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NOISE & VIBRATION IMPACT STUDY

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1.0 Introduction

At the request of Urban Solutions on behalf of Sam's Scrap Metal Ltd., Thornton Tomasetti (TT) has prepared a Noise and Vibration Impact Study for the proposed residential development located at 338 and 338-1/2 Cumberland Avenue, Hamilton, Ontario (the Project). It is our understanding that the proposed development consists of two 3-1/2 storey townhouse buildings, with a total of 13 units. We understand that the study is required by the City of Hamilton for a Zoning By-law Amendment (ZBA) application.

The objective of this study is to assess the noise and vibration impact on the proposed development from surrounding noise and vibration sources and the noise impact of the development on the surrounding noise-sensitive areas. Noise and vibration control recommendations are provided to meet the requirements of the City of Hamilton and CP Rail, using criteria developed by the Ontario Ministry of the Environment, Conservation and Parks (MECP) and CP Rail.

2.0 Project Site

The Project site is located on the south side of Cumberland Avenue, between Norway Avenue and Lorne Avenue. A CP Rail rail yard borders the site to the south. The Project site and the area directly to the west and east are currently zoned as Restricted Light Industrial. Further to the east is the Notre-Dame Elementary School. The area to the north along both sides of Cumberland Avenue is zoned as Residential and consists of one and two-storey dwellings. The Project buildings will be located to the south of the existing dwellings fronting on Cumberland Avenue, with access via a driveway at the existing 338 ½ Cumberland Avenue lot.

An aerial photo of the surrounding area is provided in Appendix A, Figure 1, and a Project site plan is provided in Figure 2. A zoning map of the area is provided in Appendix B.

3.0 Noise and Vibration Sources

A site visit was conducted on October 22, 2021, to identify significant noise sources that may impact the Project and to review the surrounding area. The major transportation noise sources that impact the site are rail traffic on the CP rail lines and road traffic on Cumberland Avenue. Noise impacts from transportation noise sources are discussed in Section 4.0.

The CP rail yard includes significant stationary noise sources that may impact the Project. Noise measurements were taken on site, and the noise impact from stationary noise sources are discussed in Section 5.0.

The CP rail line is a vibration source that may impact the Project. Vibration measurements were taken on site, and the results are discussed in Section 6.0.

4.0 Transportation Noise Sources

4.1 Sound Level Limits

Noise assessment criteria for environmental noise sources are given in the MECP publication NPC-300 "Environmental Noise Guideline, Stationary and Transportation Sources – Approval and Planning," dated August 2013, and the Railway Association of Canada and the Federation of Canadian Municipalities (RAC/FCM) "Guidelines for New Development in Proximity to Railway Operations," dated May 2013.

4.1.1 MECP Outdoor Sound Level Limits

The MECP outdoor sound level limit for combined road and rail traffic noise is 55 dBA during the daytime period only, as shown in Table 1. Train whistle noise is not included in the train sound level for outdoor receptors.

Table 1: MECP Outdoor Living Area (OLA) sound level limit for road and rail sources

Time Period	Sound Level ($L_{eq,\ 16\text{-}hour}$), Combined Road and Rail [dBA]
Daytime (07:00 - 23:00)	55

In addition to the above outdoor level, the MECP has a sliding scale to determine the need for outdoor noise reduction measures depending on outdoor sound levels, as shown in Table 2.

Table 2: MECP noise control requirements for outdoor receptors

Outdoor Sound Level (Daytime L_{eq}) [dBA]	Noise Control Measures
$55 < L_{eq} \leq 60$	Noise control measures may be implemented. If no noise control measures are planned, a Type A warning clause must be included in the unit title or lease agreement.
$L_{eq} > 60$	Noise control measures are required to reduce the L_{eq} to below 60 dBA and as close to 55 dBA as technically, economically, and administratively feasible. A Type B warning clause is required if resultant L_{eq} exceeds 55 dBA.

4.1.2 MECP Indoor Sound Level Limits

The MECP indoor sound level limits for rail sources are shown in Table 3.

Table 3: MECP indoor sound level limit for road and rail sources

Room Type	Time Period	Sound Level Limit, L_{eq} [dBA]	
		Road Sources	Rail Sources
Living/dining areas of residences	Daytime (07:00 - 23:00)	45	40
	Nighttime (23:00 - 07:00)	45	40
Sleeping quarters of residences	Daytime (07:00 - 23:00)	45	40
	Nighttime (23:00 - 07:00)	40	35

In addition to the above indoor levels, the MECP has a sliding scale to determine the need for noise reduction measures depending on the sound level at the plane of window. Ventilation and associated warning clause requirements are based on the combined road and rail noise sources, and are shown in Table 4. The rail noise level for ventilation requirements does not include train whistle noise.

Table 4: Ventilation and warning clause requirements

Assessment Location	L_{eq} (dBA), Road and Rail Sources (Excluding Whistle)	Ventilation Requirements	Warning Clause
Plane of Bedroom or Living Room Window, Daytime (07:00 – 23:00)	$55 < L_{eq} \leq 65$	Forced air heating with provision for central air conditioning	Type C Required
	$L_{eq} > 65$	Central air conditioning	Type D Required
Plane of Bedroom Window, Nighttime (23:00 – 07:00)	$50 < L_{eq} \leq 60$	Forced air heating with provision for central air conditioning	Type C Required
	$L_{eq} > 60$	Central air conditioning	Type D Required

Building component requirements are assessed for road and rail sources separately and are shown in Table 5. The rail noise level for building component requirements includes train whistle noise.

Table 5: Building component requirements for road and rail sources

Assessment Location	L_{eq} (dBA)		Building Component Requirements
	Road Sources	Rail Sources (including whistle)	
Plane of Bedroom or Living Room Window, Daytime (07:00 – 23:00)	$L_{eq} \leq 65$	$L_{eq} \leq 60$	Building components must be compliant with the Ontario Building Code (OBC).
	$L_{eq} > 65$	$L_{eq} > 60$	Building components must be designed to achieve indoor sound level criteria in Table 3.
Plane of Bedroom Window, Nighttime (23:00 – 07:00)	$L_{eq} \leq 60$	$L_{eq} \leq 55$	Building components must be compliant with the Ontario Building Code (OBC).
	$L_{eq} > 60$	$L_{eq} > 55$	Building components must be designed to achieve indoor sound level criteria in Table 3.

In addition to the requirements above, the MECP has additional requirements for the first row of dwellings within 100m of railway tracks. If the rail traffic L_{eq} (24-hour) at the location of a nighttime receptor for these dwellings is greater than 60 dBA, they are required to be built to a minimum of brick veneer or masonry equivalent construction.

4.1.3 RAC/FCM Noise Guidelines

The Railway Association of Canada and the Federation of Canadian Municipalities (RAC/FCM) recommended indoor and outdoor sound levels for rail noise are summarized in Table 6. These sound level limits agree with the MECP sound level limits (Table 1 and Table 3).

Table 6: RAC/FCM recommended noise criteria

Assessment Location	Equivalent Sound Level, L_{eq} (dBA)	
	Daytime (07:00 – 23:00)	Nighttime (23:00 – 07:00)
Bedrooms, Sleeping Quarters	40	35
Living Rooms	40	40
Outdoor Recreation Areas	55	N/A

The RAC/FRM guidelines also recommend a minimum berm, acoustical fence (barrier), and setback distance, depending on the railway classification. The recommended values for these mitigation measures for Principal Main Lines are given in Table 7. The acoustical fence should have a minimum surface density of 20 kg/m^2, with no openings in its surface.

Table 7: RAC/FCM recommended berm, acoustical fence, and setback requirements

Railway Classification	Minimum Berm Height	Minimum Combined Height of Acoustical Fence and Berm (Height Above Tracks)	Minimum Setback
Principal Main Line	2.5 m	5.5 m	30 m

Enforcement of these guidelines is at the discretion of CP Rail and the City, and other noise control measures may be considered based on an analysis of the noise.

CP Rail requirements for ground-borne vibration are discussed in Section 6.0.

4.2 Critical Noise Receptors

The critical noise receptors are the noise-sensitive areas of the proposed development that are affected by the noise sources. Points of Reception (PORs) at the plane-of-window of the highest level of the proposed buildings (referred to as Level 4) are set as the critical noise receptors. An Outdoor Living Area (OLA) is located on the south side of the buildings, in the rear yard area of the buildings. The locations of all critical noise receptors are summarized in Table 8 and shown in Appendix A, Figure 2.

Table 8: Critical noise receptor locations

Receptor ID	Floor	Receptor Location
POR1	4	South façade of the buildings, Level 4
POR2	4	East façade of the buildings, Level 4
POR3	4	West façade of the buildings, Level 4
POR4	4	North façade of the buildings, Level 4
OLA1	1	South side outdoor living area, ground level

4.3 Sound Levels

4.3.1 Road Traffic

The traffic volume on Cumberland Avenue was obtained from the City of Hamilton Transportation Data Management System. The data is attached in Appendix C and summarized in Table 9. The 2019 AADT on Cumberland Avenue, west of Gage Avenue South, is 5014. The traffic volume consists of 4% Business and Commercial (BC) vehicles. This 4% is assumed to consist of 50% "medium trucks" and 50% "heavy trucks." In addition, the following assumptions were made regarding the traffic volume:

- A typical daytime (07:00 – 23:00) to night-time (23:00 – 07:00) traffic split of 92%/8% was assumed.
- An annual growth rate of 2% was applied for 13 years to estimate the AADT for 2032 (10 years in the future).

Table 9: Road traffic data summary

Road	Speed Limit (km/h)	AADT (2019)	Annual Growth Rate (%)	Growth Period (years)	Future AADT (2032)	Medium Trucks (%)	Heavy Trucks (%)	Day/Night (%)
Cumberland Avenue	50	5014	2	13	6486	2	2	92 / 8

4.3.2 Rail Traffic

The main rail line at the Project location is classified by CP Rail as a Principal Main Line track. According to the CP guidelines, Principal Main Lines have the following characteristics:

- Volume generally exceeds 10 trains/day
- High speeds, frequently exceeding 80 kph
- Includes heavy trains with 3 or 4 locomotives/train
- Crossings, gradients, etc. may increase normal railway noise and vibration

Based on the information above, site visit observations of the train passbys and our understanding of the use of this rail line, the estimated train activity is summarized in Table 10. The total number of train passes per day was estimated as 20, which is double the minimum number specified by CP Rail for Principal Main Line tracks, and is greater than the number of train passes observed by TT on site. The daytime and nighttime percentages were assumed to be 80%/20%, which results in a maximum of 16 trains during the daytime and 4 trains during the nighttime. As per the RAC guidelines, an annual compounded growth rate of 2.5% over a period of 10 years is included for future traffic projections.

Table 10: Rail traffic data summary

Parameter	Value
Train type	Diesel Freight
Maximum trains per day (Day / Night), 2021	16 / 4
Annual growth rate	2.5%

Parameter	Value
Growth period (years)	11
Maximum trains per day (Day / Night), 2032	21.0 / 5.2
Locomotives per train	4
Cars per train	25
Maximum speed (km/hr)	80

Noise sources associated with the rail yard, including train switching, shunting, and idling, are assessed separately from train passbys. The rail yard is considered a stationary noise source and is discussed in Section 5.0.

4.3.3 Sound Level Calculations

Sound levels were calculated at each critical noise receptor using the software STAMSON 5.04, which was developed by the MECP for the assessment of road and rail noise. All trains were modeled as diesel trains. Train whistling noise was excluded, since there are no road crossings close to the site where whistling is expected to be used. Noise barriers from a crash wall or other obstructions are not included in the calculations, as a conservative measure. The elevation of the rail lines is approximately 1m higher than the site. This 1m source elevation is included in the model calculations.

The results are shown in Table 11 for indoor and outdoor receptors. The results for indoor receptors are given for daytime, nighttime, and 24-hour periods, as required by the MECP indoor sound level limits. Full calculation results for all receptors are attached in Appendix B.

Table 11: Calculated sound levels at critical noise receptors

Receptor ID	Daytime L_{eq} (dBA)	Nighttime L_{eq} (dBA)	24-Hour L_{eq} (dBA)
POR1	72	68	71
POR2	68	65	67
POR3	68	65	67
POR4	56	48	54
OLA1	71	N/A	N/A

4.4 Noise Control Measures for Traffic Noise

Noise control measures to meet the requirements of the MECP for the critical receptors are summarized in Table 12 and discussed in the subsequent sections.

Table 12: MECP noise control measures

Receptor	Location	Noise Barrier	Ventilation	Building Components	Warning Clause
POR1	South façade of the buildings, Level 4	N/A	Central air conditioning	Building components must be designed to achieve indoor sound level criteria in Table 3.	Type D
POR2	East façade of the buildings, Level 4	N/A	Central air conditioning	Building components must be designed to achieve indoor sound level criteria in Table 3.	Type D
POR3	West façade of the buildings, Level 4	N/A	Central air conditioning	Building components must be designed to achieve indoor sound level criteria in Table 3.	Type D
POR4	North façade of the buildings, Level 4	N/A	Forced-air heating	Building components must be compliant with the Ontario Building Code (OBC).	Type C
OLA1	South side outdoor living area, ground level	Yes	N/A	N/A	Type B

4.4.1 Outdoor Living Area

The calculated noise level at the outdoor living area (OLA1) is greater than 60 dBA. Therefore, based on the requirements of Table 2, noise control measures are required to reduce the noise level to below 60 dBA and as close to 55 dBA as technically, economically, and administratively feasible. A Type B warning clause is required if resultant noise level exceeds 55 dBA.

A minimum 4.0m high noise barrier is required along the south property line and part of the east and west property lines of the Project site to reduce the noise level to below 60 dBA. The location of this barrier is shown in Appendix A, Figure 3. The height of the barrier must be increased to 7.5m high to reduce the noise level to below 55 dBA, which may be unfeasible. If the barrier is between 4.0m and 7.5m, a Type B warning clause is required (see Section 4.4.4). Noise barriers should have a minimum surface density of 20 kg/m^2 and the barriers should have no gaps or holes on the surface throughout the span of the barrier. A crash wall or earth berm may make up part or all of this barrier, provided that it meets these specifications.

4.4.2 Ventilation

For point of reception POR1, POR2, and POR3, the daytime noise level exceeds 65 dBA and/or the nighttime noise level exceeds 60 dBA. Therefore, central air conditioning is required for all dwelling units, based on the requirements of Table 4. A Type D warning clause is also required (see Section 4.4.4).

4.4.3 Building Components

For point of reception POR1, POR2, and POR3, the daytime rail noise level exceeds 60 dBA and the nighttime rail noise level exceeds 55 dBA. Therefore, the requirements of Table 5 specify that building

components for the south, west, and east façades of all dwelling units must be designed to achieve the indoor sound level criteria found in Table 3.

For point of reception POR4, the daytime road noise level is less than 65 dBA and the nighttime road noise level is less than 60 dBA. Therefore, building components that meet minimum OBC requirements are sufficient for the north façade of all dwelling units.

Because building floor plans are not available, the Sound Transmission Class (STC) requirements for the building components were determined based on assumed component areas. It is assumed that a noise-sensitive room (bedroom or living/dining room) is located at each POR location. The maximum surface area of exterior wall, fixed glazing, and operable glazing for each noise-sensitive room is assumed to be 80%, 40%, and 20% of the floor area of the room. The minimum STC requirement for glazing and exterior wall components are provided in Table 13.

Table 13: Building envelope STC requirements to meet MECP indoor noise limits

Component	Maximum Component Area Percentage Versus Floor Area of Room	Minimum STC Required
POR1 – South-facing rooms		
Exterior Wall	80%	46
Fixed Glazing	40%	42
Operable Glazing	20%	39
POR2 – East-facing rooms		
Exterior Wall	80%	43
Fixed Glazing	40%	39
Operable Glazing	20%	36
POR3 – West-facing rooms		
Exterior Wall	80%	43
Fixed Glazing	40%	39
Operable Glazing	20%	36

Typical minimum constructions to meet the STC requirements for exterior wall construction and glazing are given below.

Exterior Wall Construction

The highest required STC rating for the exterior walls is STC 46, for the south-facing dwelling units (POR1). The rail traffic L_{eq} (24-hour) on the south, east, and west façades are greater than 60 dBA, so they are required to be built to a minimum of brick veneer or masonry equivalent construction.

Any brick veneer or masonry wall construction which meets the STC requirements in Table 13 will be acceptable for the south, east, and west walls. An example of a wall construction which meets this requirement is below:

- 12.7 mm gypsum board
- Vapour barrier
- 38 x 89 mm studs

- 50 mm (or thicker) mineral wool or glass fibre batts
- Sheathing
- 25 mm air space
- 100 mm brick veneer

The north façade is shielded from the railway tracks. Exterior wall assemblies that meet OBC criteria can achieve the required indoor sound level.

Glazing

The highest required STC rating for the glazing is STC 42, for the south-facing rooms (POR1). Table 14 provides glazing recommendations which are expected to meet this requirement, and the requirements for the other PORs. The glazing requirements are presented in the form "*x* (*y*) *zL*" to denote "*x* mm glass (*y* mm airspace) *z* mm laminated glass."

Table 14: Glazing requirements to meet MECP indoor noise limits

Receptor	Location	Glazing Requirement
POR1	South-facing rooms	6 (13) 11L
POR2	East-facing rooms	6 (13) 7L
POR3	West-facing rooms	6 (13) 7L

The above constructions are provided for reference only – STC requirements should be verified with the glazing manufacturer. Any constructions with equivalent or greater STC values will be acceptable. For the north-facing exterior wall and glazing, building components meeting minimum OBC requirements will be suitable. Differences in window sizes and unit layouts from what is assumed in this report will change these requirements. Specifically, reduced window sizes will reduce the window requirements.

4.4.4 Warning Clauses for Traffic Noise

If the noise barrier for the outdoor living area to the south of the buildings is between 4.0m and 7.5m high, the following Type B warning clause is required for all dwelling units with access to this outdoor living area:

> "Purchasers/tenants are advised that despite the inclusion of noise control features in the development and within the building units, sound levels due to increasing rail traffic may on occasions interfere with some activities of the dwelling occupants as the sound levels exceed the sound level limits of the Municipality and the Ministry of the Environment, Conservation and Parks."

Since central air conditioning is required for all dwelling units, the following Type D warning clause is required for all dwellings:

> "This dwelling unit has been supplied with a central air conditioning system which will allow windows to remain closed, thereby ensuring that the indoor sound levels are within the sound level limits of the Municipality and the Ministry of the Environment, Conservation and Parks."

5.0 Stationary Noise Sources

5.1 Noise Criteria for Stationary Noise Sources

The guidelines for assessing the noise impact of noise-generating facilities on proposed noise-sensitive areas in Ontario are given in Part C of the MECP publication NPC-300 "Environmental Noise Guideline, Stationary and Transportation Sources – Approval and Planning," dated 2013. The Project site is considered a Class 1 Area (urban environment). The exclusionary limits for stationary sources in a Class 1 Area are given in Table 15. The site-specific noise criteria for each time of day are either the value in Table 15 or the minimum hourly background noise level ($L_{EQ[1hr]}$), whichever is higher. The minimum hourly background noise levels on site are expected to be lower than the MECP exclusionary noise level criteria for all time periods.

