Railway Vibration Study

5209 Stonehaven Drive

Proposed Residential Development

City of Burlington

May 25, 2017
Project: 117-0082-100

Prepared for

IBI Group

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VALCOUSTICS
Canada Ltd.

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5209 Stonehaven Drive

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EXECUTIVE SUMMARY

Valcoustics Canada Ltd. (VCL) has prepared this report in support of the Draft Plan of Subdivision and Re-zoning application for the proposed residential development on the south side of Dundas Street (municipally known as 5209 Stonehaven Drive) as well as for the Consent application for the 3-lot parcel on the east side of Orchard Road (municipally known as 2474 Sutton Drive) in the City of Burlington.

This report addresses the potential vibration impact on the proposed residential development due to train movements on the Canadian National Railway (CN) Halton Subdivision.

Ground-borne vibration velocities measured on-site April 28, 2017 at the locations of the closest proposed dwelling facades to the rail line did not exceed the Federation of Canadian Municipalities/Railway Association of Canada vibration guideline limit. Therefore, vibration mitigation measures are not required for this development.

1.0 INTRODUCTION

Measurements of railway induced ground-borne vibration have been carried out to determine if vibration isolation of the proposed building foundations is warranted, relative to vibration guidelines recommended by the Federation of Canadian Municipalities/Railway Association of Canada (FCM/RAC).

1.1 SITE

The site consists of two parcels: a larger parcel (5209 Stonehaven Drive) located at the southeast corner of Dundas Street and the CN Railways Halton Subdivision consisting of 10 detached lots and one 8-unit townhouse block; and a smaller parcel (2474 Sutton Drive) on the east side of Orchard Road consisting of three detached lots.

The larger portion of the site is surrounded by:

- the CN rail line, with an existing fitness facility (gym) and other retail/commercial uses beyond, to the west;

- Dundas Street, with existing industrial and commercial uses beyond, to the north;
- a proposed public park, with an existing school (John William Boich Public School) to the east; and
- existing residential uses to the south.

The smaller portion of the site is located southeast of the larger portion, to the southeast of the proposed park, and is an extension of the existing dwellings located on the east side of Orchard Road.

Figure 1 shows a key plan.

On the west side of the site, adjacent to the CN rail line, there is an existing 3 m high sound barrier atop the 2.5 m high rail safety berm. The concept plan also shows the locations of proposed sound barriers.

The assessment is based on the Concept Plan (Concept A1) prepared by IBI Group dated May 23, 2017. Figure 2 shows the Concept Plan in reduced form.

1.2 CN HALTON SUBDIVISION

The CN Halton Subdivision is classified as a Principal Main Line. Rail activity includes freight traffic only. Information provided by CN Engineering Services indicates the railway line consists of a double mainline track and is continuously welded rail in the vicinity of the site. The grade of Dundas Street is elevated relative to the railway line, as there is an underpass for the railway.

Note, the traffic data provided by CN shows volumes in terms of “eastbound” and “westbound”. However, in the vicinity of the site the CN tracks are oriented more towards the north and south directions. For ease of reference in this report relative to the figures and consistency of the on-site observations, the “northbound” and “southbound” directions have been used.

Rail traffic data correspondence are included as Appendix A.

2.0 VIBRATION GUIDELINES

At the present time, there are no railway vibration guidelines in the land use approvals process in Ontario. However, in May 2013, the FCM and the RAC jointly released *"Guidelines for New Development in Proximity to Railway Operations"*. The FCM/RAC guideline recommends a maximum vibration threshold of 0.14 mm/sec root-mean-square (RMS) (using a one second averaging time) between 4 Hz and 200 Hz.

It is understood that CN has adopted the use of this guideline. Thus, the FCM/RAC guideline limit has been applied to the railway vibration analysis in this study.

3.0 METHOD

3.1 MEASUREMENT LOCATIONS

Vibration measurements were done at three locations and are labelled as Locations 1, 2 and 3 on Figure 3.

Location 1 was approximately 30 m east from the CN right-of-way, 15 m from the existing acoustic fence atop the safety berm. Location 1, represents the first row of dwellings with the closest proposed building facades to the rail line. Locations 2 and 3 were located approximately 40 m and 55 m from the CN right-of-way, respectively, and were used to determine the vibration decay on the site and vibration magnitudes at dwellings located beyond the first row.

3.2 TRANSDUCER PLACEMENT

An accelerometer was used at each location to measure the ground-borne vibration generated by the train pass-bys. The accelerometer was securely mounted with a stud, onto the top surface of a heavy metal plate and placed on the existing ground at-grade.

3.3 DATA ACQUISITION

A total of six railway movements (all freight trains) were monitored on April 28, 2017. Simultaneous recordings of the vibration signals were made at Locations 1, 2 and 3 for train pass-bys #2 to #5. Vibration monitoring for pass-bys #1 and #6 were made at Location 1 only.

The vertical axis signal from each accelerometer was recorded digitally, using an NI Sound and Vibration Assistant data acquisition and analysis system, and integrated from the measured acceleration to obtain the vibration velocity, in mm/s.

The accelerometers were calibrated prior to measurements with a Metra Meβ-und Frequenztechnik (MMF) vibration calibrator, model: VC20.

3.4 DATA ANALYSIS

Time histories of the overall integrated vibration velocity produced by each train pass-by were plotted using an RMS averaging time constant of one second. The analysis procedure conforms with the guidelines recommended by FCM/RAC.

4.0 RESULTS

Table 1 summarizes the maximum, measured, overall vibration velocity for each train pass-by, together with the train details.

Appendix B contains recorded time histories for the railway trains at each measurement location.

The train pass-bys produced maximum vibration velocity magnitudes ranging from:

- 0.02 to 0.04 mm/s at Locations 1 and 2; and
- 0.01 to 0.03 mm/s at Location 3.

The overall vibration velocity magnitudes reported are the maximum (one second RMS averaging) that occurred for the duration of each individual pass-by.

