PORT METRO vancouver

Project & Environmental Review

Guidelines – Environmental Noise Assessment

July 2015

Canada

TABLE OF CONTENTS

1. INTRODUCTION

These guidelines are intended to assist applicants of projects on lands and waters managed by Port Metro Vancouver (PMV) in the assessment of potential noise impacts associated with operational activities and proposed projects.

An environmental noise assessment may be required as a supporting technical study for PER Category C and D projects. Section 4 Applicability should be reviewed and can assist in determining how these guidelines may apply and the general scope of the assessment.

2. OVERVIEW

This document provides guidance to PMV tenants and their consultants who are proposing works and activities (referred to herein as “projects”) on PMV-managed lands and waters (PMV jurisdiction). These guidelines support PMV’s Project and Environmental Review (PER) process and should be used by both applicants and qualified environmental professionals who should be retained to assist with technical aspects of an environmental noise assessment. These guidelines also include a noise screening procedure to assist in identifying projects which do not warrant full noise assessments. These guidelines outline the typical objectives of an environmental noise assessment and describe the processes that will generally need to be followed. The intention is to assure that, where projects are found to warrant an environmental noise assessment, the assessment is carried out in a consistent manner and to an appropriate level of care and attention.

The environmental noise assessment study should be submitted as a written document, following the general outline presented in this guidance document and as part of a PER Application Guide. As these guidelines are broad in nature it is recommended that refinement of the scope for the assessment is conducted with input during the preliminary review phase.

Note that this document provides guidance only and is not intended to address all aspects of an environmental noise assessment. PMV at its sole discretion and through the PER process will determine actual requirements and the adequacy of an assessment.

3. PRINCIPLES/OBJECTIVES

The majority of port terminals and facilities within PMV jurisdiction are located adjacent to urban populations. Local communities are growing and the urban lands adjacent to the port are densifying. Meanwhile, Port activities are intensifying as a result of continued growth, with many operations conducted on a 24 hour per day, 7 days per week (24/7) basis. Increasingly, this results in community noise complaints and local government concerns. In an effort to better manage the interaction between port activities and local communities, PMV seeks to minimize port-related noise in balance with operational requirements. Where feasible and practicable, PMV will promote continual improvement in noise management practices.

One of the ways in which PMV seeks to understand and manage port-related noise is through environmental noise assessments for proposed projects.

3.1 ENVIRONMENTAL NOISE ASSESSMENT COMPONENTS

An environmental noise assessment will generally contain the following components:

Project definition/categorization:
The project and its primary functions/activities are defined in relation to their potential to generate operational noise.

Noise screening procedure:
A screening procedure is used for determining whether a proposed project has sufficient community noise impact potential to warrant a further environmental noise assessment. In many cases this screening will be carried out by the applicants. In others cases, it may be necessary to obtain assistance from a qualified environmental professional and in all cases the process will be subject to review and agreement by PMV.

Record of community interaction:
The history of interaction between a tenant and the surrounding community concerning noise and other nuisance issues is useful in understanding the context for considering potential for noise impacts.

Identification of prominent noise sources:
Activities and processes which are expected to generate noise on an ongoing basis will need to be identified and ranked according to their noise generation potential. Examples include industrial or transshipment processes, materials handling, marine, road and rail transportation, and audible warning devices.

Quantification of noise emissions:
For projects not screened out from further consideration of noise impacts, it will be necessary to establish the levels of noise that are expected to be emitted by the various dominant sources identified. At this stage it will likely be necessary to obtain assistance from a qualified environmental professional specializing in acoustics to assemble the necessary information regarding noise source emissions.

Assessment of potential noise impacts:
The noise impact assessment draws upon ISO 1996-1 2003(E), ANSI S12.9, and other community noise guidance documents and is based on project-related changes in annual average daily community noise exposures as quantified by the Day-Evening-Night Average

Noise Level[1] (L_{den}) and predicted changes in L_{den} that may then be used to anticipate levels of community response.

Development of noise impact mitigation plan:
A noise impact mitigation plan should be developed for projects which are expected to have significant noise impact potential. Requirement for mitigation will be determined during the PER application review phase. This would typically include measures to reduce noise emissions at the source(s) through engineering and/or operational controls, equipment selection, and/or along the noise path in the form of noise barriers.

Post-project noise monitoring:
Applicants may be required to monitor the post-project noise environment in the affected community to document any project-related changes in noise exposures, to assess the effectiveness of any mitigation measures and possibly to initiate the tracking of noise trends over time. Post-project noise monitoring will generally be identified as a condition within a project permit.

4. APPLICABILITY

These guidelines cover the assessment of potential impacts from the proposed project resulting from operational noise. Noise resulting from construction, demolition or non-routine maintenance activities are addressed through the Construction Environmental Management Plan (CEMP) Guidelines and/or through project permit conditions.

