Railway Vibration Study

989 Yonge Street

Proposed Residential Development

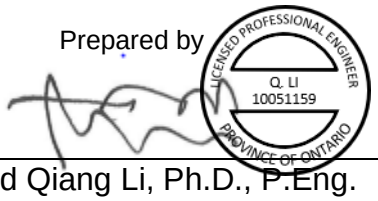
Barrie, Ontario

July 17, 2020
Project: 120-0182

Prepared for

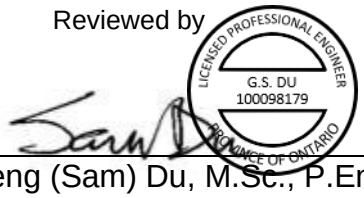
ASA Development Inc.

Prepared by



Richard Qiang Li, Ph.D., P.Eng.

Reviewed by



Guangsheng (Sam) Du, M.Sc., P.Eng.

VALCOUSTICS
Canada Ltd.

Version History

Version #	Date	Comments
1.0	July 17, 2020	Issued for Use

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Barrie, Ontario

EXECUTIVE SUMMARY

Valcoustics Canada Ltd. (VCL) was retained to prepare a Railway Vibration Study to support the Rezoning and Plan of Condominium application submissions to the City of Barrie. The proposed development will consist of eight blocks of 3-storey townhouses and nine apartment buildings.

The significant source of vibration in the vicinity of the site is the rail traffic on the GO Barrie line. Ground-borne railway vibration were measured on site. The measured vibration velocity magnitudes due to the train pass-bys exceeded the applicable vibration guideline limit at the proposed residential dwelling building. Vibration mitigation measures are required for the proposed development.

1.0 INTRODUCTION

VCL was retained to prepare a Railway Vibration Study to support the Rezoning and Plan of Condominium application submissions to the City of Barrie. Measurements of railway induced ground-borne vibration have been carried out to determine if vibration isolation of the proposed building foundation is warranted, relative to the vibration guidelines. The results are outlined herein.

1.1 SITE LOCATION AND SURROUNDING AREA

The proposed development is located at 989 Yonge St in the City of Barrie. The proposed development will consist of eight (8) blocks of 3-storey townhouses and nine (9) apartment buildings. There are also parking garage at grade to be constructed under the berm, for Buildings 5 to 8 adjacent to the rail corridor to the east.

The site is bounded by:

- existing residential dwellings to the north;
- GO (Metrolinx) Barrie rail line, with future residential development beyond, to the east;
- Lockhart Road, with agricultural/vacant lands beyond to the south; and

- Yonge Street, with the existing Carpe Diem Orchard and future residential/school development beyond, to the west.

A Key Plan is included as Figure 1.

This report is based on the architectural drawings prepared by SRM Architects Inc., received May 12, 2020. The site plan from the drawings is included as Figure 2.

2.0 THE EFFECT ON THE ENVIRONMENT ON THE PROJECT

2.1 VIBRATION SOURCES

The main vibration source with the potential to impact on the development is the rail traffic on the GO Barrie line located to the south of the subject site.

2.2 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 residential developments, the FCM/RAC Guideline 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 is used in this study.

2.3 MEASUREMENT LOCATIONS

Vibration measurements were made on May 12, 2020 at four (4) locations labelled as A, B, C and D on Figure 2.

Location A is at the east facade of the under-berm parking garage at grade, shared between Buildings 5 and 6, approximately 10 m from the rail right of way (ROW) (30 m from centreline of the GO line rail track), representing the closest building structure to the rail line. Location B is at the southeast corner of Building 8, approximately 30 m setback from the rail ROW (50 m from the centreline of the rail track).

Locations C and D were, respectively, at the east facade of Townhouse Block F approximately 58 m from the rail ROW (75 m from centreline of the track) and east facade of Building 9 approximately 87 m from the rail ROW (107 m from the centreline of the CPR line), representing the 2nd row of closest buildings to the rail line.

2.4 TRANSDUCER PLACEMENT

A triaxial geophone transducer was used at each location to measure the ground-borne vibration produced by the train pass-bys. The transducers were placed approximately 15 cm below grade such that they were resting on compacted soil. The transducers were securely anchored with ground spikes.

2.5 DATA ACQUISITION AND ANALYSIS

Three (3) GO trains were monitored at Locations A to D on May 12, 2020.

The signals (vertical, transversal and longitudinal) from the triaxial geophone were recorded digitally using a MetricPro Model MPV3C21 vibration data acquisition and analysis system. The measurement system recorded vibration velocity, in mm/s.

The vibration data acquisition system recorded the ground borne vibration continuously throughout the measurement period, using a sampling rate of 1000 samples per second.

Time histories of the measure vibration velocity were plotted using an RMS (root-mean-square) averaging routine with a time constant of one second. The analysis procedure conforms with the FCM/RAC guidelines.

3.0 RESULTS

Table 1 summarizes details of the three (3) train pass-bys, as well as the maximum measured vibration velocity (one second RMS) for each train pass-by.

Appendix A contains the time histories of measured vibration velocities for the train pass bys.

The measured maximum vibration velocity magnitudes due to the train pass-bys were summarized below.

