Railway Vibration Study

750 Lockhart Road

Proposed Residential Development
City of Barrie

March 6, 2019
Project: 118-0671-100

Prepared for

Ballymore Building (Barrie) Corp.

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VALCOUSTICS
Canada Ltd.

Version History

Version #	Date	Comments
1.0	March 6, 2019	Issued to Client

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EXECUTIVE SUMMARY

Valcoustics Canada Ltd. (VCL) was retained to prepare a Railway Vibration Study for the proposed residential development to support the Zoning By-law Amendment (ZBA) and Draft Plan of Subdivision application submissions to the City of Barrie. The proposed development consists of 21 blocks of street townhouses (Blocks 1 to 21), and three additional blocks for future residential development (Blocks 22 to 24). Detailed plans for Blocks 22 (40± units), 23 (40± units) and 24 (266± units) are not yet available. Additional Blocks for a natural heritage buffer/area, a SWM pond, road widening and open space are also planned.

The significant source of ground-borne vibration with potential for impact at the proposed development is rail traffic on the GO Barrie line. The measured ground-borne vibration velocity magnitudes due to GO trains did not exceed the applicable vibration guideline limit at the proposed development.

Therefore, vibration mitigation measures are not mandatory for the proposed development.

1.0 INTRODUCTION

VCL was retained to prepare a Railway Vibration Study for the proposed residential development to support the ZBA and Draft Plan of Subdivision application submissions to the City of Barrie.

The ground-borne vibration on site due to the train pass-bys was measured and compared with the applicable vibration guideline to determine the need for mitigation. The results are outlined herein.

1.1 THE SITE AND THE SURROUNDING AREA

The site is located at 750 Lockhart Road in the City of Barrie, County of Simcoe (within Part of the south half of Lot 16, Concession 11). The site is bounded by:

- Agricultural/vacant lands (future residential development) to the north;
- Agricultural/vacant lands and rural residential dwellings to the east;

- Lockhart Road, with agricultural/vacant lands beyond to the south; and,
- The GO Barrie (Metrolinx) rail line, with rural residential dwellings/agricultural land and Yonge Street beyond to the west.

A Key Plan is included as Figure 1. The study is based on the Draft Plan of Subdivision, prepared by KLM Planning Partners Inc., dated February 14, 2019. The Draft Plan is included as Figure 2.

1.2 THE PROPOSED DEVELOPMENT

The proposed development site spans approximately 26.4 acres northeast of the intersection of Yonge Street and Lockhart Road in the City of Barrie. Residential portions of the development are located at the north and south ends of the site, with natural heritage buffer areas (Blocks 25 and 27), natural heritage area (Block 30), and a stormwater management pond area (Block 28) in between. A collector road (Kneeshaw Drive) connects the northern lands to those in the south.

The northern portion of the site consists of 16 blocks of street townhouses (Blocks 1 to 16). Five blocks of street townhouses (Blocks 17 to 21) will be located in the southern part of the site. It is understood that all street townhouse units could be up to 3.5 storeys in height and will be provided with rear yard outdoor amenity areas.

In addition to the street townhouses, the southern portion of the site also includes three blocks for future residential development (Blocks 22 to 24). Detailed plans for these blocks are not yet available. It is expected that these blocks will include a combination of apartment buildings up to 6 storeys in height, residential street townhouses, residential stacked decked townhouses, and open space/park space.

1.3 SOURCES OF VIBRATION

The anticipated vibration source with the potential to impact the development is rail traffic on the Barrie GO Rail Line along the west side of the site. The Barrie GO Rail Line is classified as a Principal Main Line. At this point, trackage adjacent to the site consists of one main line track.

It is understood that Canadian National Railway (CN) does not run trains along this segment of track. Thus, only GO passenger trains are using the rail line.

Ground-borne vibration due to vehicle movements on surrounding roadways is not expected to create significant impact on the proposed development and thus, has not been considered further in the analysis. There are no other sources of vibration in the vicinity of the site.

2.0 VIBRATION GUIDELINES

The Federation of Canadian Municipalities (FCM) and the Railway Association of Canada (RAC) jointly developed “Guidelines for New Development in Proximity to Railway Operations”, dated May 2013 (herein referred to as the FCM/RAC guideline).

For a residential development, the FCM/RAC guideline suggests a dwelling setback of 30 m adjacent to a principal main line and recommends a maximum vibration threshold of 0.14 mm/s root mean square (RMS, using a 1 second averaging time) between 4 Hz and 200 Hz (Reference 1).

The FCM/RAC guideline limit has been applied to complete this study.

3.0 METHOD

3.1 MEASUREMENT LOCATIONS

Vibration measurements were done at three locations and are labelled as Locations A, B and C on Figure 3.

Locations A and B were in the Phase 1 area. Location A was approximately 30 m setback from the rail right of way (ROW), representing the western facades of the first row of the proposed Phase 1 buildings, closest to the rail line. Location B was approximately 10 m east of Location A.

Location C was in the Phase 3 area, approximately 30 m from the rail right of way (ROW), representing the closest dwelling setback suggested by FCM/RAC for a residential development adjacent to a principal main line.

3.2 TRANSDUCER PLACEMENT

Geophones were used to measure the vibration velocity produced by the train pass-bys. At each of Locations A, B and C, the transducer was placed into a small hole dug into the ground, such that they were resting on compacted soil and were securely anchored with metal ground spikes.

3.3 DATA ACQUISITION

A total of five (5) GO train pass-bys were monitored on January 18, 2019. For each pass-by, the vibration signals were recorded simultaneously at Locations A, B and C. The vertical axis signal from each geophone was recorded digitally, using a MetricPro Model MPV3C21 vibration data acquisition and analysis system. The monitors recorded vibration velocity, in mm/s.

At each location the vibration data acquisition system recorded the ground-borne vibration continuously throughout the monitoring period, using a sampling rate of 1000 samples per second.

3.4 DATA ANALYSIS

Time histories of the vibration velocity produced by each train pass-by were band-pass filtered between 4 Hz and 200 Hz and were plotted using a RMS (root-mean-square) averaging routine with a time constant of one second. The analysis procedure conforms to the FCM/RAC guideline requirements.

4.0 RESULTS

Table 1 summarizes the maximum measured overall vibration velocity (1-second RMS) for each train pass-by. All of the GO trains consisted of 1 locomotive and 12 passenger cars, except Pass-by #3 which consisted of 1 locomotive and 10 passenger cars. Train speeds of the 5 pass-bys were estimated to be 70 to 90 km/hr.

Appendix A contains recorded time histories of the measured vibration velocity for each train pass-by at each measurement location.

