Technical Report

Onshore Acoustic Assessment

Revolution Wind Offshore Wind Farm

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Executive Summary

VHB has conducted an airborne sound assessment of the construction and operation of onshore components of the Revolution Wind Farm (RWF) and Revolution Wind Export Cable (RWEC) Project. The report presents background on airborne sound concepts, applicable federal, state, and local noise laws, ordinances, and guidelines, methodologies used to evaluate construction and operational sound, ambient sound monitoring results, an assessment of how the project will comply with relevant noise standards, and an evaluation of the need for practicable operational and/or construction best management practices (BMPs) to minimize potential noise effects.

The U.S. Environmental Protection Agency (EPA) has noise guidelines (*"Information on the Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety"*) which recommend limiting operational noise to a day-night average sound level of 55 dBA (Ldn) which is equivalent to a constant equivalent sound level of 48.6 dBA (Leq). The State of Rhode Island general laws (Chapter 11-45) does not include quantitative noise limits and defers to municipalities to establish and enforce noise limits. The Town of North Kingston, Rhode Island noise ordinance (Town Code Article VI) limits continuous noise to 50 dBA between 10:00 PM and 7:00 AM and to 60 dBA between 8:00 AM and 10:00 PM at residential property lines. The noise ordinance limits continuous noise to 75 dBA any time of day at commercial/industrial property lines. The town ordinance prohibits construction activities between 6:00 PM and 7:00 AM, but has no quantitative noise limits for construction activities.

Noise sensitive receptors (NSRs) near the potential landfall sites, transmission cable routes, and proposed onshore substation (OnSS) and interconnection facility (ICF) include single-family residences on the south side of Camp Avenue, multi-family residences on Millcreek Drive, industrial properties on Circuit Drive and Whitecap Drive, and Blue Beach including a walkway from Circuit Drive. Long-term (approximately 72 hours) ambient sound measurements were conducted at three locations near the proposed OnSS and Landfall Work Area envelope. Insect sound was filtered out of the ambient sound measurements to provide results more representative of quieter nighttime conditions during the year when insects are not present. The ambient sound measurements results ranged from 44 to 45 dBA (Leq) at night (10:00 PM to 7:00 AM) and 49 to 50 dBA during the day (7:00 AM to 10:00 PM).

The proposed OnSS would introduce new sources of sound including transformers, shunt reactors, harmonic filters, cooling and ventilation associated with the outdoor substation equipment, as well as condensers, pumps, skids and auxiliary transformers associated with the synchronous condenser building. Based on the model results, sound from the substation would be below the Town of North Kingston, Rhode Island nighttime noise ordinance limit for residential properties (50 dBA). Operational sound from the OnSS would also be below 50 dBA at the nearest residential property lines and below 70 dBA at the nearest commercial/industrial property lines which is below the noise ordinance noise limits. Therefore, the operation of the proposed OnSS would comply with relevant federal, state, and local noise limits and there is no need for measures to avoid, minimize or mitigate operational noise.

Airborne sound will be generated onshore during construction by vessels and aircraft traffic. Construction vehicles and equipment will also generate noise at ports used for construction staging. Decommissioning may result in similar noise generation if it involves the removal of Project components with comparable equipment and methods as construction.

Construction sound has been evaluated assuming operations on the western end of the Landfall Work Area envelope as this is closest to noise-sensitive receptors on Middle Street and Sauga Avenue. The building at 61 Whitecap Drive to the west of the site would provide sound acoustic shielding to the residences farther west. Construction sound associated with the HDD site preparations, including sheet pile driving for an anchor wall which will take approximately three days.

HDD operations would be below existing ambient daytime and nighttime sound conditions and are not expected to cause significant adverse noise impacts. Therefore, the construction of the proposed Project would comply with relevant state and local noise limits for all daytime construction activities, including HDD operations, and would not be expected to result in significant adverse noise impact at any time.

The results of the acoustic model are presented in Section 5 of this report.

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Acronyms and Abbreviations

BMP	Best Management Practice
BOEM	Bureau of Ocean Energy Management
COP	Construction and Operations Plan
dBA	A-weighted decibel
dB	Un-weighted decibel
EPA	U.S. Environmental Protection Agency
GIS	Geographic information system
HDD	Horizontal directional drilling
Hz	Hertz
ISO	Organization for International Standardization
kHz	kilohertz
km	kilometer
Ldn	Day-night average sound level
Leq	Equivalent sound level
Lmax	Maximum sound level
Lmin	Minimum sound level
Ln	Statistical sound level
Mi	Mile
NEMA	National Electrical Manufacturers Association
nm	Nautical mile
NSR	Noise sensitive receptor
OSS	Offshore substation
OnSS	Onshore substation and interconnection facility
PDE	Project Design Envelope
RIDEM	Rhode Island Department of Environmental Management
RWF	Revolution Wind Farm
RWEC	Revolution Wind Farm Export Cable
WTG	Wind turbine generator

1 Introduction

This Onshore Airborne Sound Assessment Technical Report ("report") includes an overview of the Revolution Wind Farm Project (RWF) (the "Project" or the "proposed Project") and the onshore components that are the subject of the sound study including the Revolution Wind Export Cable (RWEC) to connect the transmission cable to the onshore substation (OnSS) and interconnection facility (ICF) located in Davisville, Rhode Island (a village in the town of North Kingston). The report includes background information on airborne sound level concepts, applicable federal, state, and local regulations, and ordinances and standards related to noise, methodologies for analyzing operational and construction airborne sound, characterizing existing ambient sound conditions in the study area, the results of ambient sound monitoring, an assessment of the potential effects of operational and construction sound due to the Project, and an evaluation of the need for practicable operational and/or construction-period best management practices (BMPs) to minimize potential airborne noise effects.

1.1 Project Description

Revolution Wind, LLC (Revolution Wind) proposes to construct and operate the Revolution Wind Farm Project (Project). The Project consists of the offshore RWF, located in federal waters on the Outer Continental Shelf, in BOEM Renewable Energy Lease Area OCS-A 0486 (Lease Area), and the RWEC, traversing federal and state waters with a landfall in Rhode Island. The Lease Area is approximately 20 miles (mi) (30 kilometers [km]) southeast of Block Island, Rhode Island.

In accordance with the BOEM Draft Guidance (BOEM, 2018), the Construction and Operations Plan (COP) and the airborne acoustic assessment have been evaluated based on a Project Design Envelopes (PDE) representing a reasonable range of design parameters. The Project generally includes the following: Revolution Wind Farm (RWF), inclusive of up to 100 wind turbine generators (WTGs), up to two offshore substations (OSSs), Inter-Array Cables, and OSS Interconnector Cable; up to two submarine export cables (referred to as the Revolution Wind Export Cable [RWEC]), inclusive of up to 25 mi (40 km) in federal waters and up to 23 mi (37 km) Rhode Island State Waters; and onshore facilities, inclusive of an up to 500-ft (152-m) segment of the RWEC, onshore transmission cable, and an OnSS and ICF. Refer to Section 3 of the Project's COP for a complete description of the PDE. This report evaluates airborne sound expected from construction and operation of onshore facilities including the RWEC Landfall Work Area envelope, onshore transmission cable, OnSS, and ICF.

This airborne sound assessment assumes the maximum design envelope footprint for the Project. For example, the sound evaluation of the OnSS uses sound emissions for transformers based on National Electrical Manufacturers Association (NEMA) ratings. The NEMA rating is generally considered to be an upper bound of the sound generated by a transformer. Manufacturers will often provide guaranteed sound levels lower than the NEMA rating and the actual measured sound level of equipment is typically below the guaranteed level. Construction sound has been evaluated assuming operations on the western end of the Landfall Work Area envelope as this is closest to noise-sensitive receptors on Middle Street and Sauga Avenue.

1.2 Airborne Sound Concepts and Terminology

Sound is the rapid fluctuation of pressure above and below the ambient conditions and can occur in any medium such as air or water. When sound becomes unwanted, it is defined as noise. Sound becomes an adverse impact when it interferes with the normal habits or activities of fish, wildlife or people. Sound is described based on its loudness or intensity (sound level), the frequencies of sound, and the variation of sound over time. Sound levels are most often measured on a logarithmic scale of decibels (dB) relative to 20 micro-Pascals in air and relative to 1 micro-Pascal in water. Since airborne and underwater sound levels are based on different reference levels, they should not be directly compared. For some activities, such as pile driving for foundations, both airborne and underwater sound will be generated.

Airborne sound can have a range of effects on humans including pain and hearing loss, at high amplitudes, speech interference, sleep interference, annoyance, and physiological effects such as anxiety or tinnitus and at high amplitudes could result in pain or hearing loss. Potential effects from underwater sound on fish and mammals include altering their behavior, disrupting their functions or physiology, causing injury or resulting in mortality. Behavioral effects from sound may include causing fish to be startled, moving away from typical habitats, reducing the ability to locate prey, or inability to communicate. Physiological effects may include stress, temporary hearing loss, or cellular changes to organs such as a fish's swim bladder, eyes or brain. The severity of these effects depends on the intensity and characteristics of underwater sound and the size and type of fish present.

Airborne sound is the rapid fluctuations of air pressure above and below ambient pressure levels. Noise is defined as unwanted or excessive sound. Sound becomes unwanted when it interferes with normal activities such as sleep, work, communication, or recreation. How people perceive sound depends on several measurable physical characteristics, including:

- **Sound Level** – Sound level is based on the amplitude change in pressure and is related to the loudness or intensity. Human hearing covers a wide range of changes in sound pressure amplitude. Therefore, sound levels are most often measured on a logarithmic scale of decibels (dB) relative to 20 micro-pascals. The dB scale compresses the audible range of acoustic pressure levels, which can vary from the threshold of hearing (0 dB) to the threshold of pain (120 dB). Because sound levels are measured in dB, the addition of two sound levels is not linear. For example, adding two equal sound levels results in a 3-dB increase in the overall level. Research indicates the general relationships between sound level and human perception are as follows:
  - A 3-dB increase is a doubling of acoustic energy and is approximately the smallest difference in sound level that can be perceived in most environments.
  - A 10-dB increase is a tenfold increase in acoustic energy and is generally perceived as a doubling in loudness to the average person.
- **Frequency** – Sounds are comprised of acoustic energy distributed over a range of frequencies. Acoustic frequencies, commonly referred to as tone or pitch, are typically measured in Hertz (Hz). Human hearing generally ranges from 20 to 20,000 Hz; however, the human ear does not perceive sound levels from each frequency as equally loud. To compensate for this phenomenon in perception, a frequency filter known as A-weighting is commonly used to evaluate environmental noise levels, and sound levels are denoted as "dBA." Sound is often presented in frequency bands such as octave or one-third octave bands.
- Sound levels reported in octave or one-third-octave frequency bands are often used to describe the frequency content of different sounds. Some sources of sound can generate "pure tones," which is when there is a concentration of sound within a narrow frequency range such as a whistle. Humans can hear pure tones very well, and such conditions can be a cause of increased annoyance.

