APPENDIX E

Noise Assessment Study

Bear Head Energy Green Hydrogen and Ammonia Production, Storage and Loading Facility, Acoustic Assessment Report

Final Report

February 10, 2023

Prepared for:

Bear Head Energy Inc.

Prepared by:

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File: 121431287

BEAR HEAD ENERGY GREEN HYDROGEN AND AMMONIA PRODUCTION, STORAGE AND LOADING FACILITY, ACOUSTIC ASSESSMENT REPORT

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Table of Contents

LIST OF TABLES

LIST OF FIGURES

Abbreviations

%HA	percent highly annoyed
Δ %HA	change in percent highly annoyed
ASA	Acoustic Study Area
ASU	air separation units
BHE	Bear Head Energy Inc
BHLNG	Bear Head LNG Corporation
dB	decibel
dBA	A-weighted dB scale
H_2	Hydrogen
kHz	kilohertz
Hz	Hertz
km	kilometre
kW	kilowatt
L_{Aeg}	weighted continuous sound level
L_d	daytime equivalent sound levels
L_{dn}	day-night average sound level
L_n	nighttime equivalent sound levels
m	metre
m^3	square meter
MOF	marine offloading facility
MW	Megawatt
O_2	oxygen

Glossary

Ambient Sound Level or Ambient Noise	All-encompassing sound that is associated with a given environment, usually a composite of sounds from many sources near and far. Includes noise from all sources other than the sound of interest (i.e., sound other than that being measured), such as sound from other industrial noise, transportation sources, animals and nature.
Attenuation	The reduction of sound intensity by various means (e.g., air, humidity and porous materials).
A-Weighting	The weighting network used to account for changes in level sensitivity as a function of frequency. The A-weighting network de-emphasizes the high (i.e., 6.3 kHz and above) and low (i.e., below 1 kHz) frequencies, and emphasizes the frequencies between 1 kHz and 6.3 kHz, in an effort to simulate the relative response of the human ear. See also frequency weighting.
Background Sound Level or Background Noise	Same as the ambient sound level.
Decibel	A logarithmic measure of any measured physical quantity and commonly used in the measurement of sound. The decibel (dB) provides the possibility of representing a large span of signal levels in a simple manner. The difference between the sound pressure for silence versus a loud sound is a factor of 1,000,000:1 or more, therefore it is less cumbersome to use a small range of equivalent values: 0 to 130 dB. A tenfold increase in sound power is equal to +10 dB.
Decibel, A-weighted	A-weighted decibels (dBA). Most common units for expressing sound levels since they approximate the response of the human ear.
Decibel, Linear	Unweighted decibels (dBL). Logarithmic units associated with a sound pressure level, where the sound pressure signal is unfiltered and represents the full spectrum of incoming noise.
Frequency	The number of times per second that the sine wave of sound repeats itself. It can be expressed in cycles per second, or Hertz (Hz). Frequency equals Speed of Sound / Wavelength.
Noise	Any unwanted sound. "Noise" and "sound" are used interchangeably in this document.
Noise level	Same as sound level.

Octave	The interval between two frequencies having a ratio of two to one. For acoustic measurements, the octaves start a 1,000 Hz centre frequency and go up or down from that point, at the 2:1 ratio. From 1,000 Hz, the next filter's centre frequency is 2,000 Hz, the next is 4,000 Hz, or 500 Hz, 250 Hz, etc. Octave filtering is usually referred to as the class of octave filters typically 1, 3 or 12, thus creating full octaves, one-third octaves, or one-twelfth octaves.
Receptor	A representative point considered for the purpose of assessment within noise-sensitive receptor such as a residence, campground, daycare, school, church, or hospital.
Sound	A wave motion in air, water, or other media. It is the rapid oscillatory compression changes in a medium that propagate to distant points. It is characterized by changes in density, pressure, motion, and temperature as well as other physical properties. Not all rapid changes in the medium are due to sound (e.g., wind distortion on a microphone diaphragm).
Sound Level	Generally, sound level refers to the weighted sound pressure level obtained by frequency weighting, usually A- or C-weighted, and expressed in decibels
Sound Power Level	The total sound energy radiated by a source per unit time. The unit of measurement is the Watt. The acoustic power radiated from a given sound source as related to a reference power level (i.e., typically 1E-12 watts, or 1 picowatt) and expressed as decibels. A sound power level of 1 watt = 120 decibels relative to a reference level of 1 picowatt.
Sound Pressure	The root-mean-square of the instantaneous sound pressures during a specified time interval in a stated frequency band.
Sound Pressure Level	Logarithmic ratio of the root mean square sound pressure to the sound pressure at the threshold of human hearing (i.e., 20 micropascals).
Weighting	Adjustment of sound level data to achieve a desired measurement. A-weighting is used to account for changes in human hearing sensitivity as a function of frequency. The A-weighting network de-emphasizes the high (i.e., 6,300 Hz and above) and low (i.e., below 1,000 Hz) frequencies, and emphasizes the frequencies between 1,000 Hz and 6,300 Hz, in an effort to simulate the relative response of human hearing. C-Weighting is linear over the mid frequency range from 200 Hz to 1,600 Hz, and de-emphasizes the low (i.e., below 200 Hz) and high (i.e., above 1,600 Hz) frequencies.

