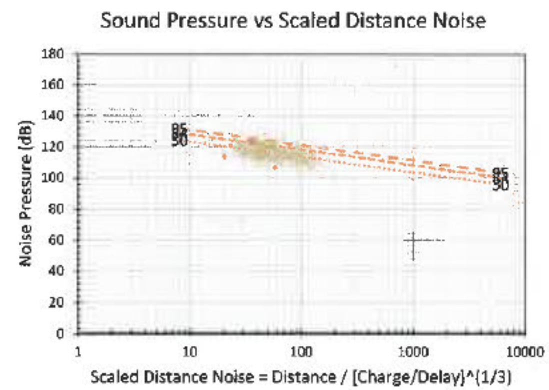

Sound Pressure vs Scaled Distance Noise
Noise Pressure (dB)
180
160
140
120
100
80
60
40
20
0
1
10
100
1000
10000
Scaled Distance Noise = Distance / [Charge/Delay]^(1/3)

1190 Barrington Street Project

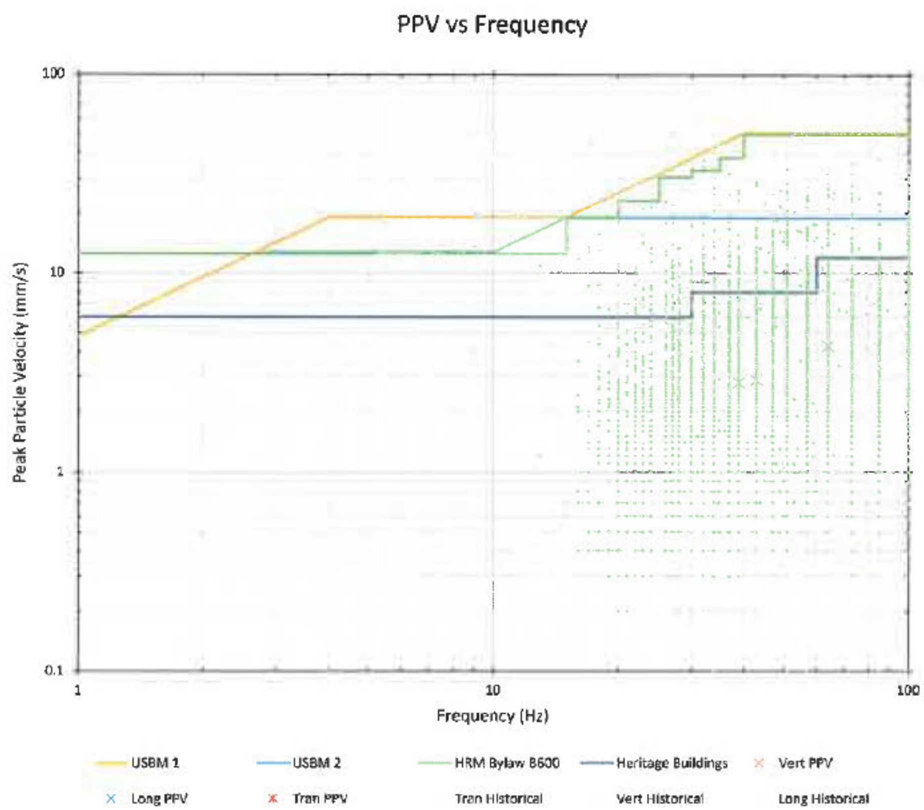
Blast Monitoring Dashboard

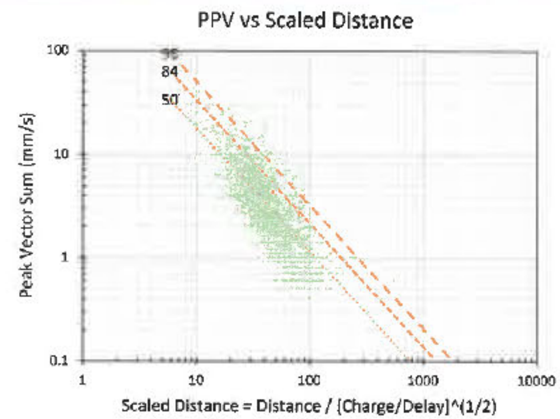


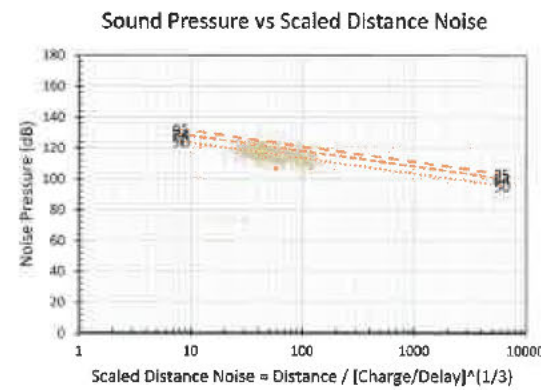




Background Cloud represents monitored results from historical blast monitoring and is provided for reference only


PPV vs Frequency
Peak Particle Velocity (mm/s)
100
10
1
0.1
1
10
100
Frequency (Hz)
USBM 1
USBM 2
HRM Bylaw B600
Heritage Buildings
Vert PPV
Long PPV
Tran PPV
Tran Historical
Vert Historical
Long Historical


PPV vs Scaled Distance
Peak Vector Sum (mm/s)
100
10
1
0.1
84
50
1
10
100
1000
10000
Scaled Distance = Distance / [Charge/Delay]^(1/2)


Sound Pressure vs Scaled Distance Noise
Noise Pressure (dB)
180
160
140
120
100
80
60
40
20
0
1
10
100
1000
10000
Scaled Distance Noise = Distance / [Charge/Delay]^(1/3)

Appendix D

Explosive Specifications

TECHNICAL DATA SHEET

Fortel™ Pro
USA & Canada

Description
Fortel™ Pro packaged emulsion explosive is a robust, booster sensitive explosive. The explosive is orange in color with a firm putty-like consistency.

Application
Fortel™ Pro is a small diameter water resistant packaged explosive designed for use as a medium density column explosive in mining and general blasting work. Fortel™ Pro can be used to build a toe charge out of water in conjunction with an Amex™ column charge.

Key Benefits
- Fortel™ Pro is a cost efficient, emulsion formulation suitable for a range of blasting applications.
- Fortel™ Pro improves digging and mucking efficiency in benching and other applications, even in deep holes.
- Fortel™ Pro is pre-compression resistant with excellent heave energy.
- Fortel™ Pro reduces post-blast fumes and improves turnaround time.
- Fortel™ Pro is highly water resistant, which minimizes leaching and reduces environmental impact.
- OH&S issues around the handling and storage of nitroglycerin are eliminated.
- The packaging and emulsion color of Fortel™ Pro provides high visibility in a range of environments.

Technical Properties

Fortel™ Pro 65 x 400 mm (2 ½ x 16 in.)		
Cartridge Density		1.25 g/cc
Typical Velocity of Detonation[1]		5,200 m/s 17,000 ft/s
Water Resistance		Excellent
Fume Class		1
Relative Effective Energy (REE) [2]	Relative Weight Strength (RWS)	113
	Relative Bulk Strength (RBS)	170

Recommendations for Use

Priming and Initiation
Fortel™ Pro is a booster sensitive emulsion explosive and must be in direct contact with the largest possible diameter Senatel™ detonator sensitive explosive or an appropriately sized Pentex™ booster. Use of detonating cord with Fortel™ Pro is not recommended. Detonating cord may adversely affect the performance of Fortel™ Pro and could result in misfires in boreholes less than 75 mm (3 in.) in diameter. Consult an Orica representative before attempting to use with detonating cord.

Charging
Cartridges may be placed into blastholes intact or, where maximum energy is required, may be slit lengthways prior to loading to achieve a higher degree of coupling. Care should be taken when loading slit cartridges into wet blastholes as the explosive could bridge at the air-water interface.

Sleep-Time within Blastholes
The sleep-time in a blasthole is influenced by the extent of damage to the packaging and by the nature of any water present. Fortel™ Pro will give good performance after two weeks immersion.

TECHNICAL DATA SHEET

Fortel™ Pro
USA & Canada

Ground Temperature
Fresh product is reliable down to –10°C (14°F) at 65 mm (2½ in.) primed in confinement with a 454 g (1 lb) cast booster.

Packaging
Fortel™ Pro is distinctively packaged in high strength, tear-resistant blue Valeron plastic film, to clearly differentiate it from detonator sensitive packaged explosives. Standard cartridge sizes are as follows:

Size (mm)	Size (in.)	Nominal Count per case	Film Type
65 x 400	2½ x 16	16	Valeron
75 x 400	3 x 16	11	Valeron
90 x 400	3½ x 16	8	Valeron

Storage and Handling
Product Classification

Authorized Name:	Fortel™ Pro
Proper Shipping Name:	Explosive, blasting, type E
UN No:	0332
Classification:	1.5D

All regulations pertaining to the handling and use of such explosives apply.