A variety of sound level descriptors can be used for environmental noise analyses. These descriptors relate to the way sound varies in level over time. The following is a list of common sound level descriptors:

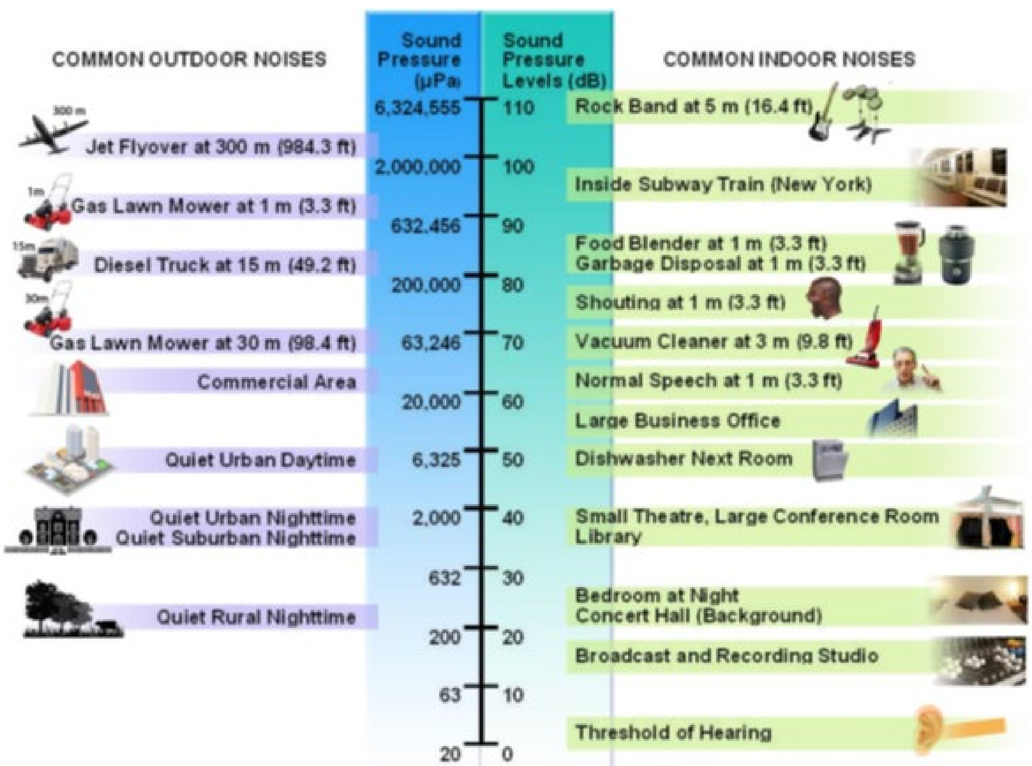
Energy-Average Sound Level (Leq) – Leq is a single value, which represents the same acoustic energy as the fluctuating levels, that exist over a given period of time. The Leq takes into account how loud noise events are during the period, how long they last, and how many times they occur. Leq is commonly used to describe environmental noise and relates well to human annoyance. An Leq over an 8-hour period is commonly used to evaluate construction noise and is denoted Leq[8hr].

Day-night Average Sound Level (Ldn) – Ldn is similar to the Leq in that it is a single value, which represents the same acoustic energy as the fluctuating levels, that exists over a 24-hour period. The Ldn takes into account how loud sound events are, how long they last, how many times they occur over a 24-hour period, and whether they occur during the day (7:00 AM to 10:00 PM) or night (10:00 PM to 7:00 AM). Sound that occurs during the night is given a 10-dB penalty to account for the increased human sensitivity to noise at night. If sound levels are constant over a 24-hour period, the Ldn level is 6.4 dB greater than the Leq level due to the 10-dB nighttime penalty.

Statistical Sound Levels – Sound level metrics, such as L01, L10, L50 or L90, represent the levels that are exceeded for a particular percentage of time over a given period. For example, L10 is the level that is exceeded for 10 percent of the time. Therefore, it represents the higher end of the range of sound levels. The L90, on the other hand, is the level that is exceeded 90 percent of the time, and therefore, is representative of the background sound level.

Maximum Sound Level (Lmax) – Many sources of sound, including mobile sources and stationary sources, change over time. Stationary sources associated with energy facilities can often generate different sound levels depending on the operational condition of the equipment. It is common to describe sound in terms of the maximum (Lmax) sound level emissions. **Figure 1.2-1** (FHWA, 2018) presents a list of the maximum sound levels of common outdoor and indoor sources.

Figure 1.2-1 Maximum Airborne Sound Levels of Common Sources



Source: FHWA, 2019

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Regulatory Context

This section describes the federal, state, and local noise laws, regulations, ordinances, and guidelines applicable to the proposed Project. **Table 2.0-1** summarizes the jurisdiction, agency, standard, and residential operational and construction noise limits.

Table 2.0-1 Summary of Noise Limits

Jurisdiction	Agency	Standard	Operational Noise Limit (dBA)	Construction Noise Limit (dBA)
Federal	EPA	*Information on the Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety*	55 dBA (Ldn) 48.6 dBA (Continuous Leq)	None
State of Rhode Island	General Laws	Chapter 11-45.1 Unreasonable Noise Levels	N/A	None
Town of North Kingston, RI		Town Code Article VI: Noise	Residential: 60 dBA 8 AM – 10 PM 50 dBA 10 PM – 7 AM	No construction between 6 PM – 7 AM

Sources: North Kingston, Rhode Island Town Code Chapter 8, Article VI, Noise, April 9, 2019.

2.1.1 Federal

The Noise Control Act of 1972 authorized federal agencies to adequately control noise that may endanger the health and welfare of the nation's population. In 1974, the EPA conducted a study on noise impacts relative to public health and safety (EPA, 1974). This EPA study provides guidance on the potential effects of noise that can be considered by federal, state, and local agencies; however, it does not constitute a standard or regulation.

As shown in **Table 2.1-1**, the EPA study concluded that a day-night average sound level of 55 dBA (Ldn) or less for outdoor residential areas, or 55 dBA (Leq[24]) or less for outdoor areas where people spend limited amounts of time, such as schools and playgrounds, would protect public health and welfare in regard to potential interference with outdoor activity and annoyance. The study also concluded that a sound level of 45 dBA (Ldn) or (Leq[24]) or less for indoor residential uses and schools, respectively, would protect public health and welfare in regard to potential interference and annoyance. Since most buildings with windows closed provide 20 dB or more, and buildings with windows open provide 10 dB of outdoor-to-indoor sound attenuation, the exterior criteria are more stringent, and noise from the proposed Project will be evaluated according to the outdoor criteria.

The EPA noise guidelines are based on the evaluation of pervasive long-term noise, and therefore, are applied to future operational noise conditions and are not typically applied to short-term construction-period activities.

Table 2.1-1 EPA Noise Levels Identified to Protect Public Health and Welfare

Effect	Level	Area
Outdoor Activity Interference	LDN [55 dBA]	Outdoors in residential areas and farms, other outdoor areas where people spend widely varying amounts of time, and other places in which quiet is a basis for use
	LEQ(24) [55 dBA]	Outdoor areas where people spend limited amounts of time, such as school yards, playgrounds, parks, etc.
Indoor Activity Interference and Annoyance	LDN [45 dBA]	Indoor residential areas
	LEQ(24) [45 dBA]	Other areas with human activities, such as schools

Source: EPA, 1974.

2.1.2 State

The following summarizes the relevant federal, state, and local laws, regulations, policies, and guidance applicable to the Project.

2.1.2.1 Rhode Island

The State of Rhode Island general laws include a noise policy (Chapter 11-45.1 Unreasonable Noise Levels) which prohibits unreasonable, excessive and annoying noise levels from all sources subject to its police power. The Rhode Island Department of Environmental Management (RIDEM) does not have environmental noise regulations applicable to the Project. Therefore, there are no state-wide quantitative noise criteria for operations or construction of the Project. The State of Rhode Island relies on individual communities to establish noise regulations through community by-laws.

2.1.2.2 Local

The Town of North Kingston, Rhode Island noise ordinance (Chapter 8, Article VI) establishes standards for the control of noise pollution by setting maximum permissible sound levels at or within the real property boundary of a receiving land use, to protect the public health, safety and welfare. These sound level limits, shown in **Table 2.1-2** are applicable to construction and operation of the OnSS. The sound level limits do not apply to construction activities which are controlled by limiting the operation of construction, drilling or demolition work between the hours of 6:00 PM and 7:00 AM in any manner that creates a noise disturbance.

Table 2.1-2 Town of Kingston, Rhode Island Noise Ordinance

Municipality	Location of Receiving Land Use	Time	Sound Level Limit, dBA
Town of Kingston, RI	Residential, and open space	8 AM - 10 PM	60
		10 PM - 7 AM	50
	Business (neighborhood, waterfront and general)	At all times	65
	Business (heavy, planned and industrial)	At all times	70
	Noise sensitive area	At all times	60

Sources: North Kingston, Rhode Island Town Code Chapter 8, Article VI, Noise, April 9, 2019. Accessed https://library.municode.com/ri/north_kingstown/codes/code_of_ordinances?nodeId=PTIIIREOR_CH8HESA_ARTVINO.

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Airborne Sound Analysis Methodology

The methodology used to assess potential effects of onshore airborne sound from the construction and operation of the Onshore Facilities includes 1) identifying noise-sensitive receptors in the study area, 2) characterizing the existing ambient sound environment with measurements, 3) modeling future sound emissions from the construction and operation of the proposed Project, 4) assessing potential impact according to applicable criteria (see Section 2, Regulatory Context) and 5) evaluating the need for construction or operational airborne noise mitigation.

Noise sensitive receptors (NSRs) have been identified near the potential Landfall Work Area envelope, transmission cable routes, and proposed OnSS by reviewing the North Kingston land use data base and making field observations.

Ambient sound measurements were conducted at three locations within the study area. Measurements were conducted using sound level meters certified to have Type I accuracy according to the ANSI S1.4 "Specifications for Sound Level Meters." Larson Davis model 831 and model LxT sound level meters were utilized. The sound level meters were calibrated in the field prior to and after the measurements and by a laboratory traceable to the National Institute of Standards and Technology within one year of the field measurements. The measurements included overall A-weighted sound levels and one-third-octave band sound levels, which provide information on the frequency content (i.e. low or high-pitched) character of sound. Data collection included one-second time histories of all sound level metrics and hourly interval summaries of the minimum, maximum, percentile values (L01, L10, L33, L50, L90, and L99), and the energy-average sound level (Leq). Atmospheric observations of wind speed, wind direction, air temperature, precipitation, barometric pressure and sky conditions were made in the field and from a nearby weather station (data accessible online).

During attended measurements, observations were made of the predominant sources of sound. For long-term unattended measurements, audio recordings and/or sound level time histories were reviewed to understand the character of different sources of sound. The noise data was evaluated to determine whether there was significant insect noise present. This was done based on knowledge of the potential presence of insects, by listening to audio recordings and by analyzing the frequency content to identify high-frequency tonal conditions, which are indicative of insect noise. The sound levels were evaluated for the presence of insect noise which can cause nighttime sound levels to be higher than they would be without insects. Since insect noise is a seasonal occurrence and is not always present, they have been filtered out of the sound measurement results to provide results which are representative of the periods throughout the year when insect noise is not as prevalent. By filtering insect noise, the ambient sound measurement results are more conservative in that they represent the ambient sound levels during quieter periods of the year where there is greater potential for increases in noise due to the Project. The process to filter out insect noise is to identify the frequencies of sound that the insects generate (typically between 2,000 and 10,000 Hz) and to remove the tones generated by the insects. Ambient sound measurement results are presented in Section 4, *Affected Environment*.

Operational and construction sound has been predicted using Cadna-A sound software. Cadna-A is an internationally-accepted sound prediction program that implements the International Standards Organization 9613-2 sound propagation standard. This model takes into account the sound emissions of equipment, the ground cover, terrain, and intervening objects such as buildings. Terrain near the OnSS has been obtained from the Rhode Island Geographic Information System (RIGIS) LiDAR database.

3.1 Operational

Operational sound generated by onshore components of the Onshore Facilities include the OnSS and ICF in Davisville, Rhode Island.

3.1.1 Onshore Substation Operations

The proposed OnSS would introduce new sources of sound including transformers, shunt reactors, harmonic filters, cooling and ventilation associated with the outdoor substation equipment, as well as condensers, pumps, skids and auxiliary transformers associated with the synchronous condenser building. The ICF has wave traps that generate sound. At this phase of the substation design, specific manufacturers and models of equipment have not been finalized. Reference sound levels for transformers have been given as the equivalent National Electrical Manufacturers Association (NEMA, 2014) rating for difference sized transformers and reactors which follow the Institute of Electrical and Electronics Engineers (IEEE) measurement standard. While the design of the OnSS continues to be refined as the Project approaches construction, based on the present design, the onshore substation is assumed to include the following sound-generating equipment as shown in **Table 3.1-2**. The loudest pieces of equipment are the closed-circuit cooling systems with a sound level of 96 dBA at approximately 1 foot. The synchronous condenser building is conservatively assumed to provide 20 dBA of indoor-to-outdoor noise reduction for the equipment inside.