Executive Summary

Stantec Consulting Ltd. (Stantec) was retained by Bear Head Energy Inc. (BHE, formerly Bear Head LNG Corporation; BHLNG) to conduct an acoustic assessment of the proposed Green Hydrogen and Ammonia Production, Storage and Loading Facility (the Project). The Project will be located within the footprint of the previously approved Bear Head Liquified Natural Gas Export Facility (Bear Head LNG Project) in the Point Tupper Industrial Park near Port Hawkesbury on the Strait of Canso on Cape Breton, Nova Scotia.

Acoustic modelling was completed by Stantec to predict noise levels at nearby receptors due to Project activities. The predicted sound pressure levels were added to existing baseline data collected near the Project and compared to applicable guideline levels to estimate the change in sound quality, including:

- The Municipality of the District of Guysborough Noise Control By-Law limits noise levels to 65 decibels (dBA) during daytime hours and 55 dBA at night.
- The province of Nova Scotia's "Guideline for Environmental Noise Measurement and Assessment" (NSEL 1990) also includes noise criteria for different periods of the day (65 dBA during the day, 60 dBA in the evening and 55 dBA at night).
- Health Canada's "Guidance for Evaluating Human Health Impacts in Environmental Assessment: Noise" (Health Canada 2017) includes noise criteria related to nuisance and sleep disturbance.

Stantec's assessment predicted that noise levels associated with the operation of the proposed Project would not likely exceed the local Noise Control By-Law limits, the Nova Scotia noise assessment guidelines, or Health Canada's guidelines for nuisance and sleep disturbance.

1.0 INTRODUCTION

Bear Head Energy Inc. (BHE, formerly Bear Head LNG Corporation; BHLNG) proposes to construct and operate a Green Hydrogen and Ammonia Production, Storage and Loading Facility (the Project). Hydrogen production is based on 2,860 MW power input with 2,000 MW consumed by the electrolysers and 860 MW consumed in the balance of the plant including Haber-Bosch ammonia synthesis unit and utilities. The facility will be located within the footprint of the previously approved Bear Head Liquified Natural Gas Export Facility (Bear Head LNG Project) in the Point Tupper Industrial Park near Port Hawkesbury on the Strait of Canso on Cape Breton, Nova Scotia. The Project includes the following key components as shown in Figure 1-1.

- Electric Substation(s) – transforms renewable energy and delivers it to the electrolysers, Haber-Bosch ammonia synthesis unit, ASU, and balance of the plant
- Water purification plant (reverse osmosis [RO] unit) – purifies the water used in the electrolysers to reduce fouling and enhance hydrogen purity
- Electrolysers – Using electricity, electrolysers split water into hydrogen (H_2) and oxygen (O_2) gas
- Air separation unit(s) (ASUs) – cryogenically distills nitrogen in the air effectively separating nitrogen gas from the atmosphere
- Haber-Bosch ammonia synthesis unit(s) – synthesizes ammonia from gaseous nitrogen and hydrogen at high temperatures and pressures
- Ammonia storage tank (s) with a total volume of approximately 124,000 m^3
- High pressure flare and low pressure (marine) flare
- Administration buildings and parking
- Marine facility – transfers ammonia from the storage tanks to marine vessels; includes a MOF and a berth (design of these marine facilities will be the same as previously approved for the Bear Head LNG Project)

Stantec Consulting Ltd. (Stantec) was retained to conduct an acoustic assessment of the proposed facility.

Noise emissions during construction were previously assessed as part of the Bear Head LNG Project and were found to meet regulatory requirements. The purpose of this acoustic assessment was to estimate the potential change in sound levels at the nearby receptor locations due to the operation of the Project.

Legend

Project Area

0 100 200 Metres

(At original document size of 8.5x11)
1:8,000

N

Notes

1. Coordinate System: NAD 1983 CSRS UTM Zone 20N
2. Data Sources: Bear Head Energy, Government of Nova Scotia
3. Background: Province of Nova Scotia, Esri Canada, Esri, HERE, Garmin, FAO, NOAA, USGS, NRCan, Parks Canada, Esri, USGS, Maxar

Stantec

Project Location
Richmond County, NS

Prepared by NW on 2023-01-12

Client/Project
121431287_045

Bear Head Energy
Regulatory Permitting Support

Figure No.
1-1

Title
Preliminary Site Plan for Green Hydrogen and Ammonia Facility at Bear Head Site

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2.0 STUDY AREA

The proposed Project will be located in the Point Tupper Industrial Park near Port Hawkesbury on the Strait of Canso in Richmond County, Cape Breton, Nova Scotia. Project is located in an area zoned for industrial use; the nearest residences are located across the Strait of Canso in the Municipality of the District of Guysborough County.

Most of the site preparation work was already conducted for the Bear Head LNG Project, therefore additional civil related construction activities such as land clearing, excavation and grading will be limited and will occur within the previously approved site boundaries.

A study area was chosen to assess the sphere of influence of noise around the Project and is referred to as the Acoustics Study Area (ASA). The ASA is shown in Figure 2-1, including the proposed Project Area and adjacent lands within approximately 5 km of the Project boundaries.