The measured ground-borne vibration velocities on the site, a locations representing the proposed dwelling locations, were below the FCM/RAC guideline limit. Thus, vibration mitigation is not required for any dwelling on the site.

Note, the above conclusion is based on the dwelling locations as shown on Figure 3. If the site concept is altered and dwellings are to be located closer than 30 m to the rail right-of-way, the assessment should be reviewed.

5.0 SIMULTANEOUS RAIL PASS-BYS

There are two railway tracks in the vicinity of the site. However, the tracks merge to one at the bridge crossing over the creek, about 1 km north of the site (just south of Highway 407). Thus, it is unlikely that two simultaneous train pass-bys would occur opposite the site. If by chance there were two trains opposite the site at the same time, one of the trains would likely need to be stopped to let the other pass through.

Notwithstanding the above, the passing of two simultaneous trains at speed would not be expected to create any significant vibration impact at the site. In the worst case, simultaneously pass-bys could result in vibration levels being 3 dB (or less) higher than any of the vibration levels measured on site from a single train pass-by. Accounting for this, the resulting vibration would still be below the FCM/RAC limit. See Table 1.

6.0 CONCLUSIONS

The maximum overall ground-borne vibration velocities measured on site at the locations of the closest proposed dwellings to the adjacent CN railway line were below the vibration guideline limit suggested by FCM/RAC. Therefore, vibration mitigation measures are not required for this development.

7.0 REFERENCES

1. “Guidelines for New Development in Proximity to Railway Operations”, prepared for The Federation of Canadian Municipalities and the Railway Association of Canada, May 2013.

RL\ML\tk
J:\2017\1170082\100\Reports\Vibration\5209 Stonehaven Drive, Burlington - Railway Vibration V1_0.wpd

TABLE 1

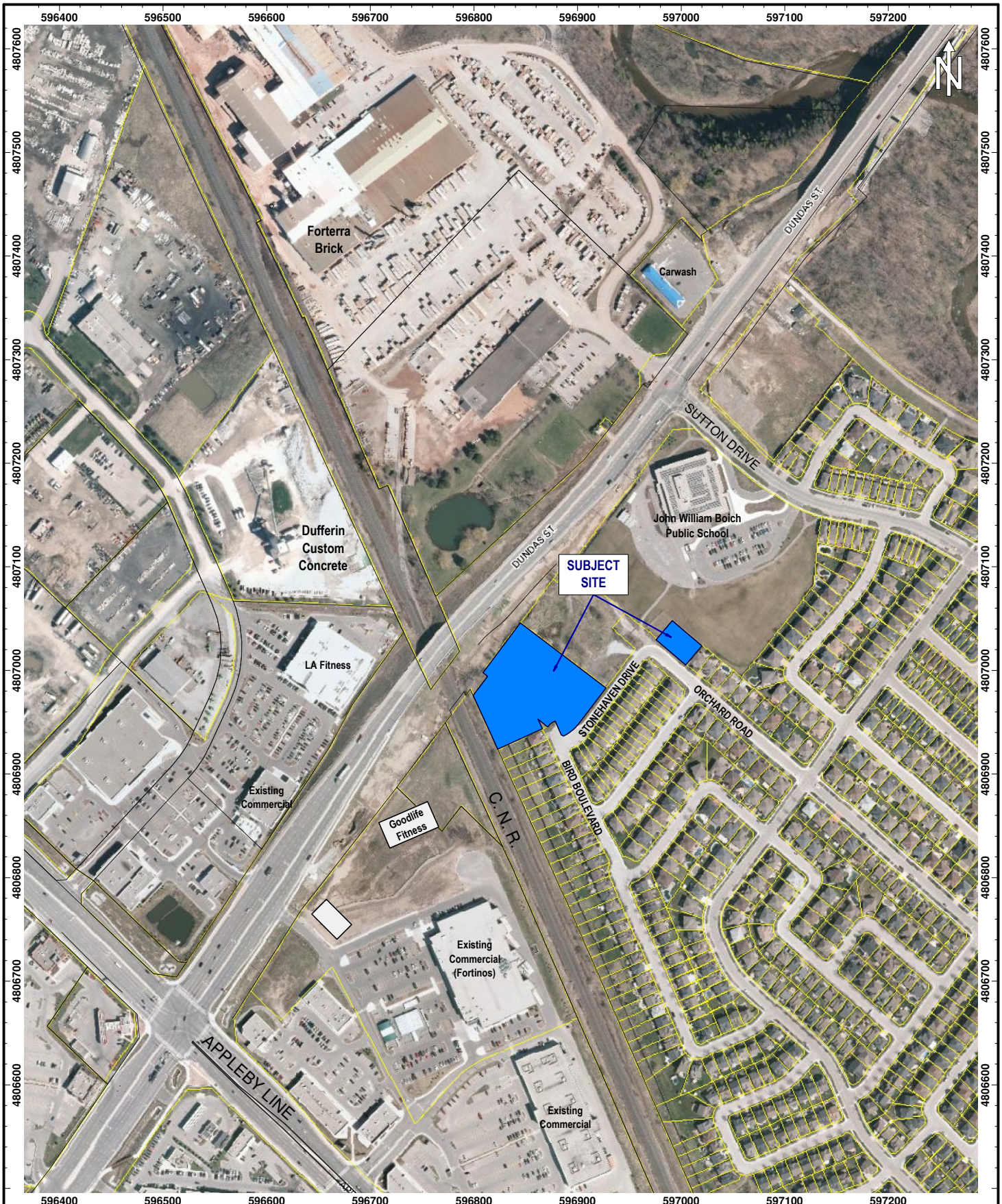
SUMMARY OF MEASURED OVERALL MAXIMUM VIBRATION VELOCITY MAGNITUDES OF CN FREIGHT TRAINS