Table 3.1-2 Onshore Substation and ICF: Equipment Sound Levels

Source	Sound Level (dBA)	Reference
Inside Synchronous Condenser Building		
Synchronous Condenser (x2)	95	Sound Pressure Level at 3 feet
Lube Oil Skid (x2)	106	Sound Power Level (Sound Pressure at approximately 1 foot)
Water Skid (x2)	111	Sound Power Level (Sound Pressure at approximately 1 foot)
Vacuum Pump (x2)	104	Sound Power Level (Sound Pressure at approximately 1 foot)
Auxiliary Transformer (x2)	98	Sound Power Level (Sound Pressure at approximately 1 foot)
Outdoor Equipment		
GSU Transformer (x2)	76	NEMA Rated Sound Pressure Level (at 1 to 6 feet)
Main Transformer (x2)	76	NEMA Rated Sound Pressure Level (at 1 to 6 feet)
Shunt Reactor (x4)	77	Sound Pressure Level at 3 feet
Harmonic Filter Reactor (x12)	83	Sound Power Level (Sound Pressure at approximately 1 foot)
Harmonic Filter Capacitor (x12)	79	Sound Power Level (Sound Pressure at approximately 1 foot)
Building Fans and Louvers	75	Sound Pressure Level at 3 feet
Closed Circuit Cooling System (x2)	96	Sound Power Level (Sound Pressure at approximately 1 foot)
Cooling Water Pumps (x2)	85	Sound Pressure Level at 3 feet
ICF Wave Traps (x2)	82	Sound Power Level (Sound Pressure at approximately 1 foot)

Source: Burns & McDonnell.

3.2 Construction

Airborne sound will be generated onshore during construction of the RWEC landfall, transmission cable to the OnSS, and the OnSS and ICF. The overall installation schedule for onshore facilities including landfall, onshore transmission cables, and the OnSS and ICF is approximately 18 months (see COP Section 3.2, Project Schedule). Construction will typically result in temporary increases in sound. Sound has been evaluated based generally on a noisiest condition when the loudest construction equipment would be in operation.

Construction noise has been modeled using standard methods for energy and transmission line projects in a manner that is consistent with federal guidelines. The construction noise model accounts for the types of construction equipment, the number of each type of equipment, the amount of time they typically operate during a work period (usage factor), and the distance between receptor locations and the equipment. Cadna-A has been used to predict sound at nearby receptor locations for construction of the cofferdam, RWEC landfall, and the OnSS and ICF. The model includes specific locations of the equipment, heights of the construction noise sources, terrain, and location and height of intervening objects such as sound walls surrounding the HDD site. The model provides construction sound level contours from the sites. For the transmission cable along the streets, the Federal Highway Administration's (FHWA) Roadway Construction Noise Model (RCNM) has been used which provides construction noise levels as a function of distance from the linear construction activities.

For typical daytime construction activities, construction noise is evaluated according to the 8-hour energy-average Leq(8h). For construction activities that may occur continuously, such as horizontal directional drilling (HDD), construction noise is evaluated according to the 24-hour energy-average Leq(24h). Noise emissions of construction equipment are based on reference data from the FHWA's RCNM and other Project-specific equipment. RCNM includes a database of sound emissions for commonly used construction equipment such as dump trucks, backhoes, concrete saws, air compressors, and portable generators.

3.2.1 Landfall Construction

The installation method for the RWEC landfall will be determined based on an analysis of the ground conditions and other engineering or environmental constraints. Construction would be completed using the HDD methodology which involves drilling underneath the seabed using a rig that would be located in the Landfall Work Area envelope. Ducts for the transmission cable would be fit into the borehole and pulled back through the hole with winches. A key factor relating to noise is that it is typically necessary to continually pump fluids through the hole and to operate the HDD to prevent the hole from collapsing or the drill rig from ceasing. There would be a maximum of two HDD rigs and two cable ducts installed. The primary sound-generating construction equipment associated with HDD operations includes the drill rig, a generator, excavator, and mud pumps. Unlike most other construction activities that can be limited to daytime hours, it is typically necessary for HDD operations to occur continuously to minimize the risk of the soil settlement and equipment failures.

HDD construction at the landfall site would also include site preparation, including support of excavation (anchor wall), and excavation for the vault. The equipment included in the HDD site preparation activities includes an excavator, crane, and either an impact or vibratory sheet pile driver. The loudest phase of construction at the transition site will be HDD site preparation activities associated with sheet piling which is expected to last approximately two days to install and remove.

As described in the COP Section 3, a temporary cofferdam may be installed at a sea depth of approximately 13 feet (4 m) which is between approximately 1,700 feet (518 m) and 5,000 feet (1524 m) offshore from the mean high-water line. For the purposes of the noise assessment, the analysis conservatively assumed the closest potential cofferdam location of 1,700 feet. Results are presented for the Landfall Work Area envelope assuming that activities occur on the western end. Since the closest residential receptors are west of the envelope area, this is a conservative assessment of potential construction noise impact. The cofferdam will be installed using either sheet pile or gravity cell and would take approximately three days.

If the temporary cofferdam is constructed of steel sheet pile, vibratory hammer pile driving will be used for installation and removal. Vibratory hammering for the cofferdam differs from impact hammering for the foundations because it is non-impulsive (or continuous). Installation of the sheet pile cofferdam would take approximately 3 days. **Table 3.2-1** presents the typical equipment used during open-cut, HDD site preparation, and HDD operations.

Table 3.2-1 Landfall Construction Equipment Noise Emissions

Construction Activity	Equipment	Sound Level at 50 feet (dBA)	Utilization Factor
Landfall HDD Site Preparation (Anchor Wall)	Impact Pile Driver [A]	101	20%
	Excavator [A]	81	40%
	Small Crane [A]	76	10%
Landfall HDD Operations	HDD Rig [C]	70	100%
	Mud pump [D]	67	50%
	Small Crane [A]	76	10%
	Generator (75 kW) [B]	56	40%
	Backhoe [A]	78	40%
Landfall Cofferdam Construction	Vibratory Sheet Pile Driver [A]	95	20%

Sources:
A: Source: RCNM, 2011.
B: Source: WhisperWatt.Ultra Silent 75 kW Generator.
C: Source: Vermeer, Caterpillar.
D Source: eNoise Control Case Study (Sound Power Level, 98 dBA).

3.2.2 Onshore Transmission Cable Construction

Construction of the Onshore Transmission Cable involves different phases such as clearing the transmission cable route, excavation of the route, support of excavation with shoring, installing the duct, and then backfilling and final restorative activities. The types of construction equipment used during Onshore Transmission Cable installation generally include bulldozers, backhoes, front end loaders, aerial lifts, trenchers, compactors, concrete saws, graders, pumps, compressors, and trucks. It is anticipated that construction of the Onshore Transmission Cable will take approximately 12 months occurring within the overall 18-month period for installation of Onshore Facilities. Since the Onshore Transmission Cable installation process progresses along the cable route during this period, the exposure to construction noise is of a substantially shorter duration at any particular location along the route. The transmission cable route extends west along Circuit Drive and continues across 135 Circuit Drive to Assessor’s Plat 179 Lot 32, continues north on a private access drive across 101 and 75 Circuit Drive to 646 Camp Avenue where the route turns west across that property, and crosses Assessor’s Plat 179 Lot 5, before finally entering the Onshore

Substation site. **Table 3.2-2** presents the reference sound emissions of the equipment used during each phase of the onshore transmission cable construction.

Table 3.2-2 Onshore Transmission Cable Construction Equipment Noise Emissions

Construction Activity	Equipment	Sound Level at 50 feet (dBA)	Utilization Factor
Cable Installation- Route Clearance	Generator [A]	82	50%
	Small Bulldozer [A]	85	40%
	Small Tractor [A]	84	40%
	Small Excavator [A]	85	40%
Cable Installation – Excavation	Backhoe [A]	85	40%
	Front End Loader [A]	85	40%
	Medium Excavator [A]	85	40%
	Concrete Saw [A]	90	20%
	Large Excavator [A]	85	40%
Cable Installation – Shoring/Trenching	Trencher [A]	82	50%
	Pump [A]	77	50%
	Compressor [A]	80	40%
Cable Installation – Duct Installation	Aerial Lift [A]	85	20%
	Cable Puller [A]	82	50%
	Generator [A]	82	50%
	Welder [A]	73	40%
Cable Installation - Backfilling	Small Bulldozer [A]	85	40%
	Bobcat [A]	80	40%
	Hydraulic Tamper [A]	85	20%
	Roller [A]	85	20%
	Compactor [A]	80	20%
	Grader [A]	85	40%
	Concrete Vibrator [A]	80	20%

Sources:
A: Source: RCNM, 2011.

3.2.3 Onshore Substation and ICF Construction

The OnSS and ICF will be designed to meet Rhode Island State Building Code/2015 International Building Code, American Society of Civil Engineers (ASCE) Standard 7-10, ASCE 113, ASCE 24-14, all applicable Institute of Electrical and Electronics Engineers (IEEE) standards, and local climate and geotechnical conditions. The sequence for construction the OnSS and ICF typically includes clearing the site of vegetation, grading the site, installing environmental erosion controls, installing the foundations and erecting buildings, such as the synchronous condenser building, for housing equipment, and restoring any disturbed areas on the site and removing environmental controls. **Table 3.2-3** presents the primary sound-generating construction equipment typically used during OnSS and ICF construction.

Table 3.2-3 Onshore Substation and ICF Construction Equipment Noise Emissions

Construction Activity	Equipment	Sound Level at 50 feet (dBA)	Utilization Factor
Onshore Substation and ICF	Backhoe	80	40%
	Cranes (2)	85	16%
	Refrigerator Unit	82	100%
	Front End Loader	80	40%
	Generator	82	50%

Sources:
A: Source: RCNM, 2011.

4

Affected Environment

This section presents the affected environment including the study area used to assess potential onshore airborne sound effects and the noise sensitive receptors (NSRs) within the study area.

4.1 Study Area

The study area for onshore airborne sound includes the Landfall Work Area envelope which is bordered by Circuit Drive to the north, Whitecap Drive to the west, Burlingham Avenue to the east, and the shoreline to the south. The transmission cable route extends west along Circuit Drive and continues across 135 Circuit Drive to Assessor's Plat 179 Lot 32, continues north on a private access drive across 101 and 75 Circuit Drive to 646 Camp Avenue where the route turns west across that property, and crosses Assessor's Plat 179 Lot 5, before finally entering the Onshore Substation site. The OnSS would be located on the following three contiguous parcels of land; 574 Camp Avenue, 594 Camp Avenue, and 109 Circuit Avenue.

NSRs have been identified near the Landfall Work Area envelope, transmission cable routes, and proposed OnSS by reviewing the North Kingston land use data base and field observations. NSRs include single-family residences on the south side of Camp Avenue, multi-family residences on Millcreek Drive, industrial properties on Circuit Drive and Whitecap Drive, and Blue Beach including a walkway from Circuit Drive.

4.2 Ambient Sound Measurement Results

Ambient sound measurements have been conducted at three sites near the OnSS and the Landfall Work Area envelope from August 27 to August 31, 2019, as shown in **Figure 4.2-1**. The ambient sound measurement data were evaluated and observations were made to determine that there was significant sound from insects present during the nighttime period. Sound from the insects caused nighttime sound levels to be higher than they would be without insects. Since insect noise is a seasonal occurrence and is not always present, they have been filtered out of the sound measurement results to provide results which are representative of the periods throughout the year when insect noise is not as prevalent. Sound levels with insect noise filtered out are denoted as "dBA-i". By filtering insect noise, the ambient sound measurement results are more conservative in that they represent the ambient sound levels during quieter periods of the year where there is greater potential for increases in noise due to the Project. The process to filter out insect noise is to identify the frequencies of sound that the insects generate (typically between 2,000 and 10,000 Hz) and to replace the sound energy in these frequencies with sound levels that do not include the insect generated tones.

