BRITISH COLUMBIA ENERGY REGULATOR

BRITISH COLUMBIA NOISE CONTROL BEST PRACTICES GUIDELINE

VERSION: 2.4

June 2024

About the Regulator

The BC Energy Regulator (Regulator) is the single-window regulatory agency with responsibilities for regulating oil and gas activities in British Columbia, including exploration, development, pipeline transportation and reclamation.

The Regulator's core roles include reviewing and assessing applications for industry activity, consulting with First Nations, ensuring industry complies with provincial legislation and cooperating with partner agencies. The public interest is protected by ensuring public safety, protecting the environment, conserving petroleum resources and ensuring equitable participation in production.

Vision, Mission and Values

Vision

A resilient energy future where B.C.'s energy resource activities are safe, environmentally leading and socially responsible.

Mission

We regulate the life cycle of energy resource activities in B.C., from site planning to restoration, ensuring activities are undertaken in a manner that:

- Protects public safety and the environment
- Supports reconciliation with Indigenous peoples and the transition to low-carbon energy
- Conserves energy resources
- Fosters a sound economy and social well-being

Values

Respect is our commitment to listen, accept and value diverse perspectives.

Integrity is our commitment to the principles of fairness, trust and accountability.

Transparency is our commitment to be open and provide clear information on decisions, operations and actions.

Innovation is our commitment to learn, adapt, act and grow.

Responsiveness is our commitment to listening and timely and meaningful action.

Additional Guidance

As with all Regulator documents, this document does not take the place of applicable legislation. Readers are encouraged to become familiar with the acts and regulations and seek direction from Regulator staff for clarification.

The Regulator publishes both application and operations manuals and guides. The application manual provides guidance to applicants in preparing and applying for permits and the regulatory requirements in the planning and application stages. The operation manual details the reporting, compliance and regulatory obligations of the permit holder. Regulator manuals focus on requirements and processes associated with the Regulator's legislative authorities. Some activities may require additional requirements and approvals from other regulators or create obligations under other statutes. It is the applicant and permit holder's responsibility to know and uphold all legal obligations and responsibilities. For example, Federal Fisheries Act, Transportation Act, Highway Act, Workers Compensation Act and Wildlife Act.

Throughout the document there are references to guides, forms, tables and definitions to assist in creating and submitting all required information. Additional resources include:

- Glossary and acronym listing on the Regulator website.
- Documentation and guidelines on the Regulator website.
- Frequently asked questions on the Regulator website.
- Advisories, bulletins, reports and directives on the Regulator website.
- Regulations and Acts listed on the Regulator website.

In addition, this document may reference some application types and forms to be submitted outside of the Application Management System but made available on the Regulator's website. Application types and forms include:

- Heritage Conservation Act, Section 12
- Road use permits
- Water licences
- Master licence to cut
- Certificate of restoration
- Waste discharge permit
- Experimental scheme application
- Permit extension application

Table of Contents

Manual Revisions

The Regulator is committed to the continuous improvement of its documentation. Revisions to the documentation are highlighted in this section and are posted to the Documentation Section of the Regulator's website.

Stakeholders are invited to provide input or feedback on Regulator documentation to ServiceDesk@bc-er.ca or submit feedback using the feedback form.

Version Number	Posted Date	Effective Date	Chapter Section	Summary of Revision(s)
2.0	October 29, 2018	November 30, 2018	Various	Various changes have been made to this document. Users are encouraged to review in full. For more information, refer to INDB 2018-27 and INDB 2018-26 on the Regulator's website.
2.1	December 10, 2018	January 1, 2019	Various	Updated sections 1.3, 1.5, 1.7, 4.1, and 4.2 to provide further clarification.
2.2	July 12, 2021	July 12, 2021	Various	Updated sections 1.2, 1.3, 1.7, 2.1, 2.2, 2.3.2, 2.3.4, 2.3.5 & 3.3 to clarify requirements after the completion of northeast BC OGRIS major road noise studies. For more information, refer to INDB 2021-24.
2.3	Dec 18, 2023	Dec. 18, 2023	Various	Replace BCOGC with BCER; OGAA with ERAA; new logos, references and associations
2.4	Jun 3, 2024	Jun 3, 2024	Pg. 16 Fig 1	Removal of incorrect calculation for Fig.1

British Columbia Noise Control Best Practices Guideline

The BC Noise Control Best Practices Guideline (the guideline) outlines the recommended best practices for noise control of operations associated with wells and facilities in the province of British Columbia under the jurisdiction of the Energy Resource Activities Act. The primary focus of the guideline is noise resulting from operations at a well or facility, including processing facilities and liquefied natural gas (LNG) facilities. The guideline also provides background information and guidance regarding noise management.

Chapter 1: Requirements and Expectations

This guideline is intended to help define legal requirements for managing noise from well and facility operations, as set out in the Drilling & Production Regulation, the Oil and Gas Processing Facility Regulation, and the Liquefied Natural Gas Facility Regulation, to assist permit holders with managing noise from their operations and to prevent, "excessive noise," so that well and facility construction and operations comply with the legal requirements.

The Regulator addresses noise emissions within the Drilling and Production Regulation, the Oil and Gas Processing Facility Regulation, and the Liquefied Natural Gas Facility Regulation as follows.

Drilling and Production Regulation, Section 40:

Noise

40 A permit holder must ensure that operations at a well or facility for which the permit holder is responsible do not cause excessive noise or excessive emanation of light.

Oil and Gas Processing Facility Regulation, Section 9 (3)

General requirements respecting construction

9 (3) A processing facility permit holder must ensure that construction does not cause excessive noise or light.

Oil and Gas Processing Facility Regulation, Section 18 (4)

General requirements respecting operation

18 (4) A processing facility permit holder must ensure that normal operations at the processing facility do not cause excessive noise or light.

Liquefied Natural Gas Facility Regulation, Section 4 (1) (c):

Engineering design and LNG facility siting

4 (1) An LNG facility permit holder must, subject to anything in the LNG facility permit, ensure that the engineering design and siting for an LNG facility.

(c) is based on a consideration of the effects of noise associated with the normal operation of the LNG facility.

Liquefied Natural Gas Facility Regulation, Section 15:

Noise and light control

15 An LNG facility permit holder must ensure that the construction of and normal operations at the LNG facility do not cause excessive noise or excessive emanation of light.

The Drilling and Production Regulation, the Oil and Gas Processing Facility Regulation, and the Liquefied Natural Gas Facility Regulation state that the permit holder must ensure operations activities do not cause excessive noise. The LNG Facility Regulation and the Oil and Gas Processing Facility Regulation also address noise from construction activities. The guideline encourages the management of noise for all facilities and wells from both construction and operations activities. If this guideline is adhered to, the activity will be viewed by the Regulator as meeting the above stated regulatory requirements relating to noise.

For the purposes of this guideline, well and facility operations includes drilling, completing, recompleting, intervening, re-entering, carrying out a workover, suspending, or abandoning a well, and routine and non-routine activities at a facility.

1.1 Need for Balance

This guideline considers the interests of both nearby residents and the permit holder. It is not a guarantee that residents will not hear noise from a well activity, or a facility; rather, it aims to address noise levels for residents nearby. The guideline sets out Permissible Sound Levels (PSLs) for noise so that normal sleep patterns are generally not disturbed. (See Appendix E: Sound Levels of Familiar Noise Sources from Alberta's Directive 038: Noise Control Directive).

1.2 Receptor Based

The guideline refers to noise at the point of the receptor (15 metres from a dwelling), rather than at the property line. Where access to a dwelling is restricted, the 15 metres requirement may be altered, and measurement at a property line or access roadway may be acceptable.

Measuring noise levels at the dwelling allows a permit holder to take maximum advantage of the normally substantial distance in rural areas between a facility and any dwellings. The only exception is for facilities in remote areas where a receptor is not present. In such cases a PSL of 40 decibels energy level equivalent (dBA Leq) during nighttime hours (the period between 22:00 and 07:00) should be met at 1.5 kilometers (km) from the facility property line.

1.3 Systems Approach

The management of noise is part of the overall management of oil and gas activities and permit holders must, before undertaking permitted activities on or after January 31, 2019 develop, implement and maintain a documented Noise Management Program which:

i. Establishes the responsibility for the noise management program;
ii. Identifies the sources of noise that may be encountered during oil and gas activities undertaken by the permit holder;
iii. Sets out the requirements for Noise Impact Assessments;
iv. Describes how noise will be monitored and measured over the lifecycle of permitted activities;
v. Establishes noise mitigation methods;
vi. Establishes a communication strategy including complaint response procedures;
vii. Sets out how and where individual site or activity Noise Mitigation Plans will be established;
viii. Incorporates measurement and continual improvement; and
ix. Encompasses required reporting to the Regulator and others.

Noise Management Programs must be documented and kept by the permit holder and provided to the Regulator upon request.

1.4 Industrial Noise and Domestic Animals and Wildlife

Landowners, residents and First Nations have often expressed concern about the impact of industrial noise on domestic animals and wildlife. The Regulator continues to examine peer-reviewed scientific literature and traditional environmental knowledge on this subject and may address it further in future guideline revisions. The objective of this guideline is to ensure noise levels from new and existing well and facility operations

adhere to legal requirements as defined by Section 40 of the Drilling & Production Regulation, Section 9 and 18 of the Oil and Gas Processing Facility Regulation, and Section 4 and 15 of the Liquefied Natural Gas Facility Regulation.

1.5 Best Practices

Permit holders are encouraged to adopt and incorporate a best practices approach to noise management within their maintenance and operating procedures and include this in their Noise Management Program. This includes regular measurements to determine if there are any significant changes to sound emanating from the facility and improving notification measures to neighbors of a planned noisy event. Permit holders wishing more information on a best practices approach may contact the Regulator.

1.6 Scope Levels

This guideline applies to specific oil and gas activities approved under the *Energy Resource Activities Act*.

The specific activities include: wells, facilities, processing facilities, and liquefied natural gas facilities. Primary considerations are production facilities, gas processing plants, and, more specifically, compressor, process cooler, pump, and electrical generator installations. The management of noise from well operations is a new and integral part of the guideline, and it has been included to address the existing requirement in the Drilling and Production Regulation to not cause excessive noise.

It is expected that some cases will need to be managed on a site-specific, issues-oriented basis. For example, while the guideline does not set specific noise limits for construction activity, these activities should be conducted with consideration for potential noise. For more details about construction noise, see Section 3.1.1.

1.7 Noise Levels at Well Sites

For drilling, completing, and servicing activities, well permit holders are responsible for noise control at well sites. Noise control practices during drilling and completions/servicing activities are evaluated on a site-specific basis.

Prior to preparation and construction of the well site when noise concerns have been expressed either during the permit application consultation and notification process or during First Nations consultation, or if a dwelling is located within 800 metres of the well site, the permit holder shall prepare and implement a site-specific noise mitigation plan to minimize noise during drilling and completions/servicing activities.

The plan should include the following:

1. When feasible, an assessment of expected cumulative energy industry noise sources in the area of the well site prior to starting construction activities can be completed if adjustments to the Permissible Sound Level based on Ambient Sound Level are being considered.
2. A Screening Noise Impact Assessment (NIA) for the proposed drilling and completions activities. See Section 3.3 on a description of requirements for a Screening NIA.
3. If the Screening NIA indicates that the PSL will be exceeded at a dwelling, a description of the permit holder's plan to mitigate noise (considering the best available technology) including site layout and the potential use of berms, tanks, enclosures, or other sound barriers, and treatment of dominant sources such as engine exhausts and radiators, shall be provided.

Permit holders are expected to adopt and incorporate a best practices approach to noise management into their drilling and completions activities procedures. The noise mitigation plan should be located at the well site while drilling and completions activities are being conducted, and be available to the Regulator upon request.

1.8. Development of Dwellings

Permit holders are to consider noise when choosing sites, designing facilities, and negotiating leases where future dwellings may be constructed. Permit holders are encouraged to communicate with nearby residents to identify potential future developments. Permit holders and their representatives are to work proactively to minimize potential impacts on new developments.

Permit holders should communicate existing noise levels (using existing Sound Level Survey data, or modeling data extrapolated to the proposed building site) to any landowners, residents, and developers proposing dwellings near a facility. In all cases, the permit holder is encouraged to keep documentation of communication between the permit holder and landowners, residents, and developers.

Where landowners, residents, or developers build dwellings near an existing facility, the PSL will be the existing noise level at the new dwelling. The existing noise levels should be established through modeling, or measurements that meet the procedures in this guideline.

Chapter 2: Determining Sound Levels and Adjustments

2.1 Acceptable Sound Level

Well and facility operations should meet a PSL of 40 dBA Leq (nighttime) at the nearest or most impacted dwelling, if no adjustments are applicable, or at 1.5 kilometers from the well or facility fence line, whichever is the lesser distance. If dwellings exist within 1.5 kilometers, the PSL is determined as described below. Cases where development occurs after a well or facility has begun operations are covered in Section 1.8.

This section sets out the tables used to determine PSLs, basic sound levels (BSLs), and adjustments. The PSL is generally derived from a base value (the BSL) which includes a 5 dBA allowance for industrial activity to the assumed ambient sound level (ASL), plus adjustments intended to more accurately reflect site specific aspects of the well or facility, and the environment.

The PSL is determined for the nearest or most impacted dwelling(s).

Predicted noise levels from well and facility operations, plus average rural ambient levels, are compared to the PSL in a Noise Impact Assessment (NIA) (Section 3.2). Actual isolated well and facility operation noise levels are compared to the PSL in complaint situations.

As a majority of noise concerns for residents occur during the summer months, the PSL definition is based on summertime conditions. If complaints do occur in the winter, the PSL may be modified to reflect site-specific wintertime conditions.

The PSL is calculated as follows:

Permissible Sound Level	=	Basic Sound Level (Table 1)	+	Daytime Adjustment	+/-	Class A Adjustment (Table 2)	+	Class B Adjustment (Table 3)

Note: The nighttime permissible sound level cannot exceed 65 dBA after adjustments.

The Regulator retains the discretion to assess the permissible sound level on a site-specific basis and may permit a permissible sound level in excess of the permissible sound level as determined in accordance with this section, e.g. if compliance with the PSL cannot be reasonably ensured.

PSLs do not apply in emergency situations where there may be temporary elevated noise emissions.

Planned maintenance or operational events (e.g., blow downs, catalyst changes) may be considered temporary activities and thus qualify for a Class B adjustment. Prior to such events, permit holders should inform nearby residents of the potential for increased sound levels and should make every attempt to schedule events during daytime hours to reduce the noise impact on nearby residents.