The maximum overall vibration velocity magnitudes were measured to be:

- 0.13 mm/s at Location A;
- 0.10 mm/s at Location B; and
- 0.08 mm/s at Location C.

All of the measured vibration velocity magnitudes were below the 0.14 mm/s FCM/RAC guideline limit. Thus, vibration mitigation is not required for the proposed development.

5.0 CONCLUSIONS

The ground-borne vibration velocity magnitudes due to railway traffic on the Barrie GO Rail Line, measured at the 30 m setback to the rail ROW, suggested by FCM/RAC guideline for residential development, did not exceed the FCM/RAC vibration limit for any train pass-bys. Therefore, vibration mitigation measures are not mandatory for this development.

6.0 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.

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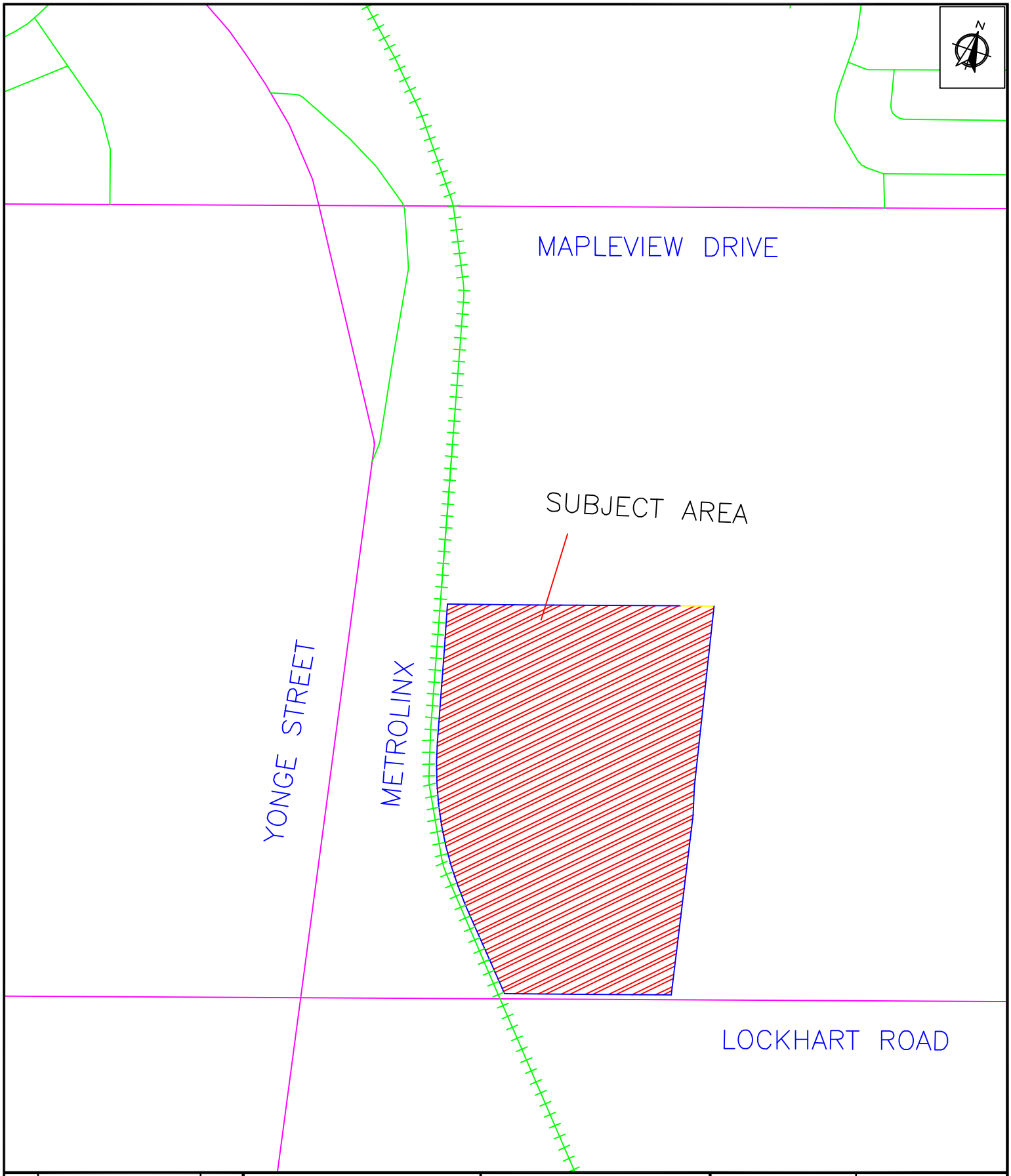
TABLE 1: SUMMARY OF MEASURED MAXIMUM VIBRATION VELOCITY DUE TO GO TRAIN PASS-BYS

Pass-by #	Time/Period	Direction	Maximum Vibration Velocity(1) (mm/s)		
			Location A(2)	Location B(2)	Location C(2)
1	17:22 – 17:23	Northbound	0.13	0.08	0.07
2	17:45 – 17:46	Northbound	0.12	0.09	0.08
3	18:14 – 18:15	Northbound	0.12	0.10	0.08
4	18:46 – 18:47	Northbound	0.12	0.08	0.08
5	19:12 – 19:13	Northbound	0.13	0.08	0.08

Notes:

(1) Maximum overall vibration velocity occurring for the entire pass-by, one second RMS averaging.

(2) See Figure 3.



