Appendix B

Updated Noise Assessment

aci Acoustical Consultants Inc.
5031 – 210 Street
Edmonton, Alberta, Canada T6M 0A8
Phone: (780) 414-6373, Fax: (780) 414-6376
www.aciacoustical.com

Environmental Noise Impact Assessment
For

STP McKay Thermal Project – Phase 2 Update

Prepared for:
Southern Pacific Resource Corp.

Prepared by:
S. Bilawchuk, M.Sc., P.Eng.

aci Acoustical Consultants Inc.
Edmonton, Alberta
APEGGA Permit to Practice #P7735

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Executive Summary

aci Acoustical Consultants Inc., of Edmonton AB, was retained by Southern Pacific Resource Corp. (STP) to conduct an environmental noise impact assessment (NIA) for the proposed STP McKay Thermal Project – Phase 2 (the Project) in northeast Alberta. The purpose of the work was to generate a computer noise model of the Project under Application Case conditions and to compare the resultant sound levels to the Alberta Energy Resources Conservation Board (ERCB) permissible sound level guidelines (Directive 038 on Noise Control, 2007) as well as the Alberta Utilities Commission (AUC) Rule 012 on Noise Control. This noise assessment is an update to a previous one completed in November, 2011[1].

The results of the noise modeling indicated Application Case noise levels associated with the 16,920 bpd Phase 1 CPF, the 18,000 bpd Phase 2 CPF, and all Project wellpads (with the average ambient sound level of 35 dBA included) will be below the ERCB Directive 038 PSL of 40 dBA L_{eq}Night[2] for all surrounding theoretical 1,500 m receptors. The noise levels without the ASL are modeled to be more than 5 dBA below the PSL at most locations.

The dBC – dBA sound levels are projected to be less than 20 dB at most locations. There are some locations, however with values greater than 20 dB, resulting in the possibility of low frequency tonal noise. The dominant low frequency noise sources are the gas turbine exhaust stacks. These tend not to be specifically tonal in nature. They tend to have a more broadband low frequency quality. As such, the possibility of a low frequency tonal component (as specified by ERCB Directive 038 and AUC Rule 012) is low. In addition, there are no residential receptors nearby to express concerns for the low frequency noise. As a result, no additional noise mitigation is required.

[1] *Environmental Noise Impact Assessment for STP McKay Thermal Project - Phase 2,* Prepared for Southern Pacific Resource Corp., by aci Acoustical Consultants Inc., November, 2011.
[2] The term L_{eq} represents the energy equivalent sound level. This is a measure of the equivalent sound level for a specified period of time accounting for fluctuations.

Application Case Modeled Sound Levels

Receptor (1,500m From Project)	ASL-Night (dBA)	Application Case L_{eq}Night (dBA)	ASL + Application Case L_{eq}Night (dBA)	PSL-Night (dBA)	Compliant		Application Case L_{eq}Night (dBC)	dBC - dBA	Tonal
R_01	35.0	21.3	35.2	40.0	YES		37.7	16.4	NO
R_02	35.0	19.9	35.1	40.0	YES		36.7	16.8	NO
R_03	35.0	20.9	35.2	40.0	YES		37.6	16.7	NO
R_04	35.0	23.9	35.3	40.0	YES		43.0	19.1	NO
R_05	35.0	23.8	35.3	40.0	YES		40.9	17.1	NO
R_06	35.0	27.4	35.7	40.0	YES		47.5	20.1	POSSIBLE
R_07	35.0	31.8	36.7	40.0	YES		52.0	20.2	POSSIBLE
R_08	35.0	37.3	39.3	40.0	YES		57.2	19.9	NO
R_09	35.0	38.0	39.8	40.0	YES		57.6	19.6	NO
R_10	35.0	36.0	38.5	40.0	YES		55.3	19.3	NO
R_11	35.0	33.4	37.3	40.0	YES		52.8	19.4	NO
R_12	35.0	31.7	36.7	40.0	YES		49.9	18.2	NO
R_13	35.0	34.1	37.6	40.0	YES		52.2	18.1	NO
R_14	35.0	33.9	37.5	40.0	YES		53.8	19.9	NO
R_15	35.0	33.6	37.4	40.0	YES		53.3	19.7	NO
R_16	35.0	37.0	39.1	40.0	YES		56.7	19.7	NO
R_17	35.0	32.5	36.9	40.0	YES		52.5	20.0	POSSIBLE
R_18	35.0	29.0	36.0	40.0	YES		47.2	18.2	NO
R_19	35.0	28.0	35.8	40.0	YES		48.8	20.8	POSSIBLE
R_20	35.0	27.2	35.7	40.0	YES		48.2	21.0	POSSIBLE
R_21	35.0	28.1	35.8	40.0	YES		48.9	20.8	POSSIBLE
R_22	35.0	30.6	36.3	40.0	YES		49.5	18.9	NO
R_23	35.0	29.3	36.0	40.0	YES		48.9	19.6	NO
R_24	35.0	29.2	36.0	40.0	YES		47.6	18.4	NO
R_25	35.0	32.6	37.0	40.0	YES		51.1	18.5	NO
R_26	35.0	27.6	35.7	40.0	YES		47.0	19.4	NO
R_27	35.0	29.3	36.0	40.0	YES		49.6	20.3	POSSIBLE
R_28	35.0	26.8	35.6	40.0	YES		47.1	20.3	POSSIBLE
R_29	35.0	24.6	35.4	40.0	YES		45.0	20.4	POSSIBLE
R_30	35.0	20.1	35.1	40.0	YES		36.9	16.8	NO

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1.0 Introduction

aci Acoustical Consultants Inc., of Edmonton AB, was retained by Southern Pacific Resource Corp. (STP) to conduct an environmental noise impact assessment (NIA) for the proposed STP McKay Thermal Project – Phase 2 (the Project) in northeast Alberta. The purpose of the work was to generate a computer noise model of the Project under Application Case conditions and to compare the resultant sound levels to the Alberta Energy Resources Conservation Board (ERCB) permissible sound level guidelines (Directive 038 on Noise Control, 2007) as well as the Alberta Utilities Commission (AUC) Rule 012 on Noise Control. This noise assessment is an update to a previous one completed in November, 2011[1].

2.0 Project Location and Description

The Project is situated in the McKay River area within the Municipal District of Wood Buffalo and is located approximately 40 km north-west of the community of Fort McMurray, as shown in Figure 1. In 2010, STP received approval for the STP McKay Thermal Project – Phase 1 with a production capacity of 1908 m^3 (12,000 barrels) of bitumen per day for 30 years (Phase 1). Phase 1 (currently under construction) consists of a central processing facility (CPF) located at NE-07-91-14-W4M and three well pads located within Section 07-91-14-W4M. The updated design will increase Phase 1 to 18,000 bpd.

The overall Project is designed for 22,920 bpd Capacity (additional 4,920 bpd for Phase 1 and 18,000 bpd for Phase 2) which will bring the total capacity for Phase 1 and Phase 2 to 34,920 bpd. The Project will span Sections 6-10, 15-18, 20-23, 27-28, 34-35 in 91-14-W4M as well as Sections 1 and 12-13 of 91-15-W4M. The Phase 2 CPF will be located in the middle of Section 10-91-14-W4M and the well pads will be located throughout the study area. As indicated in Figure 1, the initial stages of the Project will have the Phase 1 CPF and 4 well pads as well as the Phase 2 CPF and 4 well pads. In time, additional well pads will be brought on-line and existing well pads will be decommissioned. For the purposes of the noise impact assessment, however, all of the proposed well pad locations have been modeled as fully operational at the same time. This provides a more conservative result and covers all possible well pad operational configurations.

[1] *Environmental Noise Impact Assessment for STP McKay Thermal Project - Phase 2,* Prepared for Southern Pacific Resource Corp., by aci Acoustical Consultants Inc., November, 2011.

There are no major roadways nearby and there are no existing industrial facilities within 5 km of the Project lease boundary. In addition, there are no residents or Trappers' Cabins within at least 5 km of the Project lease area. Topographically, the land in the area has a general downward slope into the MacKay River from the CPF and the well pads (maximum elevation change of approximately 40 m). The land is covered with field grasses, trees and bushes (as observed through aerial photos). As such, the level of vegetative sound absorption is considered moderate.

3.0 Measurement & Modeling Methods

3.1. Baseline Noise Monitoring

Due to the lack of residential receptors or existing industrial noise sources in the surrounding area, baseline noise monitoring was not conducted. This conforms with the requirements of the ERCB Directive 038 and AUC Rule 012.

3.2. Computer Noise Modeling (General)

The computer noise modeling was conducted using the CADNA/A (version 4.2.140) software package. CADNA/A allows for the modeling of various noise sources such as road, rail, and stationary sources. Topographical features such as land contours, vegetation, and bodies of water and meteorological conditions such as temperature, relative humidity, wind-speed and wind-direction are considered in the assessment. The modeling methods utilized met or exceeded the requirements of the ERCB Directive 038 and AUC Rule 012.

The calculation method used for noise propagation follows the International Standards Organization (ISO) 9613-2. All receiver locations were assumed as being downwind from the source(s). In particular, as stated in Section 5 of the ISO 9613-2 document:

> *"Downwind propagation conditions for the method specified in this part of IS0 9613 are as specified in 5.4.3.3 of IS0 1996-2:1987, namely*
>
> - *wind direction within an angle of ± 45^0 of the direction connecting the centre of the dominant sound source and the centre of the specified receiver region, with the wind blowing from source to receiver, and*

- *wind speed between approximately 1 m/s and 5 m/s, measured at a height of 3 m to 11 m above the ground.*

The equations for calculating the average downwind sound pressure level LAT(DW) in this part of IS0 9613, including the equations for attenuation given in clause 7, are the average for meteorological conditions within these limits. The term average here means the average over a short time interval, as defined in 3.1.

These equations also hold, equivalently, for average propagation under a well-developed moderate ground-based temperature inversion, such as commonly occurs on clear, calm nights".

Due to the large size of the study area and the density of vegetation within the study area, vegetative sound absorption was included in the model. A ground absorption coefficient of 0.5 was used along with a temperature of 10^{0}C and a relative humidity of 70%. Although there are trees in the area, they were not incorporated into the model. As a result, all sound level propagation calculations are considered a conservative representation of summertime conditions (as specified in ERCB Directive 038 and AUC Rule 012).

As part of the study, an Application Case noise modeling scenario was modeled: This included the updated 16,920 bpd Phase 1 CPF, the 18,000 bpd Phase 2 CPF, and all proposed wellpads. For Baseline Case conditions with the existing 12,000 bpd Phase 1 CPF, refer to the previous noise impact assessment[1].

The computer noise modeling results were calculated in two ways. First, sound levels were calculated at the theoretical 1,500 m receiver locations. Second, sound levels were calculated using a 20 m x 20 m receptor grid pattern within the entire study area. This provided color noise contours for easier visualization and evaluation of the results.

3.3. Noise Sources

The noise sources for the equipment associated with the Project are provided in Appendix I. The data were obtained from equipment specific noise level information provided by STP and assessments carried out for other projects using similar operating equipment combined with aci in-house information and

[1] *Environmental Noise Impact Assessment for STP McKay Thermal Project - Phase 2,* Prepared for Southern Pacific Resource Corp., by aci Acoustical Consultants Inc., November, 2011.

calculations using methods presented in various texts. All sound power levels (PWLs) used in the modeling are considered conservative.

All noise sources have been modeled as point sources at their appropriate heights[1]. Sound power levels for all noise sources were modeled using octave-band information. Buildings and tanks were included in the modeling calculations because of their ability to provide shielding as well as reflection for noise[2]. Refer to Appendix I for building and tank dimensions.

Finally, ERCB Directive 038 and AUC Rule 012 require the assessment to include background ambient noise levels in the model. As specified in ERCB Directive 038 and AUC Rule 012, in most rural areas of Alberta where there is an absence of industrial noise sources the average night-time ambient noise level is approximately 35 dBA. This is known as the average ambient sound level (ASL). This value was used as the ambient condition in the modeling with the various Project related noise sources added.

3.4. Modeling Confidence

As mentioned previously, the algorithms used for the noise modeling follow the ISO 9613 standard. The published accuracy for this standard is ±3 dBA between 100 m – 1,000 m. Accuracy levels beyond 1,000 m are not published. Professional experience based on similar noise models and measurements conducted over large distances shows that, as expected, as the distance increases, the associated accuracy in prediction decreases. Experience has shown that environmental factors such as wind, temperature inversions, topography and ground cover all have increasing effects over distances larger than approximately 1,500 m. As such, for all receptors within approximately 1,500 m of the various noise sources, the prediction confidence is considered high, while for all receptors beyond 1,500 m, the prediction confidence is considered moderate.

[1] The heights for many of the sources are generally slightly higher than actual. This makes the model more conservative
[2] Exterior building and tank walls were modeled with an absorption coefficient of 0.21 which is generally highly reflective.

4.0 Permissible Sound Levels

Environmental noise levels from industrial noise sources are commonly described in terms of equivalent sound levels or L_{eq}. This is the level of a steady sound having the same acoustic energy, over a given time period, as the fluctuating sound. In addition, this energy averaged level is A–weighted to account for the reduced sensitivity of average human hearing to low frequency sounds. These L_{eq} in dBA, which are the most common environmental noise measure, are often given for day-time (07:00 to 22:00) L_{eq}Day and night-time (22:00 to 07:00) L_{eq}Night while other criteria use the entire 24-hour period as L_{eq}24. Refer to Appendix II for a description of the acoustical terms used and to Appendix III for a list of common noise sources.

The documents which relate to the Permissible Sound Levels (PSLs) for this NIA are the ERCB Directive 038 on Noise Control (2007) and the AUC Rule 012 on Noise Control. Both documents are essentially identical, in particular, as they pertain to the PSLs for this project. Both documents set the PSL at the receiver location based on population density and relative distances to heavily traveled road and rail as shown in Table 1. In all instances, there is a Basic Sound Level (BSL) of 40 dBA for the night-time (night-time hours are 22:00 – 07:00) and 50 dBA for the day-time (day-time hours are 07:00 – 22:00). Note that for this location, none of the adjustments to the BSL apply. Finally, both documents specify that new or modified facilities must meet a PSL-Night of 40 dBA at 1,500 m from the facility fence-line if there are no closer dwellings. As such, the PSLs at a distance of 1,500 m are an **L_{eq}Night of 40 dBA and an L_{eq}Day of 50 dBA.** Refer to Appendix IV for a detailed determination of the permissible sound levels.

The PSLs provided are related to noise associated with activities and processes at the Project and are not related to vehicle traffic on nearby highways (or access roads). This includes all traffic related to the construction and operation of the Facility. Noises from traffic sources are not covered by any regulations or guidelines at the municipal, provincial, or federal levels. As such, an assessment of the noises related to vehicle traffic was not conducted. In addition, construction noise is not specifically regulated by ERCB Directive 038 or AUC Rule 012. However, construction noise mitigation recommendations are provided in Section 5.3.1.