- Location A: 0.15 mm/s vertical axis (Z), 0.17 mm/s transversal (Y) axis and 0.24 mm/s longitudinal (X) axis;
- Location B: 0.06 mm/s vertical axis (Z), 0.09 mm/s transversal (Y) axis and 0.08 mm/s longitudinal (X) axis;
- Location C: 0.04 mm/s vertical axis (Z), 0.06 mm/s transversal (Y) axis and 0.07 mm/s longitudinal (X) axis;
- Location D: 0.03 mm/s vertical axis (Z), 0.05 mm/s transversal (Y) axis and 0.04 mm/s longitudinal (X) axis;

The measured vibration velocity magnitudes, due to the train pass-bys on the GO Barrie line, exceeded the 0.14 mm/s FCM/RAC guideline limit at Location A. Thus, vibration mitigation is required for the proposed development.

4.0 MITIGATION MEASURES

Based on the measured vibration velocities, vibration mitigation is required for the building structures within 30 m setback distance from the ROW.

The specific vibration isolation details for the development can be developed at the building design stage when the structural drawings are developed.

5.0 CONCLUSIONS

The ground-borne vibration velocity magnitudes due to railway traffic on the GO Barrie line, measured at the proposed development exceeded the FCM/RAC vibration limit for the train pass-by. Vibration mitigation measures are required 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 MEASUREMENT SUMMARY OF GO TRAIN PASS-BYS ON 2020-05-12

Pass-by #	Time Period	Train Details				Maximum Vibration Velocity[1] (mm/s)		
		Direction	# of Locomotivess	# of Cars	Location[2]	Vertical (Z)	Transversal (Y)	Longitudinal (X)
1	17:27	Northbound	2	5	A	0.13	0.17	0.21
					B	0.06	0.07	0.08
					C	0.04	0.06	0.07
					D	0.03	0.05	0.04
2	18:27	Northbound	2	5	A	0.15	0.16	0.24
					B	0.06	0.09	0.08
					C	0.04	0.05	0.07
					D	0.03	0.05	0.04
3	19:29	Northbound	2	5	A	0.09	0.12	0.20
					B	0.05	0.06	0.07
					C	0.02	0.04	0.04
					D	0.02	0.03	0.02

Notes:

(1) Maximum overall vibration velocity occurring for the entire pass-by; one second RMS averaging between 4 Hz and 200 Hz.

(2) See Figure 2.

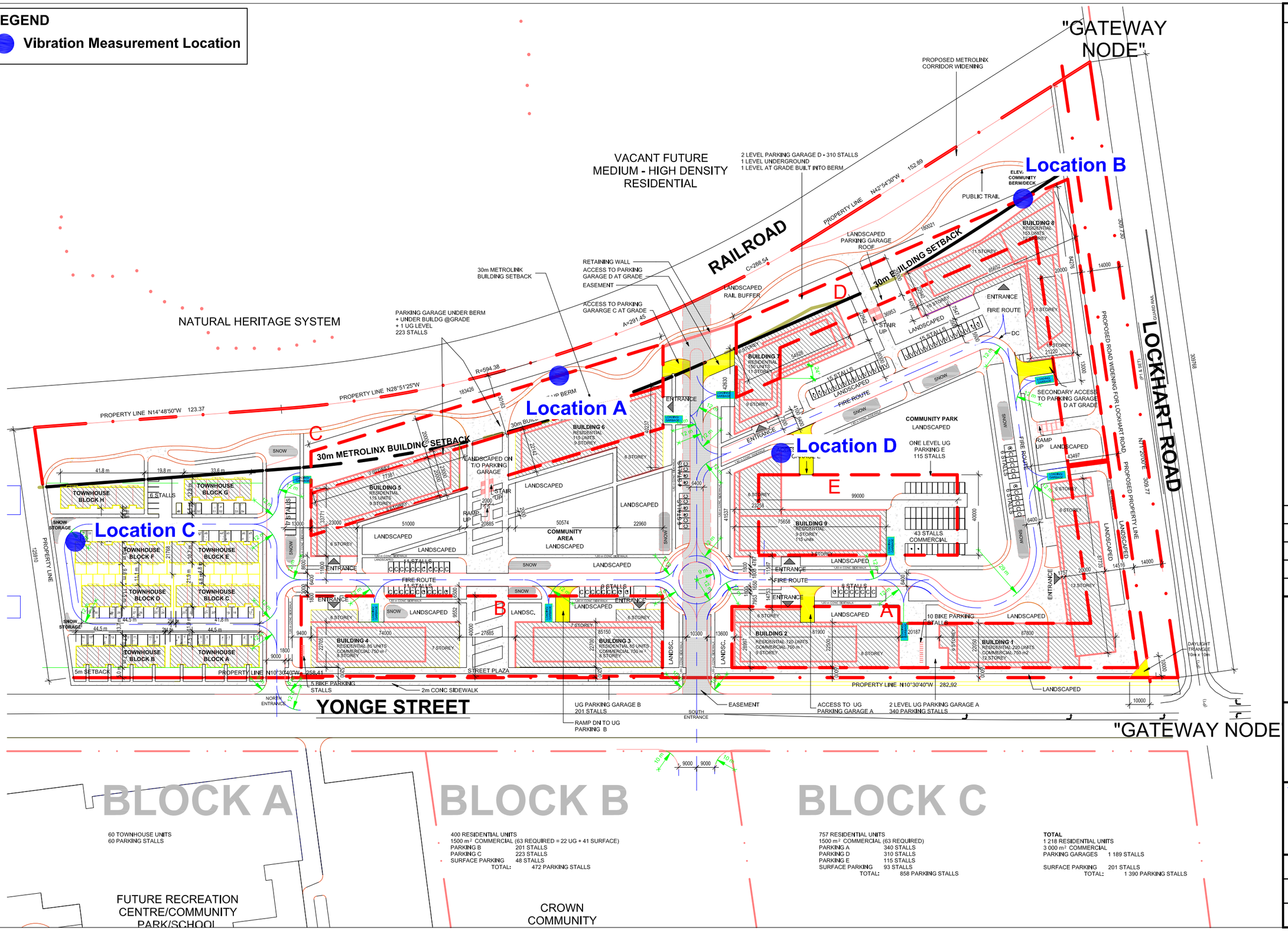
VALCOUSTICS Canada Ltd. consulting acoustical engineers	Title: **KEY PLAN**	Date: **June 16, 2020**	Figure: **1**
	Project Name: **989 Yonge St, Barrie - Railway Vibration**	Project No.: **120-0182**	