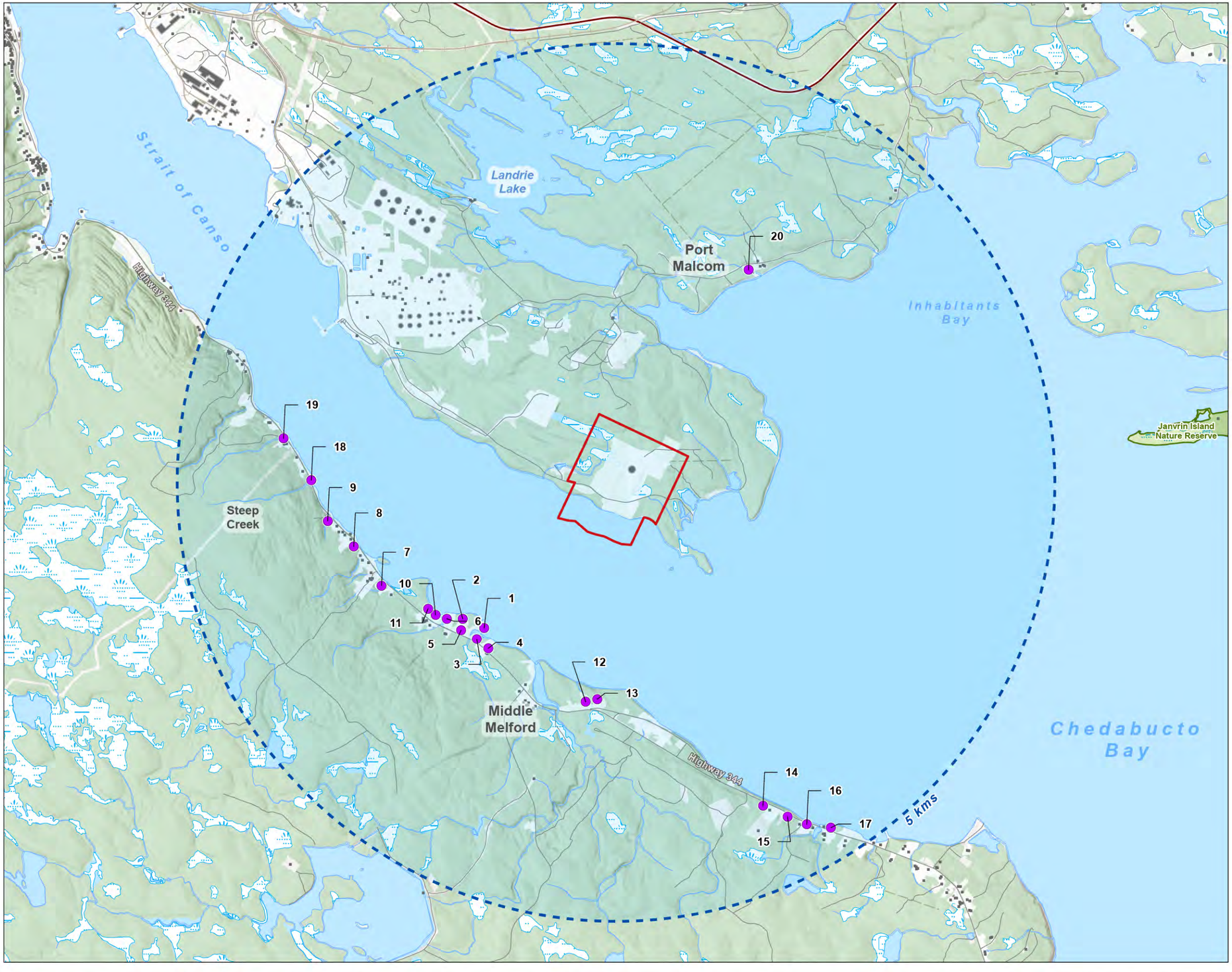

Figure No.

2-1

Title

Predicted Operation Sound Receptors within 5km

Client/Project

121431287_047

Bear Head Energy
Regulatory Permitting Support

Project Location

Prepared by NW on 2022-11-30

Richmond County, NS

N

0 0.5 1 Kilometres
(At original document size of 11x17)
1:45,000

Legend

- Receptors within 5 km of Bear Head Facilty
- Project Area
- 5 km radius from Bear Head Facility
- Highway
- Local Road
- Railway
- Buildings
- Wetlands
- Waterways (1:10k)
- Waterbody (1:10k)
- Nature Reserve

Project Location

Notes

1. Coordinate System: NAD 1983 CSRS UTM Zone 20N
2. Data Sources: Stantec, NS DNR, NS DOE, NSTB, NSODB, Service NS (Government of Nova Scotia)
3. Background: NSODB, Service NS (Government of Nova Scotia)

Stantec

2.1 RECEPTOR LOCATIONS

Receptors are noise-sensitive locations, such as homes, schools or hospitals located outside of the facility fence line. Receptors do not include industrial or commercial locations. The most sensitive receptors within the ASA were identified from site plans and aerial photos. A total of 20 receptors were considered in the acoustic model and are listed in Table 2.1, and graphically presented in Figure 2-1. The receptors are in regions located to the southwest and northeast of the facility.

Table 2.1 Receptors within the Acoustic Assessment Area

Receptor ID	UTM Coordinates (Zone 21)		Elevation Above Sea Level (m)
	Easting (m)	Northing (m)	
1	631,052	5,044,640	8.1
2	630,808	5,044,746	7.9
3	630,968	5,044,513	8.4
4	631,100	5,044,404	12.6
5	630,789	5,044,616	9.0
6	630,627	5,044,746	11.0
7	629,883	5,045,123	8.9
8	629,566	5,045,570	16.7
9	629,269	5,045,859	12.6
10	630,498	5,044,790	12.0
11	630,412	5,044,860	11.0
12	632,208	5,043,797	23.1
13	632,341	5,043,825	22.8
14	634,229	5,042,612	21.2
15	634,509	5,042,488	20.3
16	634,728	5,042,402	10.4
17	635,003	5,042,363	7.0
18	629,083	5,046,324	13.7
19	628,766	5,046,801	10.2
20	634,064	5,048,721	14.5