Table 1. Basic Night-Time Sound Levels (as per ERCB Directive 038 and AUC Rule 012)

Proximity to Transportation	Dwelling Density per Quarter Section of Land		
	1-8 Dwellings	9-160 Dwellings	>160 Dwellings
Category 1	40	43	46
Category 2	45	48	51
Category 3	50	53	56

Category 1 Dwelling units more than 500m from heavily travelled roads and/or rail lines and not subject to frequent aircraft flyovers

Category 2 Dwelling units more than 30m but less than 500m from heavily travelled roads and/or rail lines and not subject to frequent aircraft flyovers

Category 3 Dwelling units less than 30m from heavily travelled roads and/or rail lines and not subject to frequent aircraft flyovers

5.0 Results and Discussion

5.1. Application Case Results

The results of the Application Case noise modeling are presented in Table 2 and illustrated in Figure 2. The modeled noise levels at the theoretical 1,500 m receptor locations are under the PSLs with all Project equipment noise combined with the 35 dBA ASL. In addition, the noise levels resulting from the Project equipment noise alone (i.e. no ASL) are more than 5 dBA below the PSL at most locations. The order-ranked noise source contribution from the Project equipment noise sources at the theoretical 1,500 m receptor with the highest noise levels (R_09) are presented in Appendix V.

Table 2. Application Case Modeled Sound Levels

Receptor (1,500m From Project)	ASL-Night (dBA)	Application Case L_{eq}Night (dBA)	ASL + Application Case L_{eq}Night (dBA)	PSL-Night (dBA)	Compliant
R_01	35.0	21.3	35.2	40.0	YES
R_02	35.0	19.9	35.1	40.0	YES
R_03	35.0	20.9	35.2	40.0	YES
R_04	35.0	23.9	35.3	40.0	YES
R_05	35.0	23.8	35.3	40.0	YES
R_06	35.0	27.4	35.7	40.0	YES
R_07	35.0	31.8	36.7	40.0	YES
R_08	35.0	37.3	39.3	40.0	YES
R_09	35.0	38.0	39.8	40.0	YES
R_10	35.0	36.0	38.5	40.0	YES
R_11	35.0	33.4	37.3	40.0	YES
R_12	35.0	31.7	36.7	40.0	YES
R_13	35.0	34.1	37.6	40.0	YES
R_14	35.0	33.9	37.5	40.0	YES
R_15	35.0	33.6	37.4	40.0	YES
R_16	35.0	37.0	39.1	40.0	YES
R_17	35.0	32.5	36.9	40.0	YES
R_18	35.0	29.0	36.0	40.0	YES
R_19	35.0	28.0	35.8	40.0	YES
R_20	35.0	27.2	35.7	40.0	YES
R_21	35.0	28.1	35.8	40.0	YES
R_22	35.0	30.6	36.3	40.0	YES
R_23	35.0	29.3	36.0	40.0	YES
R_24	35.0	29.2	36.0	40.0	YES
R_25	35.0	32.6	37.0	40.0	YES
R_26	35.0	27.6	35.7	40.0	YES
R_27	35.0	29.3	36.0	40.0	YES
R_28	35.0	26.8	35.6	40.0	YES
R_29	35.0	24.6	35.4	40.0	YES
R_30	35.0	20.1	35.1	40.0	YES

In addition to the broadband A-weighted (dBA) sound levels, the modeling results at the theoretical 1,500 m receptor locations indicated C-weighted (dBC) sound levels will be less than 20 dB above the dBA sound levels at most locations, as shown in Table 3. As specified in ERCB Directive 038 and AUC Rule 012, if the dBC – dBA sound levels are less than 20 dB, the noise is not considered to have a low frequency tonal component. For those locations with dBC – dBA values above 20, the modeling indicates that the possibility exists for a low frequency tonal component. However, both ERCB Directive 038 and AUC Rule 012 have additional requirements related to the 1/3 octave band sound pressure levels to have an identified low frequency tonal component. Sound level data for the various noise sources is only available in 1/1 octave band resolution. As such, a specific low frequency tonal component cannot be determined. The modeling does indicate that the dominant source of the low frequency noise is the gas turbine exhaust from the CoGen units. Noise from this equipment tends to have a more broadband low frequency content with no specific tones. Note also that the study area is remote and there are no residential receptors nearby. Both ERCB Directive 038 and AUC Rule 012 require a complaint to be filed with a specific low frequency concern before and investigation would be required to even determine the presence of a low frequency tonal component. At this location, this is very unlikely. Finally, the locations with the possible low frequency tonal component all have dBA values well below 35 dBA. As such, even if a low frequency tonal component did exist, the 5 dBA penalty prescribed in ERCB Directive 038 and AUC Rule 012 would still result in noise levels below 40 dBA.

Table 3. Application Case Modeled dBA and dBC Sound Levels

Receptor (1,500m From Project)	Application Case L_{eq}Night (dBA)	Application Case L_{eq}Night (dBC)	dBC - dBA	Tonal
R_01	21.3	37.7	16.4	NO
R_02	19.9	36.7	16.8	NO
R_03	20.9	37.6	16.7	NO
R_04	23.9	43.0	19.1	NO
R_05	23.8	40.9	17.1	NO
R_06	27.4	47.5	20.1	POSSIBLE
R_07	31.8	52.0	20.2	POSSIBLE
R_08	37.3	57.2	19.9	NO
R_09	38.0	57.6	19.6	NO
R_10	36.0	55.3	19.3	NO
R_11	33.4	52.8	19.4	NO
R_12	31.7	49.9	18.2	NO
R_13	34.1	52.2	18.1	NO
R_14	33.9	53.8	19.9	NO
R_15	33.6	53.3	19.7	NO
R_16	37.0	56.7	19.7	NO
R_17	32.5	52.5	20.0	POSSIBLE
R_18	29.0	47.2	18.2	NO
R_19	28.0	48.8	20.8	POSSIBLE
R_20	27.2	48.2	21.0	POSSIBLE
R_21	28.1	48.9	20.8	POSSIBLE
R_22	30.6	49.5	18.9	NO
R_23	29.3	48.9	19.6	NO
R_24	29.2	47.6	18.4	NO
R_25	32.6	51.1	18.5	NO
R_26	27.6	47.0	19.4	NO
R_27	29.3	49.6	20.3	POSSIBLE
R_28	26.8	47.1	20.3	POSSIBLE
R_29	24.6	45.0	20.4	POSSIBLE
R_30	20.1	36.9	16.8	NO

5.2. Noise Mitigation Measures

The results of the noise modeling indicated that no specific additional noise mitigation measures are required.

5.2.1. Construction Noise

Although there are no specific construction noise level limits detailed by ERCB Directive 038, there are general recommendations for construction noise mitigation. This includes all activities associated with construction of the facility, well-pads (including drilling), borrow-pits, etc. The document states:

> "*While Directive 038 is not applicable to construction noise, licensees should attempt to take the following reasonable mitigating measures to reduce the impact on nearby dwellings of construction noise from new facilities or modifications to existing facilities. Licensees should:*
>
> - *Conduct construction activity between the hours of 07:00 and 22:00 to reduce the potential impact of construction noise;*
> - *Advise nearby residents of significant noise-causing activities and schedule these events to reduce disruption to them;*
> - *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.*
>
> *Should a valid complaint be made during construction, the licensee is expected to respond expeditiously and take appropriate action to ensure that the issue has been managed responsibly.*"

6.0 Conclusion

The results of the noise modeling indicated Application Case noise levels associated with the 16,920 bpd Phase 1 CPF, the 18,000 bpd Phase 2 CPF, and all Project wellpads (with the average ambient sound level of 35 dBA included) will be below the ERCB Directive 038 PSL of 40 dBA L_{eq}Night for all surrounding theoretical 1,500 m receptors. The noise levels without the ASL are modeled to be more than 5 dBA below the PSL at most locations.

The dBC – dBA sound levels are projected to be less than 20 dB at most locations. There are some locations, however with values greater than 20 dB, resulting in the possibility of low frequency tonal noise. The dominant low frequency noise sources are the gas turbine exhaust stacks. These tend not to be specifically tonal in nature. They tend to have a more broadband low frequency quality. As such, the possibility of a low frequency tonal component (as specified by ERCB Directive 038 and AUC Rule 012) is low. In addition, there are no residential receptors nearby to express concerns for the low frequency noise. As a result, no additional noise mitigation is required.

A short form (ERCB form) noise impact assessment is presented in Appendix VI.

7.0 References

- *Environmental Noise Impact Assessment for STP McKay SAGD Project at LSD NW-07-91-14-W4M.* Prepared for Southern Pacific Resource Corp., by aci Acoustical Consultants Inc., April, 2009.
- *Environmental Noise Impact Assessment for STP McKay Thermal Project - Phase 2,* Prepared for Southern Pacific Resource Corp., by aci Acoustical Consultants Inc., November, 2011.
- Alberta Energy Resources Conservation Board (ERCB), *Directive 038 on Noise Control, 2007*, Calgary, Alberta.
- Alberta Utilities Commission (AUC), *Rule 012 on Noise Control*, *2010*, Calgary, Alberta.
- International Organization for Standardization (ISO), *Standard 1996-1, Acoustics – Description, measurement and assessment of environmental noise – Part 1: Basic quantities and assessment procedures, 2003*, Geneva Switzerland.
- International Organization for Standardization (ISO), *Standard 9613-1, Acoustics – Attenuation of sound during propagation outdoors – Part 1: Calculation of absorption of sound by the atmosphere, 1993*, Geneva Switzerland.
- International Organization for Standardization (ISO), *Standard 9613-2, Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation, 1996*, Geneva Switzerland.