(untitled)

Date Plotted: 16.06.20

LEGEND

Vibration Measurement Location



BLOCK A

60 TOWNHOUSE UNITS
60 PARKING STALLS

FUTURE RECREATION CENTRE/COMMUNITY PARK/SCHOOL

BLOCK B

400 RESIDENTIAL UNITS
1500 m² COMMERCIAL (63 REQUIRED = 22 UG + 41 SURFACE)

PARKING B	201 STALLS
PARKING C	223 STALLS
SURFACE PARKING	48 STALLS
TOTAL:	472 PARKING STALLS

CROWN COMMUNITY

BLOCK C

757 RESIDENTIAL UNITS
1500 m² COMMERCIAL (63 REQUIRED)

PARKING A	340 STALLS
PARKING D	310 STALLS
PARKING E	115 STALLS
SURFACE PARKING	93 STALLS
TOTAL:	858 PARKING STALLS

TOTAL
1 218 RESIDENTIAL UNITS
3 000 m² COMMERCIAL

PARKING GARAGES	1 189 STALLS
SURFACE PARKING	201 STALLS
TOTAL:	1 390 PARKING STALLS

General Notes

BASE DRAWING BY
SRM Architects Inc.

Project North

True North

No.	Revision/Issue	Date

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Project Name

989 Yonge St, Barrie - Railway Vibration

Title

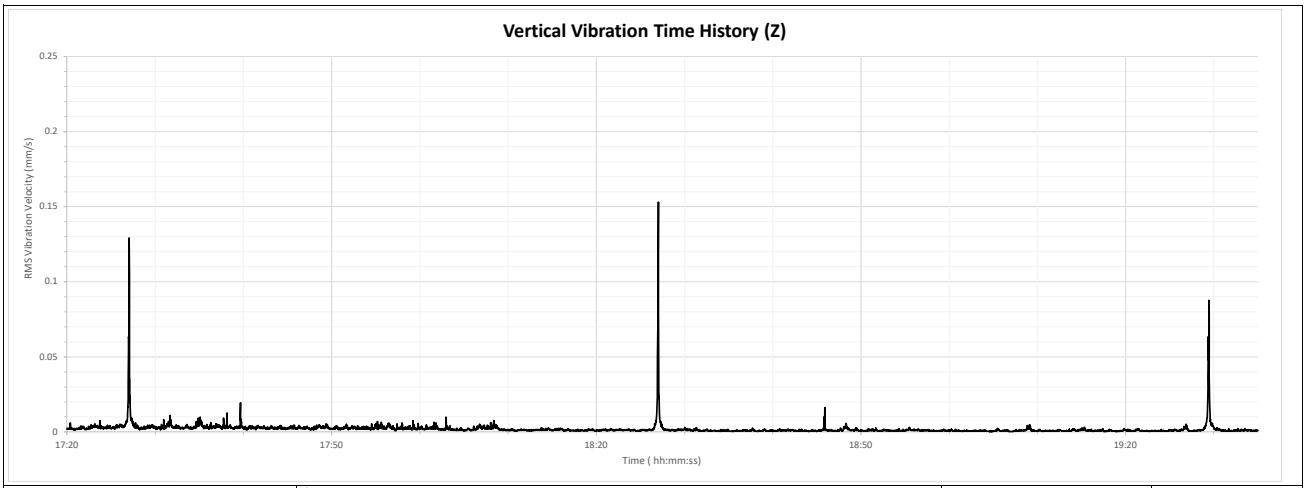