Storage
Store Fortel™ Pro in a suitably licensed magazine for Class 1.5D explosives. The cases should be stacked in the manner designated on the case.

Fortel™ Pro has a **shelf life** of up to 12 months from date of manufacture in a well ventilated, approved magazine, even in hot and humid extremes.

Fortel™ Pro is best stored at temperatures above -15°C (5°F). This is especially important in cold weather "load and shoot" worksites where there is insufficient in-hole warm up time.

For recommended good practices in transporting, storing, handling, and using this product, refer to the "Always and Never" booklet packed inside each case.

Transport
Fortel™ Pro should be transported between -40°C (40°F) and +40°C (104°F).

Disposal
Disposal of explosive materials can be hazardous. Methods of safe disposal of explosives may vary depending on the user's situation. Please contact an Orica Technical Services Representative for information on safe practices.

Safety
The post detonation fume characteristics of Fortel™ Pro make the product suitable for both underground and surface blasting applications. Users should ensure that adequate ventilation is provided prior to re-entry into the blast area.

Fortel™ Pro can be initiated by extremes of shock, friction or mechanical impact. As with all explosives, Fortel™ Pro should be handled and stored with care and must be kept clear of flame and excessive heat.

Disclaimer

Fortel™ Pro
USA & Canada

For more information please visit our website: www.orica.com

Orica's North America headquarters can be reached at:
Tel: +1 303 268 5000
Fax: +1 303 268 5250

Emergency Telephone Numbers

For chemical emergencies (24 hour) involving transportation, spill, leak, release, fire or accidents:

Canada: Orica Canada emergency response 1-877-561-3636

USA: Chemtrec 1-800- 424-9300

Notes:

(1.) Unconfined at 5ºC (41ºF). VOD will depend on application including explosive density, blasthole diameter and degree of confinement. The VOD range is based on minimum unconfined and calculated ideal.

(2.) The Relative Effective Energy" (REE) of an explosive is the energy calculated to be available to do effective blasting work. All energy values are calculated using the IDeX™ computer code owned by Orica for the exclusive use of its companies. Energy values are based on standard ANFO with a density of 0.84 g/cc and a cut-off pressure of 100Mpa. Other computer codes may give different values.

Technical Data Sheet

The Power of Partnership

Handidet™

Non-Electric, Surface Delay and In-hole Detonator Assembly

Description

Handidet™ non-electric, surface delay and in-hole detonator assemblies are easy-to-use components in non-electric sequential blasting applications. Used in pipeline and utility trenching, quarries, open pits and construction projects, *Handidet*™ assemblies are easy to connect, easy to verify, and provide accurate surface and in-hole timing.

Benefits

- Reduce the number of components on site
- Allow pre-blast changes to pattern design
- Reduce inventory
- Provide excellent blast control
- Allow easy hookup - increase productivity
- Facilitate rapid hookup verification
- Reduce chance of ground movement cutoff failures
- Can be used in all weather conditions
- No tangles, no waste
- Reduce operating costs

Features

- Surface and in-hole delays in one unit
- New lower energy design
- Accurately timed
- Quick and simple to connect
- Highly visible 6 tube ergonomic connector design
- Highly visible
- Rugged, with new abrasion resistant tubing
- Resistant to hot or cold conditions; easy to handle in figure-eight coils

Properties

In-hole Detonator	High Strength, 12 grain (780 mg) PETN base charge (USBM 8+)
Surface Delay Initiator	New Low Shrapnel
Connector Block	6 tube capacity, color coded by surface delay time, indelibly printed with length and delays
Exel ™ Shock Tube	Bright yellow color

Delay Nominal Times	
Surface/In-hole (ms)	**Connector block color**
17/500	Yellow
25/475	Orange
# 25/500	Orange
42/475	White
42/500	White
42/700	White
# Standard short delay combination	

Other delays may be available by special arrangements.

Handling and Initiation

Do not use the *Handidet*™ assembly as a lowering line. Keep the shock tube taut until loading has been completed. Avoid damage to the shock tube during loading and stemming operations.

Never pull so hard as to stretch or break shock tubing. A premature detonation may result.

Handidet™ detonator assemblies are unidirectional. They can be initiated by:

- The surface initiator from another *Handidet*™
- A *Mantelec Electric DCD*™ initiating assembly
- An electric detonator
- An Orica shock tube surface delay system

Technical Data Sheet

Handidet™

Non-Electric, Surface Delay and In-hole Detonator Assembly

The Power of Partnership

***Note**: The surface connector block of the Handidet™ assembly contains an explosive device that can be initiated by heat, impact or friction. The surface connector is not designed to initiate detonating cord.*

Packaging

Handidet™ detonator assemblies are wound in figure-eight coils. Assemblies are bulk packed in fiberboard cases.

Length (approx)		Quantity per Case	
Meters	Feet	1.1B	1.4B
4	12	100	90
5	16	100	90
7	23	75	70
8	24	75	70
9	30	65	60
12	40	50	50
15	50	45	45
18	60	40	30
25	80	25	25
30	100	25	25
37	120	20	20

Other lengths may be available by special arrangements. Some length/delay combinations may not be available.

Storage

For best results, store under moderate temperatures and dry conditions in a well ventilated, approved detonator magazine.

Hazardous Materials Shipping Description

Detonator Assemblies, Non-electric,
Class and Division 1.1B,
UN 0360, PG II

Class and Division 1.4B,
UN 0361, PGII

Trademarks

The word Orica, the Ring device and the Orica mark are trademarks of Orica Group Companies. *Mantelec Electric DCD™* and *Handidet™* are trademarks of Orica Explosives Technology Pty Ltd. ACN 075 659 353, 1 Nicholson Street, East Melbourne, VIC, Australia.

Disclaimer

The information contained herein is based on experience and is believed to be accurate and up to date as at the date of its preparation. However, uses and conditions of use are not within the manufacturer's control and users should determine the suitability of such products and methods of use for their purposes. Neither the manufacturer nor the seller makes any warranty of any kind, express or implied, statutory or otherwise, except that the products described herein shall conform to the manufacturer's or seller's specifications. The manufacturer and the seller expressly disclaim all other warranties, INCLUDING, WITHOUT LIMITATION, WARRANTIES CONCERNING MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Under no circumstances shall the manufacturer or the seller be liable for indirect, special, consequential, or incidental damages including, without limitation, damages for lost or anticipated profits.

Emergency Contact Telephone Numbers

For chemical emergencies (24 hour) involving transportation, spill, leak, release, fire or accidents:
Canada: Orica Canada emergency response **1-877-561-3636**
USA: Chemtrec **1-800- 424-9300**

For lost, stolen or misplaced explosives:
USA: BAFT **1-800-800-3855**. Form ATF F5400.0 must be completed and local authorities (state / municipal police, etc) must be advised.

Orica Canada Inc.
301 Hotel De Ville
Brownsburg, QC J8G 3B5
Tel: +1 303 268 5000
Fax: +1 303 268 5250

Orica USA Inc.
33101 East Quincy Ave
Watkins, CO 80137
Tel: +1 303 268 5000
Fax: +1 303 268 5250

TECHNICAL DATA SHEET

Pentex™ BC Cast Boosters

USA & Canada

Description

Pentex™ BC Cast Boosters are detonator sensitive boosters that provide high energy initiating power for a wide range of explosive applications. The internal through tunnel and detonator well of the Pentex™ BC Cast Boosters ensures reliable initiation with all types of detonator assemblies. They can be used to provide safe and reliable priming of booster sensitive explosives on most surface and underground blasting operations. They are ideal for use in detonator only blasting applications.

Key Benefits

- High velocity
- High density
- High detonation pressure
- Long shelf life
- Excellent water resistance
- High safety and reliability
- Concentrated detonation energy

Technical Properties

Pentex™ BC "Blasting Cap" Sensitive Booster				
Nominal Weight	200 g (7 oz)	340 g (12 oz)	454 g (16 oz)	908 g (32 oz)
Nominal Diameter	41 mm (1.6 in)	50 mm (2.0 in)	58 mm (2.3 in)	79 mm (3.1 in)
Nominal Length	117 mm (4.6 in)	119 mm (4.7 in)	119 mm (4.7 in)	129 mm (5.1 in)
Shell Material	Plastic			Cardboard
Shell Color	Fluorescent Orange			
Nominal Density	1.65 g/cc			
VOD	> 7,200 m/s (23,600 ft/s)			
Detonation Pressure	> 214 kb			
Water Resistance	Excellent			
Detonator Retention	Mold in Detlock			N/A
Tunnel Arrangement	One blind detonator well and one through tunnel			

Recommendations for Use

Priming and Initiation

Pentex™ BC Cast Boosters can be initiated by standard high strength electric, electronic and non-electric detonators.

Note: Detonating cords are not to be used to initiate Pentex™ BC Cast Boosters.

When used with booster-sensitive explosives, ensure that the primer is in intimate contact with, and surrounded by, the explosive.