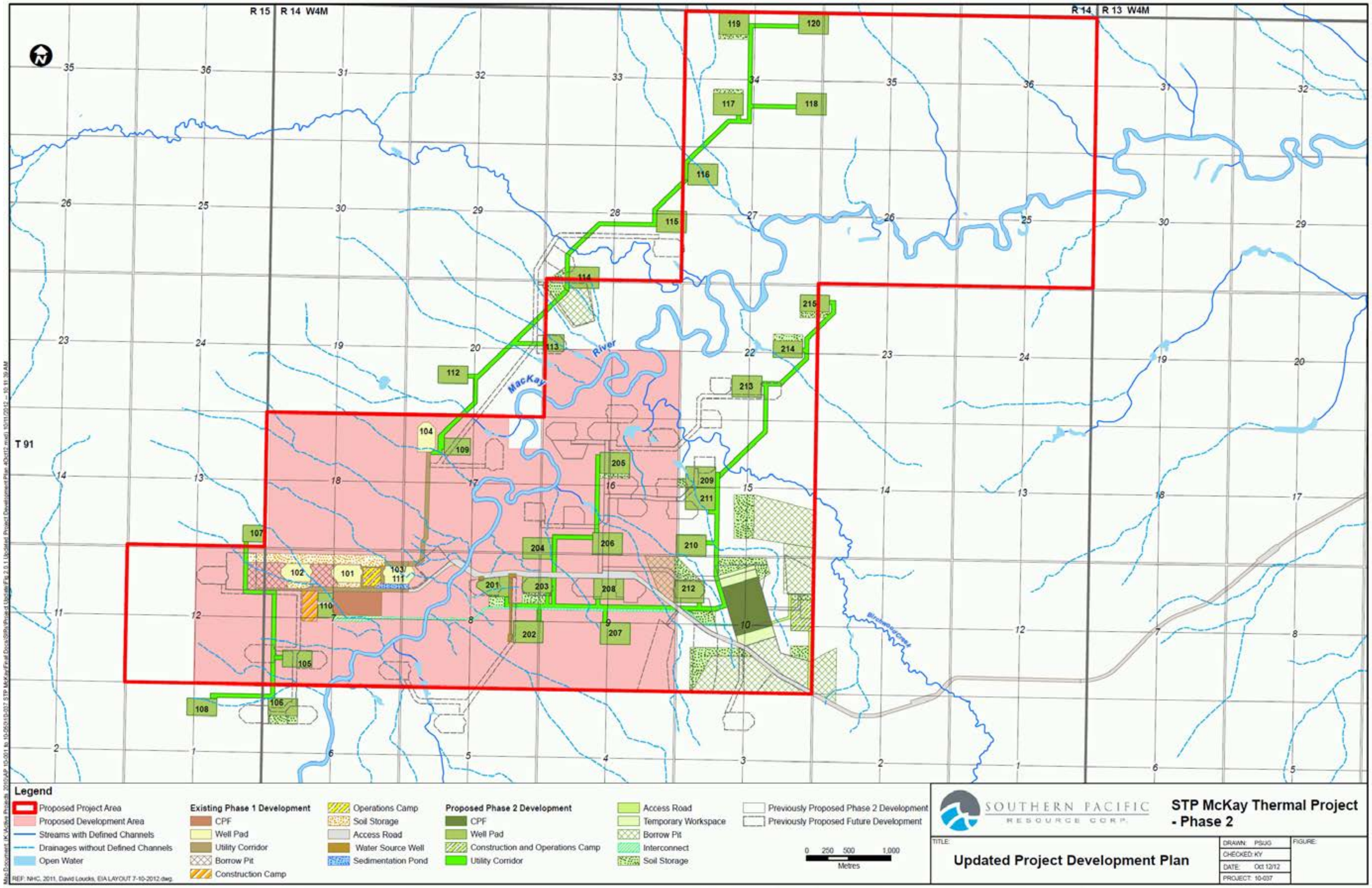


Figure 1. Study Area

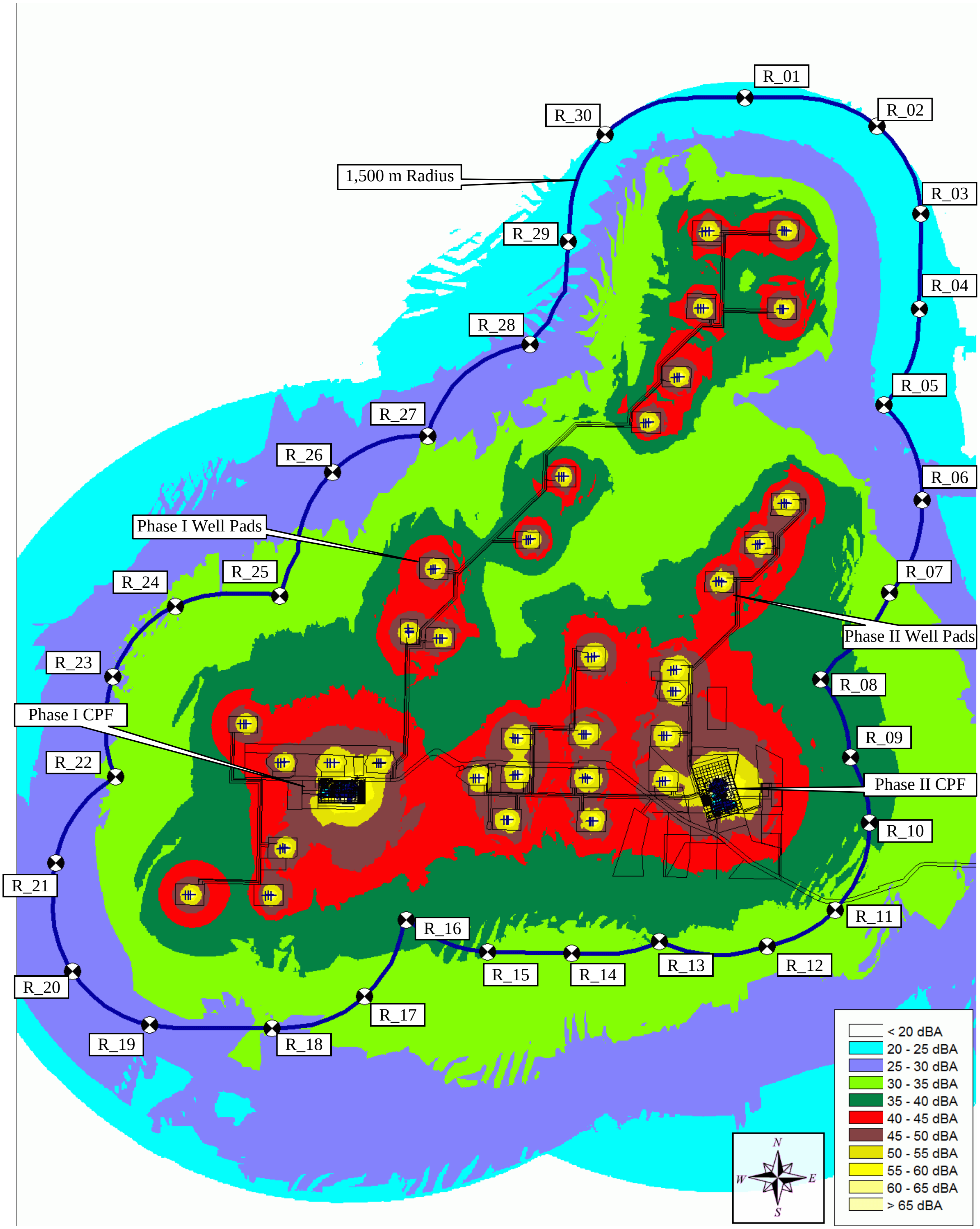


Figure 2. Application Case Modeled Night-time Noise Levels (Without ASL)

Appendix I NOISE MODELING PARAMETERS

Phase 1 (18,000 bpd) Noise Source Broadband Sound Power Levels (Re 10^{-12} Watts, un-mitigated)

Tag	Description	Location	Height (m)	Model/Type	Rating (kW)	# Units	Equipment Sound Power Level (dBA)	Building Attenuation (dBA)	Overall Sound Power Level (dBA)
100P-2150	Wash Water Pump	West Water Building	2	Centrifugal	30.0	1	102.2	18.8	83.4
100P-2170A/B	Surge Pump	West Water Building	2	Centrifugal	30.0	2	105.2	18.8	86.4
100P-2260A/B	De-oiled Water Pump	New IGF Building	2	Centrifugal	56.0	2	106.1	18.8	87.3
100P-2280A/B	Diluent Pump	Diluent Meter Building	2	Centrifugal	56.0	2	106.1	18.8	87.3
100P-2380A/B	Dilbit Load Pumps	Dilbit Meter Building	2	Centrifugal	56.0	2	106.1	18.8	87.3
100P-2800	Clean Oil Storage Pump	Clean Oil Building	2	Centrifugal	56.0	1	103.0	18.8	84.2
100P-2910A/B	IGF Recycle / Eductor Supply Pumps	New IGF Building	2	Centrifugal	44.8	2	105.8	18.8	87.0
100P-2920A/B	ORF Feed Pumps	New IGF Building	2	Centrifugal	93.3	2	106.7	18.8	87.9
100P-3125A/B/C	OTSG BFW Booster Pumps	LP BFW Pump Building	2	Centrifugal	52.2	3	107.7	18.8	88.9
100P-3180A/B	Evaporator Feed Pumps	Evaporator Building	2	Centrifugal	30.0	2	105.2	18.8	86.4
100P-3190/290	Evaporator Distilate Pumps	Evaporator Building	2	Centrifugal	30.0	2	105.2	18.8	86.4
100P-3220	Evap #1 Recirc. Pump	Evaporator Building	2	Centrifugal	265.0	1	105.1	18.8	86.3
100P-3225A/B	WAC Polisher Feed Pumps	Softener Building	2	Centrifugal	14.9	1	101.3	18.8	82.5
100K-3260	Evap #1 Vapour Compressor	Evaporator Building	2	Reciprocating	2300.0	1	124.5	22.6	101.9
100P-3320	Evap #2 Recirc. Pump	Evaporator Building	2	Centrifugal	265.0	1	105.1	18.8	86.3
100K-3360	Evap #2 Vapour Compressor	Evaporator Building	2	Reciprocating	2300.0	1	124.5	22.6	101.9
100P-3470	Crystallizer Recirc. Pump	Evaporator Building	2	Centrifugal	190.0	1	104.6	18.8	85.8
100K-5371/80	Instrument Air Compressor	Evaporator Building	2	Screw Compressor	60.0	2	111.7	22.6	89.1
100P-3680A/B/C	L.P. BFW Pumps	LP BFW Pump Building	2	Centrifugal	120.0	3	108.8	18.8	90.0
100P-3800A/B/C	H.P. BFW Pumps	HP BFW Pump Building	2	Centrifugal	300.0	3	110.0	18.8	91.2
100P-5630A/B/C	OTSG BFW Charge Pumps	OTSG Building	2	Centrifugal	373.0	2	108.5	18.8	89.7
100H-5530	OTSG #1 Stack	OTSG Building	30.5	OTSG	36900.0	1	95.0	0.0	95.0
100H-5540	OTSG #2 Stack	OTSG Building	30.5	OTSG	36900.0	1	95.0	0.0	95.0
100K-5720	OTSG #1 Air Blower	OTSG Building	5	Centrifugal Blower	223.8	1	105.7	0.0	105.7
100K-5730	OTSG #2 Air Blower	OTSG Building	5	Centrifugal Blower	223.8	1	105.7	0.0	105.7
100K-1410/20	Instrument Air Compressor	OTSG Building	2	Screw Compressor	60.0	2	111.7	22.6	89.1
100H-	Steam Boiler #1 Stack	Steam Generator Bldg	30.5	Boiler	73300.0	1	99.5	0.0	99.5
100H-	Steam Boiler #2 Stack	Steam Generator Bldg	30.5	Boiler	73300.0	1	99.5	0.0	99.5
100K-5100	Steam Boiler #1 Air Blower	Steam Generator Bldg	5	Centrifugal Blower	373.0	1	107.9	0.0	107.9
100K-5120	Steam Boiler #2 Air Blower	Steam Generator Bldg	5	Centrifugal Blower	373.0	1	107.9	0.0	107.9
	Glycol Heater Stack	Existing Glycol Building	8.5	Heater	255 BHP	1	95.3	0.0	95.3
100P-6030A/B	Heating Glycol Circ. Pumps	Existing Glycol Building	2	Centrifugal	56.0	2	106.1	18.8	87.3
100P-6080A/B/C	Cooling Glycol Circulation Pump	Existing Glycol Building	2	Centrifugal	149.2	3	109.1	18.8	90.3
100E-6100A	Glycol Cooler	Glycol Exchanger Bank	5	Aerial Cooler	37.3	2	101.8	0.0	101.8
100E-6100B	Glycol Cooler	Glycol Exchanger Bank	5	Aerial Cooler	37.3	2	101.8	0.0	101.8
100E-6100C	Glycol Cooler	Glycol Exchanger Bank	5	Aerial Cooler	37.3	2	101.8	0.0	101.8
100E-6100D	Glycol Cooler	Glycol Exchanger Bank	5	Aerial Cooler	37.3	2	101.8	0.0	101.8
100E-6100E	Glycol Cooler	Glycol Exchanger Bank	5	Aerial Cooler	37.3	2	101.8	0.0	101.8
	Utility Boiler Stack	Existing Glycol Building	10.1	Heater	380 BHP	1	96.0	0.0	96.0
100K-2930	VRU Liquid Ring Compressor	New VRU Building	2	Liquid Ring	149.2	3	117.4	22.6	94.8
	Gas Turbine #1 Inlet	CoGen Building	5	Gas Turbine	N/A	1	103.2	0.0	103.2
	Gas Turbine #1 Exhaust	CoGen Building	20.5	Gas Turbine	N/A	1	104.8	0.0	104.8
	Gas Turbine #1 Casing	CoGen Building	3	Gas Turbine	N/A	1	104.9	17.6	87.3
	Generator #1	CoGen Building	3	Generator	5670.0	1	111.2	17.7	93.5
	HRSG #1 Casing	CoGen Building	3	HRSG	N/A	1	104.9	17.6	87.3
	Turbine #1 Lube Oil Cooler	CoGen Building	3	Axial Fan	N/A	1	103.1	0.0	103.1
	Gas Turbine #2 Inlet	CoGen Building	5	Gas Turbine	N/A	1	103.2	0.0	103.2
	Gas Turbine #2 Exhaust	CoGen Building	20.5	Gas Turbine	N/A	1	104.8	0.0	104.8
	Gas Turbine #2 Casing	CoGen Building	3	Gas Turbine	N/A	1	104.9	17.6	87.3
	Generator #2	CoGen Building	3	Generator	5670.0	1	111.2	17.7	93.5
	HRSG #2 Casing	CoGen Building	3	HRSG	N/A	1	104.9	17.6	87.3
	Turbine #2 Lube Oil Cooler	CoGen Building	3	Axial Fan	N/A	1	103.1	0.0	103.1
	Gas Turbine #3 Inlet	CoGen Building	5	Gas Turbine	N/A	1	103.2	0.0	103.2
	Gas Turbine #3 Exhaust	CoGen Building	20.5	Gas Turbine	N/A	1	104.8	0.0	104.8
	Gas Turbine #3 Casing	CoGen Building	3	Gas Turbine	N/A	1	104.9	17.6	87.3
	Generator #3	CoGen Building	3	Generator	5670.0	1	111.2	17.7	93.5
	HRSG #3 Casing	CoGen Building	3	HRSG	N/A	1	104.9	17.6	87.3
	Turbine #3 Lube Oil Cooler	CoGen Building	3	Axial Fan	N/A	1	103.1	0.0	103.1
	Gas Turbine #4 Inlet	CoGen Building	5	Gas Turbine	N/A	1	103.2	0.0	103.2
	Gas Turbine #4 Exhaust	CoGen Building	20.5	Gas Turbine	N/A	1	104.8	0.0	104.8
	Gas Turbine #4 Casing	CoGen Building	3	Gas Turbine	N/A	1	104.9	17.6	87.3
	Generator #4	CoGen Building	3	Generator	5670.0	1	111.2	17.7	93.5
	HRSG #4 Casing	CoGen Building	3	HRSG	N/A	1	104.9	17.6	87.3
	Turbine #4 Lube Oil Cooler	CoGen Building	3	Axial Fan	N/A	1	103.1	0.0	103.1
100E-6220	OTSG Glycol Cooler	Outside	5	Aerial Cooler	29.8	2	101.0	0.0	101.0
	Well Pad Instrument Air Compressor (Typical)	Phase 1 Wellpad	2	Screw Compressor	37.3	2	109.6	22.6	87.0
	Well Pad Emulsion Pump (Typical)	Phase 1 Wellpad	2	Centrifugal	186.5	2	107.6	18.8	88.8
	Well Pad Piping (Typical)	Phase 1 Wellpad	2	Piping / Valves	N/A	6	103.3	0.0	103.3

Phase 1 (18,000 bpd) Noise Source Octave Band Sound Power Levels (Re 10^{-12} Watts, un-mitigated)

