5.0 NOISE

5.1 NOISE STANDARDS

Bodwell EnviroAcoustics performed an analysis of the anticipated sound levels associated with the Weaver Wind Project (project) in accordance with the No Adverse Environmental Effect Standard of the Site Location Law 06-096 CMR 375.10(I) (Sound Level Standards for Wind Energy Developments).

The project is required to meet the following sound level limits as detailed in 06-096 CMR 375.10(I):

a) 75 dBA at any time of day at any property line of the wind energy development or contiguous property owned or controlled by the wind energy developer; and

b) 55 dBA between 7:00 a.m. and 7:00 p.m. (the "daytime limit") and 42 dBA between 7:00 p.m. and 7:00 a.m. (the "nighttime limit") at any protected location.

Although the MDEP noise regulation specifies a 75 dBA limit at the facility property line, the most restrictive limits apply at noise sensitive land uses that meet the definition of a “protected location,” as set forth in 06-096 CMR 375.10(G). At protected locations more than 500 feet from living and sleeping quarters, the daytime hourly sound level limits apply regardless of the time of day.

Additionally, when a development is located in a municipality that has a duly enacted quantifiable noise standard that contains limits that are not higher than the applicable MDEP limits by more than 5 dBA and which address the types of sounds regulated by the MDEP, then the local standard is applied rather than the MDEP standard. In accordance with this provision, certain provisions of the Town of Eastbrook Wind Energy Facility Ordinance apply and were evaluated in the sound level assessment for the project, including its standard of 40 dBA within 660 feet of a protected location.

5.2 SOUND ASSESSMENT

The sound level assessment determined predicted sound levels for the project at full rated sound output and compared them to the MDEP sound level limits including, where applicable, the limits set forth in the Town of Eastbrook Wind Energy Facility Ordinance. The sound level assessment conservatively estimates wind turbine sound levels and outdoor sound propagation by assuming the following:

a) All turbines are operating simultaneously at full rated sound output;

b) Receptor points are simultaneously located downwind of all turbines;

c) A ground absorption factor of 0.5 was used to represent a mix of hard and soft ground;

d) Surface water bodies were mapped and assigned a ground absorption factor of 0.0 similar to hard ground for an acoustically reflective surface;

e) No attenuation was calculated due to trees or other foliage that could act to reduce sound levels; and,

f) An additional 1 dBA for uncertainty in the model, plus the manufacturer provided uncertainty factor for the sound power levels for the individual turbine model, was added to the full rated sound power level to determine predicted sound levels at receptor points.

The sound level assessment conservatively demonstrates that with all wind turbines operating simultaneously at full rated capacity, the project will meet the MDEP daytime sound level limit of 55 dBA at all protected locations, as well as the night-time limit of 42 dBA within 500 feet of dwellings on nearby protected locations, and the applicable limits of the Town of Eastbrook Wind Energy Facility Ordinance.

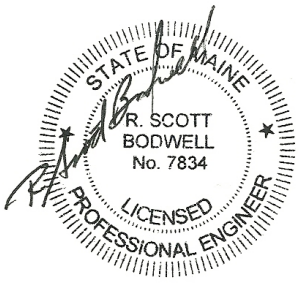
While the sound level predictions indicate that the project will comply with applicable MDEP limits, post-construction compliance monitoring will be conducted in accordance with MDEP protocols for wind energy developments. Prior to commercial operation, a formal protocol for response and resolution of sound complaints will be established to reduce the potential for noise problems associated with long-term operation of the project. Additional sound level data and information is available in the Sound Level Assessment (Exhibit 5-1).

Exhibit 5-1

Weaver Wind Project Sound Level Assessment

Sound Level Assessment
Weaver Wind Project
Hancock County, Maine

October 2018



Prepared for:
Weaver Wind LLC

Prepared by:
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Bodwell EnviroAcoustics LLC

1.0 Introduction

Bodwell EnviroAcoustics LLC (BEA) assessed sound levels expected to result from construction and operation of the Weaver Wind Project proposed for Hancock County, Maine. The Project plans to install and operate Vestas V126 wind turbines on twenty-two turbine sites located in Osborn, T16 MD, T22 MD, and Eastbrook, Maine, resulting in a total generating capacity of 72.6 megawatts (MW).

The objective of this Sound Level Assessment is to evaluate sound levels at locations designated by rule as noise sensitive land uses from simultaneous operation of all proposed turbines at full-rated and warranted sound power output during nighttime stable atmospheric conditions. A terrain-based model is used to calculate sound propagation and predict sound levels at noise sensitive land uses (protected locations) in the vicinity of the Project. The predicted "worst-case" sound levels are compared to applicable noise limits as set forth by Maine Department of Environmental Protection (DEP) Site Location of Development regulations for Control of Noise (ref. 06-096 CMR c. 375.10). A comparison of predicted sound levels to relevant noise limits established by the Town of Eastbrook is also provided.

Commented [BB1]: Keep a note here to delete "and warranted" if we don't get a warranty

This report describes the project and surrounding area, state and local noise regulations, turbine sound performance by wind speed, the details and results of predictive sound model, evaluation of compliance, and provisions for operations testing and sound complaint response.

2.0 Environmental Acoustics

The study of environmental acoustics primarily concerns the functions and effects that audible sounds (or noise) have in the outdoor environment and how changes to existing and new sound sources can impact that environment. From a geographic standpoint, this is an extremely diverse area of study ranging from wilderness to urban settings and from airborne and indoor sound to the underwater sound environments of oceans and lakes. Environmental acoustics is most commonly associated with assessing the noise impact of industrial, transportation, energy, or commercial land uses for suitability with nearby land uses. The following subsections provide an overview of acoustic terminology and characteristics of wind turbine noise.

2.1 Sound and Decibels

Sound is produced by many different sources that generate pressure fluctuations in air that the human ear often has the capability to detect as audible. Sound can also travel through other media such as water, metal, and structural components of a building. The types of sounds that humans experience every day can be divided into two distinct categories as natural and man-made sound. However, the range of sound subcategories is extensive.

There are many types of natural sounds audible to humans and other animals. The most common of these are wildlife (e.g. birds, frogs, mammals, insects), sounds generated by wind forces acting on terrain and vegetation, and sounds generated by water action such as ocean waves, falling rain, and

river rapids. There are also many man-made sounds generated by industrial, transportation, energy and construction sources as well as sounds generated for warning signals or strictly for enjoyment such as music. Common residential sounds include outdoor recreation, yard maintenance, human voices, and amplified music.

The magnitude or loudness of sound waves is measured in units of pressure (pascals) that yield very large numbers that are difficult to interpret. For simplicity, the decibel unit, dB was developed to quantify sound pressure levels to reduce the exponential range of typical sound pressures. The dB unit equates to an exponential ratio of the actual sound pressure to a standard pressure, usually 20 micropascals. This is a logarithmic expression of the pressure ratio similar to the Richter scale for earthquakes so that a small change in sound level expressed in dB represents a larger change in the sound pressure. For example, a 10 dB change in sound level is a tenfold increase in sound pressure as pascals. However, this does not mean that the received sound is perceived as ten times as loud. A change in sound levels of 3 dB is a doubling of the sound pressure but is considered to be threshold of change perceptible to human hearing. A change of 5 dB becomes quite noticeable and an increase of 10 dB is perceived as twice as loud.

The frequency or pitch of sound is expressed in Hertz (Hz) and is the number of sound waves passing a specific point each second, i.e. cycles per second. Frequencies generally considered audible to the human ear range from 20 to 20,000 Hz. Within this range, there are octave bands that represent a range of frequencies for purposes of sound characterization and calculating sound propagation and attenuation. Standard whole octave bands are centered around 31.5 Hz, 63 Hz, 125 Hz, 250 Hz, 500 Hz, 1000 Hz, 2000 Hz, 4000 Hz and 8000 Hz. The center frequency of each octave is double that of the previous octave. Octave bands can be further divided (typically third octaves) and used to determine if a sound source generates an audible pure tone such as a whistle, buzzing or hum that may be more perceptible than a broad mixture of frequencies. Low frequency sound is typically considered to be at frequencies of 200 Hz and below. Within this range, infrasound has frequencies below 20 Hz and is not generally considered audible to humans except at very high decibel levels.

Sound levels in frequencies ranging from 500 to 2500 Hz are more audible to humans than frequencies below 100 Hz. Accordingly, the A-weighting scale was developed to express sound pressure levels in units of dBA to simulate the hearing response of humans. Under this weighting system, the sound pressure level at low frequencies is reduced based on its audibility to humans. The linear (no weighting) and C-weighting scales are often used to determine the relative contribution of low frequency sounds during a sound measurement. These low frequency sounds have reduced audibility to humans, hence the use and wide acceptance of the A-weighting network for noise standards. Figure 2-1 provides a graph that shows the reduction by frequency for A- and C-weighting scales.

Sound level measurements are also time-weighted to represent the relevant parameters or timeframes of interest or identify short duration events. The most common time weightings are “Fast” and “Slow”. Fast-time weighting is based on 1/8 second intervals and is useful for determining rapid changes in sound levels. The slow-time weighting integrates the measured sound levels over a one-second period that reduces the rapid fluctuations for ease of observation.

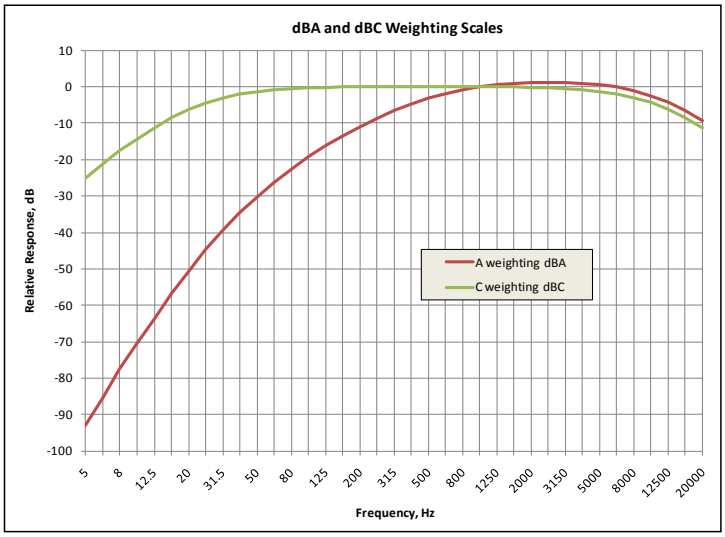


Figure 2-1. Weighting Curves for dBA and dBC Sound Levels

Similar to the size and period of ocean waves, sound pressure waves can vary considerably in amplitude and frequency. When using fast-time weighting, a sound level meter will measure a sound pressure level every 1/8 of second which results in 480 measurements each minute and 28,800 measurements in an hour. Because it would be nearly impossible to evaluate over 28,000 measurements per hour, numerous statistical parameters have been developed for use in quantifying long-term sound level measurements. The most common is the A-weighted equivalent sound level or LAeq, which represents the time-varying sound level as a single dBA level by effectively spreading the sound energy across the entire measurement period. Other common parameters are percentile levels that represent the percentage of time that a specific sound level was exceeded. For example, the LA10 provides the sound level that was exceeded 10% of the time during the measurement period. This means that 10% of the measured sound levels were higher and 90% were lower than the measured LA10. Other commonly used percentiles include the LA50 or median sound level and the LA90 for which 90% of the measured sound levels are higher. The LA90 is often referred to as the background sound level as it eliminates most fluctuations from short term sound events such as aircraft flights and wind gusts. Figure 2-2 presents a graph that shows the measured sound pressure levels and the resulting equivalent (LAeq), LA10 and LA90 sound level parameters.