4.1 ASSESSMENT CONSIDERATIONS

Information on the proposed project should thoroughly identify potential to generate ongoing operational noise. Generally this will involve responding to the following queries:

- Will the project involve non-static processes or activities such as the operation of heavy mobile equipment or machinery, or the movement and/or processing of goods or raw materials?
- Will the project involve an expansion of the hours and/or days of operation?
- Will the project involve noisy outdoor mechanical equipment (e.g., HVAC, dust extraction, conveyors, crushers)?
- Will equipment and/or processes be largely located/conducted in the open (i.e., not enclosed)?
- If the equipment and/or processes described above will be enclosed, will noise escape to the outdoors via doorways, windows or other access openings, exhaust outlets, air inlets etc.?

[1] Lden is an adjustment applied to all noise levels occurring outside normal daytime hours (07:00 to 19:00 hrs.) in order to reflect the generally greater sensitivity of communities to noise during the evening and nighttime

- Will the project result in an increased throughput capacity?
- Will the project generate significant volumes of road and/or rail traffic?
- Will the project change the type or frequency of marine traffic?

4.2 NOISE SCREENING PROCEDURE

The project noise screening procedure should be undertaken by one or more informed individuals representing the applicant in order to establish the potential for noise impacts within surrounding areas that could warrant a full noise impact assessment. Since this screening procedure is opinion-based and largely qualitative in nature, it cannot be assumed to distinguish definitively between projects which could have non-trivial community noise impacts and those which could not. Unique circumstances, such as nosier than expected equipment or processes, changes in operating hours, and unusually favorable sound propagation conditions could result in community noise issues arising even for projects which have been screened out.

This screening procedure is expected to assist in identifying the appropriate level of care and attention to be exercised for noise impacts when planning projects within PMV lands. Noise screening is required for PER Category C and D reviews. Table 1 provides a screening overview and submission requirements to support a PER project permit application.

Table 1: Screening Overview and Submission Requirements

Project Noise Screening	Information to be Provided to PMV
Projects defined as PER Category C or D that score below 30 from the noise screening procedure	• A copy of the Project Noise Score, Appendix II • Record of noise complaints
Projects defined as PER Category C or D that score 30 and above from the noise screening procedure	• A copy of the Project Noise Score, Appendix II • An environmental noise assessment report as outlined in this guide

The project screening procedure involves completing a series of questions regarding the project and its setting and is provided as a questionnaire in the appendices. Each question involves rating an attribute on a two-point, three-point, five-point or six-point scale. The weighting factors, as listed in Appendix II – Noise Assessment Project Score, are applied to the score selected for each question to reflect the relative importance of that attribute in forecasting noise impact potential. The overall noise impact potential of the project, and hence its likelihood of requiring a full noise impact assessment, is determined by tallying the weighted values of all response scores to obtain a *Total Weighted Project Score*.

Screening Procedure:

1. Complete the questionnaire as provided in Appendix I – Noise Assessment Screening Worksheet, scoring each of the ten items.
2. Transfer the ten questionnaire scores into the Weighted Project Screening Scorecard provided as Appendix II – Noise Assessment Project Score.
3. Apply the *Importance Weighting* factor (multiplying the weighting factor by the questionnaire score) and determine a *Weighted Score* for each item.
4. Tally the *Weighted Scores* and determine the *Total Weighted Project Score*
5. If the *Total Weighted Project Score* is **30 or greater** a full noise impact assessment should be conducted.

Regardless of the total weighted scoring, as part of the PER project permit application, provide a copy of the Appendix II – Noise Assessment Project Score sheet. In all cases, PMV will confirm the outcome of the noise screening procedure and requirement for an environmental noise impact assessment.

4.3 COMMUNITY INTERACTION

The history of interaction between a tenant and the surrounding community concerning noise and other nuisance issues is useful in understanding the current level of acceptance. In particular the following should be considered when documenting community concerns and comments:

- History of complaints in the last 5 years, detailing how many, type, etc.
- How the applicant/tenant responded, detailing any documented process, follow up measures with community, description of policy, internal metrics, etc.
- Indicate if, and what changes were made to operations or what mitigations were applied as a result of community concerns.
- Community response to changes made.

5. ENVIRONMENTAL NOISE ASSESSMENT GUIDELINES

Those projects that have scored **30 and above** from the screening procedure are required to conduct an environmental noise assessment. To assess the degree of impact as a result of changes to noise due to a project, a comparison between a measured and modelled baseline condition is made to a predicted future condition (post project). As the assessment relies on a noise rating comparison, it is important to detail both the underlying activity and noise potential. A clear connection needs to be made between the activities (pre and post project), such as commodity throughput, hours of operation, vessel calls, rail and truck delivers, fleet size changes, etc. and the anticipated changes in the community noise environment.

5.1 ESTABLISHING STUDY AREA

The basis for defining the study area should be detailed in the noise assessment report and should capture: leased area associated with the project, surrounding community that may be impacted, and consideration of consequential activities (see section 5.6.6 Considering Consequential Project Noise Impacts).