Table 4.2-1 presents the results of the daytime and nighttime ambient sound level results at sites M1, M2, and M3. Photos of the measurement sites and ambient sound measurement results at each site including hourly maximum, minimum, energy-equivalent, and statistical sound levels are presented in the Appendix.

Table 4.2-1 Ambient Sound Measurement Results

Measurement Site	Location	Measurement Period	Overall (dBA-i)	Octave-Band Sound Pressure Level (Leq, dBA)								
				31.5	63	125	250	500	1000	2000	4000	8000
M1	Blue Beach	Night	43.9	16.2	27.5	32.8	34.1	37.6	38.1	37.2	30.7	29.1
		Day	49.1	20.2	32.0	36.3	38.4	41.8	42.1	42.2	41.5	38.1
M2	Project Site (Southern Portion)	Night	45.4	15.7	27.3	31.0	33.1	39.3	40.3	37.6	36.1	30.6
		Day	50.5	19.5	31.6	36.0	38.0	42.9	44.7	44.1	42.4	39.0
M3	Project Site (Western Portion)	Night	45.0	15.4	26.0	29.1	33.8	38.5	39.6	37.2	35.8	33.6
		Day	50.0	19.2	29.4	34.4	37.6	41.7	43.0	43.8	43.2	39.8

Source: VHB, 2019.
Day is between 7:00 AM and 10:00 PM
Night is between 10:00 PM and 7:00 AM

Figure 4.2-1 Ambient Sound Monitoring Locations

5

Environmental Consequences and Mitigation

This section presents the results of the airborne sound assessment which assesses the compliance of the proposed Project with relevant federal, state, and local noise laws, regulations, and ordinances. This section presents the results of the operational sound impact assessment, including an evaluation of sound generated by the OnSS and ICF, and the construction sound impact assessment, including an evaluation of sound generated during onshore activities such as the landfall construction, transmission cable installation, and OnSS and ICF construction.

5.1 Operational Sound Impact Assessment

This section presents the results of the sound predictions and the impact assessment for operation of the Project.

5.1.1 Onshore Substation and ICF

Table 5.1-1 presents the overall A-weighted sound emissions from the operations of the OnSS and ICF at nearby receptor locations. **Figure 5.1-1** presents the operational sound level contours. This figure shows the contours of equal sound levels between 35 and 55 dBA. The highest sound level at an NSR is 43.9 dBA at 129 Cattail Lane. This sound level is below the EPA guideline of 48.6 dBA (Leq), which is equivalent to a day-night average sound level of 55 dBA (Ldn), and therefore complies with the EPA guidance for exterior noise. Operational sound from the OnSS and ICF would also be below 50 dBA at the nearest residential property lines and below 70 dBA at the nearest commercial/industrial property lines which is below the Town of North Kingston, RI Noise Ordinance noise limits.

Future sound levels at 129 Cattail Lane, which include existing ambient sources and the proposed OnSS and ICF, would be 50.9 dBA during the daytime and 47.5 dBA during the night. The overall increase in sound would be 0.9 dBA during the day and 2.5 dBA during the night at this location. At NSRs south of the OnSS and ICF, sound would be 43.0 dBA (Leq) or quieter and future sound levels would increase by 2 dBA or less. An increase in sound level of 3 dBA or less is typically considered to be the threshold of perceptible change in sound. Therefore, the operation of the proposed OnSS and ICF would comply with relevant federal, state, and local noise limits.

Since most buildings with windows closed provide 20 dB or more, and buildings with windows open provide 10 dB of outdoor-to-indoor sound attenuation, interior noise conditions would be substantially quieter.

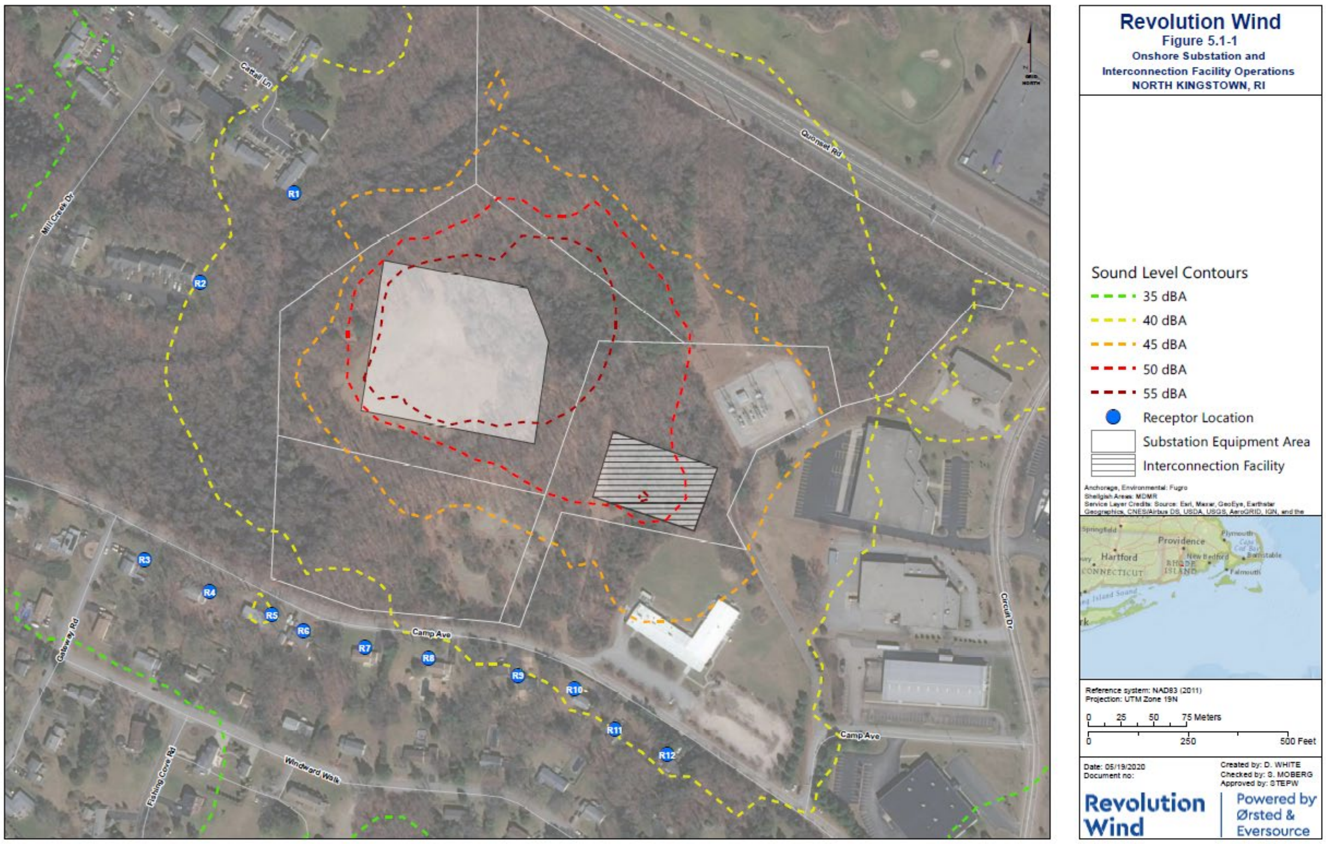
Table 5.1-1 Onshore Substation: Operational Noise

		Existing Sound Level (dBA-i, L_{eq})		Substation Sound Level	Future Sound Level (dBA, L_{eq})		Increase (dBA)	
Receptor	Address	Daytime	Nighttime	(dBA, L_{eq})	Daytime	Nighttime	Daytime	Nighttime
R1	129 Cattail Lane	50.0	45.0	43.9	50.9	47.5	0.9	2.5
R2	140 Brook View Drive	50.0	45.0	40.8	50.5	46.4	0.5	1.4
R3	10 Gateway Road	50.5	45.4	38.3	50.8	46.2	0.3	0.8
R4	511 Camp Avenue	50.5	45.4	38.8	50.8	46.3	0.3	0.9
R5	525 Camp Avenue	50.5	45.4	40.7	50.9	46.7	0.4	1.3
R6	541 Camp Avenue	50.5	45.4	39.3	50.8	46.4	0.3	1.0
R7	553 Camp Avenue	50.5	45.4	39.3	50.8	46.3	0.3	0.9
R8	571 Camp Avenue	50.5	45.4	39.9	50.9	46.5	0.4	1.1
R9	595 Camp Avenue	50.5	45.4	39.9	50.9	46.5	0.4	1.1
R10	613 Camp Avenue	50.5	45.4	41.0	51.0	46.7	0.5	1.3
R11	629 Camp Avenue	50.5	45.4	40.2	50.9	46.5	0.4	1.1
R12	643 Camp Avenue	50.5	45.4	43.0	51.2	47.4	0.7	2.0

Source: VHB, 2019.

As noted in Section 3.1.1, the Project continues to refine the design of the OnSS and will revisit the noise model as needed during the design process to confirm that operational sound levels generated by the OnSS continue to meet applicable noise standards.

Figure 5.1-1 Onshore Substation and ICF Operational Sound Contours



5.2 Construction Sound Impact Assessment

This section presents the airborne onshore sound level results from construction of the cofferdam, RWEC landfall, transmission cable to the OnSS, the OnSS, and the ICF.

5.2.1 Landfall Construction

Construction activities at the landfall site will include building a cofferdam offshore along the RWEC. For the purposes of the noise assessment, the cofferdam installation site was conservatively assumed to be approximately 1,700 feet (518 m) offshore. Construction activities will include site preparation for HDD activities, such as pile driving a sheet pile anchor wall, and HDD operations.

As shown in **Table 5.2-1** and **Figure 5.2-1**, onshore airborne construction sound levels from cofferdam construction would be up to 51 dBA (Leq(8h)) at the nearest beach locations. At the nearest residential receptors on Middle Street and Sauga Avenue, construction sound levels would range from 47 to 50 dBA (Leq(8h)). Cofferdam construction would occur during daytime hour and would be within all applicable state and local noise standards.

As shown in **Table 5.2-2** and **Figure 5.2-2**, onshore airborne construction sound levels from HDD site preparation activities would be up to 70 dBA (Leq(8h)) at the closest beach locations. At residential receptors on Middle Street and Sauga Avenue, construction sound levels would be 36 to 43 dBA (Leq(8h)). HDD site preparation would occur during daytime hour and would be within all applicable state and local noise standards.

As shown in **Table 5.2-3** and **Figure 5.2-3**, onshore airborne construction sound levels from HDD operations would be up to 54 dBA (Leq(8h)) at the beach. At the nearest residential receptors, HDD operations, which may occur during the daytime and nighttime, would generate sound from 14 to 33 dBA (Leq(8h)). HDD operations during the daytime would be within all applicable state and local noise standards.

As described in Section 4.2, ambient sound measurements at M3 near Blue Beach were 50 dBA (Leq) during the day and 45 dBA (Leq) during the night. Therefore, HDD operations would generate sound below ambient conditions during the day and night at the closest residences on Middle Street.

Table 5.2-1 Landfall: Cofferdam Construction Noise

Receptor	Address	Cofferdam Construction Sound Level (dBA, $L_{eq(8r)}$)
R13	133 Middle St	46.9
R14	125 Middle St	46.9
R15	119 Middle St	47.0
R16	111 Middle St	47.2
R17	91 Middle St	47.5
R18	41 Middle St	47.7
R19	216 Sauga Ave	46.0
R20	221 Sauga Ave	49.6
R21	159 Sauga Ave	48.7
R22	89 Sauga Ave	46.7
--	Blue Beach	51.2

Source: VHB, 2021.

Table 5.2-2 Landfall: HDD Site Preparation Noise

Receptor	Address	HDD Site Preparation Construction Sound Level (dBA, $L_{eq(8hr)}$)
R13	133 Middle St	43.2
R14	125 Middle St	42.2
R15	119 Middle St	41.4
R16	111 Middle St	40.7
R17	91 Middle St	39.2
R18	41 Middle St	38.0
R19	216 Sauga Ave	38.3
R20	221 Sauga Ave	38.9
R21	159 Sauga Ave	37.3
R22	89 Sauga Ave	35.8
--	Blue Beach	69.5

Source: VHB, 2021.