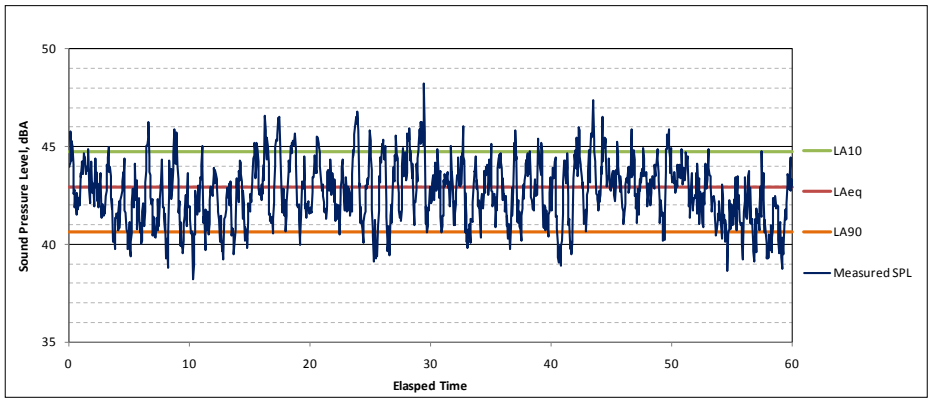


Figure 2-2. Measured Sound Pressure Levels and Statistical Parameters.

For purposes of quantifying industrial and other man-made sound sources, the term "sound power level" is used. The unit of sound power level is watts and the term is commonly expressed as Lw. When applied to sound power, the dB unit represents a logarithmic ratio of the source sound power to a reference sound power (10^{-12} watt). Sound power levels are determined by measuring the sound pressure level from a source at a specific distance and calculating the sound attenuation between the source and measurement location. The sound power level provides a mechanism for ranking and quantifying noise sources, such as wind turbines, in a consistent and standardized manner. It is commonly used in sound performance specifications and as a source input to sound level prediction models. By its nature, the sound power level cannot be measured directly and can be a source of confusion to the public relative to sound pressure levels that are predicted and measured at community locations.

The combination of all existing sound sources, natural and man-made, at a specific location or in a community is known as the ambient sound environment or soundscape. The amplitude and characteristics of the soundscape vary significantly depending on the amount of industrial and residential development, proximity to transportation uses such as highways and airports, and the presence of natural sounds such as wind, flowing water, and wildlife. In general, the more rural or undeveloped an area is, the lower the ambient sound levels will be. Ambient sound levels are usually higher during daytime hours than at night due to more traffic and human activity, higher wind speeds and other natural sounds during the day. At night, these daytime sources typically diminish and sound levels are reduced with the exception of strong winds or rain occurring during the overnight period.

Noise is generally defined as unwanted sound. The perception of noise as an unwanted sound can vary significantly by individual and preferences concerning types of sound. A simple example of this is music. One person may enjoy a certain type of music that another may find extremely annoying. Some individuals find enjoyment and solitude in listening to natural sounds or the nighttime quiet of a rural area while others have little interest in such soundscapes.

The character of sound is determined by its loudness or amplitude and its pitch or frequency. Humans can detect a wide range of sound level amplitudes and frequencies as audible but are more sensitive to a specific range of frequencies. Consequently, the perceived loudness of sound also depends not only on its amplitude but on its frequency characteristics as well. For example, the sound of birds, frogs or flowing water is often perceived as quieter than man-made sounds at the same amplitude. The sound levels associated with some common noise sources and sound environments is presented as Table 2-1.

Indoor Setting	Outdoor Setting	Sound Sources	Sound Pressure Level, dBA
*Rock Concert**		*Jet Takeoff at 300 feet**	*120*
Ship Engine Room	*Loud Thunder**	*Rifle Blast at 100 feet*	*110*
*Movie Theater**		*Chain Saw high rpm at 5 feet* *Siren at 100 ft*	*100*
*Heavy Industrial Work Space**		*Lawn Mower high rpm at 10 feet* *Large Truck or Loader high rpm 50 feet**	*90*
Busy Airport	*Heavy Rain*	*Motor Boat high rpm at 100 feet*	*80*
Light Industrial Workspace	*Heavy Surf Beach** *Busy City or Highway*	*AC Unit at 5 feet* *Automobile 45 mph at 50 feet*	*70*
Busy Office/Conversation Room with TV	*Urban Daytime*	*Strong Wind in Trees** *Nighttime Frogs* *Airplane Flyover**	*60*
	Suburban Daytime/Urban Nighttime	*Bird Calls/Morning Chorus* *Small waves on shoreline*	*50*
Quiet Office *Library*	*Rural Area Daytime*	*Moderate Wind in Trees*	*40*
Sleeping Quarters at Night	*Rural Area Nighttime*	*Light Wind in Trees*	*30*
Idle Recording Studio	*Very Remote Area* *Nighttime* *Perceived Silence*		*20*
			10
		Threshold of Hearing	*0*

Table 2-1. Typical A-Weighted Sound Levels

Note: These are typical sound levels and subject to significant variation depending on the number of and distances from sound and transportation sources.

**Sound with prominent Low Frequency components*

Sources:
www.mvn.usace.army.mil/ss/osha600/s600/refer/menu14c.pdf
Measurements and Observations by R. Scott Bodwell, P.E.

2.2 Outdoor Sound Propagation

Sound travels through air at a speed of approximately 1126 feet per second or 768 miles per hour. Thus it takes just over two seconds for a sound wave to travel a half mile. The number of sound waves that travel past a given point in one second is determined by its frequency or pitch. The sound pressure level decreases or attenuates as sound spreads out and travels over distance through the air. Attenuation results from distance, atmospheric absorption, and terrain effects. The rate of attenuation due to distance or spreading of the sound wave (i.e. divergence) is the same for all frequencies, which is approximately 6 dB per doubling of distance from a simple point source.

Table 2-2 provides the sound pressure level at various distances from a point source having a sound power level of 106 dBA. This relationship is shown graphically in Figure 2-3. The sound level reduction shown in Table 2-2 and Figure 2-3 is due only to distance attenuation and does not include attenuation from atmospheric absorption, terrain and foliage, or reflection from hard surfaces.

Source Sound Power Level, LwA = 106 dBA	
Distance, Feet	**Sound Pressure Level, dBA**
25	80
50	74
100	68
200	62
400	56
800	50
1600	44
3200	38

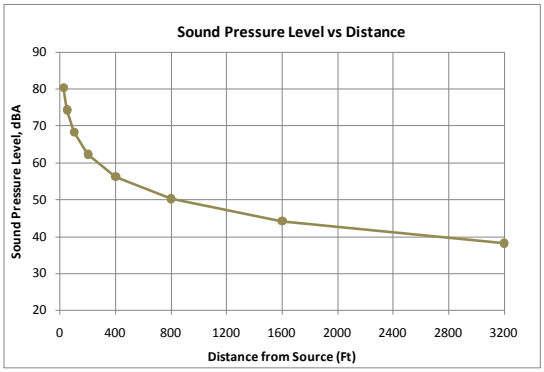


Table 2-2 & Figure 2-3. Attenuation of Sound Levels over Distance

Sound energy is absorbed by the atmosphere as it travels through the air. The amount of absorption varies by the frequency of the sound and the temperature and humidity of the air. More sound is absorbed at higher frequencies than at lower frequencies due to the relative wavelengths.

In addition to temperature and humidity, wind speed and direction can affect outdoor sound propagation. When sound travels upwind the sound waves can bend upward creating a “shadow” zone near the ground where sound levels decrease when compared to downwind sound propagation. Wind gradients, temperature inversions and cloud cover can cause refraction or bending of sound waves toward the ground resulting in less sound attenuation from terrain and ground cover over large distances.

Sound attenuation can also result from intervening terrain and certain types of ground cover and vegetation. An example of intervening terrain is a hill or ridge that blocks the horizontal sound path

between a sound source and receiver. This same effect can result from buildings and other solid structures such as a sound barrier fence. Sound will also attenuate as it travels over soft ground cover or through vegetation such as trees and shrubs. The amount of ground and foliage attenuation depends on the characteristics of the ground cover and the height and density of vegetation. Conversely, reflective ground or the surface of a water body can cause reflection of sound and less overall attenuation.

When multiple sound sources are present in an area, the sound level contribution from each source must be added to determine of the combined sound level of all sources. Due to logarithmic basis of the dB unit, adding sound levels is different than standard arithmetic. Adding two equal sound sources that each measure 50 dBA at a specific point will result in a combined sound level of 53 dBA. It will then take two more equal sound sources of 50 dBA each, or four total, to cause the sound level to increase by another 3 dBA. Thus, four equal sources at 50 dBA results in a total sound level of 56 dBA.

Specifications for calculating outdoor sound propagation have been developed by international standards organizations as well as individual countries based on empirical data developed over many years. These specifications form the basis for computerized sound level prediction models that allow calculation of outdoor sound propagation through the use of three-dimensional terrain models. The most widely used and accepted standard for calculating outdoor sound propagation is ISO 9613-2 Acoustics - Attenuation of Sound During Propagation Outdoors - Part 2: General Method of Calculation. This standard has been applied to accurately calculate the sound levels that result from operation of wind turbines and is the standard applied in this analysis. Further details concerning the sound level prediction model developed for Weaver Wind to account for various site and weather conditions can be found in Section 6.2 of this report.

2.3 Wind Turbine Sound

When operating at or near full sound output, the primary sound source from a wind turbine is rotation of the rotor blades with more sound energy generated from the outer sections of the blade and blade tip. Less significant sources of sound from operation of wind turbines are mechanical noise from gears, electric motors and cooling equipment in the turbine nacelle.

An international standard has been developed as IEC 61400-11 *Wind turbine generator systems – Part 11: Acoustic noise measurement techniques* that provides specific and detailed procedures for determining the sound power level from wind turbines. The IEC standard was developed by industry and acoustic experts to establish a consistent and repeatable methodology with full documentation for determining the sound output of any type of vertical blade wind turbine. Manufacturers of utility-scale wind turbines follow this methodology to determine the sound output and uncertainty of their turbines for purposes of estimating community sound levels and providing performance guarantees to owners and operators of wind energy facilities.

There has been much advancement in the technology of wind turbines over the last 10 to 20 years. The first generation of utility wind turbines consisted of downwind rotors that were capable of generating

significant levels of low frequency sound. Turbines with upwind rotors have replaced the early designs and drastically reduced low frequency sound emissions. Modern wind turbines are known to generate a "whoosh" type sound under certain operating and weather conditions that results from the passage of each blade. A short-term increase in sound levels often occurs on the down-stroke motion of the blade that is referred to as "amplitude modulation" and generally results in sound level fluctuations of 2 to 5 dBA for utility-scale wind turbines with occasional excursions above 6 dBA.[1] Amplitude modulation occurs at a mixture of audible frequencies and should not be confused with low frequency sound and infrasound.

Sound from wind turbines has been the subject of extensive research, conferences and publications over the past 10 to 15 years. There is considerable technical and related information available that addresses the characteristics, control and impact of sound from wind turbines. There is an abundance of well-researched and informative studies and reports from reputable institutions and individuals.

It is a common assertion that wind turbines generate significant and perhaps harmful levels of infrasound and low frequency sound. In relation to the modern generation of upwind turbines, there is little basis for this claim that can be found in any well-researched and impartial technical studies and literature. In fact, the consensus of the independent research community is that annoyance from wind turbine sound is primarily in the most audible mid to high frequencies and not from infrasound or low frequency sound.[2]

2.4 Noise Impact and Regulation

The noise impact that results from wind turbines depends on several factors, notably the change or increase in ambient or background sound levels that will result from turbine operation. For rural areas where hill or ridge top wind turbines are located, the ambient sound level at lower elevations and community locations varies by time of day, weather conditions, and to some degree, by season. Sound levels from wind turbines vary based on the wind speed and turbulence at the turbine hub and can range from no sound output during calm winds to full sound output when winds at the turbine hub reach approximately 20 miles per hour. Sound from wind turbines will be most noticeable during stable atmospheric conditions when surface winds are light and the winds aloft (at the turbine hub) remain high enough for full turbine sound output. At other times, when surface winds increase or when wind turbine output diminishes, the sound from operating wind turbines will be less noticeable.