Packaging

Pentex™ BC Cast Boosters are packed in fiberboard cases. External case dimensions: 420 mm x 330 mm x 140 mm (16.6 in x 13.0 in x 5.5 in).

Pentex™ BC Cast Boosters

USA & Canada

Product	Quantity Per Case	Gross Weight / Case kg (lbs)
Pentex™ BC 7 * 200	72	15.6 (34.4)
Pentex™ BC 12 * 340	49	17.6 (38.9)
Pentex™ BC 16 * 454	36	17.3 (38.2)
Pentex™ BC 32 * 908	18	17.0 (37.5)

Storage and Handling

Product Classification

Authorized Name:	Pentex™ BC
Correct Shipping Name:	Boosters, without detonator
UN No:	0042, PG II
Classification:	1.1D
EX No:	211010500

All regulations pertaining to the handling and use of such explosives apply.

Storage

Cast boosters are high explosives. For best results, store under moderate temperatures and dry conditions in a well ventilated, approved explosives magazine.

Shelf Life

If stored in a cool, dry, well ventilated magazine and handled properly, the maximum shelf life of Pentex™ BC Cast Boosters is 5 years from date of manufacture.

Disposal

Disposal of explosive materials can be hazardous. Methods of safe disposal of explosives may vary depending on the user's situation. Please contact an Orica Technical Services Representative for information on safe practices.

Disclaimer

 All information contained in this document is provided for informational purposes only and is subject to change without notice. Since the Orica Group cannot anticipate or control the conditions under which this information and its products may be used, each user should review the information in the specific context of the intended application. To the maximum extent permitted by law, the Orica Group specifically disclaims all warranties express or implied in law, INCLUDING ACCURACY, NON INFRINGEMENT, AND IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. The Orica Group specifically disclaims, and will not be responsible for, any liability or damages resulting from the use or reliance upon the information in this document.

The word Orica and the Ring device are trademarks of the Orica Group.

For more information please visit our website: www.orica.com

Orica's North America headquarters can be reached at:
Tel: +1 303 268 5000
Fax: +1 303 268 5250

Emergency Telephone Numbers

For chemical emergencies (24 hour) involving transportation, spill, leak, release, fire or accidents:

Canada: Orica Canada emergency response 1-877-561-3636

USA: Chemtrec 1-800- 424-9300

Attachment B

TECHNICAL MEMORANDUM

DATE 24 October 2024 **Project No.** CA0041716.8938

TO Ashley Bisset, P.Eng., Manager Development Engineering (HRM)
Halifax Regional Municipality (HRM)

FROM Francis Trépanier, P.Eng.; Scott Benton, P.Geo. **EMAIL Francis.Trepanier@wsp.com; Scott.Benton@wsp.com**

HENRY HOUSE HERITAGE PROPERTY
REVIEW OF BLASTING NEAR THE HENRY HOUSE PROPERTY IN HALIFAX, NOVA SCOTIA

Halifax Regional Municipality (HRM) has retained WSP Canada Inc. on September 10, 2024 to provide a review of blasting near the Henry House Property in Halifax, Nova Scotia.

This technical memorandum presents a review of the appropriateness of the proposed blasting and vibration control plan by the contractor for the continuation of blasting work at the 1190 Barrington Street Development near the Henry House Property as well as our comments and recommendations.

1.0 BACKGROUND

The Henry House is a privately owned, commercially used building located at 1222 Barrington Street in Downtown Halifax, between Harvey and South Streets. This building is located on Municipally designated Heritage Properties.

The lot under development is located at 1190 Barrington Street, and an application has been made to complete blasting at the site, pursuant to HRM Blasting By-law B-600.

The Henry House is near the development at 1190 Barrington Street and Halifax Regional Municipality (HRM) is concerned that the construction and condition of the Henry House is uniquely sensitive to the potential effects of blasting. Figure 1 (on the following page) shows the location of the Henry House Property and the 1190 Barrington Street Development.

It should be noted that the initial blasting was permitted and following the first two blasts carried out in April 2024, damage was reported at the Henry House. Following observations of the damages that were alleged to have been caused by the initial blasts, blasting work on the 1190 Barrington Street Development was stopped by HRM.

As part of their new Blasting Permit Application, HRM have requested that the blasting proponent include an engineering opinion of appropriate blasting limits for the site-specific conditions, with focus on the potential sensitivity of the Henry House. A report was prepared by Mitchelmore Engineering Company Limited (MECO) outlining their research findings and an opinion of appropriate maximum limits for maximum peak particle velocity (PPV) as it compares to associated ground vibration frequencies.

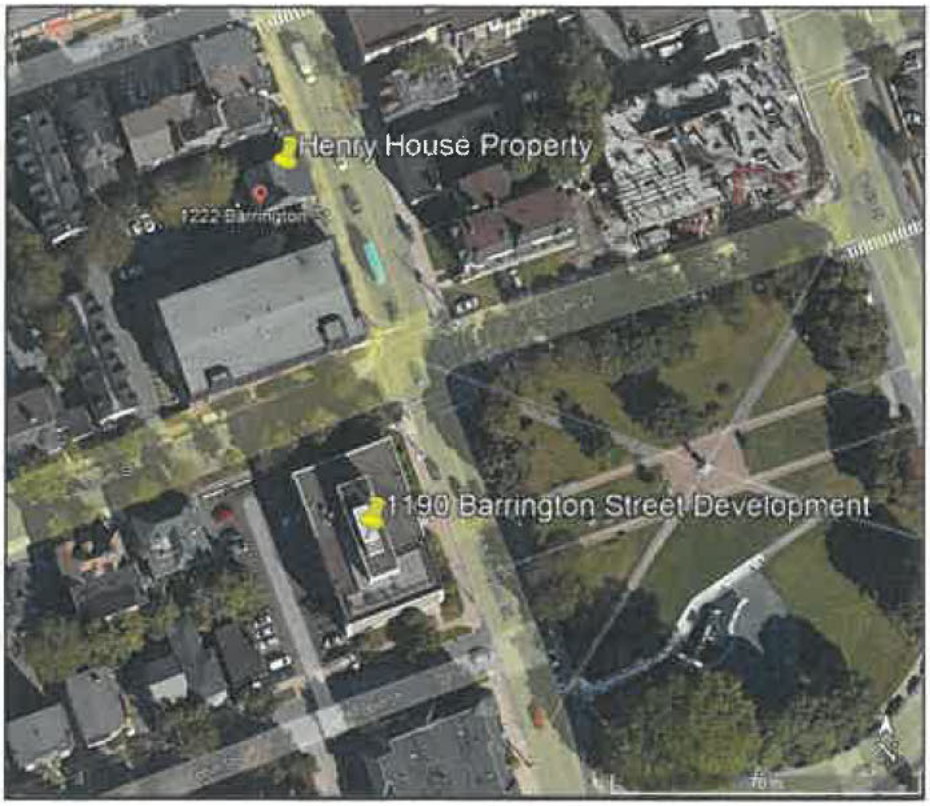


Figure 1: Location of the Henry House Property and the 1190 Barrington Street Development

2.0 GROUND VIBRATIONS FROM BLASTING

To enable excavation work in the presence of solid rock, contractors use explosives to fragment the rock. The explosives are placed within drill holes according to pre-established parameters, such as the drill pattern, the drillhole diameter, the bench height, the depth of the collars, the sub-drilling, the type of explosives and the firing sequence. The determination of each of these parameters will vary depending on the nature of the rock, the planned excavation methods and the environmental constraints (ground vibrations, air overpressure, flyrock).

The energy released by the detonation of explosives in a rock mass is mainly used for fragmentation and movement of the mass, but a small part of this energy is released in vibrations, air overpressures and occasionally, flyrock (ejected rock fragments).

The vibrations generated by a blast propagate around the explosion site and gradually decrease in intensity as a function of distance, in the same way as the waves generated when throwing an object into water. It should be noted that the maximum vibrations of a bench-type blast will generally be measured at the rear of it.

The air overpressure of a blast is mainly generated by the rapid displacement of air caused by the movement of the rock during the blast.

The air overpressures propagate around the blast site in a similar way to vibrations in the ground, but at a much slower speed. Blasting air overpressures between 100 and 120 dBL will have the same impact as winds between 5 and 16 km/h, while winds of 25 km/h have the same impact as air overpressures of the order of 128 dBL.

Blasting vibrations are measured using seismographs designed and adapted for this type of measurement. These devices are manufactured and calibrated annually according to international standards in order to measure blasting according to parameters recognized by the scientific community. These devices are equipped with a velocity sensor (triaxial geophone) which measures the particle speed in mm/s and the frequencies in Hz of the seismic wave, as well as a microphone for measuring air overpressures in linear decibels (dBL) and the frequencies of the sound wave in Hz

Vibrations attenuate with distance much more quickly than air overpressures and therefore fall below the threshold of perception more quickly than air overpressures.