No.	Revision/Issue	Date

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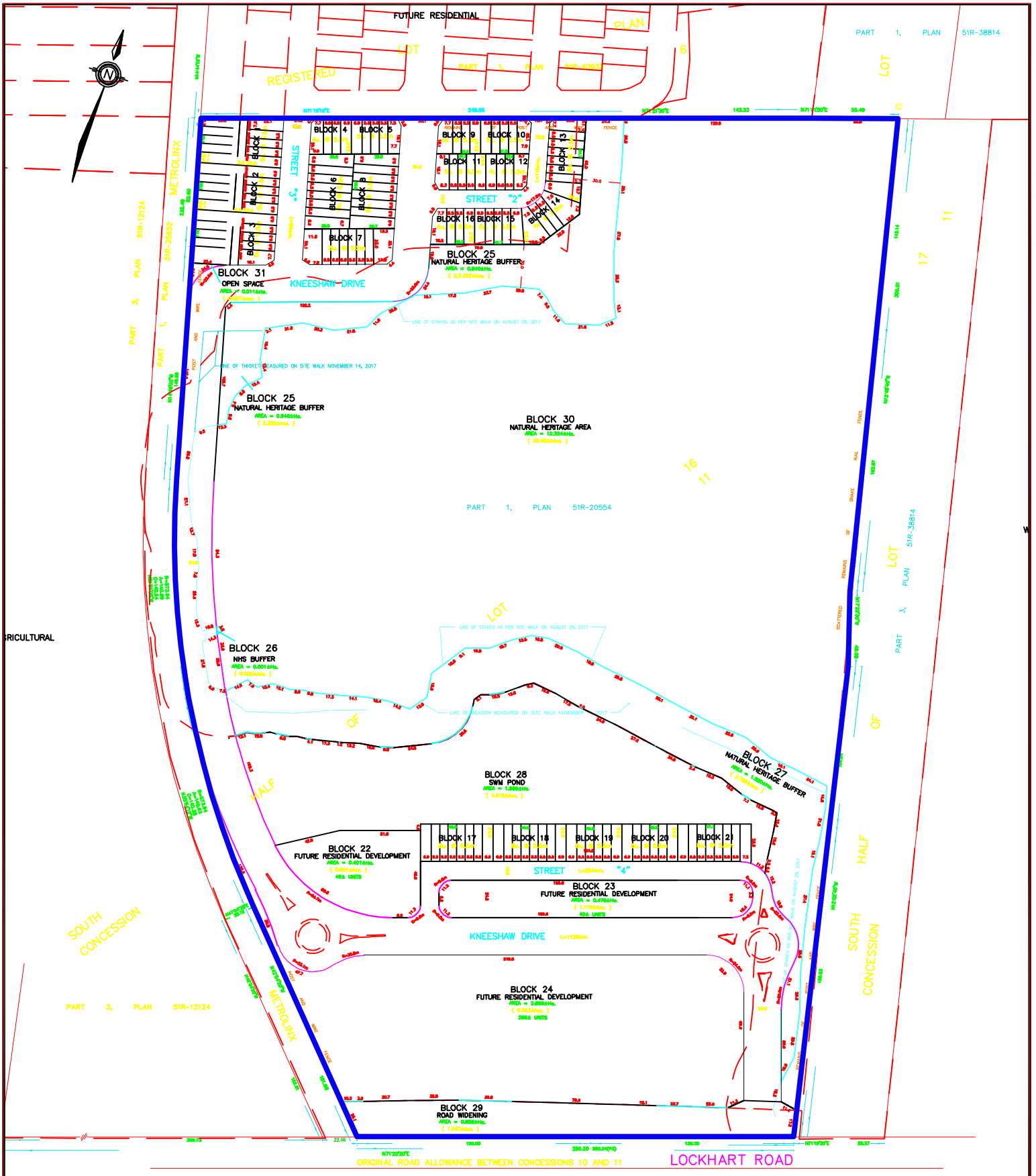
Title	Project No.	Date
Key Plan	118-0671-100	Feb. 28, 2019
Project Name	**Scale**	**Figure**
750 Lockhart Road Barrie / Vibration	N.T.S.	1



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Draft Plan	118-0671-100	Feb. 28, 2019
Project Name	**Scale**	**Figure**
750 Lockhart Road Barrie / Vibration	N.T.S.	2

VALCOUSTICS Canada Ltd. consulting acoustical engineers	Title: **Railway Vibration Measurement Locations**	Measurement Date: **Feb. 28, 2019**	Figure: **3**
	Project Name: **750 Lockhart Road, Barrie**	Project No.: **118-0671-100**	

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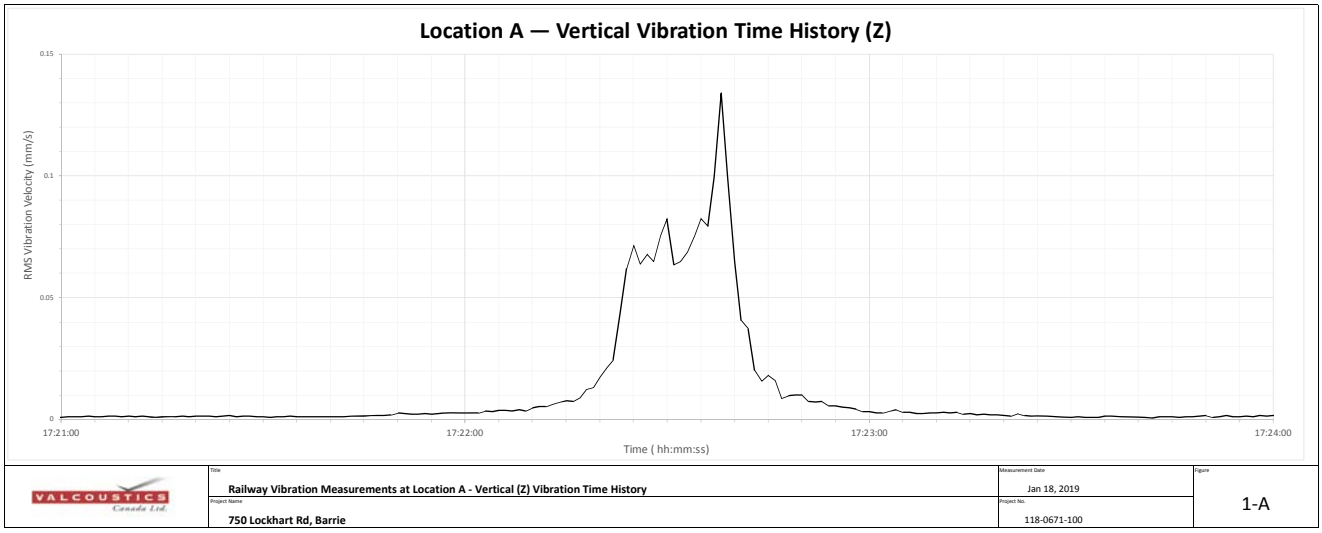
Date Plotted: 28.02.19