During the planning stages of a wind energy project, considerable effort is made to accurately map land uses and the topography of the entire area potentially impacted by sound from wind turbine operation. Along with wind turbine sound level performance data, this information is used to develop a sound level prediction model for the project. The model inputs and settings are typically adjusted to produce

[1] Observations and analysis of sound level measurements for Mars Hill Wind Farm and Stetson Wind Project, R. S. Bodwell, P.E.; G.P. van den Berg, The Sounds of High Winds.
[2] G.P. van den Berg, The Sounds of High Winds.
Danish Electronics, Light and Acoustics (DELTA), Low Frequency Noise from Large Wind Turbines.

conservative sound level predictions for wind turbine operation. These results are compared to various noise regulations and guidelines to assess the impact of the proposed wind energy project.

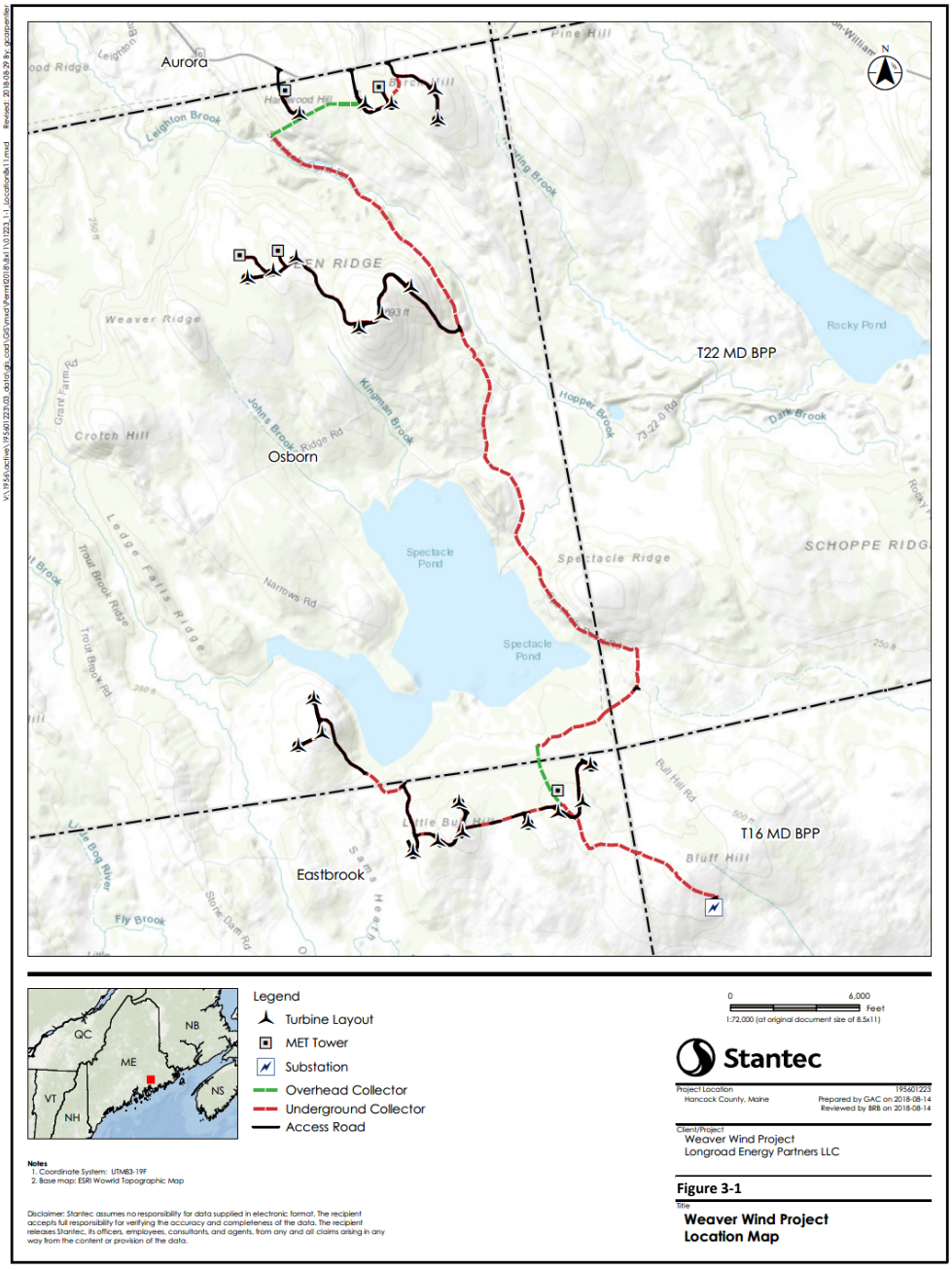
In 2012, the Maine legislature approved noise control regulations developed by the Maine DEP that are specific to wind energy developments. Chapter 375.10 Section I of Site Location of Development Law Regulations specifies sound level limits for wind energy facilities as 55 dBA daytime and 42 dBA nighttime for hourly equivalent sound levels (LAeq) at protected locations. Maine DEP nighttime limits apply up to 500 feet from a residence on a protected location or the property line if closer. In most cases, the resulting sound levels at the residence will be lower. Beyond 500 feet, the daytime limit applies 24 hours per day. The Maine DEP regulation applies sound level limits on an hourly basis whereas compliance is evaluated by averaging hourly sound levels over twelve or more ten-minute measurements with turbines operating at full rated sound output. There are also special provisions and "penalties" that apply when the sound generated by a wind project results in tonal or short duration repetitive (SDR) sounds. This standard is described in more detail in the remainder of this report.

3.0 Project Description

Weaver Wind is a 22-turbine wind energy project proposed by Weaver Wind, LLC, a wholly owned subsidiary of Longroad Energy Partners LLC, located within Hancock County in the unorganized townships of T16 MD and T22 MD, and the incorporated towns of Osborn and Eastbrook. Weaver Wind is located south of State Route 9, northwest of Bull Hill Wind, and west of Hancock Wind, which are both operating wind projects. Figure 3-1 provides a Project Location Map that shows proposed Weaver Wind turbines in relation to surrounding land uses and other wind projects. The proposed turbines for Weaver Wind will be Vestas V126, which can generate up to 3.45 MW power output, but are rated at 3.3 MW for proposed operations at Weaver. The V126 turbines would have a hub height of 117 meters and a 126-meter rotor diameter, for a total height of 180 meters (591 feet).

The power generated from each turbine will be collected in approximately 24.5 miles of 34.5-kilovolt (kV) collector lines and will flow to a new substation adjacent to the existing Bull Hill Wind substation in T16 MD. The majority of the collector lines will be placed underground. The new substation will be located within a fenced area and "step up" the power from Weaver Wind to 115 kV and transmit it directly to an existing 115-kV transmission line with capacity to accept power from the project. The Operations and Maintenance (O&M) building will be sited in the Town of Aurora at the location that was previously permitted as part of the Hancock Wind Project. Like other wind projects in the area, Weaver Wind also includes both temporary and permanent meteorological towers.

Weaver Wind, LLC has an Easement Agreement with Ursa Major, LLC for all applicable Ursa Major lands in the Town of Osborn, and a Lease Agreement with Tree Top Manufacturing, Inc. for all applicable Tree Top lands in the Towns of Osborn and Eastbrook. A lease agreement exists with Donald Jordan for the


Aurora
Osborn
Eastbrook
T22 MD BPP
T16 MD BPP
Pine Hill
Leighton Brook
Weaver Ridge
Crotch Hill
Johns Brook
Kingman Brook
Hopper Brook
Rocky Pond
Dark Brook
Spectacle Pond
Spectacle Ridge
SCHOPPE RIDG
Ledge Falls Ridge
Trout Brook Ridge
Narrows Rd
Bull Hill Rd
Bluff Hill
Fly Brook
Stone Dam Rd
Grant Farm Rd
Trout Brook Rd
Ridge Rd
Legend
Turbine Layout
MET Tower
Substation
Overhead Collector
Underground Collector
Access Road
QC
NB
ME
VT
NH
NS
0
6,000
Feet
1:72,000 (at original document size of 8.5x11)
Stantec
Project Location
Hancock County, Maine
195601223
Prepared by GAC on 2018-08-14
Reviewed by BRB on 2018-08-14
Client/Project
Weaver Wind Project
Longroad Energy Partners LLC
Figure 3-1
Title
Weaver Wind Project
Location Map
Notes
1. Coordinate System: UTM83-19F
2. Base map: ESRI Wowrld Topographic Map
Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants, and agents, from any and all claims arising in any way from the content or provision of the data.

Operations and Maintenance building site in Aurora. For the Bull Hill substation site in T16 MD (including access thereto), Weaver Wind, LLC has an easement agreement from Lakeville Shores.

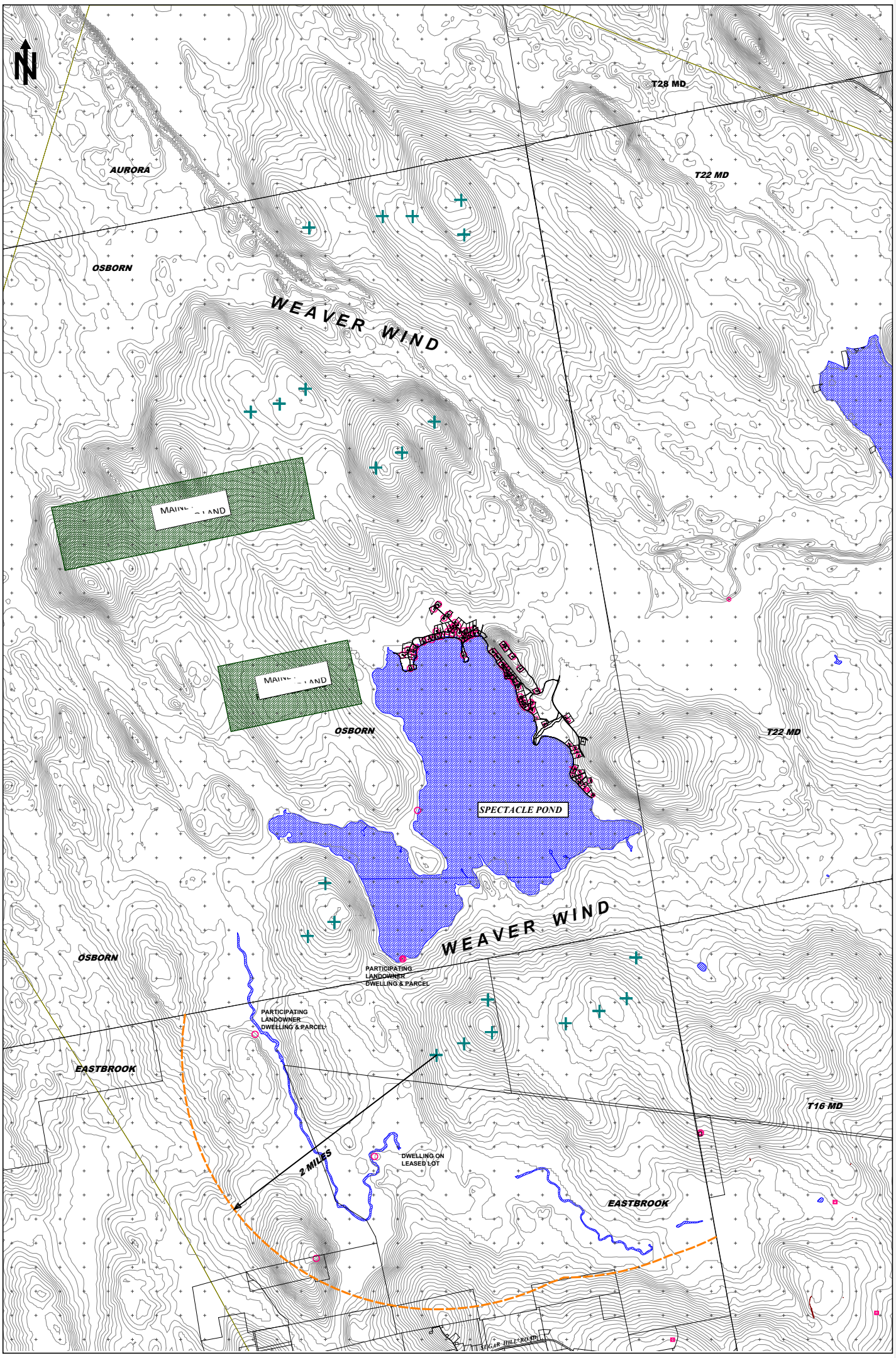
General site topography is nearly flat to gently sloping with narrow valleys between the small hills and low ridges. Ridges within the project area and include Little Bull Hill, Een Ridge, Hardwood Hill, and Birch Hill; which range in elevation from about 500 to 700 feet. Spectacle Pond in Osborn is centrally located within the project area. Large portions of the project area are managed for commercial timber production and there are many existing gravel roads providing vehicular access. Two existing wind projects in the area are Bull Hill Wind, an 18 turbine project to the southeast, and Hancock Wind, a 17 turbine project to the east and southeast of Spectacle Pond. At their closest point, turbines proposed for Weaver Wind are approximately 5,100 feet from Vestas V100 turbines operating at Bull Hill Wind and 1.6 miles from V117 turbines operating at Hancock Wind.