SITE PLAN

Project	120-0182
Date	July 16, 2020
Scale	N.T.S.
Figure	2

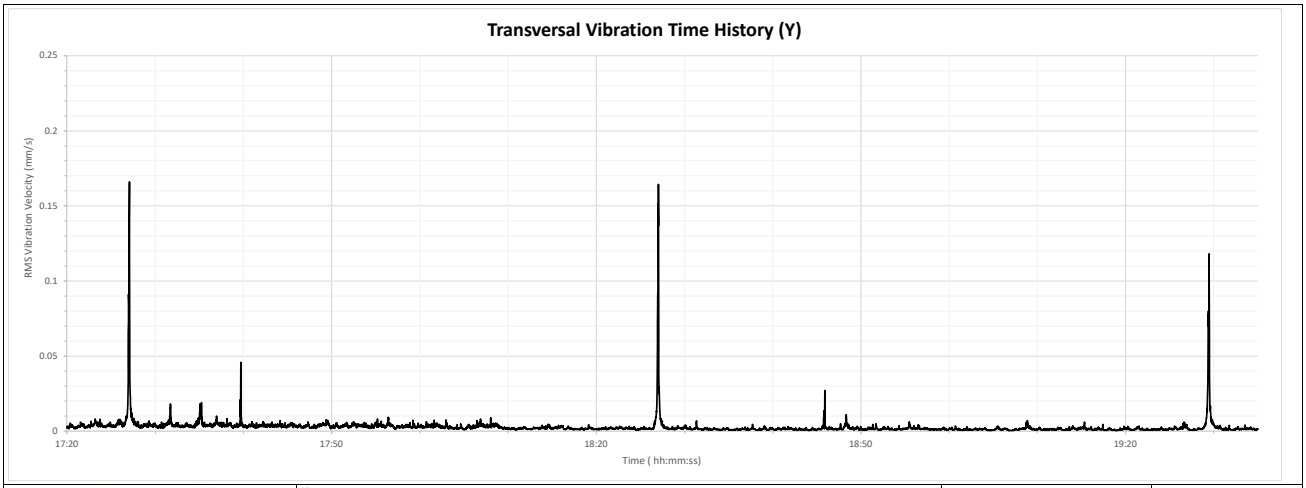
APPENDIX A

MEASURED VIBRATION VELOCITY TIME HISTORIES OF TRAIN PASS-BYS

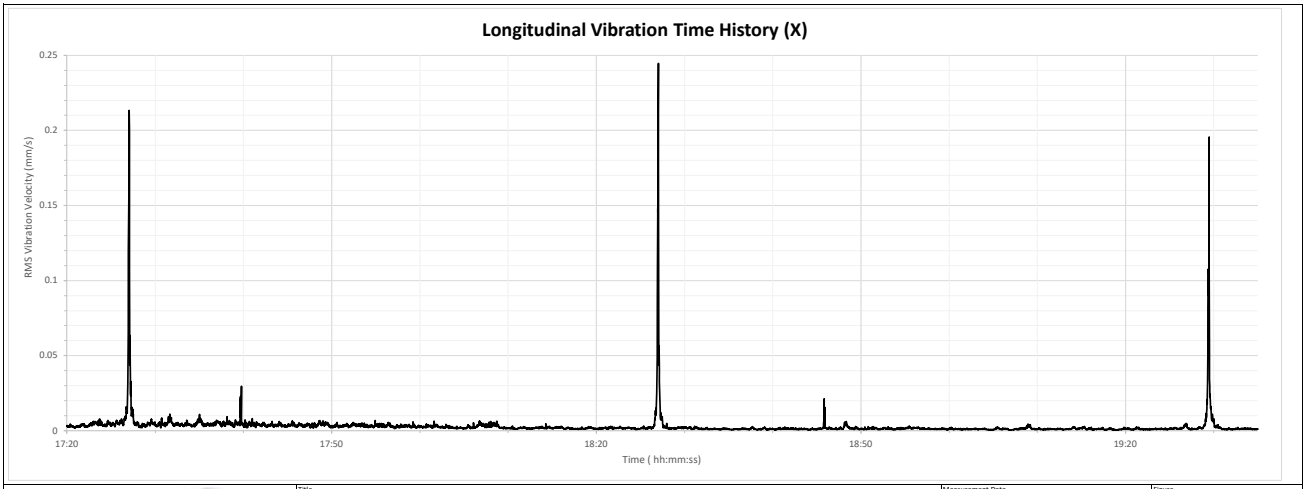
Railway Vibration Measurements



	Title	Measurement Date	Figure
VALCOUSTICS Canada Ltd.	Railway Vibration Measurements at Location A - Vertical (Z) Vibration Time History	May 12, 2020	A-1
	Project Name: 989 Yonge St, Barrie-Vibration	Project No.: 120-0182	



	Title	Measurement Date	Figure
VALCOUSTICS Canada Ltd.	Railway Vibration Measurements at Location A - Transversal (Y) Vibration Time History	May 12, 2020	A-2
	Project Name: 989 Yonge St, Barrie-Vibration	Project No.: 120-0182	



	Title	Measurement Date	Figure
VALCOUSTICS Canada Ltd.	Railway Vibration Measurements at Location A - Longitudinal (X) Vibration Time History	May 12, 2020	A-3
	Project Name: 989 Yonge St, Barrie-Vibration	Project No.: 120-0182	