Table 15: MECP exclusionary noise level criteria for stationary noise sources (steady noise sources)

Time Period	Class 1 Area	
	Plane of Window Point of Reception $L_{EQ\ [1hr]}$ (dBA)	Outdoor Point of Reception $L_{EQ\ [1hr]}$ (dBA)
Day-time (07:00 – 19:00)	50	50
Evening (19:00 – 23:00)	50	50
Night-time (23:00 – 07:00)	45	-

The site-specific sound level limits for stationary sources at the critical receptors are given in Table 16. The locations of these receptors are shown in Figure 2.

Table 16: Site-specific sound level limits for stationary noise sources (steady noise sources)

Receptor	Receptor Location	Time Period	Stationary Source Sound Level Limit, $L_{eq\text{-}1hr}$ (dBA)
R1	South façade of the buildings, Level 2-4	Day-time (07:00-19:00)	50
		Evening (19:00-23:00)	50
		Night-time (23:00-07:00)	45
R2	East façade of the buildings, Level 2-4	Day-time (07:00-19:00)	50
		Evening (19:00-23:00)	50
		Night-time (23:00-07:00)	45
R3	West façade of the buildings, Level 2-4	Day-time (07:00-19:00)	50
		Evening (19:00-23:00)	50
		Night-time (23:00-07:00)	45
OR1	South side outdoor living area, ground level	Day-time (07:00-19:00)	50
		Evening (19:00-23:00)	50

Impulsive noise sources are assessed separately from steady noise sources. The exclusion limit values for impulsive noise sources are given in Table 17.

Table 17: Exclusion limit values for impulsive noise sources (L_{LM}, dBAI)

Number of Impulses in One-Hour Period	Class 1 Area		
	Plane of Window Points of Reception		Outdoor Points of Reception
	Daytime/Evening, 07:00-23:00	Nighttime, 23:00-07:00	Daytime/Evening, 07:00-23:00
9 or more	50	45	50
7 to 8	55	50	55
5 to 6	**60**	55	**60**
4	65	**60**	65
3	70	65	70
2	75	70	75
1	80	75	80

5.2 Existing Stationary Noise Sources

TT conducted a site visit on October 22, 2021. Noise from the CP Rail yard was identified as a significant stationary noise source, and measurements of this noise were taken from the Project site. Based on information provided by CP Rail and TT's observations on site, noise from the rail yard includes switching and shunting of trains, material storage and delivery, and train idling. Train switching and shunting is considered an impulsive noise source, while train idling is a steady noise source. Based on information provided by CP Rail, train activity at the rail yard may occur 24 hours per day.

Nine CP Rail freight trains were observed on site during a 7-hour period from 09:00 to 16:00 on October 22, 2021. Six of the nine were observed during the worst-case hour between 11:00 and 12:00. Noise measurements were taken at the southeast corner of the site, at the location shown in Figure 4, for all trains except for Train #1.

For all trains which produced significant impulsive noise, the maximum measured impulsive noise is shown in Table 18. The sound power level of each of these impulses was calculated using the distance from the source to the measurement location. The average sound power level of the impulsive noise (112 dBAI) was used to assess the impact of the impulsive noise on the Project.

Based on TT's observations on site, rail yard activity from a maximum of 6 trains is expected during the worst-case daytime or evening hour, with approximately one significant impulse from each train. It is expected that the activity at the rail yard will be relatively lower at night. Therefore, a maximum of 4 impulses are expected during the worst-case nighttime hour. Based on the number of impulses and the exclusion limit values in Table 17, the noise limit for impulsive noise sources is 60 dBAI at all points of reception and all time periods.

Table 18: Maximum impulsive noise measurements from train activity

Train #	Time	Track	Train Loco-motives	Train Cars	Number of Passes (Direction)	Maximum Impulsive Noise Level (dBAI)	Distance from Impulsive Noise Source (m)	Sound Power Level of Impulsive Noise (dBAI)
1	09:00 – 09:15	North	3	24	2 (Westbound, Eastbound)	-[1]	-[1]	-[1]
2	11:03 – 11:07	North	3	20	1 (Westbound)	81	15	112
3	11:19	South	?	?	1 (Eastbound)	75	35	114
4	11:22	North	3	0	1 (Eastbound)	No Impulse	N/A	N/A
5	11:29 – 11:31	North	3	15	1 (Westbound	78	15	110
6	11:43 – 11:46	South	?	?	1 (Eastbound)	71	35	110
7	11:54 – 11:57	North	3	0	3 (Eastbound, Westbound, Eastbound)	81	15	113
8	13:00 – 13:02	North	?	3	2 (Westbound, Eastbound)	84	15	116
9	13:27 – 13:30	South	?	?	1 (Eastbound)	No Impulse	N/A	N/A
Average Sound Power Level of Impulsive Noise (dBAI)								112

[1]No noise measurements were taken of Train #1.

During TT's site visit, only one train (Train #7) idled next to the Project site, for a duration of less than one minute. However, based on the information provided by CP Rail, it is assumed that the worst-case daytime or evening periods consist of one train idling adjacent to the Project site for a full hour. Train idling is not expected during the nighttime period. Train idling is assessed as a steady stationary noise source, using the noise limits in Table 16.

TT's measurement of train idling and the corresponding sound power level is shown in Table 19.

Table 19: Train idling noise measurement

Train #	Time	Track	Train Locomotives	Train Cars	Train Idling Noise Level (dBA)	Distance from Train Idling Noise Source (m)	Sound Power Level of Train Idling Noise (dBA)
7	11:56	North	3	24	69	15	100

Noise from train passes is considered a transportation noise source and is assessed separately from the rail yard noise sources (see Section 4.0). Train passes include trains which pass through the rail yard without any switching, shunting, or idling.

5.3 Predicted Unmitigated Sound Levels

Sound levels at the PORs due to the steady and impulsive noise sources were calculated using the software CadnaA. The noise source was positioned on the middle railway track in the rail yard, directly adjacent to R1 and OR1, 23m south of the south façade of the Project buildings. Each indoor receptor was assessed at heights of 3m, 6m, and 9m, which are the approximate heights of the plane-of-window of the 2nd, 3rd, and 4th floors, and indicated with the a, b, and c suffixes, respectively. The results are shown in Table 20 for steady noise sources and Table 21 for impulsive noise sources. Full results are attached in Appendix E.

Table 20: Predicted sound levels at the receptors due to steady stationary noise sources – no mitigation

Receptor	Receptor Height (m)	Time Period	Predicted Sound Level due to Steady Noise Sources (dBA)	Steady Noise Source Sound Level Limit (dBA)	Compliance
R1a	3	Daytime/Evening (07:00-23:00)	62	50	No
R1b	6	Daytime/Evening (07:00-23:00)	62	50	No
R1c	9	Daytime/Evening (07:00-23:00)	61	50	No
R2a	3	Daytime/Evening (07:00-23:00)	53	50	No
R2b	6	Daytime/Evening (07:00-23:00)	53	50	No
R2c	9	Daytime/Evening (07:00-23:00)	46	50	Yes
R3a	3	Daytime/Evening (07:00-23:00)	46	50	Yes
R3b	6	Daytime/Evening (07:00-23:00)	46	50	Yes
R3c	9	Daytime/Evening (07:00-23:00)	46	50	Yes
OR1	1.5	Daytime/Evening (07:00-23:00)	65	50	No

Table 21: Predicted sound levels at the receptors due to impulsive stationary noise sources – no mitigation

Receptor	Receptor Height (m)	Time Period	Predicted Sound Level due to Impulsive Noise Sources (dBAI)	Impulsive Noise Source Sound Level Limit (dBAI)	Compliance
R1a	3	Daytime/Evening (07:00-23:00)	74	60	No
		Nighttime (23:00-07:00)	74	60	No
R1b	6	Daytime/Evening (07:00-23:00)	74	60	No
		Nighttime (23:00-07:00)	74	60	No
R1c	9	Daytime/Evening (07:00-23:00)	74	60	No
		Nighttime (23:00-07:00)	74	60	No
R2a	3	Daytime/Evening (07:00-23:00)	65	60	No
		Nighttime (23:00-07:00)	65	60	No
R2b	6	Daytime/Evening (07:00-23:00)	65	60	No
		Nighttime (23:00-07:00)	65	60	No
R2c	9	Daytime/Evening (07:00-23:00)	51	60	Yes
		Nighttime (23:00-07:00)	51	60	Yes
R3a	3	Daytime/Evening (07:00-23:00)	52	60	Yes
		Nighttime (23:00-07:00)	52	60	Yes
R3b	6	Daytime/Evening (07:00-23:00)	52	60	Yes
		Nighttime (23:00-07:00)	52	60	Yes
R3c	9	Daytime/Evening (07:00-23:00)	52	60	Yes
		Nighttime (23:00-07:00)	52	60	Yes

Receptor	Receptor Height (m)	Time Period	Predicted Sound Level due to Impulsive Noise Sources (dBAI)	Impulsive Noise Source Sound Level Limit (dBAI)	Compliance
OR1	1.5	Daytime/Evening (07:00-23:00)	77	60	No

The calculated sound levels at R1a/b/c, R2a/b, and OR1 exceed the steady and impulsive noise limits. Therefore, noise mitigation is required to reduce the impact of the stationary noise sources.

5.4 Noise Mitigation Requirements

The impact of the impulsive noise can be reduced at some receptors by providing a noise barrier along the south property line of the Project (as shown in Figure 3). In order to be effective, the height of the barrier needs to be approximately the same height or higher than the receptors, to block the line of sight from the receptors to the impulsive noise sources.

As shown in Table 7, the RAC/FCM guidelines recommend a barrier height of 5.5m above the railway tracks for Principal Main Line tracks. Because the tracks are elevated approximately 1m above the Project site, this is equivalent to a 6.5m high noise barrier from the Project grade. The impact of a 6.5m high noise barrier is assessed below. The resultant noise levels at the receptors are shown in Table 22 for steady noise sources and Table 23 for impulsive noise sources.

Table 22: Predicted sound levels at the receptors due to steady stationary noise sources – 6.5m Barrier

Receptor	Receptor Height (m)	Time Period	Predicted Sound Level due to Steady Noise Sources (dBA)	Steady Noise Source Sound Level Limit (dBA)	Compliance
R1a	3	Daytime/Evening (07:00-23:00)	48	50	Yes
R1b	6	Daytime/Evening (07:00-23:00)	52	50	No
R1c	9	Daytime/Evening (07:00-23:00)	56	50	No
R2a	3	Daytime/Evening (07:00-23:00)	44	50	Yes
R2b	6	Daytime/Evening (07:00-23:00)	46	50	Yes
R2c	9	Daytime/Evening (07:00-23:00)	46	50	Yes
R3a	3	Daytime/Evening (07:00-23:00)	40	50	Yes
R3b	6	Daytime/Evening (07:00-23:00)	40	50	Yes
R3c	9	Daytime/Evening (07:00-23:00)	46	50	Yes

Receptor	Receptor Height (m)	Time Period	Predicted Sound Level due to Steady Noise Sources (dBA)	Steady Noise Source Sound Level Limit (dBA)	Compliance
OR1	1.5	Daytime/Evening (07:00-23:00)	50	50	Yes

Table 23: Predicted sound levels at the receptors due to impulsive stationary noise sources – 6.5m Barrier

Receptor	Receptor Height (m)	Time Period	Predicted Sound Level due to Impulsive Noise Sources (dBAI)	Impulsive Noise Source Sound Level Limit (dBAI)	Compliance
R1a	3	Daytime/Evening (07:00-23:00)	56	60	Yes
		Nighttime (23:00-07:00)	56	60	Yes
R1b	6	Daytime/Evening (07:00-23:00)	60	60	Yes
		Nighttime (23:00-07:00)	60	60	Yes
R1c	9	Daytime/Evening (07:00-23:00)	68	60	No
		Nighttime (23:00-07:00)	68	60	No
R2a	3	Daytime/Evening (07:00-23:00)	50	60	Yes
		Nighttime (23:00-07:00)	50	60	Yes
R2b	6	Daytime/Evening (07:00-23:00)	54	60	Yes
		Nighttime (23:00-07:00)	54	60	Yes
R2c	9	Daytime/Evening (07:00-23:00)	51	60	Yes
		Nighttime (23:00-07:00)	51	60	Yes
R3a	3	Daytime/Evening (07:00-23:00)	45	60	Yes
		Nighttime (23:00-07:00)	45	60	Yes
R3b	6	Daytime/Evening (07:00-23:00)	45	60	Yes

Receptor	Receptor Height (m)	Time Period	Predicted Sound Level due to Impulsive Noise Sources (dBAI)	Impulsive Noise Source Sound Level Limit (dBAI)	Compliance
		Nighttime (23:00-07:00)	45	60	Yes
R3c	9	Daytime/Evening (07:00-23:00)	50	60	Yes
		Nighttime (23:00-07:00)	50	60	Yes
OR1	1.5	Daytime/Evening (07:00-23:00)	58	60	Yes

The calculated sound levels exceed the steady noise limits at R1b/c and the impulsive noise limits at R1c with a 6.5m high noise barrier. Therefore, in order to meet the MECP noise guidelines, we recommend that the south side of the 3rd and 4th stories do not contain any windows to noise-sensitive spaces. Noise-sensitive spaces include living and sleeping quarters of dwellings, including bedrooms, living/dining rooms, kitchens, and dens. If noise-sensitive spaces are located on the south side of the 3rd or 4th stories, they must not have any south-facing operable windows. The noise-sensitive spaces on the 3rd or 4th stories may have east or west-facing operable windows at the ends of the buildings. Spaces which are not noise sensitive, such as washrooms, corridors, mechanical/electrical rooms, closets, etc. may contain south-facing operable windows.

Because the unmitigated noise levels from the rail yard stationary noise sources exceeds the MECP noise limits at the noise receptors, a Type E warning clause should be provided with the purchase/lease agreement for all dwelling units (see Section 5.5).

The recommended noise mitigation measures are summarized below:

- Provide a 6.5m high noise barrier (5.5m above the railway tracks) along the south property line and part of the west and east property lines, as shown in Figure 3.
- Do not include any south-facing operable windows for noise-sensitive spaces on the 3rd and 4th stories of the Project buildings.
- Provide a Type E warning clause (see Section 5.5) with the purchase/lease agreement for all dwelling units.

5.5 Warning Clause for Stationary Noise Sources

Because the unmitigated noise levels from the rail yard stationary noise sources exceeds the MECP noise limits at the noise receptors, the following Type E warning clause is required for all dwelling units:

> "Purchasers/tenants are advised that due to the proximity of the adjacent CP Rail rail yard, noise from the rail yard may at times be audible."

5.6 Future Stationary Noise Sources

There are no known future potential stationary noise sources associated with the Project or other developments in the vicinity of the Project.

6.0 Ground-Borne Vibration Impact

6.1 Vibration Criteria

Currently, there are no guidelines for the impact of railway vibration in the land use approval process in Ontario. However, in May 2013, the Federation of Canadian Municipalities (FCM) and the Railway Association of Canada (RAC) issued "Guidelines for New Development in Proximity to Railway Operations" to address developments in close proximity to railway operations. The FCM/RAC guidelines identify dwellings within 75 meters from railways alignments as susceptible to vibration impact and recommend an overall maximum vibration limit of 0.14 mm/s root-mean-square (RMS). The limit should be based on a one-second averaging time between 4 Hz and 200 Hz. Mitigation is prescribed when this limit is exceeded.

It is our understanding that CP Rail has adopted the use of this guideline and the criterion for train vibration on the proposed development is an overall vertical vibration level of 0.14 mm/s (RMS) between 4 Hz and 200 Hz.

6.2 Vibration Measurement Locations and Instrumentation

Rail vibration measurements were taken on October 22, 2021, at two locations on the Project site. The first location was at the southwest corner of the site, and the second location was at the southeast corner of the site. Both locations were at the closest point of the proposed buildings to the rail lines. The measurement locations are shown in Appendix A, Figure 4. Vibration measurements were taken using two Bruel & Kjaer Type 4450 vibration monitoring terminals, connected to Type 8380 tri-axial geophones.

6.3 Vibration Measurement Results

Nine measurements of CP Rail freight trains were recorded during a 7-hour period from 09:00 to 16:00 on October 22, 2021. Several of these trains passed the site more than once during a short duration. Most of the measured train passes were on the northernmost track, which is closest to the Project site and is expected to produce the highest vibration levels at the site compared to the other tracks. The maximum number of locomotives and train cars from the measured trains was 3 and 24, respectively, which agrees with the estimated number of locomotives and rail cars used in the transportation noise assessment (see Table 10). The trains on the south tracks were partially shielded from view from the site, so the number of locomotives and train cars could not be counted. The maximum speed of the trains was approximately 30 km/hr, which is much lower than the maximum speed of 80 km/hr for Principal Main Lines (Table 10). The maximum recorded vertical vibration velocity for each train pass is presented in Appendix F and summarized in Table 24. All ground vibration levels due to train passbys were found to be below the CP vibration limits at both measurement locations.

Table 24: Maximum measured vibration velocity from train passes

Train #	Time	Track	Train Loco-motives	Train Cars	Number of Passes (Direction)	Max RMS Velocity (mm/s)	
						Location #1: SW Corner	Location #2: SE Corner
1	09:00 – 09:15	North	3	24	2 (Westbound, Eastbound)	0.106	-
2	11:03 – 11:07	North	3	20	1 (Westbound)	0.060	0.062
3	11:19	South	?	?	1 (Eastbound)	0.006	0.005
4	11:22	North	3	0	1 (Eastbound)	0.094	0.074
5	11:29 – 11:31	North	3	15	1 (Westbound	0.067	0.062
6	11:43 – 11:46	South	?	?	1 (Eastbound)	0.005	0.003
7	11:54 – 11:57	North	3	0	3 (Eastbound, Westbound, Eastbound)	0.092	0.068
8	13:00 – 13:02	North	?	3	2 (Westbound, Eastbound)	0.003	0.014
9	13:27 – 13:30	South	?	?	1 (Eastbound)	0.020	0.025

7.0 Concluding Comments

With the incorporation of the noise control measures as presented in Section 4.4 and Section 5.4 of this report, the noise impact of the transportation noise sources and stationary noise sources on the Project will meet MECP criteria. Vibration due to train passbys is not expected to be a concern at the Project site.

Achieving the required noise control requirements relies on correct incorporation of noise control recommendations into Architectural and Mechanical drawings and specifications, as well as correct installation during construction. On request, TT will conduct drawing reviews and onsite reviews of noise control measures and provide observations as appropriate; however, notwithstanding the foregoing, it is expressly understood and agreed that TT shall not have control or charge of, and shall not be responsible for the acts or omissions, including but not limited to means, methods, techniques, sequences and procedures, of the Design Professionals and/or Contractors performing design and/or construction on the Project. Accordingly, TT shall not be held responsible for the failure of any party to properly incorporate the noise control measures stated in this report.

Please do not hesitate to contact us if there are any questions.

