Viterra's Pacific Terminal
Dust Control & Ship Loader Upgrades
Community Noise Asessment Report

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Executive Summary

Viterra is seeking permit approval from Port Metro Vancouver (PMV) to upgrade the terminal's dust control system (Project A - PP 2014-036) and shiploading system (Project B - PP 2014-081).

This report documents existing noise conditions in the immediate area of Pacific Terminal and provides a community noise impact assessment for the proposed upgrade projects.

Baseline noise monitoring was conducted at two community locations that are exposed to noise from Pacific Terminal. The average weekday Ldn at Site 1 – 2001 Wall Street was 76dBA. The average weekday Ldn at Site 2 – 1801 Powell Street was 77dBA. The baseline noise survey results confirm that noise exposure levels within the immediate community fronting the rail corridor within the Study Area are in excess of Ldn 75dBA.

The US Department of Housing and Urban Development suggests that a noise exposure level in excess of Ldn 75dBA is considered unacceptable for new housing. Therefore, for the purposes of this noise assessment, any predicted increase in total noise exposure at a community residence resulting from the proposed Pacific Terminal upgrade Projects A and B is considered to result in a significant noise impact, which could be regarded as unacceptable without satisfactory mitigation.

Noise levels within the Study Area were assessed under the following conditions:

- Scenario 1: Existing Conditions
- Scenario 2: Future Conditions following Project A upgrade (Dust Control Upgrade)
- Scenario 3: Future Conditions following Project A and B upgrades (Dust Control Upgrade and Ship Loading Upgrade)

Analysis of the Scenario 2 noise model results indicate no increases in total noise exposure resulting from the Pacific Terminal Dust Control Upgrade. Therefore, this project will present no noise impact to the community.

A 1dBA increase in total noise exposure (in terms of the Ldn) is predicted at 1701 Powell Street, which is an artist work/live studio complex, under Scenario 3 conditions. The increase in noise at this receiver is attributed to projected increases in rail movements at Pacific Terminal permitted by the Ship Loader Upgrade Project. This 1dBA increase in Ldn is considered significant. Noise mitigation in the form of whistling cessation at the two Pacific Terminal road crossings can be used to offset this impact. This, however, would require the approval of Transport Canada.

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1 Introduction

Viterra is the owner and operator of Pacific Terminal which is located at 1803 Stewart Street on the south shore of the Burrard Inlet in Vancouver. Pacific Terminal is a specialty crop (canola, peas, lentils, soybeans and corn) bulk handling facility. Viterra is modernizing the facility to increase its capacity to up to 6,000,000 metric tonnes (mt) per annum. As part of the modernization program for Pacific Terminal, Viterra is seeking permit approval from Port Metro Vancouver (PMV) to upgrade the terminal's dust control system (Project A - PP 2014-036) and shiploading system (Project B - PP 2014-081).

This report documents existing noise conditions in the immediate area of Pacific Terminal and provides a community noise impact assessment for the proposed upgrade projects.

1.1 Project Description

1.1.1 Modernization of Dust Control Systems (Project A)

This upgrade includes the installation of ten Collection Filters and one Transportation Filter for meeting future ASHRAE/HRSDC suspended dust standards, and preparation of the facility for increased throughput. The filters will be installed on a new elevated structure to be constructed between Pacific 1 (PAC1) and Pacific 2 (PAC2) Storage Buildings (see Figure 1). A total of five existing filters will be eliminated and demolished as part of the upgrade.

1.1.2 Ship Loading System Upgrade (Project B)

A new ship loading system is to be constructed along LaPointe Pier as shown in Figure 1. The new ship loading system will replace the existing ship loading system which is situated along the PAC1 Jetty. The existing ship loading system is capable of conveying up to 1350 metric tonnes per hour (mtph) of material. The proposed ship loading system will be capable of conveying up to 2800mtph of bulk material. The new ship loading system will be able to load vessels up to 38m beam width with full hatch coverage. The ship loader design will utilize a Cleveland Cascade chute system for loading in an effort to control fugitive dust.

Figure 1: Overview of Pacific Terminal Ship Loading Operation Upgrade

1.2 Study Objectives

The main objectives of this study are to:

1. Establish through noise monitoring, the existing noise conditions at two community locations exposed to noise from the Pacific Elevators Terminal.

2. Implement a noise model to predict Pacific Terminal noise emissions within the immediate community in terms of overall total[1] and specific[2] noise under the following scenarios:

   - Scenario 1: Existing Conditions
   - Scenario 2: Future Conditions following Project A upgrade
   - Scenario 3: Future Conditions following Project A and B upgrades

3. Compare predicted Scenario 2 and Scenario 3 noise levels with predicted Scenario 1 baseline noise levels and assess the significance of any indicative noise increases.

4. Where necessary, assess the effectiveness of practical mitigation measures.

1.3 Study Area

Noise exposure levels were assessed at a total of 23 discrete community receiver locations (see Figure 2). The receivers represent residences within the nearby community. They were identified by using Google Street View. The receivers were divided into three groups, G1 through G3. G1 consists of nine receivers (G1-01 to G1-09) which directly front the rail corridor on Powell Street and Wall Street between Commercial Drive and North Templeton Drive. G2 receivers are situated on the south site of Wall Street between Dundas Street and McGill Street. G3 receivers are located on the north side of Triumph Street between Salisbury Drive and Lakewood Drive.