Description	31.5 Hz	63 HZ	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
Wash Water Pump	94.4	95.4	96.4	97.4	96.4	98.4	95.4	91.4	85.4
Surge Pump	97.4	98.4	99.4	100.4	99.4	101.4	98.4	94.4	88.4
De-oiled Water Pump	98.3	99.3	100.3	101.3	100.3	102.3	99.3	95.3	89.3
Diluent Pump	98.3	99.3	100.3	101.3	100.3	102.3	99.3	95.3	89.3
Dilbit Load Pumps	98.3	99.3	100.3	101.3	100.3	102.3	99.3	95.3	89.3
Clean Oil Storage Pump	95.2	96.2	97.2	98.2	97.2	99.2	96.2	92.2	86.2
IGF Recycle / Eductor Supply Pumps	98.0	99.0	100.0	101.0	100.0	102.0	99.0	95.0	89.0
ORF Feed Pumps	98.9	99.9	100.9	101.9	100.9	102.9	99.9	95.9	89.9
OTSG BFW Booster Pumps	99.9	100.9	101.9	102.9	101.9	103.9	100.9	96.9	90.9
Evaporator Feed Pumps	97.4	98.4	99.4	100.4	99.4	101.4	98.4	94.4	88.4
Evaporator Distilate Pumps	97.4	98.4	99.4	100.4	99.4	101.4	98.4	94.4	88.4
Evap #1 Recirc. Pump	97.3	98.3	99.3	100.3	99.3	101.3	98.3	94.3	88.3
WAC Polisher Feed Pumps	93.5	94.5	95.5	96.5	95.5	97.5	94.5	90.5	84.5
Evap #1 Vapour Compressor	114.6	110.6	115.6	114.6	112.6	115.6	120.6	117.6	110.6
Evap #2 Recirc. Pump	97.3	98.3	99.3	100.3	99.3	101.3	98.3	94.3	88.3
Evap #2 Vapour Compressor	114.6	110.6	115.6	114.6	112.6	115.6	120.6	117.6	110.6
Crystallizer Recirc. Pump	96.8	97.8	98.8	99.8	98.8	100.8	97.8	93.8	87.8
Instrument Air Compressor	101.8	97.8	102.8	101.8	99.8	102.8	107.8	104.8	97.8
L.P. BFW Pumps	101.0	102.0	103.0	104.0	103.0	105.0	102.0	98.0	92.0
H.P. BFW Pumps	102.2	103.2	104.2	105.2	104.2	106.2	103.2	99.2	93.2
OTSG BFW Charge Pumps	100.7	101.7	102.7	103.7	102.7	104.7	101.7	97.7	91.7
OTSG #1 Stack	103.5	102.5	97.5	91.5	90.5	88.5	86.5	86.5	86.5
OTSG #2 Stack	103.5	102.5	97.5	91.5	90.5	88.5	86.5	86.5	86.5
OTSG #1 Air Blower	106.5	109.5	109.5	106.5	103.5	99.5	96.5	93.5	85.5
OTSG #2 Air Blower	106.5	109.5	109.5	106.5	103.5	99.5	96.5	93.5	85.5
Instrument Air Compressor	101.8	97.8	102.8	101.8	99.8	102.8	107.8	104.8	97.8
Steam Boiler #1 Stack	108.0	107.0	102.0	96.0	95.0	93.0	91.0	91.0	91.0
Steam Boiler #2 Stack	108.0	107.0	102.0	96.0	95.0	93.0	91.0	91.0	91.0
Steam Boiler #1 Air Blower	108.7	111.7	111.7	108.7	105.7	101.7	98.7	95.7	87.7
Steam Boiler #2 Air Blower	108.7	111.7	111.7	108.7	105.7	101.7	98.7	95.7	87.7
Glycol Heater Stack	98.6	98.6	97.6	95.6	92.6	89.6	86.6	83.6	80.6
Heating Glycol Circ. Pumps	98.3	99.3	100.3	101.3	100.3	102.3	99.3	95.3	89.3
Cooling Glycol Circulation Pump	101.3	102.3	103.3	104.3	103.3	105.3	102.3	98.3	92.3
Glycol Cooler	102.6	105.6	105.6	102.6	99.6	95.6	92.6	89.6	81.6
Glycol Cooler	102.6	105.6	105.6	102.6	99.6	95.6	92.6	89.6	81.6
Glycol Cooler	102.6	105.6	105.6	102.6	99.6	95.6	92.6	89.6	81.6
Glycol Cooler	102.6	105.6	105.6	102.6	99.6	95.6	92.6	89.6	81.6
Glycol Cooler	102.6	105.6	105.6	102.6	99.6	95.6	92.6	89.6	81.6
Utility Boiler Stack	99.3	99.3	98.3	96.3	93.3	90.3	87.3	84.3	81.3
VRU Liquid Ring Compressor	107.5	103.5	108.5	107.5	105.5	108.5	113.5	110.5	103.5
Gas Turbine #1 Inlet	107.5	110.5	111.5	110.5	94.5	68.5	56.5	80.5	82.5
Gas Turbine #1 Exhaust	120.5	121.5	113.5	106.5	103.5	92.5	91.5	86.5	85.5
Gas Turbine #1 Casing	106.5	99.5	100.5	101.5	102.5	98.5	98.5	94.5	87.5
Generator #1	104.0	107.0	108.0	108.0	108.0	106.0	104.0	101.0	96.0
HRSG #1 Casing	106.5	99.5	100.5	101.5	102.5	98.5	98.5	94.5	87.5
Turbine #1 Lube Oil Cooler	107.5	114.5	111.5	104.5	99.5	96.5	92.5	88.5	83.5
Gas Turbine #2 Inlet	107.5	110.5	111.5	110.5	94.5	68.5	56.5	80.5	82.5
Gas Turbine #2 Exhaust	120.5	121.5	113.5	106.5	103.5	92.5	91.5	86.5	85.5
Gas Turbine #2 Casing	106.5	99.5	100.5	101.5	102.5	98.5	98.5	94.5	87.5
Generator #2	104.0	107.0	108.0	108.0	108.0	106.0	104.0	101.0	96.0
HRSG #2 Casing	106.5	99.5	100.5	101.5	102.5	98.5	98.5	94.5	87.5
Turbine #2 Lube Oil Cooler	107.5	114.5	111.5	104.5	99.5	96.5	92.5	88.5	83.5
Gas Turbine #3 Inlet	107.5	110.5	111.5	110.5	94.5	68.5	56.5	80.5	82.5
Gas Turbine #3 Exhaust	120.5	121.5	113.5	106.5	103.5	92.5	91.5	86.5	85.5
Gas Turbine #3 Casing	106.5	99.5	100.5	101.5	102.5	98.5	98.5	94.5	87.5
Generator #3	104.0	107.0	108.0	108.0	108.0	106.0	104.0	101.0	96.0
HRSG #3 Casing	106.5	99.5	100.5	101.5	102.5	98.5	98.5	94.5	87.5
Turbine #3 Lube Oil Cooler	107.5	114.5	111.5	104.5	99.5	96.5	92.5	88.5	83.5
Gas Turbine #4 Inlet	107.5	110.5	111.5	110.5	94.5	68.5	56.5	80.5	82.5
Gas Turbine #4 Exhaust	120.5	121.5	113.5	106.5	103.5	92.5	91.5	86.5	85.5
Gas Turbine #4 Casing	106.5	99.5	100.5	101.5	102.5	98.5	98.5	94.5	87.5
Generator #4	104.0	107.0	108.0	108.0	108.0	106.0	104.0	101.0	96.0
HRSG #4 Casing	106.5	99.5	100.5	101.5	102.5	98.5	98.5	94.5	87.5
Turbine #4 Lube Oil Cooler	107.5	114.5	111.5	104.5	99.5	96.5	92.5	88.5	83.5
OTSG Glycol Cooler	101.8	104.8	104.8	101.8	98.8	94.8	91.8	88.8	80.8
Well Pad Instrument Air Compressor (Typical)	99.7	95.7	100.7	99.7	97.7	100.7	105.7	102.7	95.7
Well Pad Emulsion Pump (Typical)	99.8	100.8	101.8	102.8	101.8	103.8	100.8	96.8	90.8
Well Pad Piping (Typical)	108.8	111.8	101.8	99.8	98.8	97.8	95.8	94.8	89.8

Phase 2 (18,000 bpd) Noise Source Broadband Sound Power Levels (Re 10^{-12} Watts, un-mitigated)

Tag	Description	Location	Height (m)	Model/Type	Rating (kW)	# Units	Equipment Sound Power Level (dBA)	Building Attenuation (dBA)	Overall Sound Power Level (dBA)
200P-2010	Oil Recycle Pump	South Tank Building	2	Progressive Cavity	29.8	1	102.2	18.8	83.4
200P-2050	Off Spec. Oil Recycle Pump	South Tank Building	2	Progressive Cavity	29.8	1	102.2	18.8	83.4
200P-2080	Slop Oil Transfer Pump	North Tank Building	2	Progressive Cavity	22.4	1	101.8	18.8	83.0
200P-2090	Slop Water Pump	North Tank Building	2	Progressive Cavity	22.4	1	101.8	18.8	83.0
200P-2150	Wash Water Pump	North Tank Building	2	Centrifugal Pump	29.8	1	102.2	18.8	83.4
200P-2170	Surge Pump	North Tank Building	2	Centrifugal Pump	59.7	1	103.1	18.8	84.3
200P-2220A/B	IGF Recycle Pumps / Eductor Supply Pumps	North Tank Building	2	Centrifugal Pump	74.6	1	103.4	18.8	84.6
200P-2230A/B	ORF Feed Pumps	North Tank Building	2	Centrifugal Pump	74.6	1	103.4	18.8	84.6
200P-2260A/B	De-Oiled Water Pumps	North Tank Building	2	Centrifugal Pump	74.6	1	103.4	18.8	84.6
200P-2280A/B	Diluent Pumps	South Tank Building	2	Centrifugal Pump	111.9	1	103.9	18.8	85.1
200P-2285A/B	Diluent Transfer Pumps	South Tank Building	2	Centrifugal Pump	149.2	1	104.3	18.8	85.5
200K-2330/40	VRU Liquid Ring Compressor	South Tank Building	2	Liquid Ring	223.8	1	114.4	22.6	91.8
200P-2380A/B	Dilbit Load Pumps	South Tank Building	2	Gear Pumps	111.9	1	103.9	18.8	85.1
200P-3180A/B	Evaporator Feed Pump	Evaporator Building	2	Centrifugal Pump	29.8	1	102.2	18.8	83.4
200P-3190	Evaporator-1 Distillate Pump	Evaporator Building	2	Centrifugal Pump	29.8	1	102.2	18.8	83.4
200P-3220	Evaporator-1 Recirculation Pump	Evaporator Building	2	Centrifugal Pump	261.1	1	105.1	18.8	86.3
200K-3260	Evaporator-1 Vapor Compressor	Evaporator Building	2	Centrifugal Pump	2300.0	1	124.5	22.6	101.9
200P-3290	Evaporator-2 Distillate Pump	Evaporator Building	2	Centrifugal Pump	29.8	1	102.2	18.8	83.4
200P-3320	Evaporator-2 Recirculation Pump	Evaporator Building	2	Centrifugal Pump	261.1	1	105.1	18.8	86.3
200K-3360	Evaporator-2 Vapor Compressor	Evaporator Building	2	Centrifugal Pump	2300.0	1	124.5	22.6	101.9
200P-3470	Crystallizer Recirculation Pump	Evaporator Building	2	Centrifugal Pump	186.5	1	104.6	18.8	85.8
200P-3670A/B	Make-up Water Pumps	Evaporator Building	2	Centrifugal Pump	22.4	1	101.8	18.8	83.0
200P-3680A/B/C	L.P. Boiler Feedwater Pump	LP BFW Pump Building	2	Centrifugal Pump	223.8	2	107.9	18.8	89.1
200P-3780A/B	Utility Water Pumps	Evaporator Building	2	Centrifugal Pump	22.4	1	101.8	18.8	83.0
200P-3790A/B	Soft Water Pumps	Evaporator Building	2	Centrifugal Pump	29.8	1	102.2	18.8	83.4
200P-3800A/B/C	H.P. Boiler Feedwater Pump	HP BFW Pump Building	2	Centrifugal Pump	596.8	2	109.1	18.8	90.3
200K-4000	Gas Turbine #1 Inlet	CoGen Building	5	Gas Turbine	N/A	1	94.3	0.0	94.3
200K-4000	Gas Turbine #1 Exhaust	CoGen Building	20.5	Gas Turbine	N/A	1	107.2	0.0	107.2
200K-4000	Gas Turbine #1 Casing	CoGen Building	3	Gas Turbine	N/A	1	108.7	16.8	91.9
200G-4010	Generator #1	CoGen Building	3	Generator	13000.0	1	114.8	17.7	97.1
200H-4100	HRSG #1 Casing	CoGen Building	3	HRSG	N/A	1	108.7	16.8	91.9
	Turbine #1 Lube Oil Cooler	CoGen Building	3	Axial Fan	N/A	1	103.1	0.0	103.1
200K-4200	Gas Turbine #2 Inlet	CoGen Building	5	Gas Turbine	N/A	1	94.3	0.0	94.3
200K-4200	Gas Turbine #2 Exhaust	CoGen Building	20.5	Gas Turbine	N/A	1	107.2	0.0	107.2
200K-4200	Gas Turbine #2 Casing	CoGen Building	3	Gas Turbine	N/A	1	108.7	16.8	91.9
200G-4210	Generator #2	CoGen Building	3	Generator	13000.0	1	114.8	17.7	97.1
200H-4300	HRSG #2 Casing	CoGen Building	3	HRSG	N/A	1	108.7	16.8	91.9
	Turbine #2 Lube Oil Cooler	CoGen Building	3	Axial Fan	N/A	1	103.1	0.0	103.1
200H-5100	H.P. Steam Boiler	Steam Generator Building	30.5	Heater	106300.0	1	101.9	0.0	101.9
200K-5110	Combustion Air Blower	Steam Generator Building	5	Force Draft	373.0	1	102.9	0.0	102.9
200K-5120	Combustion Air Blower	Steam Generator Building	5	Force Draft	373.0	1	102.9	0.0	102.9
200H-5170	H.P. Steam Boiler	Steam Generator Building	30.5	Heater	106300.0	1	101.9	0.0	101.9
200H-5800	H.P. Steam Boiler	Steam Generator Building	30.5	Heater	106300.0	1	101.9	0.0	101.9
200K-5830	Combustion Air Blower	Steam Generator Building	5	Force Draft	373.0	1	102.9	0.0	102.9
200H-6000A	Glycol Heater	Glycol Building	8.5	Heater	510 BHP	1	96.5	0.0	96.5
200H-6000B	Glycol Heater	Glycol Building	8.5	Heater	510 BHP	1	96.5	0.0	96.5
200P-6080A/B/C	Cooling Glycol Circulation Pump	Glycol Building	2	Centrifugal Pump	298.4	2	108.2	18.8	89.4
200E-6100A	Glycol Air Cooler	Aerial Cooler Location	5	Arial coolers	50.0	2	102.8	0.0	102.8
200E-6100B	Glycol Air Cooler	Aerial Cooler Location	5	Arial coolers	50.0	2	102.8	0.0	102.8
200E-6100C	Glycol Air Cooler	Aerial Cooler Location	5	Arial coolers	50.0	2	102.8	0.0	102.8
200E-6100D	Glycol Air Cooler	Aerial Cooler Location	5	Arial coolers	50.0	2	102.8	0.0	102.8
200E-6100E	Glycol Air Cooler	Aerial Cooler Location	5	Arial coolers	50.0	2	102.8	0.0	102.8
200E-6100F	Glycol Air Cooler	Aerial Cooler Location	5	Arial coolers	50.0	2	102.8	0.0	102.8
200E-6100G	Glycol Air Cooler	Aerial Cooler Location	5	Arial coolers	50.0	2	102.8	0.0	102.8
200E-6100H	Glycol Air Cooler	Aerial Cooler Location	5	Arial coolers	50.0	2	102.8	0.0	102.8
200H-7140	Utility Steam Boiler	Utility Steam Building	10.1	Heater	601 BHP	1	96.8	0.0	96.8
200H-7150	Utility Steam Boiler	Utility Steam Building	10.1	Heater	601 BHP	1	96.8	0.0	96.8
	Instrument Air Compressor	Instrument Air Building	2	Screw Compressor	167.9	1	113.1	22.6	90.5
	Well Pad Instrument Air Compressor (Typical)	Phase 2 Wellpad	2	Screw Compressor	48.5	1	107.8	22.6	85.2
	Well Pad Emulsion Pump (Typical)	Phase 2 Wellpad	2	Centrifugal	298.4	1	105.2	18.8	86.4
	Well Pad Piping (Typical)	Phase 2 Wellpad	2	Piping / Valves	N/A	10	105.5	0.0	105.5

Phase 2 (18,000 bpd) Noise Source Octave Band Sound Power Levels (Re 10^{-12} Watts, un-mitigated)