Yours Truly,

Thornton Tomasetti

Paul Vanoostveen, P.Eng.
Engineer

Appendix A: Figures

Figure 1: Aerial view of the area surrounding the Project

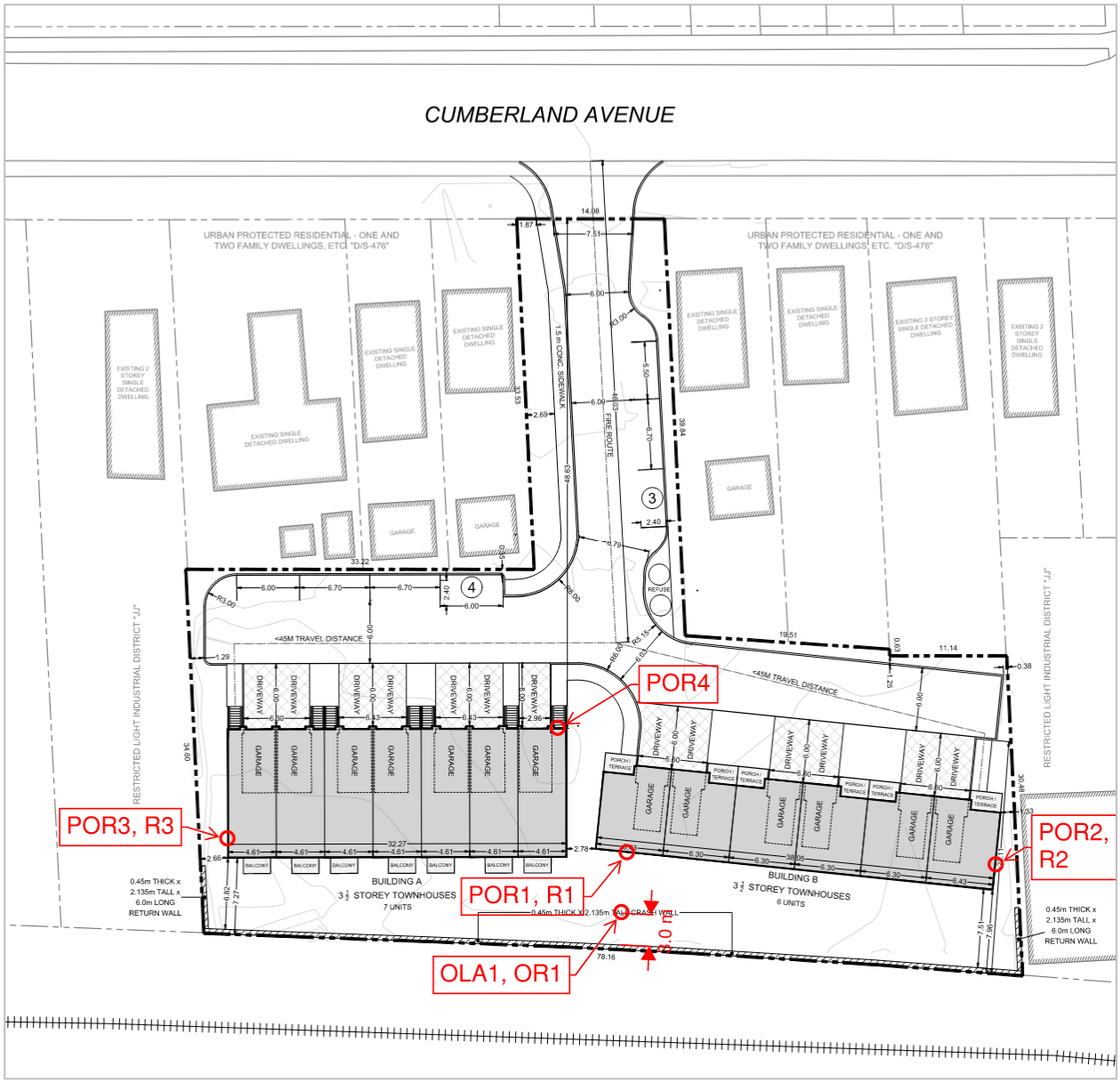


Figure 2: Point of Reception (POR, R) and Outdoor Living Area (OLA, OR) locations

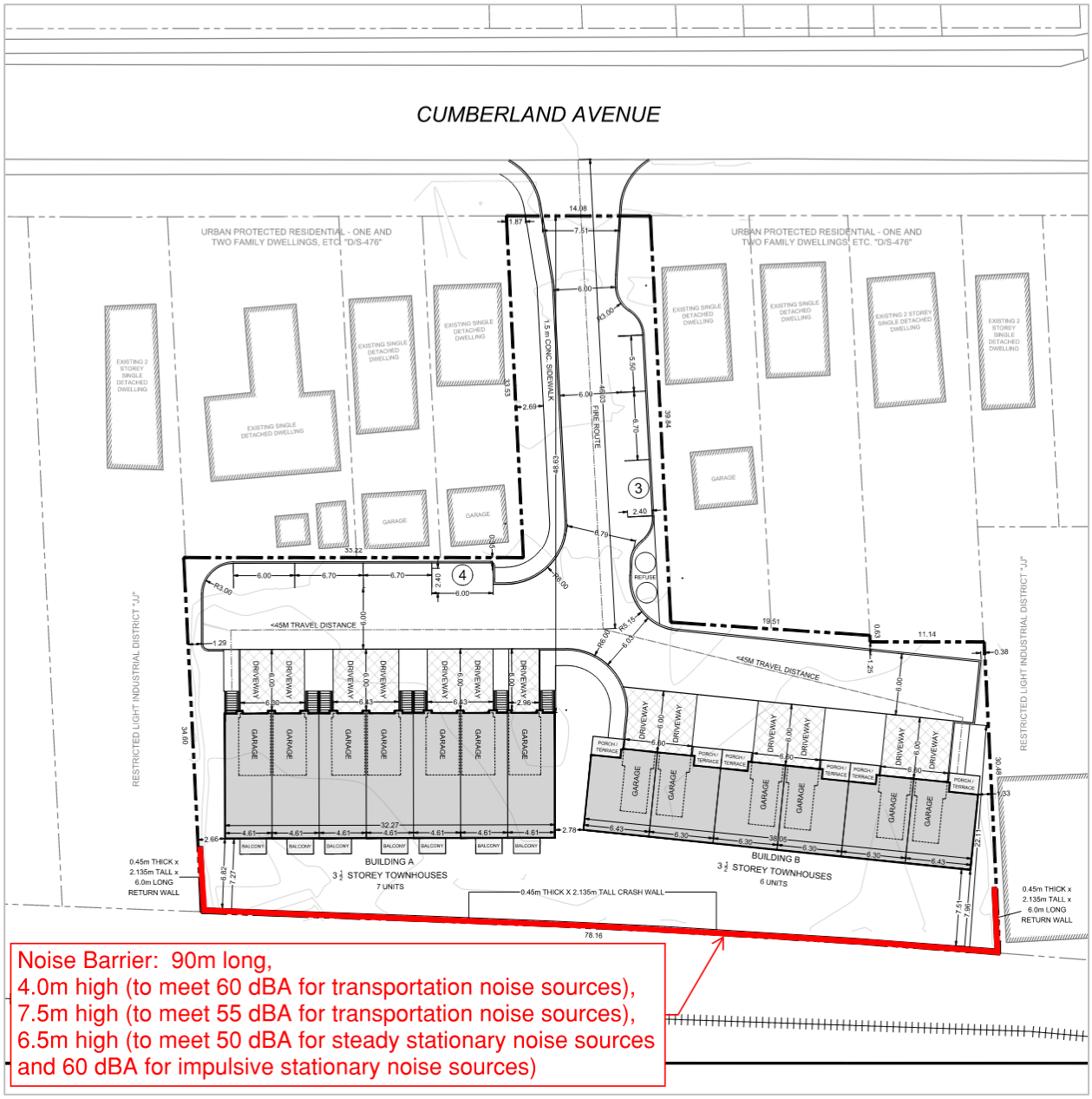


Figure 3: Recommended noise barrier location

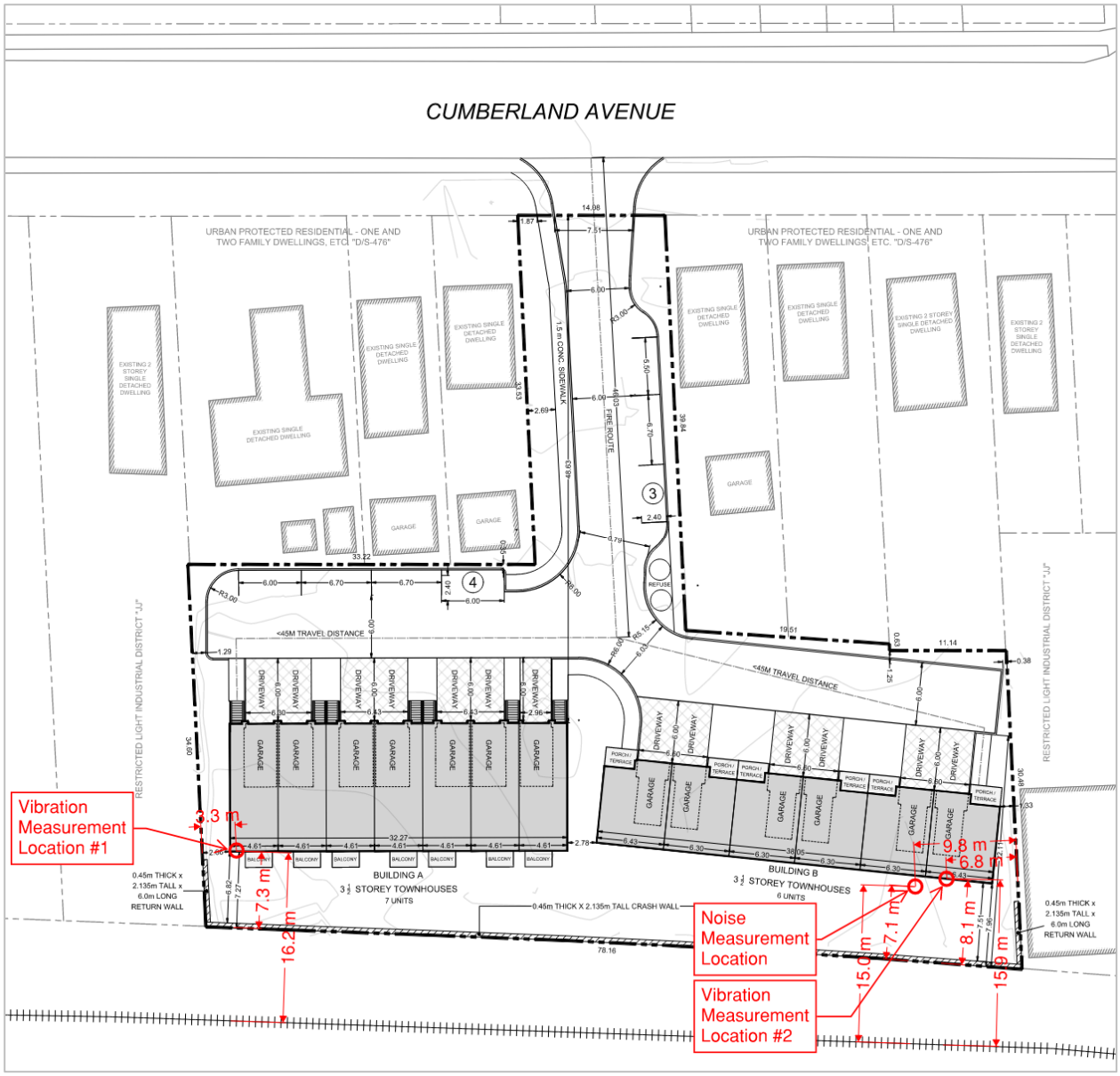


Figure 4: Noise and vibration measurement locations

Appendix B: Zoning Map

City of Hamilton Zoning Map

11/24/2021, 4:54:23 PM

1:4,514

0 0.03 0.06 0.11 mi

0 0.04 0.09 0.17 km

Zoning Legend:

A - Conservation, open space, park and recreation
C - Urban protected residential, etc.
D - Urban protected residential - one and two family dwellings, etc.
DE-H/S-1472 - Low density multiple dwellings
D/S-476 - Urban protected residential - one and two family dwellings, etc.
E - Multiple dwellings, lodges, clubs, etc.
I1 - Neighbourhood institutional
I3 - Major institutional
J - Light and limited heavy industry, etc.
JJ - Restricted light industrial district
M-14 - Prestige industrial
P1 - Neighbourhood park

City of Hamilton, City of Hamilton - Web GIS Framework

Appendix C: Road Traffic Data

Road traffic data on Cumberland Avenue was obtained from the City of Hamilton Transportation Data Management System. The traffic volume is based on the intersection of Cumberland Avenue and Gage Avenue South (Location 3856), to the east of the Project site, as shown in Figure 5. Cumberland Avenue is identified as Location ID 3856_W, and has a 2019 AADT of 5014 (Figure 6). The traffic volume consists of 4% Business and Commercial (BC) vehicles and 96% Passenger (PA) vehicles.

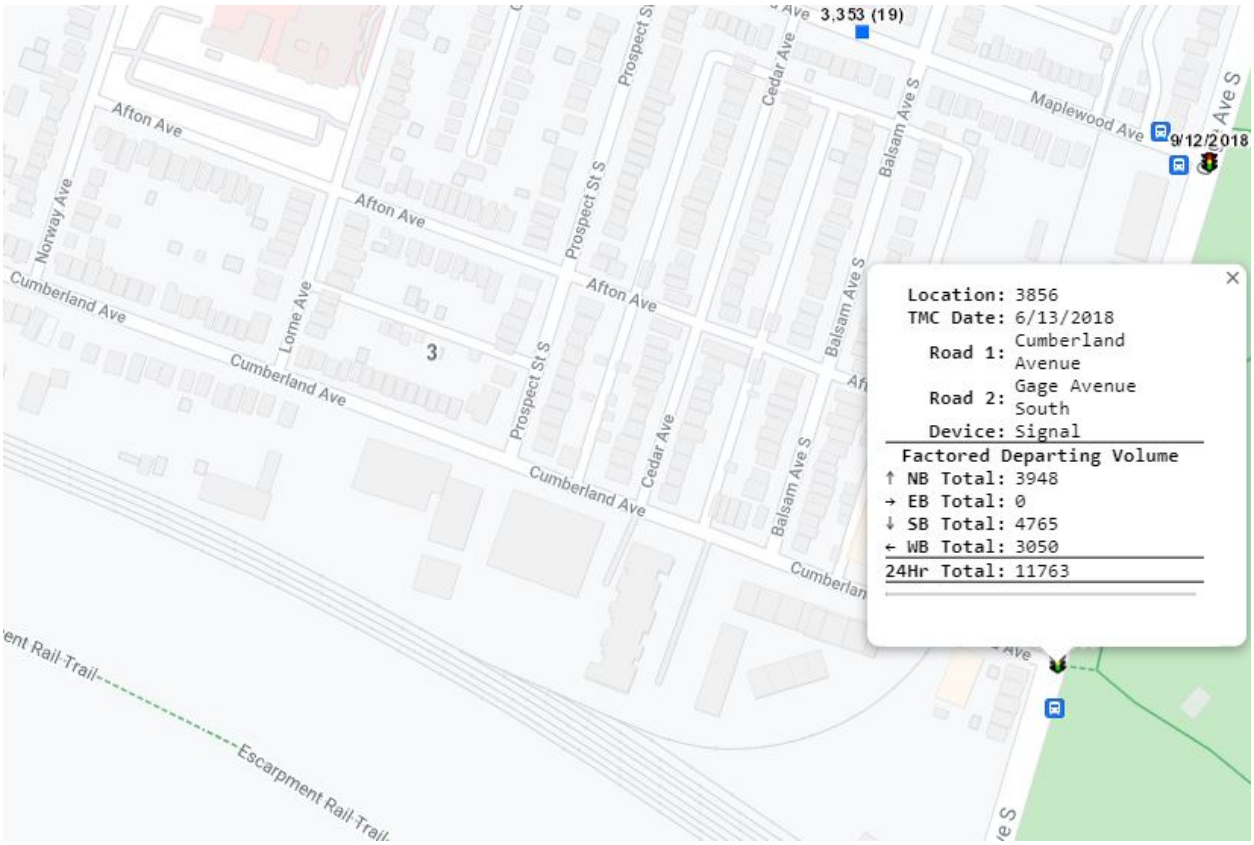


Figure 5: Location 3856, Cumberland Avenue and Gage Avenue South

Record 1 of 1 Goto Record go

Location ID	3856_W	MPO ID	
Type	SPOT	HPMS ID	
On NHS		On HPMS	
LRS ID		LRS Loc Pt.	
SF Group	-	Route Type	
AF Group		Route	
GF Group	All Locations	Active	Yes
Class Dist Grp		Category	TMC
Seas Clss Grp			
WIM Group			
QC Group	Default		
Fnct'l Class		Milepost	
Located On	Cumberland Avenue		
Loc On Alias			
West of	Gage Avenue South		
More Detail			

STATION DATA

Directions: 2-WAY

AADT

	Year	AADT	DHV-30	K %	D %	PA	BC	Src
	2019	5,014[3]		9	54	4,794 (96%)	220 (4%)	Grown from 2018
	2018	5,520[2]		8	54	5,302 (96%)	218 (4%)	TMC

Figure 6: Traffic data for Cumberland Avenue, west of Gage Avenue South (Location ID 3856_W)

Appendix D: STAMSON Calculation Results

STAMSON 5.0 NORMAL REPORT Date: 26-04-2022 19:08:02
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: por1.te Time Period: Day/Night 16/8 hours
Description:

Rail data, segment # 1: CP Rail (day/night)

Train Type	Trains	Speed (km/h)	# loc /Train	# Cars /Train	Eng type	Cont weld
* 1.	21.0/5.2	80.0	4.0	25.0	Diesel	No

* The identified number of trains have been adjusted for future growth using the following parameters:

No	Train type: Name	Unadj. Trains	Annual % Increase	Years of Growth
1.		16.0/4.0	2.50	11.00

Data for Segment # 1: CP Rail (day/night)

Angle1 Angle2	: -90.00 deg	90.00 deg
Wood depth	: 0	(No woods.)
No of house rows	: 0 / 0	
Surface	: 1	(Absorptive ground surface)
Receiver source distance	: 16.00 / 16.00	m
Receiver height	: 9.00 / 9.00	m
Topography	: 3	(Elevated; no barrier)
No Whistle		
Elevation	: 1.00 m	
Reference angle	: 0.00	

Results segment # 1: CP Rail (day)

LOCOMOTIVE (0.00 + 70.63 + 0.00) = 70.63 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.33	71.83	-0.37	-0.83	0.00	0.00	0.00	70.63

WHEEL (0.00 + 64.13 + 0.00) = 64.13 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.44	65.59	-0.40	-1.05	0.00	0.00	0.00	64.13

Segment Leq : 71.51 dBA

Total Leq All Segments: 71.51 dBA

Results segment # 1: CP Rail (night)

LOCOMOTIVE (0.00 + 67.57 + 0.00) = 67.57 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.33	68.78	-0.37	-0.83	0.00	0.00	0.00	67.57

WHEEL (0.00 + 61.08 + 0.00) = 61.08 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.44	62.53	-0.40	-1.05	0.00	0.00	0.00	61.08