3.0 APPLICABLE REGULATIONS AND GUIDELINES

Locally, the Municipality of the County of Richmond has developed a noise by-law that states no person shall engage in activities between the hours of 12 a.m. (midnight) to 7 a.m. which disturbs or tends to disturb the peace and tranquility of a neighbourhood to which the by-law applies. Exemptions are allowed by application (Municipality of the County of Richmond 2019). The Municipality of the District of Guysborough Noise Control By-Law prohibits noise that disturbs the peace and tranquility in the community. The by-law limits noise levels between 6 a.m. and 11 p.m. to 65 dBA and from 11 p.m. to 6 a.m. to 55 dBA (Municipality of the District of Guysborough 2011).

The province of Nova Scotia has a published noise guideline, "Guideline for Environmental Noise Measurement and Assessment" (NSEL 1990). This guideline includes noise criteria for different periods of the day (day, evening and night) and includes a measurement duration of a minimum of two continuous hours of data in one time period to be representative. The Nova Scotia noise guidelines are presented in Table 3.1. Although not explicitly stated, these values are interpreted to represent hourly averages measured at the property boundary of receptors (i.e., noise-sensitive locations such as residential properties). The document is currently under review (NSECC 2022).

Table 3.1 NSE Noise Guidelines

Averaging Time Period	NSE Noise Guideline (dBA)
Day (7:00 to 19:00)	65
Evening (19:00 to 23:00)	60
Night (23:00 to 7:00)	55
Source: NSEL 1990	

Health Canada's "Guidance for Evaluating Human Health Impacts in Environmental Assessment: Noise" document (Health Canada 2017) provides guidance for assessing noise impacts from a variety of internationally recognized standards for acoustics, including the World Health Organization's (WHO) *Guidelines for Community Noise* (1999) and *Night Noise Guidelines for Europe* (2009).

Health Canada recommends using a guideline level related to annoyance called percent highly annoyed or %HA. The %HA is an estimate of the percentage of people who are potentially annoyed by noise emissions and is based on studies completed by the United States Environmental Protection Agency (US EPA). To calculate the %HA, the daytime equivalent sound levels (or L_d, a 15-hour time average of sound levels over the daytime period from 7:00 AM to 10:00 PM) and nighttime equivalent sound levels (or L_n, a 9-hour time average over the nighttime period from 10:00 PM to 7:00 AM) are combined to calculate an adjusted day-night average sound level (or L_{dn}). In the L_{dn} calculation, the L_n value is increased by 10-dB to account for higher sensitivity to noise emissions at night.

The L_{dn} value is used to calculate the %HA value. A %HA value is calculated for the existing environment (i.e., the baseline conditions). A second %HA is calculated for the total sound levels from baseline conditions and project-related sound emissions. The difference between the values of %HA is then

compared with guideline criteria. Health Canada recommends that the maximum change in %HA due to project activities be no more than 6.5%. If the change in %HA threshold is exceeded, the effects due to noise are considered to be of concern and may require mitigation.

The noise guidance from Health Canada (2017) references the guidelines and recommendations of the WHO for community noise and night noise (WHO 1999 and 2009). The WHO guideline recommends a target for sleep disturbance as being an indoor sound level of no more than 30 dBA L_{eq} for continuous noise during the sleep period (WHO 1999). Health Canada recommends that an outdoor-to-indoor transmission loss with windows at least partially open is 15 dBA and fully closed windows are assumed to reduce outdoor sound levels by approximately 27 dBA (Health Canada 2017). The corresponding outdoor sound level targets for sleep disturbance is 45 dBA and 57 dBA for partially open windows and fully closed windows, respectively.

A summary of sound level criteria developed by Health Canada used for this assessment is provided in Table 3.2.

Table 3.2 Summary of Guideline Criteria Developed by Health Canada used for the Acoustics Assessment

Criteria	Threshold
Change in Percent Highly Annoyed (Δ %HA)	6.5%
Sleep Disturbance	45 dBA

4.0 BASELINE NOISE

A noise assessment of the Bear Head LNG Project was conducted by SNC Lavalin (2015). As part of that assessment, ambient noise monitoring was conducted on October 1 and 2, 2014 at the Project site and at three residential receptors across the Strait for a period of 24 hours. The locations included for ambient noise monitoring are shown in Figure 4-1. There have been no documented changes in industrial activity or land use since this assessment, and the project is proposed to be located within the same footprint as the previous LNG project, so the results of the noise monitoring were considered to still be representative of the baseline for the assessment.

Sound pressure levels are measured in decibels (dB). For environmental assessments where the effect of sound on humans is the focus, an A-weighted dB scale (dBA) is used to report sound pressure levels as the A-weighting accounts for the sensitivity of the human ear to different frequencies.

At the Project site, birds, insects, and the adjacent wind farm could be heard during noise monitoring. An occasional noise of banging on metal could be heard across the Strait. A summary of the measured ambient sound levels is reproduced in Table 4.1. The L_{Aeq} values ranged from 37 – 50 dBA, and L_{dn} values were 54 - 55 dBA. These sound pressure levels were used to represent the baseline noise conditions for this acoustics assessment.