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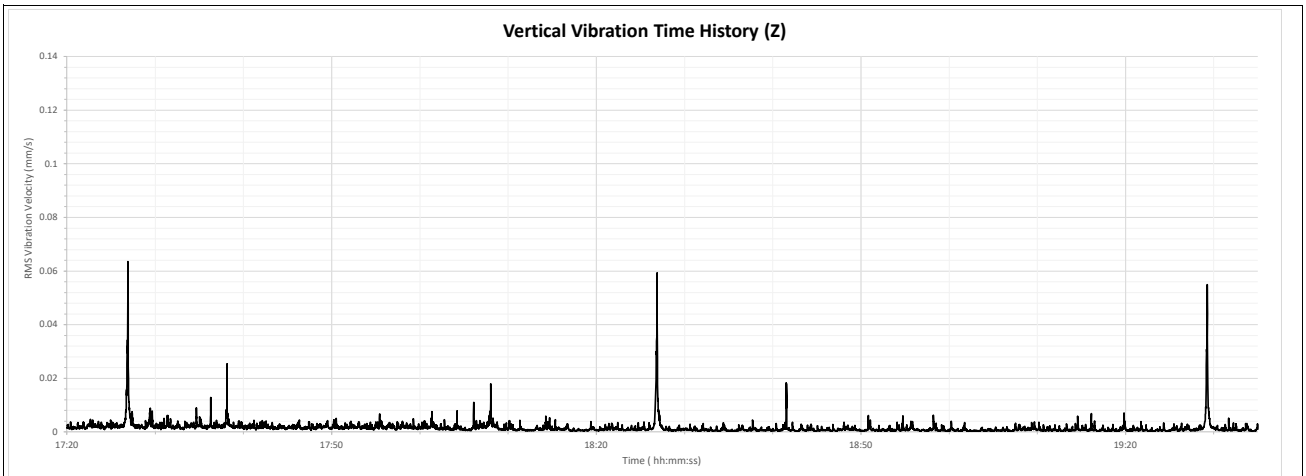
Railway Vibration Measurements



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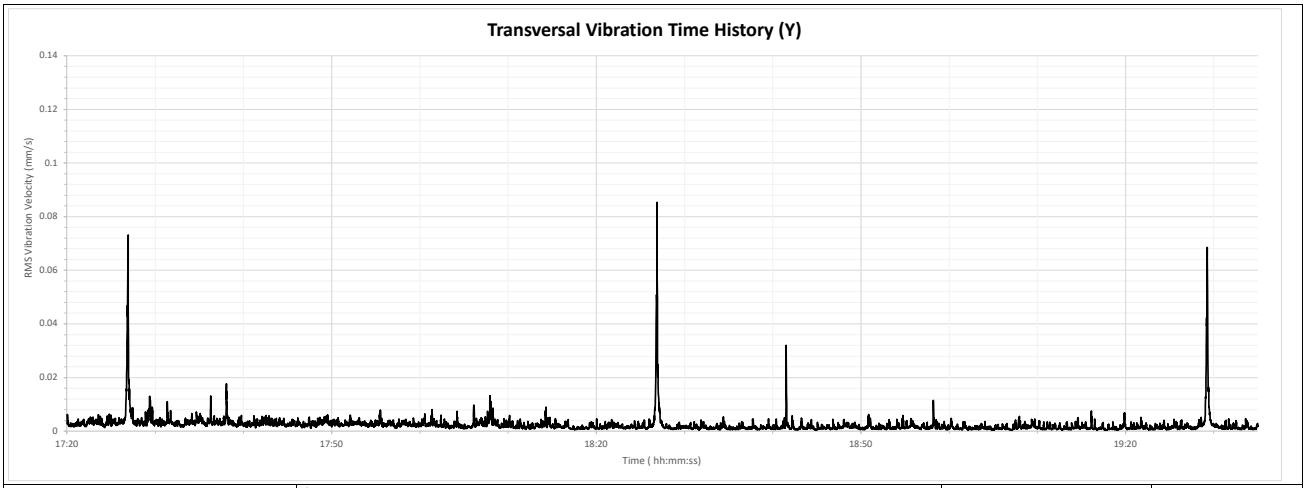
	Project Name: 989 Yonge St, Barrie-Vibration	Project No.: 120-0182	