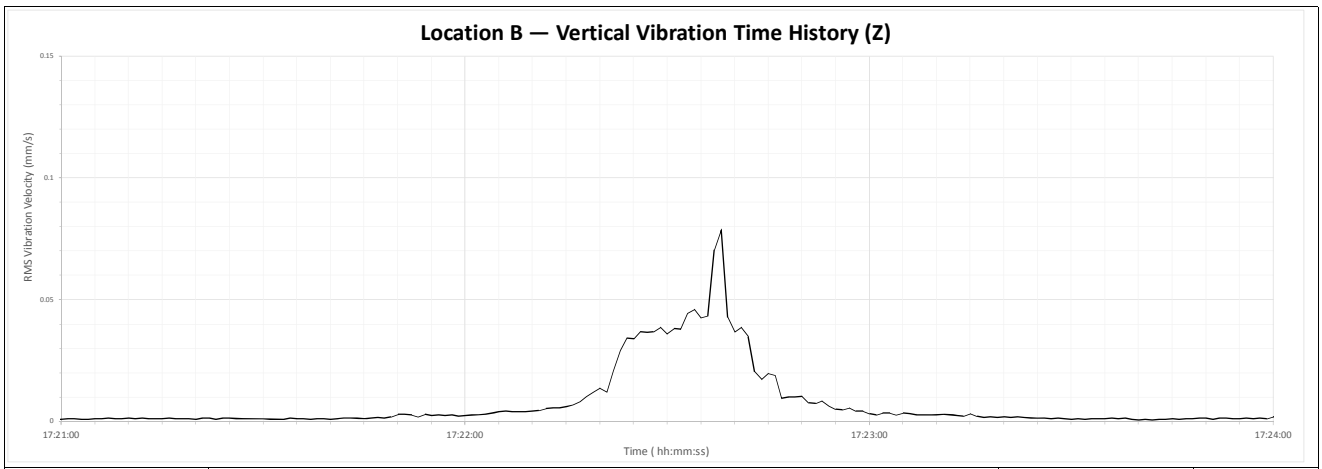
APPENDIX A

VIBRATION VELOCITY TIME HISTORIES DUE TO RAILWAY TRAIN PASS-BYS

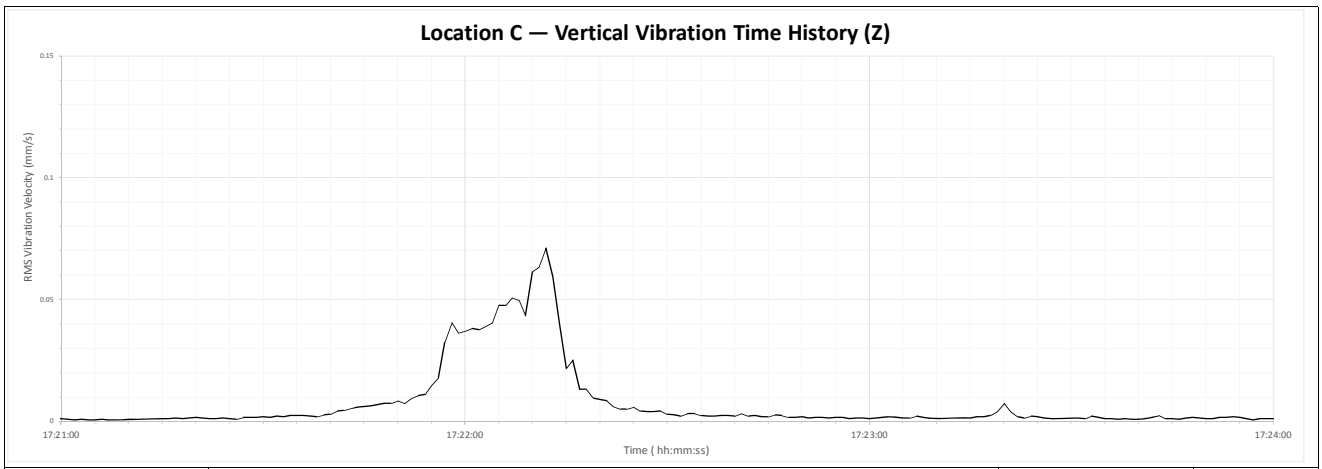
Vibration Measurements — Train Pass-by #1 Northbound



VALCOUSTICS Canada Ltd.	Title: Railway Vibration Measurements at Location A - Vertical (Z) Vibration Time History	Measurement Date: Jan 18, 2019	Figure: 1-A
	Project Name: 750 Lockhart Rd, Barrie	Project No.: 118-0671-100	

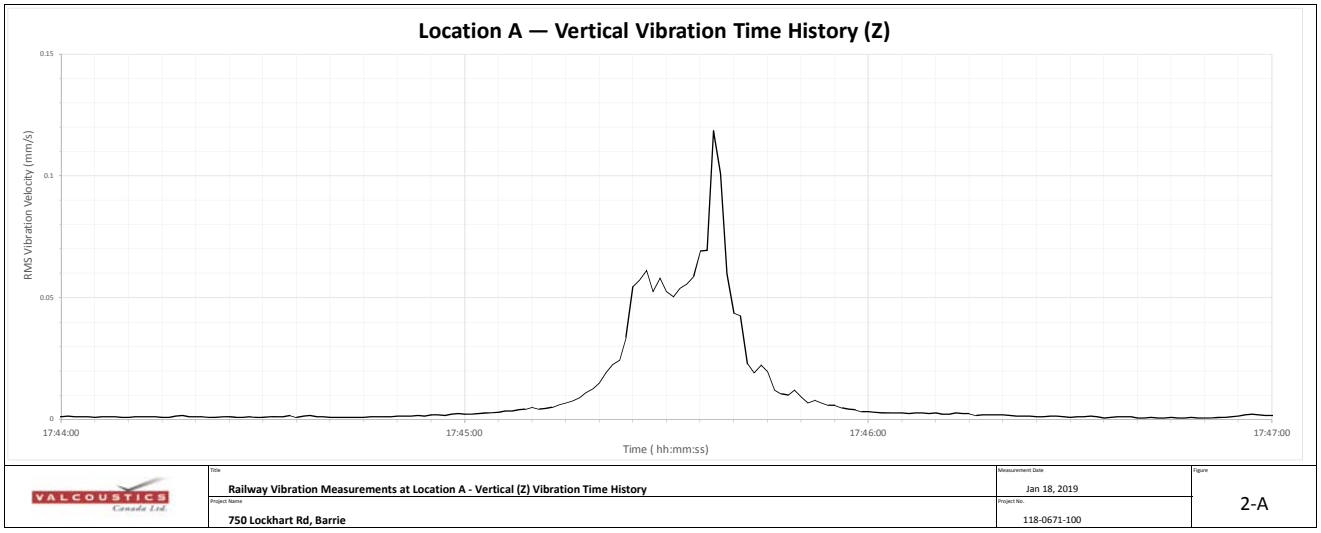


VALCOUSTICS Canada Ltd.	Title: Railway Vibration Measurements at Location B - Vertical (Z) Vibration Time History	Measurement Date: Jan 18, 2019	Figure: 1-B
	Project Name: 750 Lockhart Rd, Barrie	Project No.: 118-0671-100	