Segment Leq : 68.45 dBA

Total Leq All Segments: 68.45 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 71.51
(NIGHT): 68.45

STAMSON 5.0 NORMAL REPORT Date: 26-04-2022 19:16:44
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: por2.te Time Period: Day/Night 16/8 hours
Description:

Rail data, segment # 1: CP Rail (day/night)

Train Type	Trains	Speed (km/h)	# loc /Train	# Cars /Train	Eng type	Cont weld
* 1.	21.0/5.2	80.0	4.0	25.0	Diesel	No

* The identified number of trains have been adjusted for future growth using the following parameters:

Train type: No	Name	Unadj. Trains	Annual % Increase	Years of Growth
1.		16.0/4.0	2.50	11.00

Data for Segment # 1: CP Rail (day/night)

Angle1	Angle2	: -90.00 deg 0.00 deg
Wood depth		: 0 (No woods.)
No of house rows		: 0 / 0
Surface		: 1 (Absorptive ground surface)
Receiver source distance		: 18.00 / 18.00 m
Receiver height		: 9.00 / 9.00 m
Topography		: 3 (Elevated; no barrier)
No Whistle		
Elevation		: 1.00 m
Reference angle		: 0.00

Results segment # 1: CP Rail (day)

LOCOMOTIVE (0.00 + 66.93 + 0.00) = 66.93 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	0	0.33	71.83	-1.05	-3.85	0.00	0.00	0.00	66.93

WHEEL (0.00 + 60.39 + 0.00) = 60.39 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	0	0.44	65.59	-1.14	-4.06	0.00	0.00	0.00	60.39

Segment Leq : 67.80 dBA

Total Leq All Segments: 67.80 dBA

Results segment # 1: CP Rail (night)

LOCOMOTIVE (0.00 + 63.88 + 0.00) = 63.88 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	0	0.33	68.78	-1.05	-3.85	0.00	0.00	0.00	63.88

WHEEL (0.00 + 57.34 + 0.00) = 57.34 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	0	0.44	62.53	-1.14	-4.06	0.00	0.00	0.00	57.34

Segment Leq : 64.75 dBA

Total Leq All Segments: 64.75 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 67.80
(NIGHT): 64.75

STAMSON 5.0 NORMAL REPORT Date: 26-04-2022 19:17:48
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: por3.te Time Period: Day/Night 16/8 hours
Description:

Rail data, segment # 1: CP Rail (day/night)

Train Type	Trains	Speed (km/h)	# loc /Train	# Cars /Train	Eng type	Cont weld
* 1.	21.0/5.2	80.0	4.0	25.0	Diesel	No

* The identified number of trains have been adjusted for future growth using the following parameters:

No	Train type: Name	Unadj. Trains	Annual % Increase	Years of Growth
1.		16.0/4.0	2.50	11.00

Data for Segment # 1: CP Rail (day/night)

Angle1 Angle2	:	0.00 deg 90.00 deg
Wood depth	:	0 (No woods.)
No of house rows	:	0 / 0
Surface	:	1 (Absorptive ground surface)
Receiver source distance	:	18.00 / 18.00 m
Receiver height	:	9.00 / 9.00 m
Topography	:	3 (Elevated; no barrier)
No Whistle		
Elevation	:	1.00 m
Reference angle	:	0.00

Results segment # 1: CP Rail (day)

LOCOMOTIVE (0.00 + 66.93 + 0.00) = 66.93 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	90	0.33	71.83	-1.05	-3.85	0.00	0.00	0.00	66.93

WHEEL (0.00 + 60.39 + 0.00) = 60.39 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	90	0.44	65.59	-1.14	-4.06	0.00	0.00	0.00	60.39

Segment Leq : 67.80 dBA

Total Leq All Segments: 67.80 dBA

Results segment # 1: CP Rail (night)

LOCOMOTIVE (0.00 + 63.88 + 0.00) = 63.88 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	90	0.33	68.78	-1.05	-3.85	0.00	0.00	0.00	63.88

WHEEL (0.00 + 57.34 + 0.00) = 57.34 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
0	90	0.44	62.53	-1.14	-4.06	0.00	0.00	0.00	57.34

Segment Leq : 64.75 dBA

Total Leq All Segments: 64.75 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 67.80
(NIGHT): 64.75

STAMSON 5.0 NORMAL REPORT Date: 26-04-2022 19:20:46
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: por4.te Time Period: Day/Night 16/8 hours
Description:

Road data, segment # 1: Cumberland (day/night)

Car traffic volume : 5729/498 veh/TimePeriod *
Medium truck volume : 119/10 veh/TimePeriod *
Heavy truck volume : 119/10 veh/TimePeriod *
Posted speed limit : 50 km/h
Road gradient : 0 %
Road pavement : 1 (Typical asphalt or concrete)

* Refers to calculated road volumes based on the following input:

24 hr Traffic Volume (AADT or SADT): 5014
Percentage of Annual Growth : 2.00
Number of Years of Growth : 13.00
Medium Truck % of Total Volume : 2.00
Heavy Truck % of Total Volume : 2.00
Day (16 hrs) % of Total Volume : 92.00

Data for Segment # 1: Cumberland (day/night)

Angle1 Angle2 : -90.00 deg 90.00 deg
Wood depth : 0 (No woods.)
No of house rows : 0 / 0
Surface : 2 (Reflective ground surface)
Receiver source distance : 58.80 / 58.80 m
Receiver height : 9.00 / 9.00 m
Topography : 1 (Flat/gentle slope; no barrier)
Reference angle : 0.00

Results segment # 1: Cumberland (day)

Source height = 1.19 m

ROAD (0.00 + 55.87 + 0.00) = 55.87 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.00	61.80	0.00	-5.93	0.00	0.00	0.00	0.00	55.87

Segment Leq : 55.87 dBA

Total Leq All Segments: 55.87 dBA

↟

Results segment # 1: Cumberland (night)

Source height = 1.18 m

ROAD (0.00 + 48.18 + 0.00) = 48.18 dBA

Angle1	Angle2	Alpha	RefLeq	P.Adj	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.00	54.11	0.00	-5.93	0.00	0.00	0.00	0.00	48.18

Segment Leq : 48.18 dBA

Total Leq All Segments: 48.18 dBA

↟

TOTAL Leq FROM ALL SOURCES (DAY): 55.87
(NIGHT): 48.18

↟

↟

STAMSON 5.0 NORMAL REPORT Date: 26-04-2022 19:22:19
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: ola1.te Time Period: Day/Night 16/8 hours
Description:

Rail data, segment # 1: CP Rail (day/night)

Train Type	Trains	Speed (km/h)	# loc /Train	# Cars /Train	Eng type	Cont weld
* 1.	21.0/5.2	80.0	4.0	25.0	Diesel	No

* The identified number of trains have been adjusted for future growth using the following parameters:

No	Train type: Name	Unadj. Trains	Annual % Increase	Years of Growth
1.		16.0/4.0	2.50	11.00

Data for Segment # 1: CP Rail (day/night)

Angle1 Angle2	: -90.00 deg	90.00 deg
Wood depth	: 0	(No woods.)
No of house rows	: 0 / 0	
Surface	: 1	(Absorptive ground surface)
Receiver source distance	: 15.00 / 15.00	m
Receiver height	: 1.50 / 1.50	m
Topography	: 3	(Elevated; no barrier)
No Whistle		
Elevation	: 1.00 m	
Reference angle	: 0.00	

Results segment # 1: CP Rail (day)

LOCOMOTIVE (0.00 + 70.56 + 0.00) = 70.56 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.56	71.83	0.00	-1.28	0.00	0.00	0.00	70.56

WHEEL (0.00 + 64.13 + 0.00) = 64.13 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.66	65.59	0.00	-1.46	0.00	0.00	0.00	64.13

Segment Leq : 71.45 dBA

Total Leq All Segments: 71.45 dBA

Results segment # 1: CP Rail (night)

LOCOMOTIVE (0.00 + 67.51 + 0.00) = 67.51 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.56	68.78	0.00	-1.28	0.00	0.00	0.00	67.51

WHEEL (0.00 + 61.08 + 0.00) = 61.08 dBA

Angle1	Angle2	Alpha	RefLeq	D.Adj	F.Adj	W.Adj	H.Adj	B.Adj	SubLeq
-90	90	0.66	62.53	0.00	-1.46	0.00	0.00	0.00	61.08

Segment Leq : 68.40 dBA

Total Leq All Segments: 68.40 dBA

TOTAL Leq FROM ALL SOURCES (DAY): 71.45
(NIGHT): 68.40

STAMSON 5.0 NORMAL REPORT Date: 26-04-2022 20:27:28
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: ola1_b1.te Time Period: Day/Night 16/8 hours
Description:

Rail data, segment # 1: CP Rail (day/night)

Train Type	Trains	Speed (km/h)	# loc /Train	# Cars /Train	Eng type	Cont weld
* 1.	21.0/5.2	80.0	4.0	25.0	Diesel	No

* The identified number of trains have been adjusted for future growth using the following parameters:

Train type: No	Name	Unadj. Trains	Annual % Increase	Years of Growth
1.		16.0/4.0	2.50	11.00

Data for Segment # 1: CP Rail (day/night)

Angle1	Angle2	: -90.00 deg	90.00 deg
Wood depth		: 0	(No woods.)
No of house rows		: 0 / 0	
Surface		: 1	(Absorptive ground surface)
Receiver source distance		: 15.00 / 15.00	m
Receiver height		: 1.50 / 1.50	m
Topography		: 4	(Elevated; with barrier)
No Whistle			
Barrier angle1		: -90.00 deg	Angle2 : 90.00 deg
Barrier height		: 4.00 m	
Elevation		: 1.00 m	
Barrier receiver distance		: 3.00 / 4.00	m
Source elevation		: 1.00 m	
Receiver elevation		: 0.00 m	
Barrier elevation		: 0.00 m	
Reference angle		: 0.00	

Results segment # 1: CP Rail (day)

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)

```
       4.00 !        1.50 !        2.20 !         2.20
       0.50 !        1.50 !        1.50 !         1.50

LOCOMOTIVE (0.00 + 59.39 + 0.00) = 59.39 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -90     90   0.31  71.83   0.00  -0.80   0.00   0.00 -11.64  59.39
-------------------------------------------------------------------------

WHEEL (0.00 + 50.46 + 0.00) = 50.46 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -90     90   0.42  65.59   0.00  -1.02   0.00   0.00 -14.10  50.46
-------------------------------------------------------------------------

Segment Leq : 59.91 dBA

Total Leq All Segments: 59.91 dBA

🠉
Results segment # 1: CP Rail (night)
-----------------------------------

Barrier height for grazing incidence
-----------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       4.00 !        1.50 !        2.43 !         2.43
       0.50 !        1.50 !        1.50 !         1.50

LOCOMOTIVE (0.00 + 57.56 + 0.00) = 57.56 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -90     90   0.31  68.78   0.00  -0.80   0.00   0.00 -10.42  57.56
-------------------------------------------------------------------------

WHEEL (0.00 + 47.93 + 0.00) = 47.93 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -90     90   0.42  62.53   0.00  -1.02   0.00   0.00 -13.58  47.93
-------------------------------------------------------------------------

Segment Leq : 58.01 dBA

Total Leq All Segments: 58.01 dBA

🠉
```

TOTAL Leq FROM ALL SOURCES (DAY): 59.91
(NIGHT): 58.01

STAMSON 5.0 NORMAL REPORT Date: 26-04-2022 20:28:25
MINISTRY OF ENVIRONMENT AND ENERGY / NOISE ASSESSMENT

Filename: ola1_b2.te Time Period: Day/Night 16/8 hours
Description:

Rail data, segment # 1: CP Rail (day/night)

Train Type	Trains	Speed (km/h)	# loc /Train	# Cars /Train	Eng type	Cont weld
* 1.	21.0/5.2	80.0	4.0	25.0	Diesel	No

* The identified number of trains have been adjusted for future growth using the following parameters:

Train type: No	Name	Unadj. Trains	Annual % Increase	Years of Growth
1.		16.0/4.0	2.50	11.00

Data for Segment # 1: CP Rail (day/night)

Angle1	Angle2	: -90.00 deg	90.00 deg
Wood depth		: 0	(No woods.)
No of house rows		: 0 / 0	
Surface		: 1	(Absorptive ground surface)
Receiver source distance		: 15.00 / 15.00	m
Receiver height		: 1.50 / 1.50	m
Topography		: 4	(Elevated; with barrier)
No Whistle			
Barrier angle1		: -90.00 deg	Angle2 : 90.00 deg
Barrier height		: 7.50	m
Elevation		: 1.00	m
Barrier receiver distance		: 3.00 / 4.00	m
Source elevation		: 1.00	m
Receiver elevation		: 0.00	m
Barrier elevation		: 0.00	m
Reference angle		: 0.00	

Results segment # 1: CP Rail (day)

Barrier height for grazing incidence

Source Height (m)	Receiver Height (m)	Barrier Height (m)	Elevation of Barrier Top (m)

```
       4.00 !        1.50 !        2.20 !         2.20
       0.50 !        1.50 !        1.50 !         1.50

LOCOMOTIVE (0.00 + 54.30 + 0.00) = 54.30 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -90     90   0.10  71.83   0.00  -0.30   0.00   0.00 -17.23  54.30
-------------------------------------------------------------------------

WHEEL (0.00 + 47.11 + 0.00) = 47.11 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -90     90   0.21  65.59   0.00  -0.56   0.00   0.00 -17.91  47.11
-------------------------------------------------------------------------

Segment Leq : 55.06 dBA

Total Leq All Segments: 55.06 dBA

🠉
Results segment # 1: CP Rail (night)
-----------------------------------

Barrier height for grazing incidence
-----------------------------------
Source      ! Receiver    ! Barrier     ! Elevation of
Height  (m) ! Height  (m) ! Height  (m) ! Barrier Top  (m)
------------+-------------+-------------+--------------
       4.00 !        1.50 !        2.43 !         2.43
       0.50 !        1.50 !        1.50 !         1.50

LOCOMOTIVE (0.00 + 51.56 + 0.00) = 51.56 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -90     90   0.10  68.78   0.00  -0.30   0.00   0.00 -16.92  51.56
-------------------------------------------------------------------------

WHEEL (0.00 + 44.19 + 0.00) = 44.19 dBA
Angle1 Angle2  Alpha RefLeq  D.Adj  F.Adj  W.Adj  H.Adj  B.Adj SubLeq
-------------------------------------------------------------------------
   -90     90   0.21  62.53   0.00  -0.56   0.00   0.00 -17.78  44.19
-------------------------------------------------------------------------

Segment Leq : 52.29 dBA

Total Leq All Segments: 52.29 dBA

🠉
```

TOTAL Leq FROM ALL SOURCES (DAY): 55.06
(NIGHT): 52.29

Appendix E: CadnaA Calculation Results

Report (Cumberland - 20220426.cna)

Calculation Configuration

Configuration	
Parameter	Value
General	
Country	(user defined)
Max. Error (dB)	0.00
Max. Search Radius (#(Unit,LEN))	2000.00
Min. Dist Src to Rcvr	0.00
Partition	
Raster Factor	0.50
Max. Length of Section (#(Unit,LEN))	1000.00
Min. Length of Section (#(Unit,LEN))	1.00
Min. Length of Section (%)	0.00
Proj. Line Sources	On
Proj. Area Sources	On
Ref. Time	
Reference Time Day (min)	960.00
Reference Time Night (min)	480.00
Daytime Penalty (dB)	0.00
Recr. Time Penalty (dB)	6.00
Night-time Penalty (dB)	10.00
DTM	
Standard Height (m)	0.00
Model of Terrain	Triangulation
Reflection	
max. Order of Reflection	2
Search Radius Src	100.00
Search Radius Rcvr	100.00
Max. Distance Source - Rcvr	1000.00 1000.00
Min. Distance Rvcr - Reflector	1.00 1.00
Min. Distance Source - Reflector	0.10
Industrial (ISO 9613)	
Lateral Diffraction	some Obj
Obst. within Area Src do not shield	On
Screening	Excl. Ground Att. over Barrier
	Dz with limit (20/25)
Barrier Coefficients C1,2,3	3.0 20.0 0.0
Temperature (#(Unit,TEMP))	10
rel. Humidity (%)	70
Ground Absorption G	0.80
Wind Speed for Dir. (#(Unit,SPEED))	3.0
Roads (RLS-90)	
Strictly acc. to RLS-90	
Railways (Schall 03 (1990))	
Strictly acc. to Schall 03 / Schall-Transrapid	
Aircraft (???)	