Measurement Date: 2017-04-28

Pass-by #	Train Details					Maximum Vibration Velocity[1] (mm/s) (# in brackets is dB re: 1 microinch/sec) at Locations[2]			Vibration Guideline Limit Velocity[1] (mm/s) (# in brackets is dB re: 1 microinch/sec)	Complies with Limit
	Time/Period	Estimated speed (kph)	# of Locos	# of Cars	Direction	1	2	3		(Yes/No)
1	10:50 – 10:56	30	3	100+	Northbound	0.02 (58)	–	–	0.14 (75)	Yes
2	12:28 – 12:38	20	2	100+	Northbound	0.02 (58)	0.02 (58)	0.01 (52)		Yes
3	12:44 – 12:48	50	2	100+	Southbound	0.02 (58)	0.04 (64)	0.02 (58)		Yes
4	13:56 – 13:59	60	2	100+	Southbound	0.03 (62)	0.04 (64)	0.03 (62)		Yes
5	14:40 – 14:41	70	2	13	Northbound	0.03 (62)	0.03 (62)	0.02 (58)		Yes
6	17:11 – 17:12	60	2	6	Southbound	0.04 (64)	–	–		Yes

Notes:

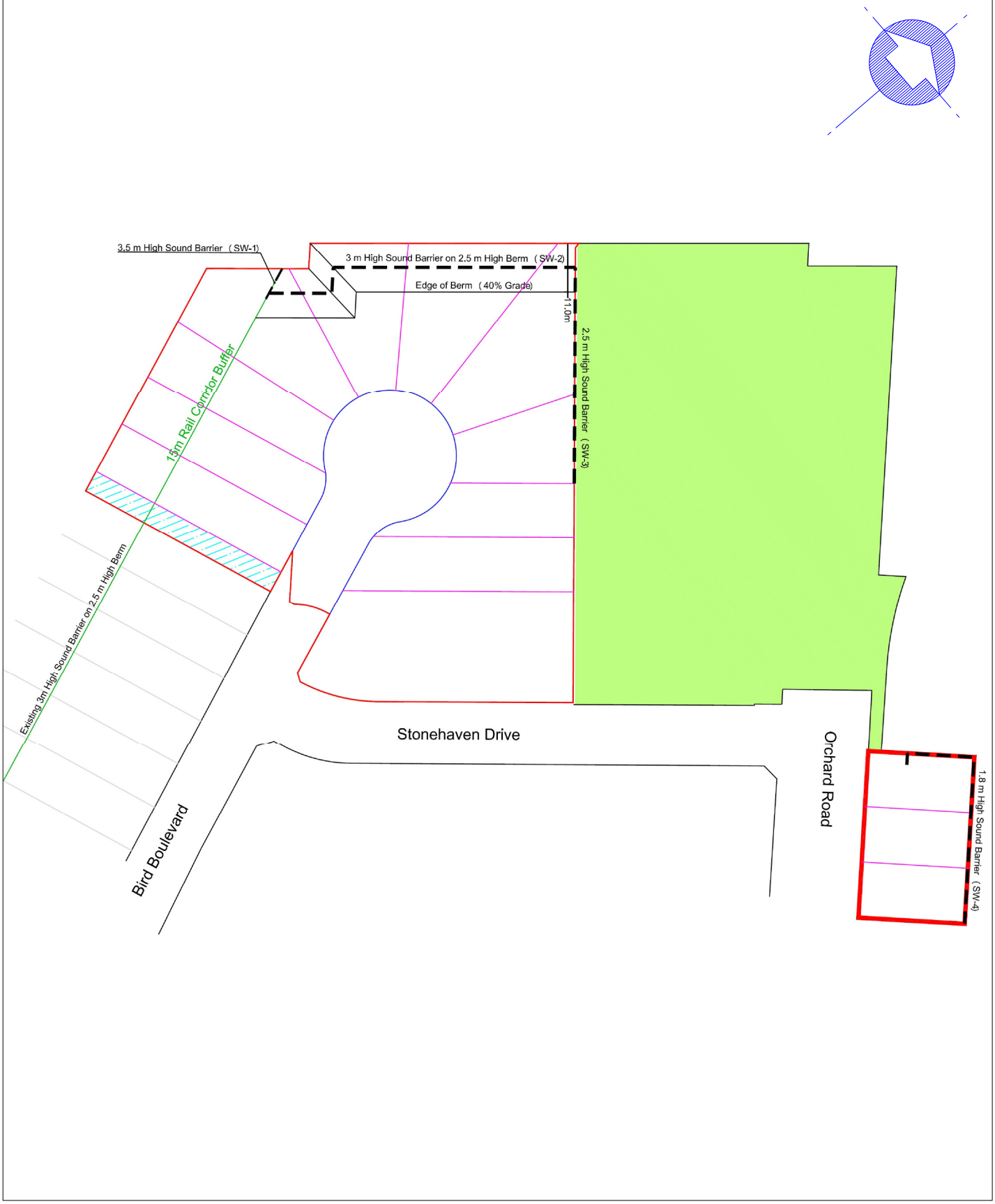
(1) Maximum overall vibration velocity occurring for the entire pass-by; one second RMS averaging.
(2) See Figure 3.