Other surrounding land uses consist mostly of undeveloped forestry land and rural residential and seasonal properties such as hunting and lakeside camps. The majority of residential and seasonal properties in the project vicinity are located in the Town of Osborn along the eastern shore of Spectacle Pond and are various directions from the proposed turbines. There are also a few seasonal/hunting camps located east and southwest of the proposed turbines in T22 MD and Eastbrook, respectively.

Within the Town of Osborn there are two "Original Public Lots" located on Maine Public Reserved Lands. The nearest proposed turbine is approximately 2,350 feet north of the north lot. Neither of these lots meet the criteria for "protected locations" as defined under Maine DEP Chapter 375.10.

Weaver Wind LLC has acquired fee, lease, or easement interests from local landowners to install and operate wind turbines at the proposed sites. Figure 3-2 provides a map of the proposed wind turbine sites along with parcel and land use information including topographic contours of the study area and dwellings/protected locations within two miles of a proposed wind turbine, and annotates parcels/dwellings subject to lease, easement or other agreements with Weaver Wind LLC. Additional discussion concerning leases and sound easements in relation to potentially applicable noise standards can be found in Section 5.0 of this report.

Figure 3-2. Land Uses and Proposed Weaver Wind Turbine Sites



Proposed Wind Turbine

Dwelling

Coordinate Grid Spacing = 1000 ft

Topographic Contour Interval = 3 meters (10 ft)

4.0 Wind Turbine Specifications

Weaver Wind LLC proposes to erect Vestas V126 load-optimized wind turbines (Mode LO1) with a regulated capacity of 3.3 megawatts (MW) to generate electric power for Weaver Wind. The load-optimized option decreases the maximum power rating to avoid full stops and increase overall production for specific wind conditions. The proposed V126 Mode LO1 is a pitch-regulated, upwind turbine equipped with Serrated Trailing Edges (STE) turbine blades that provide reduced sound output compared with standard "clean" blades. The turbine nacelles are mounted on tubular steel towers and house the generator, gearbox, step-up transformer, and cooling and other mechanical equipment.

Sound performance ratings are determined from acoustic testing per IEC 61400-11 and proprietary computer models developed by Vestas Wind Systems A/S. IEC 61400-11 is an international standard that establishes detailed procedures for measuring wind turbine sound and the methodology for calculating the turbine sound power level at various wind speeds. Turbine sound power levels are quantified as a "point source" for the stated purpose of conducting assessments of community sound levels resulting from wind turbine operation. The following provides a brief description of the specific characteristics of the proposed V126 turbine and its sound performance based on calculation of whole octave sound levels from one-third octave band and warranted sound levels provided by Vestas.

4.1 Vestas V126 Wind Turbine Sound Levels

The V126 would be installed at a hub height at 117 meters above the turbine base. The turbine cut-in wind speed is 3 meters/sec and the cut-out wind speed is 27.5 m/s at the turbine hub. The overall sound power level per IEC 61400-11 produced by the V126 Mode LO1 ranges from 91.3 dBA at 3 m/s low rpm to 104.3 dBA at hub height wind speeds of 10 m/s or higher. Table 4-1 provides sound levels at various hub height wind speeds ranging from 7 to 14 m/s calculated for whole (1/1) octave bands from 16 to 8,000 Hz. Sound power levels for V126 Mode LO1 (STE blades) in relation to hub height wind speeds are shown graphically in Figure 4-1[3,4].

At full operation, the Vestas V126 Load Optimized Wind Turbine with STE blades (Mode LO1) produces a warranted sound power level of 104.3 dBA with an uncertainty of 2.0 dBA. Vestas has issued a Sound Level Performance Standard with a Warranted Sound Power Level for the V126 Mode LO1, which is attached to this report as Appendix I.

Commented [BB2]: Delete if necessary

[3] Vestas Wind Systems A/S, Performance Specification, V126-3.45MW 50/60 Hz, High Torque (HTq) Variant, Document no.: 0056-6303 V05, Restricted, January 2018.
[4] Vestas Wind Systems A/S, Third octave noise emission, V126-3.45MW High Torque (HTq) DMS 0055-1399_V02, Restricted, September 2017.

Mode LO1	Hub Height Wind Speed m/s							
Frequency (Hz)	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
16	56.1	59.0	60.5	60.9	62.0	63.1	63.8	64.5
31.5	67.8	70.4	71.6	72.0	73.3	74.7	75.5	76.3
63	80.2	82.0	83.0	83.3	84.0	84.7	85.2	85.6
125	87.2	89.0	90.2	90.3	90.6	91.0	91.2	91.4
250	92.8	95.2	96.8	96.8	96.7	96.6	96.5	96.5
500	93.2	96.7	98.9	99.0	99.1	99.2	99.2	99.3
1000	93.1	96.9	99.3	99.4	99.3	99.3	99.3	99.2
2000	91.0	93.6	95.4	95.5	95.4	95.2	95.2	95.1
4000	85.3	87.1	88.5	88.5	88.3	88.2	88.1	88.0
8000	68.1	68.7	69.3	69.2	68.8	68.7	68.7	68.7
All	**99.2**	**102.2**	**104.2**	**104.3**	**104.3**	**104.3**	**104.3**	**104.3**

Hub Height: 117 m Air Density 1.225 kg/m^3
Values in accordance with IEC 61400-11 Ed. 3
Maximum turbulence at hub height: 30%
Inflow angle (vertical): +/- 2 deg

Table 4-1. Sound Power Levels for Vestas V126 STE Wind Turbine – Load Optimized (Mode LO1)

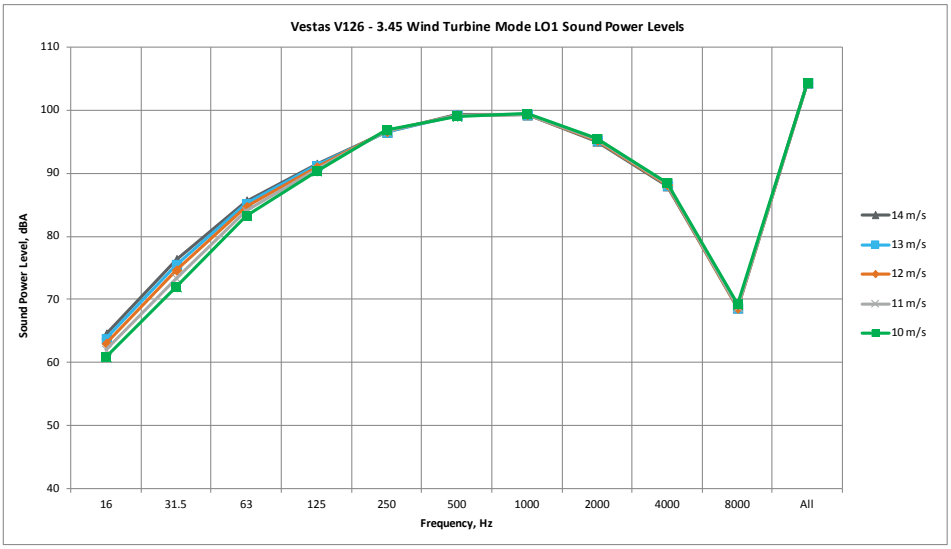


Figure 4-2. Sound Power Levels for Vestas V126 STE Load Optimized Wind Turbine (Mode LO1) for Hub Height Wind Speeds of 7 to 14 meters/second

4.3 Meteorological Conditions

Meteorological conditions have the potential to affect turbine sound levels and sound level fluctuations (i.e. amplitude modulation) from the passage of turbine blades. In addition to wind speed and direction, the primary meteorological factors are generally wind shear and turbulence intensity. These factors

have been analyzed from long-term measurements of wind data at other wind projects in Maine and at operating wind projects where sound testing has been conducted under high wind shear conditions in accordance with the Maine DEP testing protocol. Wind measurement data indicates that wind speeds are lowest during the summer months and highest during the winter months. Wind shear is typically higher during nighttime hours and turbulence intensity is higher during daytime hours.

The majority of available wind and sound level measurement data indicates that extremes in turbulence intensity and wind shear are unlikely to occur at wind projects in Maine operating at sites with characteristics similar to Weaver Wind.[5] In addition, this sound level assessment uses a widely recognized sound level prediction methodology and modeling assumptions that have been demonstrated by testing to be reliable for accuracy. See Section 6.3 of this report for further detail on verification of the sound level prediction methodology.

In addition, during winter operations, accumulation of snow and ice on turbine blades can increase turbine sound output beyond the rated sound power levels while also decreasing turbine power production. Sound level increases that can result from turbine icing conditions are addressed in Section 6.5 of this report.

5.0 Noise Standards and Guidelines

The following provides a description of State of Maine noise regulations including applicable sound level limits, model uncertainty, compliance determination and consideration of noise standards enacted by a local municipality. Relevant noise standards established by the Town of Eastbrook are also described.

5.1 Maine DEP Sound Level Limits

Maine DEP Chapter 375.10, Control of Noise, establishes hourly sound level limits for wind energy facilities based on time of day. These limits are described in Section I, Sound Level Standards for Wind Energy Developments, and apply to sound levels resulting from routine operation of a wind energy development measured in accordance with the measurement procedures described in subsection I(8).

Weaver Wind is required to meet the following sound level limits (ref. Maine DEP 375.10.I(2)):

(a) 75 dBA at any time of day at any property line of the wind energy development or contiguous property owned or controlled by the wind energy developer; and

(b) 55 dBA between 7:00 a.m. and 7:00 p.m. (the "daytime limit"), and 42 dBA between 7:00 p.m. and 7:00 a.m. (the "nighttime limit") at any protected location.