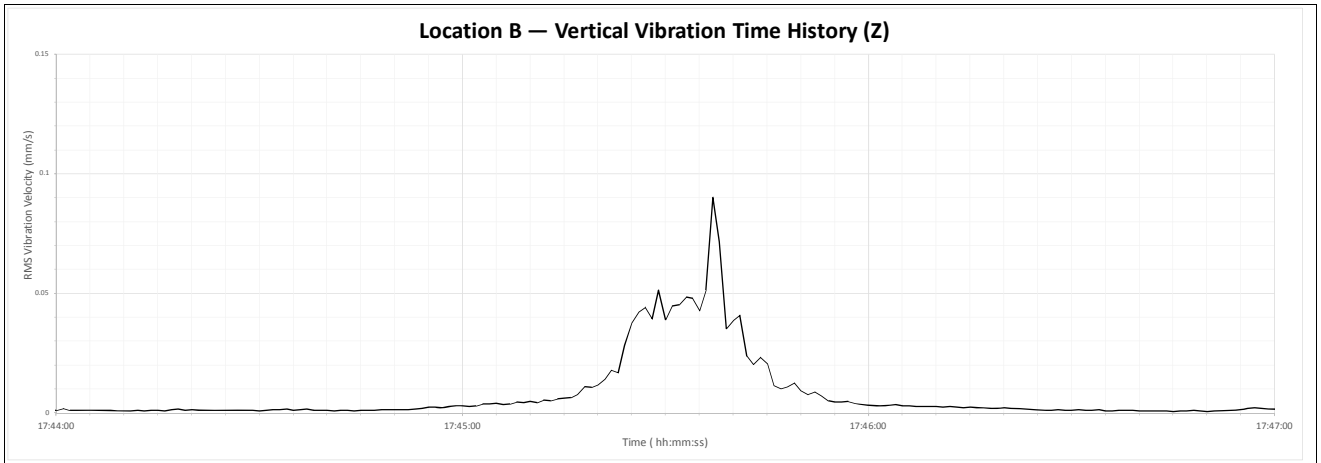


VALCOUSTICS Canada Ltd.	Title: Railway Vibration Measurements at Location C - Vertical (Z) Vibration Time History	Measurement Date: Jan 18, 2019	Figure: 1-C
	Project Name: 750 Lockhart Rd, Barrie	Project No.: 118-0671-100	

Vibration Measurements — Train Pass-by #2 Northbound



VALCOUSTICS Canada Ltd.	Title: Railway Vibration Measurements at Location A - Vertical (Z) Vibration Time History	Measurement Date: Jan 18, 2019	Figure: 2-A
	Project Name: 750 Lockhart Rd, Barrie	Project No.: 118-0671-100	



VALCOUSTICS Canada Ltd.	Title: Railway Vibration Measurements at Location B - Vertical (Z) Vibration Time History	Measurement Date: Jan 18, 2019	Figure: 2-B
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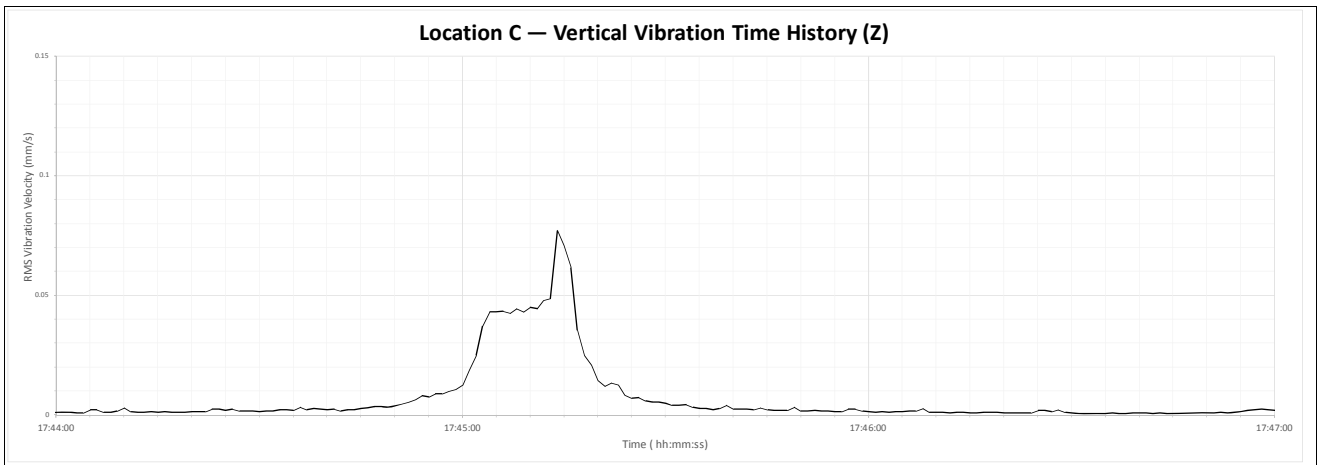
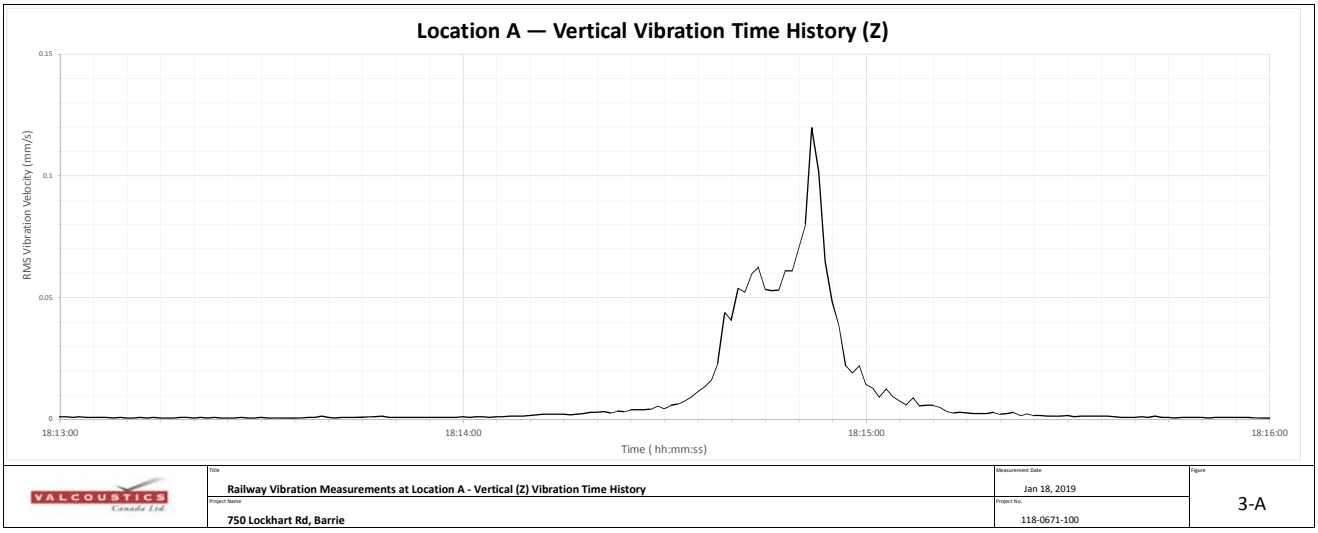
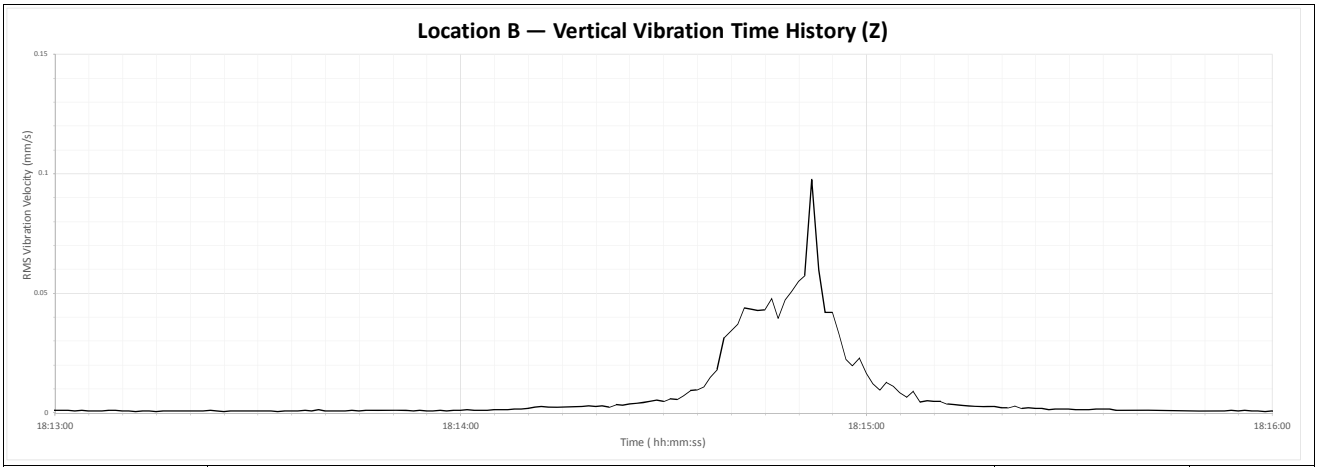