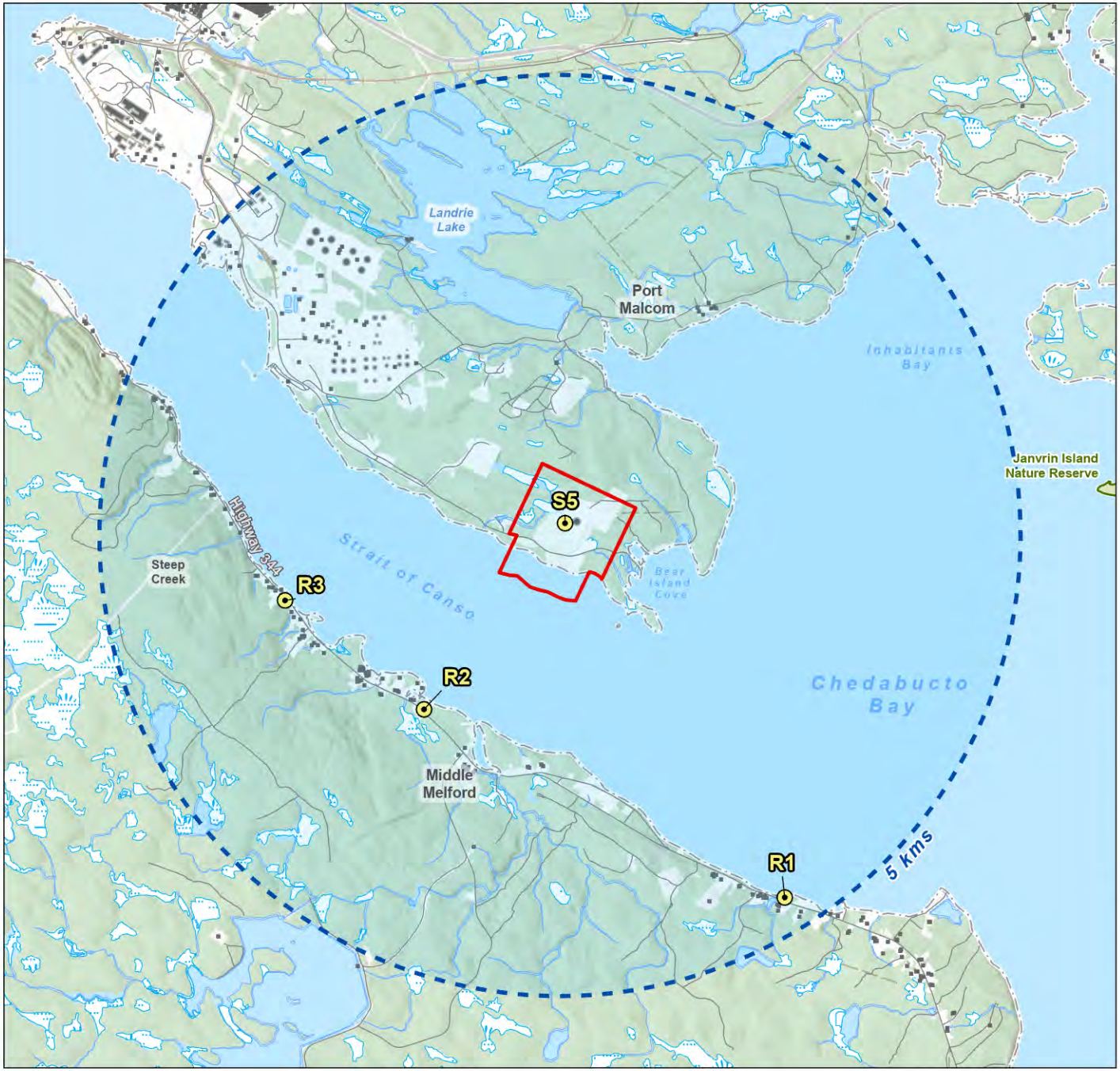

Figure No. 4-1

Title
Baseline Noise Monitoring Stations

Client/Project 121431287-046

Bear Head Energy
Regulatory Permitting Support

Project Location Prepared by NWhite on 2023-01-19

Richmond County, NS

N

0 0.5 1 Kilometre
(At original document size of 8.5x11)
1:65,000

Legend

- Baseline Noise Monitoring Locations[2]
- Project Area
- 5 km radius from Bear Head Facility
- Highway
- Local Road
- Railway
- Buildings
- Wetlands
- Waterways (1:10k)
- Waterbody (1:10k)

Project Location

Notes
1. Coordinate System: NAD 1983 CSRS UTM Zone 20N
2. SNC Lavalin. 2015. Bear Head LNG Updated Registration Document. Bear Head LNG Corporation.
3. Data Sources: NS DNR, NS DOE, NSTB, NSODB, Service NS (Government of Nova Scotia)
4. Background: NSODB, Service NS (Government of Nova Scotia)

Stantec

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Table 4.1 Ambient Sound Levels at Residential Monitoring Sites and the Project Site, October 1-2, 2014

Monitoring Location	Coordinates (ATS77 MTM4)		Approximate Distance from Site Boundary, Loading Platform (km)	07:00 to 19:00 L_{Aeq} (dBA)*	19:00 to 23:00 L_{Aeq} (dBA)*	23:00 to 07:00 L_{Aeq} (dBA)*	Day-Night Average Sound Level (L_{dn}) (dBA)
	Latitude	Longitude					
R1	4517855	4517855	4.4	50	47	43	55
R2	4513977	4513977	1.8	50	43	42	55
R3	4512490	5045776	2.8	50	41	40	54
S5	4515546	5046557	N/A	46	39	37	46
Provincial Criteria**				65	60	55	N/A

Notes:
NA = Not Applicable
*Source: SNC Lavalin 2015
**Source: Guideline for Environmental Noise Measurement Assessment (NSEL 1990), 7:00 – 19:00 LAeq (dBA)

5.0 ACOUSTICS MODELLING METHODS

During Project operations, noise emissions will result from the operation of the electrical substation transformers, hydrogen and nitrogen collection, ammonia production and process piping. Acoustic modelling was completed to predict sound levels at nearby receptors due to Project activities. The predicted sound pressure levels were added to measured baseline data collected within the Project Area and compared to applicable guideline levels to estimate the impact on in sound quality.