2.2 Basic Sound Level

Nighttime BSLs can be determined from Table 1. See Section 2.3.1 for the adjustment used for daytime values. Based on research conducted by a neighboring jurisdiction, the average rural ambient sound level is approximately 35 dBA Leq at night. Therefore, the BSL is determined to be 40 dBA Leq (5 dBA Leq above ambient) to generate the minimum PSL.

Moving down each column in Table 1, an adjustment is made to the BSL for proximity to transportation noise sources. Moving across each row, an adjustment to the BSL is made for higher population density.

Table 1 - Basic Sound Levels for Nighttime*

	Dwelling unit density per quarter section of land		
Proximity to Transportation	1 - 8 dwellings; 22:00 - 07:00 (nighttime) (dBA Leq)	9 - 160 dwellings; 22:00 - 07:00 (nighttime) (dBA Leq)	>160 dwellings; 22:00 - 07:00 (nighttime) (dBA Leq)
Category 1	40	43	46
Category 2	45	48	51
Category 3	50	53	56

Notes:

- The average rural ambient sound level is 5 dBA less than the BSL.
- Category 1—dwelling units more than 500 metres from heavily travelled roads and/or rail lines and not subject to frequent aircraft flyovers.
- Category 2—dwelling units more than 100 metres but less than 500 metres from heavily travelled roads and/or rail lines and not subject to frequent aircraft flyovers.

- Category 3—dwelling units less than 100 metres from heavily travelled roads and/or rail lines and/or subject to frequent aircraft flyovers.
- Density per quarter section—refers to an area equivalent to a quarter section (a circle of 451 metre radius) with the affected dwelling at the centre. For quarter sections with various land uses or with mixed densities, the density chosen is then averaged for the area under consideration.
- See Glossary of Terms within this document for more definitions.

2.3 Adjustments to Basic Sound Level

2.3.1 Daytime Adjustment

The daytime adjustment recognizes that daytime ambient sound levels are commonly 10 dBA Leq higher than nighttime levels and that nighttime noise disturbances are generally considered less acceptable. The daytime period is 07:00 to 22:00, and the daytime adjustment is 10 dBA Leq above the nighttime.

2.3.2 Class A Adjustments

Class A adjustments are based on the nature of the activity and/or actual ambient sound levels. Noise modeling for temporary activities may be acceptable for adjustments along heavily travelled roads.

Technical verification, or modeling where applicable should be supplied when using any of the adjustments to the BSL. More than one Class A adjustment may be claimed if applicable to a maximum of 10 dBA Leq.

Table 2 – Adjustments to Basic Sound Levels

Class	Reason for Adjustment	Value (dBA Leq)
A1	Seasonal adjustment (wintertime conditions)	+ 5
A2	Ambient monitoring adjustment	-10 to +10

*Class A Adjustment = Sum of A1 and A2 (as applicable), but not to exceed a maximum of 10 dBA Leq.

2.3.3 A1 – Seasonal Adjustment

The PSL determination is for summertime conditions. Therefore, a seasonal adjustment may be allowed for wintertime complaints. However, permit holders should not add this adjustment when determining the PSL for design purposes. Seasonal adjustment should only be used when warranted under the best practices guideline.

In consultation with, and after approval from the BCER engineering division, the PSL may be modified to reflect site-specific conditions for seasonal issues. For example, if it is demonstrated that the facility may affect a winter recreation area where a quiet environment is a key aspect, the seasonal adjustment may not be permitted.

2.3.4 A2 – Ambient Monitoring Adjustment

The ambient sound level (ASL) is the average sound environment in a given area without contribution from any energy-related industry. An adjustment for an incremental change to the BSL is applicable only when BSLs (Table 1) are thought not to be representative of the actual sound environment and when ASLs have been measured with an ambient Sound Level Survey, or are supported by models accepted by the Regulator. The only two cases where it may be necessary to determine the ambient sound level are:

- Areas considered to be pristine (defined in Glossary of Terms), and
- Areas with non-energy activity that would impact the ambient sound levels

In either case, permit holders should obtain prior approval from the Regulator's engineering division to determine if an ambient sound adjustment is applicable.

Models accepted by the Regulator include the Regulator's published models for some of the heavily travelled roads in northeast British Columbia. These models are based on a statistical year round average northwest wind. For other wind directions modeling can be completed on a case by case basis.

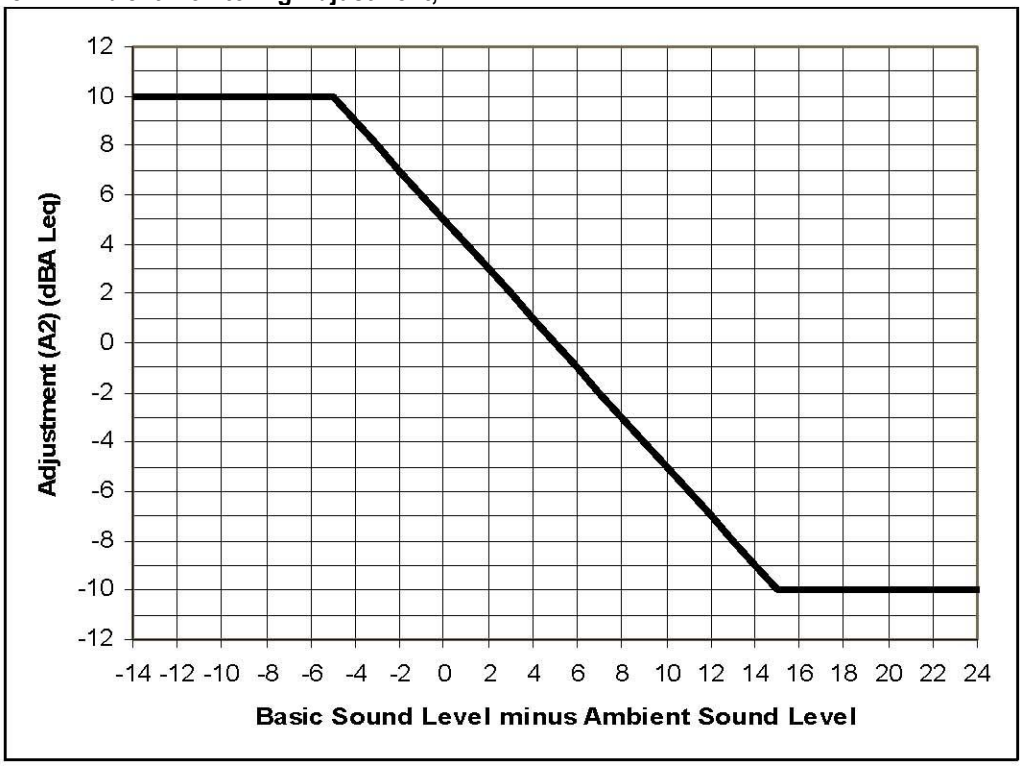
Permit holders may choose to conduct background noise surveys determining the total sound levels currently existing in an area and incorporate those values into the predictive sound level modeling for a specific project for information purposes, or utilize models accepted by the Regulator. The background noise includes all current noise sources (such as energy-related industry, non-energy industry, transportation).

An ambient Sound Level Survey consists of a 24-hour continuous Sound Level Survey, with measured ASLs presented for daytime and nighttime periods, conducted 15 m from the nearest dwelling or dwelling most likely to be affected and under representative conditions. The 15 m requirement may be altered if it is considered to be physically impossible or acoustically illogical.

Ambient Sound Level Surveys should be conducted without any energy-related industrial components.

See Figure 1 to determine the appropriate adjustment value, A2, which will be added to any other applicable Class A adjustment factors.

Figure 1 - Ambient Monitoring Adjustment, A2



A2 adjustments must fall within the range of -10dBA and +10dBA

To Use Figure 1:

- Determine the difference between the BSL (Table 1) for the appropriate dwelling density and transportation proximity and the measured ASL to the nearest whole number.
- Look up this difference on the x-axis of Figure 1.
- Move up on the figure until the plotted line is intersected.
- Move left on the figure and read off the applicable A2 adjustment factor; it may be positive or negative.
- Add this adjustment factor to any other applicable Class A adjustment factors to arrive at the Class A adjustment. Note that if the sign of A2 is negative, you will be adding a negative number to arrive at the Class A adjustment.

2.3.5 Class B Adjustment

These values are intended to permit adjustments to the BSLs based on responses to temporary noise-generating activity.

In order to use this adjustment, permit holders should inform the potentially impacted residents of the duration and nature of the noise.

Please Note:

For the purposes of this guideline, the Class B adjustments shown in Table 3 are applicable for activities with a combined duration that exceed the Basic Sound Level plus any applicable Class A adjustment for an individual residence over a 12 - month period. Only average weighted predicted sound levels (Leq) that exceed the Basic Sound Level plus applicable Class A adjustment are to be considered when determining the duration of activity in Table 3.

Table 3 - Class B Adjustments*

Class	Duration of Activity	Value (dBA Leq)
B1	<_1 day	+ 15
B2	<_30 days	+ 10
B3	≤ 60 days	+ 5
B4	> 60 days	0

*Class B Adjustment = one only of B1, B2, B3, or B4.

2.4 PSL Determination for pre-1998 Facilities

Current Requirements for Pre-1998 "Exempt" Facilities:

Facilities constructed and in operation prior to October 17, 1998, are considered 'exempt facilities'. Such facilities are exempt from following the same PSL criteria as facilities constructed after this time period. This does not relieve these facilities from guideline best practices, but recognizes they were potentially designed without the same consideration for noise as recently constructed facilities.

Exempt facilities without outstanding noise complaints registered against them with the Regulator are considered to meet community noise tolerance levels. This existing noise level is considered to be the PSL for the facility even if it is currently above the PSL as calculated using Chapter 2.

If expanded or modified, the pre-expansion or pre-modification PSL will become the PSL for the expanded facility even if it is currently above the PSL as calculated using Chapter 2. This means that existing noise sources at a facility will typically have to be reduced in acoustic output to make room for the introduction of the new noise sources, so that there is no net increase in noise emitted from the facility.

Requirement for pre-1998 Facilities with "Exempt" Status Removed after November 30, 2018

Effective November 30, 2018, the Regulator eliminated the exempt status for facilities built and in operation prior to 1998. Any application received after this date for modification or expansion of an exempt facility that increases noise levels should demonstrate compliance with the permissible sound level as calculated using Chapter 2.

In cases where a valid complaint is registered from an existing resident after November 30, 2018, the PSLs are determined by application of the BSLs and adjustments (Chapter 2). However, where landowners, residents, or developers build dwellings near an existing facility, the PSL will be the existing noise level at the new dwelling.

Chapter 3: Noise Impact Assessments

3.1 Intent and Objective

A Noise Impact Assessment (NIA) predicts sound levels from the proposed well or facility operation at the most impacted permanent or seasonally occupied dwelling, or at a distance of 1.5 kilometres from the oil and gas activity site fence line if there is no dwelling within the 1.5 km radius. Best practical technology should be considered to minimize potential noise for existing dwellings.

Please Note:

The facility should be modeled under operating conditions.
For example: if the compressor is modeled to operate with doors and windows closed, the facility should operate under those conditions to meet the PSL. Permit holders are encouraged to consider the potential for future development of dwellings.

Permit holders moving into an area should establish good relationships by discussing noise matters with area residents during the design, construction, and operating phases of a well or facility.

If a valid complaint is registered after a facility is in operation, permit holders should meet the PSL as determined by this guideline.

It is in the permit holder's best interest to achieve the most accurate predicted sound level possible. Compliance determination is based on measurements.

When planning a well or facility in an area where there is an existing facility or approved energy-related facility, the permit holder should ensure that its planned operations will not cause the cumulative noise levels to exceed the permissible sound level. The permit holder may wish to discuss the proposed project with adjacent permit holders to examine potential sound attenuation measures that are both effective and economical.

3.1.1 Construction Noise

Construction noise management is a required consideration for liquefied natural gas facilities and processing facilities as stated in Section 15 of the Liquefied Natural Gas Facility Regulation, and Section 9 (3) of the Oil and Gas Processing Facility Regulation. It is a recommended consideration for wells and facilities permitted under the Drilling & Production Regulation.

Permit holders should take the following reasonable mitigating measures to reduce construction noise on nearby dwellings from new or modified wells and facilities. Permit holders should:

- Conduct construction activity between the hours of 07:00 and 22:00;
- Advise nearby residents of potential noise-causing activities and schedule these events to reduce disruption;
- Ensure all internal combustion engines are fitted with appropriate muffler systems; and,
- Take advantage of acoustical screening from existing on-site buildings to shield dwellings from construction equipment noise.
- Utilize other applicable and innovative mitigation to address noise.

In the event a complaint is made during construction, permit holders are requested to work expeditiously with the complainant to resolve or come to a mutually agreed upon resolution.

For more information relating to recommended construction practices to reduce noise see the following Health Canada guidance and any future updates: “Commonly Applied Construction Noise Mitigation Measures And Considerations For Noise Reduction” in Appendix H of the Health Canada Guidance for Evaluating Human Health Impacts in EA Jan 2017.

3.2 NIA Submission Requirements

Permit holders should complete a Noise Impact Assessment (NIA) for any new well or facility where there is reasonable expectation of excessive noise at a nearby dwelling, unless a noise mitigation plan has already been developed for the site as per Section 1.7 in this guideline. This includes situations when modifications are proposed at existing facilities where there is a reasonable expectation of changes in noise source or level, and if there is a receptor within 1.5 km distance. Permit holders should always consider possible noise impacts in the siting and design phase before a well or facility is located for a permit application.

A NIA does not have to be included with the well or facility permit application if analysis indicates consistency with best practices in this guideline. If a NIA indicates inability to meet with the PSL, the permit holder should consider further attenuation measures. If such measures are not practicable, the permit holder should include the completed NIA with the application, along with reasons why the measures proposed to reduce noise levels are not practicable.

The Regulator may request a NIA to be submitted at any time for an existing or proposed oil and gas activity. Permit holders should keep a copy of the NIA and have it available in case of audit or request by the Regulator in the permit review process.

3.2.1 Comparing Predicted Noise Level to the PSL

The predicted well and facility sound pressure level is added to the average rural ASL using the methodology in Appendix F. The combined well and/or facility operations and ambient sound level is compared to the PSL. The average rural ASL is 5 dBA less than the BSL (Table 1, Section 2.1.1).

3.2.2 Cumulative Noise Environment

The PSL is determined using the methodology described in Chapter 2. The cumulative noise level of the existing, approved, and proposed wells and facility operations should not exceed the PSL.