Configuration	
Parameter	Value
Strictly acc. to AzB	

Result Table

Receiver		Land Use	Limiting Value		rel. Axis			Lr w/o Noise Control		dL req.		Lr w/ Noise Control		Exceeding		passive NC
Name	ID		Day	Night	Station	Distance	Height	Day	Night	Day	Night	Day	Night	Day	Night	
			dB(A)	dB(A)	m	m	m	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)
POR1	POR1		0	0				61.4	-38.6	61.4	-	0.0	0.0	-	-	-
POR2	POR2		0	0				45.6	-54.3	45.6	-	0.0	0.0	-	-	-
POR3	POR3		0	0				46.3	-53.7	46.3	-	0.0	0.0	-	-	-
POR1-outdoor	POR1		0	0				64.7	-35.3	64.7	-	0.0	0.0	-	-	-

Group Day and Night

Name	Expression	Partial Sum Level							
		POR1		POR2		POR3		POR1-outdoor	
		Day	Night	Day	Night	Day	Night	Day	Night
Root	!*								

Partial Day/Night

Source			Partial Level							
Name	M.	ID	POR1		POR2		POR3		POR1-outdoor	
			Day	Night	Day	Night	Day	Night	Day	Night
ImpulseNoise	-	ImpulseNoise								
SteadyNoise	+	SteadyNoise	61.4	-38.6	45.6	-54.4	46.3	-53.7	64.7	-35.3

Sound Sources

Point Sources

Name	M.	ID	Result. PWL			Lw / Li			Correction			Sound Reduction		Attenuation	Operating Time			K0	Freq.	Direct.	Height		Coordinates		
			Day	Evening	Night	Type	Value	norm.	Day	Evening	Night	R	Area		Day	Special	Night						X	Y	Z
			(dBA)	(dBA)	(dBA)			dB(A)	dB(A)	dB(A)	dB(A)		(m²)		(min)	(min)	(min)	(dB)	(Hz)		(m)		(m)	(m)	(m)
ImpulseNoise	-	ImpulseNoise	112.4	112.4	112.4	Lw	Impulse		0.0	0.0	0.0							0.0		(none)	1.00	r	17594323.85	4788315.55	2.00
SteadyNoise	+	SteadyNoise	100.0	100.0	0.0	Lw	Idling		0.0	0.0	-100.0							0.0		(none)	1.00	r	17594323.80	4788315.51	2.00

Line Sources

Name	M.	ID	Result. PWL			Result. PWL'			Lw / Li			Correction			Sound Reduction		Attenuation	Operating Time			K0	Freq.	Direct.	Moving Pt. Src		
			Day	Evening	Night	Day	Evening	Night	Type	Value	norm.	Day	Evening	Night	R	Area		Day	Special	Night				Number		Speed
			(dBA)	(dBA)	(dBA)	(dBA)	(dBA)	(dBA)			dB(A)	dB(A)	dB(A)	dB(A)		(m²)		(min)	(min)	(min)	(dB)	(Hz)		Day	Evening	Night	(km/h)

Geometry Line Sources

Name	Height				Coordinates					
	Begin		End		x		y		z	Ground
	(m)		(m)		(m)		(m)		(m)	(m)

Area Sources

Name	M.	ID	Result. PWL			Result. PWL"			Lw / Li			Correction			Sound Reduction		Attenuation	Operating Time			K0	Freq.	Direct.	Moving Pt. Src		
			Day	Evening	Night	Day	Evening	Night	Type	Value	norm.	Day	Evening	Night	R	Area		Day	Special	Night				Number		
			(dBA)	(dBA)	(dBA)	(dBA)	(dBA)	(dBA)			dB(A)	dB(A)	dB(A)	dB(A)		(m²)		(min)	(min)	(min)	(dB)	(Hz)		Day	Evening	Night

Geometry Area Sources

Name	Height				Coordinates			
	Begin		End		x	y	z	Ground
	(m)		(m)		(m)	(m)	(m)	(m)

Vertical Area Sources

Name	M.	ID	Result. PWL			Result. PWL"			Lw / Li			Correction			Sound Reduction		Attenuation	Operating Time			K0	Freq.	Direct.
			Day	Evening	Night	Day	Evening	Night	Type	Value	norm.	Day	Evening	Night	R	Area		Day	Special	Night			
			(dBA)	(dBA)	(dBA)	(dBA)	(dBA)	(dBA)			dB(A)	dB(A)	dB(A)	dB(A)		(m²)		(min)	(min)	(min)	(dB)	(Hz)	

Geometry Vertical Area Sources

Name	Height				Coordinates			
	Begin		End		x	y	z	Ground
	(m)		(m)		(m)	(m)	(m)	(m)

Road

Name	M.	ID	Lme			Count Data		exact Count Data						Speed Limit		SCS	Surface		Gradient	Mult. Reflection		
			Day	Evening	Night	DTV	Str.class.	M			p (%)			Auto	Truck	Dist.	Dstro	Type		Drefl	Hbuild	Dist.
			(dBA)	(dBA)	(dBA)			Day	Evening	Night	Day	Evening	Night	(km/h)	(km/h)		(dB)		(%)	(dB)	(m)	(m)

Geometry Road

Name	Height				Coordinates				Dist	LSlope
	Begin		End		x	y	z	Ground	(m)	(%)
	(m)		(m)		(m)	(m)	(m)	(m)		

Receptors

Name	M.	ID	Level Lr		Limit. Value		Land Use			Height		Coordinates		
			Day	Night	Day	Night	Type	Auto	Noise Type			X	Y	Z
			(dBA)	(dBA)	(dBA)	(dBA)				(m)		(m)	(m)	(m)
POR1		POR1	61.4	-38.6	0.0	0.0		x	Total	9.00	a	17594335.38	4788335.79	9.00
POR2		POR2	45.6	-54.3	0.0	0.0		x	Total	9.00	a	17594367.95	4788322.35	9.00
POR3		POR3	46.3	-53.7	0.0	0.0		x	Total	9.00	a	17594299.16	4788350.50	9.00
POR1-outdoor		POR1	64.7	-35.3	0.0	0.0		x	Total	1.50	a	17594333.50	4788330.35	1.50

Obstacles

Barriers

Name	M.	ID	Absorption		Z-Ext.	Cantilever		Height			
			left	right		horz.	vert.	Begin		End	
					(m)	(m)	(m)	(m)		(m)	
Barrier	-	Barrier	0.37	0.37				6.50	a		

Geometry Barriers

Name	M.	ID	Absorption		Z-Ext.	Cantilever		Height				Coordinates			
			left	right		horz.	vert.	Begin		End		x	y	z	Ground
					(m)	(m)	(m)	(m)		(m)		(m)	(m)	(m)	(m)
Barrier	-	Barrier	0.37	0.37				6.50	a			17594296.28	4788349.47	6.50	0.00
												17594294.03	4788342.76	6.50	0.00
												17594367.14	4788313.26	6.50	0.00
												17594368.75	4788318.20	6.50	0.00

Building

Name	M.	ID	RB	Residents	Absorption	Height	
						Begin	
						(m)	
Townhouse1		Townhouse1	x	0	0.37	12.00	a
Townhouse2		Townhouse2	x	0	0.37	12.00	a
Warehouse		Warehouse	x	0	0.37	8.00	a

Geometry Building

Name	M.	ID	RB	Residents	Absorption	Height		Coordinates			
						Begin		x	y	z	Ground
						(m)		(m)	(m)	(m)	(m)
Townhouse1		Townhouse1	x	0	0.37	12.00	a	17594302.79	4788360.34	12.00	0.00
								17594333.66	4788349.30	12.00	0.00
								17594329.51	4788337.60	12.00	0.00
								17594298.65	4788348.74	12.00	0.00
Townhouse2		Townhouse2	x	0	0.37	12.00	a	17594335.69	4788345.02	12.00	0.00
								17594370.48	4788328.33	12.00	0.00
								17594367.17	4788320.71	12.00	0.00
								17594332.34	4788337.49	12.00	0.00
Warehouse		Warehouse	x	0	0.37	8.00	a	17594367.54	4788313.29	8.00	0.00
								17594372.32	4788329.03	8.00	0.00
								17594387.45	4788324.39	8.00	0.00
								17594383.13	4788308.26	8.00	0.00

3D Reflector

Name	M.	ID	Type	Attenuation	B	m	Height
				dB/100m	%	1/m	(m)

Geometry Absorption

Name	M.	ID	Type	Attenuation	B	m	Height	Coordinates			
				dB/100m	%	1/m	(m)	x	y	z	Ground
								(m)	(m)	(m)	(m)

Ground Absorption

Name	M.	ID	G

Geometry Absorption

Name	M.	ID	G	Coordinates	
				x	y
				(m)	(m)

Contour Lines

Geometry Contour Line

Name	M.	ID	OnlyPts	Height		Coordinates		
				Begin	End	x	y	z
				(m)	(m)	(m)	(m)	(m)
1m rail line				1.00		17594249.85	4788323.72	1.00
						17594259.94	4788350.41	1.00
						17594387.83	4788300.87	1.00
						17594377.46	4788274.10	1.00

Name	M.	ID	OnlyPts	Height		Coordinates		
				Begin	End	x	y	z
				(m)	(m)	(m)	(m)	(m)
						17594250.61	4788323.33	1.00
Property Height				0.00		17594260.89	4788353.56	0.00
						17594388.78	4788303.57	0.00
						17594408.47	4788370.13	0.00
						17594278.01	4788408.74	0.00
						17594262.13	4788355.06	0.00

Report (Cumberland - 20220426.cna)

Calculation Configuration

Configuration	
Parameter	Value
General	
Country	(user defined)
Max. Error (dB)	0.00
Max. Search Radius (#(Unit,LEN))	2000.00
Min. Dist Src to Rcvr	0.00
Partition	
Raster Factor	0.50
Max. Length of Section (#(Unit,LEN))	1000.00
Min. Length of Section (#(Unit,LEN))	1.00
Min. Length of Section (%)	0.00
Proj. Line Sources	On
Proj. Area Sources	On
Ref. Time	
Reference Time Day (min)	960.00
Reference Time Night (min)	480.00
Daytime Penalty (dB)	0.00
Recr. Time Penalty (dB)	6.00
Night-time Penalty (dB)	10.00
DTM	
Standard Height (m)	0.00
Model of Terrain	Triangulation
Reflection	
max. Order of Reflection	2
Search Radius Src	100.00
Search Radius Rcvr	100.00
Max. Distance Source - Rcvr	1000.00 1000.00
Min. Distance Rvcr - Reflector	1.00 1.00
Min. Distance Source - Reflector	0.10
Industrial (ISO 9613)	
Lateral Diffraction	some Obj
Obst. within Area Src do not shield	On
Screening	Excl. Ground Att. over Barrier
	Dz with limit (20/25)
Barrier Coefficients C1,2,3	3.0 20.0 0.0
Temperature (#(Unit,TEMP))	10
rel. Humidity (%)	70
Ground Absorption G	0.80
Wind Speed for Dir. (#(Unit,SPEED))	3.0
Roads (RLS-90)	
Strictly acc. to RLS-90	
Railways (Schall 03 (1990))	
Strictly acc. to Schall 03 / Schall-Transrapid	
Aircraft (???)	

Configuration	
Parameter	Value
Strictly acc. to AzB	

Result Table

Receiver		Land Use	Limiting Value		rel. Axis			Lr w/o Noise Control		dL req.		Lr w/ Noise Control		Exceeding		passive NC
Name	ID		Day	Night	Station	Distance	Height	Day	Night	Day	Night	Day	Night	Day	Night	
			dB(A)	dB(A)	m	m	m	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)
POR1	POR1		0	0				73.8	73.8	73.8	73.8	0.0	0.0	-	-	-
POR2	POR2		0	0				51.1	51.1	51.1	51.1	0.0	0.0	-	-	-
POR3	POR3		0	0				51.8	51.8	51.8	51.8	0.0	0.0	-	-	-
POR1-outdoor	POR1		0	0				77.3	77.3	77.3	77.3	0.0	0.0	-	-	-

Group Day and Night

Name	Expression	Partial Sum Level							
		POR1		POR2		POR3		POR1-outdoor	
		Day	Night	Day	Night	Day	Night	Day	Night
Root	!*								

Partial Day/Night

Source			Partial Level							
Name	M.	ID	POR1		POR2		POR3		POR1-outdoor	
			Day	Night	Day	Night	Day	Night	Day	Night
ImpulseNoise	+	ImpulseNoise	73.8	73.8	51.1	51.1	51.8	51.8	77.3	77.3
SteadyNoise	-	SteadyNoise								

Sound Sources

Point Sources

Name	M.	ID	Result. PWL			Lw / Li			Correction			Sound Reduction		Attenuation	Operating Time			K0	Freq.	Direct.	Height		Coordinates		
			Day	Evening	Night	Type	Value	norm.	Day	Evening	Night	R	Area		Day	Special	Night						X	Y	Z
			(dBA)	(dBA)	(dBA)			dB(A)	dB(A)	dB(A)	dB(A)		(m²)		(min)	(min)	(min)	(dB)	(Hz)		(m)		(m)	(m)	(m)
ImpulseNoise	+	ImpulseNoise	112.4	112.4	112.4	Lw	Impulse		0.0	0.0	0.0							0.0		(none)	1.00	r	17594323.85	4788315.55	2.00
SteadyNoise	-	SteadyNoise	100.0	100.0	0.0	Lw	Idling		0.0	0.0	-100.0							0.0		(none)	1.00	r	17594323.80	4788315.51	2.00

Line Sources

Name	M.	ID	Result. PWL			Result. PWL'			Lw / Li			Correction			Sound Reduction		Attenuation	Operating Time			K0	Freq.	Direct.	Moving Pt. Src		
			Day	Evening	Night	Day	Evening	Night	Type	Value	norm.	Day	Evening	Night	R	Area		Day	Special	Night				Number		Speed
			(dBA)	(dBA)	(dBA)	(dBA)	(dBA)	(dBA)			dB(A)	dB(A)	dB(A)	dB(A)		(m²)		(min)	(min)	(min)	(dB)	(Hz)		Day	Evening	Night	(km/h)

Geometry Line Sources

Name	Height				Coordinates			
	Begin		End		x	y	z	Ground
	(m)		(m)		(m)	(m)	(m)	(m)

Area Sources

Name	M.	ID	Result. PWL			Result. PWL"			Lw / Li			Correction			Sound Reduction		Attenuation	Operating Time			K0	Freq.	Direct.	Moving Pt. Src		
			Day	Evening	Night	Day	Evening	Night	Type	Value	norm.	Day	Evening	Night	R	Area		Day	Special	Night				Number		
			(dBA)	(dBA)	(dBA)	(dBA)	(dBA)	(dBA)			dB(A)	dB(A)	dB(A)	dB(A)		(m²)		(min)	(min)	(min)	(dB)	(Hz)		Day	Evening	Night

Geometry Area Sources

Name	Height				Coordinates			
	Begin		End		x	y	z	Ground
	(m)		(m)		(m)	(m)	(m)	(m)

Vertical Area Sources

Name	M.	ID	Result. PWL			Result. PWL"			Lw / Li			Correction			Sound Reduction		Attenuation	Operating Time			K0	Freq.	Direct.
			Day	Evening	Night	Day	Evening	Night	Type	Value	norm.	Day	Evening	Night	R	Area		Day	Special	Night			
			(dBA)	(dBA)	(dBA)	(dBA)	(dBA)	(dBA)			dB(A)	dB(A)	dB(A)	dB(A)		(m²)		(min)	(min)	(min)	(dB)	(Hz)	

Geometry Vertical Area Sources

Name	Height				Coordinates			
	Begin		End		x	y	z	Ground
	(m)		(m)		(m)	(m)	(m)	(m)

Road

Name	M.	ID	Lme			Count Data		exact Count Data						Speed Limit		SCS	Surface		Gradient	Mult. Reflection		
			Day	Evening	Night	DTV	Str.class.	M			p (%)			Auto	Truck	Dist.	Dstro	Type		Drefl	Hbuild	Dist.
			(dBA)	(dBA)	(dBA)			Day	Evening	Night	Day	Evening	Night	(km/h)	(km/h)		(dB)		(%)	(dB)	(m)	(m)

Geometry Road

Name	Height				Coordinates				Dist	LSlope
	Begin		End		x	y	z	Ground	(m)	(%)
	(m)		(m)		(m)	(m)	(m)	(m)		

Receptors

Name	M.	ID	Level Lr		Limit. Value		Land Use			Height		Coordinates		
			Day	Night	Day	Night	Type	Auto	Noise Type			X	Y	Z
			(dBA)	(dBA)	(dBA)	(dBA)				(m)		(m)	(m)	(m)
POR1		POR1	73.8	73.8	0.0	0.0		x	Total	9.00	a	17594335.38	4788335.79	9.00
POR2		POR2	51.1	51.1	0.0	0.0		x	Total	9.00	a	17594367.95	4788322.35	9.00
POR3		POR3	51.8	51.8	0.0	0.0		x	Total	9.00	a	17594299.16	4788350.50	9.00
POR1-outdoor		POR1	77.3	77.3	0.0	0.0		x	Total	1.50	a	17594333.50	4788330.35	1.50

Obstacles

Barriers

Name	M.	ID	Absorption		Z-Ext.	Cantilever		Height			
			left	right		horz.	vert.	Begin		End	
					(m)	(m)	(m)	(m)		(m)	
Barrier	-	Barrier	0.37	0.37				6.50	a		

Geometry Barriers

Name	M.	ID	Absorption		Z-Ext.	Cantilever		Height				Coordinates			
			left	right		horz.	vert.	Begin		End		x	y	z	Ground
					(m)	(m)	(m)	(m)		(m)		(m)	(m)	(m)	(m)
Barrier	-	Barrier	0.37	0.37				6.50	a			17594296.28	4788349.47	6.50	0.00
												17594294.03	4788342.76	6.50	0.00
												17594367.14	4788313.26	6.50	0.00
												17594368.75	4788318.20	6.50	0.00

Building

Name	M.	ID	RB	Residents	Absorption	Height	
						Begin	
						(m)	
Townhouse1		Townhouse1	x	0	0.37	12.00	a
Townhouse2		Townhouse2	x	0	0.37	12.00	a
Warehouse		Warehouse	x	0	0.37	8.00	a

Geometry Building

Name	M.	ID	RB	Residents	Absorption	Height		Coordinates			
						Begin		x	y	z	Ground
						(m)		(m)	(m)	(m)	(m)
Townhouse1		Townhouse1	x	0	0.37	12.00	a	17594302.79	4788360.34	12.00	0.00
								17594333.66	4788349.30	12.00	0.00
								17594329.51	4788337.60	12.00	0.00
								17594298.65	4788348.74	12.00	0.00
Townhouse2		Townhouse2	x	0	0.37	12.00	a	17594335.69	4788345.02	12.00	0.00
								17594370.48	4788328.33	12.00	0.00
								17594367.17	4788320.71	12.00	0.00
								17594332.34	4788337.49	12.00	0.00
Warehouse		Warehouse	x	0	0.37	8.00	a	17594367.54	4788313.29	8.00	0.00
								17594372.32	4788329.03	8.00	0.00
								17594387.45	4788324.39	8.00	0.00
								17594383.13	4788308.26	8.00	0.00

3D Reflector

Name	M.	ID	Type	Attenuation	B	m	Height
				dB/100m	%	1/m	(m)

Geometry Absorption

Name	M.	ID	Type	Attenuation	B	m	Height	Coordinates			
				dB/100m	%	1/m	(m)	x	y	z	Ground
								(m)	(m)	(m)	(m)

Ground Absorption

Name	M.	ID	G

Geometry Absorption

Name	M.	ID	G	Coordinates	
				x	y
				(m)	(m)

Contour Lines

Geometry Contour Line

Name	M.	ID	OnlyPts	Height		Coordinates		
				Begin	End	x	y	z
				(m)	(m)	(m)	(m)	(m)
1m rail line				1.00		17594249.85	4788323.72	1.00
						17594259.94	4788350.41	1.00
						17594387.83	4788300.87	1.00
						17594377.46	4788274.10	1.00

Name	M.	ID	OnlyPts	Height		Coordinates		
				Begin	End	x	y	z
				(m)	(m)	(m)	(m)	(m)
						17594250.61	4788323.33	1.00
Property Height				0.00		17594260.89	4788353.56	0.00
						17594388.78	4788303.57	0.00
						17594408.47	4788370.13	0.00
						17594278.01	4788408.74	0.00
						17594262.13	4788355.06	0.00

Report (Cumberland - 20220426.cna)

Calculation Configuration

Configuration	
Parameter	Value
General	
Country	(user defined)
Max. Error (dB)	0.00
Max. Search Radius (#(Unit,LEN))	2000.00
Min. Dist Src to Rcvr	0.00
Partition	
Raster Factor	0.50
Max. Length of Section (#(Unit,LEN))	1000.00
Min. Length of Section (#(Unit,LEN))	1.00
Min. Length of Section (%)	0.00
Proj. Line Sources	On
Proj. Area Sources	On
Ref. Time	
Reference Time Day (min)	960.00
Reference Time Night (min)	480.00
Daytime Penalty (dB)	0.00
Recr. Time Penalty (dB)	6.00
Night-time Penalty (dB)	10.00
DTM	
Standard Height (m)	0.00
Model of Terrain	Triangulation
Reflection	
max. Order of Reflection	2
Search Radius Src	100.00
Search Radius Rcvr	100.00
Max. Distance Source - Rcvr	1000.00 1000.00
Min. Distance Rvcr - Reflector	1.00 1.00
Min. Distance Source - Reflector	0.10
Industrial (ISO 9613)	
Lateral Diffraction	some Obj
Obst. within Area Src do not shield	On
Screening	Excl. Ground Att. over Barrier
	Dz with limit (20/25)
Barrier Coefficients C1,2,3	3.0 20.0 0.0
Temperature (#(Unit,TEMP))	10
rel. Humidity (%)	70
Ground Absorption G	0.80
Wind Speed for Dir. (#(Unit,SPEED))	3.0
Roads (RLS-90)	
Strictly acc. to RLS-90	
Railways (Schall 03 (1990))	
Strictly acc. to Schall 03 / Schall-Transrapid	
Aircraft (???)	