[1] Total noise within the context of this report refers to the totally encompassing noise level resulting from the combined sound energy contributions of all sound sources in the area

[2] Specific noise within the context of this report refers to the totally encompassing noise level resulting from the combined sound energy contributions of all Pacific Terminal sound sources

Figure 2: Aerial photograph showing Viterra Pacific Terminal and Group 1 to Group 3 receiver locations

2 Noise Assessment Criteria

Extensive socio-acoustic studies have focused on the development of a noise metric that provides a good indicator of annoyance from various community noise sources. The most successful and influential of these studies was performed by Shultz [1]. This study provided three synthesized curves for road, air and railway traffic noise. The curves relate the percentage of people highly or moderately annoyed to the day-night average sound level (Ldn). The use of the Ldn as a metric for the assessment of community noise impact has been generally accepted by regulatory bodies worldwide (including Health Canada). A description of the Ldn can be found in Appendix A. WHO [2] states that the Ldn is, in most cases, an acceptable approximation of annoyance. However, the application of this metric to noise sources other than traffic (road, air, and railway) is questionable. For example, high levels of community annoyance can be present in a low Ldn environment where there is a frequent or continuous noise source that contains low frequency or tonal components, or is highly impulsive in nature (i.e. shooting ranges). It is also important to note that other non-acoustic factors that are typically of a social, psychological or economic nature can also contribute to community annoyance.

The US Department of Housing and Urban Development [3] suggests that a noise exposure level in excess of Ldn 75dBA is considered unacceptable for new housing. Existing noise exposure levels at residences immediately fronting the South Shore Corridor within the Study are already at or above this threshold. Therefore, for the purposes of this noise assessment, any predicted increase in total noise exposure at a community residence resulting from the proposed Pacific Terminal upgrade Projects A and B is considered to result in a significant noise impact, which could be regarded as unacceptable without satisfactory mitigation.

3 Pre-Project Noise Levels

3.1 Measurement Procedure

Measurements were conducted in accordance with ISO 1996-2. This ISO standard defines the basic quantities to be used for the description of noise in community environments, and describes basic procedures for the determination of these quantities.

3.2 Measurement Equipment

Larson Davis LxT Handheld Sound Level Analyzers were used for the measurements. The meters were calibrated using a Larson Davis CAL 200 Calibrator before and after the measurement. Table 1 below provides a summary of the measurement equipment used.

Table 1: Equipment Summary

Site	Equipment	Make & Model	Serial Number
1	Sound Level Meter	Larson Davis LxT	3617
	Microphone	PCB Type 377B20	LW134406
	Preamplifier	PCB PRMLxT1L	27684
	Calibrator	Larson Davis CAL 200	10585
2	Sound Level Meter	Larson Davis LxT	3616
	Microphone	PCB Type 377B20	LW134403
	Preamplifier	PCB PRMLxT1L	27683
	Calibrator	Larson Davis CAL 200	10585

3.3 Data Analysis

The logging feature of the Larson Davis LxT sound level meter was used to collect one second noise data over the measurement period. Data was also logged simultaneously in 10 minute periods. Proprietary software from PCB Piezotronics Inc. was used to download and export the data for tabular and graphical reporting.

3.4 Measurement Description

Baseline noise monitoring was conducted at two community locations over an 11 day period between April 25th and May 6th 2014. The two locations, referred to as Site 1 and Site 2, are shown in Figure 2.

3.4.1 Site 1: 2001 Wall Street (Cannery Row Lofts)

Noise monitoring was performed on the rooftop of the Cannery Row Lofts apartment block located at 2001 Wall Street, Vancouver. The microphone was situated near the northwest corner of the building at a height of 1.5m above the roof. This location is approximately 280m from the east railroad crossing at Pacific Terminal. The measurements were recorded from 07:00 on Friday, April 25th, 2014 to 07:00 on Tuesday, May 6th, 2014. A photograph of the monitoring location is shown in Figure 3.

The noise environment at this location is dominated by LaFarge activities, road traffic noise on Stewart Street and noise from the rail corridor. The monitoring location at Site 1 had a direct line of sight to the Pacific Terminal rooftop units and to the Pacific Terminal ship loading area. In terms of total noise, Pacific Terminal is not a significant sound energy contributor to the noise environment at this assessment location. This site was selected for monitoring primarily to assess the influence of the Pacific Terminal roof-top units on the residual[3] noise level.