Description	31.5 Hz	63 HZ	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
Oil Recycle Pump	94.4	95.4	96.4	97.4	96.4	98.4	95.4	91.4	85.4
Off Spec. Oil Recycle Pump	94.4	95.4	96.4	97.4	96.4	98.4	95.4	91.4	85.4
Slop Oil Transfer Pump	94.0	95.0	96.0	97.0	96.0	98.0	95.0	91.0	85.0
Slop Water Pump	94.0	95.0	96.0	97.0	96.0	98.0	95.0	91.0	85.0
Wash Water Pump	94.4	95.4	96.4	97.4	96.4	98.4	95.4	91.4	85.4
Surge Pump	95.3	96.3	97.3	98.3	97.3	99.3	96.3	92.3	86.3
IGF Recycle Pumps / Eductor Supply Pumps	95.6	96.6	97.6	98.6	97.6	99.6	96.6	92.6	86.6
ORF Feed Pumps	95.6	96.6	97.6	98.6	97.6	99.6	96.6	92.6	86.6
De-Oiled Water Pumps	95.6	96.6	97.6	98.6	97.6	99.6	96.6	92.6	86.6
Diluent Pumps	96.1	97.1	98.1	99.1	98.1	100.1	97.1	93.1	87.1
Diluent Transfer Pumps	96.5	97.5	98.5	99.5	98.5	100.5	97.5	93.5	87.5
VRU Liquid Ring Compressor	104.5	100.5	105.5	104.5	102.5	105.5	110.5	107.5	100.5
Dilbit Load Pumps	96.1	97.1	98.1	99.1	98.1	100.1	97.1	93.1	87.1
Evaporator Feed Pump	94.4	95.4	96.4	97.4	96.4	98.4	95.4	91.4	85.4
Evaporator-1 Distillate Pump	94.4	95.4	96.4	97.4	96.4	98.4	95.4	91.4	85.4
Evaporator-1 Recirculation Pump	97.3	98.3	99.3	100.3	99.3	101.3	98.3	94.3	88.3
Evaporator-1 Vapor Compressor	114.6	110.6	115.6	114.6	112.6	115.6	120.6	117.6	110.6
Evaporator-2 Distillate Pump	94.4	95.4	96.4	97.4	96.4	98.4	95.4	91.4	85.4
Evaporator-2 Recirculation Pump	97.3	98.3	99.3	100.3	99.3	101.3	98.3	94.3	88.3
Evaporator-2 Vapor Compressor	114.6	110.6	115.6	114.6	112.6	115.6	120.6	117.6	110.6
Crystallizer Recirculation Pump	96.8	97.8	98.8	99.8	98.8	100.8	97.8	93.8	87.8
Make-up Water Pumps	94.0	95.0	96.0	97.0	96.0	98.0	95.0	91.0	85.0
L.P. Boiler Feedwater Pump	100.1	101.1	102.1	103.1	102.1	104.1	101.1	97.1	91.1
Utility Water Pumps	94.0	95.0	96.0	97.0	96.0	98.0	95.0	91.0	85.0
Soft Water Pumps	94.4	95.4	96.4	97.4	96.4	98.4	95.4	91.4	85.4
H.P. Boiler Feedwater Pump	101.3	102.3	103.3	104.3	103.3	105.3	102.3	98.3	92.3
Gas Turbine #1 Inlet	111.5	111.5	107.5	97.5	77.5	52.5	51.5	79.5	76.5
Gas Turbine #1 Exhaust	125.5	124.5	118.5	111.5	100.5	92.5	86.5	88.5	86.5
Gas Turbine #1 Casing	119.5	112.5	109.5	106.5	104.5	103.5	101.5	98.5	93.5
Generator #1	107.6	110.6	111.6	111.6	111.6	109.6	107.6	104.6	99.6
HRSG #1 Casing	119.5	112.5	109.5	106.5	104.5	103.5	101.5	98.5	93.5
Turbine #1 Lube Oil Cooler	107.5	114.5	111.5	104.5	99.5	96.5	92.5	88.5	83.5
Gas Turbine #2 Inlet	111.5	111.5	107.5	97.5	77.5	52.5	51.5	79.5	76.5
Gas Turbine #2 Exhaust	125.5	124.5	118.5	111.5	100.5	92.5	86.5	88.5	86.5
Gas Turbine #2 Casing	119.5	112.5	109.5	106.5	104.5	103.5	101.5	98.5	93.5
Generator #2	107.6	110.6	111.6	111.6	111.6	109.6	107.6	104.6	99.6
HRSG #2 Casing	119.5	112.5	109.5	106.5	104.5	103.5	101.5	98.5	93.5
Turbine #2 Lube Oil Cooler	107.5	114.5	111.5	104.5	99.5	96.5	92.5	88.5	83.5
H.P. Steam Boiler	110.4	109.4	104.4	98.4	97.4	95.4	93.4	93.4	93.4
Combustion Air Blower	103.7	106.7	106.7	103.7	100.7	96.7	93.7	90.7	82.7
Combustion Air Blower	103.7	106.7	106.7	103.7	100.7	96.7	93.7	90.7	82.7
H.P. Steam Boiler	110.4	109.4	104.4	98.4	97.4	95.4	93.4	93.4	93.4
H.P. Steam Boiler	110.4	109.4	104.4	98.4	97.4	95.4	93.4	93.4	93.4
Combustion Air Blower	103.7	106.7	106.7	103.7	100.7	96.7	93.7	90.7	82.7
Glycol Heater	99.8	99.8	98.8	96.8	93.8	90.8	87.8	84.8	81.8
Glycol Heater	99.8	99.8	98.8	96.8	93.8	90.8	87.8	84.8	81.8
Cooling Glycol Circulation Pump	100.4	101.4	102.4	103.4	102.4	104.4	101.4	97.4	91.4
Glycol Air Cooler	103.6	106.6	106.6	103.6	100.6	96.6	93.6	90.6	82.6
Glycol Air Cooler	103.6	106.6	106.6	103.6	100.6	96.6	93.6	90.6	82.6
Glycol Air Cooler	103.6	106.6	106.6	103.6	100.6	96.6	93.6	90.6	82.6
Glycol Air Cooler	103.6	106.6	106.6	103.6	100.6	96.6	93.6	90.6	82.6
Glycol Air Cooler	103.6	106.6	106.6	103.6	100.6	96.6	93.6	90.6	82.6
Glycol Air Cooler	103.6	106.6	106.6	103.6	100.6	96.6	93.6	90.6	82.6
Glycol Air Cooler	103.6	106.6	106.6	103.6	100.6	96.6	93.6	90.6	82.6
Glycol Air Cooler	103.6	106.6	106.6	103.6	100.6	96.6	93.6	90.6	82.6
Utility Steam Boiler	100.1	100.1	99.1	97.1	94.1	91.1	88.1	85.1	82.1
Utility Steam Boiler	100.1	100.1	99.1	97.1	94.1	91.1	88.1	85.1	82.1
Instrument Air Compressor	103.2	99.2	104.2	103.2	101.2	104.2	109.2	106.2	99.2
Well Pad Instrument Air Compressor (Typical)	97.9	93.9	98.9	97.9	95.9	98.9	103.9	100.9	93.9
Well Pad Emulsion Pump (Typical)	97.4	98.4	99.4	100.4	99.4	101.4	98.4	94.4	88.4
Well Pad Piping (Typical)	111.0	114.0	104.0	102.0	101.0	100.0	98.0	97.0	92.0

Phase 1 (18,000 bpd) Building Dimensions

BLDG. No.	Building Name	Length (m)	Width (m)	Height (m)
100B-8010	Cogen Switchgear-100 Building	25.0	7.0	4.2
100B-8020	Black Start Generator Building	15.0	7.0	4.2
100B-8030	Plang 5KV MCC Building	15.0	7.0	4.2
100B-8040	MCC-110 Building	30.0	7.0	4.2
100B-8050	MCC-210 Building	30.0	7.0	4.2
100B-1100	North Inlet Building	28.3	7.0	3.6
100B-1120	South Inlet Building	34.0	6.2	6.1
100B-1130	100V-1050 FWKO Building	25.3	6.2	6.3
100B-1140	100V-1060 FWKO Building	25.3	6.2	6.3
100B-1150	100V-1070 Treater Building	25.5	5.4	6.3
100B-1160	Production Water Exchange Building	22.0	13.0	6.9
100B-1170	Clean Oil / Glycol Exchange Building	12.0	6.5	3.8
100B-2180	North Tank Building	83.4	7.0	5.2
100B-2190	South Tank Building	83.4	7.0	5.2
100B-2200	Drain Pump / Slop Sample Building	3.0	3.0	4.2
100B-3220	West Water Building	29.5	19.5	5.2
100B-3230	East Water Building	29.5	19.5	5.2
100B-3240	Evaporator/Crystallizer Building	57.0	22.5	15.0
100B-5260	H.P. BFW Pump Building	17.9	7.0	6.0
100B-5270	Steam Generator Building	32.6	31.2	13.3
100B-3300	Fuel Gas Building	12.3	6.0	5.5
100B-7330	Flare KO Building	12.0	3.4	5.0
100B-6340	Pop Drum Building	8.0	4.1	4.2
100B-6360	Glycol Building	20.0	16.0	4.5
100B-4400	Cogeneration Building	25.5	23.5	10.0
100B-2510	Diluent Meter Building	8.5	4.0	4.2
100B-2520	Dilbit Meter #2 Building	6.0	4.0	4.2
100B-2530	Dilbit Meter #1 Building	6.0	4.0	4.2
100B-	Nitrogen Package Building	10.8	7.0	4.2
100B-1560	Instrument Air Building	10.0	6.0	4.2
100B-2580	Dilbit Meter #3 Building	6.0	4.0	4.2
100B-1600	Oil Lab Building	7.3	3.7	4.2
100B-3610	Clean Lab Building	7.3	3.7	4.2
100B-3610	Steam Silencer Building	3.0	1.8	4.2
100B-0990	Office / Main Control Room Building	30.5	27.4	4.9
100B-2660	IGF Building	28.0	7.0	5.0
100B-2670	VRU Building	11.0	6.5	5.0
100B-3680	LP BFW Pump Building	15.0	7.0	4.9
100B-3690	Softener Building	16.0	14.0	6.1
100B-3700	MCC Building	20.0	7.0	4.2
100B-4710	Cogeneration 100SWG-8100	31.0	14.0	8.0
100B-5720	OTSG Building	30.0	18.0	6.1
100B-5730	MCC Building	20.0	7.0	4.2
100B-1740	Inlet Vapor Separator Building	14.0	6.0	6.1
100B-3760	Filtration Building	16	7	6.1

Phase 2 (18,000 bpd) Building Dimensions

BLDG. No.	Building Name	Width (m)	Length (m)	Height (m)
200B-4010	Cogen SWG Building	7.0	30.0	3.7
200B-4020	Black Start Generator Building	7.0	12.0	3.7
200B-3040	480VAC - MCC Building	7.0	30.0	4.2
200B-3050	4160VAC - MCC - Evap Building	7.0	30.0	4.2
200B-4060	Cogen SWG Building	25.0	35.5	10.0
200B-5070	Steam Gen Building	30.0	58.0	13.5
200B-7080	Utility Steam Building	7.0	15.0	4.6
200B-3100	H.P. BFW Pump Building	7.0	25.0	6.0
200B-4110	4160VAC - MCC- Steam Gen Building	7.0	30.0	4.2
200B-3120	Evaporator/Water Area Building	23.5	92.0	15.0
200B-4130	Clean Lab Building	3.7	7.3	2.5
200B-1140	MCC - 1 Building	7.0	30.0	4.2
200B-2150	North Tank Building	7.0	100.0	7.0
200B-2160	South Tank Building	7.0	100.0	7.0
200B-1170	South Inlet Building	7.0	32.0	6.1
200B-1190	North Inlet/Fuel Gas Building	7.0	32.0	6.6
200B-1200	FWKO Building	6.2	14.0	6.0
200B-7210	Pop Drum Building	5.7	10.0	5.0
200B-1220	Treater Building	5.6	30.0	6.0
200B-1230	Oil Lab Building	3.7	7.3	2.8
200B-1240	Prod. Water / Glycol Exchanger Building	7.0	16.0	6.5
200B-1250	Clean Oil / Glycol Exchanger Building	7.0	12.5	6.5
200B-7270	Instrument Air Building	5.7	9.5	3.7
200B-6280	Glycol Building	16.5	20.0	4.5
200B-7290	Flare KO Building	7.0	12.0	5.0
200B-9300	Office / Main Control Room Building	20.0	45.0	4.9
200B-9310	Warehouse Building	22.5	50.0	4.9
200B-2330	Dilbit & Diluent Transfer Skid Building	7.0	10.0	3.7
200B-5340	Plant Utility #1 Building	3.0	5.0	2.4
200B-3350	Plant Utility #2 Building	3.0	5.0	2.4
200B-3360	Generator Building	7.0	15.0	2.4
200B-2370	MCC Skid - 2 Building	7.0	25.0	4.2
200B-4380	MCC Skid - 3 Building	7.0	25.0	4.2
200B-5390	Steam Silencer Building	6.0	6.0	3.2
200B-3430	LP BFW Pump Building	7.0	20.0	6.0
200B-3450	Evap. Lab Building	3.7	7.3	2.8
200B-2460	Diluent Offload Building	3.7	5.5	3.0
200B-4470	Cogen Blowdown Pumphouse Building	4.0	6.0	3.0
200B-2480	Plant Utility #2 Building	3.0	5.0	2.4
200B-2500	Diluent Offload Building	3.7	5.5	3.0
200B-9510	Warm Storage Building	24.5	50.0	4.9

Building Sound Level Attenuation

	31.5 Hz	63 HZ	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
Building Attenuation (dB)	3	6	9	12	15	20	25	30	30

Phase 1 (18,000 bpd) Tank Dimensions

TAG	Tank Name	Radius (m)	Height (m)
100T-1500	Demulsifier Tank	1.2	5.1
100T-2000	Oil Production Tank	7.2	9.8
100T-2020	Sales Oil Tank	7.2	9.8
100T-2040	Off Spec. Oil Tank	7.2	9.8
100T-2060	Slop Tank	3.6	9.8
100T-2070	Slop Tank	3.6	9.8
100T-2110	Desand Tank	3.6	9.8
100T-2120	Desand Tank	3.6	9.8
100T-2130	Skim Tank	7.2	9.8
100T-2140	IGF Feed Tank	7.2	9.8
100T-2240	De-Oiled Water Tank	7.2	9.8
100T-2270	Diluent Tank	7.2	9.8
100T-2300	Demulsifier Tank	1.2	4.9
100T-2680	Floor Drain Tank	2.4	4.9
100T-3370	Regen Waste Tank	1.5	4.9
100T-3530	Crystallizer Feed Tank	2.4	7.3
100T-3560	Crystallizer Waste Tank	2.4	7.3
100T-3650	Raw Water Tank	3.6	9.8
100T-3660	Boiler Feedwater Tank	7.2	9.8
100T-3750	Brine Dissolving Tank	1.5	4.9
100T-3770	Soft Water Tank	7.2	9.8
100T-5260	Steam Generator Blowdown Tank	3.6	9.8
100T-6050	Glycol Pop Tank	1.2	4.9
100T-6060	Glycol Storage Tank	1.8	4.9
100T-3255	OTSG BFW Tank	3.6	9.9
100T-3265	Slurry Storage Tank	3.6	9.9
100T-3295	Filtration Package Feed Tank	3.6	9.9
100T-3325	Regen Caustic Tank	1.5	3.5
100T-3335	Regen Acid Tank	1.5	3.5
100T-3345	Polishing Softener Feed Tank	3.6	9.9
100T-3355	WAC Regen Waste Tank	1.9	9.0
100T-6270	Glycol Pop Tank	0.9	3.0
100T-6260	Glycol Storage Tank	0.9	3.8
100T-5780	OTSG Blowdown Tank	2.6	7.3