Configuration	
Parameter	Value
Strictly acc. to AzB	

Result Table

Receiver		Land Use	Limiting Value		rel. Axis			Lr w/o Noise Control		dL req.		Lr w/ Noise Control		Exceeding		passive NC
Name	ID		Day	Night	Station	Distance	Height	Day	Night	Day	Night	Day	Night	Day	Night	
			dB(A)	dB(A)	m	m	m	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)
POR1	POR1		0	0				56.4	-43.6	56.4	-	0.0	0.0	-	-	-
POR2	POR2		0	0				45.5	-54.5	45.5	-	0.0	0.0	-	-	-
POR3	POR3		0	0				45.5	-54.5	45.5	-	0.0	0.0	-	-	-
POR1-outdoor	POR1		0	0				49.9	-50.1	49.9	-	0.0	0.0	-	-	-

Group Day and Night

Name	Expression	Partial Sum Level							
		POR1		POR2		POR3		POR1-outdoor	
		Day	Night	Day	Night	Day	Night	Day	Night
Root	!*								

Partial Day/Night

Source			Partial Level							
Name	M.	ID	POR1		POR2		POR3		POR1-outdoor	
			Day	Night	Day	Night	Day	Night	Day	Night
ImpulseNoise	-	ImpulseNoise								
SteadyNoise	+	SteadyNoise	56.4	-43.6	45.5	-54.5	45.5	-54.5	49.9	-50.1

Sound Sources

Point Sources

Name	M.	ID	Result. PWL			Lw / Li			Correction			Sound Reduction		Attenuation	Operating Time			K0	Freq.	Direct.	Height		Coordinates		
			Day	Evening	Night	Type	Value	norm.	Day	Evening	Night	R	Area		Day	Special	Night						X	Y	Z
			(dBA)	(dBA)	(dBA)			dB(A)	dB(A)	dB(A)	dB(A)		(m²)		(min)	(min)	(min)	(dB)	(Hz)		(m)		(m)	(m)	(m)
ImpulseNoise	-	ImpulseNoise	112.4	112.4	112.4	Lw	Impulse		0.0	0.0	0.0							0.0		(none)	1.00	r	17594323.85	4788315.55	2.00
SteadyNoise	+	SteadyNoise	100.0	100.0	0.0	Lw	Idling		0.0	0.0	-100.0							0.0		(none)	1.00	r	17594323.80	4788315.51	2.00

Line Sources

Name	M.	ID	Result. PWL			Result. PWL'			Lw / Li			Correction			Sound Reduction		Attenuation	Operating Time			K0	Freq.	Direct.	Moving Pt. Src		
			Day	Evening	Night	Day	Evening	Night	Type	Value	norm.	Day	Evening	Night	R	Area		Day	Special	Night				Number		Speed
			(dBA)	(dBA)	(dBA)	(dBA)	(dBA)	(dBA)			dB(A)	dB(A)	dB(A)	dB(A)		(m²)		(min)	(min)	(min)	(dB)	(Hz)		Day	Evening	Night	(km/h)

Geometry Line Sources

Name	Height				Coordinates					
	Begin		End		x	y	z	Ground		
	(m)		(m)		(m)	(m)	(m)	(m)		

Area Sources

Name	M.	ID	Result. PWL			Result. PWL"			Lw / Li			Correction			Sound Reduction		Attenuation	Operating Time			K0	Freq.	Direct.	Moving Pt. Src		
			Day	Evening	Night	Day	Evening	Night	Type	Value	norm.	Day	Evening	Night	R	Area		Day	Special	Night				Number		
			(dBA)	(dBA)	(dBA)	(dBA)	(dBA)	(dBA)			dB(A)	dB(A)	dB(A)	dB(A)		(m²)		(min)	(min)	(min)	(dB)	(Hz)		Day	Evening	Night

Geometry Area Sources

Name	Height				Coordinates			
	Begin		End		x	y	z	Ground
	(m)		(m)		(m)	(m)	(m)	(m)

Vertical Area Sources

Name	M.	ID	Result. PWL			Result. PWL"			Lw / Li			Correction			Sound Reduction		Attenuation	Operating Time			K0	Freq.	Direct.
			Day	Evening	Night	Day	Evening	Night	Type	Value	norm.	Day	Evening	Night	R	Area		Day	Special	Night			
			(dBA)	(dBA)	(dBA)	(dBA)	(dBA)	(dBA)			dB(A)	dB(A)	dB(A)	dB(A)		(m²)		(min)	(min)	(min)	(dB)	(Hz)	

Geometry Vertical Area Sources

Name	Height				Coordinates			
	Begin		End		x	y	z	Ground
	(m)		(m)		(m)	(m)	(m)	(m)

Road

Name	M.	ID	Lme			Count Data		exact Count Data						Speed Limit		SCS	Surface		Gradient	Mult. Reflection		
			Day	Evening	Night	DTV	Str.class.	M			p (%)			Auto	Truck	Dist.	Dstro	Type		Drefl	Hbuild	Dist.
			(dBA)	(dBA)	(dBA)			Day	Evening	Night	Day	Evening	Night	(km/h)	(km/h)		(dB)		(%)	(dB)	(m)	(m)

Geometry Road

Name	Height				Coordinates				Dist	LSlope
	Begin		End		x	y	z	Ground	(m)	(%)
	(m)		(m)		(m)	(m)	(m)	(m)		

Receptors

Name	M.	ID	Level Lr		Limit. Value		Land Use			Height		Coordinates		
			Day	Night	Day	Night	Type	Auto	Noise Type			X	Y	Z
			(dBA)	(dBA)	(dBA)	(dBA)				(m)		(m)	(m)	(m)
POR1		POR1	56.4	-43.6	0.0	0.0		x	Total	9.00	a	17594335.38	4788335.79	9.00
POR2		POR2	45.5	-54.5	0.0	0.0		x	Total	9.00	a	17594367.95	4788322.35	9.00
POR3		POR3	45.5	-54.5	0.0	0.0		x	Total	9.00	a	17594299.16	4788350.50	9.00
POR1-outdoor		POR1	49.9	-50.1	0.0	0.0		x	Total	1.50	a	17594333.50	4788330.35	1.50

Obstacles

Barriers

Name	M.	ID	Absorption		Z-Ext.	Cantilever		Height			
			left	right		horz.	vert.	Begin		End	
					(m)	(m)	(m)	(m)		(m)	
Barrier	+	Barrier	0.37	0.37				6.50	a		

Geometry Barriers

Name	M.	ID	Absorption		Z-Ext.	Cantilever		Height				Coordinates			
			left	right		horz.	vert.	Begin		End		x	y	z	Ground
					(m)	(m)	(m)	(m)		(m)		(m)	(m)	(m)	(m)
Barrier	+	Barrier	0.37	0.37				6.50	a			17594296.28	4788349.47	6.50	0.00
												17594294.03	4788342.76	6.50	0.00
												17594367.14	4788313.26	6.50	0.00
												17594368.75	4788318.20	6.50	0.00

Building

Name	M.	ID	RB	Residents	Absorption	Height	
						Begin	
						(m)	
Townhouse1		Townhouse1	x	0	0.37	12.00	a
Townhouse2		Townhouse2	x	0	0.37	12.00	a
Warehouse		Warehouse	x	0	0.37	8.00	a

Geometry Building

Name	M.	ID	RB	Residents	Absorption	Height		Coordinates			
						Begin		x	y	z	Ground
						(m)		(m)	(m)	(m)	(m)
Townhouse1		Townhouse1	x	0	0.37	12.00	a	17594302.79	4788360.34	12.00	0.00
								17594333.66	4788349.30	12.00	0.00
								17594329.51	4788337.60	12.00	0.00
								17594298.65	4788348.74	12.00	0.00
Townhouse2		Townhouse2	x	0	0.37	12.00	a	17594335.69	4788345.02	12.00	0.00
								17594370.48	4788328.33	12.00	0.00
								17594367.17	4788320.71	12.00	0.00
								17594332.34	4788337.49	12.00	0.00
Warehouse		Warehouse	x	0	0.37	8.00	a	17594367.54	4788313.29	8.00	0.00
								17594372.32	4788329.03	8.00	0.00
								17594387.45	4788324.39	8.00	0.00
								17594383.13	4788308.26	8.00	0.00

3D Reflector

Name	M.	ID	Type	Attenuation	B	m	Height
				dB/100m	%	1/m	(m)

Geometry Absorption

Name	M.	ID	Type	Attenuation	B	m	Height	Coordinates			
				dB/100m	%	1/m	(m)	x	y	z	Ground
								(m)	(m)	(m)	(m)

Ground Absorption

Name	M.	ID	G

Geometry Absorption

Name	M.	ID	G	Coordinates	
				x	y
				(m)	(m)

Contour Lines

Geometry Contour Line

Name	M.	ID	OnlyPts	Height		Coordinates		
				Begin	End	x	y	z
				(m)	(m)	(m)	(m)	(m)
1m rail line				1.00		17594249.85	4788323.72	1.00
						17594259.94	4788350.41	1.00
						17594387.83	4788300.87	1.00
						17594377.46	4788274.10	1.00

Name	M.	ID	OnlyPts	Height		Coordinates		
				Begin	End	x	y	z
				(m)	(m)	(m)	(m)	(m)
						17594250.61	4788323.33	1.00
Property Height				0.00		17594260.89	4788353.56	0.00
						17594388.78	4788303.57	0.00
						17594408.47	4788370.13	0.00
						17594278.01	4788408.74	0.00
						17594262.13	4788355.06	0.00

Report (Cumberland - 20220426.cna)

Calculation Configuration

Configuration	
Parameter	Value
General	
Country	(user defined)
Max. Error (dB)	0.00
Max. Search Radius (#(Unit,LEN))	2000.00
Min. Dist Src to Rcvr	0.00
Partition	
Raster Factor	0.50
Max. Length of Section (#(Unit,LEN))	1000.00
Min. Length of Section (#(Unit,LEN))	1.00
Min. Length of Section (%)	0.00
Proj. Line Sources	On
Proj. Area Sources	On
Ref. Time	
Reference Time Day (min)	960.00
Reference Time Night (min)	480.00
Daytime Penalty (dB)	0.00
Recr. Time Penalty (dB)	6.00
Night-time Penalty (dB)	10.00
DTM	
Standard Height (m)	0.00
Model of Terrain	Triangulation
Reflection	
max. Order of Reflection	2
Search Radius Src	100.00
Search Radius Rcvr	100.00
Max. Distance Source - Rcvr	1000.00 1000.00
Min. Distance Rvcr - Reflector	1.00 1.00
Min. Distance Source - Reflector	0.10
Industrial (ISO 9613)	
Lateral Diffraction	some Obj
Obst. within Area Src do not shield	On
Screening	Excl. Ground Att. over Barrier
	Dz with limit (20/25)
Barrier Coefficients C1,2,3	3.0 20.0 0.0
Temperature (#(Unit,TEMP))	10
rel. Humidity (%)	70
Ground Absorption G	0.80
Wind Speed for Dir. (#(Unit,SPEED))	3.0
Roads (RLS-90)	
Strictly acc. to RLS-90	
Railways (Schall 03 (1990))	
Strictly acc. to Schall 03 / Schall-Transrapid	
Aircraft (???)	

Configuration	
Parameter	Value
Strictly acc. to AzB	

Result Table

Receiver		Land Use	Limiting Value		rel. Axis			Lr w/o Noise Control		dL req.		Lr w/ Noise Control		Exceeding		passive NC
Name	ID		Day	Night	Station	Distance	Height	Day	Night	Day	Night	Day	Night	Day	Night	
			dB(A)	dB(A)	m	m	m	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)	dB(A)
POR1	POR1		0	0				68.2	68.2	68.2	68.2	0.0	0.0	-	-	-
POR2	POR2		0	0				51.0	51.0	51.0	51.0	0.0	0.0	-	-	-
POR3	POR3		0	0				49.5	49.5	49.5	49.5	0.0	0.0	-	-	-
POR1-outdoor	POR1		0	0				58.3	58.3	58.3	58.3	0.0	0.0	-	-	-

Group Day and Night

Name	Expression	Partial Sum Level							
		POR1		POR2		POR3		POR1-outdoor	
		Day	Night	Day	Night	Day	Night	Day	Night
Root	!*								

Partial Day/Night

Source			Partial Level							
Name	M.	ID	POR1		POR2		POR3		POR1-outdoor	
			Day	Night	Day	Night	Day	Night	Day	Night
ImpulseNoise	+	ImpulseNoise	68.2	68.2	51.0	51.0	49.5	49.5	58.3	58.3
SteadyNoise	-	SteadyNoise								

Sound Sources

Point Sources

Name	M.	ID	Result. PWL			Lw / Li			Correction			Sound Reduction		Attenuation	Operating Time			K0	Freq.	Direct.	Height		Coordinates		
			Day	Evening	Night	Type	Value	norm.	Day	Evening	Night	R	Area		Day	Special	Night						X	Y	Z
			(dBA)	(dBA)	(dBA)			dB(A)	dB(A)	dB(A)	dB(A)		(m²)		(min)	(min)	(min)	(dB)	(Hz)		(m)		(m)	(m)	(m)
ImpulseNoise	+	ImpulseNoise	112.4	112.4	112.4	Lw	Impulse		0.0	0.0	0.0							0.0		(none)	1.00	r	17594323.85	4788315.55	2.00
SteadyNoise	-	SteadyNoise	100.0	100.0	0.0	Lw	Idling		0.0	0.0	-100.0							0.0		(none)	1.00	r	17594323.80	4788315.51	2.00

Line Sources

Name	M.	ID	Result. PWL			Result. PWL'			Lw / Li			Correction			Sound Reduction		Attenuation	Operating Time			K0	Freq.	Direct.	Moving Pt. Src		
			Day	Evening	Night	Day	Evening	Night	Type	Value	norm.	Day	Evening	Night	R	Area		Day	Special	Night				Number		Speed
			(dBA)	(dBA)	(dBA)	(dBA)	(dBA)	(dBA)			dB(A)	dB(A)	dB(A)	dB(A)		(m²)		(min)	(min)	(min)	(dB)	(Hz)		Day	Evening	Night	(km/h)

Geometry Line Sources

Name	Height				Coordinates			
	Begin		End		x	y	z	Ground
	(m)		(m)		(m)	(m)	(m)	(m)

Area Sources

Name	M.	ID	Result. PWL			Result. PWL"			Lw / Li			Correction			Sound Reduction		Attenuation	Operating Time			K0	Freq.	Direct.	Moving Pt. Src		
			Day	Evening	Night	Day	Evening	Night	Type	Value	norm.	Day	Evening	Night	R	Area		Day	Special	Night				Number		
			(dBA)	(dBA)	(dBA)	(dBA)	(dBA)	(dBA)			dB(A)	dB(A)	dB(A)	dB(A)		(m²)		(min)	(min)	(min)	(dB)	(Hz)		Day	Evening	Night

Geometry Area Sources

Name	Height				Coordinates			
	Begin		End		x	y	z	Ground
	(m)		(m)		(m)	(m)	(m)	(m)

Vertical Area Sources

Name	M.	ID	Result. PWL			Result. PWL"			Lw / Li			Correction			Sound Reduction		Attenuation	Operating Time			K0	Freq.	Direct.
			Day	Evening	Night	Day	Evening	Night	Type	Value	norm.	Day	Evening	Night	R	Area		Day	Special	Night			
			(dBA)	(dBA)	(dBA)	(dBA)	(dBA)	(dBA)			dB(A)	dB(A)	dB(A)	dB(A)		(m²)		(min)	(min)	(min)	(dB)	(Hz)	

Geometry Vertical Area Sources

Name	Height				Coordinates			
	Begin		End		x	y	z	Ground
	(m)		(m)		(m)	(m)	(m)	(m)

Road

Name	M.	ID	Lme			Count Data		exact Count Data						Speed Limit		SCS	Surface		Gradient	Mult. Reflection		
			Day	Evening	Night	DTV	Str.class.	M			p (%)			Auto	Truck	Dist.	Dstro	Type		Drefl	Hbuild	Dist.
			(dBA)	(dBA)	(dBA)			Day	Evening	Night	Day	Evening	Night	(km/h)	(km/h)		(dB)		(%)	(dB)	(m)	(m)

Geometry Road

Name	Height				Coordinates				Dist	LSlope
	Begin		End		x	y	z	Ground	(m)	(%)
	(m)		(m)		(m)	(m)	(m)	(m)		

Receptors

Name	M.	ID	Level Lr		Limit. Value		Land Use			Height		Coordinates		
			Day	Night	Day	Night	Type	Auto	Noise Type			X	Y	Z
			(dBA)	(dBA)	(dBA)	(dBA)				(m)		(m)	(m)	(m)
POR1		POR1	68.2	68.2	0.0	0.0		x	Total	9.00	a	17594335.38	4788335.79	9.00
POR2		POR2	51.0	51.0	0.0	0.0		x	Total	9.00	a	17594367.95	4788322.35	9.00
POR3		POR3	49.5	49.5	0.0	0.0		x	Total	9.00	a	17594299.16	4788350.50	9.00
POR1-outdoor		POR1	58.3	58.3	0.0	0.0		x	Total	1.50	a	17594333.50	4788330.35	1.50

Obstacles

Barriers

Name	M.	ID	Absorption		Z-Ext.	Cantilever		Height			
			left	right		horz.	vert.	Begin		End	
					(m)	(m)	(m)	(m)		(m)	
Barrier	+	Barrier	0.37	0.37				6.50	a		

Geometry Barriers

Name	M.	ID	Absorption		Z-Ext.	Cantilever		Height				Coordinates			
			left	right		horz.	vert.	Begin		End		x	y	z	Ground
					(m)	(m)	(m)	(m)		(m)		(m)	(m)	(m)	(m)
Barrier	+	Barrier	0.37	0.37				6.50	a			17594296.28	4788349.47	6.50	0.00
												17594294.03	4788342.76	6.50	0.00
												17594367.14	4788313.26	6.50	0.00
												17594368.75	4788318.20	6.50	0.00

Building

Name	M.	ID	RB	Residents	Absorption	Height	
						Begin	
						(m)	
Townhouse1		Townhouse1	x	0	0.37	12.00	a
Townhouse2		Townhouse2	x	0	0.37	12.00	a
Warehouse		Warehouse	x	0	0.37	8.00	a

Geometry Building

Name	M.	ID	RB	Residents	Absorption	Height		Coordinates			
						Begin		x	y	z	Ground
						(m)		(m)	(m)	(m)	(m)
Townhouse1		Townhouse1	x	0	0.37	12.00	a	17594302.79	4788360.34	12.00	0.00
								17594333.66	4788349.30	12.00	0.00
								17594329.51	4788337.60	12.00	0.00
								17594298.65	4788348.74	12.00	0.00
Townhouse2		Townhouse2	x	0	0.37	12.00	a	17594335.69	4788345.02	12.00	0.00
								17594370.48	4788328.33	12.00	0.00
								17594367.17	4788320.71	12.00	0.00
								17594332.34	4788337.49	12.00	0.00
Warehouse		Warehouse	x	0	0.37	8.00	a	17594367.54	4788313.29	8.00	0.00
								17594372.32	4788329.03	8.00	0.00
								17594387.45	4788324.39	8.00	0.00
								17594383.13	4788308.26	8.00	0.00