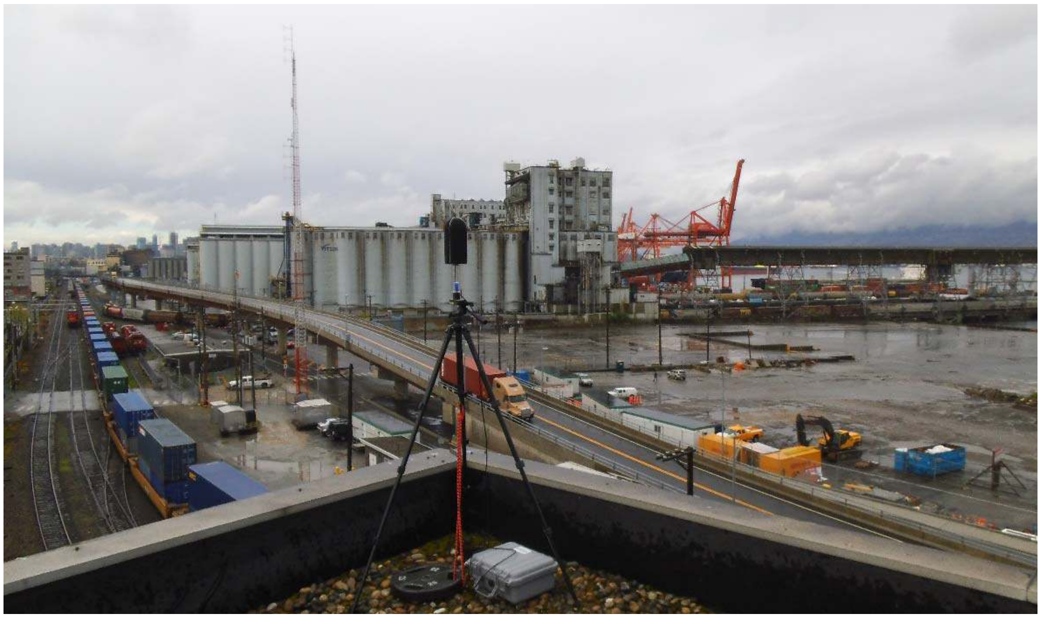

Figure 3: Cannery Row rooftop measurement position

3.4.2 Site 2: 1801 Powell Street (West Coast Alignment & Frame lot)

Noise monitoring was performed on the east lot of West Coast Alignment & Frame Ltd located on 1801 Powell Street, Vancouver. The microphone was situated on the fence along the northern property line at a height of 2.5m above the ground. This location is approximately 45m from the east railroad crossing at Pacific Terminal. Measurements at this site were recorded from 07:00 on Friday, April 26th, 2014 to 07:00 on Monday, May 5th, 2014. A photograph of the location is shown in Figure 4.

The noise environment at this location is dominated by noise from Pacific Terminal, the rail corridor, Powell Street and the Stewart Street Elevated Road Structure. This site was selected for monitoring due to its close proximity to Pacific Terminal. The site also shares a similar noise climate to the residential dwelling at 1701 Powell Street which is the nearest residential building to Pacific Terminal.

[3] Residual noise refers to the ambient noise level remaining at a given position in a given situation when one or more specified noises are suppressed

Figure 4: West Coast Alignment & Frame measurement position

3.5 Weather Conditions

The nearest Environment Canada weather stations are located in Coal Harbour in Downtown Vancouver, and at Vancouver Wharves Terminal in North Vancouver. They are approximately 4.0km and 4.7km from the measurement site respectively. The Coal Harbour station has historical temperature information, while the Vancouver Wharves station provides historical precipitation information. The archived weather information is shown in Table 2.

Table 2: Historical weather information from Environment Canada

Date	High (°C)	Low (°C)	Precipitation (mm)
Friday, April 25	13	7	0
Saturday, April 26	14	7	17
Sunday, April 27	13	7	0.2
Monday, April 28	16	6	0
Tuesday, April 29	20	10	0
Wednesday, April 30	20	9	0
Thursday, May 1	23	10	0
Friday, May 2	20	12	0
Saturday, May 3	14	10	12
Sunday, May 4	11	9	15
Monday, May 5	16	9	0

3.6 Measurement Results

Measurement results in terms of the day-night equivalent sound level (Ldn), the daytime equivalent sound level (Ld), the nighttime equivalent sound level (Ln), the 24-hour equivalent sound level (Leq24) and the sound level exceeded over 90% of the time (L90) are provided below in Table 3 for Site 1, and in Table 4 for Site 2. Further information regarding these noise metrics can be found in Appendix A. As a summary, the Weekday Average is the arithmetic mean of values from Monday to Friday, while the Weekend Average is the arithmetic mean of values on Saturday and Sunday.

Table 3: Summary of measurement results at Cannery Row

Day	Start Date	Ldn (dBA)	Ld (dBA)	Ln (dBA)	Day L90 (dBA)	Night L90 (dBA)
1	Friday, April 25	76	71	69	63	57
2*	Saturday, April 26	74	69	68	59	55
3	Sunday, April 27	75	68	69	60	58
4	Monday, April 28	75	70	69	62	58
5	Tuesday, April 29	75	71	68	62	58
6	Wednesday, April 30	76	72	69	63	59
7	Thursday, May 1	76	71	69	62	59
8**	Friday, May 2	75	71	68	62	56
9*	Saturday, May 3	76	67	70	59	57
10***	Sunday, May 4	73	67	67	60	59
11	Monday, May 5	76	72	69	63	59
Weekday Average		76	71	69	62	58
Weekend Average		75	68	68	60	57

* Pacific Terminal not in operation during monitoring period
** Pacific Terminal not in operation during nighttime period
*** Pacific Terminal not in operation during daytime period

Table 4: Summary of measurement results at West Coast Alignment & Frame

Day	Start Date	Ldn (dBA)	Ld (dBA)	Ln (dBA)	Day L90 (dBA)	Night L90 (dBA)
1	Friday, April 25	77	70	71	64	61
2*	Saturday, April 26	75	68	69	60	52
3	Sunday, April 27	78	70	72	62	61
4	Monday, April 28	76	70	70	65	63
5	Tuesday, April 29	77	72	70	66	61
6	Wednesday, April 30	79	73	72	66	64
7	Thursday, May 1	78	71	71	65	64
8**	Friday, May 2	75	70	69	66	55
9*	Saturday, May 3	77	67	71	57	51
10***	Sunday, May 4	76	68	69	60	64
Weekday Average		77	71	70	65	61
Weekend Average		76	68	70	60	57

* Pacific Terminal not in operation during monitoring period
** Pacific Terminal not in operation during nighttime period
*** Pacific Terminal not in operation during daytime period

3.7 Discussion

The L90 is a useful noise metric for quantifying the residual noise level in a given environment. At sites 1 and 2, the residual noise level is dominated mostly by local continuous noise sources, such as the dust collection filter fan units at Pacific Terminal. The residual noise level at Site 2 is strongly influenced by continuous noise sources at Pacific Terminal (i.e. externally located fans and filters). The data provided in Table 4 indicate an approximate 10dBA difference in the nighttime L90 between periods with and without the operation of Pacific Terminal. At Site 1, which is at a greater setback distance from Pacific Terminal, an approximate 2dBA difference was observed.