The rate ground vibrations attenuate or decrease from a blast site is dependent on a number of variables. These include the characteristics of the blast, topography of the site, as well as the characteristics of the bedrock and/or soil materials. The intensity of ground vibration effects from any surface blasting operation are primarily governed by the distance between the receptor and the blast and the maximum weight of explosive detonated per delay period within the blast.

Researchers have shown that the potential for ground vibrations to induce damage in structures is able to be related to the PPV and the dominant frequency of that vibration. Much of the research indicates that as the vibration frequency increases, building elements are better able to withstand higher levels of vibration.

3.0 BLAST VIBRATION LIMITS

In recent years, there has been a trend toward including both the PPV and dominant frequency of the vibration within vibration guideline limits for projects. Blasting vibration limits within the HRM By-law B-600, which is an example of frequency-based limits, is shown in Table 1 and shown graphically in Figure 1.

Table 1: Maximum Allowed Blast Vibrations

Frequency of Ground Vibrations (Hz)	Maximum Allowable PPV (mm/s)
15 or Less	12.5
16 to 20	19.0
21 to 25	23.0
26 to 30	30.5
31 to 35	33.0
36 to 40	38.0
40 or greater	50

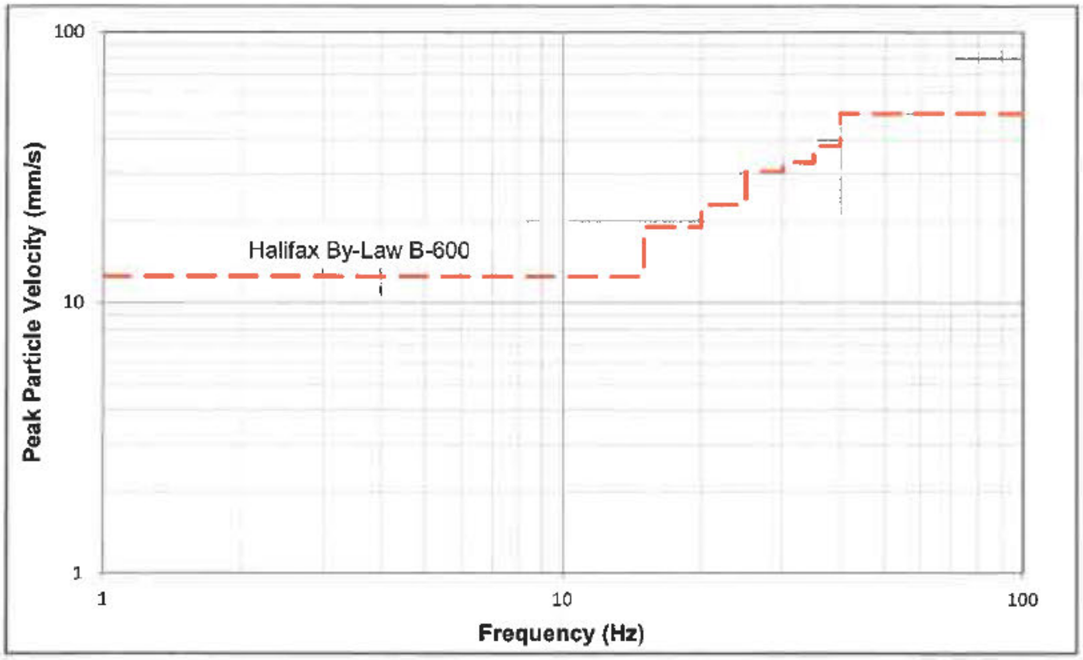


Figure 2: HRM Blasting Vibration Limits (By-Law B-600)

The blasting vibration limits shown above are intended to mitigate the potential impact on modern residential structures. Blasting near heritage structures is typically treated differently due to possible existence of weak components and or significant intrinsic value of some such structures for which special care is needed. Rainer (1982) stated that complications and uncertainties arise when attempting to assess the effect of vibrations on the historic buildings. They are as follows:

i) Historic buildings are generally older and may not be structurally sound.

ii) Building materials and structural configurations differ from these in current use, so that modern criteria may not be applicable.

iii) Both monetary and non-monetary values associated with historic buildings necessitate greater assurances against damage or failure.

iv) Possible long-term effects from past and future exposure need to be addressed.

On the other hand, Charles H. Dowding (1987) stated:

> *"Historic status does not automatically imply higher than usual sensitivity ... In a recent evaluation several buildings on the official registry of historic structures (US) were found to be of unusually good construction showed few signs of distress and withstood blast induced vibrations greater than those proposed."*

Despite Dowding's assertion, most authors on the subject suggest cautionary lower safe ground vibration levels during construction operations near historic structures.

Numerous blasting guideline limits have been proposed which have been designed to mitigate the potential impact of ground vibrations on historic and culturally sensitive structures. There is a wide range of opinion on appropriate vibration limits for historic buildings. However, many suggest that a range of PPV from 5.0 to 12.5 mm/s is appropriate as safe levels for historic structures.

Sedovic (1984) suggested the following for safe levels of vibration:

- 0.2 in/sec (5 mm/s) peak particle velocity for structures that exhibit significant levels of historic or architectural importance, or that are in a poor or deteriorated state of maintenance
- 0.5 in/sec (12.5 mm/s) peak particle velocity for all other historic sites

Konon and Schuring (1985) suggested the following frequency-based vibration limits for historic sites:

- Less than 10 Hz - 0.25 in/sec (6 mm/s)
- 10 to 40 Hz – 0.25 in/sec (6 mm/s) to 0.5 in/s (12.5 mm/s)
- Greater than 40 Hz - 0.5 in/s (12.5 mm/s)

In another review of the potential vibration limits for historic structures, Johnson and Hannen (2015) stated that an appropriate limit for historic buildings would likely be in the range of 0.12 to 0.5 in/s (3.0 to 12.5 mm/s) depending on the factors for the individual case. They also estimated that the published standards that most sensibly reflects the available research and fundamental engineering principles is the Swiss Standard (SN640 312a).

The SN640 312a for historic structures and transient construction vibrations are shown below:

- Less than 30 Hz - 6 mm/s
- 30 to 60 Hz – 8 mm/s
- Greater than 60 Hz - 12 mm/s

At the time of this report, this standard has not been adopted within HRM Bylaw B-600 for blasting near heritage buildings. The aforementioned standard is shown graphically in Figure 3.

Based on the above discussion of published literature, the use of the Swiss standard SN640 312a is deemed appropriate for the proposed blasting at 1190 Barrington Street.

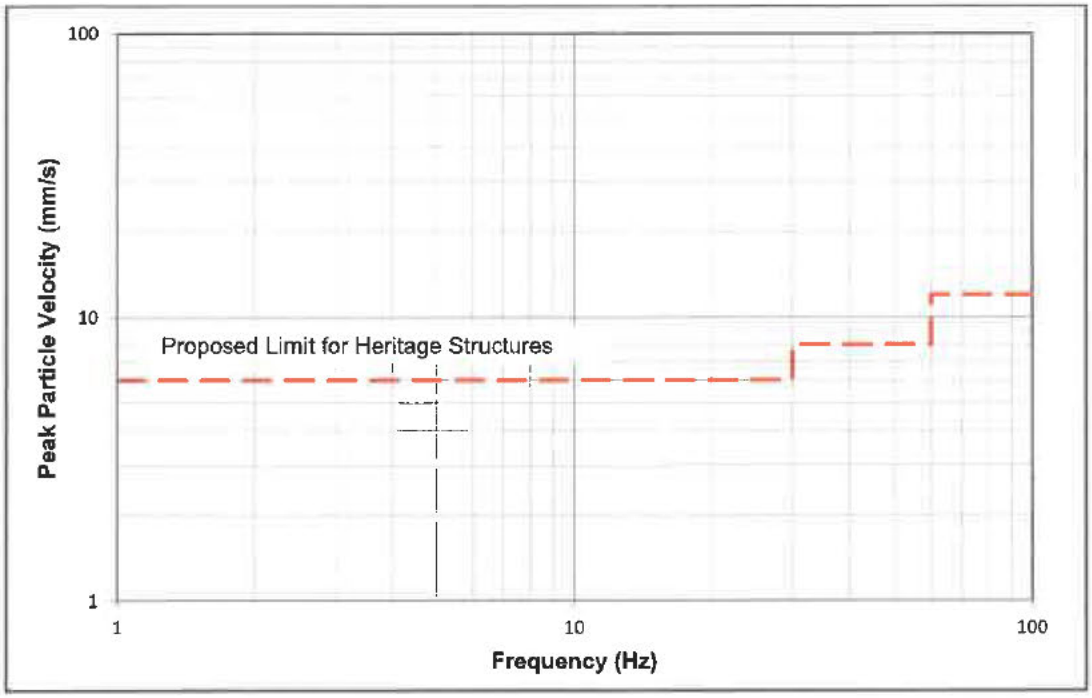


Figure 3: Proposed Blasting Vibration Limits at Heritage Properties

Based on the discussion of published literature presented above and as proposed by the Contractor, the use of the Swiss standard SN640 312a (noted as 'HRM By-law B-600 Limit for Heritage Structures) as it related to heritage structures is appropriate for the continuation of the blasting work on the 1190 Barrington Street project.