3D Reflector

Name	M.	ID	Type	Attenuation	B	m	Height
				dB/100m	%	1/m	(m)

Geometry Absorption

Name	M.	ID	Type	Attenuation	B	m	Height	Coordinates			
				dB/100m	%	1/m	(m)	x	y	z	Ground
								(m)	(m)	(m)	(m)

Ground Absorption

Name	M.	ID	G

Geometry Absorption

Name	M.	ID	G	Coordinates	
				x	y
				(m)	(m)

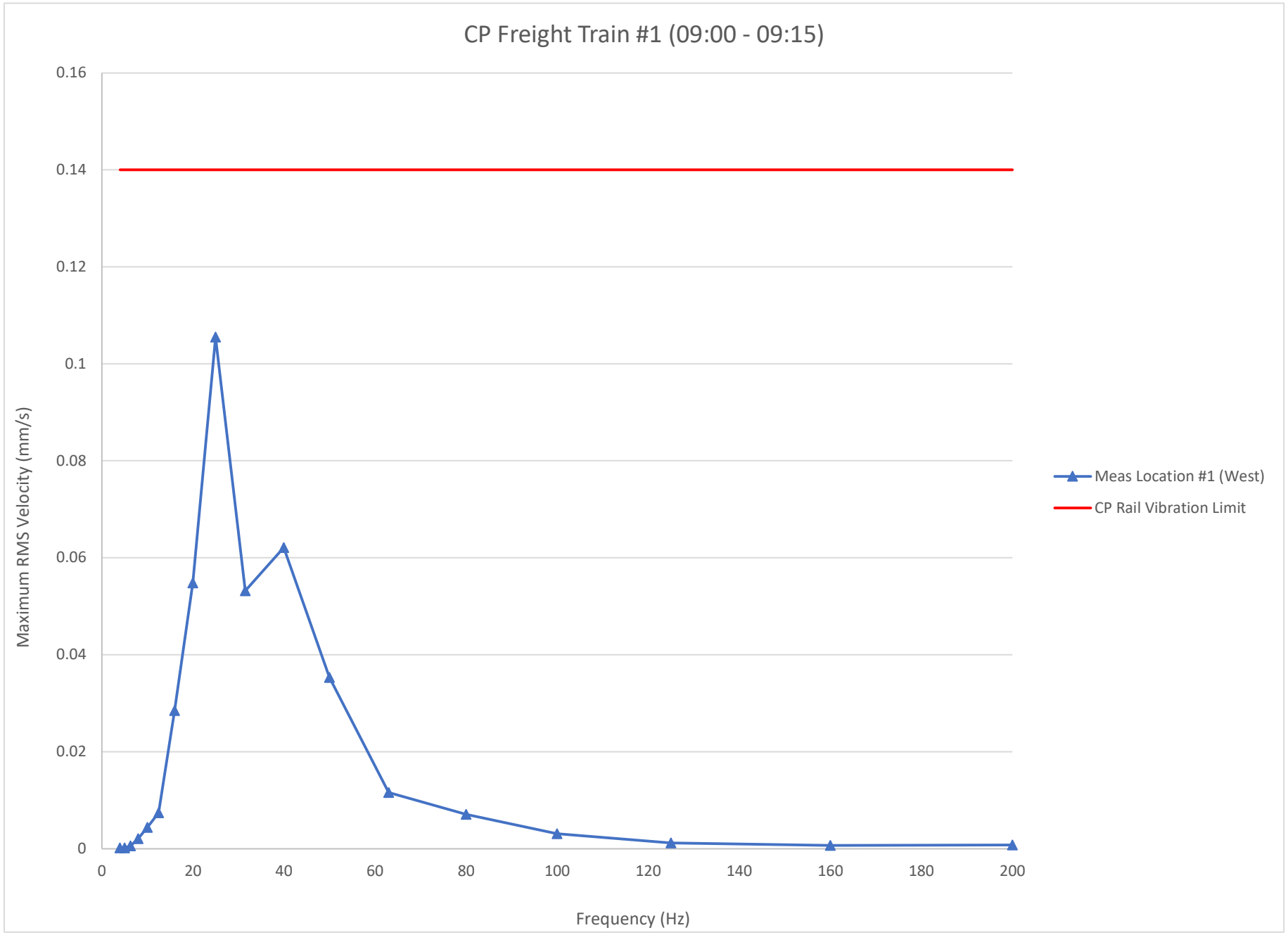
Contour Lines

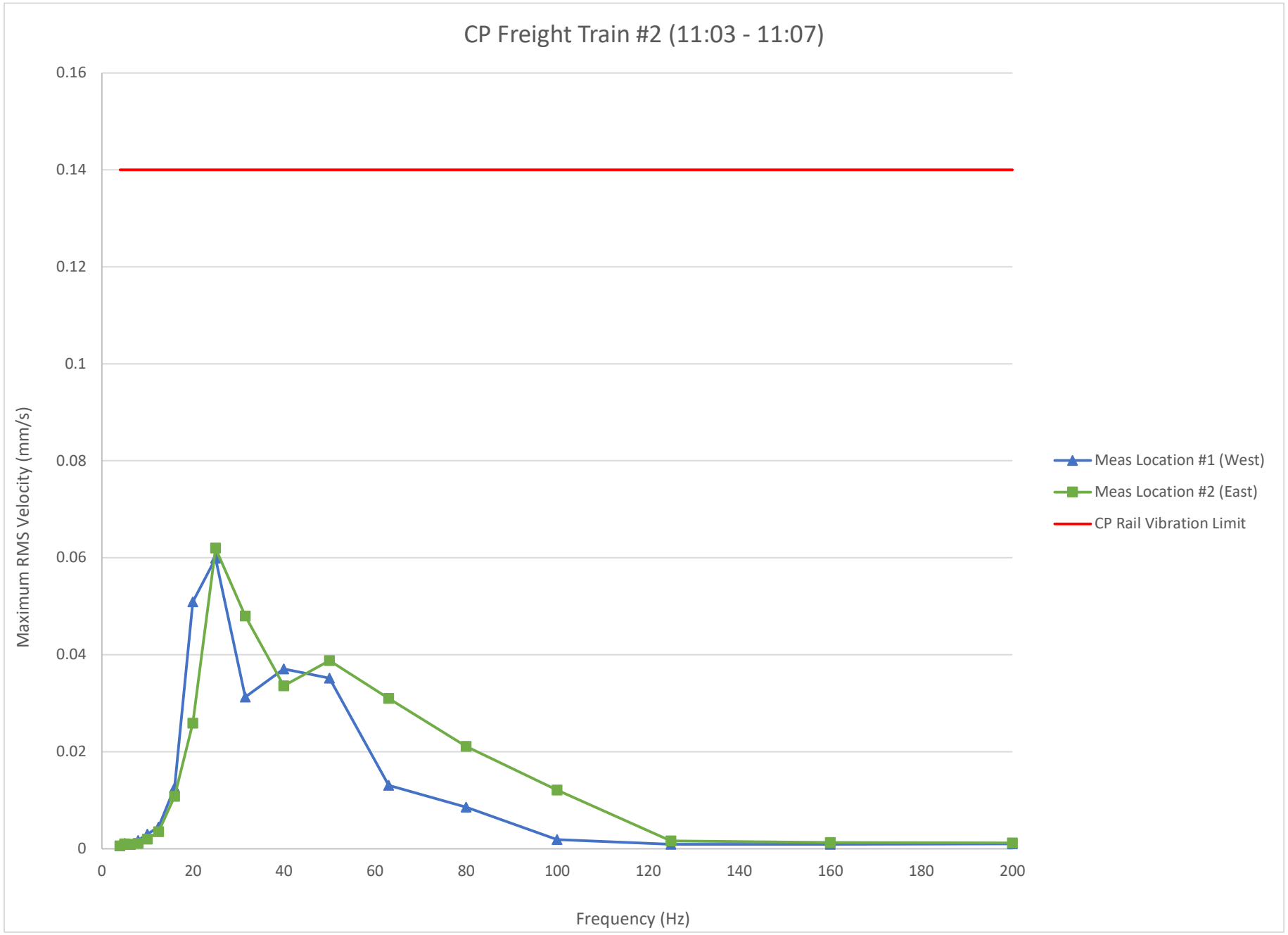
Geometry Contour Line

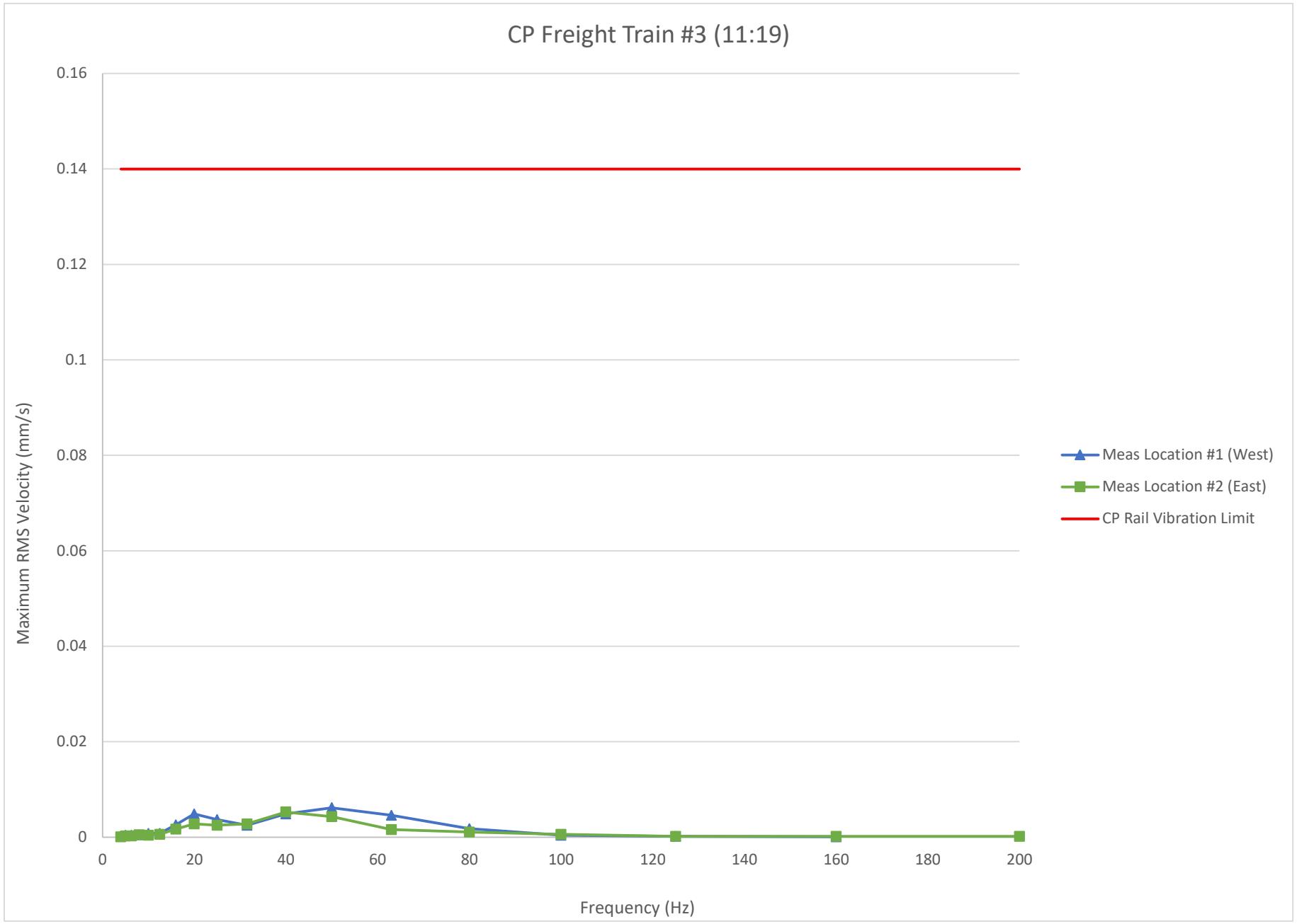
Name	M.	ID	OnlyPts	Height		Coordinates		
				Begin	End	x	y	z
				(m)	(m)	(m)	(m)	(m)
1m rail line				1.00		17594249.85	4788323.72	1.00
						17594259.94	4788350.41	1.00
						17594387.83	4788300.87	1.00
						17594377.46	4788274.10	1.00

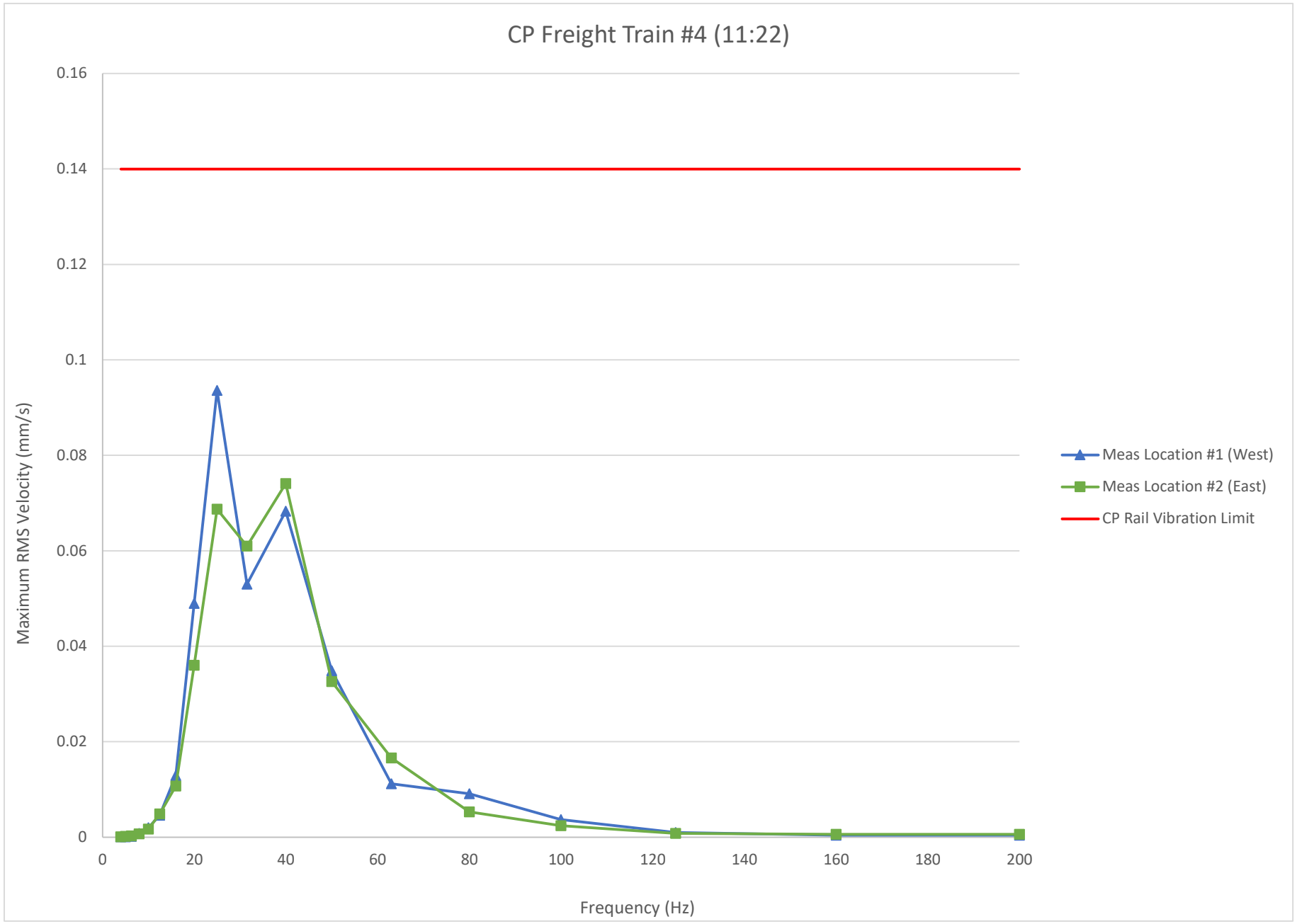
Name	M.	ID	OnlyPts	Height		Coordinates		
				Begin	End	x	y	z
				(m)	(m)	(m)	(m)	(m)
						17594250.61	4788323.33	1.00
Property Height				0.00		17594260.89	4788353.56	0.00
						17594388.78	4788303.57	0.00
						17594408.47	4788370.13	0.00
						17594278.01	4788408.74	0.00
						17594262.13	4788355.06	0.00

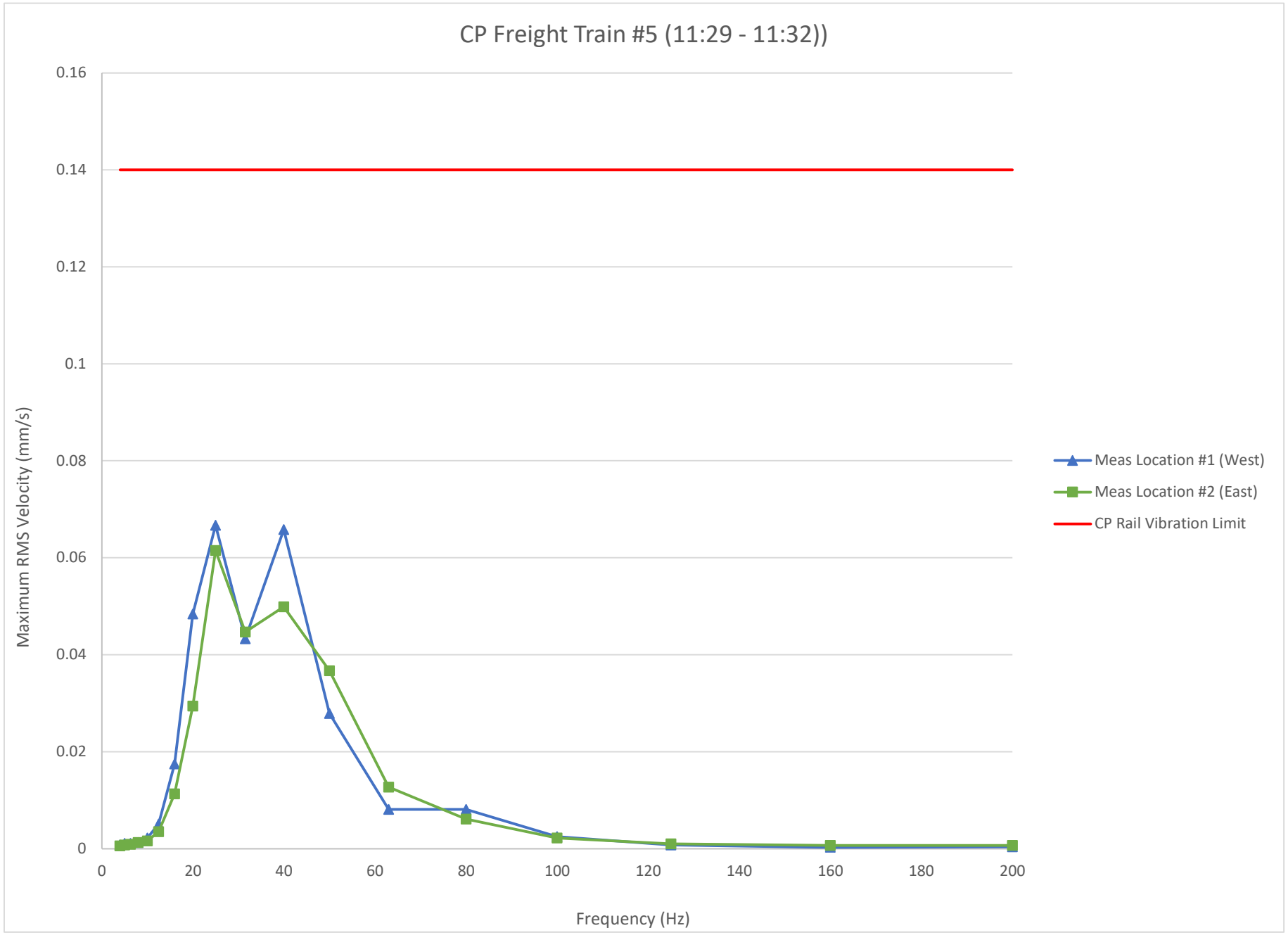
Appendix F: Rail Vibration Measurement Results