The Ld and Ln values provided in Tables 3 and 4 are considerably higher than their corresponding L90 values. This indicates that noise sources other than the continuous noise sources at Pacific Terminal, such as road and rail traffic, are the most dominant noise sources in the area of Sites 1 and 2.

4 Predictive Noise Modelling

4.1 General

Noise levels within the Study Area were assessed under the following conditions:

- Scenario 1: Existing Conditions
- Scenario 2: Future Conditions following Project A upgrade (Dust Control Upgrade)
- Scenario 3: Future Conditions following Project A and B upgrades (Dust Control Upgrade and Ship Loading Upgrade)

Datakustik's computer aided noise modelling software CadnaA was used to model Scenario 1 to 3 noise exposure levels within the Study Area. The software implements the outdoor sound propagation procedure presented in standard ISO 9613-2 for the modelling of noise emissions from industrial noise sources (i.e. point sources, line sources and area sources). CadnaA also implements the French method (Nouvelle Métode de Prevision du Bruit des Routes – NMPB) for road traffic noise prediction. NMPB has been adopted as the official noise prediction method for roads regulated by the European Directive on Environmental Noise 2002/49/CE.

The implemented noise model takes into account the effects of sound energy losses caused by geometrical divergence, atmospheric absorption, refraction in the atmosphere, ground effects and the screening of obstacles (i.e. intervening terrain, buildings, noise barriers). These phenomena are further described in Appendix A – Basics of Outdoor Sound Propagation.

Noise predictions were evaluated under the following model conditions:

- Temperature: 10°C
- Humidity: 70%
- Meteorological Conditions Favourable to Sound Propagation: 50% during the daytime hours (07:00 – 22:00 hours), 100% during night-time hours (22:00 – 07:00 hours).
- Ground absorption factor: 0
- Order of reflections: 3

The noise model included significant noise sources from Pacific Terminal, Stewart Street, the main rail corridor and local roads including Powell Street and Wall Street.

4.2 Model Input for Scenario 1 – Existing Conditions

4.2.1 Pacific Terminal

Modelled Pacific Terminal noise sources included the following:

- External continuously operating filter fans
- Pacific Terminal locomotive idling at several locations near the rail receiving shed
- Locomotive idling during the indexing of rail cars at the receiving shed
- The transport of empty rail cars from the track shed located on the east side of PAC1 to the storage tracks located on the west side of PAC3
- The transport of full rail cars from the storage tracks to the track shed
- The delivery and pickup of rail cars at the storage tracks by CP
- Whistling during road crossings
- Bell sounding during road crossings
- Vessel loading noise generated bulk discharge from shipping spouts

Table 5 summarizes the Pacific Terminal noise sources included in the model. Sound data describing the listed noise sources from Pacific Terminal were obtained from on-site measurements. Daytime and nighttime operating time periods were assigned to the intermittent activities. The operating time periods were based on the observed duration of each event and the average number of cars processed during the daytime and nightime. As an example, it was observed on site that the crossing bells were active for an approximate 3 minute period during a road crossing. Currently, Pacific Terminal processes (on average) 87 rail cars per day (67 during the daytime period and 20 during the nightime period). It is assumed that the 67 daytime rail cars are transported to/from the receiving shed in 10 sections consisting of a string of 6 to 7 rail cars. The crossing bells would be activated for a three minute duration on two occasions for each section: once as the rail string moves from the storage tracks, and once on the return trip from the receiving shed to the storage tracks. Therefore, during the daytime period, the point sources describing the crossing bells were assigned an operating time of 3 minutes x 10 sections x 2 crossing/section = 60 minutes.

The noise sources presented in Table 5 are shown graphically in the site plan provided in Figure 5. A 3D view of the noise model is shown in Figure 6.

Table 5: Summary of Modelled Scenario 1, 2 and 3 Pacific Terminal Noise Sources

Source	Source Type	Description	Estimated Sound Power Level (dBA)	Daytime Operating Time (min)	Nighttime Operating Time (min)	Scenario 1 (Existing)	Scenario 2 (Dust Collector Upgrade)	Scenario 3 (Ship Loader Upgrade)
F1 – F3	Point	Dust collection filter fans mounted on east façade of PAC1	111	Continuous		Y	N	N
F4		Pellet mill fan units mounted at grade near south façade of PAC1	107			Y	Y	Y
F5		PAC1 rooftop filter fan units	117			Y	Y	N
F6		Track shed blower units	97			Y	Y	Y
F7		Track shed filter fan	97			Y	Y	Y
F8		Track shed filter fan	95			Y	Y	Y
F9		PAC2 rooftop blower unit	98			Y	N	N
F10		PAC2 rooftop filter unit	105			Y	N	N
F11		PAC2 filter fan	98			Y	N	N

Table 5 continued on following page

Source	Source Type	Description	Estimated Sound Power Level (dBA)	Daytime Operating Time (min)	Nighttime Operating Time (min)	Scenario 1 (Existing)	Scenario 2 (Dust Collector Upgrade)	Scenario 3 (Ship Loader Upgrade)
I1 – I7		Idling Locomotive	103	48.0	14.0	Y	Y	Y - Sound power increased by 3.5dB to account for increased volumes
W1– W4		Locomotive Whistling	120	2.0	1.2	Y	Y	
B1 – B4		Crossing Bells	96	60	18	Y	Y	
R1 – R2	Line	Delivery/pickup of six car string to/from receiving shed	112	30	9	Y	Y	
C1		Delivery/Pickup of 87 rail cars by CP along storage tracks	112	22.3	22.3	Y	Y	
H1 – H3	Area	Vessel loading noise	97	Continuous		Y	Y	Y – moved to LaPointe Pier
FF1 – FF10	Point	New Dust Control Filter Fans	93	Continuous		N	Y	Y