Phase 2 (18,000 bpd) Tank Dimensions

TAG	Tank Name	Radius (m)	Height (m)
200T-3660	Boiler Feedwater Tank	10.2	9.8
200T-3770	Soft Water Tank	10.2	9.8
200T-2110	Desand Tank	3.6	9.8
200T-2120	Desand Tank	3.6	9.8
200T-2130	Skim Tank	12.0	8.5
200T-2140	Surge Tank	9.5	8.5
200T-2240	De-Oiled Water Tank	10.2	9.8
200T-2060	Slop Tank	3.6	9.8
200T-2070	Slop Tank	3.6	9.8
200T-2080	Slop Tank	3.6	9.8
200T-2270	Diluent Tank	8.9	9.8
200T-2020	Sales Oil Tank	8.9	9.8
200T-2040	Off Spec. Oil Tank	8.9	9.8
200T-5260	Steam Gen. Blowdown Tank	2.6	9.2
200T-	Process Waste Tank	2.6	9.2
200T-2000	Oil Production Tank	8.9	9.8
200T-3230	Crystallizer Feed Tank	3.6	9.8
200T-3560	Crystallizer Waste Tank	3.1	8.7
200T-3650	Raw Water Tank	3.6	9.8
200T-3620	Softener Regen Waste Tank	2.6	9.2
200T-3750	Brine Dissolving Tank	1.9	7.9
200T-4930	Cogen Blowdown Tank	2.6	9.2
200T-6050	Glycol Pop Tank	1.2	1.8
200T-6060	Glycol Storage Tank	2.0	7.9
200T-	Clean in Place Tank	2.0	7.9
200T-	Clean in Place Tank	2.0	7.9

General Modeling Parameters

Parameter	Value
Modeling Software	CADNA/A (Version 4.2.140)
Standard Followed	ISO 9613-2
Ground Sound Absorption Coefficient	0.5
Wind Speed	1 - 5 m/s (3.6 - 18 km/hr)
Wind Direction	Downwind from all sources to all receptors
Temperature	10 °C
Humidity	70%
Topography	Used Digital Terrain Model Contours Provided by Client

Appendix II THE ASSESSMENT OF ENVIRONMENTAL NOISE (GENERAL)

Sound Pressure Level

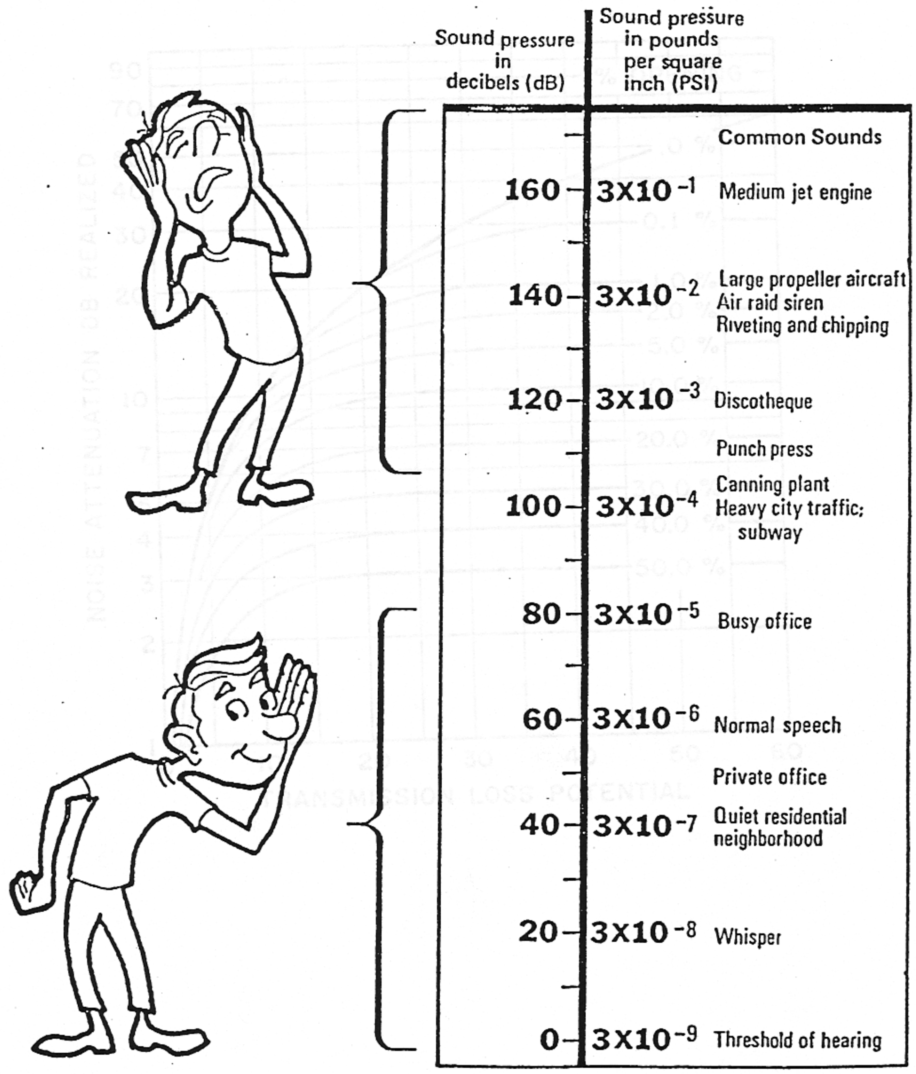
Sound pressure is initially measured in Pascal's (Pa). Humans can hear several orders of magnitude in sound pressure levels, so a more convenient scale is used. This scale is known as the decibel (dB) scale, named after Alexander Graham Bell (telephone guy). It is a base 10 logarithmic scale. When we measure pressure we typically measure the RMS sound pressure.

$$SPL = 10\log_{10}\left[\frac{P_{RMS}^{2}}{P_{ref}^{2}}\right] = 20\log_{10}\left[\frac{P_{RMS}}{P_{ref}}\right]$$

Where: SPL = Sound Pressure Level in dB
P_{RMS} = Root Mean Square measured pressure (Pa)
P_{ref} = Reference sound pressure level ($P_{ref} = 2x10^{-5}$ Pa = 20 μPa)

This reference sound pressure level is an internationally agreed upon value. It represents the threshold of human hearing for "typical" people based on numerous testing. It is possible to have a threshold which is lower than 20 μPa which will result in negative dB levels. As such, zero dB does not mean there is no sound!

In general, a difference of 1 – 2 dB is the threshold for humans to notice that there has been a change in sound level. A difference of 3 dB (factor of 2 in acoustical energy) is perceptible and a change of 5 dB is strongly perceptible. A change of 10 dB is typically considered a factor of 2. This is quite remarkable when considering that 10 dB is 10-times the acoustical energy!


Sound pressure in decibels (dB)
Sound pressure in pounds per square inch (PSI)
Common Sounds
160 3X10-1 Medium jet engine
140 3X10-2 Large propeller aircraft
Air raid siren
Riveting and chipping
120 3X10-3 Discotheque
Punch press
Canning plant
100 3X10-4 Heavy city traffic; subway
80 3X10-5 Busy office
60 3X10-6 Normal speech
Private office
40 3X10-7 Quiet residential neighborhood
20 3X10-8 Whisper
0 3X10-9 Threshold of hearing

Frequency

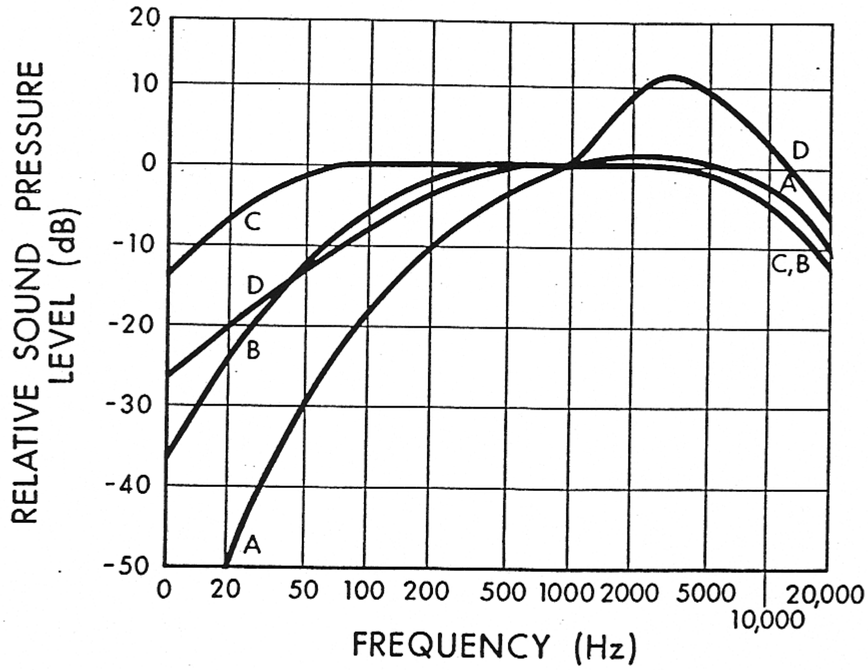
The range of frequencies audible to the human ear ranges from approximately 20 Hz to 20 kHz. Within this range, the human ear does not hear equally at all frequencies. It is not very sensitive to low frequency sounds, is very sensitive to mid frequency sounds and is slightly less sensitive to high frequency sounds. Due to the large frequency range of human hearing, the entire spectrum is often divided into 31 bands, each known as a 1/3 octave band.

The internationally agreed upon center frequencies and upper and lower band limits for the 1/1 (whole octave) and 1/3 octave bands are as follows:

Lower Band Limit	Whole Octave Center Frequency	Upper Band Limit
11	**16**	22
22	**31.5**	44
44	**63**	88
88	**125**	177
177	**250**	355
355	**500**	710
710	**1000**	1420
1420	**2000**	2840
2840	**4000**	5680
5680	**8000**	11360
11360	**16000**	22720

Lower Band Limit	1/3 Octave Center Frequency	Upper Band Limit
14.1	**16**	17.8
17.8	**20**	22.4
22.4	**25**	28.2
28.2	**31.5**	35.5
35.5	**40**	44.7
44.7	**50**	56.2
56.2	**63**	70.8
70.8	**80**	89.1
89.1	**100**	112
112	**125**	141
141	**160**	178
178	**200**	224
224	**250**	282
282	**315**	355
355	**400**	447
447	**500**	562
562	**630**	708
708	**800**	891
891	**1000**	1122
1122	**1250**	1413
1413	**1600**	1778
1778	**2000**	2239
2239	**2500**	2818
2818	**3150**	3548
3548	**4000**	4467
4467	**5000**	5623
5623	**6300**	7079
7079	**8000**	8913
8913	**10000**	11220
11220	**12500**	14130
14130	**16000**	17780
17780	**20000**	22390

Human hearing is most sensitive at approximately 3500 Hz which corresponds to the ¼ wavelength of the ear canal (approximately 2.5 cm). Because of this range of sensitivity to various frequencies, we typically apply various weighting networks to the broadband measured sound to more appropriately account for the way humans hear. By default, the most common weighting network used is the so-called "A-weighting". It can be seen in the figure that the low frequency sounds are reduced significantly with the A-weighting.



Combination of Sounds

When combining multiple sound sources the general equation is:

$$\Sigma SPL_n = 10\log_{10}\left[\sum_{i=1}^{n} 10^{\frac{SPL_i}{10}}\right]$$

Examples:

- Two sources of 50 dB each add together to result in 53 dB.
- Three sources of 50 dB each add together to result in 55 dB.
- Ten sources of 50 dB each add together to result in 60 dB.
- One source of 50 dB added to another source of 40 dB results in 50.4 dB

It can be seen that, if multiple similar sources exist, removing or reducing only one source will have little effect.

Sound Level Measurements

Over the years a number of methods for measuring and describing environmental noise have been developed. The most widely used and accepted is the concept of the Energy Equivalent Sound Level (L_{eq}) which was developed in the US (1970's) to characterize noise levels near US Air-force bases. This is the level of a steady state sound which, for a given period of time, would contain the same energy as the time varying sound. The concept is that the same amount of annoyance occurs from a sound having a high level for a short period of time as from a sound at a lower level for a longer period of time.
The L_{eq} is defined as:

$$L_{eq} = 10\log_{10}\left[\frac{1}{T}\int_0^T 10^{\frac{dB}{10}}\,dT\right] = 10\log_{10}\left[\frac{1}{T}\int_0^T \frac{P^2}{P_{ref}^2}\,dT\right]$$

We must specify the time period over which to measure the sound. i.e. 1-second, 10-seconds, 15-seconds, 1-minute, 1-day, etc**. An L_{eq} is meaningless if there is no time period associated**.

In general there a few very common L_{eq} sample durations which are used in describing environmental noise measurements. These include:

- L_{eq}24 - Measured over a 24-hour period
- L_{eq}Night - Measured over the night-time (typically 22:00 – 07:00)
- L_{eq}Day - Measured over the day-time (typically 07:00 – 22:00)
- L_{DN} - Same as L_{eq}24 with a 10 dB penalty added to the night-time

Statistical Descriptor

Another method of conveying long term noise levels utilizes statistical descriptors. These are calculated from a cumulative distribution of the sound levels over the entire measurement duration and then determining the sound level at xx % of the time.

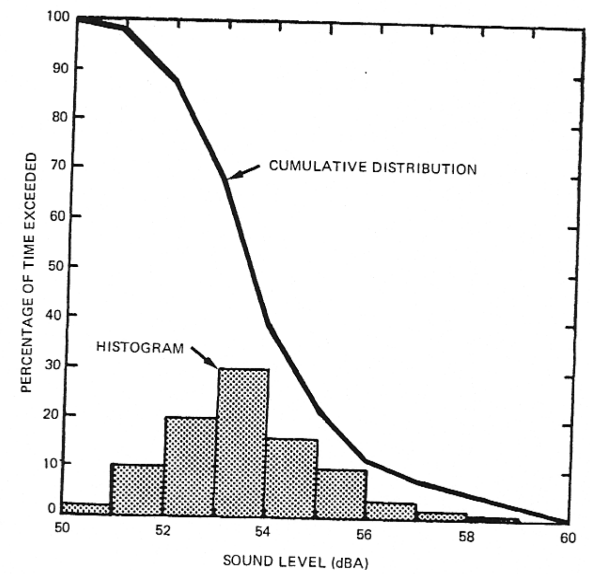


Figure 16.6 Statistically processed community noise showing histogram and cumulative distribution of A weighted sound levels.