In areas with established energy related facilities, the permit holder may want to discuss the proposed project with adjacent operators, as the PSL may already be calculated for the nearby dwellings (a dwelling can only have a single PSL).

3.2.3 Sound Level Prediction Methodology

Permit holders should follow and use appropriate acoustical engineering practices, equipment, and techniques when measuring or modelling sound levels. The proposed measurement approach should meet the requirements set out in this section. All documentation should be available for Regulator audits.

The simplified 6 dBA loss per doubling of distance is an estimate commonly used. While such simplified or other informal calculations are generally not recommended, they are acceptable under limited circumstances (see Appendix F for conditions under which the estimate may be used). In cases where the simplified approach is not acceptable, an acoustical engineering consultant should be contacted.

3.2.4 Noise Models

Differences can occur in predicted noise levels from noise modelling depending on such factors as the noise propagation algorithm used, input parameters, and sound pressure level calculations. Acoustic modellers have the flexibility to choose the appropriate model. However, modellers should be aware of the limitations of the models they use.

The model should incorporate the following parameters:

- geometric spreading,
- barrier effects,

- atmospheric absorption,
- ground attenuation, and
- specific wind speed/direction.

Note that consideration should be given to:

- source identification:
- source size and location
- isolation
- sound power level (PWL)-SPL spectrum data
- intermittency
- mild downwind and/or temperature inversion conditions.

The following should be used in modelling summertime conditions for an acceptable NIA:

- wind speed: 5.0 to 7.5 kilometers per hour (km/hr).
- wind direction: from the facility to the receptor(s).
- temperature: 0 to 25 degrees Celsius.
- relative humidity: 70 to 90 per cent.
- topography and ground cover: consistent with site conditions.

While the Regulator does not endorse any specific international standard or computer noise modelling software program, we recommend using models that meet accepted protocols and international standards (e.g. CONCAWE, ISO 9613).

Concerns expressed by local residents should be used to justify computer noise modelling parameters, such that “representative conditions” are the condition being modelled. Specifically:

- prediction models should be field-calibrated when practical;
- frequency specific predictions should be performed; and
- operational conditions should be quantified.

3.2.5 Low Frequency Noise Considerations

Low frequency noise (LFN) may be a problem in some situations where the dBA value is satisfactory, but a dominant low frequency exists. Low frequency noise should be considered in the noise modelling of new facilities, or facility modifications to minimize the potential for concerns. See Appendix G and Chapter 4 for details on LFN determination and adjustment to comprehensive sound level (CSL) results.

3.3 Reporting Requirements for an Acceptable NIA

NIA’s can range from screening to full detailed, depending on site requirements. In general, since drilling and completions activities operations on well sites are temporary, a screening NIA is normally acceptable providing the results show compliance.

As part of a well or facility application, permit holders may be required to show that the proposed well or facility operation meets this guideline. All supporting information should also be available:

- in case the Regulator conducts an audit on the application, and
- for reference if a noise complaint is registered.

Acceptable NIAs should include the following information:

PSL - Identify the PSL and the direction and distance to the nearest or most impacted dwelling(s), or at the 1.5 kilometre distance from a well or facility, if no dwellings are present within 1.5 kilometres. This includes all details on how the PSL was calculated and any adjustments claimed, including supporting documentation for a Class A2 or Class B adjustment.
Sound Source Identification - Identify major sources of noise (such as cooler fans, exhaust noise, and pump noise) from the facility and their associated sound power/pressure levels in octave bands.

- Indicate the source of sound data (vendors, field measurements, theoretical estimates, etc). Note that use of any theoretical data or extrapolation techniques can lead to inaccuracies and are therefore less reliable than actual field measurements made once equipment is in place.

Operating Conditions - When using manufacturer's data for expected performance, it may be necessary to modify the data to account for actual operating conditions (indicate design conditions, such as operating with open or closed compressor building windows and doors or restricted modes of operation).

Noise Model Parameters - The following should be clearly stated within an NIA in case of potential audit by the Regulator:

- type of model used (models or hand calculations may be used to obtain the predicted sound level),
- standards selected,
- source directivity considerations,
- ground absorption conditions,
- meteorological parameters,
- terrain parameters selected,
- reflection parameters, and
- any adjustments made. (Documentation of power level calculation assumptions made should be provided, e.g. source size considerations).

If sound pressure levels are determined using estimates, the NIA should clearly show the methodology used.

Predicted Sound Level (Leq):

- Identify the predicted overall (cumulative) sound level at the nearest or most likely affected dwelling, or at the 1.5 km distance from a well or facility if no dwellings are present within 1.5 km. Typically, only nighttime sound levels are considered necessary for wells or facilities with continuous operations. However, if there are differences between day and night operations, both levels should be calculated.
- Indicate whether the well or facility operation is consistent with best practices.

Attenuation Measures:

- If predicted sound levels indicate inconsistency with this best practices guideline, attenuation measures that the permit holder is committing to, and implementing should be identified.
- If predicted sound levels indicates inconsistency with this best practices guideline and further attenuation measures are not practical, the NIA should be included with the application, along with reasons why the measures proposed to reduce the impacts are not practical.

Analyst's Information:

- Provide the name and contact information for the person conducting the NIA.

A sample to assist in conducting an NIA is in Appendix B. It includes the major types of information that should be included in an NIA. Questions regarding NIAs may be directed to the BCER Pipelines and Facilities Engineering Department, E-mail: Pipelines.Facilities@bc-er.ca.

Acceptable Screening NIAs should include the following information:

- A noise model that follows appropriate acoustical engineering principals and/or field validation studies for the equipment planned.
- Backup information should be available if requested, including the underlying studies showing sound power calculations and/or field validations, noise modeling parameters, analysis method and analysts name and contact information.
- Be site specific to include planned activities and consider actual residences, and establish a PSL and Predicted Sound Level (Leq) for each dwelling within 1.5 km.
- An indication of how the Screening NIA will be used to assess risk of complaints and as part of the notification or noise mitigation strategy.

Chapter 4: Adherence to Best Practices

4.1 Noise Complaints and Noise Management Plans (NMP)

Permit holders should make every reasonable attempt in a timely manner to investigate any noise-related complaint. When investigating a noise complaint, the permit holder should first attempt to understand the issue through direct contact with the complainant to hear the concerns and establish a dialogue.

If a noise complaint is filed by a resident of a dwelling near a well or facility operation, the permit holder is to meet the permissible sound level (PSL) as determined in accordance with Chapter 2. When a noise complaint is filed with the Regulator, the Regulator may require the permit holder to conduct a Comprehensive Sound Level Survey to determine the PSL.

If a well or facility operation is found to exceed the PSL, the permit holder should provide both a detailed noise control mitigation plan and a timeline as to when adherence to the PSL will be achieved.

Well and facility operations noise may be evaluated at the pre-application and application/permitting phases, during inspections, or on a complaint basis. Permit holders are expected to address noise concerns early in the planning phase where possible, and to act immediately to remedy any problems. If a valid complaint from an existing well or facility operation cannot be resolved, the permit holder may be required to submit a Comprehensive Sound Level Survey (CSL) to determine compliance.

Facility and well operations are considered to be within the guideline if a Comprehensive Sound Level (CSL) Survey conducted at representative conditions obtains results equal to or lower than the established PSL, considering Low Frequency Noise (LFN). In the event that the PSL is exceeded, and excessive noise continues, a detailed noise management plan (NMP) coupled with an overarching Noise Management Program approved by the Regulator may be used to demonstrate how compliance with the applicable regulation will be achieved.

A NMP should include:

- identification of noise sources,
- assessment of current noise mitigation programs,
- methods of noise measurement,
- performance effectiveness of noise control devices,
- best practices programs, and
- continuous improvement programs.

In all cases, a NMP should be discussed with and incorporate input from all potentially affected persons, which may include residents, First Nations, regulated and non-regulated industries, and local government. When submitting a NMP the permit holder should describe the consultation process and indicate if any affected persons have outstanding concerns with the plan.

4.2 Complaint Response Procedures

1. Once the permit holder is aware of a complaint or noise concern, the permit holder is expected to make direct contact with the complainant to understand the concerns and to establish a dialogue.

2. The permit holder should explain the requirements of this guideline and clearly outline the process, including timelines it intends to follow.

3. If a Comprehensive Sound Level Survey is to be performed, the permit holder and the complainant should complete Part 1 and 2 of the Noise Complaint Investigation Form (see Appendix C & D.) to determine the representative conditions that exist when noise is affecting the resident. For example, if a facility was modeled in the NIA to operate with doors and windows closed, this is a condition of operation to ensure that the PSL is met.

In Part 1 of the Noise Complaint Investigation Form, the permit holder enters information about the quality and characterization of the noise from the resident(s) to help determine the source of the noise. This part also examines the weather and ground cover conditions that exist when the noise is most disruptive to the residents. With this information, the permit holder, or its representative, can establish the typical representative conditions that exist under which sound level monitoring should take place. If the complainant has highlighted specific weather conditions, facility operating conditions, or seasons, the monitoring should take place under these representative conditions.

Representative conditions do not constitute absolute worst-case conditions or the exact conditions the complainant has highlighted if those conditions are not easily duplicated. In order to expedite complaint resolution, sound measurements should be conducted at the earliest opportunity when sound propagation towards the impacted dwelling is likely and representative conditions might exist. An extended-duration Comprehensive Sound Level (CSL) Survey (more than 24 hours) may be considered to ensure that representative conditions have been met (see Section 4.2.2 Multiple Nights of Monitoring). The permit holder may consult the Regulator for help in establishing criteria for determining when favourable conditions exist.

Part 2 of the Noise Complaint Investigation Form, the event log, is designed for use by the residents concerned about noise. The affected residents should enter details about the noise when it is disruptive to them. The event log can then be used by the permit holder to further identify the source of the noise or the representative conditions needed to conduct a Comprehensive Sound Level (CSL) survey.

1. CSL surveys must encompass a representative portion of the time of day or night on days when the noise causing the complaints typically occurs. The CSL surveys should be conducted at the first opportunity when the representative conditions can be reasonably met. Representative conditions apply both to operating conditions and propagation conditions.

2. Permit holders should provide a copy of the completed Noise Complaint Investigation Form to the complainants and include a copy in any CSL reports to demonstrate that the representative conditions were met.

3. If the complainant does not complete the Noise Complaint Investigation Form, the permit holder should use best judgement to determine representative conditions. If the Noise Complaint Investigation Form is not completed, an explanation needs to be provided in the report for the absence of the form and for how the representative conditions were determined.

4. A monitoring period may vary from 9 to 24 hours, depending on the type, time, and duration of the noise. There must be at least 3 hours of acceptable data (after isolation analysis) for each nighttime period and for each daytime period (if required) for the CSL survey to be considered valid. Nighttime and daytime periods should be consecutive. The measurements are to be conducted 15 m from the complainant's dwelling in the direction of the noise source. The 15 m requirement may be altered if it is physically impossible or acoustically illogical.

5. If the PSL was established for exempt facilities using modelling results, the outcome of the CSL must be adjusted if necessary, taking into account the input conditions used to generate the modelled results. For example, if the PSL was determined by inputting summer, calm conditions in the model, the CSL must be measured under similar seasonal and meteorological conditions.

When the measured CSL exceeds the PSL, but noise from the facility and its related activities are not considered to be the cause of the exceedance, a further assessment using appropriate isolation analysis (Section 4.4.2) may be carried out. This will, in effect, separate noises not related to the facility. This isolated facility contribution can then be compared to the PSL for compliance.

4.2.1 Low Frequency Noise (LFN)

A-weighting measurements typically discount the lower frequencies; therefore, LFN may be a problem in some situations where the dBA value is satisfactory but the concern is a dominant low frequency that increases disruption levels at nearby dwellings. Due to the complexity of determining LFN, this is a specialized process. The procedure outlined below and in Appendix G should only be done in specific response to an LFN complaint identified through the complaint response process.

The Noise Complaint Investigation Form should help to identify if there is a potential for LFN.

If the potential for LFN does exist, measurements should be conducted in both C and A weighted networks concurrently. Measurements may be made using two concurrently monitoring sound level meters, a dual-channel capable sound level meter, or other equipment capable of obtaining both the C and A weighting sound levels simultaneously.

An LFN complaint condition may exist when:

- The isolated (i.e., non-facility noise, such as wind noise, has been removed) time-weighted average dBC – dBA value for the measured day- or nighttime period is equal to, or greater than, 20 dB, and,
- A clear tonal component exists at a frequency below 250 hertz (Hz).

If LFN is confirmed to exist, a 5 dBA Leq penalty will be added to the appropriate CSL results. If this value exceeds the PSL, the permit holder will be expected to identify the potential source and outline an action plan to address the issue in a timely manner.

Once LFN noise control measures have been installed, a follow-up CSL and complaint interview will be conducted to confirm that the LFN condition has successfully been addressed.

Please Note:

In all cases where LFN may be a consideration, measurement of local wind conditions should be taken throughout the assessment period.

Wind generates high levels of low frequency (and infrasonic) sound energy, which can mask or confuse the assessment for industrial LFN. Measurements of LFN should only be taken when atmospheric conditions are favourable for accurate measurement (see Appendix G and Section 4.3, Table 4).

4.2.1.1 Determination of Tonal Component

The Regulator has defined the following conditions as indicating the presence of a low frequency pure tone in the noise measured at a receiver location. For the 1/3 octave frequency bands of 250 Hz or below:

The linear sound level of one band must be 10 dB or more above at least one of the adjacent bands within two 1/3 octave bandwidths, and there must be at least a 5 dB drop in level within two bandwidths on the opposite side. The presence of a pure tone, as defined above, is required in order to declare that there is a low frequency noise (LFN) problem. Where a clear tone is present below and including 250 Hz and the difference between the overall C-weighted sound level and the overall A-weighted sound level equal to, or greater than, 20 dB, remedial action may be required to reduce the impact of the LFN (see Appendix G).

4.2.2 Multiple Nights of Monitoring

In order to ensure that representative conditions have been captured, multiple nights of noise monitoring may be necessary in order to address uncertainty regarding representative conditions.

The following are some of the reasons to conduct multiple-night monitoring:

- conditions not representative of the complaint,
- requirement for minimal hours of valid data not achieved,
- changing weather conditions,
- changing atmospheric conditions (such as inversions),
- changing plant operating conditions,
- variable seasonal effects,
- significant contamination from noise sources,
- insufficient local meteorological data, and
- prior agreement on an extended monitoring period in order to satisfy mutual concerns between residents and permit holders.