In contrast to other developments, sound level limits for wind projects do not depend on land use, local zoning and pre-construction sound levels. Although the Maine DEP noise regulation specifies a 75 dBA

[5] Town of Oakfield Wind Energy Review Committee, 2011 Review of Evergreen Wind Power II, LLC's Proposed Wind Energy Facility, Final Report, October 2011.
Stetson II Operations Sound Testing Peer Review, Warren L. Brown, EnRad Consulting, June 2011.
Pre-Filed Direct Testimony of R. Scott Bodwell, P.E., Bodwell EnviroAcoustics LLC, July 2011.

at the facility property line, the most restrictive limits apply at noise sensitive land uses that meet the definition of a "protected location". A protected location is defined as:

> "Any location accessible by foot, on a parcel of land containing a residence or planned residence or approved residential subdivision, house of worship, academic school, college, library, duly licensed hospital or nursing home near the development site at the time a Site Location of Development application is submitted; or any location within a State Park, Baxter State Park, National Park, Historic Area, a nature preserve owned by the Maine or National Audubon Society or the Maine Chapter of the Nature Conservancy, The Appalachian Trail, the Moosehorn National Wildlife Refuge, federally-designated wilderness area, state wilderness area designated by statute (such as the Allagash Wilderness Waterway), or locally-designated passive recreation area; or any location within consolidated public reserve lands designated by rule by the Bureau of Public Lands as a protected location.
>
> At protected locations more than 500 feet from living and sleeping quarters within the above noted buildings or areas, the daytime hourly sound level limits shall apply regardless of the time of day.
>
> Houses of worship, academic schools, libraries, State and National Parks without camping areas, Historic Areas, nature preserves, the Moosehorn National Wildlife Refuge, federally-designated wilderness areas without camping areas, state wilderness areas designated by statute without camping areas, and locally-designated passive recreation areas without camping areas are considered protected locations only during their regular hours of operation and the daytime hourly sound level limits shall apply regardless of the time of day.
>
> Transient living accommodations are generally not considered protected locations; however, in certain special situations where it is determined by the Board that the health and welfare of the guests and/or the economic viability of the establishment will be unreasonably impacted, the Board may designate certain hotels, motels, campsites and duly licensed campgrounds as protected locations." (ref. MDEP 375.10 G(16))

Maine DEP Chapter 375.10 defines a "residence" as:

> "A building or structure, including manufactured housing, maintained for permanent or seasonal residential occupancy providing living, cooking and sleeping facilities and having permanent indoor or outdoor sanitary facilities, excluding recreational vehicles, tents and watercraft." (ref. MDEP 375.10 G(14))

The nighttime limit of 42 dBA applies on portions of a protected location within 500 feet of a residence or other sleeping quarters, or at the property boundary line of the protected location, whichever is closer to the dwelling. At locations greater than 500 feet from the residence or sleeping quarters, the 55 dBA daytime limit applies 24 hours a day. Sound from regular and routine maintenance of the wind project is subject to the same sound level limits as routine operation.

Construction during daytime or daylight hours, whichever is longer, is exempt from the Maine DEP sound limits by Maine statute (ref. 38 MRSA 484). Sound from nighttime construction that occurs beyond daytime or daylight hours is subject to the nighttime limits that apply to routine operation. More information concerning construction of Weaver Wind is presented in Section 6.1 of this report.

Sound associated with certain equipment and activities is exempt from the Maine DEP noise regulation. Examples that may be associated with the proposed project include:

- Registered and inspected vehicles traveling to and from the project
- Forest management, harvesting and transportation
- Snow removal and landscaping
- Emergency maintenance and repairs, warning signals and alarms
- Major concrete pours when started before 3:00 pm
- Sounds from a regulated development received at a protected location when the generator of the sound has been conveyed a noise easement for that location
- A force majeure event and other causes not reasonably within control of the owners or operators of the development

The Maine DEP limits do not apply to noise received within the project boundary or where Weaver Wind, LLC has obtained a sound easement. As set forth by Maine DEP 375.10, Section C.5.s, a landowner may grant a noise (sound) easement that exempts the project from Maine DEP noise limits for the specific development, parcel of land, and term covered by the agreement. In addition, dwellings located on lease lots are subject to the terms of the lease agreement whereby the landowner can grant an easement from Maine DEP noise limits.

5.2 Tonal and Short Duration Repetitive (SDR) Sounds

Maine DEP Chapter 375.10 Section I requires that 5 dBA be added to tonal and short duration repetitive (SDR) sounds when determining compliance with hourly sound level limits. Further details and an assessment of these types of sound for Weaver Wind are presented in Section 6.3 of this report.

5.2.1 Tonal Sounds

For wind energy facilities, a tonal sound exists if, at a protected location, the 10-minute equivalent one-third octave band sound pressure level in the band containing the tonal sound exceeds the arithmetic average of the sound pressure levels of the two contiguous one-third octave bands by 5 dB for center frequencies at or between 500 Hz and 10,000 Hz, by 8 dB for center frequencies at or between 160 and 400 Hz, and by 15 dB for center frequencies at or between 25 Hz and 125 Hz. When a tonal sound occurs from routine operation of the wind energy development, 5 dBA is added to the 10-minute equivalent sound level (LeqA 10-min) for purposes of demonstrating compliance with the applicable daytime and nighttime sound level limits (ref. Maine DEP 375.10.I(3)).

5.2.2 Short Duration Repetitive (SDR) Sounds

An SDR sound is a sequence of repetitive sounds clearly discernible as an event resulting from the development and causing an increase in the sound level of 5 dBA or greater on the fast meter response above the sound level observed immediately before and after the event. An SDR sound event for wind turbines can potentially result from the down-stroke of wind turbine blade at intervals of ±1 second.

When routine operation of a wind energy development produces SDR sounds, a 5 dBA penalty is arithmetically added to each 10-minute LAeq (LeqA 10-min) measurement interval in which greater than five SDR sound events are present (ref. Maine DEP 375.10.I(4)).

5.3 Compliance with the Sound Level Limits

Compliance with the applicable sound level limits for wind energy developments is demonstrated in accordance with the following:

(a) Sound level data shall be aggregated in 10-minute measurement intervals within a given compliance measurement period under the atmospheric and site test conditions set forth in subsection I(8).
(b) Compliance will be demonstrated when the arithmetic average of the sound level of twelve or more 10-minute measurement intervals (i.e. average of twelve 10-min measurement intervals) in a given compliance measurement period is less than or equal to the applicable sound level limits.
(c) Alternatively, if a given compliance measurement period does not produce a minimum of twelve, 10-minute measurement intervals under the atmospheric and site conditions set forth in subsection I(8), the wind energy development may combine six or more contiguous 10-minute measurement intervals from one 12 hour (7:00 am to 7:00 pm daytime or 7:00 pm to 7:00 am nighttime) compliance measurement period with six or more contiguous 10-minute intervals from another compliance measurement period.

Compliance is demonstrated when the arithmetic average of the combined 10-minute measurement intervals is less than or equal to the applicable sound level limit. The 10-minute intervals are measured under the required atmospheric and site conditions and include any applicable adjustments for the presence of tonal and SDR sounds (ref. Maine DEP 375.10.I(5)).

5.4 Local Standards

When a development is located in a municipality that has duly enacted a quantifiable noise standard that (1) contains limits that are not higher than the Maine DEP limits by more than five dBA, and (2) limits or addresses the types of sounds regulated by the Maine DEP, then the Maine DEP is to apply the local standard rather than the Maine DEP standard. When noise produced by a facility is received in another municipality, the quantifiable noise standards of the other municipality must be taken into consideration (ref. Maine DEP 375.10.B.1).

The proposed wind turbines for Weaver Wind are located in unorganized townships T16 MD and T22 MD, and incorporated towns of Osborn and Eastbrook. Unorganized townships have no local land use ordinances. The Town of Osborn has not enacted any land use ordinance or comprehensive plan, and land use in Osborn is regulated by the Maine Land Use Planning Commission (LUPC). Accordingly, Osborn does not have a duly enacted municipal noise control ordinance for the purposes of Maine DEP Chapter 375.10 noise rules. On January 19, 2011, the Town of Eastbrook enacted the Eastbrook Wind Energy Facility (WEF) Ordinance establishing noise standards that apply to wind energy facilities located within the Town.

The main components of the Eastbrook Ordinance addressing noise are as follows:

- Sound Limits - the hourly sound levels resulting from routine operation of the facility and measured in accordance with the measurement procedures described in Subsection F[6] may not exceed the following limits within 660 feet of any Protected Location:

[6] Measurement procedures are also described in Appendix B Subsection D of the Wind Energy Facility Ordinance.

  - 55 dBA between 7:00 a.m. and 6:00 p.m. (the "daytime hourly limit"), and
  - 40 dBA between 6:00 p.m. and 7:00 a.m. (the "nighttime hourly limit")
- Tonal Sounds - 5 dBA must be added to the observed measurements of any tonal sounds that result from routine operation of the facility. For example, if sound from the facility is measured to be 50 dBA, then the sound level for the purposes of determining compliance with the sound level limits is 55 dBA.
  NOTE: Per Subsection F. Measurement Procedures, tonal sounds are evaluated on an hourly basis.
- SDR Sounds - When routine operation of a facility produces an SDR sound, the following limits apply:
  - 5 dBA must be added to the observed measurements of SDR sounds that result from routine operation of the facility
  - For SDR sounds which the Planning Board determines are particularly annoying or pose a threat to the health and welfare of other persons due to their character or duration, a second 5 dBA increment must be added to the observed levels of the short duration repetitive sounds that result from routine operation of the facility and the maximum sound level of the SDR sounds shall not exceed 55 dBA within 660 feet of any Protected Location at any time
- Two Mile Limit - the hourly sound levels resulting from routine operation of the facility may not exceed 35 dBA at any location greater than 2 miles from a wind turbine.
- Wildlife - The sound level limits do not preclude the Planning Board from requiring an Applicant to demonstrate that sound levels from a facility will not unreasonably disturb wildlife or adversely affect wildlife populations. In addition, the sound level limits shall not preclude the Planning Board, as a term or condition of approval, from requiring that lower sound level limits be met to ensure that the Applicant has made adequate provision for the protection of wildlife resources.
- Compliance Testing - During the period April through December of the first year of commencement of operation of an approved Wind Energy Facility, the applicant shall arrange a post-construction sound study with all wind turbines operating to be performed by a qualified firm to determine actual noise levels from the WEF and assess compliance with noise standards set forth in the facility permit and this ordinance. The Applicant shall notify the Planning Board at least 30 days prior to conducting the study and the town may observe all field work and shall be given an opportunity to review the study's methodology and results. A second sound study must be performed during the same period in the second year and at least every 3 years thereafter.
- Other Testing - Measurements of the sound from routine operation of facilities are generally necessary for specific compliance testing purposes in the event that community complaints result from operation of the facility, for validation of an Applicant's calculated sound levels when requested by the Planning Board, for determination of existing hourly sound levels for an existing facility or for enforcement purposes.
- In addition to technical information and predicted sound levels from wind turbine operations, specific submission requirements include:
  - a description of the Protected Locations within two miles of the proposed facility[7]
  - the turbine sound power level frequency spectrum in 1/3-octave bands
- Sound from construction activities at the facility location occurring between 7:00 a.m. and 6:00 p.m. is subject to the following limits within 660 feet of a protected location based on the duration of the activity:

>6 hours	80 dBA
2 to 6 hours	85 dBA
>1 hour but <2 hours	95 dBA
1 hour or less	105 dBA

- Sound from construction activities occurring between 6:00 p.m. and 7:00 a.m., including construction activities conducted concurrently with routine operation of the facility, is subject to the nighttime sound levels for routine operation of the facility as shown above.