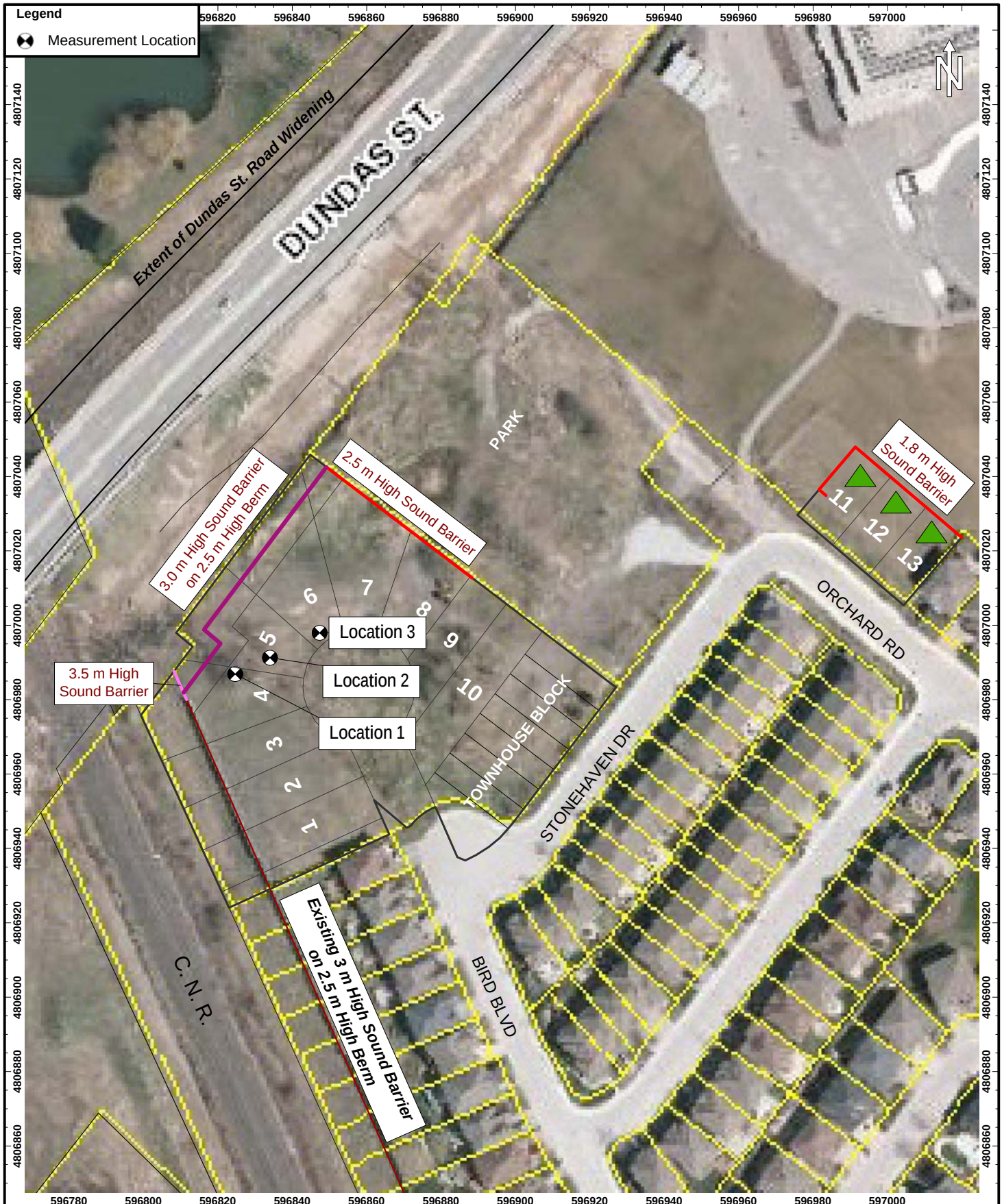
VALCOUSTICS Canada Ltd. consulting acoustical engineers	Title: **Key Plan**	Date: **2017-05-15**	Figure: **1**
	Project Name: **5209 Stonehaven Drive/Burlington - Vibration**	Project No.: **117-0082-100**	

E:\AA\1170082\Cadna\Stonehaven.cna

Date Plotted: 15.05.17



VALCOUSTICS Canada Ltd.	Title: Concept Plan	Date: 2017-05-23	Figure: 2
	Project Name: 5209 Stonehaven Drive/Burlington - Vibration	Project No.: 117-0082-100	



VALCOUSTICS
Canada Ltd.
consulting acoustical engineers

Title	Date	Figure
CN Railway Vibration Measurement Locations	**2017-05-25**	**3**
Project Name: **5209 Stonehaven Drive/Burlington - Vibration**	Project No.: **117-0082-100**	

\\10.7.11.12\Jobs\2017\1170082\100\Reports\Vibration\For V1_0\Figure 3 - Stonehaven Measurement Locations_2017-05-25.cna

Date Plotted: 25.05.17

APPENDIX A

RAIL TRAFFIC CORRESPONDENCE

System Engineering
Engineering Services

1 Administration Road
P.O. Box 1000
Concord, ON, L4K 1B9
T: 905.669.3184
F: 905.760.3406

Train Count Data

TRANSMITTAL

To: *Destinataire :*	Valcoustics Canada LTD 30 Wertheim Court, Unit 25 Richmond Hill, ON L4B 1B9	*Project :*	HAL-41.63 – Tremaine Road, Burlington, ON
Att'n:	Anthony Amarra	*Routing:*	Anthony@valcoustics.com
From: *Expéditeur :*	Derek Basso	*Date:* *date :*	June 13th, 2016
Cc:	Raymond Beshro CN via e-mail		

☐ Urgent ☐ For Your Use ☐ For Review ■ For Your Information ☐ Confidential

Re: Train Traffic Data – CN Hatlon Subdivision near Tremain Road in Burlington, ON

Please find attached the requested Train Traffic Data; this data does not reflect GO Metrolinx Traffic. The application fee in the amount of **$500.00** +HST will be invoiced.

Should you have any questions, please do not hesitate to contact the undersigned at 905-669-3184.

Sincerely,
CN Design & Construction

Derek Basso
Engineering Technician
Derek.Basso@cn.ca

Date: 2016/06/13 Project Number: HAL-41.63 – Tremaine Road, Burlington, ON

Dear Anothony:

Re: Train Traffic Data – CN Halton Subdivision near Tremaine Road in Burlington, ON

The following is provided in response to Anthony's 2015/05/24 request for information regarding rail traffic in the vicinity of Tremaine in Burlington at approximately Mile 41.63 on CN's Halton Subdivision.

Typical daily traffic volumes are recorded below. However, traffic volumes may fluctuate due to overall economic conditions, varying traffic demands, weather conditions, track maintenance programs, statutory holidays and traffic detours that when required may be heavy although temporary. For the purpose of noise and vibration reports, train volumes must be escalated by 2.5% per annum for a 10-year period.