However, the vibration limits discussed above are for transient sources such as blasting and hydraulic hammers. Most authors suggest that the levels for steady state vibrations (e.g. vibratory compactors) should be about half of those for transient sources.

4.0 ANALYSIS OF THE FIRST TWO BLASTS

4.1 Blast plan and vibration results

Table 2 below presents the explosive loading information from the first two blasts which are mentioned in the MECO report of July 8, 2024 and provided by HRM for our analysis.

Table 2: Explosives Loading Information

Items	Description
General information	- Fortel Pro package explosive (no cartridge diameter mentioned) - Pentex Booster - Handidet delay detonators (25ms/500ms) - 25 ms delay between lines holes - 17 ms delay across lines
Blast #1: April 24, 2024	**Information included in the MECO report** - Sinking blast - 80 holes - Total explosive weight of 250 kg - Maximum charge weight per delay of 3.2 kg - Vibration monitoring results **Information not included in the MECO report** - No information on the blast design (hole diameter, hole depth, drilling pattern, reamed holes, cut holes, typical loading of explosives for each type of hole, etc.) - No information on the localisation and orientation of the blast - No seismograph records - No vibration report (installation detail, pictures, localisation, etc.) - No as-built blasting report
Blast #2: April 25, 2024	**Information included in the MECO report** - Production blast - 12 holes - Total explosive weight of 38.4 kg - Maximum charge weight per delay of 3.2 kg - Vibration monitoring results **Information not included in the MECO report** - No information on the blast design (hole diameter, hole depth, drilling pattern, typical loading of explosives, etc.) - No information on the localisation and orientation of the blast - No seismograph records - No vibration report (installation detail, pictures, localisation, etc.) - No as-built blasting report

While Blast #2 had contained fewer holes than Blast #1, the maximum explosive charge weight per delay was the same for both blasts. Table 3 below shows the vibration results for the two first blasts (Ref.: Table 3.5 of the MECO report, July 8, 2024).

Table 3: Monitoring results for Blast #1 and Blast #2 (MECO 2024)

Location	Date	PPV (mm/s) [Frequency (Hz)]			Load (kg/delay)	Distance (m)	Scaled Distance
		Trans	Vert	Long			
5206 Tobin Street	24 Apr	2.4 [58]	15.8 [75]	8.6 [69]	3.2	85	47.5
	25 Apr	1.7 [57]	7.2 [57]	3.5 [64]	3.2	34	19.0
5225 Tobin Street	24 Apr	17.2 [75]	15.8 [75]	7.9 [69]	3.2	99	55.3
	25 Apr	15.6 [57]	11.1 [39]	6.3 [51]	3.2	30	16.8
5217 South Street	24 Apr	7.7 [68]	9.3 [70]	6.3 [67]	3.2	70	39.1
	25 Apr	2.5 [64]	2.5 [47]	2.3 [57]	3.2	51	28.5
1222 Barrington Street	25 Apr	4.2 [64]	2.9 [43]	2.8 [39]	3.2	85	47.5

As shown Table 3, no vibration monitoring data is available for Blast #1 at Henry House (1222 Barington Street). The monitoring results for Blast #2 were below the vibration limits for heritage structures as discussed in Section 3.0 and shown in Figure 3. The PPV levels at the other three monitoring locations were higher for Blast #1 than for Blast #2. As such, WSP is not able to determine accurately the level of the PPV at the Henry House or whether the level was below the PPV limit for heritage structures.

4.2 Vibration analysis

For the purpose of vibration analysis and to enable the analysis of the blasting data provided in the MECO report, the following formula below was used. It is recognized and typically implemented for the purpose of monitoring blasting work:

$$V = K\,(d/w^{1/2})^{\beta}$$

where V: Peak Particle Velocity (mm/s)
w: Maximum charge per delay (kg)
d: Distance (m)
K and β: Blasting and site vibration constants

The constants K and β must be determined by plotting particle velocity and scalar distance data (30 data points minimum for a good statistical representation) on a log-log plot. While the MECO report provided a plot of the historic vibration monitoring data, the K and β were not provided. When few or no results are available, the vibrations can be estimated using basic[1] metric values for K (1140) and β (-1.6), which are commonly used as an assessment at the start of open-pit bench blasting operations. The MEC (2024) report provided recommendations for blast design and bast rock excavation as well as developing a site-specific vibration attenuation model, if necessary. The model would provide a K and β for the site and inform future blast designs.

[1] The International Society of Explosives Engineers (ISEE), BLASTERS' HANDBOOK, 17th Edition, 1998.

This empirical equation takes into account several factors that can influence the attenuation curve according to their respective variabilities. These main factors are:

- Type and pattern of blasting;
- Geology of loose deposits and rock;
- Location and orientation of the blast;
- Hydrogeological conditions; and,
- Location of the measurement point.

This equation makes it possible to assess the impact of blasting according to specific conditions and also makes it possible to extrapolate the impacts for different conditions (e.g., location of the measurement point, explosive charge per delay, location of the blast, type of blast, etc.).

Finally, it is important to mention that the control and limitation of ground vibrations and air overpressures emitted during blasting are mainly governed by the following variables:

- Rock quality in the collar area:
- Height and type of collar material;
- Accuracy of detonators;
- Firing sequence;
- Limitation of the maximum explosive charge per delay;
- Design of blasts according to geology (fractures and cavities in free faces, etc.);
- Orientation of the blast;
- Pre-shearing of the pit excavation limits;
- Degree of blast confinement;
- Control of drilling depths;
- Regularity of the drilling pattern; and,
- Deviation of drilling.

Given that WSP was not provided with enough site data to accurately assess the K and β constants for the project site, we have therefore chosen to set the β constant at -1.6 in order to assess the K constants for each of the measurement points during the first two blasts.

Based on the known parameters for the blasts, the value of the blast constant K was estimated in order to assess the consistency of the measurements according to the location and type of blast.

Table 4 below presents the estimated K values for each measurement point assessed using the loading parameters, the distance to the monitoring location and the seismograph results for the two blasts.

Table 4: Estimated K values for each measurement point

Blast #1 (24 Apr)		
Localisation	**Distance (m)**	**K**
5206 Tobin Street	85	7613.90
5225 Tobin Street	99	10578.52
5217 South Street	70	3284.88

Blast #2 (25 Apr)		
Localisation	**Distance (m)**	**K**
5206 Tobin Street	34	800.90
5225 Tobin Street	30	1420.36
5217 South Street	51	532.03
1222 Barrington Street (Henry House)	85	2023.95

Based on WSP's previous experiences in this type of blasting, a more appropriate K constant value between 900 and 1800 would be appropriate and logical. Blasting #1 presents K constants that seem to us to be quite high, unrepresentative and inconsistent at the three measurement points.

Our understanding of this situation could be explained on the basis of the following elements:

1) Blasting confinement (ability of the fragmented rock to move forward);

2) Blasting design;

3) Firing sequence; and,

4) Conformity of seismograph installations

A likely difference between Blast #1 and Blast #2 would be the degree of confinement. It is understood that the second blast would have the opening of the first blast to reduce the confinement. This may account for the reduced PPV levels recorded in the second blast which had the same maximum explosive charge weight per delay.

The items listed above may account for they elevated K values, they do not explain the large differences in the K value across the three monitoring locations. Another possible explanation for the large and significant variations in K values would be the differences in seismograph sensor setup. One of the essential aspects for the installation of the geophone when monitoring blasting vibrations is the choice of location and coupling of the sensor according to the nature of the vibrations measured. The positioning and the coupling procedure must be carried out in order to comply with the rules of the art for this type of monitoring, such as the field practice guide for the installation of seismographs for blasting activities published by the International Society of Explosives Engineers (ISEE 2020). The ISEE (2020) guide presents several recommendations for the installation of seismographs for blast vibration monitoring, including the following:

- The location and surface/sensor contact are the most important factors to ensure consistency and accuracy of vibration measurements;
- The installation of the sensor must ensure that the data is obtained adequately and that it represents the vibration levels received by the structure to be protected; and,
- Avoid loose backfill materials, flower beds and unusual materials because they can have a significant impact on the accuracy of the measurements.

Any future blasts must ensure that the geophone installation complies with the recommendations presented within the ISEE's field guide (ISEE 2020).

5.0 SITE VISIT

A one-day site visit was carried out by a WSP Professional Engineering Geologist, Scott Benton, M.Sc., P.Geo., to review the existing site conditions of the Henry House Property located in Downtown Halifax at 1222 Barrington Street.

According to the site description by Canada's Historic Places, the Henry House Property is valued as an excellent example of the Halifax House architectural style. It is a typical freestanding two-and-one-half storey stone house with a granite block façade and ironstone sides, following a style developed in Halifax by Scottish masons. The house was built in 1835 by well known Halifax mason and land owner John Metlez. The two-and-one-half storey house is also valued for its rare surviving freestone construction. Since 1968 the building has had a commercial use, housing the Henry House Restaurant and Granite Brewery Pub.