5.2 ESTABLISHING BASELINE NOISE ENVIRONMENT

When establishing the baseline, or pre-project, noise environment in adjacent areas, the following steps would typically be carried out by a qualified acoustic professional following best practices:

- Select one or more monitoring locations which, collectively, represent the range of baseline noise environments that exist within the areas potentially affected by project noise.
- Conduct the noise monitoring over a time period sufficient to capture the normal diurnal and day-to-day variations in noise levels within the community. This will generally involve continuous monitoring for at least two or three 24-hour days (ideally 4-7 days) to reveal systematic or random variations due to changes in activity within the community or within adjacent industrial areas or transportation corridors (e.g., weekday vs. weekend traffic volumes and tenant activities).
- If it is expected that there are significant seasonal variations in baseline noise environments within the adjacent community, consideration should be given to monitoring during the quieter portion(s) of the year, or during both the quieter and noisier times.

Recording the activity levels along with the sound levels during the measurement period is an important aspect of establishing a baseline condition. Applicants/tenants should work in collaboration with the qualified acoustic professional to document the type and timing of terminal activity and other significant noise sources occurring during the measurement periods in order to correlate measured sound levels to variations in activity (i.e. vessel calls, number of rail car deliveries, size of deliveries, etc.)

As the assessment is based on a comparison between a baseline condition to a predicted future condition, the baseline would generally be modelled (based on techniques discussed in section 5.6.2 Noise Prediction Techniques) to allow for a suitable comparison. The measurements should be used to validate and calibrate a noise model to provide greater confidence in the modelling results. If activity levels are different during baseline monitoring as compared to average existing conditions, the calibrated baseline model may need to be adjusted. The supporting assumptions for model adjustments should be fully documented and described in the assessment.

5.3 ESTABLISHING FUTURE NOISE ENVIRONMENT CONDITION

Predicting future noise levels is based on techniques discussed in a later section (5.6.2 Noise Prediction Techniques). In addition, a future time horizon will need to be specified and a decision made as to whether a no-Project condition should be considered.

Noise Prediction Timeframe (Horizon Year)

If the project will reach its full capacity within the first year following completion, then post-project noise levels should be predicted for the first year. If the capacity or scale of the project is expected to increase over time, then the post-project noise levels should be forecast for an appropriate horizon year that will encompass all or most of the anticipated growth – a 10-year horizon is commonly selected.

Project and no-Project Condition

A no-Project future condition can be useful to establish how activities and external factors within the vicinity of the project, such as the supply chain, can play a significant role to perceived noise. It is recommended that the environmental noise assessment include predicted long-term noise levels in the vicinity of the site with and without the project, in order to assist in understanding the impacts of project-related noise relative to expected growth in the background environmental noise levels.

5.4 IDENTIFICATION OF PROMINENT SOURCES OF NOISE

Activities, processes and equipment expected to generate noise on an ongoing basis will need to be identified. Direct and indirect sources should be considered: these may include processing of materials, fabrication of goods, transshipment, loading and unloading of goods or materials, road and rail transportation, signaling/warning devices etc. The sources should be identified, labelled, and located spatially on a site map for both the existing site (baseline condition) and the future site (project condition).

5.5 QUANTIFICATION OF NOISE EMISSIONS

It is necessary to establish the levels of noise that are expected to be emitted by the various prominent sources. This information can be obtained either from published data, data previously collected/assembled by an acoustical expert or through new source measurements of similar equipment and/or processes. Noise source data should be collected in terms of, or converted to, Equivalent Sound Levels, or L_{eq}. The following noise source attributes should be considered when quantifying noise emissions:

- For noise sources which create intermittent noise events displaying wide variations in noise levels over brief time periods, it is important to establish the Leq over a representative time period and document the maximum noise levels (LAFmax) created during such events.

- The frequency content of the various noises is required in order to model sound propagation from the project as accurately as possible and to identify the presence of undesirable noise characteristics (see Section 5.6.4 Accounting for the Character of Project and Total Noise).
- In addition to the rated emissions of the various prominent noise sources, the expected hours of operation of each source or activity should be confirmed and documented.

5.6 ASSESSMENT OF PROJECT NOISE IMPACTS

The noise impact assessment procedure presented herein draws upon guidance provided in three key documents, namely ISO 1996-1 (2003)[2], ANSI S12.9 2005/Part 4[3] and Michaud, D. S., Bly, S. H. P. & Keith, S. E. (2008)[4]. These procedures are all fundamentally based on project-related changes in long-term community noise exposures as quantified by a sound energy-based daily-average noise level of some form. For consistency with the approach taken by PMV's long term Noise Monitoring Program[5], which bases a Port Noise Rating (PNR) on the Day-Evening-Night Average Noise Level, or L_{den}, the same noise metric is used herein in the prediction of future project-related noise exposures.

In computing L_{den}, adjustments (penalties) are applied to all noise levels occurring outside normal daytime hours (07:00 to 19:00 hrs.) in order to reflect the generally greater sensitivity of communities to noise during the evening and nighttime. More specifically, the L_{den} includes a 5 dBA adjustment (increase) to noise levels created during the evening (19:00 to 22:00 hours) and a 10 dBA adjustment (increase) to noise levels occurring during the night (22:00 to 07:00 hours).