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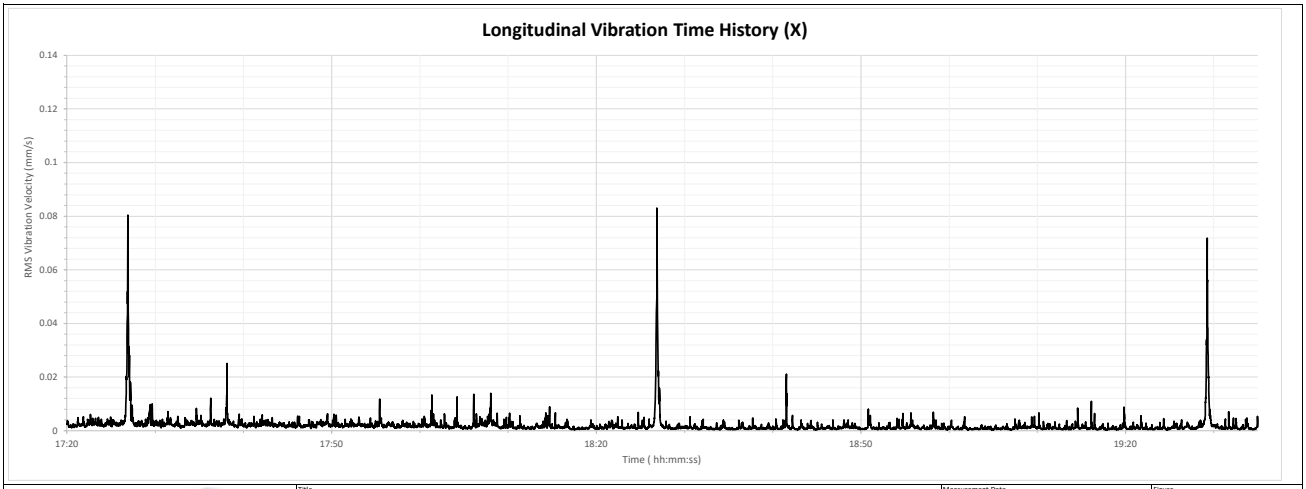
VALCOUSTICS Canada Ltd.	Railway Vibration Measurements at Location B - Transversal (Y) Vibration Time History	May 12, 2020	B-2
	Project Name: 989 Yonge St, Barrie-Vibration	Project No.: 120-0182	



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VALCOUSTICS Canada Ltd.	Railway Vibration Measurements at Location B - Longitudinal (X) Vibration Time History	May 12, 2020	B-3
	Project Name: 989 Yonge St, Barrie-Vibration	Project No.: 120-0182	

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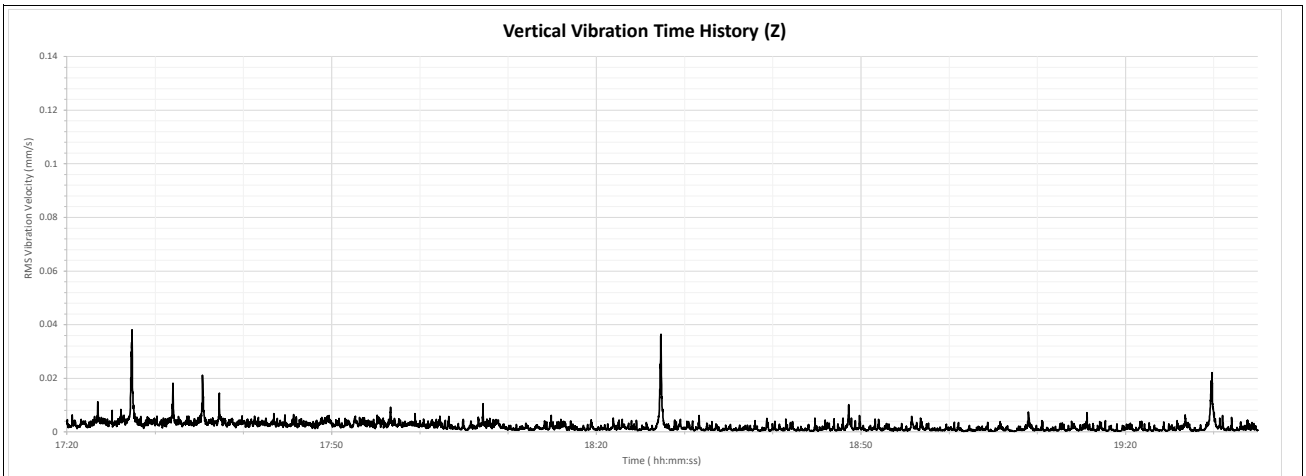
Railway Vibration Measurements