The following are reasons for accepting single-night monitoring or for concluding a multiple-night CSL survey:

- favourable and representative weather conditions (see Section 4.2),
- achievement of representative conditions, as described in the Noise Complaint Response Form,
- agreement from complainant that CSL survey conditions were appropriate, and
- permit holder acknowledgement that compliance is not achieved.

Generally, a single-night CSL survey should be sufficient if representative conditions have been achieved and the permit holder has been diligent. Section 4.2 describes suitable conditions for a single-night CSL survey. Alternatively, a multiple-night CSL survey may be necessary if representative conditions in Section 4.2 are not met. Finally, the Regulator may require more than a single CSL survey if either the complainant or the permit holder demonstrates such a need.

The result from each night for multiple-night monitoring must be evaluated against this best practices guideline. If multiple nights are deemed to be representative, the worst-case condition (highest nighttime Leq) is compared to the PSL.

4.3 Noise Monitoring Conditions

The completed Noise Complaint Investigation Form is used to determine conditions representative of the complaint. If this completed form is not available, Table 4, which outlines the recommended noise monitoring conditions, is used. Measurements should be conducted when sound propagates towards the impacted dwelling and it is likely that representative conditions exist.

Invalid data may result if wind speeds are greater than those shown in Table 4. Wind gradients can greatly affect the sound levels measured. The table is less applicable in situations where hills exist between the facility and the measurement location. Appropriate judgement must be used in determining the applicability of the table; short-term wind gusts less than five (5) minutes in duration and up to 20 km/hr may be acceptable.

Note that the limits for wind speed (measured at a height between 1.2 and 10 m based on the judgement of the acoustical consultant) and precipitation apply at the measurement position, not at a remote sensing position many kilometres away. While data from a location nearby (nearest meteorological station) may serve as an indicator, that does not guarantee the same conditions at the measurement position. Permit holders may want to consider measuring wind speed and direction using a meteorological station at the monitoring location to ensure accurate data.

The seasonal adjustment may be appropriate for a wintertime complaint, but the permit holder should discuss the adjustment option with the Regulator.

Table 4. Favorable summertime weather conditions

Parameter	Preferred condition
Ground cover	No snow, water, or ice (frozen) ground cover
Precipitation	No steady precipitation, monitoring invalid
Wind speed	Wind speed limits (noise data may be invalid if limits are exceeded): • Less than 500 metre from noise source - Upwind: 10 km/hr limit - Crosswind: 15 km/hr limit - Downwind: 15 km/hr limit • 500–1000 m from noise source - Upwind: 5 km/hr limit - Crosswind: 10 km/hr limit - Downwind: 10 km/hr limit • Greater than 1000 m from noise source - Upwind: less than 5 km/hr limit - Crosswind: 10 km/hr limit - Downwind: 10 km/hr limit Note: Applicable to all sound monitoring surveys -24-hour noise sampling period: there should be at least 3 hours of wind blowing directly to the complainant in the nighttime sampling period (22:00 to 7:00) and 3 hours in the daytime sampling period (7:00 to 22:00)

If a wintertime complaint is received, the appropriate representative conditions must be determined and a CSL survey conducted under those or similar conditions.

4.4 Comprehensive Sound Level Survey Analysis

4.4.1 Methodology for Assessing Multiple Noise Sources

Each case of multiple noise sources presents its own complexities. An appropriate methodology for assessment of multiple noise sources or isolation techniques is based on the professional judgement of an acoustical consultant or investigator, and must be documented in the Noise Investigation Report.

Examples of techniques that may be used:

- If the sound levels at the receiver are due to the cumulative contributions from several sources, the relative contributions of each source at the nearest or most impacted dwelling must be determined in order to address noise control options. This is most commonly done by

assessing the Sound Power Level (PWL or SWL) of each contributor or a measured Sound Pressure Level (SPL) at a standard distance where each individual source is dominant.

- If the noise sources are separated, the relative sound emission of each can be determined by taking measurements in the direction of the receiver at points where each source, in turn, is completely dominant. Usually, these measurements are conducted at a common distance in the far field.
- If the noise sources are close enough that the sound fields overlap or if there are elevated sources that may not be adequately taken into account at the fence line (due to vertical directionality of the sources), professional judgement should be used.

At points where two or more sources contribute, the relative contributions must be determined using good engineering practices and should be explained in the Noise Investigation Report.

For example, extensive near-field diagnostic surveys can be conducted at the various sources, with computer-aided modelling, to properly assess the source contributions. This is most useful if the noise has particular characteristics that are major factors in the noise complaint. An extensive near-field diagnostic survey is also useful for ranking the sources to effectively focus noise control efforts.

4.4.2 Isolation Analysis

Isolation analysis techniques consist of various sound measurements and methods used to separate out sound sources and obtain the sound level from the source of interest alone. During a Comprehensive Sound Level (CSL) Survey, all sound levels are captured for the survey period. However, noise contributions from the permit holder's well or facility operations are of particular interest.

In cases where the Comprehensive Sound Level Survey results exceed the PSL but noise from well or facility operations may not be responsible for the exceedance, further assessment using an appropriate isolation technique should be carried out to separate the noise contribution from the measured CSL.

Invalid or abnormal data not typical of an average ambient sound level should be extracted from the measured CSL. Invalid data can include periods with unacceptable meteorological conditions or non-representative ground cover. Temperature inversions or lapse conditions[1] are excluded unless they are considered a frequent occurrence (that is, they occur more than 10 per cent of the time for a particular season) and can be captured at the receptor site. Such conditions affect the sound level at the receptor location, but unless the event occurs with regularity due to local topography or other factors, the condition is dismissed. Abnormal data are those from noise events such as aircrafts and animals.

The extraction of data from the measured CSL should be justified and supported by an appropriate reference, such as a digital or analog audio recording, operational log, or event log. The

[1] Temperature inversions or lapse conditions are defined as situations when temperatures in the atmosphere (usually measured at a height of 10 m) are 1°C or more higher than at ground level (usually measured at a height of 2 m).

accumulated isolated facility contribution data must encompass the previously stipulated minimum time-period.

Criteria for removing data:

- Exceedance of maximum wind speed,
- Measurement periods when precipitation is present,
- Measurement periods where the monitor is upwind of the source,
- Periods of noise dominated by biological activity, typically at dawn or dusk, such as birdcalls, frogs (such periods are commonly referred to as the "Dawn Chorus"),
- Abnormal noise events, including aircraft flyovers and off-plant site vehicular traffic (on- site noise is controlled by the facility, but off-site noise is under the authority of the responsible municipal jurisdiction and therefore not subject to BCER control), and,
- Other sources of noise not under BCER jurisdiction.

4.5 Measurement Instrumentation and Techniques

4.5.1 Measurement Instrumentation (Sound Level Meters)

Instrumentation used to conduct Comprehensive Sound Level Surveys should be able to measure the A-weighted (dBA) and/or C-weighted (dBC) continuous energy equivalent sound level (Leq) of steady, intermittent, and fluctuating sounds. It should be able to accumulate the data and calculate the Leq values over the time periods required and should meet the minimum technical specifications in the IEC or EN 61672-2 (2013) + AMD1:2017 CSV Class 1 or newer, for Class 1 sound level meters.

The sound measurement instrumentation necessary to conduct the one-third octave band sound pressure level measurements to characterize the presence of tonal components should meet the minimum technical specification in IEC or EN publication 61260-2:2016 + AMD1:2017 Class 1 or newer, or American National Standards Institute (ANSI) publication S1.11-2014 Part 1 for Class I filter sets used in conjunction with conventional sound level meters that meet the minimum technical specifications in IEC publication EN61672-2 (2013) or ANSI publication S1.4-2014 for Class 1 sound level meters.

4.5.1.1 Sound Level Meter Calibration

In this section manufacturer certificate means a certificate indicating the new equipment, identified by a serial number, has passed all production tests in an accredited calibration facility, and that the final tests have been performed using calibrated equipment.

The sound level meters used for noise measurements made under this guideline should:

1. Be field calibrated, or have their calibration tested using a Class 1 calibrator, immediately prior to the measurement using a sound calibrator meeting the requirements of EN/IEC 60942:2017 Class LS, and ANSI S1.40-2006 (latest revision) for Class 1 calibrators.

2. Have their calibration checked immediately after the measurement using the same calibrator and a record of calibration results should be included in the report.

3. Be calibrated by the instrument manufacturer, or an authorized instrument calibration facility within a two-year period immediately preceding the measurements. Records of calibration should be maintained, although formal calibration certificates are not necessary. Meters which fail a pre-use or post-use calibration test (e.g. the meter does not read within plus or minus one dB) should not be used until re-calibrated for accuracy, applicability and the cause of deviation has been removed. Data collected from noise meters that fail a pre-use or post-use field calibration test should not be used.

The sound level meter may be used for a two-year period dated from the manufacturer certificate prior to needing recalibration. The manufacturer certificate should be kept on record, the same as a certificate of calibration. If the sound level meter does not come with a manufacturer certificate as described above, an initial certificate of calibration for the sound level meter is required prior to use.

4.5.1.2 Calibrator Certification

Calibrators should be recertified in accordance with ANSI publication SI.40-1984 (or latest revision), which requires that a calibrator be recalibrated at least once a year. The calibrator may be used for a one-year period dated from the manufacturer certificate prior to requiring recalibration.

The manufacturer certificate should be kept on record, the same as a certificate of calibration. If the calibrator does not come with a manufacturer certificate as described above, an initial certificate of calibration for the calibrator is required prior to use.

4.6 Audits

The Regulator may conduct random audits in the future, and expects sound levels and NIAs to be complete and technically relevant as set out in this best practices guideline.

If the Regulator determines that an event causes sound levels exceeding the PSL or an unacceptable noise impact on nearby residents, the Regulator may take enforcement actions including, but not limited to suspension of operations.

Appendix A: Glossary of Terms

TERM	DEFINITION
Abnormal noise events	Noises that are sufficiently infrequent as to be uncharacteristic of an area or that occur so close to the microphone as to dominate the measurements in an unrealistic manner. Examples of abnormal noises include a dog barking close to the microphone, a vehicle passing nearby, people talking in the vicinity of the microphone in a quiet environment, or a passing road grader.
Ambient sound level (ASL)	The sound level that is a composite of different airborne sounds from many sources far away from and near the point of measurement. The ASL does not include any energy-related industrial component. Also see Representative conditions. In the absence of measurement, the nighttime ambient sound level is assumed to be five dBA less than the basic sound level and the daytime ambient sound level is assumed to be five dBA less than the basic sound level plus the daytime adjustment.
A-weighted sound level	The sound level as measured on a sound level meter using a setting that emphasizes the middle frequency components similar to the frequency response of the human ear at levels typical of rural backgrounds in mid frequencies. See Figure 2 below.

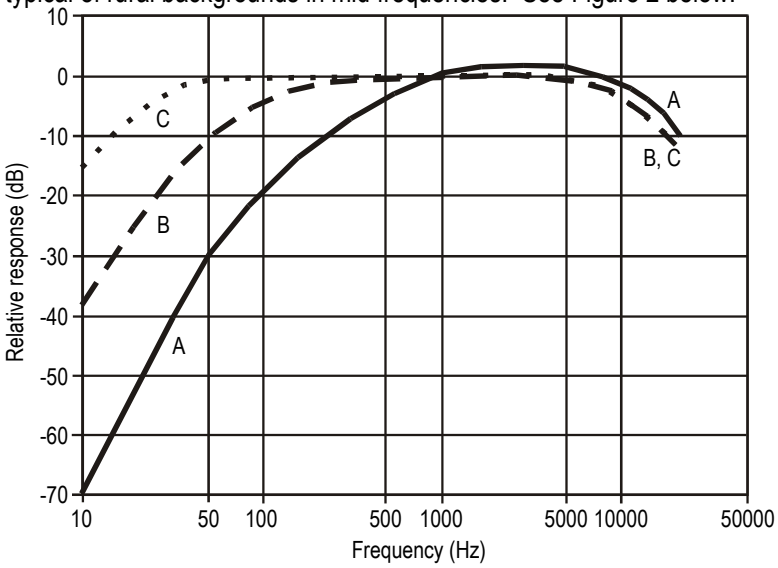


Figure 2 - Weighting network curves

Background noise	The total noise from all sources that currently exist in an area. Background noise includes sounds from the energy industry, as well as other industrial noise not subject to this directive such as transportation sources, animals, and nature.
Bands (octave, one-third octave)	A series of electronic filters separate sound into discrete frequency bands, making it possible to know how sound energy is distributed as a function of frequency. Each octave band has a center frequency that is double the center frequency of the octave band preceding it. The one-third octave band analysis provides a finer breakdown of sound distribution as a function of frequency.

Basic sound level (BSL)	The A-weighted Leq sound level commonly observed to occur in the designated land-use categories with industrial presence. The BSL is assumed to be 5 dBA above the ASL and is set out in Table 2.
Calibration	The procedure used for the adjustment of a sound level meter using a reference source of a known sound pressure level and frequency.
Category	A classification of a dwelling unit in relation to transportation routes used to arrive at a basic sound level (BSL) using Table 1.
Category 1	Dwelling units distance is more than or equal to 500 m from heavily travelled roads and/or rail lines and not subject to frequent aircraft flyovers.
Category 2	Dwelling units distance is more than or equal to 100 m but less than 500 m from heavily travelled roads and/or rail lines and not subject to frequent aircraft flyovers.
Category 3	Dwelling units distance is less than 100 m from heavily travelled roads and/or rail lines and/or subject to frequent aircraft flyovers.
Class A adjustment	Consists of the sum of adjustments that account for the seasonal nature of the noise source (A1) and the actual ambient sound level in an area (A2). The Class A adjustment is added to the basic sound level (BSL), the daytime adjustment and the Class B adjustment to arrive at the permissible sound level.
Class B adjustment	An adjustment based on the duration of a noisy activity that recognizes that additional noise can be tolerated if it is known that the duration will be limited. An adjustment of B1, B2, B3, or B4 may be selected as applicable.
Comprehensive Sound Level (CSL)	The sound level that is a composite of different airborne sounds from many sources far away from and near the point of measurement. The CSL does include industrial components and should be measured with them, but abnormal noise events are excluded. The CSL is used to determine whether a facility is consistent with this guideline. Also see Representative conditions.
Cumulative noise level	The sound level that is the total contribution of all industrial noise sources (existing and proposed) and the ambient sound level from BCER-regulated facilities at the receptor. The cumulative noise (sound) level includes the comprehensive sound level, noise from proposed facilities, energy-related facilities approved but not yet constructed, and the predicted noise from the permit holder's proposed facility.