Industrial Noise Control, Lewis Bell, Marcel Dekker, Inc. 1994

The most common statistical descriptors are:

L_{min} - minimum sound level measured
L_{01} - sound level that was exceeded only 1% of the time
L_{10} - sound level that was exceeded only 10% of the time.
- Good measure of intermittent or intrusive noise
- Good measure of Traffic Noise

L_{50} - sound level that was exceeded 50% of the time (arithmetic average)
- Good to compare to L_{eq} to determine steadiness of noise

L_{90} - sound level that was exceeded 90% of the time
- Good indicator of typical "ambient" noise levels

L_{99} - sound level that was exceeded 99% of the time
L_{max} - maximum sound level measured

These descriptors can be used to provide a more detailed analysis of the varying noise climate:

- If there is a large difference between the L_{eq} and the L_{50} (L_{eq} can never be any lower than the L_{50}) then it can be surmised that one or more short duration, high level sound(s) occurred during the time period.
- If the gap between the L_{10} and L_{90} is relatively small (less than 15 – 20 dBA) then it can be surmised that the noise climate was relatively steady.

Sound Propagation

In order to understand sound propagation, the nature of the source must first be discussed. In general, there are three types of sources. These are known as 'point', 'line', and 'area'. This discussion will concentrate on point and line sources since area sources are much more complex and can usually be approximated by point sources at large distances.

Point Source

As sound radiates from a point source, it dissipates through geometric spreading. The basic relationship between the sound levels at two distances from a point source is:

$$\therefore SPL_1 - SPL_2 = 20\log_{10}\left(\frac{r_2}{r_1}\right)$$

Where: SPL_1 = sound pressure level at location 1, SPL_2 = sound pressure level at location 2
r_1 = distance from source to location 1, r_2 = distance from source to location 2

Thus, the reduction in sound pressure level for a point source radiating in a free field is **6 dB per doubling of distance**. This relationship is independent of reflectivity factors provided they are always present. Note that this only considers geometric spreading and does not take into account atmospheric effects. Point sources still have some physical dimension associated with them, and typically do not radiate sound equally in all directions in all frequencies. The directionality of a source is also highly dependent on frequency. As frequency increases, directionality increases.

Examples (note no atmospheric absorption):

- A point source measuring 50 dB at 100m will be 44 dB at 200m.
- A point source measuring 50 dB at 100m will be 40.5 dB at 300m.
- A point source measuring 50 dB at 100m will be 38 dB at 400m.
- A point source measuring 50 dB at 100m will be 30 dB at 1000m.

Line Source

A line source is similar to a point source in that it dissipates through geometric spreading. The difference is that a line source is equivalent to a long line of many point sources. The basic relationship between the sound levels at two distances from a line source is:

$$SPL_1 - SPL_2 = 10\log_{10}\left(\frac{r_2}{r_1}\right)$$

The difference from the point source is that the '20' term in front of the 'log' is now only 10. Thus, the reduction in sound pressure level for a line source radiating in a free field is **3 dB per doubling of distance**.

Examples (note no atmospheric absorption):

- A line source measuring 50 dB at 100m will be 47 dB at 200m.
- A line source measuring 50 dB at 100m will be 45 dB at 300m.
- A line source measuring 50 dB at 100m will be 34 dB at 400m.
- A line source measuring 50 dB at 100m will be 40 dB at 1000m.

Atmospheric Absorption

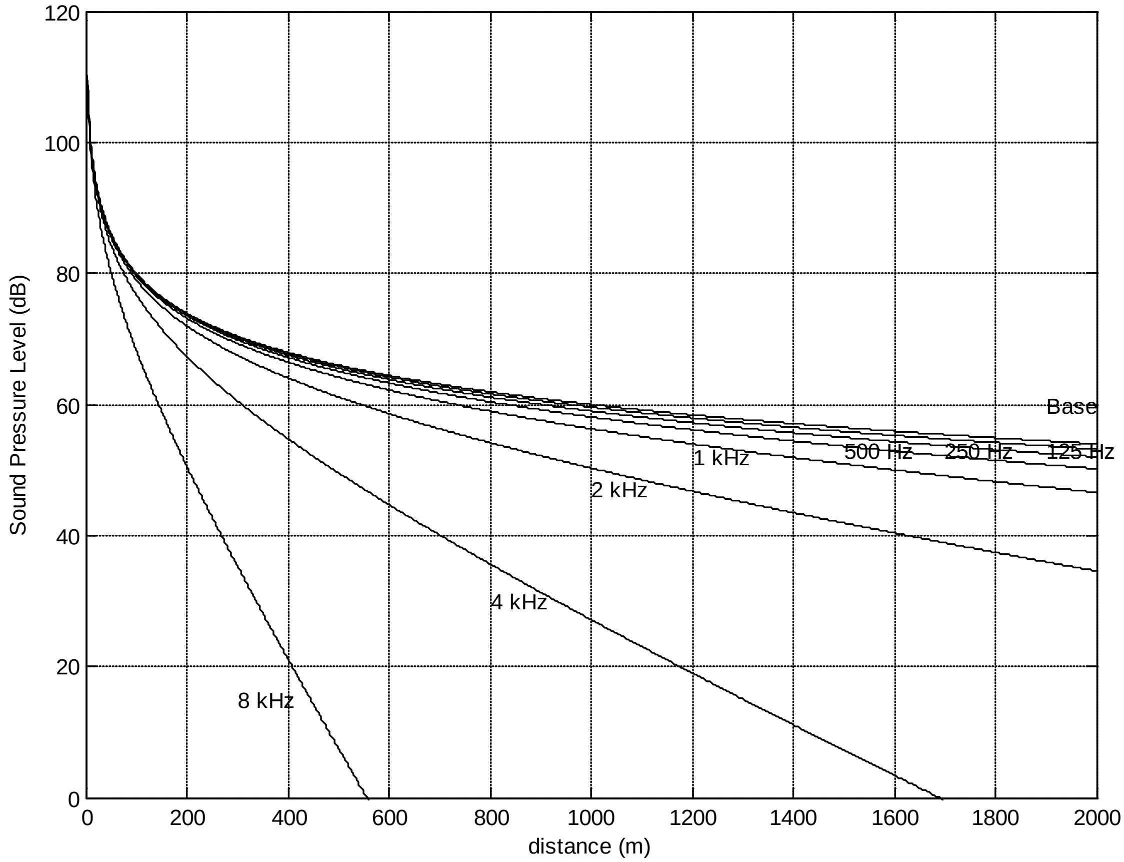
As sound transmits through a medium, there is an attenuation (or dissipation of acoustic energy) which can be attributed to three mechanisms:

1) **Viscous Effects** - Dissipation of acoustic energy due to fluid friction which results in thermodynamically irreversible propagation of sound.
2) **Heat Conduction Effects** - Heat transfer between high and low temperature regions in the wave which result in non-adiabatic propagation of the sound.
3) **Inter Molecular Energy Interchanges** - Molecular energy relaxation effects which result in a time lag between changes in translational kinetic energy and the energy associated with rotation and vibration of the molecules.

The following table illustrates the attenuation coefficient of sound at standard pressure (101.325 kPa) in units of dB/100m.

Temperature °C	Relative Humidity (%)	Frequency (Hz) 125	250	500	1000	2000	4000
30	20	0.06	0.18	0.37	0.64	1.40	4.40
	50	0.03	0.10	0.33	0.75	1.30	2.50
	90	0.02	0.06	0.24	0.70	1.50	2.60
20	20	0.07	0.15	0.27	0.62	1.90	6.70
	50	0.04	0.12	0.28	0.50	1.00	2.80
	90	0.02	0.08	0.26	0.56	0.99	2.10
10	20	0.06	0.11	0.29	0.94	3.20	9.00
	50	0.04	0.11	0.20	0.41	1.20	4.20
	90	0.03	0.10	0.21	0.38	0.81	2.50
0	20	0.05	0.15	0.50	1.60	3.70	5.70
	50	0.04	0.08	0.19	0.60	2.10	6.70
	90	0.03	0.08	0.15	0.36	1.10	4.10

- As frequency increases, absorption increases
- As Relative Humidity increases, absorption decreases
- There is no direct relationship between absorption and temperature
- **The net result of atmospheric absorption is to modify the sound propagation of a point source from 6 dB/doubling-of-distance to approximately 7 – 8 dB/doubling-of-distance (based on anecdotal experience)**



Atmospheric Absorption at 10^{o}C and 70% RH

Meteorological Effects

There are many meteorological factors which can affect how sound propagates over large distances. These various phenomena must be considered when trying to determine the relative impact of a noise source either after installation or during the design stage.

Wind

- Can greatly alter the noise climate away from a source depending on direction
- Sound levels downwind from a source can be increased due to refraction of sound back down towards the surface. This is due to the generally higher velocities as altitude increases.
- Sound levels upwind from a source can be decreased due to a "bending" of the sound away from the earth's surface.
- Sound level differences of ±10dB are possible depending on severity of wind and distance from source.
- Sound levels crosswind are generally not disturbed by an appreciable amount
- Wind tends to generate its own noise, however, and can provide a high degree of masking relative to a noise source of particular interest.

Temperature

- Temperature effects can be similar to wind effects
- Typically, the temperature is warmer at ground level than it is at higher elevations.
- If there is a very large difference between the ground temperature (very warm) and the air aloft (only a few hundred meters) then the transmitted sound refracts upward due to the changing speed of sound.
- If the air aloft is warmer than the ground temperature (known as an *inversion*) the resulting higher speed of sound aloft tends to refract the transmitted sound back down towards the ground. This essentially works on Snell's law of reflection and refraction.
- Temperature inversions typically happen early in the morning and are most common over large bodies of water or across river valleys.
- Sound level differences of ±10dB are possible depending on gradient of temperature and distance from source.

Rain

- Rain does not affect sound propagation by an appreciable amount unless it is very heavy
- The larger concern is the noise generated by the rain itself. A heavy rain striking the ground can cause a significant amount of highly broadband noise. The amount of noise generated is difficult to predict.
- Rain can also affect the output of various noise sources such as vehicle traffic.

Summary

- In general, these wind and temperature effects are difficult to predict
- Empirical models (based on measured data) have been generated to attempt to account for these effects.
- Environmental noise measurements must be conducted with these effects in mind. Sometimes it is desired to have completely calm conditions, other times a "worst case" of downwind noise levels are desired.

Topographical Effects

Similar to the various atmospheric effects outlined in the previous section, the effect of various geographical and vegetative factors must also be considered when examining the propagation of noise over large distances.

Topography

- One of the most important factors in sound propagation.
- Can provide a natural barrier between source and receiver (i.e. if berm or hill in between).
- Can provide a natural amplifier between source and receiver (i.e. large valley in between or hard reflective surface in between).
- Must look at location of topographical features relative to source and receiver to determine importance (i.e. small berm 1km away from source and 1km away from receiver will make negligible impact).

Grass

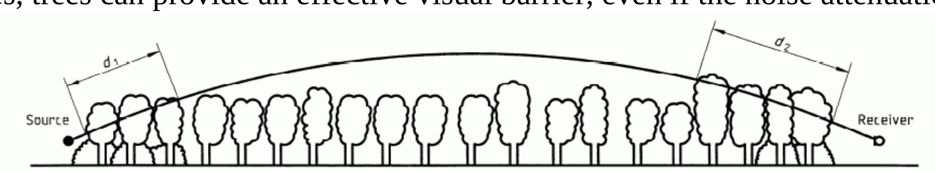
- Can be an effective absorber due to large area covered
- Only effective at low height above ground. Does not affect sound transmitted direct from source to receiver if there is line of sight.
- Typically less absorption than atmospheric absorption when there is line of sight.
- Approximate rule of thumb based on empirical data is:

$$A_g = 18\log_{10}(f) - 31 \qquad (dB/100m)$$

Where: A_g is the absorption amount

Trees

- Provide absorption due to foliage
- Deciduous trees are essentially ineffective in the winter
- Absorption depends heavily on density and height of trees
- No data found on absorption of various kinds of trees
- Large spans of trees are required to obtain even minor amounts of sound reduction
- In many cases, trees can provide an effective visual barrier, even if the noise attenuation is negligible.



NOTE — $d_f = d_1 + d_2$

For calculating d_1 and d_2, the curved path radius may be assumed to be 5 km.

Figure A.1 — Attenuation due to propagation through foliage increases linearly with propagation distance d_f through the foliage

Table A.1 — Attenuation of an octave band of noise due to propagation a distance d_f through dense foliage

Propagation distance d_f m	Nominal midband frequency Hz 63	125	250	500	1 000	2 000	4 000	8 000
$10 \leq d_f \leq 20$	Attenuation, dB: 0	0	1	1	1	1	2	3
$20 \leq d_f \leq 200$	Attenuation, dB/m: 0,02	0,03	0,04	0,05	0,06	0,08	0,09	0,12

Tree/Foliage attenuation from ISO 9613-2:1996

Bodies of Water

- Large bodies of water can provide the opposite effect to grass and trees.
- Reflections caused by small incidence angles (grazing) can result in larger sound levels at great distances (increased reflectivity, Q).
- Typically air temperatures are warmer high aloft since air temperatures near water surface tend to be more constant. Result is a high probability of temperature inversion.
- Sound levels can “carry” much further.

Snow

- Covers the ground for much of the year in northern climates.
- Can act as an absorber or reflector (and varying degrees in between).
- Freshly fallen snow can be quite absorptive.
- Snow which has been sitting for a while and hard packed due to wind can be quite reflective.
- Falling snow can be more absorptive than rain, but does not tend to produce its own noise.
- Snow can cover grass which might have provided some means of absorption.
- Typically sound propagates with less impedance in winter due to hard snow on ground and no foliage on trees/shrubs.