Table 5.2-3 Landfall: HDD Operations Noise

Receptor	Address	HDD Operations Construction Sound Level (dBA, $L_{eq(8hr)}$)
R13	133 Middle St	33.2
R14	125 Middle St	26.4
R15	119 Middle St	22.1
R16	111 Middle St	20.8
R17	91 Middle St	18.9
R18	41 Middle St	17.3
R19	216 Sauga Ave	17.7
R20	221 Sauga Ave	18.3
R21	159 Sauga Ave	16.0
R22	89 Sauga Ave	14.3
--	Blue Beach	53.5

Source: VHB, 2021

Figure 5.2-1 Landfall: Cofferdam Construction Sound Contours

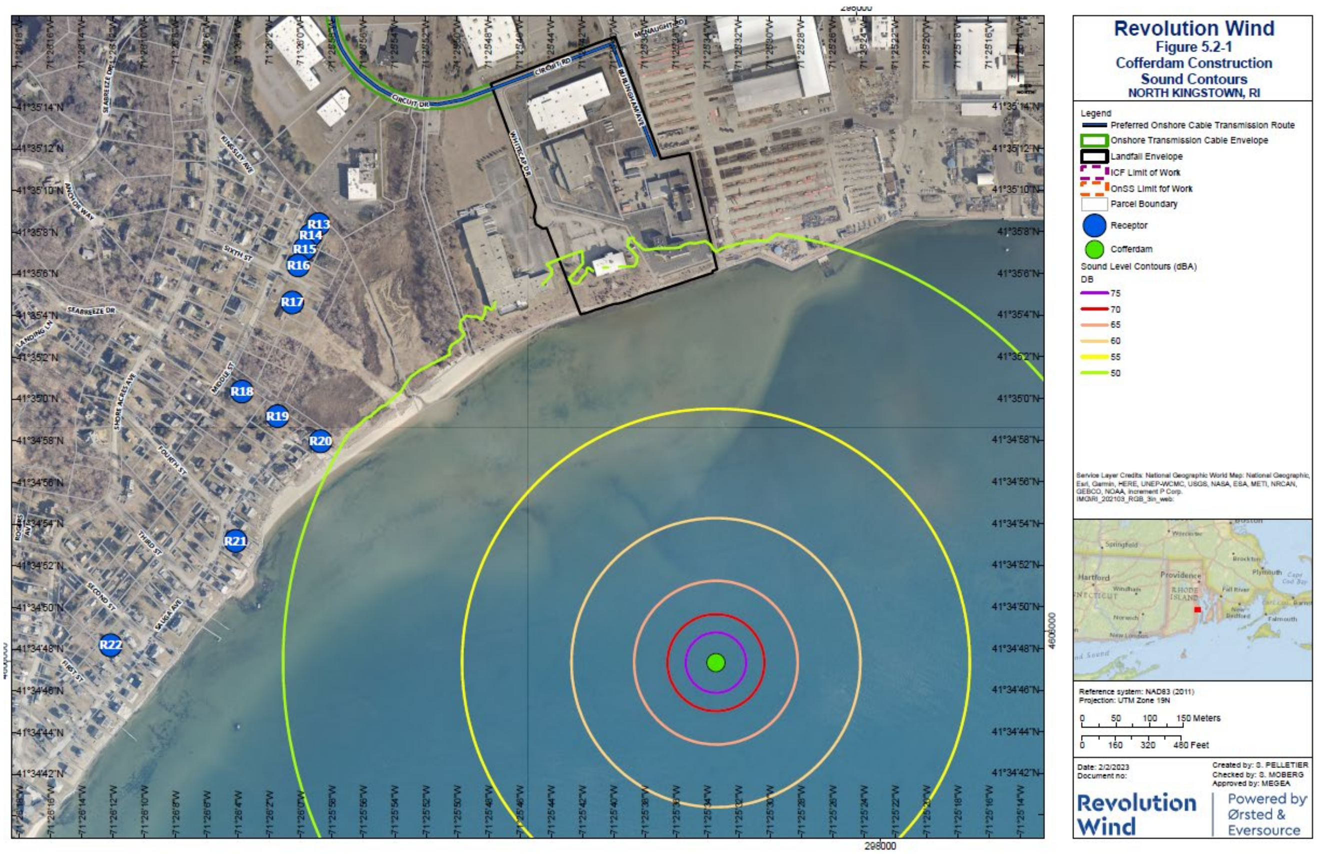


Figure 5.2-2 Landfall: HDD Site Preparation Sound Contours

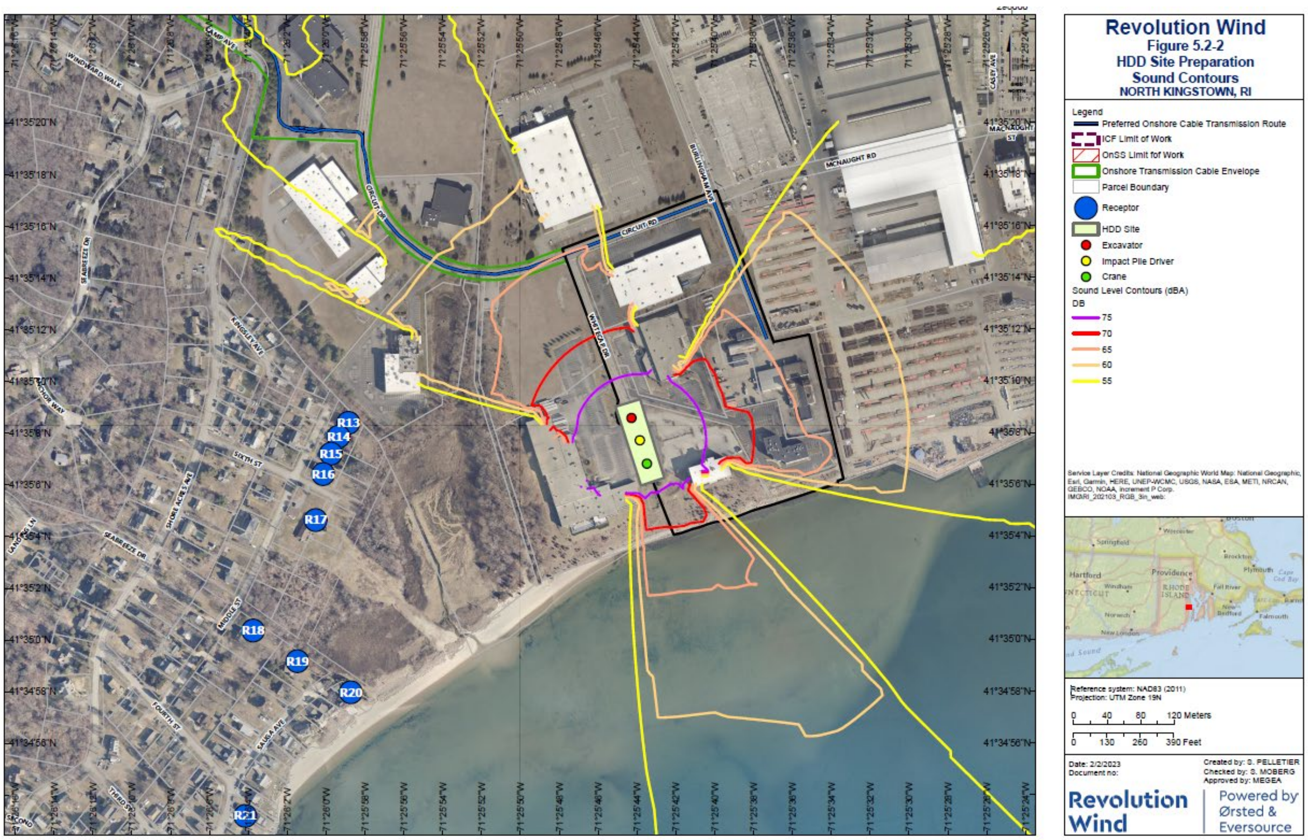
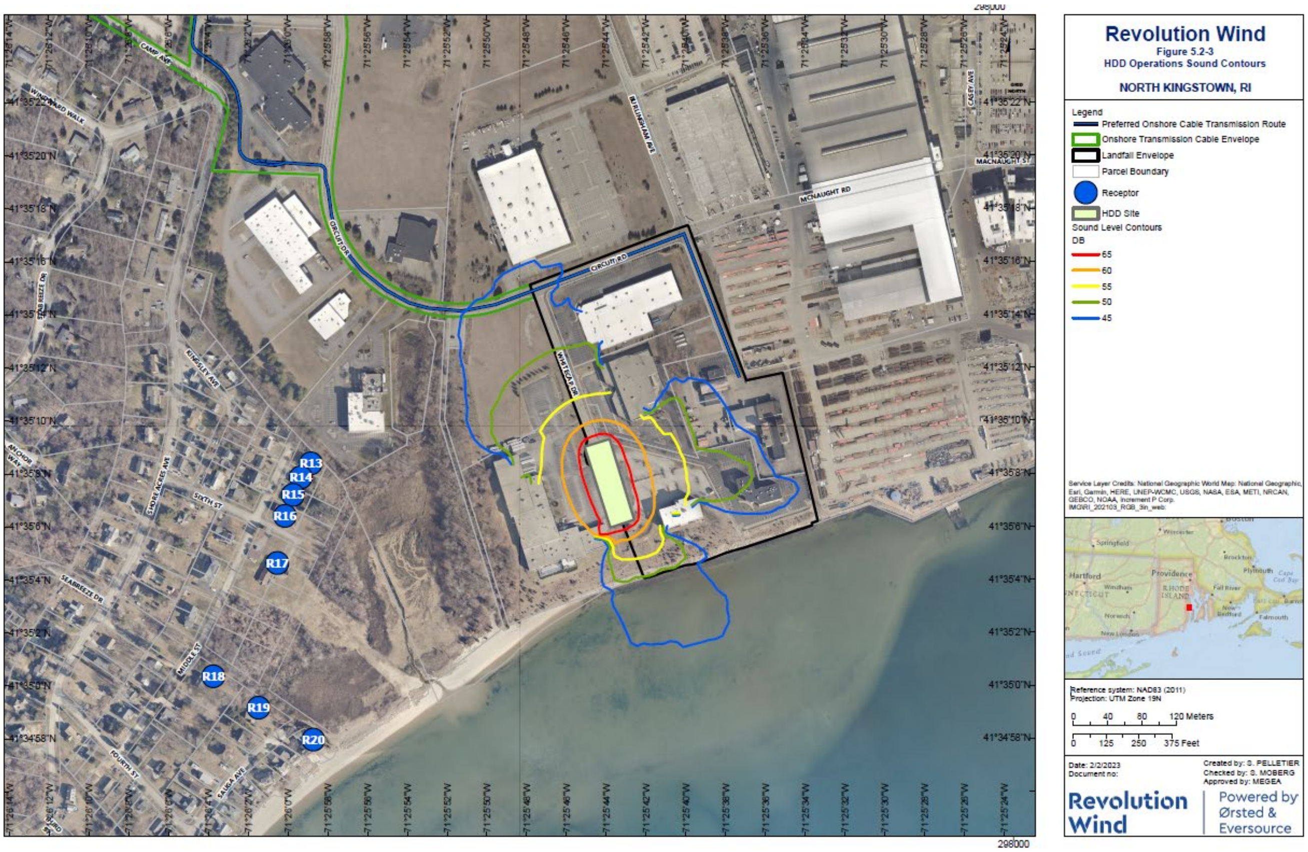


Figure 5.2-3 Landfall: HDD Operations Sound Contours



Construction activities associated with the Onshore Transmission Cable installation include clearing the route, excavating and shoring the trench, installing the duct, and backfilling. The construction would typically occur in the roadway right-of-way except where the cable route transitions from Circuit Drive to the OnSS across 75, 101, 109 and 135 Circuit Drive and 646 Camp Avenue. As shown in **Table 5.2-4**, construction sound levels would range from 84 to 89 dBA (Leq(8h)) at a distance of 50 feet for all construction phases. At 100 and 200 feet from the transmission cable construction, construction sound would be approximately 6 and 12 dBA lower, respectively.