[7] The Eastbrook definition of a protected location is consistent with Maine DEP Chapter 375.10 but also includes "active bald eagle nest" (ref. Section 4.0 Definitions).

- All equipment used in construction on the facility site must comply with applicable federal noise regulations and must include environmental noise control devices in proper working condition, as originally provided with the equipment by its manufacturer.

As set forth in Maine DEP 375.10, the local quantifiable noise standards of a town where sound emissions will be received are also to be taken into consideration. Noise standards contained in the Eastbrook Wind Energy Facility Ordinance were taken into account for Bull Hill Wind and Hancock Wind, which have no turbines within the Town of Eastbrook. The applicability of the Eastbrook noise standard to wind turbines located outside the Town of Eastbrook is set forth in LUPC Development Permit 4886 for Bull Hill Wind. Finding no. 40 of LUPC Permit DP 4886 issued to Bull Hill Wind in 2011 describes the criteria of Eastbrook noise standards and evaluates their applicability with respect to noise rules established under the Site Location of Development Law. The applicable noise standards were evaluated with respect to the pre-construction sound level assessment for the Bull Hill Wind Project and additional sound modeling analysis requested by LUPC staff. Findings were made by LUPC with assistance from EnRad, Inc., the Commission's sound peer review consultant at that time. [8]

LUPC Permit DP 4886 establishes the following noise control criteria for operation of Bull Hill Wind pursuant to Maine DEP 375.10 and after full consideration of the noise standards contained in the Eastbrook Wind Energy Facility Ordinance (ref. DP 4886 Finding 40.D (2)).

a. Protected Locations. The nighttime hourly noise level produced during routine operation during the hours 7:00 p.m. to 7:00 a.m. at the nearest quiet protected location in Eastbrook is not to exceed 40 dBA.
b. Two-mile limit. A sound level limit of 35 dBA applies at any location two miles from the project within the Town of Eastbrook as set forth in the Eastbrook ordinance.
c. Tonal Sounds. The Commission applied the provisions for tonal sounds at a protected location as set forth in Section C (1)(d) of MDEP 375.10.
d. Short Duration Repetitive Sounds. The Commission applied the provisions for SDR sounds at a protected location as set forth in Section C (1)(e) of MDEP 375.10. The Commission specifically found the additional SDRS penalty of a second 5 dBA to be imposed at the discretion of the local planning board was not quantifiable because it is a "subjective determination".

For Bull Hill Wind and consistent with the Maine DEP definition of a protected location, the LUPC applied the 40 dBA Eastbrook nighttime limit up to 500 feet from a dwelling within a protected location (parcel) in the Town of Eastbrook. Consequently, the Eastbrook 40 dBA limit applied only within protected locations inside the Eastbrook town boundaries. Maine DEP limits per MDEP 375.10 Section C. were applied at all other protected locations. The Eastbrook sound limits were not evaluated for sound from Hancock Wind due to low turbine sound levels resulting from the relatively large distances between wind turbines and protected locations in Eastbrook.

[8] Sound Level Assessment, Bull Hill Wind Project, R. Scott Bodwell, P.E., Bodwell EnviroAcoustics LLC, Exhibit 17, LUPC Development Permit Application, February, 2011.
EnRad Consulting, Warren Brown, Bull Hill Wind Project Sound Level Assessment – Peer Review, March 2011.
Maine Land Use Planning Commission, Development Permit DP 4886, Blue Sky East, October 2011.

For Weaver Wind, eight of the proposed turbine sites are located within the Town of Eastbrook. For these turbine sites, the Eastbrook sound limits apply within the Eastbrook town boundary at protected locations and up to 660 feet from protected locations, as set forth in the Eastbrook WEF Ordinance. The remainder of the turbine sites are located outside the Town of Eastbrook. The nearest of these turbines is located in Osborn approximately 2,290 feet north of the Eastbrook town boundary and 1.8 miles from the nearest protected location in Eastbrook. Due to distances from protected locations in Eastbrook, proposed turbines for Weaver Wind located outside of Eastbrook are not expected to be a significant source of sound at protected locations in Eastbrook. Under these circumstances, there does not appear to be a need for the Maine DEP to consider the Eastbrook ordinance to wind turbine sites outside of Eastbrook. However, for the purposes of this sound assessment, BEA evaluated compliance with the Eastbrook sound limits up to 660 feet from any protected location in Eastbrook, regardless of the turbine location. Further, although not required and for informational purposes only, Appendix II of this report presents an analysis of the combined sound levels from Weaver Wind, Hancock Wind and Bull Hill Wind taking into account turbines from all three projects. Sound levels are calculated at protected locations for all projects applying the local quantifiable standards consistent with findings made under LUPC DP 4886 for Bull Hill Wind.

5.5 Sound Model Factors and Uncertainty

Maine DEP noise rules require the predictive model used to calculate sound levels produced by wind turbines to be designed to represent the "predictable worst case" impact on adjacent properties. In particular, the predictive model is required to include the following (ref. Maine DEP 375.10.I(7)):

a. The maximum rated sound power output (IEC 61400-11) of the sound sources operating during nighttime stable atmospheric conditions with high wind shear above the boundary layer and consideration of other conditions that may affect in-flow airstream turbulence;

b. Attenuation due to geometric spreading, assuming that each turbine is modeled as a point source at hub height;

c. Attenuation due to air absorption, ground absorption and reflection, three dimensional terrain and forestation;

d. Attenuation due to meteorological factors such as but not limited to relative wind speed and direction (wind rose data), temperature/vertical profiles and relative humidity, sky conditions, and atmospheric profiles;

e. Inclusion of an “uncertainty factor” adjustment to the maximum rated output of the sound sources based on the manufacturer’s recommendation; and

f. Inclusion, at the discretion of the Maine DEP, of an addition to the maximum rated output of the sound sources to account for uncertainties in the modeling of sound propagation for wind energy developments. This discretionary uncertainty factor of up to 3 dBA may be required by Maine DEP based on the following conditions: inland or coastal location, the extent and specificity of credible evidence of meteorological operating conditions, and the extent of evaluation and/or prior specific experience for the proposed wind turbines. Subject to the Maine DEP’s discretion based on the information available, there is a rebuttable presumption of an uncertainty factor of 2 to 3 dBA for coastal developments and of 0 to 2 dBA for inland developments.

6.0 Sound Emissions

The following provides an assessment of sound levels associated with construction and operation of Weaver Wind.

6.1 Construction Sound Levels

Construction of Weaver Wind will involve the use of heavy machinery to clear and grade areas for roads and turbine pads, erect wind turbine towers, and assemble the nacelle and turbine blades. This equipment will include heavy trucks, excavators, loaders, bull dozers, cranes, portable generators and compressors among other machines. Construction staging yards will also be established in designated areas for storage of equipment, materials, and wind turbine components.

Depending upon whether aggregate material can be found on site or transported to the project, there may also be equipment operating at the project site to excavate gravel, crush rock and process aggregate. Sound levels from mobile construction and portable processing equipment is likely to generate sound levels in the range of 75 to 95 dBA at 50 feet. Due to the size and configuration of the project site, most of this equipment will be well distributed and not focused in a single area.

Operation of heavy equipment for site work and other major construction activity between 7 am and 7 pm or during daylight hours, whichever is longer, is not subject to the Maine DEP noise control regulation per Maine statute (ref. 38 MRSA Section 484). Construction activity during nighttime, non-daylight hours must comply with the nighttime limits applicable to routine facility operation.

The Town of Eastbrook regulates sound from construction activities occurring between 7:00 a.m. and 6:00 p.m. within 660 feet of a protected location with sound limits ranging from 80 dBA over six hours or more and 105 dBA for one hour or less. Similar to Maine DEP, construction activity during nighttime hours must comply with the nighttime limits applicable to routine facility operation. Per both Maine DEP and the Town of Eastbrook, all construction equipment must also comply with applicable federal noise regulations and include environmental noise control devices in proper working condition as originally provided by the equipment manufacturer.

Construction activity is expected to occur between the hours of 7 a.m. and 6 p.m. Based on the distance to the nearest protected location in Eastbrook, sound levels from construction activity during daytime hours is not expected to exceed sound limits established by the Eastbrook ordinance. Construction activity in Eastbrook that occurs during nighttime hours (6 p.m. to 7 a.m.) must comply with the nighttime limits applicable to routine facility operation. Construction activity during nighttime, non-daylight hours outside of the Town of Eastbrook must comply with the nighttime limits applicable to routine facility operation.

6.2 Wind Turbine Sound Power Levels

As described in Section 4.0, wind turbine sound power levels were provided by Vestas Wind Systems A/S based on sound testing per IEC 61400-11 and proprietary computer models.

Vestas reports and warrants that the full-rated sound power level for operation of the V126 Mode LO1 (STE blades) is 104.3 dBA with a stated uncertainty of ±2.0 dBA. For modeling purposes, adding the turbine uncertainty to the full sound output yields a maximum continuous sound power level of 106.3 dBA for the proposed V126 turbine type and mode. At a hub height of 117 meters (383.9 feet) above the ground, the resulting elevations of the turbine hubs (modeled point sources) range from 761 to 1072 feet above msl, with base elevations ranging from 377 to 688 feet.

Vestas provided third-octave band and overall sound power levels for turbine operation at various wind speeds for use in the sound level prediction model. The resulting octave band sound levels calculated for a hub wind speed of 12 m/s, yielding the highest sound level predictions, were used in the sound model for the V126 Mode LO1 turbines. An adjustment of +2 dBA was applied for the warranted sound level plus stated uncertainty for the overall sound power level of 106.3 dBA. As described in Section 6.3, an additional 1 dBA was added to the turbine sound power levels for model accuracy.

6.3 Sound Prediction Model

A sound level prediction model was prepared to calculate the sound levels from daytime and nighttime operation of Weaver Wind. The predictive sound model was created using Cadna/A software developed by DataKustik of Germany. Cadna/A provides the platform to construct topographic surface models of area terrain for calculating sound attenuation from multiple sound sources such as wind turbines. Mapping of proposed turbine locations, roads, parcels, land uses and water bodies was imported to Cadna/A in order to calculate the resulting sound levels at points within the study area. Although substation equipment emits sound, this equipment is not considered to be a significant sound source due to its relatively low sound output, low source height and large distances from regulated protected locations. Project met towers are also not expected to be significant sound sources.

Sound level predictions are calculated in accordance with ISO 9613-2, an international standard for calculating outdoor sound propagation. This method calculates sound levels as though all receiver points were located downwind simultaneously from the sound sources, which is for calculation purposes and not a physical possibility. According to ISO 9613-2, the calculation method is also equivalent to sound propagation for a "well-developed moderate ground-based temperature inversion." The stated accuracy of the ISO 9613-2 method is ±3 dBA for a source and receiver mean height of 5 to 30 meters and a distance of 100 to 1000 m. Although the mean source height between wind turbine hubs (117 meters) and receivers (1.5 meters) is closer to 59 meters, use of Cadna/A and ISO 9613-2 has been

found to be accurate for prediction of wind turbine sound levels at distances of the regulated protected locations.[9]

The terrain for the surface model was mapped from USGS topographic contours at 3 meter intervals (10 ft) provided to BEA by Weaver Wind, LLC with proposed turbine site locations and used to determine approximate turbine base elevations. The parcel boundaries and dwelling locations for the model were provided by project mapping consultants and provided to BEA. Dwellings locations were mapped through use of aerial photography and field verification in 2014 with the parcel associations confirmed from review of tax assessor records. Any additional parcels with approved residential building permits or that are part of an approved residential subdivision since 2014 were researched in August 2018 by review of state and municipal records by Stantec Consulting.