The present condition of the Heritage Property was observed during WSP's visit on September 12th, as well as the actual conditions of the 1190 Barrington Development. During the site visit from WSP, special attention was paid to observing apparent structural sensitivities of the Heritage Property. Additionally, extra attention was also given to any visible cracking of interior and exterior areas of the building, with some areas showing supposed damage post-blast (as noted by the owner and staff members), which included:

- A number of cracks, noting that they were predominantly seen in areas of the house that had been plastered (upper most floor and the ceiling of the basement);
- The exterior of the chimney stack (showing some overhanging bricks) and some dislodgement within the chimney in the form of debris that was noted to have fallen on the day of the blasting; and,
- Some cracking of windowsill stones on the first and second floors.

It is understood that the location of the seismograph for the second relatively smaller blast was shown during the inspection (as shown in APPENDIX A), which was outside of the building on what is assumed to be a separate concrete pad foundation at the rear of the building at approximately the first storey. This location for the placement of the geophone at Henry House is not considered appropriate as there may have been movement induced in the pad, which could lead to PPV amplification.

Furthermore, it is noted that no photographs were taken or inspection conducted of the Henry House prior to the initial blast being undertaken. Therefore, the cracks and defects present in the Henry House cannot be confirmed to have been caused by the blasting.

Appendix A contains photographs taken during the site visit of cracks and deteriorated sections of the interior and exterior of the Henry House, although certain sections of the exterior could not be captured as clearly due to their height (it was noted that during a previous inspection a drone survey was conducted, which is anticipated to have captured the exterior condition of the building at the higher levels).

6.0 CONCLUSION AND RECOMMENDATIONS

Given that Henry House Property is located close to the property boundary of the blast site (at 1190 Barrington Street), HRM is concerned that the construction and current condition of the heritage property makes it particularly susceptible to the potential impacts of blasting.

WSP visited the property to observe the structure, reviewed the documentation provided and provided appropriate blasting vibration levels for the proposed blasting operations (see Section 3.0). WSP also analyzed the vibration results for the first two blasts.

The following recommendations are intended to allow the continuation of the blasting operations at 1190 Barrington Street while mitigating the impact on the heritage structure at 1222 Barrington Street:

- Vibration limits should adhere to the Swiss standard SN640 312a for historic structures and transient construction vibrations, as discussed in Section 3.
- A copy of the blast report is submitted to the HRM representative at the beginning of the next working day.
- If blast vibration levels exceed the levels, the blaster should immediately communicate the monitoring results to the HRM representative and provide a description of their proposed mitigative strategy. If a second level exceeds the ground vibration limits, work should cease, and a revised pattern should be prepared and submitted to HRM for review.
- Optimize the design of the bench opening blasting to minimize the blast confinement.
- Optimize the firing sequence.
- A revised blast plan shall be submitted to HRM for review prior to the re-commencement of blasting.
- Evaluate the possibility of using the electronic detonator in order to benefit from its precision and flexibility. The electronic detonator also allows to check the entire firing circuit before firing the blast. The firing console of the electronic system requires the response of each detonator to allow the initiation of the blast. This system thus allows the blaster to progressively follow the response of the firing circuit when laying the blast mats. In the presence of an anomaly, the blaster will be able to remove the mats and make any necessary corrections. In order to benefit from its precision and flexibility. The use of the electronic detonator also allows a complete check of the system before firing, thus avoiding misfires.
- Record each blast using a video camera for quality control.
- For monitoring vibrations at Henry House use approximately 2 seismographs, one installed on the foundation and one on the upper floor.

- Monitoring of crack widths allows for the monitoring of any lateral and/or shear displacement. Measurements of the monitoring device should be set up at selected cracks. During the blasting, records of the crack measurement should be taken at various times during the day to observe whether any change is visible.
- Secure areas where falling pieces of stone or mortar could occur as a result of vibrations given the altered state of certain areas.

Finally, it is important to recognize the importance of human perception of blast-induced vibrations. Vibrations are one of many environmental factors that act on structures. Because vibrations are readily perceived, they are often assumed to have caused or contributed to structural deterioration. However, people are able to feel vibrations at levels that are only a small percentage of those needed to cause damage, and they hear small sounds that accompany those vibrations (either primary sound or secondary sound effects). Additionally, humans are not sufficiently accurate observers to make reliable observations about crack conditions in a building without the benefit of very careful documented, professional examinations before and after the events in question.

WSP Canada Inc.

[redacted]

Francis Trépanier, P.Eng. (OIQ# 115941)
Blasting and Vibration Expert

[redacted]

Scott Benton, P.Geo., (NS#0306)
Site Engineer and Project Manager

Reviewed by:
Daniel Corkery
Principal, Senior Blasting / Vibration Consultant
WSP Canada Inc.

FT/SB/DC/ha

Attachments: Appendix A – Site Visit Photos

https://wsponlinecan.sharepoint.com/sites/ca-ca0041716.8938/shared documents/05. technical/2. draft report/ca0041716-tm-rev0 blasting r/w oct2024.docx

REFERENCES

Dowding C., 1987. "Vibration Criteria for Historic Buildings" Journal of Construction Engineering and Management 111, Ed. W. Konon and J. Schuring, no.3 1985:208-215.

Halifax Regional Municipality (HRM) "By-Law Number B-600 Respecting Blasting", pp. 21

International Society of Explosives Engineers (ISEE), "Blaster's Handbook ", 17th Edition, 1998.

ISEE, 2020. "Field Practice Guidelines for Blasting Seismographs 2020", pp. 11

Johnson, A.P. and W Robert Hannen, W.R., 2015. "Vibrations for Historic Buildings and Art Collections" APT Bulletin Journal of Preservation Technology /46:2-3 2015 pp 66-74.

Konon, W. and Schuring, J.R. 1985. "Vibration Criteria for Historic and Sensitive Older Buildings". Journal of Construction Engineering and Management 111(3): 208–215.

Mitchelmore Engineering Company Ltd. (MECO) and Atlantic Road Construction & Paving, "Blasting Vibration Control Plan – 1190 Barrington Street Development, Revision 2", July 8, 2024, Halifax (Nova Scotia).

Rainer, J.H., "Effect of Vibrations on Historic Buildings: An Overview", NRCC 21092, Ottawa, Canada (1982).

Sedovic, W. 1984. "Assessing the Effect of Vibration on Historic Buildings". Association for Preservation Technology Bulletin. Vol. XVI, Nos. 3&4.

Swiss Standards Association. 1992. "Effects of Vibration on Construction". SN 604 312a.

APPENDIX A

Site Visit Photographs

Fig 1-1 Cracking and repairs in the north-east corner of the basement.

Fig 1-2 Cracking in the ceiling on the northern-eastern side of the dining section of the basement.

Fig 1-3 Further cracking of the ceiling in the dining area of the basement.

Fig 1-4 cracking of brickwork on the south-western side of the dining area in the basement.

Fig 1-5 Mortar deterioration and cracking in south-western portion of dining area of the basement.

Fig 1-6 Cracking in the stone wall on the south side of the main dining room, first floor.

Fig 1-7 Cracking of the predominantly the southern wall on the third floor.