C-weighted sound level	The C-weighting approximates the sensitivity of human hearing at industrial noise levels (above about 85 dBA). The C-weighted sound level (i.e., measured with the C-weighting) is more sensitive to sounds at low frequencies than the A-weighted sound level and is sometimes used to assess the low-frequency content of complex sound environments.
Daytime	Defined as the hours from 07:00 to 22:00.
Daytime adjustment	An adjustment that allows a 10 dBA increase because daytime ambient sound levels are generally about 10 dBA higher than nighttime values.
dB (decibel)	A unit of measure of sound pressure that compresses a large range of numbers into a more meaningful scale. Hearing tests indicate that the lowest audible pressure is about 2×10^{-5} Pa (0 dB), while the sensation of pain is about 2×10^{2} Pa (140 dB). Generally, an increase of 10 dB is perceived as twice as loud. $\text{Sound pressure level (dB)} = 10 \log \left(\frac{p^2}{p_o^2} \right)$ $= 20 \log \left(\frac{p}{p_o} \right)$ p = root-mean-square sound pressure (Pa) p_o = reference root-mean-square-sound pressure, generally 2×10^{-5} Pa The decibel is a linear weighting and can also be used when referring to differences in weightings.
dBA	The decibel (dB) sound pressure level filtered through the A filtering network to approximate human hearing response at low intensities. Also see dB and A-weighted sound level.
Density per quarter section	Refers to a quarter section, with the most likely affected dwelling at the center (a 451 m radius). For quarter sections with various land uses or with mixed densities, the density chosen should be factored for the area under consideration.
Down wind	The wind direction from the noise source towards the receiver (± 45 degrees), measured at either dwelling height or source height. The 45 degrees requirement is consistent with the definition for downwind conditions, as included in ISO 9613-1996, Attenuation of Sound During Propagation Outdoors – Part 2: general method of calculation.
Dwelling	Any permanently or seasonally occupied structure used for habitation for the purpose of human rest; including a nursing home or hospital with the exception of an employee or worker residence, dormitory, or construction camp located within an energy-related

	industrial plant boundary. Trailer parks and campgrounds may qualify as a dwelling if it can be demonstrated that they are in regular and consistent use. A permanent dwelling is a fixed residence occupied on a full-time basis. In the case of a condominium or apartment complex, each unit is considered a dwelling. A seasonally occupied dwelling is a fixed residence that, while not being occupied on a full-time basis, is occupied on a regular basis. A regular basis does not imply a scheduled occupancy but implies use of six weeks per year or more. The dwelling must not be mobile and should have some sort of foundation or features of permanence (e.g., electrical power, domestic water supply, septic system) associated with it. Summer cottages or manufactured homes are examples of seasonally-occupied dwellings, while a holiday trailer simply pulled onto a site is not. The most impacted dwelling(s) are those subject to the highest average weighted sound level relative to the permissible sound level. The nearest dwelling may not necessarily be the one most impacted by noise because of factors such as topography or manmade features. For example the nearest dwelling to a facility may be behind an intervening ridge, while a more distant dwelling may be in direct line of sight of the facility and experience louder noise.
Energy equivalent sound level (Leq)	The Leq is the average weighted sound level over a specified period of time. It is a single-number representation of the cumulative acoustical energy measured over a time interval. The time interval used should be specified in brackets following the Leq—e.g., Leq (9) is a 9-hour Leq. If a sound level is constant over the measurement period, the Leq will equal the constant sound level. If the sound level shows a variety of constant levels for different intervals, then fi is the fraction of time the constant level Li, is present.
Energy-related facility	A facility under the jurisdiction of the Regulator or other regulatory agency, used for energy generation, transport (except by road or rail line) and resource extraction. These include mining, extraction, processing and transportation (except by road or rail line) as well as federally regulated electrical transmission lines and pipelines.
Facility property	The facility property is used to establish the 1.5 km compliance distance from a facility. The boundary of the facility property is defined by the legal interest in the land (e.g., property line, right-of-way, easement or lease).
Far field	The far field is that area far enough away from the noise source that the noise emissions can be treated as if they come from a single point or line source and the individual components of the noise source are not apparent as separate sources. This is typically at a distance of at least three to five times the major dimensions of the noise source.

	The far field may consist of two parts, the free part and the reverberant part. In the free part, the sound pressure level obeys the inverse-square law (6 dBA loss per doubling of distance for a point source) with considerations for ground and air absorption. The reverberant part exists for enclosed or semi-enclosed situations where there are many reflected sound waves from all directions. An example of a reverberant field is industrial equipment enclosed in a room.
Fast response	A standardized detector response on a sound level meter. Fast response has a time constant of 125 milliseconds on a sound level meter. Also, see Slow response.
Filter	A device separating the components of an incoming signal by its frequencies.
Frequent aircraft flyovers	Used in the assessment of categories as part of a site-specific analysis for dwellings that lie within a contour area with a noise exposure forcast (NEF) 25 or greater, as designated by Transport Canada. In the absence of any NEF contours for a local airport, Transport Canada is to be contacted for current air traffic statistics. In this case, to qualify for the BSL adjustment, a dwelling must be within 5 km of an airport that has a minimum of nine aircraft takeoffs or landings over the nighttime period.
Heavily travelled road	Generally includes highways and any other road where the average traffic count is at least 10 vehicles/hour over the nighttime period. It is acknowledged that highways are sometimes lightly travelled during the nighttime period, which is usually the period of greatest concern. The Regulator will use the 10 vehicles/hour criterion to determine whether highways qualify as heavily travelled during the nighttime period.
Heavy industrial area	Usually an area zoned by the appropriate municipality containing or meant to contain a concentration of large industrial complexes, thereby helping permit holders avoid a multiplicity of industrial effects on surrounding residents. A buffer zone is generally established between the industrial facilities and where people live.
Heavy truck	Any truck having a gross vehicle weight of 12 000 kg or more and having three or more axles.
Isolation analysis techniques	Various sound measurements and analytical techniques used to separate various sound sources and to determine the sound level from the source of interest alone.
L_{eq}	See Energy equivalent sound level. $$L_{eq} = 10 \log\left(\sum_{i=1}^{n} f_i \times 10^{L_i/10}\right)$$
L_n	A generic notation for the sound level that is exceeded *n*% of the time, e.g. L_{90}, L_{50} or L_{10}.
Linear weighting (or Z-weighting)	The sound level measured without any adjustment for the sensitivity of human hearing. It is a direct measure in decibels of the variation in air pressure and is often referred to as the “sound pressure level”. This level is sometimes called the “linear weighted level” or “the unweighted level,” as it includes no frequency weighting beyond the tolerances and limits of the sound level meter being used for the measurements.

Low frequency noise	Where a clear tone is present below and including 250 Hz and the difference between the overall C-weighted sound level and the overall A-weighted sound level is equal to or greater than 20 dB.
Manufacturer's certificate	A certificate issued by the manufacturer indicating that the instrument has passed tests performed in an ISO 9001: 2008 certified facility.
Near field	The region close to the source where the inverse-square law (six dBA loss per doubling of distance for a point source) does not apply. Usually this region is closer than three to five times the major dimensions of the noise source such as length, width, height or diameter.
Nighttime	Defined as the hours from 22:00 to 07:00.
Noise	Generally associated with the unwanted portion of sound.
Noise Management Plan (NMP)	A NMP is a document prepared by a permit holder after consultation with the applicable public, First Nation communities, and stakeholders to address a situation where noise emissions from an existing or proposed oil or gas activity, or the combination of existing and proposed oil and gas operations will result in sound levels above the recommended PSL (permissible sound level) stated in this guideline. See section 4.1 for more details.
Noise Mitigation Plan	A noise mitigation plan is a detailed site-specific document prepared by a permit holder to address a situation where noise emissions from a proposed **well permit operation may be excessive, or as specified in** section 1.7 of the guideline.
Noise exposure forecast (NEF)	The noise exposure forecast contours are site specific to each airport and take into account such factors as traffic levels, proximity to runways, flight paths, and aircraft type and size.
Noise impact assessment (NIA)	An NIA identifies the expected sound level emanating from a well or facility as measured 15 m from the nearest or most impacted permanently or seasonally occupied dwelling. It also identifies what the permissible sound level is and how it was calculated.
Permanently occupied dwelling	A fixed residence occupied on a full-time basis.
Permissible sound level (PSL)	The maximum sound level that a facility should not exceed at a point 15 m from the nearest or most impacted dwelling unit. The PSL is the sum of the BSL, daytime adjustment, Class A adjustment, and Class B adjustment.
Practical	Action or activity performed in a timely manner taking into consideration availability of required equipment to perform the action or activity, access requirements, season, and location of project.
Pristine area	A pure, natural area that might have a dwelling but no industrial presence, including energy, agricultural, forestry, manufacturing, recreational, or other industries that already impact the noise environment.

Rail lines	Includes any rail line where there is a minimum of one train passage during every nighttime period consisting of 25 cars.
Representative conditions	Those conditions typical for an area and/or the nature of the complaint. For ambient sound levels, these are conditions that portray the typical activities for the area, not an unusually quiet time (non-frequent occurrence – less than 10 per cent of the time for a particular season). For Comprehensive Sound Levels (CSLs), these do not constitute absolute worst-case conditions or the exact conditions the complainant has highlighted if those conditions are not easily duplicated.
Seasonally occupied dwelling	A fixed residence that, while not being occupied on a full-time basis, is occupied on a regular basis. A regular basis does not imply a scheduled occupancy but implies use of six weeks per year or more. The residence should not be mobile and should have some sort of foundation or features of permanence (e.g., electrical power, domestic water supply, septic system) associated with it. Summer cottages or mobile homes are examples of seasonally occupied dwellings, while a holiday trailer simply pulled onto a site is not.
Slow response	A standardized detector response on a sound level meter that dampens the movement of displays so that rapidly fluctuating sound levels may be read. Slow response has a time constant of 1 second, which helps average out the display fluctuations.
Sound level meter	An instrument designed and calibrated to respond to sound and to give objective, reproducible measurements of sound pressure level. It normally has several features that would enable its frequency response and averaging times to be changed to make it suitable to simulate the response of the human ear.
Sound Level Survey	The measurement and recording of sound levels and pertinent related information over a given time period. The best practice guideline sets out two types of monitoring surveys. The first is an ambient Sound Level Survey; it helps determine the PSL and can be used to determine an ASL. Also see Ambient sound level. The second type is a Comprehensive Sound Level (CSL) Survey; it is required to determine a facility's compliance with the BC Noise Control Best Practices Guideline. Also see Comprehensive Sound Level.
Sound power level (PWL,SWL, or Lw)	The decibel equivalent of the rate of energy (or power) emitted in the form of noise. The sound power level is given by: $Sound\ Power\ Level = 10 \log\left(\frac{sound\ as\ power\ (watts)}{W_o}\right)$ By international agreement, $W_O = 10^{-12}$ watts (W) The sound power level is an inherent property of a noise source.
Sound pressure level	The decibel equivalent of the pressure of sound waves at a specific location, which is measured with a microphone. Since human reaction and material behaviors vary with frequency, the sound pressure level may be measured using frequency bands or with an overall weighting scale such as the A-weighting system. The sound pressure level

	depends on the noise sources, as well as the location and environment of the measurement path.
Spectrum	A wide range or sequence of frequencies. Octave band center frequency 31.5 Hz to 8,000 Hz.
Summertime conditions	Ground cover and temperatures that do not meet the definition for wintertime conditions. These can occur at any time of the year.
Tonal components	The test for the presence of tonal components consists of two parts. The first should demonstrate that the sound pressure level of any one of the slow-response, linear, one-third octave bands between 20 and 250 Hz is 10 dB or more than the sound pressure level of at least one of the adjacent bands within two one-third octave bandwidths. In addition, there should be a minimum of a five dB drop from the band containing the tone within two bandwidths on the opposite side. The second part is that the tonal component should be a pronounced peak clearly obvious within the spectrum. An example of tonal component is shown in Appendix G.
Wintertime conditions .	There is snow, ice, or frozen ground cover and temperatures are typically below zero degrees Celsius.

Appendix B: Noise Impact Assessment Summary Form

BC Energy Regulator

Permit holder: _____
Facility Name: _____ Type: _____
Legal Location: _____
Contact: _____Telephone: _____

1. Permissible Sound Level (PSL) Determination (BC Best Practices Noise Control Guideline)

(Note that the PSL for a pre-1998 facility undergoing modifications may be the sound pressure level (SPL) that currently exists at the dwelling if no complaint exists and the current SPL exceeds the calculated PSL from Section 2.).

Complete the following for the nearest or most impacted dwelling(s):

Distance from well or facility	Direction from well or facility	BSL (dBA)	Daytime adjustment (dBA)	Class A adjustment (dBA)	Class B adjustment (dBA)	Nighttime PSL (dBA)	Daytime PSL(dBA)

2. Sound Source Identification

For the new and existing equipment, identify major sources of noise from the facility, their associated sound power level (PWL) or sound pressure level (SPL), the distance (far or free field) at which it was calculated or measured, and whether the sound data are from vendors, field measurement, theoretical estimates, etc.

New Equipment	Predicted ↑PWL (dBA) ↑SPL (dBA)	OR Measured ↑PWL (dBA) ↑SPL (dBA)	Data Source	Distance calculated or measured (m)
_____	_____		_____	_____
_____	_____		_____	_____
_____	_____		_____	_____
_____	_____		_____	_____

3. Operating Conditions

When using manufacturer's data for expected performance, it may be necessary to modify the data to account for actual operating conditions (for example, indicate conditions such as operating with windows/doors open or closed). Describe any considerations and assumptions used in conducting engineering estimates:

_____

(continued)

4. Modeling Parameters
If modeling was conducted, identify the parameters used (see Section 3):

5. Predicted Sound Level
Identify the predicted overall cumulative sound level at the nearest of most impacted dwelling. Typically, only the nighttime sound level is necessary, as levels do not often change from daytime to nighttime. However, if there are differences between day and night operations, both levels should be calculated.

Predicted cumulative sound level at the nearest or most impacted dwelling from new facility (including any existing facilities):

_____ ____ dBA (night) Permissible sound level: _____ dBA (night)
If applicable: _____ dBA (day) Permissible sound level: _____ dBA (day)

Is the predicted sound level less than the permissible sound level? Yes _____ No _____

6. Attenuation Measures

(a) If 5 is **NO**, identify the noise attenuation measures the permit holder is committing to:

Predicted sound level to the nearest or most impacted dwelling from the facility (**with** noise attenuation measures):
_____ dBA (night); if applicable: _____ dBA (day)
Is the predicted sound level less than the permissible sound level? Yes _____ No _____

(b) If 6(a) is **NO** or the permit holder is not committing to any noise attenuation measures, the facility is not consistent with best practices. If further attenuation measures are not practical, provide the reasons why the measures proposed to reduce the impacts are not practical.
Note: If 6(b) is NO, the Noise Impact Assessment should be included with the application filed as non-routine.