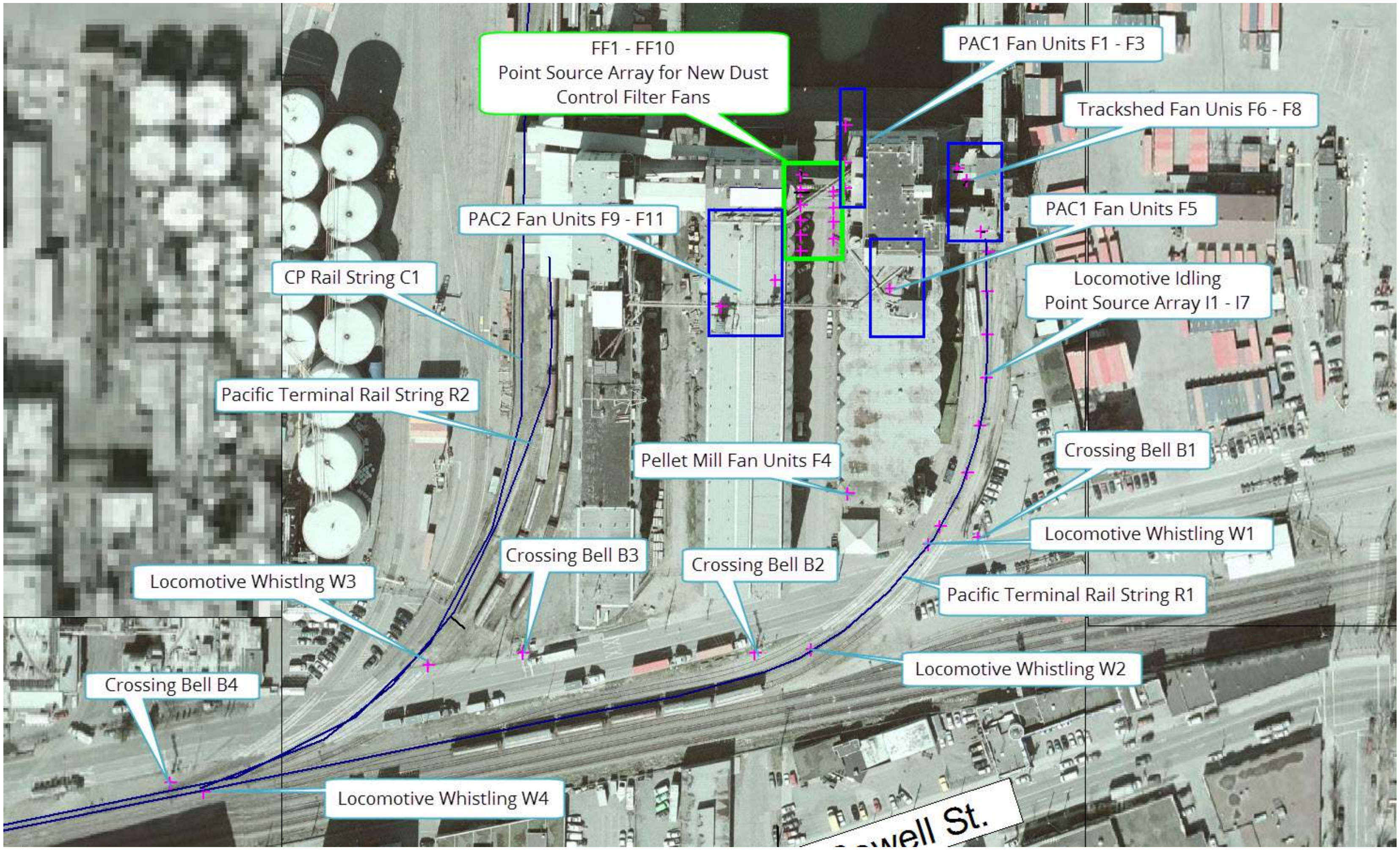

Figure 5: Overview of modelled Pacific Terminal noise sources

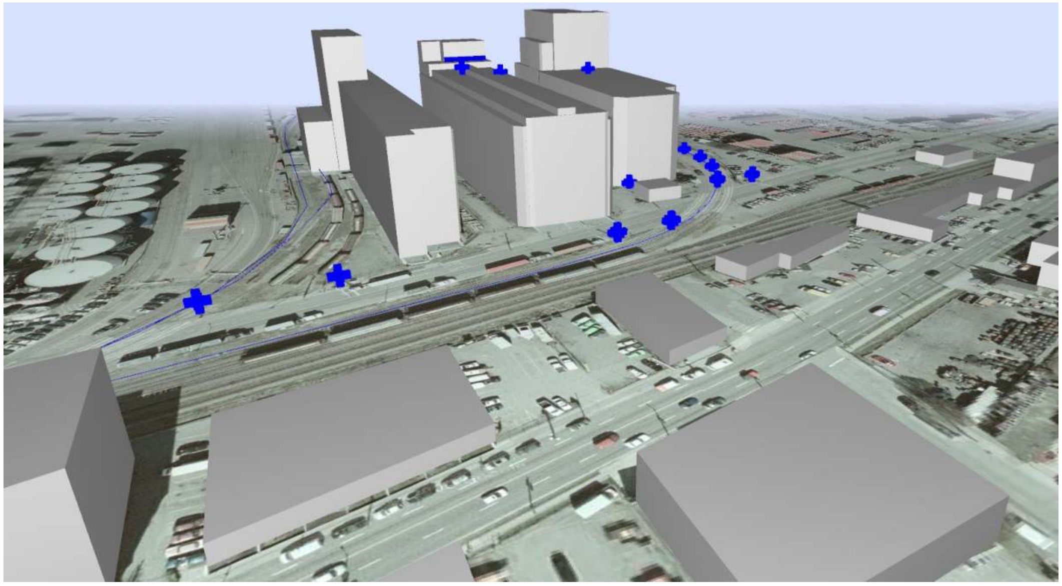

Figure 6: 3D view of Pacific Terminal Noise Model

4.2.2 Road Traffic

Noise emissions from Powell Street, Wall Street and Stewart Street (including the recently constructed Stewart Street Elevated Road Structure - SSERS) were included in the noise model. Modelled road noise emissions are defined by road traffic volumes, vehicular road speed, and the percentages of heavy vehicles. Table 3 summarizes the road traffic noise model input parameters applied in the noise model.