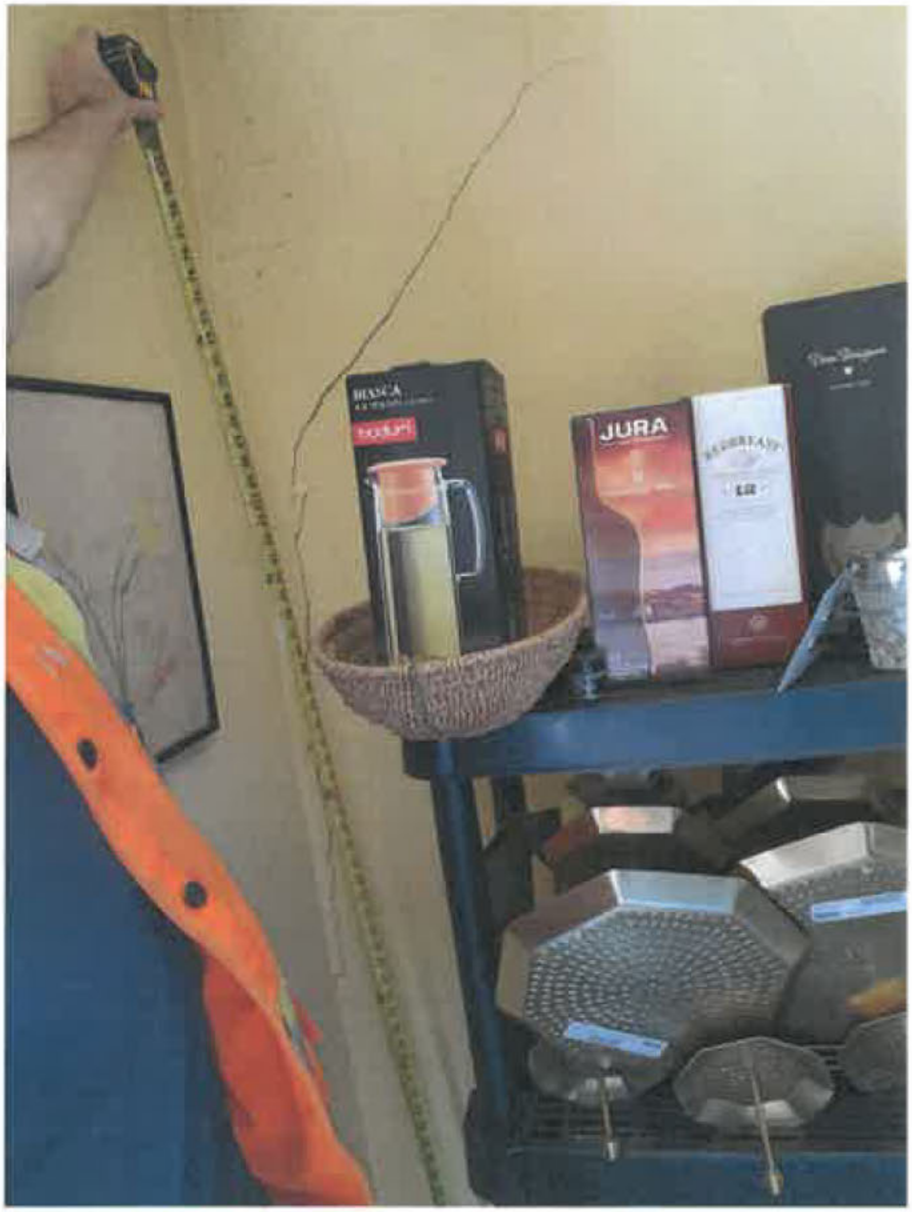


Fig 1-8 Cracking on the southern side of the third floor.

Fig 1-9 Cracking on the southern side of the third floor.

Fig 1-10 Cracking of the windowsill stone on the southern side of the second floor.

Fig 1-11 Cracking in windowsill at ground level on northern exterior of building.

Fig 1-12 Cracking at base of building on eastern exterior of the building.

Fig 1-13 Missing mortar and zoomed out view of crack at base of building on the eastern exterior of the building.

Fig 1-14 Cracking of windowsill on eastern exterior of building at ground level.

Fig 1-15 Freshly chipped stone on south-eastern corner of the exterior.

Fig 1-16 A second freshly chipped stone on the south-eastern corner of the exterior.

Fig 1-17 Freshly filled in cracks/gaps at base of south-eastern corner exterior.

Fig 1-18 Loose overhanging bricks at top of chimney stack.

Fig 1-19 Noted location of seismograph – located on the western side of the building.

Attachment C - Summary of MECO and WSP Report Findings and Recommendations

<table>
<tr><th>MECO Report (July 8, 2024)</th><th>WSP (October 24, 2024)</th></tr>
<tr><td colspan="2">Blasting Impact on Henry House</td></tr>
<tr><td>• Henry House is 50–100 meters from the blast site.
• Confirms that blasting must comply with HRM By-law B600 and that limits should be reduced by 50% for heritage structures.
• Pre-blast survey found:
• Interior is Good to Fair condition.
• Exterior and chimney are in Poor condition and may shift or dislodge even if PPV is within limits.
• Proposed additional mitigation measures, including:
o Halting vibration-generating activities at Henry House during blasting.
o Establishing a perimeter around the chimney (inside and outside).</td><td>• Henry House is susceptible to blasting impacts due to its age and structural composition.
• Recommends adherence to Swiss Standard SN640 312a for heritage structures.
• Vibration levels should be lower than for modern buildings, and a 50% reduction in peak particle velocity (PPV) should be considered.
• Notes that human perception of vibrations can be misleading, and careful monitoring is required.
• Condition review identified two areas in poor condition:
o Exterior chimney (risk of stone/mortar falling).
o Entrance walkway (unstable and at risk of displacement).</td></tr>
<tr><td colspan="2">Blasting Limits and Compliance</td></tr>
<tr><td>• Uses HRM By-law B600 with a 50% reduction for heritage sites.
• Provides specific loading limits per distance.
• Initial blast monitoring results (April 24 & 25, 2024):
o All results were within compliance limits.
o Henry House experienced a PPV of 4.2 mm/s on April 25.
• Blast Monitoring Plan:
o Three seismographs should be used (one at Henry House).
o If frequency exceeds 30 Hz consistently, blast design can be adjusted.</td><td>• Recommends Swiss Standard SN640 312a as a basis for vibration limits.
• Suggests test blasts before full-scale blasting.
• If vibration levels exceed limits, work should cease immediately, and a revised blast pattern must be approved.
• Monitoring should include two seismographs (one at the foundation, one on the upper floors).</td></tr>
<tr><td colspan="2">Mitigation Strategies</td></tr>
<tr><td>• Limits blast hole depth to 3 meters.
• Uses scaled distance approach to adjust charge weight based on distance.
• Recommends gradual increase in production blasting after test results.
• Safety measures include:
o Pause vibration-generating activities at Henry House during blasting
o Provide a perimeter around the stone chimney inside and outside during blasting to prevent hazards from falling debris.</td><td>• Recommends submission of a blast plan before work begins.
• Test blasts required before production blasting.
• Vibration monitoring at multiple points. Including 2 seismographs (one installed on the foundation and one on the upper floor), as well as monitoring of crack widths.
• Blast pattern modifications if limits are exceeded.
• Electronic detonators recommended for precision.
• Secure areas where falling pieces of stone or mortar could occur because of vibrations give the altered state of certain areas.</td></tr>
<tr><td colspan="2">Condition Assessment of Henry House</td></tr>
<tr><td>• Conducted detailed structural review.
• Found that mortar cracks, stone displacement, and deterioration exist but may not be entirely blast-related.
• Stressed that even small vibrations from current operations from the business could affect loose stones.</td><td>• Conducted a visual inspection.
• Identified two problem areas:
o Chimney: Risk of falling debris.
o Walkway: Unstable and shifting.
• Recommended pre- and post-blast condition surveys.</td></tr>
</table>

HALIFAX

Visit: halifax.ca
Phone: Dial 311 or 1-800-835-6428
Email: ContactUs@311.halifax.ca

Blasting Permit

Permit Number: BLAST-2024-09274

DATE OF PERMIT ISSUANCE

November 4, 2024

DATE OF PERMIT EXPIRY

May 4, 2025

APPLICANT

Atlantic Road Construction & Paving Ltd

PROPERTY OWNER(S)

NELSON INVESTMENTS LIMITED
PO BOX 384
HALIFAX, NS B3J2P8

ADDRESS OF PROPERTY

PRIMARY ADDRESS

1190 BARRINGTON ST, HALIFAX, NS B3H2R4

PARCEL

00049965

1190 BARRINGTON ST, HALIFAX, NS B3H2R4

LOT DETAILS

RESPONSIBLE CONTRACTOR

Atlantic Road Construction & Paving Ltd
Phone: (902) 404-8547

BUILDING STRUCTURE / USE DESIGNATION

Commercial

TYPE OF WORK

Blasting

SCOPE OF WORK

Blasting

ADDITIONAL WORK SCOPES

DESCRIPTION OF WORK

Blasting for new multi dwelling/mixed use construction

CONDITIONS

TERMS

Visit: halifax.ca
Phone: Dial 311 or 1-800-835-6428
Email: ContactUs@311.halifax.ca

Blasting Permit

Permit Number: BLAST-2024-09274

TERMS

- If excessive readings are recorded by the Qualified Monitor the Monitor & Blaster must fill out the Blasting Compliance form in detail and submit it to HRM.

- All blasting operations must be in compliance with the HRM B-600 By-Law at all times.
- The applicant must provide a copy of notice delivered to residents, along with a distribution list, to HRM at least 4 days prior to the start of blasting activity.

Visit: halifax.ca
Phone: Dial 311 or 1-800-835-6428
Email: ContactUs@311.halifax.ca

Blasting Permit

Permit Number: BLAST-2024-09274

TERMS

- -Applicant is responsible for any damage to HRM Infrastructure as a result of construction activities.

-If excessive readings are recorded by the Qualified Monitor the Monitor & Blaster must fill out the Blasting Compliance form in detail and submit it to HRM.

-All blasting operations must be in compliance with the HRM B-600 By-Law at all times.