Typical daily traffic volumes at this site location are as follows:

***Maximum train speed is given in Miles per Hour**

	0700-2300			
Type of Train	Volumes	Max.Consist	Max. Speed	Max. Power
Freight	10	140	50	4
Way Freight	0	25	50	4
Passenger	0	10	50	2

	2300-0700			
Type of Train	Volumes	Max.Consist	Max. Speed	Max. Power
Freight	8	140	50	4
Way Freight	0	25	50	4
Passenger	0	10	50	2

The volumes recorded reflect westbound and eastbound freight and passenger operations on CN's Halton Subdivision.

Except where anti-whistling bylaws are in effect, engine-warning whistles and bells are normally sounded at all at-grade crossings. There is one at-grade crossing in the immediate vicinity of the study area at Mile 42.20 (Burnhamthorpe Rd. W.). Anti-whistling bylaws are in effect at this crossing. Please note that engine warning whistles may be sounded in cases of emergency, as a safety and or warning precaution at station locations and pedestrian crossings and occasionally for operating requirements.

With respect to equipment restrictions, the gross weight of the heaviest permissible car is 286,000 lbs.

The double mainline track is considered to be continuously welded rail throughout the study area.

The Canadian National Railway continues to be strongly opposed to locating developments near railway facilities and rights-of-way due to potential safety and

environmental conflicts. Development adjacent to the Railway Right-of-Way is not appropriate without sound impact mitigation measures to reduce the incompatibility. For confirmation of the applicable rail noise, vibration and safety standards, Mr. Raymond Beshro, Canadian National Railway Properties at 514-399-7627 should be contacted directly.

I trust the above information will satisfy your current request.

Sincerely,

Derek Basso

Derek Basso
Engineering Technician
Derek.Basso@cn.ca

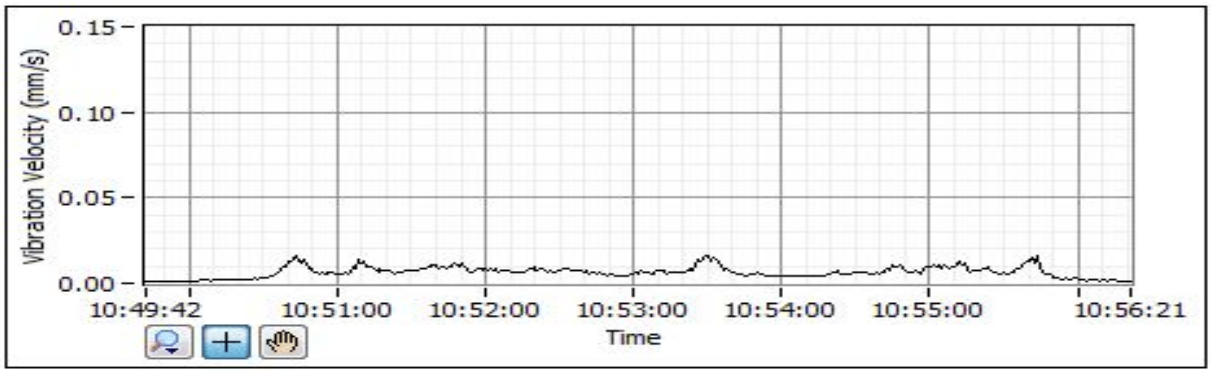
cc. Raymond Beshro – CN – via e-mail

APPENDIX B

VIBRATION VELOCITY TIME HISTORIES
RAILWAY TRAIN PASS-BYS

CN Freight Pass-by #1

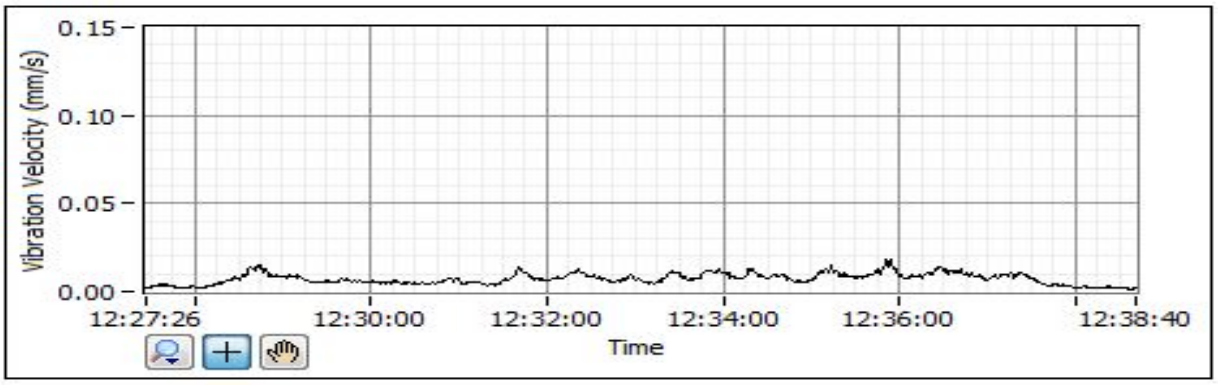
Overall Vibration Velocity



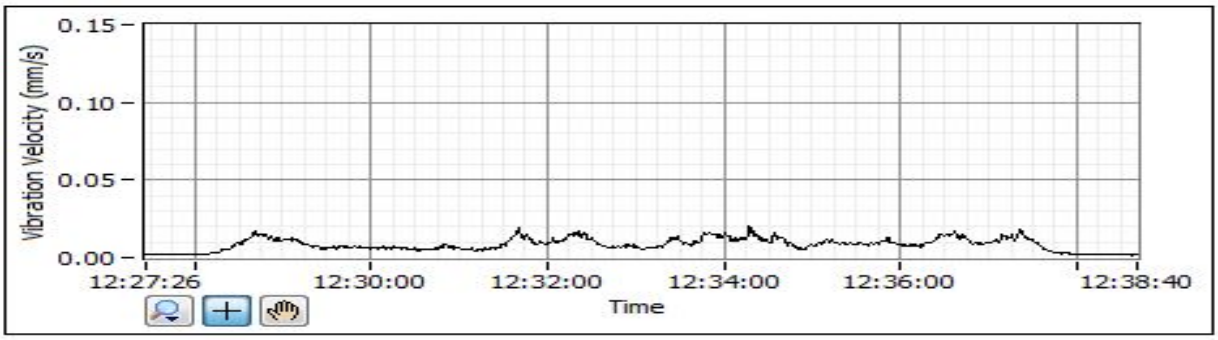
Location	Time	Pass-by's	Max. Vibration Velocity (mm/s)
1	10:50 – 10:56	Northbound	0.02