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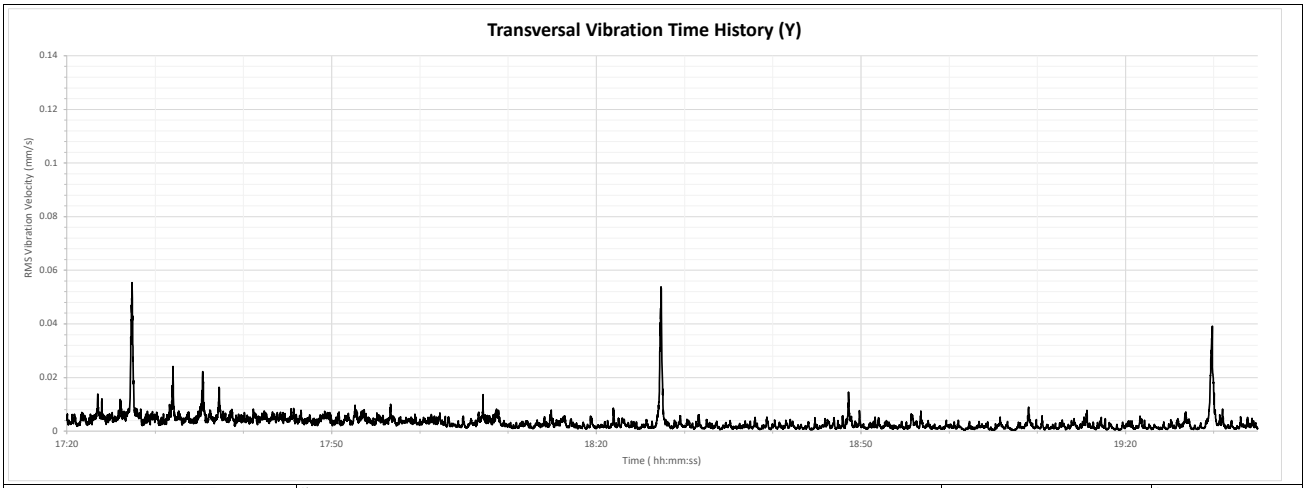
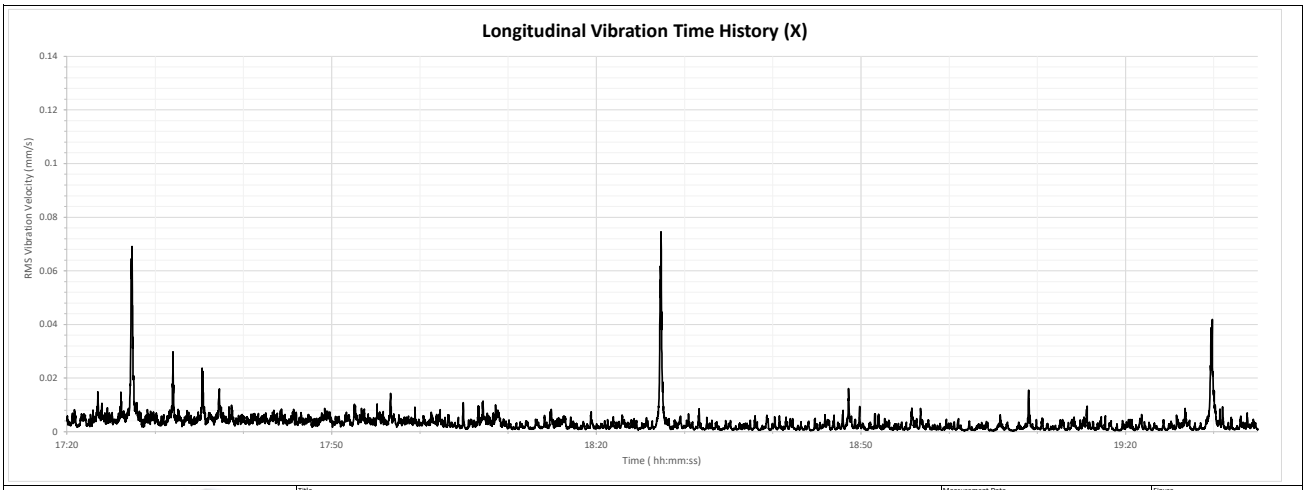
VALCOUSTICS Canada Ltd.	Railway Vibration Measurements at Location C - Vertical (Z) Vibration Time History	May 12, 2020	C-1
	Project Name: 989 Yonge St, Barrie-Vibration	Project No.: 120-0182	



	Title	Measurement Date	Figure
VALCOUSTICS Canada Ltd.	Railway Vibration Measurements at Location C - Transversal (Y) Vibration Time History	May 12, 2020	C-2
	Project Name: 989 Yonge St, Barrie-Vibration	Project No.: 120-0182	



	Title	Measurement Date	Figure
VALCOUSTICS Canada Ltd.	Railway Vibration Measurements at Location C - Longitudinal (X) Vibration Time History	May 12, 2020	C-3
	Project Name: 989 Yonge St, Barrie-Vibration	Project No.: 120-0182	

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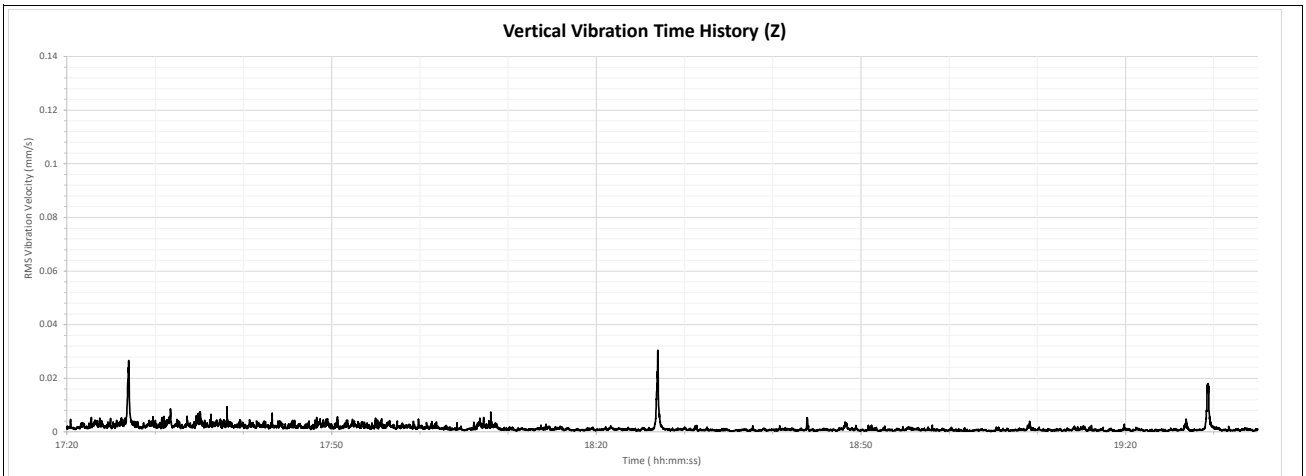
Railway Vibration Measurements