It is anticipated that construction of the Onshore Transmission Cable will take approximately 12 months. Since construction progresses along the cable route during this period, the exposure to construction noise is of a substantially shorter duration at any particular location along the route. Transmission Cable construction would generally occur during daytime hours and would be within all applicable state and local noise standards.

Table 5.2-4 Onshore Transmission Cable Construction Noise

Distance from Cable Route (feet)	Construction Sound Level (dBA, $L_{eq(8hr)}$)				
	Route Clearance	Excavation	Shoring/ Trenching	Duct Installation	Backfilling
50	89.2	88.0	83.9	85.2	89.0
100	83.2	82.0	77.9	79.2	83.0
200	77.2	76.0	71.9	73.2	77.0

Source: VHB, 2020.

5.2.2 Onshore Substation and ICF Construction

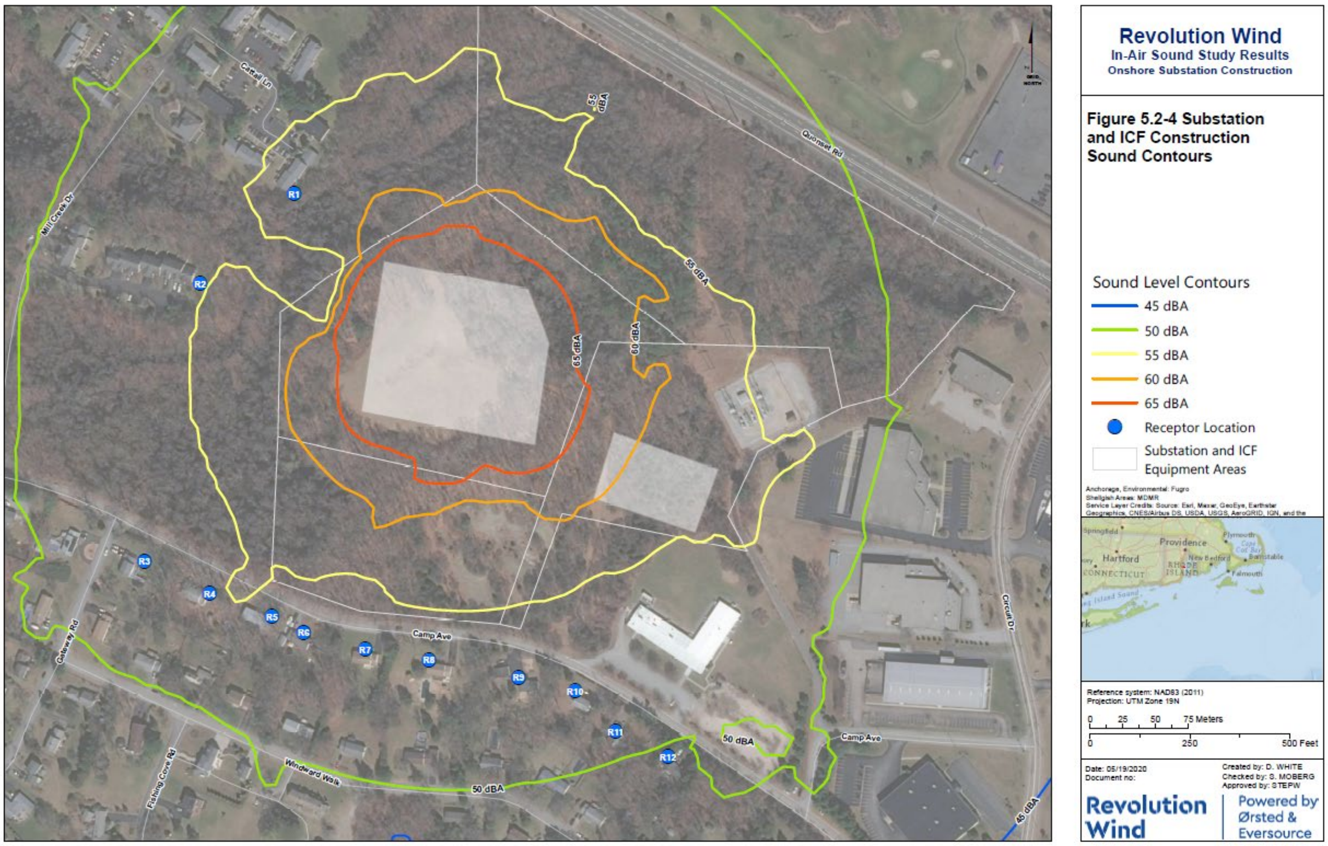
Construction activities associated with the OnSS and ICF typically include clearing the site of vegetation, grading the site, installing erosion controls, installing the foundations and erecting buildings, and restoring any disturbed areas. As shown in **Table 5.2-5** and **Figure 5.2-4**, construction sound would range from approximately 54 to 64 dBA at the nearest residential receptors on Cattail Lane, Brook View Drive, and Camp Avenue. The existing ambient sound levels at these receptors is 50 to 51 dBA-i during the daytime and 45 dBA-i during the night. Construction sound during the day would generally be up to 10 to 15 dBA above ambient conditions. Construction of the OnSS and ICF would occur during daytime hour and would be within all applicable state and local noise standards.

Table 5.2-5 Onshore Substation and ICF: Construction Noise

Receptor	Address	Existing Sound Level (dBA, L_{eq})		Construction Sound Level (dBA, L_{eq})
		Daytime	Nighttime	
R1	129 Cattail Lane	50.0	45.0	57.3
R2	140 Brook View Drive	50.0	45.0	55.8
R3	10 Gateway Road	50.5	45.4	54.4
R4	511 Camp Avenue	50.5	45.4	55.6
R5	525 Camp Avenue	50.5	45.4	55.8
R6	541 Camp Avenue	50.5	45.4	55.7
R7	553 Camp Avenue	50.5	45.4	55.9
R8	571 Camp Avenue	50.5	45.4	56.6
R9	595 Camp Avenue	50.5	45.4	57.7
R10	613 Camp Avenue	50.5	45.4	60.4
R11	629 Camp Avenue	50.5	45.4	57.2
R12	643 Camp Avenue	50.5	45.4	59.6

Source: VHB, 2020.

Figure 5.2-4 Substation and ICF Construction Sound Contours



5.3 Avoidance, Minimization and Mitigation

As described in Section 5, *Environmental Consequences and Mitigation*, there would be no operational or construction-period airborne noise impact due to onshore components of the Project. Open-cut construction would generally occur during the daytime hours and would therefore comply with relevant state and local noise limits. HDD operations would generate sound below ambient conditions during the day and up to 4 dBA above ambient conditions at night at a few of the closest residences on Middle Street. This is a relatively small increase in sound conditions at night and would not be expected to cause significant adverse noise impacts. Therefore, there is no requirement for measures to avoid, minimize, or mitigate construction or operational offshore airborne noise.

Best practices to reduce construction noise as safe, reasonable and effective will be included such as:

- Replacing back-up alarms with strobes, as allowed within Occupational Safety and Health Administration (OSHA) regulations, to eliminate the annoying impulsive sound.
- Assuring that equipment is functioning properly and is equipped with mufflers and other noise-reducing features.
- Locating especially noisy equipment as far from sensitive receptors as possible.
- Using quieter construction equipment and methods, as feasible, such as smaller backhoes.
- Using path noise control measures such as portable enclosures for small equipment (e.g., jackhammers and saws).
- Limiting the periods of time when construction may occur is a common approach to minimizing impact.
- Maintaining strong communication and public outreach with adjacent neighbors is an important step in minimizing impact. Often, providing abutters information about the time and nature of construction activities can minimize the effects of construction noise.

5.4 Summary of Impacts

The proposed OnSS and ICF would introduce new sources of sound including transformers, shunt reactors, harmonic filters, cooling and ventilation associated with the outdoor substation equipment, as well as condensers, pumps, skids and auxiliary transformers associated with the synchronous condenser building. Operational sound from the OnSS and ICF would be 43.9 dBA or lower at the closest NSRs which would be below the EPA guideline for noise exposure (48.6 dBA Leq) and below the Town of North Kingston, Rhode Island nighttime noise ordinance limit for residential properties (50 dBA). Operational sound from the OnSS and ICF would also be below 50 dBA at the nearest residential property lines and below 70 dBA at the nearest commercial/industrial property lines which is below the noise ordinance noise limits. Therefore, the operation of the proposed OnSS and ICF would comply with relevant federal, state, and local noise limits and there is no need for measures to avoid, minimize or mitigate operational noise.

Construction sound associated with the cofferdam construction would be up to 51 dBA (Leq(8h)) at the nearest beach and residences. Construction sound associated with the HDD site preparations, including sheet pile driving for an anchor wall which will take approximately three days, would be up to 70 dBA (Leq(8h)) at the closest beach locations and approximately 36 to 43 dBA (Leq(8h)) at the nearest residences. Construction sound from HDD operations would be approximately up to 54 dBA (Leq(8h)) at the beach and between 14 and 33 dBA (Leq(8h)) at residential receptors.

HDD operations would be below existing ambient daytime and nighttime sound conditions and is not to be expected to cause significant adverse noise impacts. Therefore, the construction of the proposed Project would comply with relevant state and local noise limits for all daytime construction activities, including HDD operations, and would not be expected to result in significant adverse noise impact at any time.

6

References

ANSI, 2006. American National Standards Institute ANSI/ASA Standard S1.4-2006: “American National Standard Specification for Sound Level Meters”.

ANSI, 2013. American National Standards Institute ANSI/ASA Standard 12.9: 2013/ Part 3 “Quantities and Procedures for Description and Measurement of Environmental Sound – Part 3: Short-Term Measurements with an Observer Present”.

BOEM, 2018. U.S. Department of the Interior, Bureau of Ocean Energy Management Office of Renewable Energy Programs, “Draft Guidance Regarding the Use of a Project Design Envelope in a Construction and Operations Plan”.

U.S. Environmental Protection Agency (EPA), 1974. “Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety”.

FHWA, 2018. Federal Highway Administration, “Techniques for Reviewing Noise Analyses and Associated Noise Reports, Final Report FHWA-HEP-18-067.

IEEE, 1999. Institute of Electrical and Electronics Engineers, Standard C57.12.90-1999 “Standard Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers”.

ISO, 1993. International Organization for Standardization ISO 9613-1, “Acoustics—Sound attenuation during propagation outdoors, Part 1: Calculation of the absorption of sound by the atmosphere”.

ISO, 1996. International Organization for Standardization ISO 9613-2, “Acoustics—Attenuation of sound during propagation outdoors Part 2: General method of calculation”.

NEMA, 2014. National Electrical Manufacturers Association Standard Publication No. TR-1-2013, “Transformers, Step Voltage Regulators and Reactors”.

Appendix

This section includes photos of the ambient sound measurement sites and results at each site including hourly maximum, minimum, energy-equivalent, and statistical sound levels.