7. Explain what measures have been taken to address construction noise?

8. Analyst's Name:
_____
Company: _____
Title: _____
Telephone: _____ Date:_____

Appendix C: Noise Complaint Investigation Form - Part 1

British Columbia Energy Regulator

Date (D/M/Y): _____

Resident: _____
Legal Location: _____
Address: _____
_____
Telephone: _____

Permit holder representative: _____
Permit holder: _____
Address: _____
_____
Telephone: _____

Noise Characterization
Identify the quality and characteristics of the noise.

Distance to source: _____ (m) When is the noise a problem (day/night)? _____
Pitch (high/low): _____ Where is the noise most annoying (inside/outside)? _____
Is there a noticeable tone? _____ Describe: _____
Is noise steady/intermittent/pulsating?_____ Describe: _____
Is the noise heard and/or a vibration felt? ___ Describe: _____
What is noise comparable to? _____
Other Comments: _____

Weather Conditions
Identify the weather conditions under which the noise is most noticeable.

Temperature: _____ Direction wind is coming from: _____
Wind Speed (km/h): _____ Cloud Cover: _____ Precipitation: _____
Ground cover between dwelling and facility (snow, water, grass, crop, trees, ice, etc.):
_____
Other Comments:_____
_____
_____

Representative Conditions
From the above, identify the conditions that should exist as closely as possible during a Comprehensive Sound Level Survey.

Appendix D: Noise Complaint Investigation Form - Part 2 (Event Log)

Resident or Concerned Person: _____
Permit holder Contact: _____
Telephone: _____ Telephone: _____

List any details related to the sound from the industrial facility that is a disruption to you. Refer to the descriptions at the bottom for assistance in providing information.

Date (D/M/Y)	Time a.m./p.m.	Noise Characteristics	Weather Conditions	Ground Cover	Receiver Location

Noise Characteristics: Describe the sound as a high or low tone, steady or pulsing. What would you compare the sound to?

Weather Conditions: If possible, provide details on temperature, wind direction and speed, cloud conditions (clear or cloudy), and existence of precipitation when the sound is a problem.

Ground Cover: Describe what is covering the ground between you and the facility; for example, is it snow, water, grass, crop, trees, ice?

Receiver Locations: Note where you were when the sound was annoying (outdoors, such as on the deck or in the yard or corrals, or indoors, such as in the bedroom or living room).

Appendix E: Sound Levels of Familiar Noise Sources

Source[1]	Sound level (dBA)
Bedroom of a country home	30
Soft whisper at 1.5 m	30
Quiet office or living room	40
Moderate rainfall	50
Inside average urban home	50
Quiet street	50
Normal conversation at 1 m	60
Noisy office	60
Noisy restaurant	70
Highway traffic at 15 m	75
Loud singing at 1 m	75
Tractor at 15 m	78-95
Busy traffic intersection	80
Electric typewriter	80
Bus or heavy truck at 15 m	88-94
Jackhammer	88-98
Loud shout	90
Freight train at 15 m	95
Modified motorcycle	95
Jet taking off at 600 m	100
Amplified rock music	110
Jet taking off at 60 m	120
Air-raid siren	130

Sound Level Generated by Common Appliances

Source[2]	Sound level at 1 meter (dBA)
Freezer	38-45
Refrigerator	34-53
Electric heater	47
Hair clipper	50
Electric toothbrush	48-57
Humidifier	41-54
Clothes dryer	51-65
Air conditioner	50-67
Electric shaver	47-68
Water faucet	62
Hair dryer	58-64
Clothes washer	48-73
Dishwasher	59-71
Electric can opener	60-70
Food mixer	59-75
Electric knife	65-75
Electric knife sharpener	72
Sewing machine	70-74
Vacuum cleaner	65-80
Food blender	65-85
Coffee mill	75-79
Food waste disposer	69-90
Edger and trimmer	81
Home shop tools	64-95
Hedge clippers	85
Electric lawn mower	80-90

[1] Cottrell, Tom, 1980, Noise in Alberta, Table 1, p.8, ECA80 – 16/1B4 (Edmonton: Environment Council of Alberta).

[2] Reif, Z. F., and Vermeulen, P. J., 1979, "Noise from domestic appliances, construction, and industry," Table 1, p.166, in Jones, H. W., ed., Noise in the Human Environment, vol. 2, ECA79-SP/1 (Edmonton: Environment Council of Alberta).

Appendix F: Sound Level Descriptors

dB and dBA

The human ear is capable of hearing a large range of levels of sound pressure from 2 x 10-5 pascals (Pa) (just audible, 0 dB) to 2 x 102 Pa (sensation of pain, 140 dB)—a difference of seven orders of magnitude. The decibel is a logarithmic scale and is used to compress the range of sound pressure levels into a more meaningful scale. The symbol used to represent the linear decibel scale is dB (Lin), or simply dB.

The subjective or perceived loudness of a sound is determined by several factors, including the fact that the human ear is not equally sensitive to all frequency ranges. The ear emphasizes middle frequency sounds. The A-weighted decibel scale approximates the way the human ear hears different frequencies and is represented by dB(A) or dBA (see Appendix A - Glossary for A-weighted sound level and Figure 2 - Weighting network curves).

Low frequency sounds (hum) are harder for the human ear to hear than higher frequency sounds (whine). This means a low frequency sound has a higher sound pressure level on the linear scale (dB) than a high frequency sound and is perceived to be equally loud to the ear. These two sounds have the same dBA rating on the A-weighting scale because they are perceived to be equally loud.

L_{eq} concept

This guideline uses L_{eq} measurements, which represent energy-equivalent sound levels. The L_{eq} is the average weighted sound level over a specified period of time — a single-number representation of the cumulative acoustical energy measured over the interval. The time interval used should be specified in brackets following the L_{eq} (e.g., L_{eq} (nine hours) is a 9-hour L_{eq}). If a sound level is constant over the measurement period, the L_{eq} will equal the constant sound level. Figure 3 illustrates this concept.

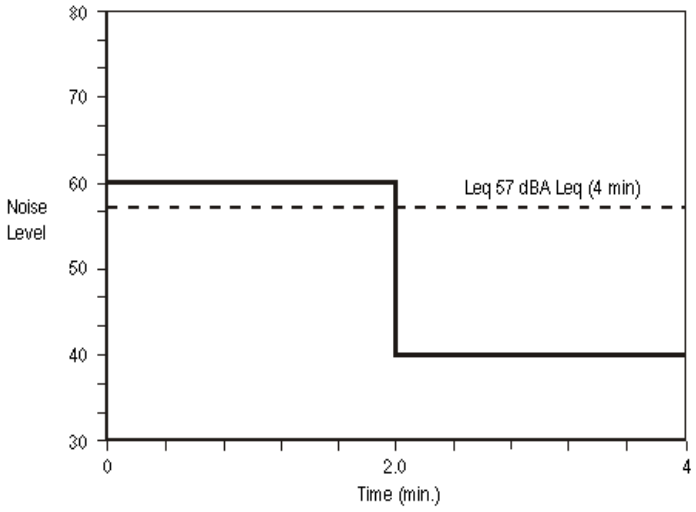


Figure 3 - Illustration of L_{eq} concept

In Figure 3, the equivalent energy during the four-minute period is not 50 dBA, as one might expect, but 57 dBA. This is due to the way in which sound energies are added, which is logarithmical rather than arithmetic. A quick look at the mathematics shows this:

$$L_{eq} = 10 \log \left(\sum_{i=1}^{n} f_i \times 10^{L_i/10} \right)$$

$$= 10 \log \left(\sum_{1}^{240} f_i \times 10^{L_i/10} \right)$$

$$= 10 \log \left(\frac{120}{240} \times 10^{60/10} + \frac{120}{240} \times 10^{40/10} \right)$$

$$= 10 \log (505\,000)$$

$$= 57\ dBA\ L_{eq}\ (4\ min)$$

In these calculations, we are adding numbers that are proportional to the corresponding sound energies. For example, the energy associated with the 60 dBA level is 100 times greater than the energy associated with the 40 dBA level (10^6 versus 10^4).

Another example of a L_{eq} calculation is useful in demonstrating how a loud noise event, such as a train passing by, can alter the L_{eq} value. Assume the sound level is measured for one hour. For 59 minutes, the sound level is 40 dBA (fairly quiet), and for one minute it is 90 dBA while a train passes:

$$L_{eq} = 10 \log \left(f_1 \times 10^{L_1/10} + f_2 \times 10^{L_2/10} \right)$$

$$= 10 \log \left(\frac{59}{60} \times 10^{40/10} + \frac{1}{60} \times 10^{90/10} \right)$$

$$= 10 \log \left(0.98 \times 10^4 + 0.02 \times 10^9 \right)$$

$$= 73\ dBA\ L_{eq}\ (1\ hr)$$

This example demonstrates how loud noise events, such as trains passing, can dominate the L_{eq} values.

Sound power and sound pressure levels

A sound source radiates power, which results in a sound pressure. Sound power is a physical property of the source alone and is an important absolute parameter used for rating and comparing sound sources. Sound power levels for specific equipment may be obtained from the manufacturer or by modelling the source using near-field sound pressure level measurements.

Sound pressure levels can be calculated using sound power levels. For sound levels in a free field, the formula is:

$$L_{pressure} = L_{power} + 10 \log_{10} Q - 20 \log_{10} r - 10.8 - A_{NC} - A_{air} - A_{ground} - ....$$

Where r = distance in metres

Q = directivity factor of source, composed of inherent directivity of the source, Q_s, and the geometry of location, Q_g and the geometry of location, Q_g

A = attenuation from noise control, air absorption, ground effects, etc.

For simplicity, with an exposed source in a free field (e.g., the distance, r, is greater than five times the size of the source and there are no significant reflections of sound) where additional attenuation factors are to be neglected, this calculation can be done using A-weighted power and pressure levels. This gives a conservative estimate of the sound pressure level at a distance, but not necessarily the worst-case level that may occur under weather conditions favouring noise propagation in a given direction, which can be considered as a negative attenuation.

If any noise control measures are to be added to the source (such as a silencer or a building that will enclose the source), or if environmental conditions (such as the barrier effect of the topography) are to be included, the calculations should be done using octave or one-third octave frequency bands and the sound pressure levels added together and A-weighted afterwards. Noise controls and environmental effects are strongly frequency dependent, and a calculation using A-weighted data is not adequate.

The directivity factor, Q, can be thought of as the portion of a sphere into which the source radiates its sound energy. Some sources radiate uniformly in all directions, while others, notably fans, are very directional. For example, a fan in a vertical plane radiates most of the sound energy in a narrow beam to the front: ($Q_s \approx 5 - 8$).

The directionality of the source is also affected by the geometry of its immediate surroundings, largely due to the presence of reflecting surfaces. The directivity of the location may or may not be significant due to the inherent directivity of the source. How the directivity factors Qs and Qg combine depends on the layout of the equipment and its surroundings. Table1 gives examples of values of Q for a variety of location geometries.

Table 1. Q values

Q	Radiation pattern	Examples
1	Spherical	Elevated sources, flares, aircraft
2	Hemispherical	Source near or on ground surface
4	¼-spherical	Source on ground beside taller building
8	1/8-spherical	In a corner of three surfaces

Addition of sound power or sound pressure levels

A similar formula can be used to add sound levels together both for the A-weighted levels and by the different frequency bands. This formula is useful for adding together sound power or sound pressure levels from different components of a facility, for example, to arrive at a composite sound level for the facility.

Sound pressure levels can be added together in this way only if they are measured or calculated for the same location.

Sound power levels can be added together and the composite source can be thought of as being at the acoustic centre of the individual sources (similar to the concept of the centre of mass of an object).

The formula for the addition of sound levels is:

$$L_{total} = 10\log\left(10^{L_1/10} + 10^{L_2/10} + \cdots + 10^{L_n/10}\right)$$

where L_i = individual component sound levels (power or pressure).

Example calculation of addition of sound power levels

A facility will be constructed and the manufacturer stated that the A-weighted sound power levels (referred to as 10^{-12} watts, also written 1 picowatt, or 1 pW) for the different components are as follows:

Engine exhaust, with muffler 106 dBA
Aerial cooler (non-directional) 113 dBA

Piping noise 79 dBA

$$L_{power,total} = 10\log\left(10^{L_1/10} + 10^{L_2/10} + \cdots + 10^{L_n/10}\right)$$

= 10 x $\log_{10}$ ($10^{106/10}$ + $10^{113/10}$ + $10^{79/10}$)
= 10 x $\log_{10}$ ($10^{10.6}$ + $10^{11.3}$ + $10^{7.9}$)
= 10 x $\log_{10}$ (2.394 x 10^{11})
= 10 x 11.38
= 113.8 dBA (ref 1 pW)

Estimate of sound pressure levels for different distances

Point sources

This estimate assumes hemispherical spreading of the sound waves and equates to a six-dB loss per doubling of distance from the sound source. The calculation does not account for any attenuation (or loss) due to atmospheric or ground absorption.

This method of calculation can only be used in the following circumstances:

(1) Simplified or other informal calculations are only acceptable for a smaller stationary single source facility without any existing industrial infrastructure and with flat ground between the facility and a single dwelling at a close distance or in remote areas where there are no dwellings within 1.5 km of the facility property.

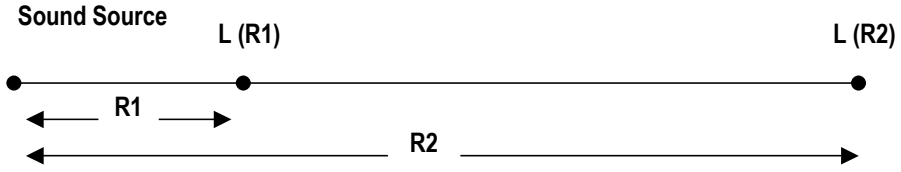
(2) An acceptable distance for applying the inverse square law depends on the sound source dimensions and the wavelength of the sound. The formula is usually safe to use as long as R_1 and R_2 are about five times the size of the source. Alternatively, a minimum distance of R_1=50 metres can be used as a rule of thumb.