Appendix III SOUND LEVELS OF FAMILIAR NOISE SOURCES

Used with Permission Obtained from ERCB Directive 038 (January, 2007)

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

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

SOUND LEVELS GENERATED BY COMMON APPLIANCES

Used with Permission Obtained from ERCB Directive 038 (January, 2007)

Source[1]	Sound level at 3 feet (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] 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 IV PERMISSIBLE SOUND LEVEL DETERMINATION

Permissible Sound Levels at Theoretical 1,500 m Receptors

Basic Sound Level

	Dwelling Density (Per Quarter Section of Land)			Night-Time	Day-Time
Proximity to Transportation	1 - 8 Dwellings	9 - 160 Dwellings	> 160 Dwellings		
Category 1	40	43	46	40	40
Category 2	45	48	51		
Category 3	50	53	56		
			Basic Sound Level (dBA)	40	40

Time of Day Adjustment

Time of Day	Adjustment (dBA)	Night-Time	Day-Time
Night-time adjustment for hours 22:00 - 07:00	0	0	n/a
Day-time adjustment for hours 07:00 - 22:00	+10	n/a	+10
	Time of day adjustment (dBA)	0	+ 10

Class A Adjustments

Class	Reason for Adjustment	Adjustment (dBA)	Night-Time	Day-Time
A1	Seasonal Adjustment (Winter)	0 to +5	0	0
A2	Ambient Monitoring Adjustment	-10 to +10	0	0
Sum of A1 and A2 cannot exceed maximum of 10 dBA Leq				
		Class A Adjustment (dBA)	0	0

Class B Adjustments

Class	Duration of Activity	Adjustment (dBA)	Night-Time	Day-Time
B1	≤ 1 Day	+ 15	0	0
B2	≤ 7 Days	+ 10	0	0
B3	≤ 60 Days	+ 5	0	0
B4	> 60 Days	0	0	0
Can only apply one of B1, B2, B3, or B4				
		Class B Adjustment (dBA)	0	0

	Night-Time	Day-Time
Total Permissible Sound Level (PSL) [dBA]	40	50

Appendix V APPLICATION CASE NOISE SOURCE ORDER-RANKING

Theoretical 1,500 m R_09

Noise Source	Location	dBA		31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
Gas Turbine #2 Exhaust	Phase2_034	30.3		48.6	49.3	42.5	33.7	22.3	11.6	-4	-38.8
Gas Turbine #1 Exhaust	Phase2_028	30.2		48.4	49.2	42.4	33.6	22.2	11.5	-4.2	-39.4
Turbine #2 Lube Oil Cooler	Phase2_038	25.1		38.2	45	33.8	25.2	21.7	18.2	4.9	-35.9
Turbine #1 Lube Oil Cooler	Phase2_032	25		38.1	44.9	33.7	25.2	21.6	18	4.7	-36.5
Glycol Air Cooler	Phase2_054	23.9		34.1	37	29.2	25.7	22.8	18.1	5.9	-34.1
Glycol Air Cooler	Phase2_055	23.9		34.1	37	29.2	25.7	22.8	18.2	6	-33.9
Glycol Air Cooler	Phase2_052	23.8		34	36.9	29.1	25.6	22.7	18	5.7	-34.6
Glycol Air Cooler	Phase2_053	23.8		34.1	36.9	29.2	25.7	22.7	18.1	5.8	-34.4
Glycol Air Cooler	Phase2_050	23.7		34	36.8	29.1	25.5	22.6	17.9	5.5	-35.1
Glycol Air Cooler	Phase2_051	23.7		34	36.9	29.1	25.6	22.6	18	5.6	-34.9
Glycol Air Cooler	Phase2_048	23.6		33.9	36.7	29	25.4	22.5	17.8	5.3	-35.6
Glycol Air Cooler	Phase2_049	23.6		33.9	36.8	29	25.5	22.5	17.9	5.4	-35.4
Combustion Air Blower	Phase2_044	21.3		23.6	26.6	26.4	23.2	21	15.1	2	-39.8
Combustion Air Blower	Phase2_041	19.7		23.3	26.3	25.9	22.2	18.5	13.7	1.6	-40.9
H.P. Steam Boiler	Phase2_043	19.6		32.6	33.6	27.6	19.7	18.3	13.7	1.5	-37.4
Combustion Air Blower	Phase2_040	19.3		23.3	26.2	25.8	22	18.2	12.9	1.5	-41.1
H.P. Steam Boiler	Phase2_039	19.2		30.8	30.8	27.5	19.5	18	13.4	1	-38.8
Gas Turbine #2 Inlet	Phase2_033	19		42.1	42	30.2	19.7	-0.2	-25.8	-36	-44.7
Generator #2	Phase2_036	19		35.2	35.1	24.9	20.3	18.7	11.3	-5	-49.9
Generator #1	Phase2_030	18.9		35.2	35	24.8	20.2	18.6	11.1	-5.2	-50.5
Well Pad Piping (Typical)	Pad2_039	18.7		37.3	40.1	21.2	16.1	15.7	13.3	-4.3	-66.8
H.P. Steam Boiler	Phase2_042	18.3		30.1	29.1	24	17.7	17.4	13.6	1.4	-37.9
Well Pad Piping (Typical)	Pad2_042	17.8		36.7	39.5	20.5	15.4	14.8	12.1	-6.6	-73.2
Evaporator-1 Vapor Compressor	Phase2_017	17.1		31.6	24.5	26	20.9	14.4	9.5	-0.5	-46.4
Evaporator-2 Vapor Compressor	Phase2_020	17		31.5	24.4	25.9	20.9	14.4	9.5	-0.3	-46.2
Utility Steam Boiler	Phase2_056	16.5		22.4	24.6	23.1	19.3	15.6	9.8	-3.1	-44
Glycol Heater	Phase2_045	16.2		21.1	23.1	22.5	19	15.3	9.5	-3.4	-44.4
Glycol Heater	Phase2_046	16.2		21.1	23.1	22.5	19	15.3	9.5	-3.4	-44.4
Utility Steam Boiler	Phase2_057	16.2		20.3	20.6	20.1	19.2	15.6	9.8	-3.1	-44.1
Well Pad Piping (Typical)	Pad2_045	16.2		35.7	38.4	19.3	14	13	9.7	-11.2	-86.5
Gas Turbine #2 Casing	Phase2_035	15.8		47.1	37	22.8	15.2	11.6	5.2	-11.1	-56
HRSG #2 Casing	Phase2_037	15.8		47.2	37	22.8	15.2	11.7	5.2	-11.1	-56
Gas Turbine #1 Casing	Phase2_029	15.7		47.1	36.9	22.7	15.1	11.5	5	-11.3	-56.6
HRSG #1 Casing	Phase2_031	15.7		47.1	36.9	22.7	15.2	11.6	5	-11.3	-56.5
Well Pad Piping (Typical)	Pad2_027	15		28.1	30.9	20.2	16.8	13.8	8.9	-6.7	-59.9
Well Pad Piping (Typical)	Pad2_018	14.9		28	30.8	20.1	16.7	13.7	8.7	-7	-60.8
Well Pad Piping (Typical)	Pad2_036	14.8		28	30.8	20.1	16.7	13.6	8.7	-7.1	-60.9
Well Pad Piping (Typical)	Pad2_033	14.3		27.6	30.4	19.7	16.2	13.1	7.9	-8.4	-64.5
Well Pad Piping (Typical)	Pad2_015	10.2		25	27.7	16.7	12.7	8.8	2.3	-19.1	-100
Well Pad Piping (Typical)	Pad2_006	10.1		24.9	27.6	16.7	12.6	8.8	2.1	-19.3	-100
Well Pad Piping (Typical)	Pad2_024	10.1		24.9	27.6	16.7	12.6	8.7	2.1	-19.4	-100
Well Pad Piping (Typical)	Pad2_030	9.6		24.6	27.3	16.3	12.2	8.2	1.3	-20.9	-100
Well Pad Piping (Typical)	Pad1_039	8.7		29.9	32.5	13	6.6	4.3	-1.8	-32.2	-100
Well Pad Piping (Typical)	Pad2_012	6.9		22.9	25.5	14.3	9.8	5.2	-2.9	-29.4	-100
Well Pad Piping (Typical)	Pad2_021	6.9		22.9	25.5	14.4	9.8	5.2	-2.9	-29.4	-100
Gas Turbine #1 Inlet	Phase2_027	6.6		29.7	27.7	20.2	5.7	-18.9	-49.7	-63.5	-73.8
H.P. Boiler Feedwater Pump	Phase2_026	6.4		18	15.9	13.4	10.3	4.8	-1.1	-19.2	-67
Well Pad Piping (Typical)	Pad2_003	6.3		22.5	25.1	13.9	9.2	4.4	-3.9	-31.5	-100
VRU Liquid Ring Compressor	Phase2_012	6.1		20.8	13.7	15.1	10	3.5	-1.5	-12.1	-60.5
Cooling Glycol Circulation Pump	Phase2_047	5.8		17.3	15.2	12.7	9.7	4.3	-1.5	-19.3	-65.9
Instrument Air Compressor	Phase2_058	5.5		20.1	12.9	14.4	9.4	2.8	-2.3	-12.7	-59.6
Well Pad Piping (Typical)	Pad2_009	5.4		21.9	24.5	13.2	8.3	3.3	-5.6	-35	-100
L.P. Boiler Feedwater Pump	Phase2_023	4.9		16.5	14.4	11.9	8.8	3.3	-2.7	-21	-69.7
Well Pad Piping (Typical)	Pad1_033	2.6		19.3	21.9	10.5	5.6	0.4	-8.8	-39.2	-100
Evaporator-2 Recirculation Pump	Phase2_019	2.6		14.1	12	9.5	6.4	1	-4.9	-22.8	-69.8
Evaporator-1 Recirculation Pump	Phase2_016	2.3		14.3	12.1	9.6	6.4	0.7	-5.6	-24.2	-71.7
Well Pad Piping (Typical)	Pad1_036	2.1		19	21.6	10.2	5.1	-0.3	-9.8	-41.3	-100
Crystallizer Recirculation Pump	Phase2_021	2.1		13.7	11.5	9.1	6	0.5	-5.3	-23.2	-70.2
Diluent Transfer Pumps	Phase2_011	1.2		12.9	10.7	8.2	5.1	-0.4	-6.4	-24.9	-74.2
Well Pad Emulsion Pump (Typical)	Pad2_038	0.9		20.6	18.4	7.5	2.4	-1	-5.5	-29.3	-100
Diluent Pumps	Phase2_010	0.8		12.5	10.4	7.9	4.8	-0.7	-6.7	-25.1	-74.2
Dilbit Load Pumps	Phase2_013	0.7		12.4	10.3	7.7	4.6	-0.9	-7	-25.5	-75.2
IGF Recycle Pumps / Eductor Supply Pumps	Phase2_007	0.3		12	9.8	7.3	4.2	-1.3	-7.3	-25.7	-74.8
ORF Feed Pumps	Phase2_008	0.2		11.9	9.8	7.3	4.2	-1.4	-7.4	-25.9	-75.3
Surge Pump	Phase2_006	0.1		11.8	9.6	7.1	4	-1.5	-7.5	-25.8	-74.6
De-Oiled Water Pumps	Phase2_009	0.1		11.9	9.7	7.2	4.1	-1.5	-7.5	-26.1	-75.7
Well Pad Emulsion Pump (Typical)	Pad2_041	0.1		20.1	17.9	7	1.8	-1.8	-6.5	-31.2	-100

Notes:

- Octave band sound levels are linear (i.e. not A-weighted)
- Data in Tables shows only those noise sources which have a broadband dBA sound level contribution greater than 0.0 dBA

Appendix VI NOISE IMPACT ASSESSMENT

Licensee: **Southern Pacific Resource Corp.**

Facility name: **STP McKay Thermal Project – Phase 2**

Type: **Steam Assisted Gravity Drain**

Legal location: **TWP 91, RG 13, 14, 15, W4M**

Contact: Vince Parsons Telephone: (403) 984-5335

1. Permissible Sound Level (PSL) Determination (*Rule 012,* Section 2)

(Note that the PSL for a pre-1988 facility undergoing modifications may be the sound pressure level (SPL) that currently exists at the residence if no complaint exists and the current SPL exceeds the calculated PSL from Section 2.1.)

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

Distance from facility	Direction from facility	BSL (dBA)	Daytime adjustment (dBA)	Class A adjustment (dBA)	Class B adjustment (dBA)	Nighttime PSL (dBA)	Daytime PSL(dBA)
1,500 m	All Directions	40	10	0	0	40	50

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 X PWL (dBA) X SPL (dBA) OR Measured X PWL (dBA) X SPL (dBA)	Data source	Distance calculated or measured (m)
Listed in Appendix I		**Measurements / Calculations**	

Existing Equipment/Facility	Predicted X PWL (dBA) X SPL (dBA) OR Measured X PWL (dBA) X SPL (dBA)	Data source	Distance calculated or measured (m)
Listed in Appendix I		**Measurements / Calculations**	

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 window/doors open or closed). Describe any considerations and assumptions used in conducting engineering estimates:

Equipment assumed to be operating at all times at maximum capacity

4. Modelling Parameters

If modelling was conducted, identify the parameters used (see Section 3.5.1):

Ground absorption 0.5, Temperature 10^{0}C, Relative Humitidy 70%, all receptors downwind, Following ISO 9613

5. Predicted Sound Level/Compliance Determination

Identify the predicted overall (cumulative) sound level at the nearest of most impacted residence. 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 must be calculated.

Predicted sound level contribution from the new or modified facility alone at the nearest or most impacted dwelling or at a distance of 1.5 km where there are no dwellings.

Nighttime sound level:	**38.0 dBA L_{eq}**	Daytime sound level:	**38.0 dBA L_{eq}**
Assumed nighttime sound level:	**35.0 dBA L_{eq}**	Assumed daytime sound level:	**45.0 dBA L_{eq}**

Predicted sound level at the nearest or most impacted dwelling or at a distance of 1.5 km where there are no dwellings, from the new or modified facility including the cumulative effects of noise from energy-related facilities and the prescribed ambient level (ASL + new facility + existing energy-related facilities).

Nighttime sound level:	**39.8 dBA L_{eq}**	Nighttime Permissible sound level:	**40.0 dBA L_{eq}**
Daytime sound level:	**45.8 dBA L_{eq}**	Daytime Permissible sound level:	**50.0 dBA L_{eq}**

Is the predicted sound level less than the permissible sound level by a margin of three dBA? **YES**
If No, conduct a detailed NIA as per Section 3 of AUC Rule 012.

6. Compliance Determination/Attenuation Measures

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

Predicted sound level to the nearest or most impacted residence from the facility (**with** noise attenuation measures):

N/A

Is the predicted sound level less than the permissible sound level? **YES** If **YES**, go to number 7
(b) If 6 (a) is **NO** or the licensee is not committing to any noise attenuation measures, the facility is not in compliance. If further attenuation measures are not practical, provide the reasons why the measures proposed to reduce the impacts are not practical.
Note: If 6 (a) is NO, the Noise Impact Assessment must be included with the application filed as non-routine.

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

Advising nearby residents of significant noise sources and the Project construction schedule
Mufflers on all internal combustion engines
Taking advantage of acoustical screening where available
Limiting vehicle access during night-time
Limiting vehicle speeds, at all times, in the Project area

8. Analyst's Name : **Steven Bilawchuk, M.Sc., P.Eng.**

Company: **ACI Acoustical Consultants Inc.**

Title: **Director**

Telephone: **(780) 414-6373** Date: **October 31, 2012**