Figure A-1 Site M1 Photo

Figure A-2 Site M2 Photo

Figure A-3 Site M3 Photo

Figure A-4 Site M1 – 8/27/2019 to 8/28/2019

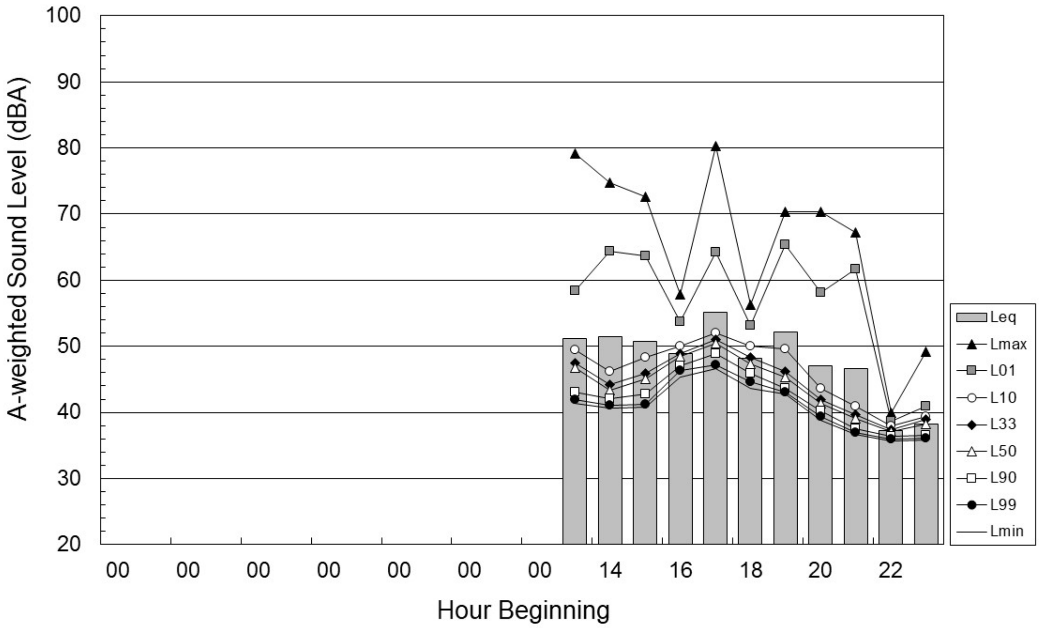


Figure A-5 Site M1 – 8/28/2019 to 8/29/2019

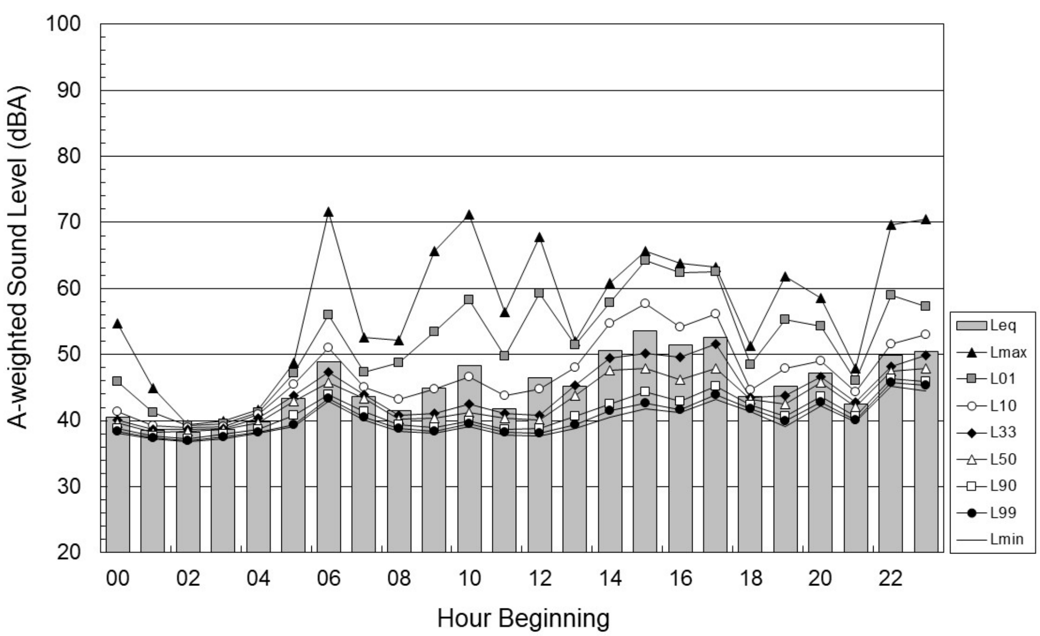


Figure A-6 Site M1 – 8/29/2019 to 8/30/2019

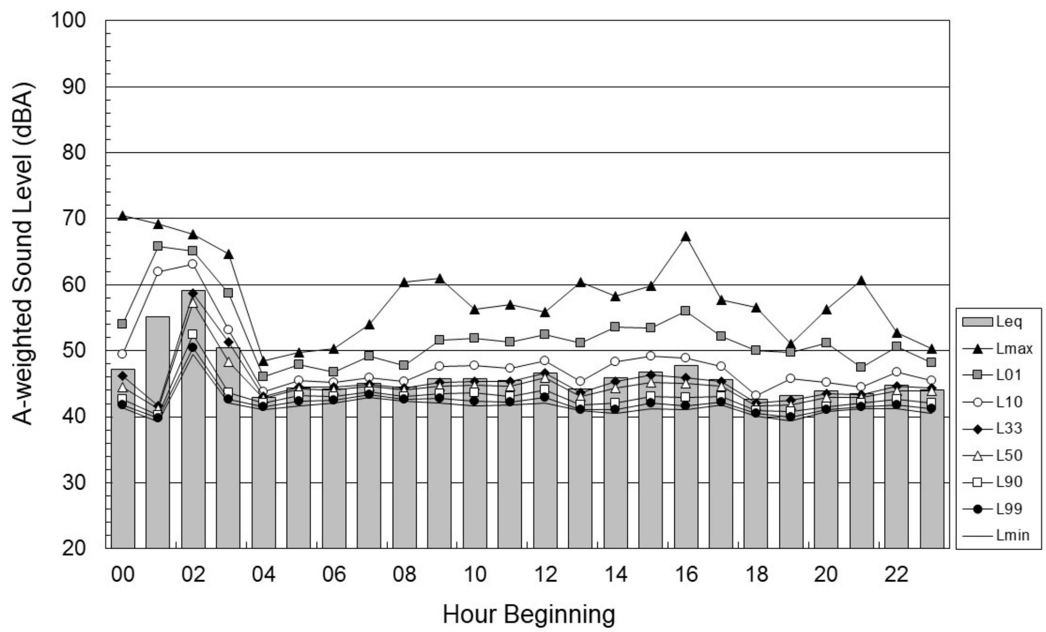


Figure A-7 Site M1 – 8/30/2019 to 8/31/2019

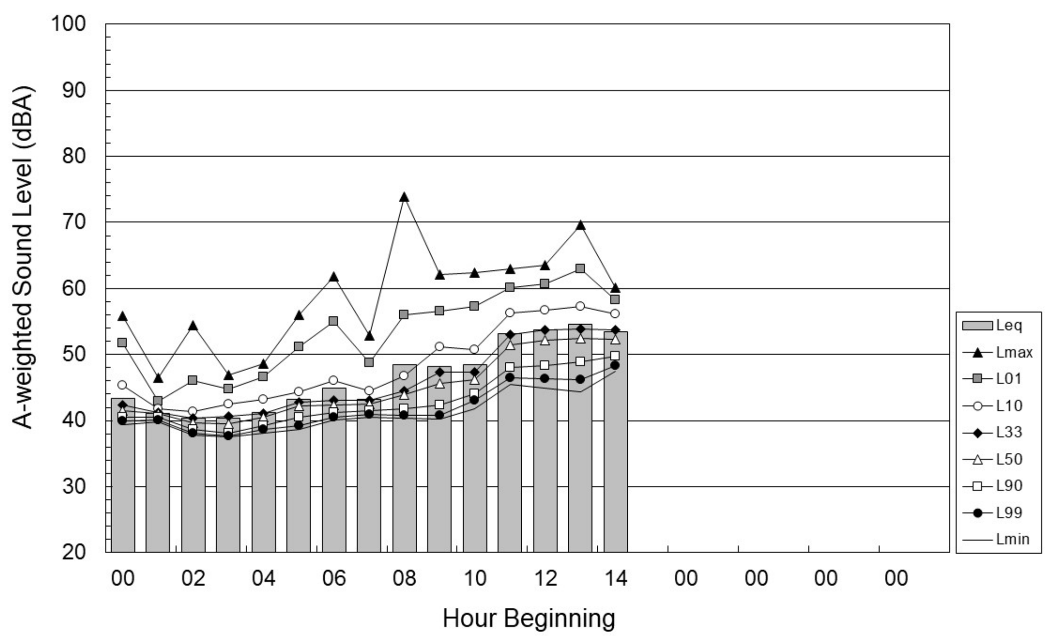


Figure A-8 Site M2 – 8/27/2019 to 8/28/2019

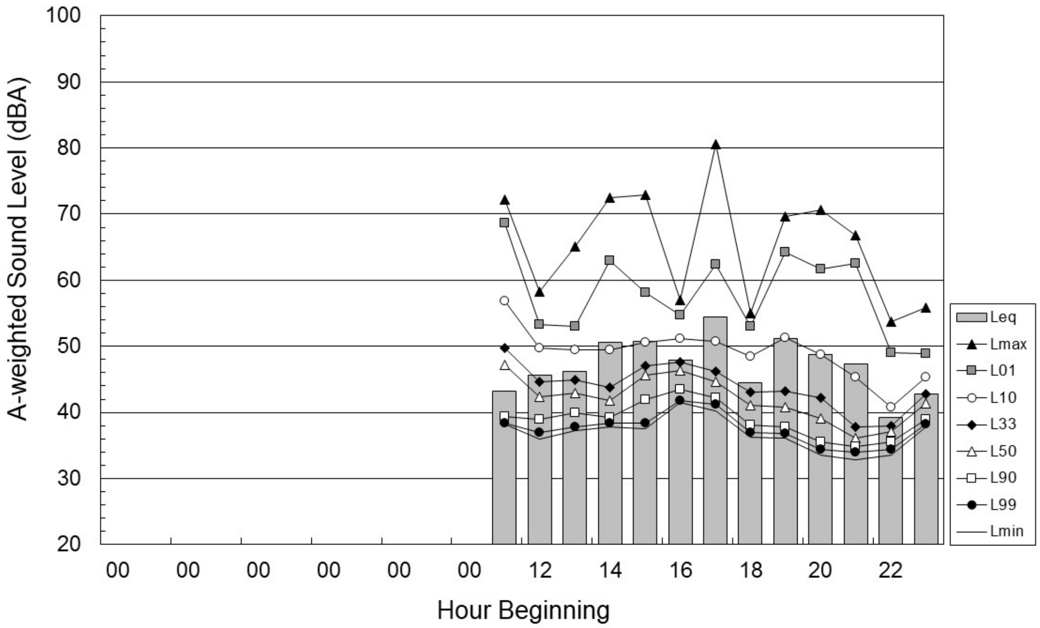


Figure A-9 Site M2 – 8/28/2019 to 8/29/2019