Cadna/A allows flexibility in defining model settings and adjustments related to calculation methods, ground absorption and other factors. Additionally, as discussed above, conservative assumptions are utilized with respect to each of these factors. Sound measurements of turbine operations at numerous projects in Maine have been evaluated to ensure that the model is "calibrated" to actual sound levels for reliable model predictions. As the following describes, model settings have been applied to predict the high range of wind turbine sound levels as measured under a wide variety of site and weather conditions at other projects.

Other model settings were selected to calculate ground attenuation using the spectral method per ISO 9613-2 and using a default ground absorption factor of 0.5 to represent a mix of hard and soft ground. Surface water bodies were mapped and assigned a ground absorption factor of 0.0 similar to hard ground for an acoustically reflective surface. Attenuation resulting from intervening terrain using USGS contours and atmospheric absorption using standard day conditions (temperature 10°C, relative humidity 70%) was also calculated. No attenuation was calculated due to trees or other foliage that could act to reduce sound levels at community locations.

Results from other wind energy facilities in Maine where wind turbines are located on similar ridge top settings indicate that the high end of the measurement range can be predicted by adding the manufacturer's warranted sound power level uncertainty and 1 dBA for the demonstrated accuracy of ISO 9613-2 in accordance with Section I of Maine DEP 375.10. For Weaver Wind, that equals a total 3 dBA added to the turbine sound power levels for model calculations.

[9] K. Kaliski and E. Duncan, Propagation Modeling Parameters for Wind Power Projects.
Town of Oakfield, Wind Energy Review Committee, Final Report.
Stetson Wind, Operations Compliance Sound Level Study.
EnRad Consulting, Oakfield Wind Project Amendment, Sound Level Assessment – Peer Review.
Stetson II Wind Project, Operations Sound Testing.
Rollins Wind Project, Operations Sound Testing.
Bull Hill Wind Project, Operations Sound Testing, Years 1, 2, and 3.
Hancock Wind Project, Year 1 Operations Sound Testing.

6.4 Tonal and Short Duration Repetitive (SDR) Sounds

The Maine DEP noise rule requires that 5 dBA be added to the measured 10-minute equivalent sound level at a protected location if sound from a development generates either 1) a tonal sound and 2) more than five SDR sound events over a ten-minute measurement interval.

6.4.1 Tonal Sounds

The Vestas V126 Sound Level Performance Standards (Appendix I) warranty the overall sound power level of the proposed turbines and further warranty that the V126 Mode LO1 will not produce tonal sounds as defined by Maine DEP 375.10. Measurement reports for the V126 Mode 0 turbines, unrestricted version of the same turbine platform as the proposed load-optimized turbine, indicate potential for tonality in some frequencies but at levels well below the Maine DEP criteria for regulated tonal sounds. From the available turbine testing data and Sound Level Performance Standards, the proposed V126 wind turbines are not expected to generate regulated tonal sounds during routine operation.[10]

Commented [BB3]: Delete if necessary

Commented [BB4]: Redraft as necessary---If no warranty may have to state this about Mode 0, and then say the same tonal sounds below regulatory criteria are expected for the Mode L01

Commented [SB5]: Per Juliet, explain Mode 0 turbines in relation to LO1

6.4.2 Short Duration Repetitive (SDR) Sounds

For wind turbines, short duration changes in sound levels occur with the movement of individual rotor blades. This is commonly referred to as "amplitude modulation". The highest sound levels are generally recognized to occur on the down stroke of each rotor blade which occurs at a rate of just over once per second at full rotational speed. The sound performance data provided for the Vestas V126 LO1 turbines do not specifically address the sound level change that occurs due to amplitude modulation.

Measurements of operating wind turbines at other projects in Maine and published literature concerning amplitude modulation from wind turbines indicate that sound level fluctuations during the blade passage of wind turbines typically range from 2 to 5 dBA (see also Section 2.3), with occasional but infrequent events reaching 6 dBA or more. Overall, sound testing at operational wind projects including Stetson I and II, Rollins, Bull Hill, and Hancock Wind indicates that SDR sound events are relatively uncommon even under stable atmospheric conditions, high wind shear and other factors identified in technical studies as having the potential to increase amplitude modulation. [11,12] Operational sound testing of Weaver Wind will evaluate the potential presence of SDR sound events and, if present, apply the required penalty for determining compliance.

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[10] DNV-GL, Results of acoustic noise measurements according to IEC 61400-11 Edition 3, Vestas V126-3.3MW IEC3A, mode 0, V201503, November 2014.

[11] Operations Sound Testing, Rollins Wind Project, Bodwell EnviroAcoustics LLC, July, 2012.
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Siponen, D., The assessment of low frequency noise and amplitude modulation of wind turbines, 2011.

[12] In addition, results of Operations Sound Testing at nearby Bull Hill and Hancock Wind indicate that turbine sound levels are below sound model predictions using these model assumptions. Further, occurrences of SDR sound events as defined by Section I of MDEP 375.10 were low.

6.5 Predicted Sound Levels

From the project sound model, wind turbine sound levels during full operations were calculated for a height of 5 feet above ground level as specified by Maine DEP 375.10. To evaluate compliance with applicable sound limits, sound levels were calculated and presented specifically for selected community receptor points. "Receptor points" are the locations in each direction from Weaver Wind with the greatest potential to exceed the Maine DEP or Town of Eastbrook sound level limits. In addition, sound level contours were calculated to provide model predictions at all locations within the study area. A grid spacing of 20 meters by 20 meters was used to calculate the sound level contours. For informational purposes only, Appendix II provides additional model predictions of combined sound levels from Weaver, Hancock and Bull Hill Wind.

Sound level predictions for Weaver Wind were calculated with all proposed wind turbines operating at full-rated sound power output, and the addition of 3 dBA for modeling the V126 Mode LO1 turbines based on turbine manufacturer uncertainty of 2 dBA and model accuracy of 1 dBA. Sound level isopleths at 1 dBA intervals were calculated for the V126 Mode LO1 and are presented in Figure 6-1 along with calculated sound levels at the selected receptor points. Figure 6-1 also shows the turbine locations, parcel boundaries, dwelling locations, public and private roads, and water bodies, as well as parcels within the study area that are owned independently from lands purchased, leased or under easement by Weaver Wind LLC.

A summary of predicted sound levels at the receptor points for daytime and nighttime operation of the proposed Vestas V126 turbines is provided in Table 6-1. This table also provides the distance from each receptor point to the nearest turbine and the applicable nighttime sound level limit.

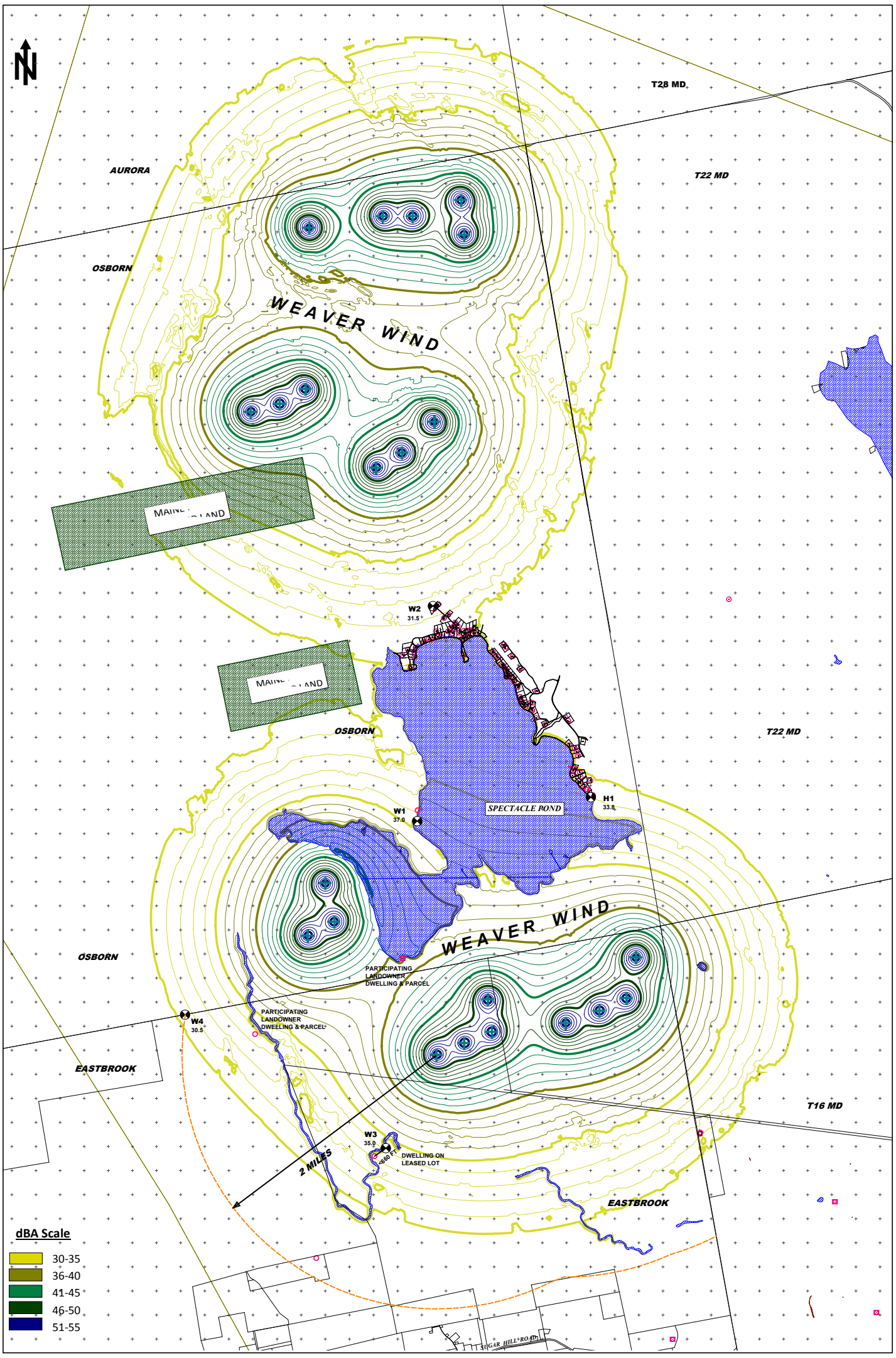
Receptor Point	Description and Approximate Distance to Nearest Weaver Wind Turbine		Predicted Hourly Sound Level and Nighttime Sound Limit, dBA	
	Description	Distance (ft)	V126 LO1	Sound Level Limit
W1	Osborn – Dwelling on Private Lot	4,590	37.0	42
W2	Osborn – Dwelling on Private Lot	6,225	31.5	42
W3[a]	Eastbrook – Dwelling on Leased Lot	4,390	35.0	40
W4	Eastbrook – Two Miles from Turbine	10,560	30.5	35
H1[b]	Osborn – Dwelling on Private Lot	4,830	33.8	42

[a] W3 is the nearest protected location subject to the Eastbrook limits. It is a dwelling on a leased lot where the extent of the leased area is the footprint of the dwelling.

[b] H1 is a receptor point used for the Hancock Wind Sound Level Assessment and Operations Sound Testing

Table 6-1. Predicted Sound Levels from Wind Turbine Operations at Receptor Points

Figure 6-1. Predicted Sound Levels from Full Routine Operation of Weaver Wind



Wind Turbine

Dwelling

W3 35.0 Receptor Point & Predicted Sound Level

Coordinate Grid Spacing = 1000 ft

Sound Level Contour Intervals:
Bold = 5 dBA
Intermediate = 1 dBA

Receptor points include the nearest protected locations to Weaver Wind and the location within Eastbrook showing the highest predicted sound level two miles from a proposed turbine. With discretionary settings and uncertainty included in the Weaver predictive model (i.e. 3 dBA added to the turbine sound power level), the resulting sound levels are below the Maine DEP and Eastbrook daytime limit of 55 dBA at all receptor points. The predicted sound levels are also below the Maine DEP 42 dBA nighttime limit applicable within 500 feet of sleeping quarters at protected locations in Osborn (Receptors W1, W2, and H1) and below the Eastbrook 40 dBA nighttime limit applicable within 660 feet of protected locations in Eastbrook (Receptor W3)[13]. In addition, the predicted sound level within two miles of a proposed turbine in Eastbrook (Receptor W4) is below the Eastbrook two-mile limit of 35 dBA. Protected locations within unorganized areas are also well below the applicable Maine DEP limits.