VALCOUSTICS Canada Ltd.	Title: Railway Vibration Measurements at Location C - Vertical (Z) Vibration Time History	Measurement Date: Jan 18, 2019	Figure: 2-C
	Project Name: 750 Lockhart Rd, Barrie	Project No.: 118-0671-100	

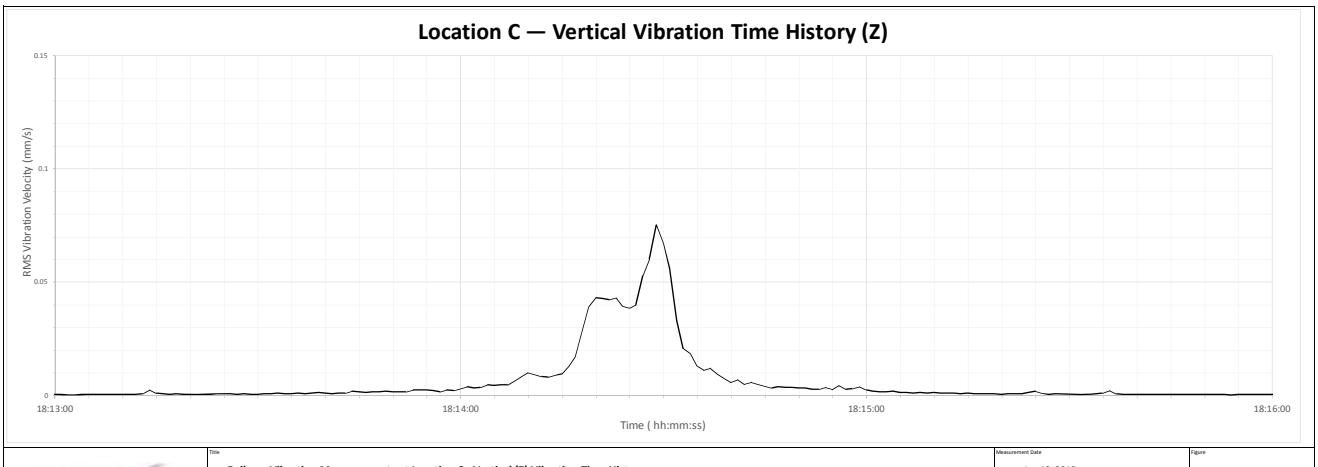
Vibration Measurements — Train Pass-by #3 Northbound



VALCOUSTICS Canada Ltd.	Title: Railway Vibration Measurements at Location A - Vertical (Z) Vibration Time History	Measurement Date: Jan 18, 2019	Figure: 3-A
	Project Name: 750 Lockhart Rd, Barrie	Project No.: 118-0671-100	

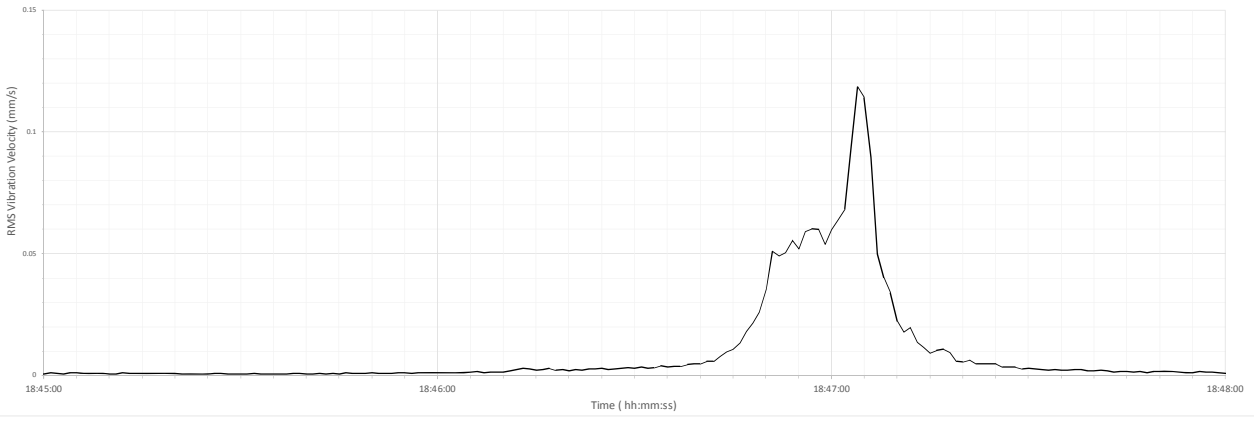


VALCOUSTICS Canada Ltd.	Title: Railway Vibration Measurements at Location B - Vertical (Z) Vibration Time History	Measurement Date: Jan 18, 2019	Figure: 3-B
	Project Name: 750 Lockhart Rd, Barrie	Project No.: 118-0671-100	