In the ISO and ANSI procedures, the L_{den} is further adjusted to account for the presence of prominent noise characteristics such as tonality, impulsiveness and strong low-frequency content, which tend to increase the intrusiveness of, and annoyance created by, noise (section 5.6.4). When adjusted for any such characteristics the predicted L_{den} may be referred to as the "*Rating Level*" of the subject noise. The *Rating Level* of the future (post-project) noise is then compared with the *Rating Level* of the baseline noise environment, with "adjustments" applied as appropriate for the character of the noise. The two *Rating Levels* are then plotted on the standard Schultz Curve which provides an empirical relationship between L_{dn} (i.e., L_{den} without the evening adjustment) and the proportion of a

[2] ISO (2003) Acoustics -- Description, measurement and assessment of environmental noise-Part 1: Basic quantities and assessment procedures. ISO 1996-1:2003(E).

[3] ANSI S12.9-PART 4-2005 -- Quantities and Procedures for Description and Measurement of Environmental Sound - Part 4: Noise Assessment and Prediction of Long-term Community Response

[4] D.Michaud, S. H.P. Bly, and S.E. Keith. Using a change in percentage highly annoyed with noise as a potential health effect measure for projects under the Canadian Environmental Assessment Act. Canadian Acoustics, 36(2): 13-28 (2008)

[5] http://portmetrovancouver.pmv.noisesentinel.com/

community that would be expected to report themselves as being "Highly Annoyed" by the noise.

5.6.1 Reporting of Noise and Activity Metrics

In addition to the equivalent sound level (L_{eq}) data which forms the basis of assessing long-term noise impacts, the baseline monitoring should also collect:

- Maximum noise level (L_{AFmax} and, if relevant, L_{peak}) information in order to establish the numbers (occurrence rates) and levels of intermittent noise events such as materials handling impacts, heavy vehicle pass-bys, train movements/couplings, audible warning devices etc. LAFmax histograms (levels versus numbers of events) are very useful in this regard. The time resolution of such monitoring must be fine enough to resolve most individual noise events. Typically this will range from 1 second to 1 minute or more depending on the frequency which the noise events occur.
- For consistency with the data that will be collected and reported by PMV's long term Noise Monitoring Stations6, it will generally be necessary to also document the nighttime equivalent sound level, or Ln.

The reporting of noise and activity levels should consider the metrics listed in Table 2:

Table 2 : Reporting Metrics

Project Case	**Noise Metrics**	**Activity Metrics** (as appropriate, not limited to)
Baseline Condition	• L_{den} • L_n • %HA • Max noise level (L_{AFmax},) • Weekday, weekend levels	• Commodity throughputs • Vessel calls • Rail movements • Truck deliveries • Traffic counts • Operational hours
Future Condition	• L_{den} • L_n • %HA • Max noise level (L_{AFmax},) • Weekday, weekend levels	

5.6.2 Noise Prediction Techniques

The technique employed to predict post-project noise levels will depend to some degree on the complexity of the project and its setting. If the ongoing noise originates in a well-

[6] Link PMV's Noise Monitoring real time data - http://portmetrovancouver.pmv.noisesentinel.com/

defined area, if the noise sensitive areas (noise receptors) are limited in extent and not far away, and if there is no significant noise shielding involved, then a manual (or computerized) sound propagation calculation utilizing basic acoustical principals may be adequate. Generally, however, proprietary outdoor sound propagation software such as CadnaA or Soundplan should be used to develop a three-dimensional model of the situation, including noise source(s), receptors and intervening terrain. The development of such a model permits more accurate prediction of noise levels in complex situations, provides graphical depictions (sound level contours) of the noise environment and facilitates the efficient exploration of project options and, if necessary, noise control options such as source level reductions, source location and the effects of noise barriers.

5.6.3 Accounting for Baseline in Prediction of Post-Project Noise

The noise impact assessment approach outlined within these guidelines is based on the comparison of the pre-project (baseline) noise environment with the total post-project noise environment. The post-project noise environment will include the contributions of sources of baseline noise that will persist into the post-project environment. Such ongoing baseline noise must then be combined with the future project-related noise to obtain the total post-project noise levels in the community. There are several possible scenarios and the qualified acoustical professional conducting the assessment, in consultation with the PMV, will determine the appropriate approach for the particular project during the PER preliminary review phase.

5.6.4 Accounting for the Character of Project and Total Noise

As introduced in section 5.5, the impact that a change in noise can create depends not only on its intensity (loudness) but also, among other things, on its character. The ISO, ANSI and other procedures recommend adjustments/penalties to be applied to the level of a given noise to reflect the greater potential for intrusion and annoyance if the noise features tonality, impulsiveness or strong low-frequency noise (LFN) content. These level adjustments for sound character should be applied only if the tonality, impulsiveness or LFN are expected to be sufficiently evident and persistent to be considered “defining characteristics” of the noise in question.

These adjustments should ideally be applied only to that portion of the overall project noise emissions which features the specific undesirable characteristic. For example, if the noise from one source (e.g. a compressor or fan) is expected to be tonal, then the adjustment for tonality should be applied to the noise emissions of that source but not to those of other non-tonal noise sources. As the overall noise output of the project is assembled (i.e., from various pieces of equipment and processes) the adjustments for sound character are applied appropriately to the emissions of the various individual noise sources. The various noise emission components, adjusted for their character as necessary, are then combined to obtain the total adjusted or “Rated” noise emission level of the project. This total rated noise level is then used to predict the noise impact potential of the project in the community.