Two-way traffic volume information for Stewart Street was obtained from [4]. Traffic volume information for Powell Street was derived from a short-term roadside measurement performed at the intersection of Powell Street and Salisbury Drive and from the diurnal traffic volume information provided the City of Vancouver's Geographical Information System (GIS) – VanMap. Traffic volume information for Wall Street was obtained directly from VanMap.

Table 6: Summary of road traffic noise model input data

Road	Daily Two Way Road Traffic Volume		Road Speed (km/hr)	% Heavy Vehicles
	Day	Night		
Stewart Street	3486	381	50	90
Powell Street	16005	1908		10
Wall Street	2115	297		1

4.2.3 Main Line Rail

Rail noise, other than that associated with Pacific Terminal, was modelled using a single line source. This source was calibrated to the baseline noise data collected at Sites 1 and 2 following the introduction of the noises sources described in 4.2.1 and 4.2.2 into the noise model.

4.3 Model Input for Scenario 2 – Duct Collection Upgrade

4.3.1 New Dust Control Filter Fans

The new dust collection filter fans have been specified to meet an 85dBA noise limit at a distance of 1 metre from the units.

Ten new filter fan units (FF1 – FF10) were introduced into the model between the PAC1 and PAC2 annexes as shown in Figure 5. The new fan units were modelled as point sources which meet the Viterra noise specification described above. The modelled point sources were assigned a sound power level of 93dBA (see Table 5).

The upgraded dust collection system will serve to replace existing filter fan units at Pacific Terminal. Accordingly, sources F1 - F3, F9 - F11 (see Table 5) were deactivated in the Scenario 2 noise model.

4.4 Model Input for Scenario 3 – Ship Loading Upgrade

As shown in Table 5, noise associated with ship loading was included in the Scenario 1 noise model. The same area sources used in Scenario 1 were included in Scenario 3 to model emissions from the upgraded ship loader. However, the sources were moved alongside LaPointe Pier. Sound power data describing noise emissions from ship loading activity was derived from on-site measurements. It was observed during the collection of this data, that noise associated with ship loading is not a significant source of noise energy at Pacific Terminal. Noise associated with the upgraded ship loader on its own is not expected to be a significant source of noise energy in the future. However, the ship loading upgrade will allow for greater throughput at Pacific Terminal. This will result in an increased number of rail movements at Pacific Terminal.

Currently, Pacific Terminal processes, on average, 87 rail cars per day. Following the ship loading upgrade, Pacific Terminal is expected to process up to 200 rail cars per day. Increases in rail noise are logarithmically proportional to increases in volumes. Therefore, a 3.5dB increase in Pacific Terminal specific rail noise is expected following the ship loading upgrade. This increase was applied to all I, W, B and R noise sources detailed in Table 5 in the Scenario 3 noise model.

It was communicated by Viterra, that following the ship loading upgrade, that external filter fan units mounted on the rooftop of PAC1 will be removed. Therefore, filter fan units F5 were removed from the Scenario 3 noise model.

5 Predictive Noise Model Results

5.1 Pacific Terminal Specific Noise Model Results

Table 7 provides a summary of predicted noise levels at all 23 modelled receivers in terms of Pacific Terminal specific noise. No increase in specific noise has been predicted within the Study Area for Scenario 2 conditions.

A 3dBA increase in the specific Ldn has been predicted at receiver G1-01 under Scenario 3 conditions. This receiver is closest to Pacific Terminal rail activity. The increase in noise results from additional rail movements in the proximity of the storage tracks. Significant decreases (up to 11dBA) in specific Ldn noise have been predicted at all other receivers within the Study Area. This results from the removal of the existing PAC1 rooftop filter fan units, which have a direct line of sight to these more distance receivers.

Table 7: Summary of predicted Pacific Terminal specific noise levels

Receiver	Scenario 1 Ldn	Scenario 2 Ldn	Scenario 3 Ldn	Scenario 2 Ldn Increase Relative to Scenario 1	Scenario 3 Ldn Increase Relative to Scenario 1
G1-01	65	65	68	0	3
G1-02	67	67	66	0	-1
G1-03	65	65	63	0	-2
G1-04	62	62	57	0	-5
G1-05	54	54	49	0	-5
G1-06	55	55	48	0	-7
G1-07	50	50	47	0	-3
G1-08	51	51	49	0	-2
G1-09	51	51	46	0	-5
G2-01	54	54	46	0	-8
G2-02	56	56	46	0	-10
G2-03	57	57	50	0	-7
G2-04	51	51	45	0	-6
G2-05	53	53	46	0	-7
G2-06	53	53	46	0	-7
G2-07	51	51	45	0	-6
G2-08	51	51	45	0	-6
G2-09	51	51	45	0	-6
G3-01	67	67	58	0	-9
G3-02	66	66	55	0	-11
G3-03	62	62	53	0	-9
G3-04	61	61	52	0	-9
G3-05	61	61	53	0	-8

5.1.1 Total Noise Model Results

Table 8 provides a summary of predicted noise levels at modelled receivers in terms of total noise. The results indicate no net change in total noise under Scenario 2 conditions.