Acoustic modelling was conducted using CADNA/A, a commercially available environmental acoustic model that complies with the algorithms described in the ISO 9613-1 and 9613-2 standards for acoustic modelling. The CADNA/A model takes into account geometrical divergence (distance attenuation), barrier effects due to intervening structures, ground effects, atmospheric absorption, and topography. Wind direction can change noise attenuation through the air, and therefore wind direction is always assumed to be blowing from each source location to each point of reception.

Sound power levels for major equipment units associated with the Project were estimated based on equipment information provided by BHE where available, and acoustic technical literature corresponding to appropriate equipment specifications (Bies and Hansen 2003).

Some equipment is planned to be operated outdoors, while other equipment units are planned to be contained within an enclosure. Outdoor noise sources include the transformers, electrolyzers, inlets for the air separation units (ASUs), piping, pipe valves, and the cooling towers. The sound power levels for the outdoor noise sources are shown in Table 5.1.

The ASUs and Haber-Bosch reactors will require compressors. These compressors are planned to be operated indoors. Sound emissions will include the compressor operation and piping noise within each building. The total indoor sound power level for the activities in the ASUs and Haber-Bosch compressor buildings are shown in Table 5.1 and Table 5.3, respectively.

Waste heat from the Haber-Bosch reactor will be used to generate steam and drive a steam turbine. The steam turbine will also be operated indoors and will include feed pumps as part of the heat recovery process. The total sound power level for the activities in the steam turbine building are shown in Table 5.4.

The estimated building sound attenuation is summarized by octave band in Table 5.5. The attenuation performance for a silencer for the ASU compressor inlet is also shown in Table 5.5.

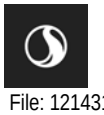


Table 5.1 Sound Power Levels used for the Acoustic Model of Project Noise Sources – Outdoor Noise Sources

Source	Sound Power Level (dB) by Octave Band (Hz)									Total Sound Power Level	
	31.5	63	125	250	500	1000	2000	4000	8000	dB	dBA
Transformers (in the electrical substations)	105	111	113	108	108	102	97	92	85	117	108
Hydrogen electrolysers	94	94	94	94	94	94	94	94	94	104	101
Inlets for the 30 MW compressors	107	109	111	115	117	119	120	115	109	125	125
Discharge piping for 30 MW compressors *	101	99	92	89	89	91	97	98	87	106	102
Discharge piping for 50 MW compressors *	104	101	94	91	92	93	99	101	90	108	105
Inlet suction piping for 50 MW compressors *	95	90	88	91	88	89	93	88	83	100	97
Valves on the piping	80	79	76	78	81	93	95	98	98	103	103
Ammonia Air Coolers	120	123	123	120	117	113	110	107	99	128	119
Air Cooled Condensers	112	115	115	112	109	105	102	99	91	120	111
* Sound power levels for piping are shown on a per-metre basis											

Table 5.2 Sound Power Levels used for the Acoustic Model of Project Noise Sources – Indoor Noise Sources, Haber-Bosch Reactor Buildings

Source	Sound Power Level (dB) by Octave Band (Hz)									Total Sound Power Level	
	31.5	63	125	250	500	1000	2000	4000	8000	dB	dBA
50 MW compressor	116	116	115	113	113	115	119	118	114	125	124
7 m of inlet piping	104	99	97	100	96	98	101	97	91	109	105
7 m of discharge piping	112	109	102	99	100	101	108	109	98	116	113

Table 5.3 Sound Power Levels used for the Acoustic Model of Project Noise Sources – Indoor Noise Sources, Air Separation Unit Buildings

Source	Sound Power Level (dB) by Octave Band (Hz)									Total Sound Power Level	
	31.5	63	125	250	500	1000	2000	4000	8000	dB	dBA
30 MW compressor	114	114	113	111	111	113	117	116	112	123	122
7 m of inlet piping	101	96	95	97	94	96	99	95	89	107	103
7 m of discharge piping	110	107	100	97	98	99	106	107	96	114	111

Table 5.4 Sound Power Levels used for the Acoustic Model of Project Noise Sources – Steam Turbine Building

Source	Sound Power Level (dB) by Octave Band (Hz)									Total Sound Power Level	
	31.5	63	125	250	500	1000	2000	4000	8000	dB	dBA
Steam turbine (12 MW)	114	118	119	116	115	115	113	112	108	125	121
Boiler feed pump (200 kW)*	83	84	85	87	87	90	87	83	77	95	94
* It was assumed that each steam turbine required 2 feed water pumps											

Table 5.5 Sound Power Levels used for the Acoustic Model of Project Noise Sources – Building Sound Attenuation