In situations where the individual components of the noise environment cannot practically be separated, a conservative approach may be taken in which the relevant adjustment is applied to all the noise, or to some larger component of the noise, created by project operation.

Adjustment for Presence of Tones

If the project noise, or some component of it, will feature clearly audible "discrete frequency spectral components", or tones, then an adjustment should be applied to the level of this noise or noise component. The presence of tones is usually identified easily by the ear, but can also be confirmed by examining the 1/3rd octave band frequency spectrum of the noise. Various criteria have been introduced for this purpose. ANSI suggests that a "prominent tone" exists if the noise level in the 1/3rd octave frequency band containing the tone exceeds those of the two neighboring bands the following numbers of decibels (dB):

- 15 dB for frequency bands from 25 to 125 Hertz inclusive,
- 8 dB for frequency bands from 160 to 400 Hertz inclusive,
- 5 dBA for frequency bands from 500 to 10,000 Hertz inclusive.

ANSI and other guidance recommend that for noise featuring a prominent tone or tones, its actual level be adjusted upwards by 5 dBA to obtain the Rated Level.

Adjustment for Impulsive Noise

A noise may be considered impulsive if it features rapid onset, rises briefly above the steadier, ambient noise at the location of interest and then rapidly decreases - typically with a total duration of less than one second. Examples are material handling "bumps and thumps", railcar shunting, pile driving, and metal forming. The ISO and ANSI documents define three types of impulsive noise:

- Regular Impulsive (e.g., car doors closing, materials handling, church bells),
- Highly Impulsive (e.g., wood or metal hammering, riveting, pile driving, railcar shunting), and
- High Energy Impulsive (e.g., explosives, artillery fire, sonic booms).

It is anticipated that only the first two types of impulsive noise will exhibit themselves with any regularity during the operating phases of projects on PMV jurisdiction. The recommended adjustments for these types of noise are:

- Regular Impulsive noises; 5 dBA,
- Highly Impulsive noises; 12 dBA.

Under the unlikely scenario that a project should create High Energy Impulsive noise on an ongoing basis, an appropriate adjustment may be determined using the procedure contained in Annex B of ANSI S12.9 2005/Part 4.

Adjustment for Strong Low-Frequency Noise Content

Low-frequency noise (LFN) is defined by ISO as noise at frequencies between 5 Hz and 100 Hz. The following discussion of the potential effects of LFN has been excerpted from ISO 1996-1 2003.

Investigations have shown that the perception and the effects of sounds differ considerably at low frequencies as compared to mid or high frequencies. The main reasons for these differences are as follows:

- a weakening of pitch sensation as the frequency of the sound decreases below 60 Hz;
- perception of sounds as pulsations and fluctuations;
- a much more rapid increase in loudness and annoyance with increasing sound pressure levels at low frequencies than at mid or high frequencies;
- complaints about feelings of ear pressure;
- annoyance caused by secondary effects like rattling of building elements, windows, and doors;
- less building sound transmission loss at low frequencies than at mid or high frequencies.

Various procedures, ranging from simple to complex, have been developed to identify the presence of strong LFN. The approach recommended here is a relatively simple one, based on the difference between the C-weighted and A-weighted levels of the noise in question. ANSI recommends that a low-frequency noise adjustment be applied when the difference between the C-weighted and A-weighted level is 10 dB or more. The appropriate adjustment is a calculated value as detailed in ANSI S12.9-2005 Part 4 Annex D.

Avoidance of Rattling due to Low-Frequency Noise

ANSI identifies a specific threshold above which there is potential for lightweight objects within a residence to rattle in response to low-frequency sound waves. For purposes of establishing this threshold, the Low-Frequency Noise Level, or LLF, has been defined as the sum of the sound levels in the 16, 31.5 and 63 Hz. octave bands. ANSI s12.9-2005 Part 4 Annex D suggests that to prevent the likelihood of noise-induced rattles, the LLF should be less than 70 dB.

Assessing Effects of Highly Intermittent Noises

In addition to a certain level of steady or quasi-steady background noise, ports, rail yards and many industrial operations also produce intermittent noise events typically of short duration. These may be associated with materials handling, fabricating processes, audible warning devices or the movement of equipment/vehicles. While, because of their brevity, such noises typically do not contribute significantly to overall daily average noise levels in adjacent communities, they can be intrusive/annoying, and particularly, if occurring during

nighttime, can cause sleep disturbance. It is thus important to establish, to the degree possible, the maximum levels and occurrence rates of noise events expected to be created by sources of intermittent noise.