(3) The inverse square law (six-dB loss per doubling of distance) for sound dissipation over distance does not apply for near-field measurements. The near field is the area where the dimensions of the source are significant; it applies to sound pressure levels measured at distances less than about five times the size of the source object. The data supplied by manufacturers is often provided as sound pressure levels measured very close to the equipment (e.g., in the near field) and is intended for use under occupational hearing requirements rather than for environmental assessment. Note that such measurements are often conducted using conditions that may not reflect field or operational conditions. Therefore, this type of measurement cannot be used in the equation below. However, given additional information about the dimensions of the equipment and the conditions of the measurement, the sound power level of the equipment can be determined, and the equation from page 51, within the '**Sound power and sound pressure levels section.'** Sound power and sound pressure levels, can be used instead.

In other circumstances, it may be advisable to contact an acoustical practitioner. The basic equation is:

$$L(R_2) = L(R_1) - 20\log\left(\frac{R_2}{R_1}\right)$$

with R_1 = distance R_1 in metres
R_2 = distance R_2 in metres
L = sound level in dBA



Please Note:

The second term in the equation is negative if R_2 is less than R_1, and $L(R_2)$ is higher than $L(R_1)$. Also, under certain source-receiver configurations, the loss per doubling of distance can be less than six dB.

Example: calculation of the sound level at a different distance

The sound level measured at 50 metres from the source is 75 dBA. A dwelling is located 800 metres away from the facility. What is the sound level calculated at the dwelling?

Measured L (50 m) = 75 dBA.

$$L(R_2) = L(R_1) - 20\log\left(\frac{R_2}{R_1}\right)$$

$$L(800\ m) = L(50\ m) - 20\log\left(\frac{800}{50}\right)$$

$$L(800\ m) = 75\ dBA - 20\log\left(\frac{800}{50}\right)$$

$$L(800\ m) = 75\ dBA - 24\ dBA$$

$$L(800\ m) = 51\ dBA$$

So the sound level contribution due to the facility is 51 dBA at 800 m.

Alternative method of determining the sound level at a different distance — the simple table approach

A simplified way to estimate the sound level is to use the rule of six dB loss per doubling of distance. With this method, subtract six dB each time the distance from the noise source is doubled.

If the measured sound level is 75 dBA at 50 m from the source:

Distance (m)	Sound level (dBA)
50	75
100	69
200	63
400	57
800	51
1600	45

This method results in 51 dBA at 800 m. This result matches the calculation above. The simple table method only estimates sound values at discrete distance points. If sound values between the distance points are required, use the formula calculation method.

Line sources

Where a long, narrow source radiates noise, the radiation pattern is that of a cylinder, not a sphere. Examples include pipes, conveyor belts, and transportation corridors, such as roads. Calculations using the spherical spreading of sound from point-like sources would involve a final step of integration over the length of the sound. It is more convenient to treat the sound as a line radiating into a cylinder. The pressure level at distance R is considered below if the length, L, of the line source is limited, once the distance, R, exceeds three to five times the length, the source can be considered as a point source.

For a line source, the sound spread equates to a three-dB loss per doubling of distance. Similar conditions apply for the line source equation as for the point source equation. The formula for noise levels at different distances from a line source is as follows:

$$L(R_2) = L(R_1) - 10\log\left(\frac{R_2}{R_1}\right)$$

with R_1 = distance R_1, in metres

R_2 = distance R_2, in metres, and

L = sound level in dB (for octave bands) or dBA

Please Note:

If $R_2 < R_1$, the second term in the equation is negative, and $L(R_2)$ is higher than $L(R_1)$.

Appendix G: Determination of Low Frequency Tonal Component

The methodologies

The methodologies shown below are intended as guidelines only and should not restrict the methods of an acoustical practitioner. The Regulator will review the proposed methodology and approve the techniques or require other methods, as deemed appropriate. As the permissible sound levels are typically higher in the daytime than during the night, the methods described focus on the nighttime periods. However, the low frequency noise concerns may be due to activities during the daytime only. The methodologies remain similar.

As part of the pre-evaluation of a potential issue with low frequency noise, the acoustical practitioner should determine the quality of the noise that has raised concerns from the affected resident(s) and assess whether the noise issue is intermittent or continuous.

Continuous low frequency noise

If there is a low frequency noise concern and it is continuous, the levels should be measured over the entire nighttime period in terms of the one-third octave L_{eq} and statistical levels (L_{10}, L_{50}, L_{90}, or some combination). The difference in the L_{eq} (equivalent-continuous) levels for adjacent spectral bands should be graphed in order to demonstrate whether there is a pure tone, as defined in Section 4.2.1. If the difference in the levels varies over the nighttime, this will be evident from such a graph.

When measurements are taken over the entire period of the nighttime, the measurement interval should be a maximum of one minute. In this case, the statistical levels are valuable to show any shorter-term fluctuations in levels.

Intermittent low frequency noise

If the suspected low frequency noise is intermittent, then short-term measurements should be taken at times when the low frequency sound is present, and the assessment of the presence of a tone should be restricted to times when the sound is present. A high-quality audio recording of the sound over the period of concern may need to be taken for later analysis and identification of the duration and intensity of the low frequency noise. If the timing of the intermittent periods is not regular, a continuous measurement may be required to obtain sufficient evidence of the presence or absence of a pure tone.

In this case, the spectral analysis can be done in terms of a short-term L_{eq} or a “slow” weighted sound level. Many instruments do allow simultaneous measurements of the one-third octave L_{eq} levels. If meters cannot track all the one-third octave frequency bands at the same time, the tonal components can be assessed by running a signal through an analyzer a number of times to get the levels of all the frequency bands of interest. The analyzer would be for “slow response” and the recordings run with different one-third octave band settings until all bands between 20 and 250 Hz have been analyzed.

Importance of wind conditions

In all cases where low frequency noise may be a consideration, measurements of the local wind conditions should be taken throughout the assessment period at the same height as the microphone above ground in the vicinity of the sound monitoring location(s).Wind generates high levels of low-frequency (and infrasonic) sound energy, which can mask or confuse the assessment of facility low frequency noise.

Example

The Table 2 below shows how the presence of low frequency tonal components is determined. For example, a tonal component is evident at 250 Hz (≥10 dB within two bandwidths on one side and five dB or greater drop within two bandwidths on the other side, in addition to being pronounced within the spectrum).

Table 2. One-third octave band frequency spectrum analysis for tonal components

		Part 1		Part 2
Band (Hz)	**Sound level (dB)**	**Maximum Δ dB within 2 bandwidths**	**≥5 dB on other side?**	**Pronounced within the spectrum**
20	10	-4	n/a	n/a
25	12	-2	n/a	n/a
31.5	14	4	n/a	n/a
40	13	-4	n/a	n/a
50	14	-3	n/a	n/a
63	17	4	n/a	n/a
80	14	-6	n/a	n/a
100	15	-8	n/a	n/a
125	20	-8	n/a	n/a
160	23	-11	n/a	n/a
200	28	8	n/a	n/a
250	34	11	**yes**	**yes**
315	31	3	n/a	n/a
400	28	-6	n/a	n/a

Figure 4 below shows some examples of tonal components. There is clearly a tonal component (pronounced peak) within the spectrum at 250 Hz and 2000 Hz (≥10 dB within two bandwidths on one side and five dB or greater drop within two bandwidths on the other side); however, the second is at a frequency greater than 250 Hz and would not be considered low frequency noise.

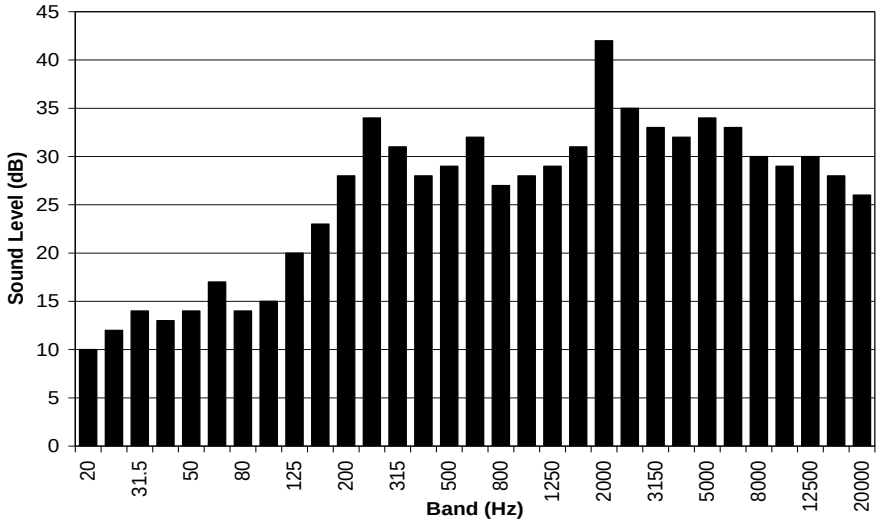


Figure 4 - One-third octave band centre frequency (Hz)

Appendix H: Examples

The examples below show a step-by-step process to determine compliance or non-compliance for new or existing wells or facilities that: may request an A2 adjustment (Example 1); use the simplified calculation described in Appendix F (Example 2) or may require consideration of cumulative effects (Example 3).

Example 1

A new facility is proposed for the area shown in Figure 5. What sound levels should the facility be designed for?

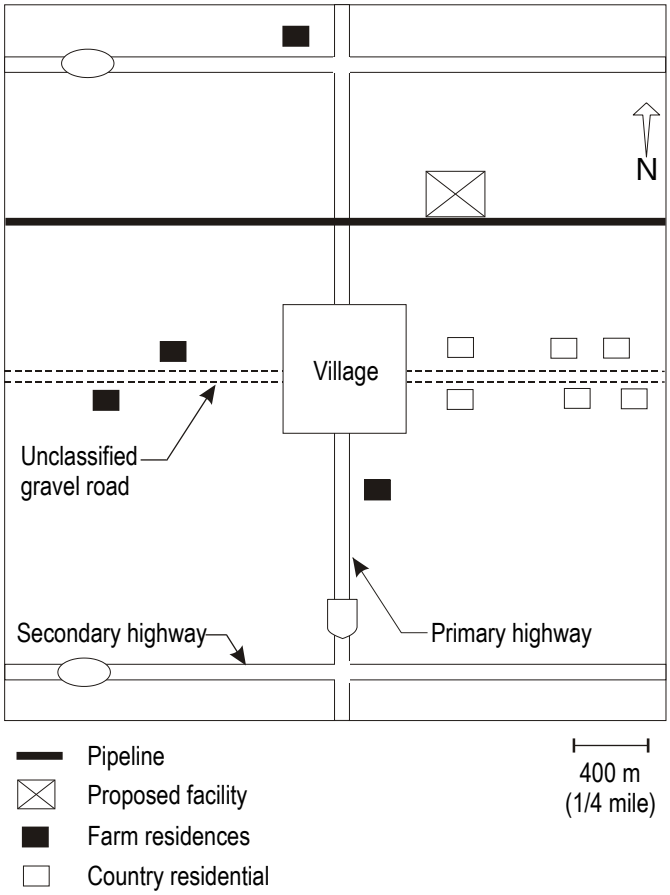


Figure 5 - Area sketch for example 1

Example 1 - Solution

Step 1 Determine BSL.

All three possible dwelling densities are represented in this study area. The four 8.1 hectares (20 acre) country residential dwellings factored over a quarter section fall into the 1 to 8 dwellings density, as do the farmhouses. The two country residential dwellings closest to the village and a portion of the village are in the 9 to 160 dwellings density, while the body of the village is in the >160 (greater than) dwellings density.

Regarding the proximity to transportation Category: the primary and secondary highways in this example are heavily travelled which causes the adjacent farmhouses to fall into

Category 2, while the dwellings in the village would fall into Category 2 or Category 3, based on population density and depending on the distance from the highway. The two country dwellings in closest proximity to the village fall into Category 2, while other four country dwellings that are east of the village further along the gravel road (which in this example is not a heavily travelled road), fall into Category 1 The farmhouses along the gravel road fall into Category 1.

It appears that the Category 1 country dwellings to the south of the proposed well or facility are probably the nearest and most impacted, with a nighttime BSL of 40 dBA L_{eq}, from Table 1-Basic Sound Levels for nighttime. However each dwelling is assigned its own site specific BSL. Where there is more than one category and dwelling density in a study area it may be difficult to ascertain the most impacted dwelling as it may not be the nearest dwelling to the proposed well or facility. The difference between the determined permissible sound level and predicted sound level will assist in the determination of the most impacted dwelling.

Step 2 What is the daytime sound level adjustment?
The daytime sound level adjustment is 10 dBA above the BSL. (For a continuous well or facility noise source where there is no difference in operational noise level between the daytime and nighttime period, the well or facility sound level should be designed to comply with the most stringent criteria which is usually the lower nighttime permissible sound level.).

Step 3 Is a Class A1 Seasonal Adjustment appropriate?
No, because this adjustment cannot be added when determining the permissible sound level for design purposes.

Step 4 Is the BSL appropriate for this area?
In this example assume no, because of presence of a non-energy related noise source in area (feedlot that operates 24-hours). The permit holder of the proposed well or facility has taken some spot measurements with a hand-held sound meter. The levels recorded ranged from 42 dBA at night to 55 dBA during the day.

Step 5 Is the use of a Class A2 monitoring adjustment required?
The remaining steps (step 6 to step 11) represent the determination of permissible sound level with a Class A2 adjustment.

Step 6 An A2 adjustment is based on the measured ambient sound level at a dwelling. A 24-hour ambient sound monitoring study measured at 15 m from the nearest country dwelling is conducted. The results of the survey are:
Daytime ASL: 53 dBA L_{eq}
Nighttime ASL: 37 dBA L_{eq}
Claim the appropriate daytime and nighttime A2 monitoring adjustment for the applicable dwelling (in this example the country dwelling nearest the well or facility and the feedlot) specific dwelling from Figure 1 - Ambient monitoring adjustment. First, subtract the appropriate daytime and nighttime ASL measured during the monitoring study from the BSL determined in step 2. In this example:

Daytime BSL - daytime ASL = 50 - 53 = -3
Nighttime BSL - nighttime ASL = 40 - 37 = +3
For each in turn, locate this difference on the horizontal axis of Figure 1, read upward until the adjustment line is intersected, and read to the left to find the applicable A2 adjustment

that will apply to the daytime and nighttime periods. The A2 adjustment that apply in this example are:

Daytime adjustment: A2 = +8 dBA L_{eq}
Nighttime adjustment: A2 = +2 dBA L_{eq}

Step 7 Sum of the Class A adjustments: (A1 + A2 (call it A))
Daytime: 0 + 8 = 8 dBA L_{eq}
Nighttime: 0 + 2 = 2 dBA L_{eq}

Step 8 Is the Class A adjustment greater than 10 dBA L_{eq} (only a maximum of 10 is allowed)?
In either case, no.
Class A ambient adjustment = 8 dBA daytime
Class A ambient adjustment = 2 dBA nighttime

Step 9 Is noise temporary in nature?
In this example assume no; well or facility operations will occur all year (more than 60 days).
Class B adjustment: B = 0 dBA

Step 10

Daytime	Nighttime
PSL = BSL + Day + A + B	PSL = BSL + Day + A + B
PSL = 40 + 10 + 8 + 0	PSL = 40 + 0 + 2 + 0
PSL = 58 dBA L_{eq}	PSL = 42 dBA L_{eq}

Step 11 Daytime PSL = 58 dBA L_{eq}
Nighttime PSL = 42 dBA L_{eq}

as measured 15 m from the nearest country dwelling.