Source	Sound Power Level (dB) by Octave Band (Hz)								
	31.5	63	125	250	500	1000	2000	4000	8000
Haber-Bosch buildings attenuation	21.0	23.5	26.1	27.4	27.4	26.9	26.3	27.0	27.9
ASU buildings attenuation	21.1	23.7	26.3	27.5	27.5	27.1	26.4	27.1	28.0
Silencer for inlet (for the 30 MW compressors)	-	6	9	18	33	19	13	10	9

5.1 ACOUSTIC MODELLING SCENARIO

The facility is expected to operate continuously, 24 hours a day, 7 days a week, except during planned maintenance periods and unplanned outages. It was assumed that all noise-generating equipment was operating simultaneously at full capacity. Ground absorption is a modelling parameter that can simulate the effects of land cover on sound propagation. Ground absorption can range from 1, providing more attenuation for areas of soil, vegetation, or other similar surfaces that provide more sound absorption, to 0, providing less attenuation for harder surfaces such as water or paved areas that absorb less sound. The acoustic model included consideration of changes in ground absorption. Ground absorption was assumed to be 0 over water and other hard surface areas, and was assumed to be 1 for undeveloped areas with vegetation cover.

6.0 ACOUSTIC MODELLING RESULTS

The predicted project-related daytime and nighttime sound levels are shown in Table 6.1. The predicted daytime (L_d), nighttime (L_n) and day-night average sound levels (L_{dn}) at the receptors do not exceed the Municipality of the County of Richmond Noise Control By-Law, the Nova Scotia noise assessment criteria (65 dBA during the day, 60 dBA in the evening, and 55 dBA at night), or the Health Canada sleep disturbance criteria (L_n of 45 dBA).

The predicted change in the percent highly annoyed in the community is shown in Table 6.2. The predicted change in percent highly annoyed was less than 0.32 % at all receptors, which is lower than the Health Canada criterion of 6.5 %HA (Table 6.2).

Figure 6-1 shows the sound pressure level isopleths (contour lines) predicted for the operation of the facility.

Table 6.1 Modelling Results – Sound Levels at Nearby Receptors

Receptor Location	Day (L_d) (dBA)	Night (L_n) (dBA)	L_{dn} (dBA)
1	40.2	40.2	46.6
2	38.7	38.7	45.1
3	38.6	38.6	45.0
4	38.6	38.6	45.0
5	37.9	37.9	44.3
6	38.0	38.0	44.4
7	36.1	36.1	42.5
8	35.9	35.9	42.3
9	34.3	34.3	40.7
10	37.7	37.7	44.1
11	37.9	37.9	44.3
12	37.3	37.3	43.7
13	38.8	38.8	45.2
14	32.0	32.0	38.4
15	31.2	31.2	37.6
16	30.1	30.1	36.5
17	29.7	29.7	36.1
18	34.6	34.6	41.0
19	32.2	32.2	38.6
20	35.2	35.2	41.6

Table 6.2 Modelling Results – Sound Levels and % Highly Annoyed at Nearby Receptors

Receptor ID	Baseline		Project Predicted L_{dn} (dBA)	Total (Baseline plus Project)		Change in %HA (Between Total and Baseline)
	L_{dn} (dBA)	%HA		L_{dn} (dBA)*	%HA	
1	55	4.15	46.6	56	4.47	0.32
2	55	4.15	45.1	55	4.38	0.23
3	55	4.15	45.0	55	4.37	0.22
4	55	4.15	45.0	55	4.37	0.22
5	55	4.15	44.3	55	4.34	0.19
6	55	4.15	44.4	55	4.34	0.19
7	54	3.65	42.5	54	3.80	0.14
8	54	3.65	42.3	54	3.79	0.13
9	54	3.65	40.7	54	3.75	0.09
10	55	4.15	44.1	55	4.33	0.18
11	55	4.15	44.3	55	4.34	0.19
12	55	4.15	43.7	55	4.31	0.17
13	55	4.15	45.2	55	4.38	0.23
14	55	4.15	38.4	55	4.20	0.05
15	55	4.15	37.6	55	4.19	0.04
16	55	4.15	36.5	55	4.18	0.03
17	55	4.15	36.1	55	4.18	0.03
18	54	3.65	41.0	54	3.75	0.10
19	54	3.65	38.6	54	3.71	0.06
20	45	1.14	41.6	47	1.41	0.27

Notes:
*The total L_{dn} represents the expected noise level at the receptors during the operation period; it is the modelled L_{dn} result at the receptor plus the baseline L_{dn} at the nearest receptor from Table 4.1.