5.6.5 Assessing Percentage of Highly Annoyed Individuals (%HA)

When the appropriate character adjustments have been made to the various components of project-related noise, the component rated levels are combined to obtain the total rated project noise level at a given location within the community. This is then added to the residual rated baseline noise level to obtain the total rated post-project noise level. The total rated post-project noise level is then entered on the horizontal axis of the Schultz Curve as shown in Figure 1 and the post-project percentage of highly annoyed individuals (%HA) read off the vertical axis. The rated baseline (pre-project) noise level is also entered into the Schultz Curve and its corresponding %HA determined.

Figure 1: Schultz Curve of Community Annoyance

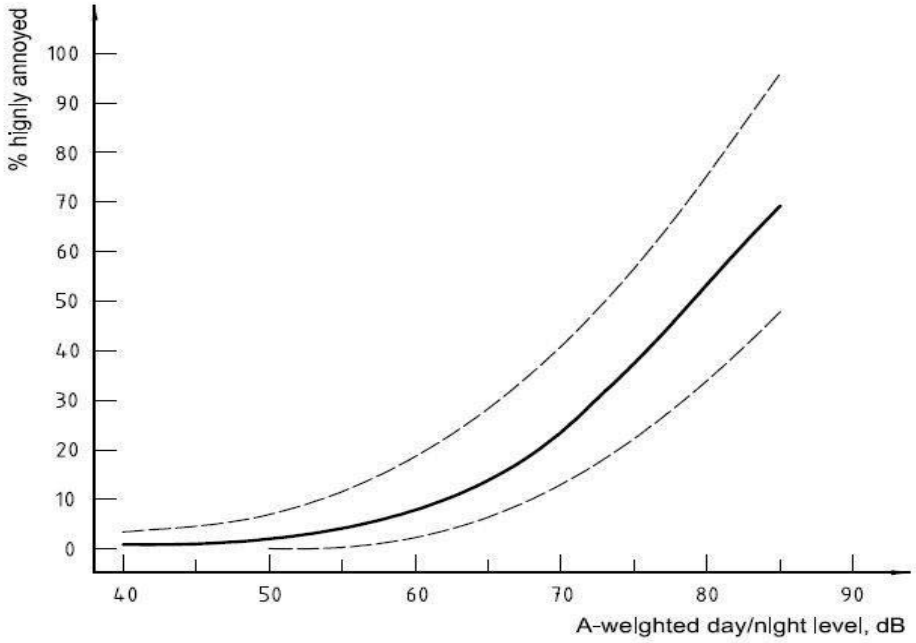

Figure D.1 — Percentage of respondents highly annoyed by road traffic sounds, as a function of the A-weighted day/night level

Note that the daily average noise level for a given noise environment will be slightly higher when expressed in terms of L_{den} than L_{dn} because of the 5 dBA adjustment applied during the evening hours in computing L_{den}. Entering L_{den} in Figure 1 will then tend to slightly overestimate %HA but generally should not affect the change (increase) in %HA to a significant degree.

5.6.6 Considering Consequential Project Noise Impacts

Port-related projects, particularly those involving new activities or increased capacities, are likely to contribute to some degree to increased noise levels in communities beyond the physical boundaries of the project. While there may be other scenarios under which consequential, or indirect, project noise impacts could occur, they will most commonly be related to increases in road and/or rail traffic volumes and potentially shipping traffic, associated with the new or expanded project operations. Increased noise exposures would then typically be experienced at locations adjacent to roadways, rail lines and/or shipping lanes leading to and from the project site.

Assessing Consequential Noise Impacts

The significance of any consequential noise impacts associated with project-related traffic volume growth would depend primarily on three factors:

- Pre-project traffic volumes,
- Ratio of pre-project to post-project traffic volumes, and
- For road traffic, the project-related change in the heavy vehicle (truck) component.

For a given project, the effects of project-related traffic growth on community noise levels will be greater in situations where pre-project road and/or rail traffic volumes are small rather than large. For example, if the traffic volume on an arterial road or highway serving a particular project site was 4,000 vehicles per day (vpd) before the project and the project created an additional 1,000 vpd (i.e., a 25% increase in volume), then, all else being equal, average daily road traffic noise levels at adjacent residences would increase by approximately 1.0 dBA. If, by comparison, the pre-project volume was 40,000 vpd, then the project-related increase in traffic volumes would be only 2.5 % and the increase in noise levels would be a negligible 0.1 dBA. This implies that, in order to significantly affect noise levels, a project must cause a substantial increase in traffic volumes – all else being equal, a doubling of volume is required to create a 3 dBA noise level increase. The significance of such a 3 dBA traffic doubling effect of course depends on the baseline noise levels and therefore, pre-project traffic volumes.

If pre-project traffic volumes are very low, it is conceivable that a project could double total traffic volumes on a given road and hence increase average traffic noise exposures by approximately 3 dBA. However, since pre-project traffic volumes were very low, post-project noise levels are not likely to be high, even after the 3 dBA increase due to the project. By contrast, if pre-project volumes were very high, then pre-project noise levels are likely to be high, but the effect of the project on noise levels is likely to be very small. Noise impacts due to project-related traffic outside the project site will then follow a trend similar to that of the Schultz Curve. That is, when baseline traffic volumes and noise levels are low, a larger project effect will be required to create a significant noise impact. When baseline levels are high, a much smaller noise increase is required to produce a significant impact.