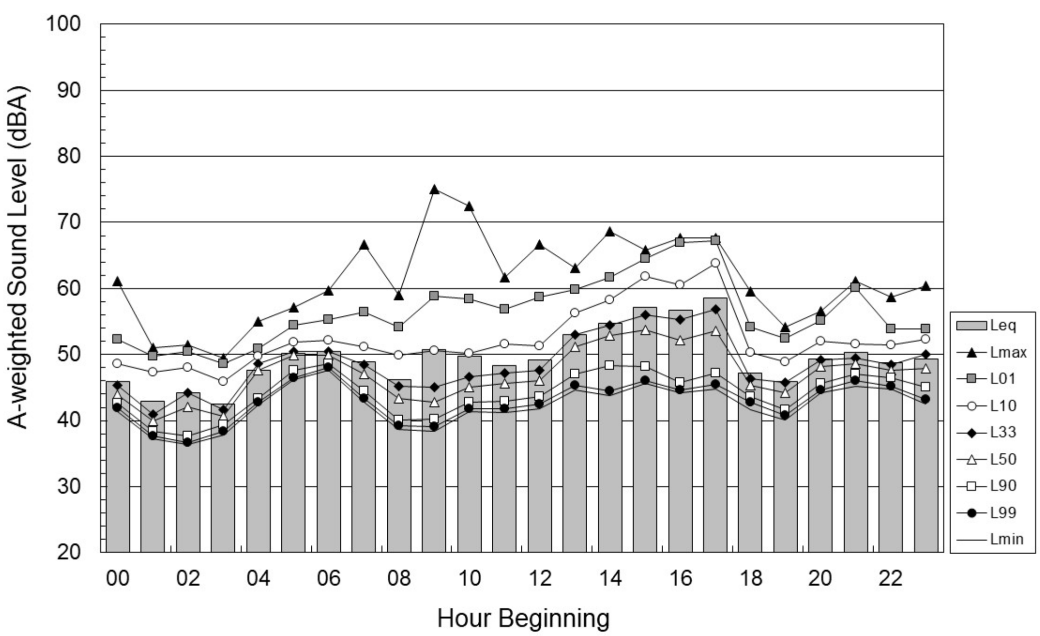


Figure A-10 Site M2 – 8/29/2019 to 8/30/2019

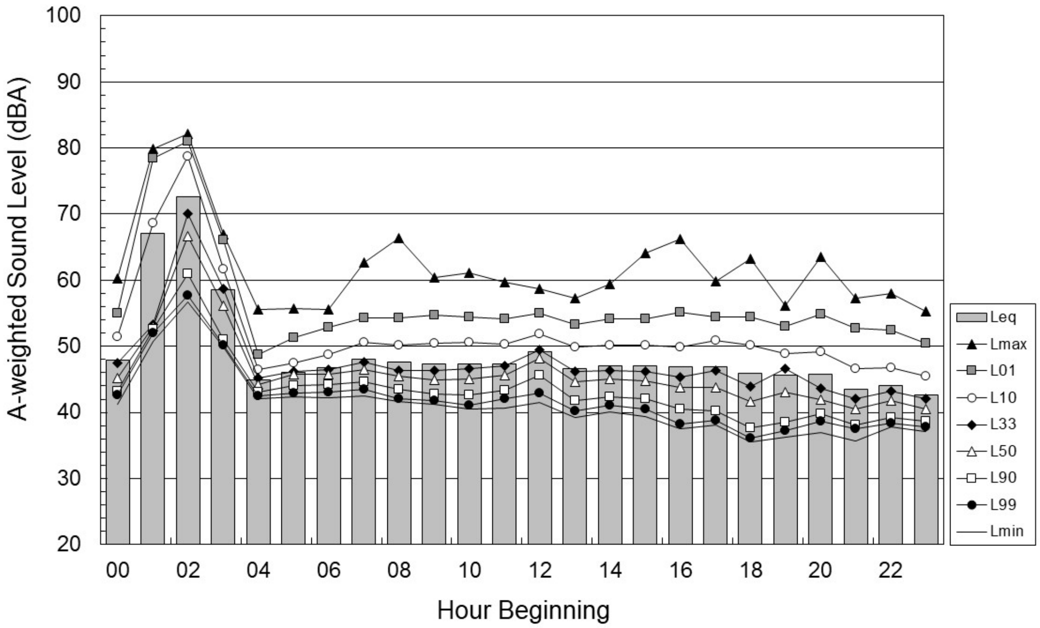


Figure A-11 Site M2 – 8/30/2019 to 8/31/2019

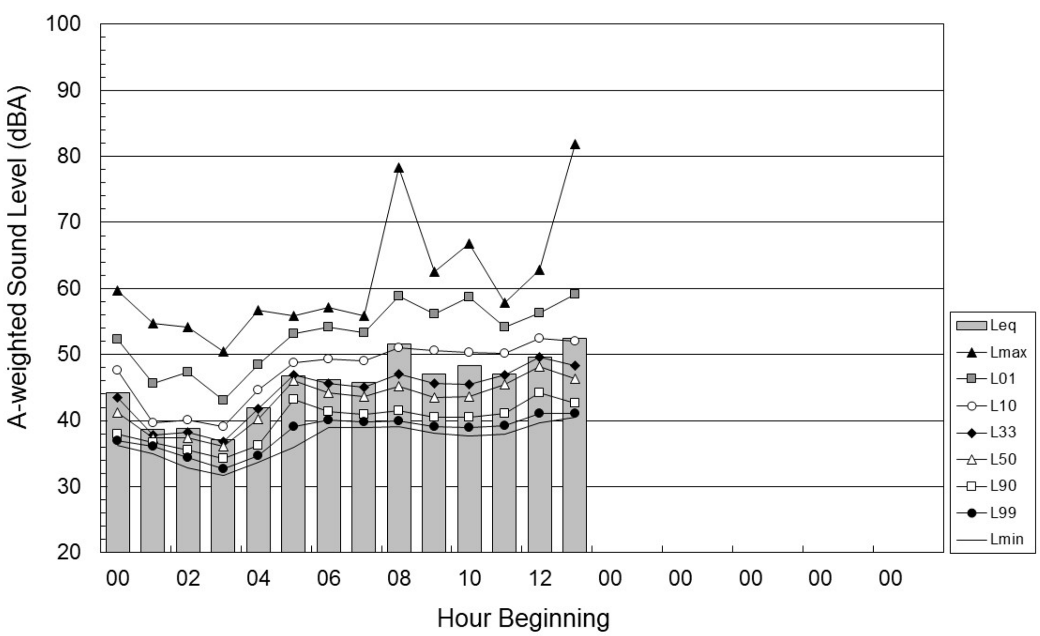


Figure A-12 Site M3 – 8/27/2019 to 8/28/2019

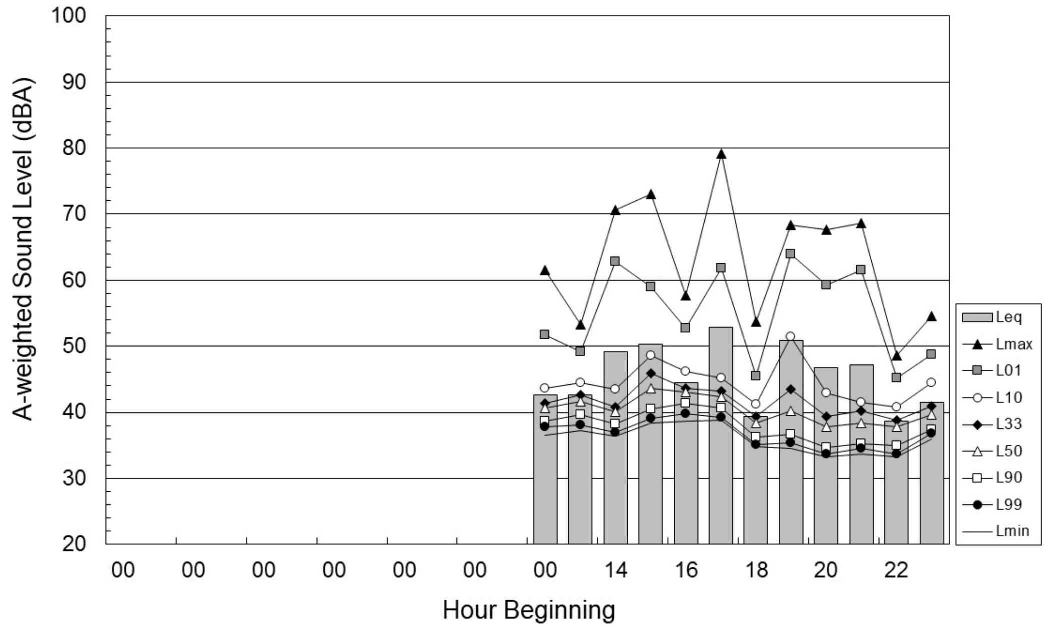


Figure A-13 Site M3 – 8/28/2019 to 8/29/2019

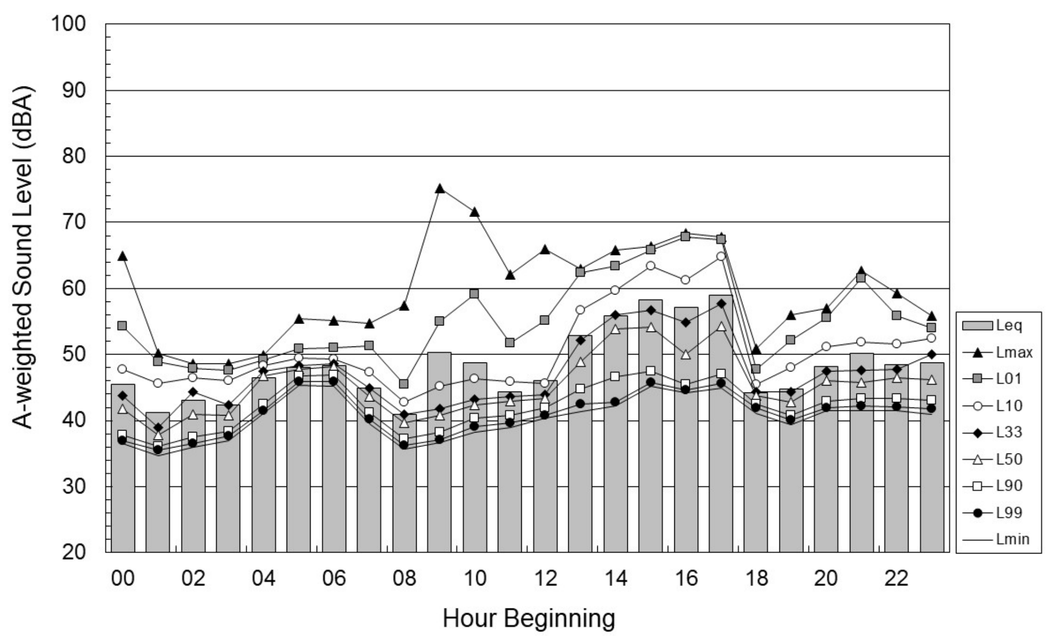


Figure A-14 Site M3 – 8/29/2019 to 8/30/2019

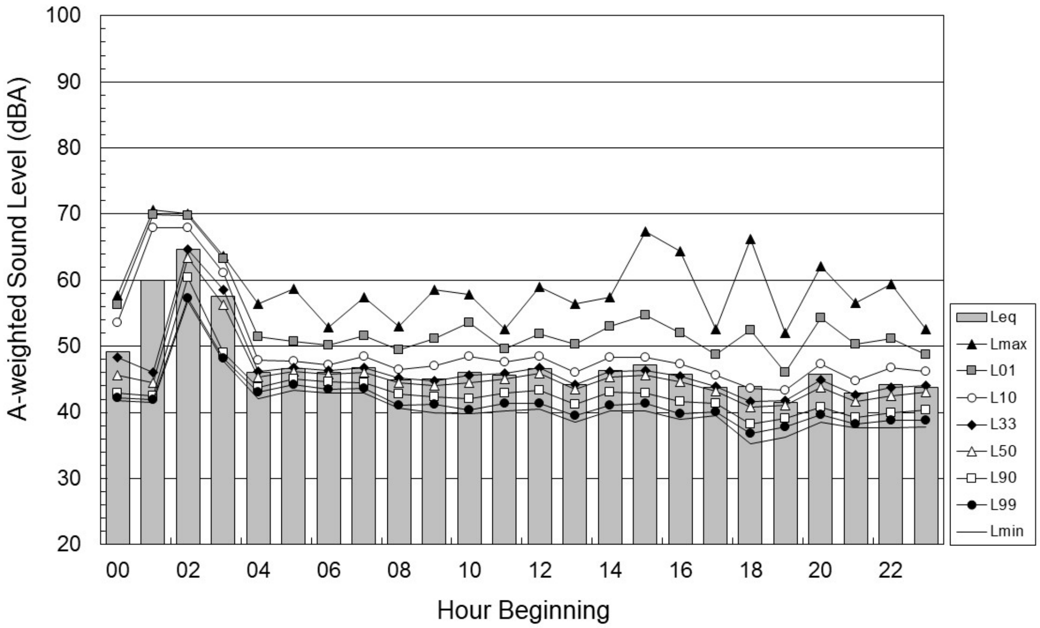


Figure A-15 Site M3 – 8/30/2019 to 8/31/2019