CN Freight Pass-by #2

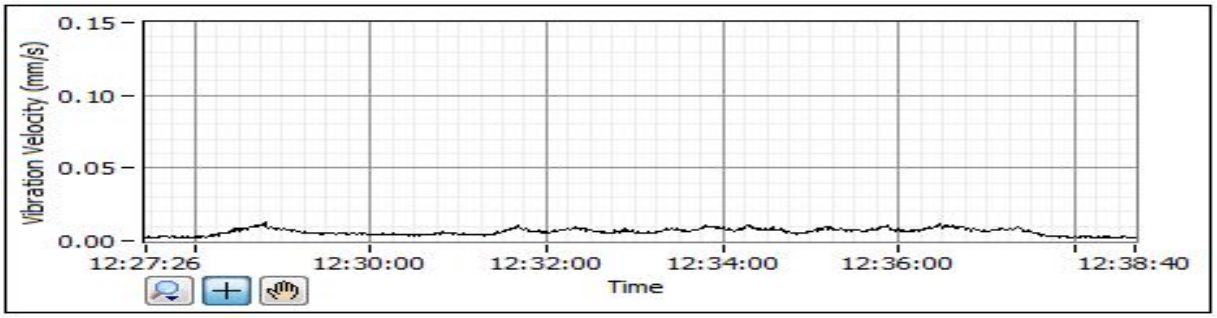
Overall Vibration Velocity



Location	Time	Pass-by's	Max. Vibration Velocity (mm/s)
1	12:28 – 12:38	Northbound	0.02



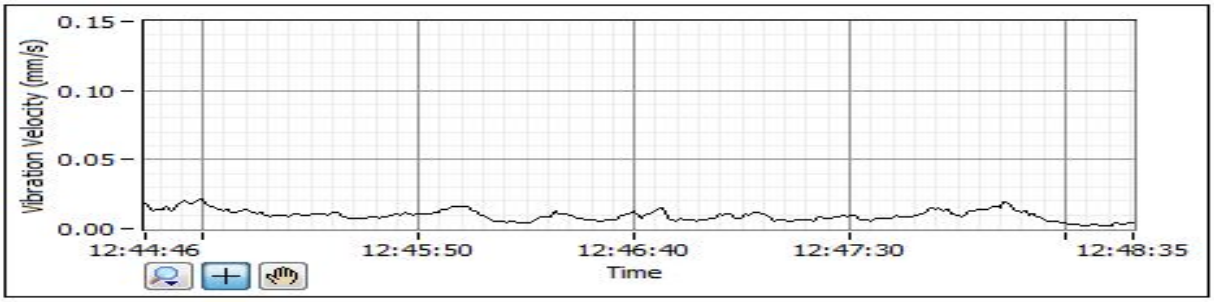
Location	Time	Pass-by's	Max. Vibration Velocity (mm/s)
2	12:28 – 12:38	Northbound	0.02



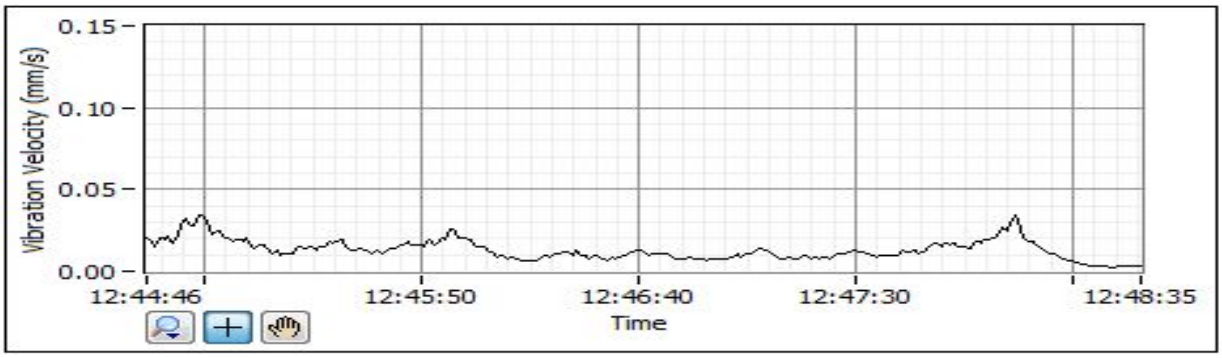
Location	Time	Pass-by's	Max. Vibration Velocity (mm/s)
3	12:28 – 12:38	Northbound	0.01

CN Freight Pass-by #3

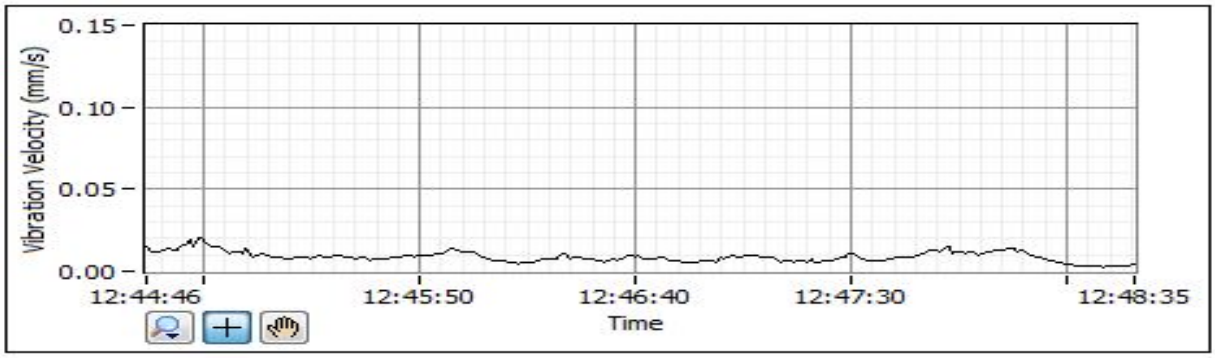
Overall Vibration Velocity



Location	Time	Pass-by's	Max. Vibration Velocity (mm/s)
1	12:44 – 12:48	Southbound	0.02