Including Consequential Impacts in the Noise Impact Assessment

The potential for a project to have significant consequential effects should be reviewed at the PER preliminary review phase and the effects assessed to a degree commensurate with their apparent significance. PMV recognizes the challenges with including consequential impacts within the noise assessment and will work in conjunction with the applicant/tenant to determine how to appropriately include them within the assessment scope.

5.7 MITIGATION OF NOISE IMPACTS

In order to minimize port–related noise PMV would consider the following during the PER application review:

- The increase in community noise exposure (expressed in terms of the Total Rated Annual Average Noise Level) associated with the operation of a project and the associated numbers of residents likely to be Highly Annoyed (HA)
- When the post-project noise environment is predicted to exceed Lden 75 dBA7
- When the Low-Frequency Nosie level (LLF) is expected to exceed 70 dB

Where mitigation measures are considered warranted, there are generally two basic options for applicants/tenants and proposed projects:

- Mitigation at the Noise Source – treatment of the noise sources (equipment or activities) to prevent/reduce noise from being created in the first place, for example, by selecting inherently quieter equipment and/or modifying processes, or by blocking, absorbing the noise before it can be radiated away from the source
- Mitigation along the Sound Path – erecting noise barriers, buildings or land forms that interrupt the line of sight (and sound) from the noise receiver to the noise source

5.8 MONITORING POST-PROJECT NOISE

Post-project noise monitoring will generally be identified as a PER project permit condition. Such monitoring is intended to verify project noise predictions, confirm the effectiveness of mitigation measures and/or serve as the initial phase of an ongoing monitoring program. The need for post-project noise monitoring will depend on several factors:

- Commitments made during the noise impact assessment process
- Sensitivity of land uses adjacent to the project
- Level of community concern regarding noise
- The severity of the predicted project noise impacts

[7] Michaud, D. S., Bly, S. H. P. & Keith, S. E., 2008

If post-project noise monitoring is carried out, it should generally feature the following:

- As with baseline noise monitoring, the duration should be sufficient to capture any significant temporal variations in project noise emissions
- It should be conducted using best practice where weather conditions are important to propagation
- The appropriate noise metrics should be collected, typically including L_{den}, L_n and L_{AFmax}
- Where the L_{AFmax} due to intermittent noise events are of concern, it is useful to collect information on the levels and rates of occurrence of such events in form of L_{max} histograms or other statistical devices.

6. NOTES/LINKS TO OTHER DOCUMENTS

These guidelines are to be used in conjunction with PMV's Project and Environmental Review Application Guide and when submitting an environmental noise assessment to PMV.

These guidelines have been developed with support from Wakefield Acoustics[8] who provided background research and developed the noise screening procedure.

7. CONTACT INFORMATION

If you require clarification, or assistance with respect to any of these guidelines, please contact Port Metro Vancouver staff who are available to help. Environmental Programs staff can be contacted as follows:

Phone: 604-655-9082 General Environmental Programs Line

Email: EnvironmentalPrograms@portmetrovancouver.com

8. UPDATES

These guidelines are available for viewing and downloading from our website (www.portmetrovancouver.com). To ensure that you are referring to the most up-to-date document please reference the version date clearly indicated on the front page.

[8] http://wakefieldacoustics.com/

APPENDIX I – NOISE ASSESSMENT SCREENING WORKSHEET

This worksheet should be employed by one or more informed individuals representing the applicant in order to establish the potential to create noise impacts within surrounding areas. This screening procedure is opinion-based and largely qualitative in nature and involves completing a series of questions.

1. Complete this worksheet scoring each of the ten items.
2. Transfer the ten questionnaire scores into the Weighted Project Screening Scorecard provided as Appendix II – Noise Assessment Project Score.
3. Follow procedure in Appendix II

Question 1 – New Activity, Replacement or Expansion	
Will the project involve only the replacement of existing equipment or activities or the expansion of a pre-existing facility or activity, or will it involve significant new noise sources or activities?	
• Replacement of Existing Equipment or Activities	Score 1 point
• Expansion of Existing Equipment or Activities	Score 3 points
• New Equipment or Activities	Score 5 points

Question 2 – Noise Levels Expected on Project Site	
Based on experience with similar operations at the current location or elsewhere, or on your best judgment, do you expect that noise levels within the project site will be:	
• Very Low	Score 1 point
• Low	Score 2 points
• Moderate	Score 3 points
• High	Score 4 points
• Very High	Score 5 points

Question 3 - Presence of Undesirable Characteristics	
Will any of the key activities/sources create ongoing noise which: (1). is clearly tonal (hums, whirs, whines), (2). is impulsive or has very rapid onset (bumps, bangs, material handling impacts, rail car shunting, compressed air release etc.), or (3). contains strong low-frequency content (e.g. large diesel engines, large fans or air compressors).	
• No	Score 0 points
• Yes, noise will contain one such characteristic	Score 3 points
• Yes, noise will contain two or three such characteristics	Score 5 points