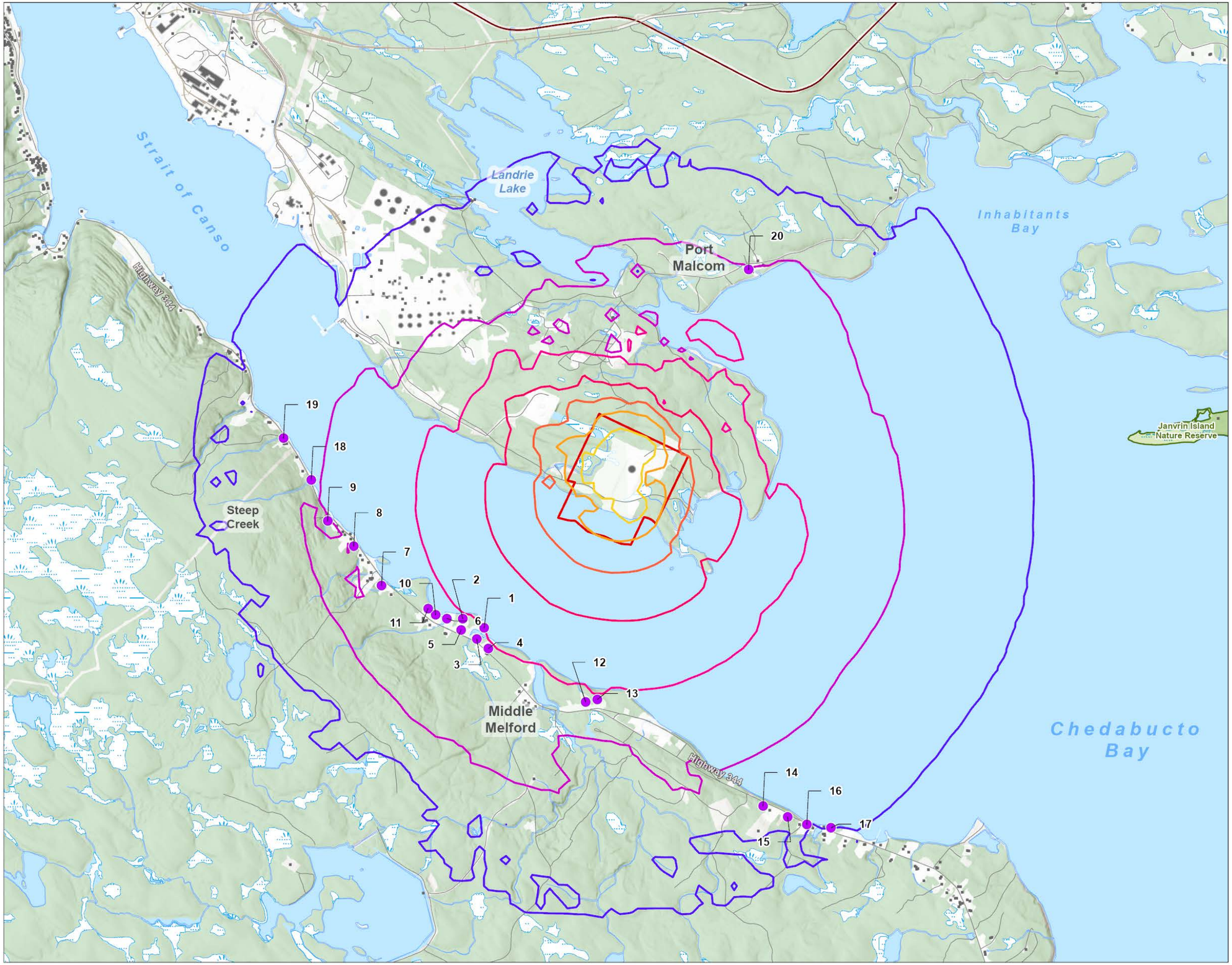


Figure No.
6-1

Title
Predicted Operation Sound Levels

Client/Project
121431287_048

Bear Head Energy
Regulatory Permitting Support

Project Location
Port Richmond
Richmond County, NS

Prepared by NW on 2022-11-30

N

0 0.5 1 Kilometres
(At original document size of 11x17)
1:45,000

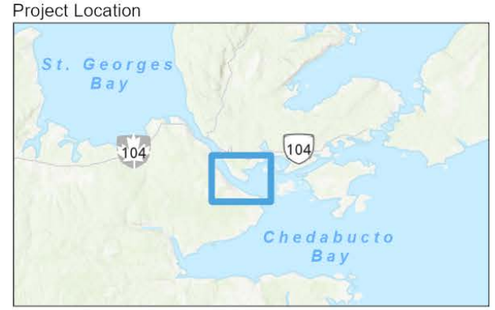
Legend

- Receptors within 5 km of Bear Head Facilty

Predicted Operation Sound Level
DB
- 30
- 35
- 40
- 45
- 50
- 55
- 60

- Project Area
- Highway
- Local Road
- Railway
- Buildings
- Wetlands
- Waterways (1:10k)
- Waterbody (1:10k)
- Nature Reserve

Project Location



Notes
1. Coordinate System: NAD 1983 CSRS UTM Zone 20N
2. Data Sources: Stantec, NS DNR, NS DOE, NSTB, NSODB, Service NS (Government of Nova Scotia)
3. Background: NSODB, Service NS (Government of Nova Scotia)

Stantec

7.0 NOISE MITIGATION OPTIONS

The Project is predicted to comply with the noise guidelines published by the province of Nova Scotia (Table 3.1), and Health Canada's change in %HA threshold of 6.5%. However, reductions to sound pressure levels could be achieved if desired, and the following mitigation measures specific to the acoustic environment have been identified for the Project:

- Use of appropriate noise muffling equipment
- Equipment maintenance
- Adherence to the Municipality of Richmond County Noise By-Law (By-Law # 65) and provincial Guidelines for Environmental Noise Measurement and Assessment Criteria

8.0 CONCLUSIONS AND RECOMMENDATIONS

Stantec was retained by BHE to conduct an acoustic assessment of the proposed Green Hydrogen and Ammonia Production, Storage and Loading Facility (the Project). Stantec's assessment predicted that noise emissions during the operation of the proposed facility would not likely exceed the applicable regulatory requirements.

9.0 CLOSURE

This report has been prepared for the sole benefit of Bear Head Energy and their representatives. The report may not be used or relied upon by any other person or entity without the express written consent of Stantec and Bear Head Energy.

Any use which a third party makes of this report, or any reliance on decisions made based on it, is the responsibilities of such third parties. Stantec accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

10.0 REFERENCES

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