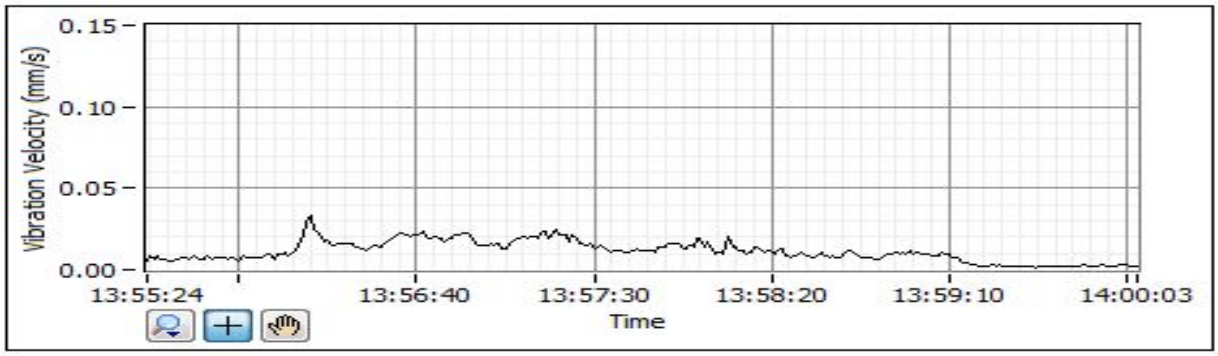
Location	Time	Pass-by's	Max. Vibration Velocity (mm/s)
2	12:44 – 12:48	Southbound	0.04



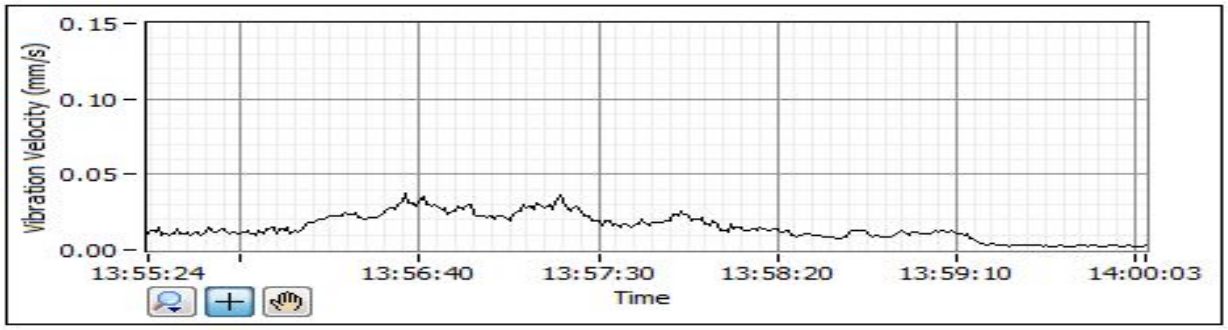
Location	Time	Pass-by's	Max. Vibration Velocity (mm/s)
3	12:44 – 12:48	Southbound	0.02

CN Freight Pass-by #4

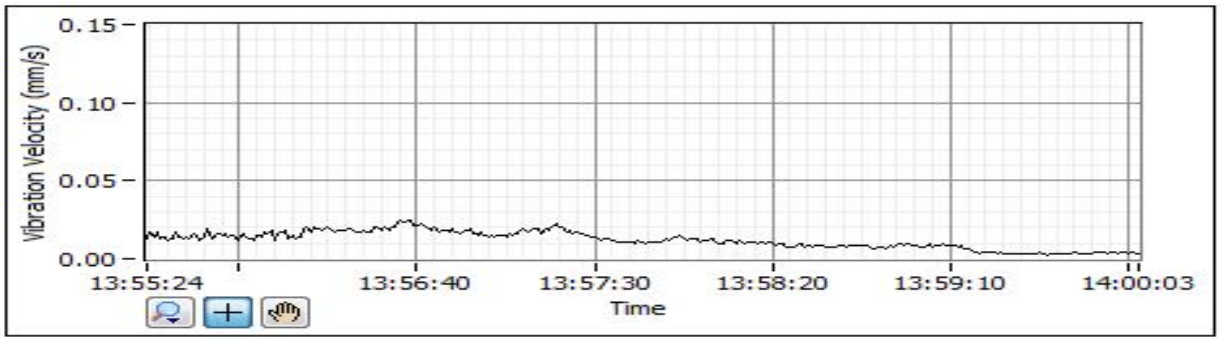
Overall Vibration Velocity



Location	Time	Pass-by's	Max. Vibration Velocity (mm/s)
1	13:56 – 13:59	Southbound	0.03