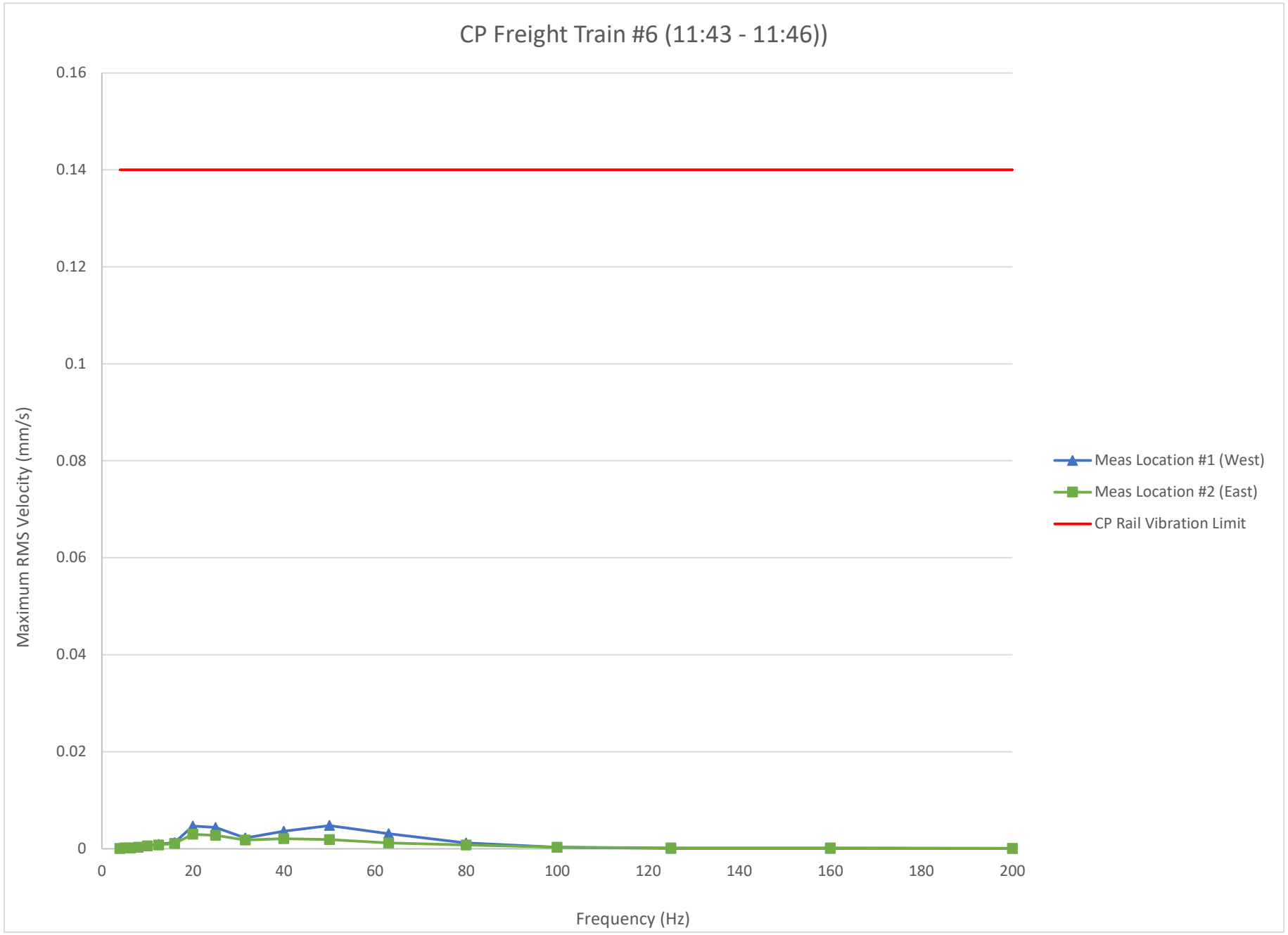

CP Freight Train #1 (09:00 - 09:15)
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Maximum RMS Velocity (mm/s)
0
20
40
60
80
100
120
140
160
180
200
Frequency (Hz)
Meas Location #1 (West)
CP Rail Vibration Limit

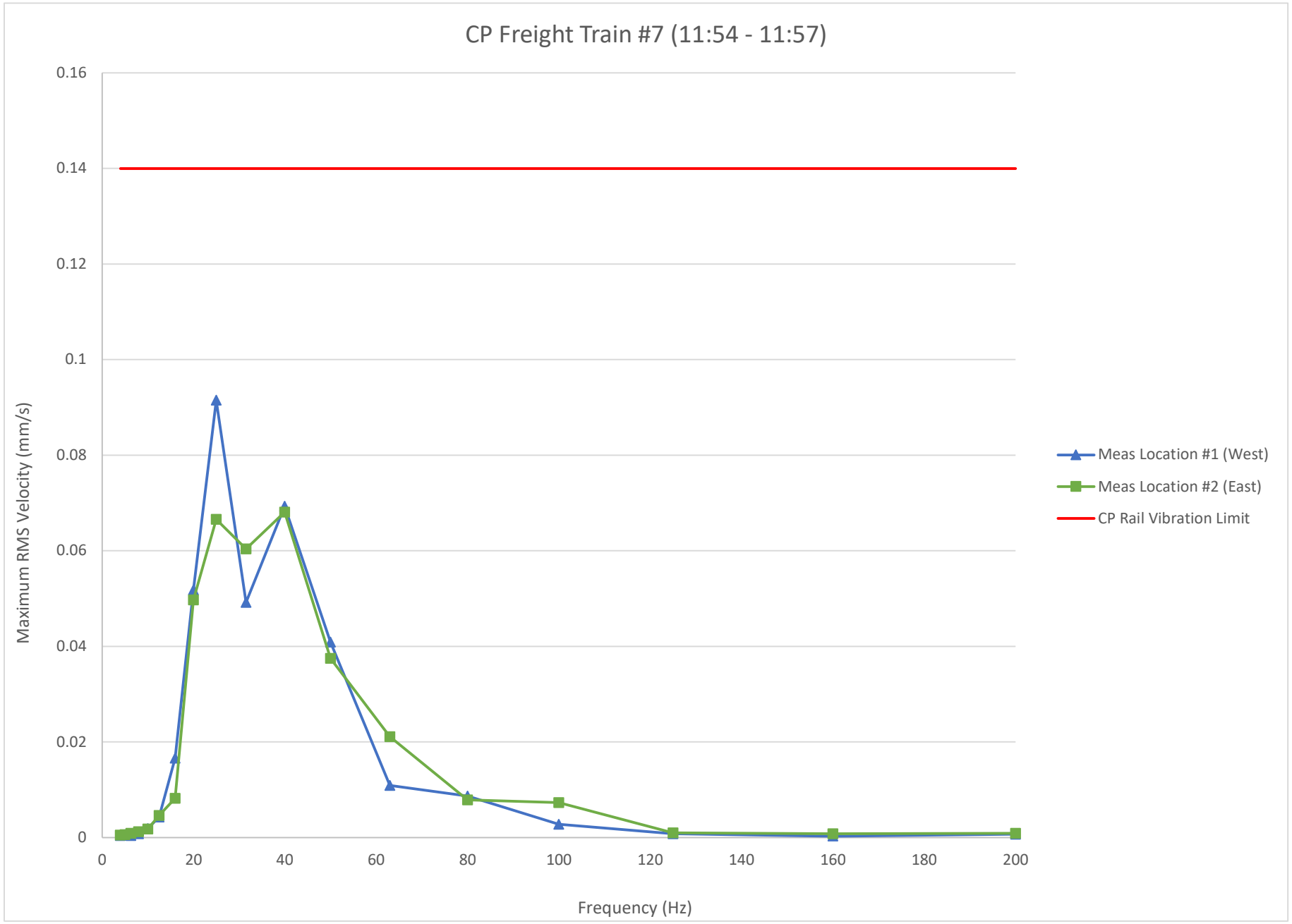

CP Freight Train #2 (11:03 - 11:07)
Maximum RMS Velocity (mm/s)
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
0
20
40
60
80
100
120
140
160
180
200
Frequency (Hz)
Meas Location #1 (West)
Meas Location #2 (East)
CP Rail Vibration Limit

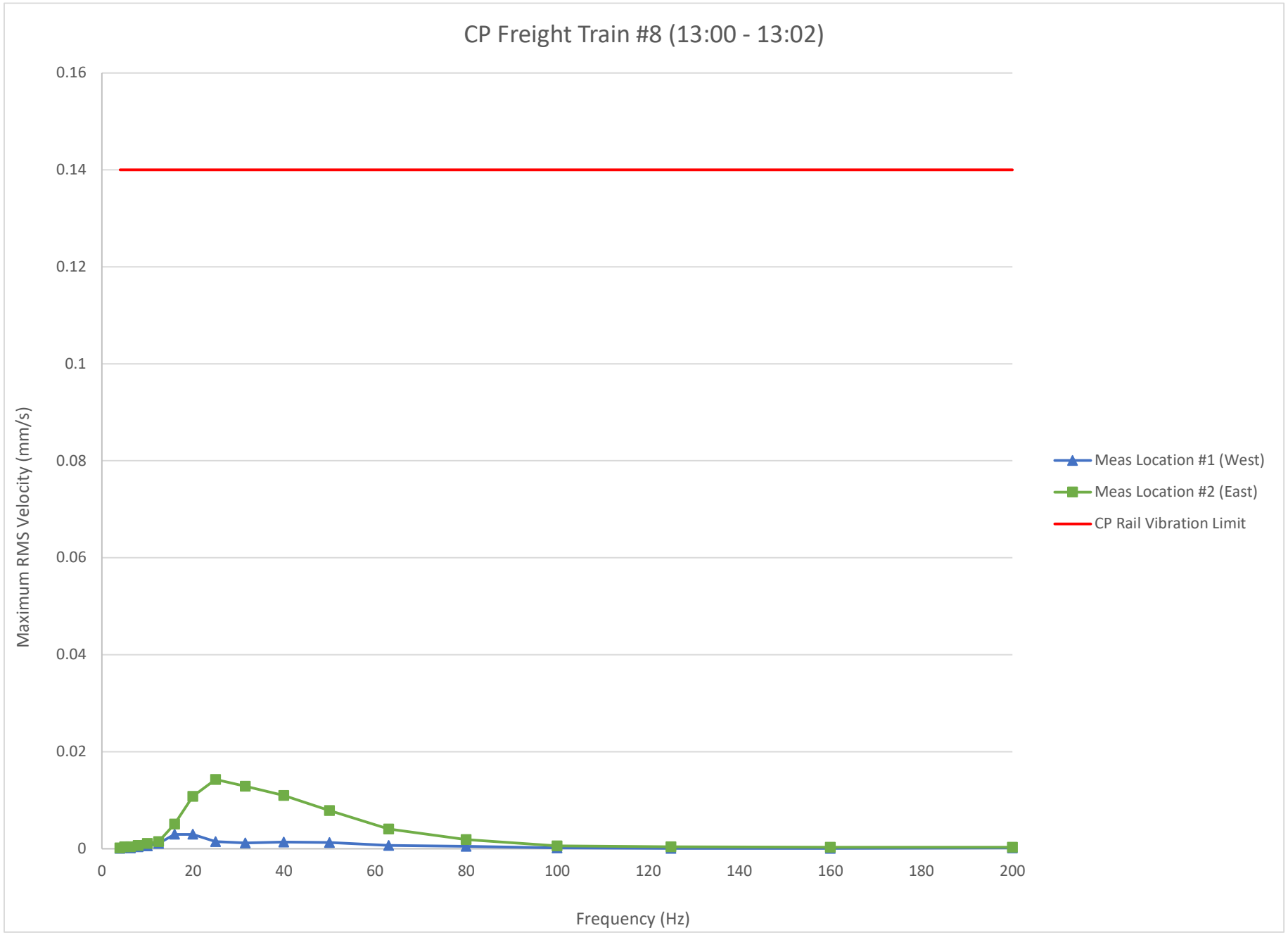

CP Freight Train #3 (11:19)
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Maximum RMS Velocity (mm/s)
0
20
40
60
80
100
120
140
160
180
200
Frequency (Hz)
Meas Location #1 (West)
Meas Location #2 (East)
CP Rail Vibration Limit

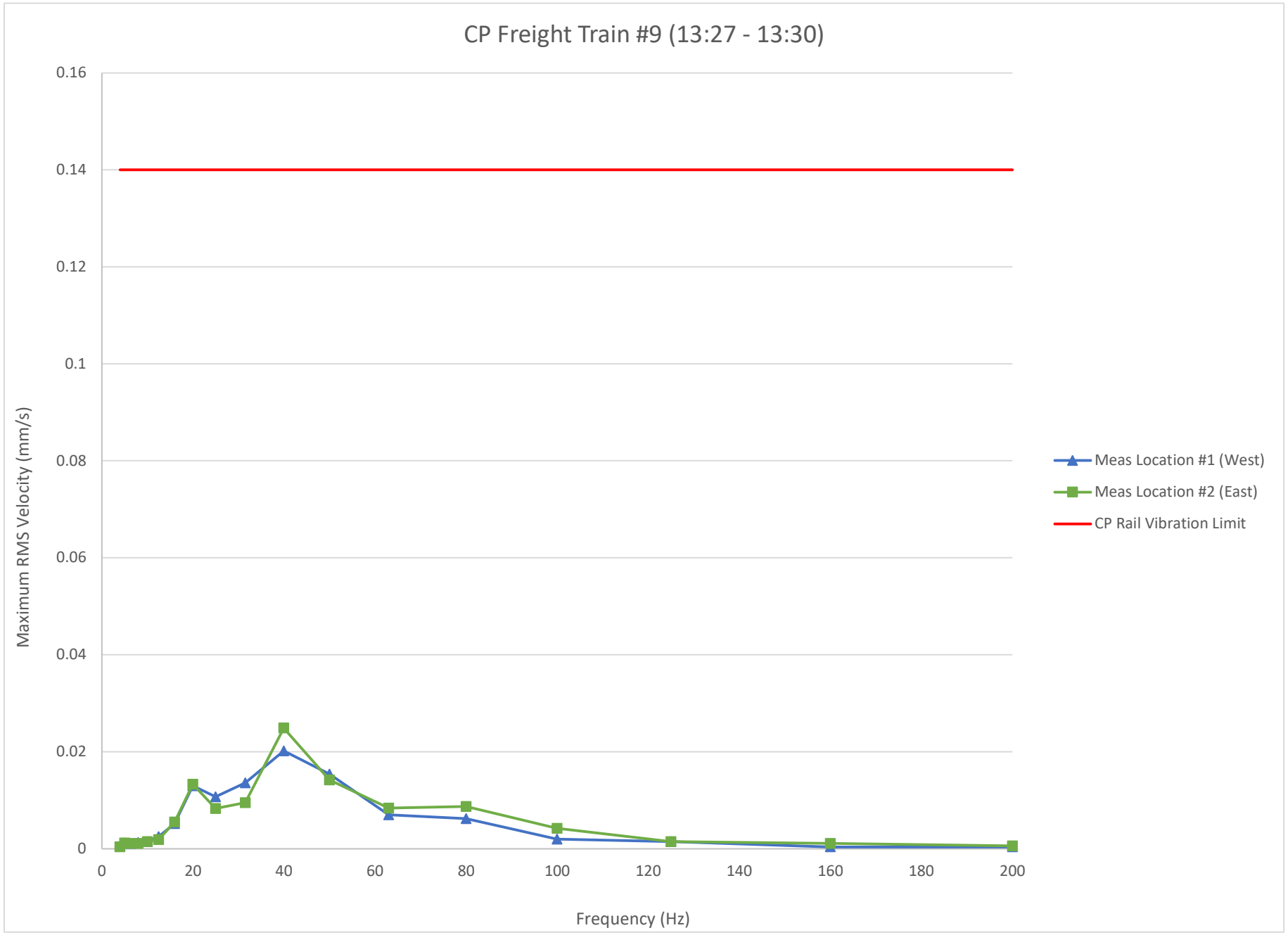

CP Freight Train #4 (11:22)
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Maximum RMS Velocity (mm/s)
0
20
40
60
80
100
120
140
160
180
200
Frequency (Hz)
Meas Location #1 (West)
Meas Location #2 (East)
CP Rail Vibration Limit


CP Freight Train #5 (11:29 - 11:32))
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Maximum RMS Velocity (mm/s)
0
20
40
60
80
100
120
140
160
180
200
Frequency (Hz)
Meas Location #1 (West)
Meas Location #2 (East)
CP Rail Vibration Limit


CP Freight Train #6 (11:43 - 11:46))
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Maximum RMS Velocity (mm/s)
0
20
40
60
80
100
120
140
160
180
200
Frequency (Hz)
Meas Location #1 (West)
Meas Location #2 (East)
CP Rail Vibration Limit


CP Freight Train #7 (11:54 - 11:57)
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Maximum RMS Velocity (mm/s)
0
20
40
60
80
100
120
140
160
180
200
Frequency (Hz)
Meas Location #1 (West)
Meas Location #2 (East)
CP Rail Vibration Limit


CP Freight Train #8 (13:00 - 13:02)
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Maximum RMS Velocity (mm/s)
0
20
40
60
80
100
120
140
160
180
200
Frequency (Hz)
Meas Location #1 (West)
Meas Location #2 (East)
CP Rail Vibration Limit


CP Freight Train #9 (13:27 - 13:30)
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Maximum RMS Velocity (mm/s)
0
20
40
60
80
100
120
140
160
180
200
Frequency (Hz)
Meas Location #1 (West)
Meas Location #2 (East)
CP Rail Vibration Limit