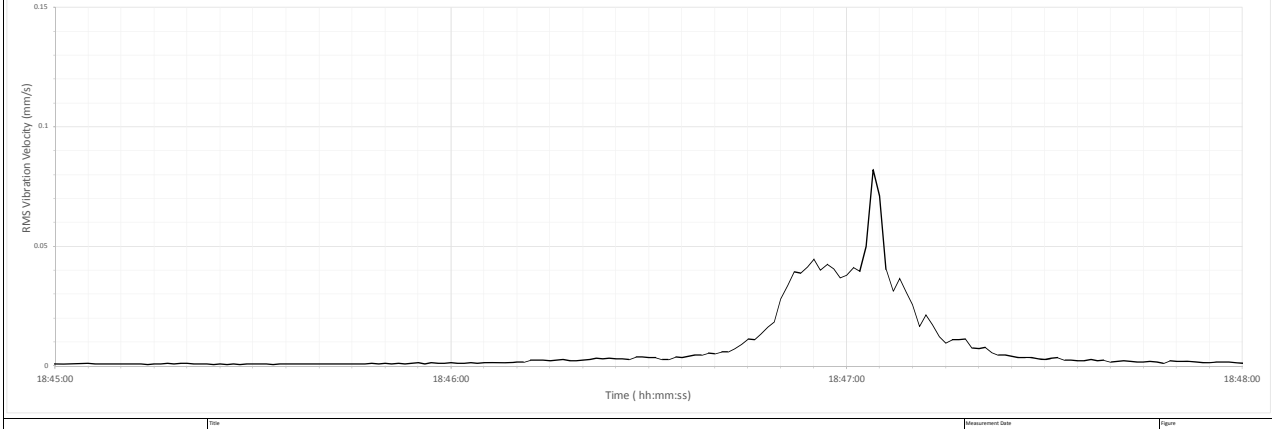


VALCOUSTICS Canada Ltd.	Title: Railway Vibration Measurements at Location C - Vertical (Z) Vibration Time History	Measurement Date: Jan 18, 2019	Figure: 3-C
	Project Name: 750 Lockhart Rd, Barrie	Project No.: 118-0671-100	

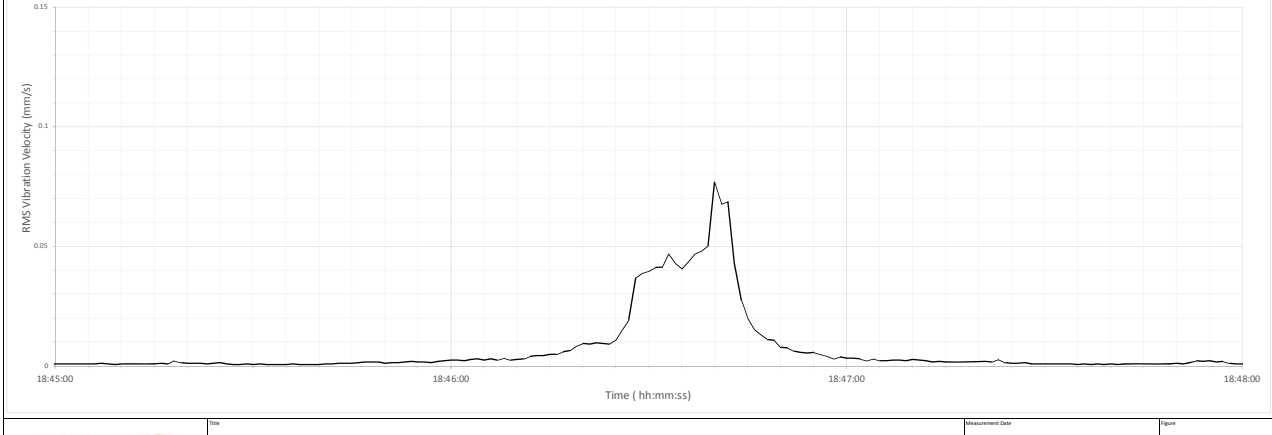
Vibration Measurements — Train Pass-by #4 Northbound



VALCOUSTICS Canada Ltd.	Title: Railway Vibration Measurements at Location A - Vertical (Z) Vibration Time History	Measurement Date: Jan 18, 2019	Figure: 4-A
	Project Name: 750 Lockhart Rd, Barrie	Project No.: 118-0671-100	