Example 2 – Noise impact assessment (simple calculation)

A new well or facility is proposed for the area shown in Figure 6. The most impacted dwelling is located 800 m northeast of the well or facility along a road not heavily travelled; therefore it is a Category 1 proximity to transportation. The density of dwelling is in the 1 to 8 range. From Table 1, the BSL at nighttime is 40 dBA and since no additional adjustments are required, the PSL is 40 dBA L_{eq} nighttime. The sources of noise from the well or facility are the cooler fans and exhaust noise. The manufacturer has stated that the maximum sound level emitted from this equipment is 55 dBA measured at 50 m in front of the cooler fans.

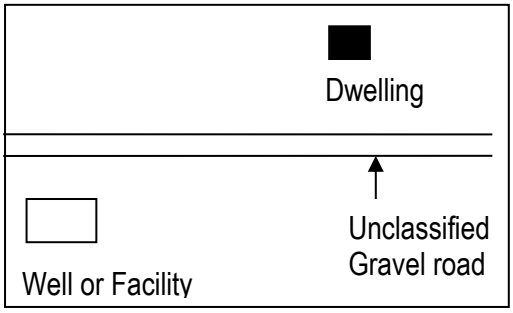


Figure 6 - Area sketch for example 2

Example 2 - Solution

The table below demonstrates the use of the doubling of distance method to estimate the sound level from the source:

Distance (m)	Sound level (dBA)
50	55
100	49
200	43
400	37
800	31

Note that this is a small, stationary, single-source well or facility without any existing well or facility operations in the proximity and with flat ground between the well or facility and a single dwelling.

The six dBA loss per doubling of distance is a rough estimate. A more accurate way to determine the sound attenuation with distance is to measure similar equipment at a topographically similar location. The sound levels would be measured at specified distances away from the facility (for example, 100 m, 200 m, 400 m, etc.) to determine the actual attenuation with distance.

The nighttime permissible sound level should be met. Many well and facility operations create the same amount of noise whether it is daytime or nighttime, and so the most stringent criterion is the nighttime permissible sound level.

The noise impact assessment developed for this example would include the following:

1) The major sources of noise in this facility include cooler fans and exhaust noise. Well-related noise may be from a service rig operation, or hydraulic fracturing activity.
2) The sound levels at the nearest dwelling have been predicted using the six dBA loss per doubling of distance calculation method. Sound level losses for air absorption, ground attenuation, or cooler fan orientation away from the dwelling have not been included. The only noise source input is the 55 dBA at 50 m.
3) The distance to the most impacted dwelling is 800 m northeast of the facility. This also happens to be the closest dwelling. If we extrapolate the 55 dBA value out to 800 m, using the theoretical six dBA loss per doubling of distance:

   L is sound level at distance R

   $L(R2) = L(R1) – 20 \log (R2/R1)$

   $L(800) = 55 – 20 \log (800/50)$

   $L(800) = 30.9$

   The predicted sound level at the dwelling from the facility alone is 30.9 dBA. Adding this to the assumed rural ambient sound level (35 dBA L_{eq}) results in a combined predicted sound level of 36.3 dBA L_{eq}. With this result, the Appendix B noise impact assessment summary form can be submitted in the application as a substitute for the noise impact assessment.
4) This noise impact assessment was conducted by Acoustical Practitioner, of XYZ Company. Also see other requirements set out in Section 3.2.

Example 3 - Noise impact assessment

A new facility is proposed for the area shown in Figure 7. For what location(s) should compliance be determined? How should the existing facility be considered?

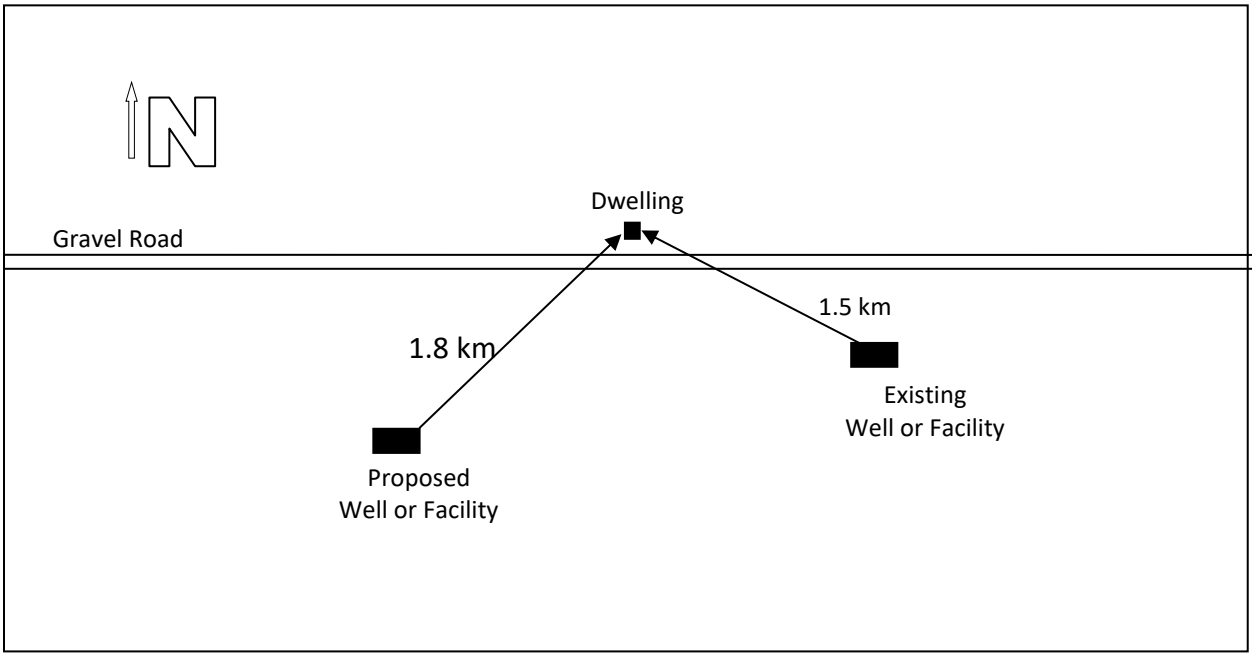


Figure 7 - Area sketch for example 3

Example 3 – Solution

A new well or facility is planned for an area where another well or facility is present. The guideline requires that cumulative effects be considered for all potentially affected dwellings in a study area and/or at 1.5 km from the well or facility property boundary where there are no dwellings in the study area. The acoustical practitioner should determine whether dwellings are present within the 1.5 km distance or if there is potential for cumulative effects to occur at dwellings beyond the 1.5 km facility property boundary. The example presented examines two situations: one where the proposed well or facility is a simple noise source and the situation where there is a dwelling beyond the proposed well or facility property boundary. The example demonstrates the concept of the area of overlap of two wells or facilities at their respective 1.5 km facility property boundaries, and compliance with the PSL.

1) The PSL based on Section 2.1 of the Noise Control Guideline is 40 dBA L_{eq} nighttime at a distance of 1.5 km from the proposed facility property boundary where there are no affected dwellings closer to the well or facility. The corresponding assumed nighttime ASL from Section 2.1 is 35 dBA L_{eq}.

2) Where there is no noise data available for existing well or facility operations, the existing well or facility may be assumed to be compliant with the PSL so that it meets a noise level of 40 dBA L_{eq} at a distance of 1.5 km from its own facility property boundary. This means the existing well or facility contribution is assumed to be 38.3 dBA, with an assumed ASL of 35 dBA L_{eq} nighttime. (38.3 dBA +35 dBA = 40 dBA).

3) Compliance of the proposed well or facility is assessed at the points of intersection of the 1.5 km well or facility property boundaries of the existing and proposed well or facility operations (see points A and B in Figure 8). Note that in the areas of overlap of the proposed and existing wells or facility 1.5 km property boundaries, the PSL may be exceeded if there are no dwellings within that area.

4) The sound emission from the proposed well or facility needs to be established. The measurements from a similar well or facility indicate that it is a simple source that emits a sound level of 56.5 dBA at 25 m from the well or facility. Using the standard distance attenuation formulae, standard distance attenuation formulae in Appendix F, 56.5 dBA at 25 m results in a noise contribution at Point A or Point B of 20.9 dBA. (For more complex sources or situations, the acoustical practitioner should conduct the calculations using modelling software or more detailed calculations).

5) Point A and Point B are the points of interest where the two well or facility property boundaries meet and where compliance should be demonstrated (in the absence of an affected dwelling in the area). The PSL is determined to be 40 dBA L_{eq} nighttime at these two points. The cumulative effects assessment at Point A and Point B considers the contributions of all energy-related regulated facilities plus the assumed ASL. In this situation the noise level at Point A and Point B is predicted to be:

   Proposed Facility contribution + Existing facility contribution + assumed ASL = dBA at Point A which is:

   20.9 dBA + 38.3 dBA + 35.0 dBA = 40.0 dBA at Point A and Point B.

6) In the situation where a dwelling is located beyond the 1.5 km proposed well or facility property (at 1.8 km), but the noise impact may be affected due to cumulative effects from multiple facilities, the noise impact needs to be assessed at those dwellings. Using the standard distance attenuation formulae in Appendix F, the proposed facility noise contribution at the dwelling is predicted to be 19.4 dBA.

7) Compliance at the dwelling is determined by adding the proposed well or facility noise contribution to the existing well or facility operation's noise contribution (based on the assumption the existing energy-related facility complies with the PSL of 40 dBA L_{eq} nighttime and its noise contribution is 38.3 dBA at the dwelling, and the assumed ambient sound level of 35 dBA L_{eq} nighttime), then comparing the result to the nighttime PSL:

   Proposed Well or Facility contribution + Well or Existing facility contribution+ assumed ASL = noise level dBA at the dwelling which is:

   19.4 dBA + 38.3 dBA + 35.0 dBA = 40.0 dBA at the dwelling.

   The PSL is not exceeded; both facilities are predicted to be in compliance.

   Summary

   If there are no dwellings in the study area that will be affected by the cumulative effects of noise from well and facility operations, the Regulator limits the nighttime permissible sound level in this example along the 1.5 km facility property boundaries and at the intersecting points (Point A and Point B) of the proposed and existing well or facility boundaries.

   The proposed well or facility which meets the permissible sound level at the 1.5 km facility property boundary intersection points (points A and B) is expected to have less noise impact at a dwelling located further from the intersection points but may have a cumulative noise impact at that dwelling. With a dwelling in the study area at a distance of 1.8 km from the proposed well or facility, it is determined through the calculations that the proposed well or facility operations demonstrate a no net increase in noise level at the dwelling. "No net increase" indicates that the total noise impact, including the proposed well or facility, will not exceed 40.0 dBA,

8) The noise assessment supplied in the example provides the details required and outlines the assumptions made and data sources and formulae used to determine compliance with the PSL at a distance of 1.5 km from the proposed well or facility property boundary with and without a dwelling in the study area. The example demonstrates a no net increase in noise level as defined in Appendix A.

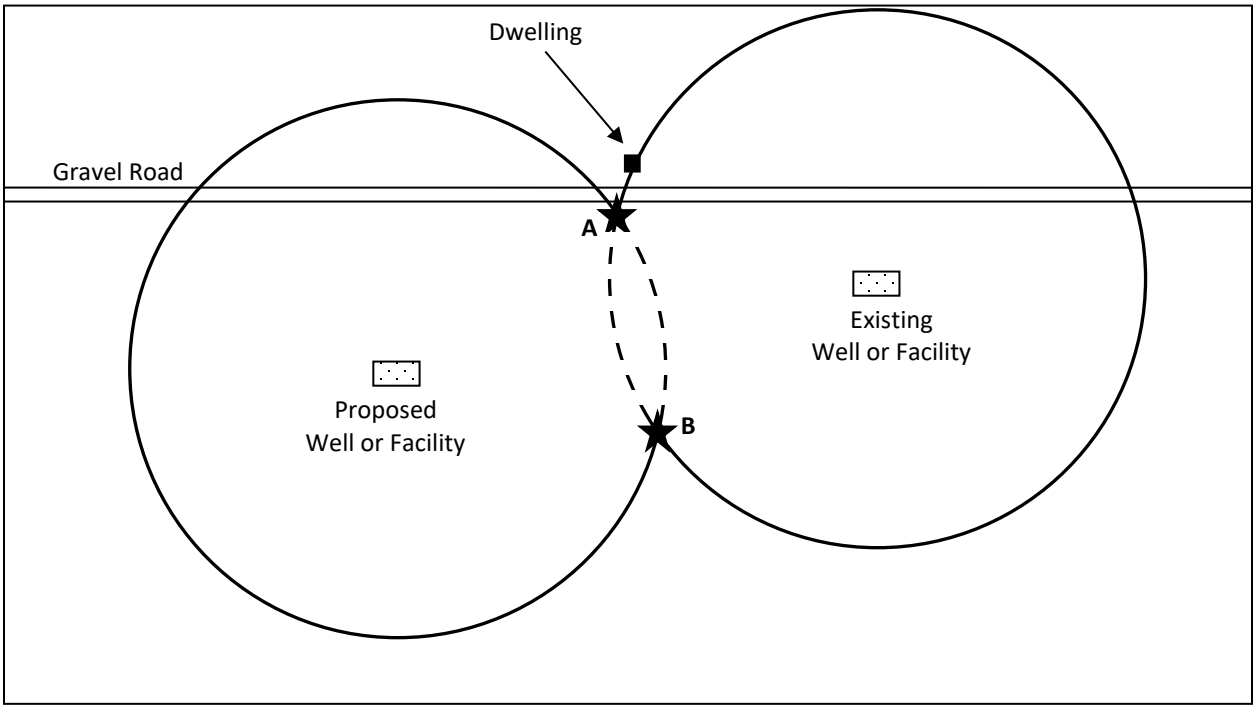


Figure 8 - 1.5 km criteria boundary for example 3