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VALCOUSTICS Canada Ltd.	Railway Vibration Measurements at Location D - Vertical (Z) Vibration Time History	May 12, 2020	D-1
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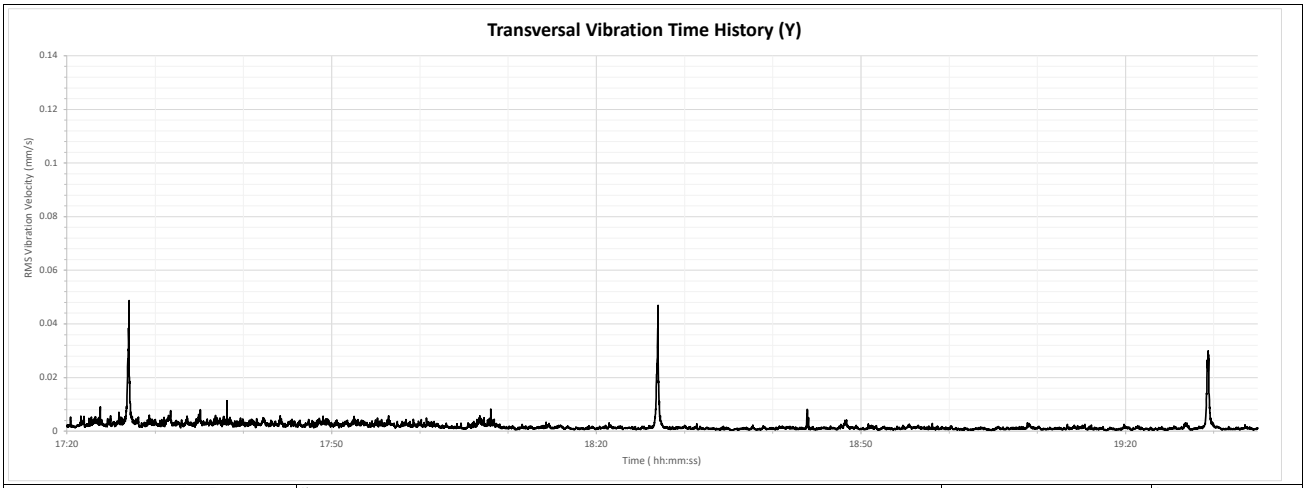

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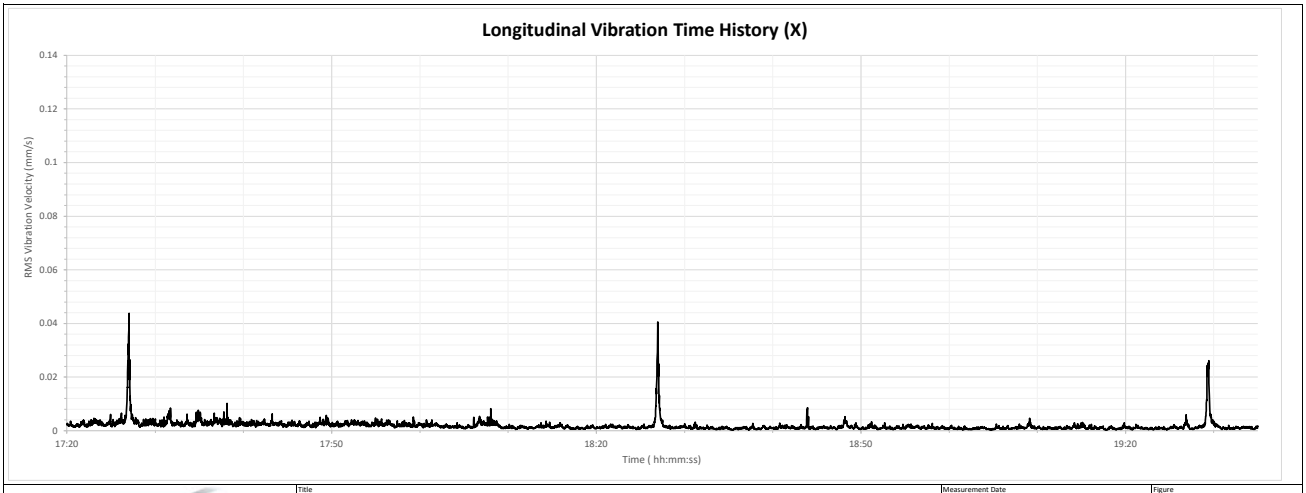
	Project Name: 989 Yonge St, Barrie-Vibration	Project No.: 120-0182	



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	Project Name: 989 Yonge St, Barrie-Vibration	Project No.: 120-0182	

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