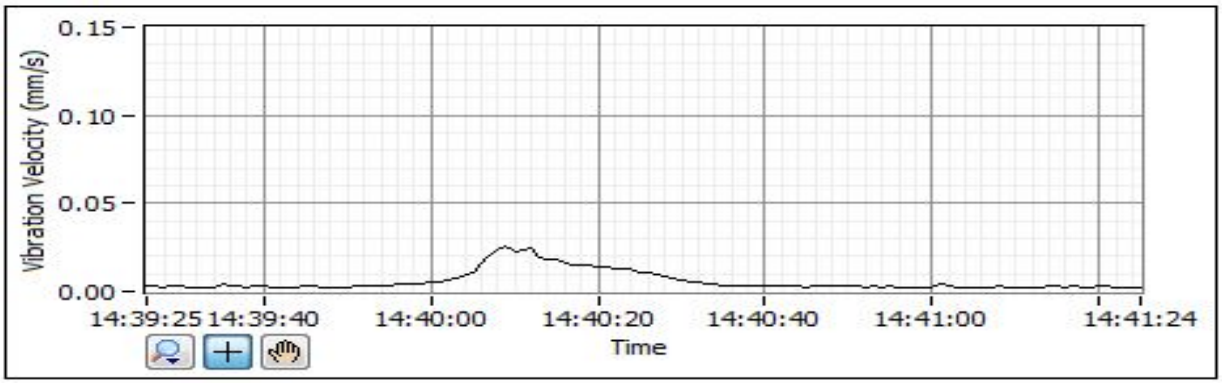
Location	Time	Pass-by's	Max. Vibration Velocity (mm/s)
2	13:56 – 13:59	Southbound	0.04



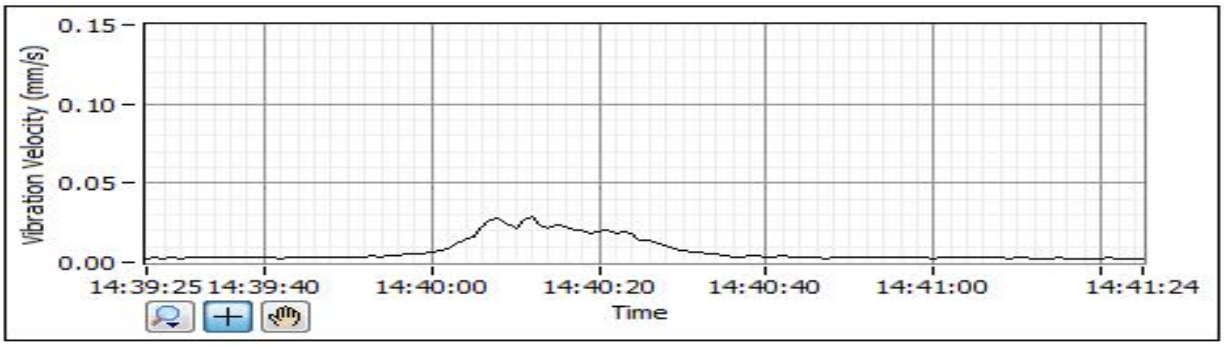
Location	Time	Pass-by's	Max. Vibration Velocity (mm/s)
3	13:56 – 13:59	Southbound	0.03

CN Freight Pass-by #5

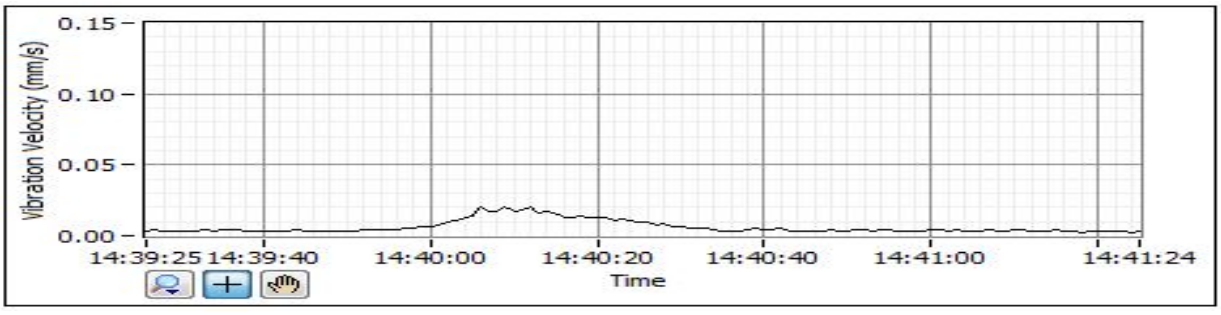
Overall Vibration Velocity



Location	Time	Pass-by's	Max. Vibration Velocity (mm/s)
1	14:40 – 14:41	Northbound	0.03



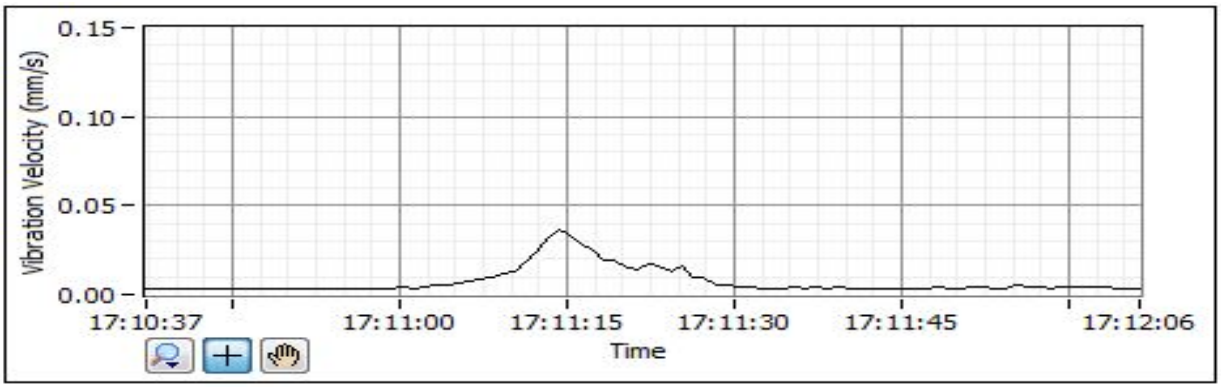
Location	Time	Pass-by's	Max. Vibration Velocity (mm/s)
2	14:40 – 14:41	Northbound	0.03



Location	Time	Pass-by's	Max. Vibration Velocity (mm/s)
3	14:40 – 14:41	Northbound	0.02

CN Freight Pass-by #6

Overall Vibration Velocity



Location	Time	Pass-by's	Max. Vibration Velocity (mm/s)
1	17:11 – 17:12	Southbound	0.04