A 1dBA increase in the total Ldn has been predicted at receiver G1-01 for reasons described in the above subsection. Total noise decreases in the range of 1dBA to 3dBA have been predicted at ten community receivers under Scenario 3 conditions.

Table 8: Summary of predicted total noise levels with Study Area

Receiver	Scenario 1 Ldn	Scenario 2 Ldn	Scenario 3 Ldn	Scenario 2 Ldn Increase Relative to Scenario 1	Scenario 3 Ldn Increase Relative to Scenario 1
G1-01	74	74	75	0	1
G1-02	76	76	76	0	0
G1-03	76	76	75	0	-1
G1-04	76	76	75	0	-1
G1-05	74	74	74	0	0
G1-06	74	74	74	0	0
G1-07	77	77	77	0	0
G1-08	74	74	74	0	0
G1-09	73	73	73	0	0
G2-01	67	67	67	0	0
G2-02	65	65	65	0	0
G2-03	66	65	65	-1	-1
G2-04	63	62	62	-1	-1
G2-05	63	63	63	0	0
G2-06	63	63	62	0	-1
G2-07	63	63	63	0	0
G2-08	63	63	63	0	0
G2-09	65	65	65	0	0
G3-01	70	70	68	0	-2
G3-02	68	68	65	0	-3
G3-03	66	66	64	0	-2
G3-04	66	66	65	0	-1
G3-05	66	66	64	0	-2

6 Noise Impact Assessment

6.1.1 Dust Control Upgrade

No net increase in total noise has been predicted as a result of the Pacific Terminal Dust Control Upgrade Project. Therefore, this project will not have a noise impact in the community.

6.1.2 Ship Loader Upgrade

Future ship loading activity on its own will not result in any noise impact on residences in the immediate Vancouver community. However, the Ship Loader Upgrade Project will allow Pacific Terminal to increase its throughput. Additional rail movements will result from the upgrade. A 1dBA increase in total noise has been predicted at receiver G1-01 (1701 Powell Street – Live/Work Artist Studio Building) as a result of projected rail movement increases at Pacific Terminal. This indicates the potential for a noise impact at this receiver.

A net decrease in total noise has been predicted at ten other receivers within the Study Area. This largely results from the removal of filter fan units mounted on the rooftop of the PAC1 annex bins.

6.1.3 South Shore Trade Area Expansion

In 2012 Port Metro Vancouver commissioned local acoustic consulting firm BKL Consultants to provide an environmental noise assessment report for the South Shore Corridor Improvement Project (SSCIP) [4]. This report concluded that noise impacts were to be expected in the community when full rail build out is achieved and when South Shore Trade Area terminals reach their anticipated capacities in 2030.

7 Mitigation Considerations

Rail cars are currently transported by the Viterra Pacific Terminal locomotive to/from the storage shed (located on the west side of PAC3) and the receiving shed (located on the east side of PAC1). The process requires the rail string to cross Stewart Street twice on its approach to the receiving shed or storage tracks. The Pacific Terminal locomotive sounds its horn five times prior to each road crossing. Train whistling at railway-roadway crossings is a public safety requirement of Transport Canada. However, there is a possibility for municipalities (or other authorities) to apply for whistling cessation at a crossing. The approval of such an application would require the installation of safety equipment that provides adequate warning of a train passing. Since the crossings at Pacific Terminal are currently both signalized and gated, it may be possible for Viterra to apply and receive approval for whistling cessation.

Locomotive horn sources were removed from the Scenario 3 noise model in order to investigate the benefit of whistling cessation at the Pacific Terminal road crossings. This resulted in a 0dBA increase in total noise relative to Scenario 1 (baseline) conditions. Therefore, whistling cessation at the Pacific Terminal road crossings would offset noise increases attributed to increased rail movements resulting from the proposed upgrades.

8 Conclusions

Baseline noise monitoring was conducted at two community locations that are exposed to noise from Pacific Terminal. The average weekday Ldn at Site 1 – 2001 Wall Street was 76dBA. The average weekday Ldn at Site 2 was 77dBA. The baseline noise survey results confirm that noise exposure levels within the immediate community fronting the rail corridor within the Study Area are in excess of Ldn 75dBA. Therefore, any predicted increase in total noise exposure at a community residence resulting from the proposed Pacific Terminal upgrade Projects A and B is considered to result in a significant noise impact, which could be regarded as unacceptable without satisfactory mitigation.

Analysis of the Scenario 2 noise model results indicate no increases in total noise exposure resulting from the Pacific Terminal Dust Control Upgrade. Therefore, this project will present no noise impact to the community.

A 1dBA increase in total noise exposure (in terms of the Ldn) is predicted at 1701 Powell Street, which is an artist work/live studio complex, under Scenario 3 conditions. The increase in noise at this receiver is attributed to projected increases in rail movements at Pacific Terminal permitted by the Ship Loader Upgrade Project. This 1dBA increase in Ldn is considered significant. Noise mitigation in the form of whistling cessation at the two Pacific Terminal road crossings can be used to offset this impact. This, however, require the approval of Transport Canada.

External filter fans which are currently mounted on the rooftop of the PAC1 and PAC2 buildings will be removed following the two upgrade projects. This will benefit certain receivers in the community by reducing Pacific Terminal`s impact on residual (or background) noise levels.

Rail noise is a significant contributor to the overall noise exposure level at residences fronting the South Shore Corridor. This is primarily due to the proximity of the rail corridor to the fronting residences and the high number of rail movements occurring during noise sensitive nighttime hours. Other terminal operators along the South

Shore Trade Area are predicted to expand their operations in the future. As a result, a greater number of rail and truck movements would result from additional terminal expansion projects that increase throughput. Significant noise impacts within the immediate community may result following cumulative terminal expansion projects along the South Shore Corridor.