Question 4 – Presence of High-Energy Impulsive Noise	
Will any activities create ongoing noise which could be classified as “High-energy Impulsive”? Examples of such sources are limited in the port context but could include the industrial use of explosives or explosive circuit breakers.	
• No	Score 0 points
• Yes	Score 5 points

Question 5 – Hours/Days of Operation	
Will the normal operating schedule be:	
• Day Shift only (5 days/week)	Score 1 point
• Day Shift only (7 days per week)	Score 2 points
• Day & Evening Shifts (5 days/week)	Score 2 points
• Day & Evening Shifts (7 days/week)	Score 3 points
• 24-hours per day (5 days /week)	Score 4 points
• 24-hours per day (7 days per week)	Score 5 points

Question 6 – Proximity to Noise-Sensitive Areas	
How far is the nearest noise-sensitive land use (residences, schools, hospitals, passive parks etc.) from the property line of the project site?	
• More than 1,000 m	Score 0 points
• 500 to 1,000 m	Score 1 point
• 250 to 500 m	Score 2 points
• 125 to 250 m	Score 3 points
• 60 to 125 m	Score 4 points
• less than 60 m	Score 5 points

Question 7 – Presence of Noise Shielding or Reflection	
Will buildings, structures and/or landforms partially or totally screen (that is, interrupt the line of sight and direct hearing) project noise sources from nearby noise receptors? Here consideration should be given to the relative elevations of the noise sources, the noise receivers (ground and upper floors) and the intervening buildings and/or landforms. Noise shielding effects are maximized when intervening buildings and/or landforms are higher and wider than both the noise source area and the noise receiver area. Alternatively, the project may involve construction of a building or other structure that, while not necessarily a significant source of noise itself, reflects noise from other sources towards adjacent noise-sensitive areas. This other noise may originate from project operations or from sources not related to the project, such as other port operations or transportation facilities related sources.	
• Substantial, continuous noise shielding	Score 0 points
• Substantial, but not total, screening	Score 1 point
• Intermittent shielding, e.g., row of smaller, non-adjoining buildings	Score 2 points
• Scattered shielding by objects, machinery, stockpiles	Score 3 points
• No shielding potential	Score 4 points
• No noise shielding and will reflect noise towards sensitive areas	Score 5 points

Question 8 – Baseline Noise Environment	
How would you rate the baseline (pre-project) noise environment within the noise sensitive area nearest the project site?	
• Very noisy (near busy highway, busy port, airport, heavy industry)	Score 1 point
• Noisy (near busy arterial road, light industrial area, urban core)	Score 2 points
• Moderately noise (near collector road, suburban residential)	Score 3 points
• Quiet (suburban residential away from collector roads)	Score 4 points
• Very Quiet (rural residential, well away from industry or main roads)	Score 5 points

Question 9 – Population Potentially Exposed to Project Noise	
Approximately how many residences or other noise sensitive land uses are located within 500 m of the project site's property line?	
• 5 or less	Score 1 point
• 5 to 15	Score 2 points
• 16 to 40	Score 3 points
• 41 to 100	Score 4 points
• more than 100	Score 5 points

Question 10 – Level of Community Concern about Noise	
What level of concern (e.g., complaint history) currently exists among residents/users of adjacent noise sensitive lands regarding noise emissions from PMV lands in general and your project site in particular?	
• No history of concern or complaints	Score 1 point
• Minor concerns have been expressed	Score 2 points
• Unknown	Score 3 points
• Moderate level of concern, some complaints	Score 4 points
• High level of concern/organized complaints	Score 5 points

APPENDIX II – NOISE ASSESSMENT PROJECT SCORE

This worksheet should be used together with the questionnaire in Appendix I – Noise Assessment Screening Worksheet. For each of the ten questions, this worksheet applies a weighting factor that is reflective of the relative importance of that attribute in forecasting noise impact potential. The overall noise impact potential of the project is determined by tallying the weighted values of all response scores to obtain a *Total Weighted Project Score* as follows:

1. Complete the questionnaire as provided in Appendix I – Noise Assessment Screening Worksheet, scoring each of the ten items.
2. Transfer the ten questionnaire scores into the Weighted Project Screening Scorecard provided below.
3. Apply the *Importance Weighting* factor (multiplying the weighting factor by the questionnaire score) and determine a *Weighted Score* for each item.
4. Tally the *Weighted Scores* and determine the *Total Weighted Project Score*
5. Submit a completed project score worksheet as part of the PER project permit application

No.	Attribute of Project or Project Setting	Questionnaire Score (Appendix I)	Importance Weighting	Weighted Score
1	New Activity, Replacement or Expansion		1.2	
2	Noise Levels Expected on Project Site		1.8	
3	Presence of Undesirable Characteristics		1.6	
4	Presence of High Energy Impulsiveness Noise		1.6	
5	Hours/Days of Operation		1.2	
6	Proximity to Noise Sensitive Areas		1.6	
7	Presence of Noise Shielding or Reflection		1.8	
8	Baseline Noise Environment		1.6	
9	Population Potentially Exposed to Project Noise		1.0	
10	Level of Community Concern About Noise		1.2	
			Total Weighted Project Score :	