-The applicant must provide a copy of notice delivered to residents, along with a distribution list, to HRM at least 4 days prior to the start of blasting activity

-Applicant must comply with the reduced vibration limits and recommendations as outlined in the HRM consultant's BLASTING PLAN REVIEW. The recommendations include:

- Vibration limits should adhere to the Swiss standard SN640 312a for historic structures and transient construction vibrations.

o The SN640 312a for historic structures and transient construction vibrations maximums are shown below:
-Less than 30 Hz - 6 mm/s
-30 to 60 Hz – 8 mm/s
-Greater than 60 Hz - 12 mm/s

- A copy of the blast report is submitted to the HRM representative at the beginning of the next working day.
- If blast vibration levels exceed the levels, the blaster should immediately communicate the monitoring results to the HRM representative and provide a description of their proposed mitigative strategy. If a second level exceeds the ground vibration limits, work should cease, and a revised pattern should be prepared and submitted to HRM for review.
- Optimize the design of the bench opening blasting to minimize the blast confinement.
- Optimize the firing sequence.
- A revised blast plan shall be submitted to HRM for review prior to the re-commencement of blasting.
- Evaluate the possibility of using the electronic detonator in order to benefit from its precision and flexibility. The electronic detonator also allows to check the entire firing circuit before firing the blast. The firing console of the electronic system requires the response of each detonator to allow the initiation of the blast. This system thus allows the blaster to progressively follow the response of the firing circuit when laying the blast mats. In the presence of an anomaly, the blaster will be able to remove the mats and make any necessary corrections. In order to benefit from its precision and flexibility. The use of the electronic detonator also allows a complete check of the system before firing, thus avoiding misfires.
- Record each blast using a video camera for quality control.
- For monitoring vibrations at Henry House use 2 seismographs, one installed on the foundation and one on the upper floor.
- Monitoring of crack widths allows for the monitoring of any lateral and/or shear displacement. Measurements of the monitoring device should be set up at selected cracks. During the blasting, records of the crack measurement should be taken at various times during the day to observe whether any change is visible.
- Secure areas where falling pieces of stone or mortar could occur as a result of vibrations given the altered state of certain areas.

Attachment E

HALIFAX

NOTICE OF APPEAL

***This form may be used for general appeals.** Appeal forms for Dangerous or Unsightly, Residential Occupancy Conditions (By-law M-200) or Regulations of Taxis and Licenses (By-law T-1000) can be found on the Standing Committee's homepage at http://www.halifax.ca/city-hall/standing-committees/appeals-standing-committee

I Kobe Shannon wish to file this Written Notice of Appeal in relation to the following decision

BLAST-2024-09274 Permit term & Conditions

*If applicable provide the Case Number

The reason for appeal is:

Terms & Conditions rely on a private third party and contradict Bylaw B-600 9(4).

*Hearings of the Appeals Standing Committee are open to the public and any information, including personal information, which is provided or obtained in relation to your appeal, will be a matter of public record.

DATED at Halifax, Nova Scotia this 21 day of January, 20 25.

Kobe Shannon
Legal Name of Appellant (please print)

[redacted]
Signature of Appellant

Preferred Name

[redacted]

[redacted]
Contact Number or Email

SEND TO:
Office of the Municipal Clerk
P.O. Box 1749
Halifax, NS B3J 3A5
Fax: 902-490-4208
Email: clerks@halifax.ca

Deliver in person: City Hall, 1841 Argyle Street, Halifax (Mon-Fri, 8:30am-4:30pm)

Attachment F

CANADA POST / POSTES CANADA
REGISTERED DOMESTIC **RECOMMANDÉ RÉGIME INTÉRIEUR** R
CUSTOMER RECEIPT / REÇU DU CLIENT

To / Destinataire
Name / Nom
Address / Adresse
City / Prov. / Postal Code / Ville / Prov. / [redacted]
Declared Value / Valeur déclarée $
33-086-584 (17-12)

January 24, 2025

REGISTERED MAIL
&
EMAIL - [redacted]

Kobe Shannon
[redacted]

Re: BLAST-2024-09274, 1190 Barrington Street, Halifax

This is to advise that your appeal will be heard by the Appeals Standing Committee on **Thursday, March 6, 2025.**

This meeting will happen in-person in the Council Chamber at Halifax City Hall, 1841 Argyle Street, Halifax. All visitors to City Hall must sign-in at the security desk and show government-issued photo ID; more detail is attached.

Please arrive for 10:00 a.m. but note that there may be other cases heard before yours on the agenda.

If you cannot attend in person and must participate using Zoom, please let me know no later than 4:30pm on the business day prior to the meeting.

The staff report for this matter will be posted online to the Appeals Standing Committee web page at Halifax.ca by end of day Friday, February 28, 2025. If you require a hard copy of the report, please contact our office.

If filing an appeal, be advised that your submission and appeal documents will form part of the public record, and will be posted on-line at www.halifax.ca. If you feel that information you consider to be personal is necessary for your appeal, please attach that as a separate document, clearly marked "PERSONAL". It will be provided to the Standing Committee and/or council members and staff, and will form part of the public record, but it will not be posted online. You will be contacted if there are any concerns.

Should you wish to include images, video or audio as part of your appeal presentation to the Standing Committee, you must notify me by end of day Tuesday, March 4, 2025 to allow for technical preparation and testing.

Should you be unable to attend, you may have a representative attend to present the appeal to the Standing Committee. Please note that your representative is required to have a letter signed by you giving permission. You or your representative may have witnesses or other evidence in support of the appeal and will be permitted up to 10 minutes to make a verbal submission. A copy of the appeals process is attached. If neither you nor a representative appears, the hearing will proceed and you will be advised of the Standing Committee's decision.

If you have any questions regarding this process, please contact me at 902.240.7164 and lovasia@halifax.ca.

Sincerely,

[redacted]

Andrea Lovasi-Wood
Legislative Assistant
Office of the Municipal Clerk

cc: Ashley Blisset, Manager, Development Engineering
Kayode Taiwo, HRM Development Engineer
Brendan Lee, HRM Engineering Technologist

Enclosures:

- Information – Attending In Person Meetings
- Order of Proceedings for Appeals Standing Committee

Attending In-Person Meetings

There are sign-in procedures in place for everyone visiting Halifax City Hall for all meetings and events.

All visitors, including media, must sign-in at the security desk, located at the main (Grand Parade) entrance of City Hall. Visitors who use the accessible entrance on Argyle Street will be escorted to the security desk by staff.

All visitors must present federal, provincial, or territorial government-issued photo ID to security. They also must provide their first and last name and the reason for their visit. If a visitor does not have government issued photo ID, they may present two pieces of federal, provincial, or territorial government-issued ID, two pieces of documentation (e.g. bills) or a combination of two pieces of government-issued ID/documentation as long as they both include their first and last name.

For children younger than 18, one piece of government-issued identification, such as an original birth certificate, health card, passport or non-government-issued ID (e.g. student card) is recommended but not mandatory as long as the child is accompanying a parent/guardian.

Once signed-in, visitors will be given a visitor badge to wear while they're in City Hall. This badge must be visible during their entire visit and be returned to security staff as they're leaving the building.

If visitors require the use of an elevator, they can notify a member of staff who can assist.

Visitors are reminded that no signs or placards are permitted in City Hall.

For questions about attending a meeting in City Hall, contact the Municipal Clerk's Office.

Order of Proceedings for Appeals Standing Committee

The Chair will open each of the hearings and address the following:

- The Chair will ask the Appellant (property owner) to identify themselves and provide their contact information
- If a person is appearing on behalf of an Appellant who is not present (legal counsel, family member, friend), they must provide written authorization to act on the Appellant's behalf
- The Chair will briefly explain the hearing will proceed (as follows):
- Staff Presentation: The HRM staff presenter explains the basis for the order under review and presents evidence in support of the order (including any documents or recent photos of the property, if applicable)
- The Committee may ask questions of the HRM staff presenter for clarification
- The Appellant may ask questions of the HRM staff presenter for clarification
- Non-party witnesses* may be permitted to provide factual evidence relevant to the appeal
- The Appellant may ask questions of non-party witnesses for clarification
- Appellant's Presentation: The Appellant is granted reasonable time to present evidence in support of the appeal (documents/photos/witnesses)
- The Committee may ask questions to the Appellant and/or their witnesses
- The Appellant or their representative is then permitted up to 10 minutes to make a verbal submission in support of their case to reverse the order
- The Committee may ask questions to the Appellant and also further questions of HRM staff (subject to Appellant's response to the answers)
- Staff may ask questions to the Appellant (subject to Appellant's response to the answers)
- The Committee then debates their decision and renders a decision with the Appellant or their representative present
- Upon motion the Committee may move In Camera (In Private) to obtain confidential legal advice at any time during the process
- The Committee has four (4) options:
  - cancel the order (allow the appeal)
  - amend the order (change the conditions)
  - keep the order as is (appeal dismissed)
  - continue the hearing at a later date (defer)

*Non-Party Witnesses

Persons who are not parties to the appeal may be permitted to provide relevant evidence of factual matters within their personal knowledge to the Appeals Standing Committee. Non-party witnesses will be given an appropriate amount of time to present their information.

Hearings of the Appeals Standing Committee are open to the public and any information, including personal information, which is provided or obtained in relation to your appeal, will be a matter of public record.

The Appeals Standing Committee meetings begin at 10:00 a.m. and cases will be heard as they appear on the approved agenda.