9 References

[1] Schultz, T.J. Synthesis of social surveys on noise annoyance. J. Acoust. Soc. Am. 64, 377-405. 1978

[2] World Health Organization (WHO). Guidelines for Community Noise. April 1999.

[3] U.S. Department of Housing and Urban Development. Environmental Planning Division. The Noise Guidebook. The Division, 1985.

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10 Appendix A: Basic Acoustics

Basics of Sound

The phenomenon we perceive as sound results from fluctuations in air pressure close to our ears. These fluctuations result from vibrating objects, such as human vocal cords, loudspeakers and engines etc. Sound pressure is measured using the Pascal. The ratio of the quietest to the loudest sound that the human ear can hear is a billion to one. Therefore, sound pressure is commonly expressed using the logarithmic decibel (dB) unit. When sound pressure is expressed in decibels, it is called sound pressure level. The loudest sound pressure level we can hear without immediately damaging our hearing is 120 dB and the faintest sound we can detect is 0 dB.

Human sound perception depends on both the level and the frequency content of a given sound source. Frequency is defined as the number of times per second that pressure fluctuations occur. The frequency reflects the pitch of the sound. It is expressed in Hertz (Hz). The average young human listener can perceive sound frequencies from 20 Hz to 20,000 Hz. Human hearing is less sensitive to low frequency sound levels (below 200 Hz) and to high frequency sound levels (above 5000 Hz). The human ear is most “tuned” to the vocal frequency range between 200 Hz and 5000 Hz. For acoustic engineering purposes, the audible frequency range is normally divided up into discrete bands. The most commonly used bands are octave bands, in which the upper limiting frequency for any band is twice the lower limiting frequency, and one-third octave bands, which are the result of subdividing each octave band into three. The bands are described by their centre frequency value. The range that is typically used for environmental purposes is from 31 Hz to 8 kHz (octave bands).

Acoustic Metrics

A-weighting: The microphone of a sound level meter, unlike the human ear, is designed to be equally sensitive to sound throughout the audible frequency range. To compensate for this, the A-weighting filter of a sound level meter is used to approximate the frequency sensitivity of the human ear. As such, A-weighted sound pressure levels (dBA) give less emphasis to low and high frequencies, and are correspondingly tuned to the vocal frequency range between 200 Hz and 5000 Hz.

LAeq: The A-weighted equivalent continuous sound pressure level (LAeq) is the most common acoustic metric used to describe sound levels that vary over time. The LAeq is an energy average. It is calculated by storing and logarithmically averaging the sound of all events recorded during the measurement period. The LAeq can be measured over any time period.

Ld: The A-weighted equivalent continuous sound pressure level (LAeq) evaluated over the 15 hour time period between 07:00 to 22:00 hours.

Ln: The A-weighted equivalent continuous sound pressure level (LAeq) evaluated over the 9 hour time period between 22:00 to 07:00 hours.

Ldn: The day-night average sound level, or Ldn, is the energy sum of the Ld and Ln + 10 dBA. The 10dBA penalty is applied to the Ln in recognition of the human population's increased sensitivity to during the nighttime.

L90: The sound exceeded over 90% of the time during the measurement period. The L90 represents the background noise level measured between discrete noise events, such as car pass-bys.

Example: A quiet fan is running at a continuous level of 30 dBA at a specific measurement location. During a 10 minute measurement period, there are 9 minutes of car pass-by events that exceed the sound level of the fan. The L90 of the measurement is 30 dBA, because this level was exceeded for over 90% of the measurement duration.

Basics of Outdoor Sound Propagation

As sound waves propagate through the environment, energy is lost through geometrical divergence, atmospheric absorption, refraction in the atmosphere, ground effects and the screening of obstacles.

Geometrical Divergence

Sound intensity decreases with increasing distance from a sound source. Losses from geometrical divergence result from the spreading of the sound source energy over larger and larger areas as the distance between the original sound source and receiver position increases. Sound attenuation through geometrical divergence is nominally independent of frequency, weather and atmospheric absorption losses.

Atmospheric Absorption

Sound waves propagating through free air are attenuated through a combination of classical (heat conduction and shear viscosity) losses and molecular relaxation losses. At long outdoor propagation distances and for higher frequencies, attenuation due to atmospheric absorption is usually much greater than the attenuation due to geometrical divergence.

Refraction

The speed of sound relative to the ground is a function of temperature and wind velocity. Both temperature and wind velocity vary with height. Temperature and wind gradients therefore cause sound waves to propagate along curved paths. On a hot summer day, solar radiation heats the earth’s surface resulting in warmer air near the ground. This condition is called a temperature lapse. It causes sound rays to curve upwards. An opposite condition, called a temperature inversion, results when air is cooler at the ground surface than at higher elevations. Sound paths curve downwards during such a condition.

Wind also causes sound waves to bend upwards or downwards. Sound will propagate upwind when a source is downwind of a receiver. Wind speeds increase with height and this leads to a negative sound speed gradient. Sound waves will bend upwards under this condition.

Ground Effect

The ground effect refers to the interference (destructive and constructive) between sound reflected off the ground surface and sound travelling directly between a source and receiver. Ground effect interference has the potential to both enhance and attenuate sound as it propagates through the outdoors. The ground effect is sensitive to the acoustical properties of the ground surface.

Screening

Intervening terrain and artificial barriers (such as buildings or noise barriers) can attenuate sound by interrupting its path to a receiver. Screening effects are most pronounced when the screening obstacle completely blocks line of sight from the receiver to the sound source.