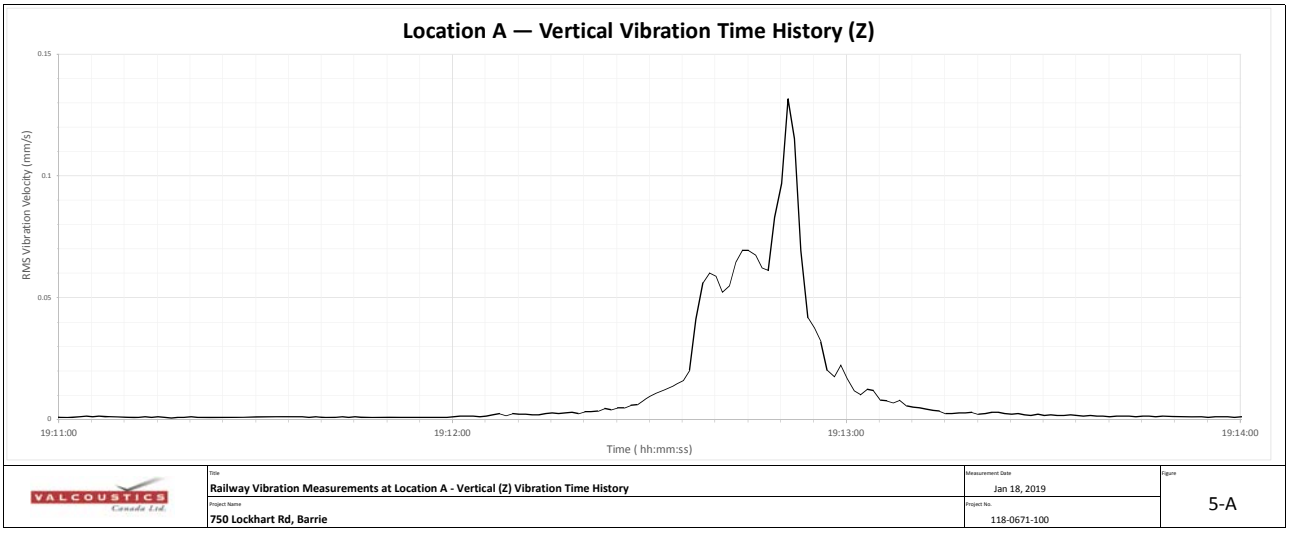


VALCOUSTICS Canada Ltd.	Title: Railway Vibration Measurements at Location B - Vertical (Z) Vibration Time History	Measurement Date: Jan 18, 2019	Figure: 4-B
	Project Name: 750 Lockhart Rd, Barrie	Project No.: 118-0671-100	

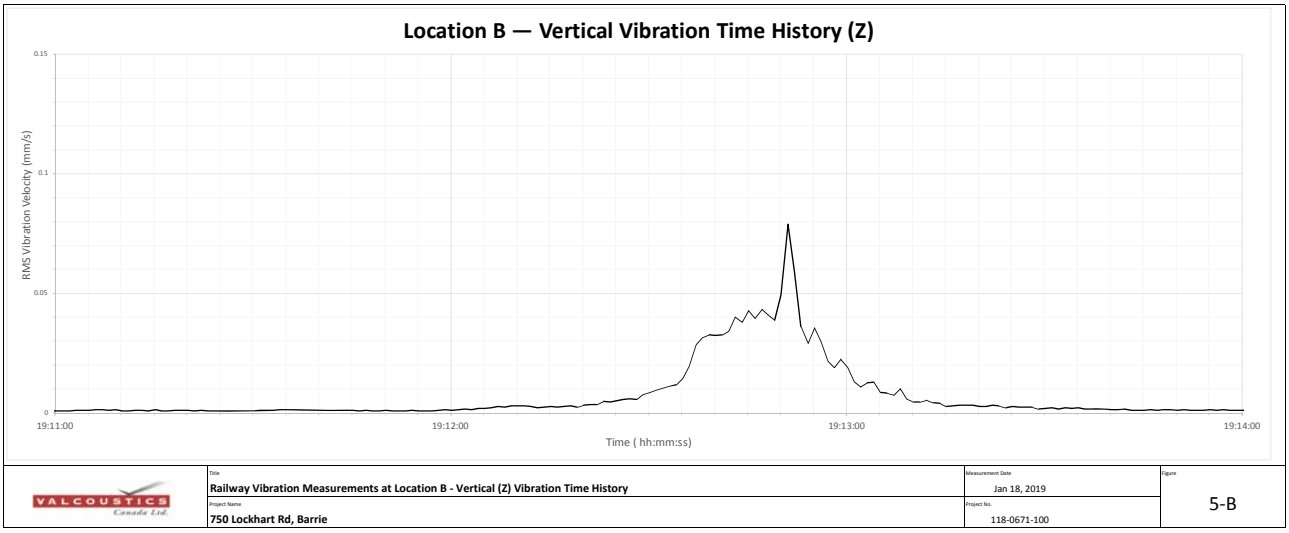


VALCOUSTICS Canada Ltd.	Title: Railway Vibration Measurements at Location C - Vertical (Z) Vibration Time History	Measurement Date: Jan 18, 2019	Figure: 4-C
	Project Name: 750 Lockhart Rd, Barrie	Project No.: 118-0671-100	

Vibration Measurements — Train Pass-by #5 Northbound



VALCOUSTICS Canada Ltd.	Title: Railway Vibration Measurements at Location A - Vertical (Z) Vibration Time History	Measurement Date: Jan 18, 2019	Figure: 5-A
	Project Name: 750 Lockhart Rd, Barrie	Project No.: 118-0671-100	



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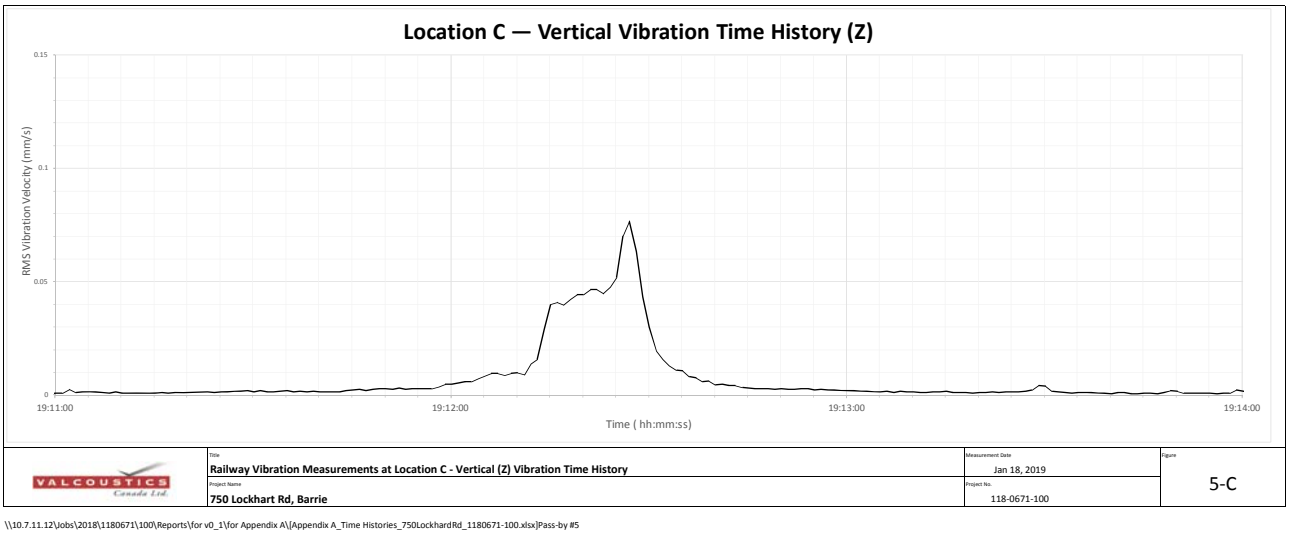
	Project Name: 750 Lockhart Rd, Barrie	Project No.: 118-0671-100	



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	Project Name: 750 Lockhart Rd, Barrie	Project No.: 118-0671-100	