A review of predicted sound levels indicates that when operating at full sound output, Weaver Wind will comply with all applicable Maine DEP and Eastbrook sound level limits. As noted in Section 3.0 above, the nearest Weaver Wind turbines to other wind projects are approximately 5,100 feet from any Bull Hill V100 turbine and 1.6 miles from any Hancock V117 turbine. Although not required, see Maine DEP 375.10 Section B (Applicability), and for informational purposes only, Appendix II of this report provides an analysis of the predicted combined sound levels from the existing Bull Hill Wind, Hancock Wind, and proposed Weaver Wind projects. As demonstrated in Appendix II, the combined sound levels will comply with the Maine DEP and Eastbrook sound level limits.

Operations sound testing of wind turbines during winter periods has demonstrated that turbine sound output can increase under conditions when turbine blade icing occurs. Detailed analysis of turbine performance in relation to sound output has shown a consistent relationship between turbine power degradation (TPD) and sound level increases. These results indicate that a moderate to heavy icing condition with a TPD of approximately 40% or more is required to increase sound levels by 5 dBA. From the Project sound model for predictable worst-case operating conditions, the sound buffers for compliance at the nearest residential receptor point to Weaver Wind turbines are 5 dBA during nighttime operations and 15 dBA during daytime periods. Consequently, even with moderate icing, the project will comply with the nighttime limit of 42 dBA. The potential exists, however, for nighttime operations under heavy icing conditions to exceed the nighttime sound limits at worst-case residential receptor point for Weaver Wind.[14] To ensure compliance during heavy icing conditions, the applicant will implement one of the following measures:

1. Programming specific turbines to pause when the TPD reaches 40% or greater for three consecutive 10-minute operating periods.
2. Programming specific turbines to implement noise-reduced operating (NRO) modes to offset the increase in turbine sound levels during icing conditions.

Commented [BB6]: Reviewers: New paragraph about winter operations and Oakfield results.

[13] The Eastbrook nighttime limit of 40 dBA applies only at protected locations in Eastbrook and to turbines located in the Town of Eastbrook. Nonetheless, the model predictions account for sound from all project turbines, not just the Eastbrook turbines.

[14] Winter Operations Sound Testing, Oakfield Wind Project, BEA, September 2017.

6.6 Infrasound and Low Frequency Sound

Maine DEP does not specifically regulate infrasound or low frequency sound or vibrations and other impacts that may result from such sounds. Independent research and testing have indicated that impacts from infrasound and low frequency sounds from wind turbines are uncommon and not likely to be of concern from a properly sited, designed, and operated wind energy facility. The findings of several of these independent sources are outlined in the Site Location of Development Orders issued by the Maine DEP for other projects in Maine and therefore will not be discussed further in this report. Further, the Maine DEP found "that compliance with Chapter 375§10 is likely to ensure that there are no adverse health effects due to the proposed project."[15]

7.0 Sound Level Testing

The purpose of sound level testing is to confirm by measurement that sound levels emitted by Weaver Wind are at or below the sound level limits applicable to the project.

7.1 Project Construction

Construction of Weaver Wind is planned to primarily occur during daytime hours when sound levels generated by construction activity are exempt from the Maine DEP sound level limits by Maine statute and the Town of Eastbrook specifies higher construction sound limits. Therefore, no sound level testing is planned for the construction phase of the project.

If nighttime non-daytime construction occurs, such construction activity is required to comply with nighttime sound level limits for routine operation and maintenance of the project.

7.2 Wind Turbine Operations

Sound level testing of wind turbine operations is a complex and critical component of the proper and responsible operation of a wind energy facility. The most difficult aspect of wind turbine sound testing is to perform the required measurements under the appropriate site and weather conditions. Operation of wind turbines at full sound output requires significant wind speed acting on the turbine hubs for an extended period of time. Often when hub wind speeds are at the required levels, surface winds will also be high enough to cause extraneous sound levels from wind forces acting on terrain and vegetation. These extraneous sounds can mask noise from turbines making it difficult to isolate and quantify sound levels from the wind power project.

However, during nighttime periods, the winds aloft along the project ridges and wind turbine hubs can remain strong while the surface winds at lower elevations near protected locations can diminish to light or nearly calm. These conditions are commonly referred to as a "stable atmosphere" and are the best

[15] Maine DEP, Site Location of Development Act Order, Oakfield Wind Project, January 2010.

conditions under which to measure the sound level contributions of wind turbines for several reasons. First, the ambient (non-wind turbine) sound levels from wind and daytime activities are reduced so that the sound levels from wind turbines become more prominent and easier to quantify. Second, technical literature concerning wind turbine noise emissions indicates that the potential for amplitude modulation (and resulting potential for SDR sounds) increases with rotor-plane wind shear, which typically increases under stable atmospheric conditions. Therefore, full sound output under stable atmospheric conditions is favorable for measuring wind turbine sound levels for the presence of SDR sounds.

BEA worked closely with the Maine DEP and EnRad Consulting, former acoustical consultant to Maine DEP, to develop a specific and detailed testing protocol for measuring sound levels from wind turbines in Maine. This testing protocol was refined and adopted in as Subsection I(8) of Maine DEP 375.10 noise regulations for wind energy developments. The purpose of this protocol is to facilitate measurement of wind turbine sound levels under worst-case operating conditions to evaluate compliance with Maine DEP sound level limits, including appropriate adjustments for tonal and SDR sounds.

Prior to operation of Weaver Wind, an Operations Sound Testing Plan will be prepared to identify sound test locations and other test details. These test locations will be selected based on post-construction site conditions and accessibility to represent receptors W1 and W3 as the nearest protected locations where Maine DEP or Eastbrook nighttime sound level limits apply. If tonal sounds occur or amplitude modulation reaches the Maine DEP threshold of 5 dBA for more than 5 events in a 10-minute test interval, a 5 dBA "penalty" will be added to the measured 10-minute equivalent sound levels. Compliance will be demonstrated based on the arithmetic average of the sound levels, of at a minimum, twelve, 10-minute measurement intervals in a given compliance measurement period. Similarly, if tonal or SDR sounds occur at or nearby receptor W3 in Eastbrook, the appropriate 5 dBA penalties will be applied as set forth in the Eastbrook Wind Energy Facility Ordinance. In the unlikely event that tonal or SDR sounds occur more frequently than anticipated, operating adjustments could be made to ensure that turbines are operating within the applicable sound limits, including any penalties for SDR sound events.

The Maine DEP requires operations sound testing during the first year and each fifth consecutive year of wind turbine operations. The Eastbrook ordinance requires compliance testing between April and December during the first year of commencing operations with a second sound study performed during the same period in the second year and at least every 3 years thereafter. Advance notice to the Eastbrook Planning Board is required at least 30 days prior to conducting operations sound testing. In order to achieve the required wind and site conditions, operations sound testing is typically performed during November or December. Implementing the operations test schedule specified by the Eastbrook ordinance would also meet Maine DEP test requirements.

8.0 Complaint Response Protocol

Weaver Wind, LLC will develop and implement a formal protocol for addressing sound complaints from local residents during wind turbine operations. The purpose of this protocol is to ensure that local residents are informed of how to report a sound complaint and that each sound complaint is fully documented and resolved in a consistent manner. Similar to complaint response protocols approved by Maine DEP for other wind power projects, Weaver Wind will establish guidelines for reporting, documenting, investigating, reporting and responding to sound complaints.

9.0 Summary of Findings

This Sound Level Assessment establishes sound level limits to be applied to the Weaver Wind Project and provides sound level predictions for daytime and nighttime turbine operations using a terrain-based computer model. Model settings reflect Section I of Maine DEP 375.10 and the Eastbrook Wind Energy Facility Ordinance as well as the results of turbine sound level testing of similar wind energy facilities in Maine. The Maine DEP hourly sound level limits of 55 dBA daytime and 42 dBA nighttime apply at all residential protected locations. The Eastbrook nighttime limit of 40 dBA applies within 660 feet of a protected location in Eastbrook. Sound level predictions indicate that with all wind turbines operating simultaneously at full capacity, Weaver Wind, LLC will meet Maine DEP daytime sound level limit of 55 dBA at all protected locations, the Maine DEP nighttime limit of 42 dBA within 500 feet of dwellings on nearby protected locations, and the Eastbrook nighttime limit of 40 dBA within 660 feet of protected locations in Eastbrook.

The Sound Level Assessment establishes procedures for sound level testing of turbine operations to evaluate compliance with applicable sound level limits, including methods for measurement and analysis of tonal and SDR sounds. A formal protocol for response and resolution of sound complaints will be established to reduce the potential for noise problems associated with long-term operation of Weaver Wind.

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APPENDIX I: VESTAS SOUND LEVEL PERFORMANCE STANDARDS

Exhibit D.2

Sound Level Performance Standard and Testing Procedures

Sound Level Performance Standard V126-3.3MW WTG

When measured in accordance with the Sound Level Testing Procedures set forth herein, the **V126-3.3MW WTG** warranted maximum sound level is as follows:

Mode LO1 Operation: Lwa = 104.3dB(A).

This warranted sound level is subject to a tolerance for measurement uncertainties of the greater of (i) the actual measurement uncertainty determined in accordance with the Sound Level Test Standard and (ii) ± 2dB. If the measured sound power level is at or below the warranted sound power level plus the uncertainty, the standard has been met. In the event that actual measured uncertainties exceed 2 dB and the standard has been met, Buyer is allowed to retest the turbine.

Supplier also warrants that the sound generated by any Wind Turbine shall not produce a Tonal Sound during operation in any mode when measured in accordance with the Sound Level Test Standard and on the linear scale for one-third octave bands with center frequencies ranging from 20 to 12,500 Hz . A Tonal Sound is defined to exist if the one-third (1/3) octave band sound pressure level in the band, including the tone, exceeds the arithmetic average of the sound pressure levels of the two (2) contiguous one-third (1/3) octave bands by five (5) dB(A) for center frequencies between five hundred (500) Hz and ten thousand (10,000) Hz, by eight (8) dB(A) for center frequencies between one hundred and sixty (160) Hz and four hundred (400) Hz, or by fifteen (15) dB(A) for center frequencies between twenty-five (25) Hz and one hundred and twenty-five (125) Hz.

Supplier acknowledges that Buyer intends to use many of the turbines for projects proposed in the State of Maine. Any permit in the State of Maine will be subject to Maine Department of Environmental Protection Rule 375.10.I(4) respecting short duration repetitive sounds. If during permit-required sound testing, evidence of SDRS events (as defined by the State of Maine) occurs, Supplier will, at its cost, work with Buyer to identify the root cause of the SDRS events and will cooperate with Buyer to remediate until the project is in compliance.

Sound Level Testing Procedures – means the test protocol as defined in IEC 61400-11-ed3.

APPENDIX II: SOUND MODEL PREDICTIONS FOR COMBINED OPERATION OF WEAVER WIND, HANCOCK WIND AND BULL HILL WIND

Appendix II presents sound level predictions for the combined operation of Weaver Wind, Hancock Wind and Bull Hill Wind including sound level isopleths for the project area and sound levels calculated at receptor points for each project. The combined model consists of Vestas V126 Mode LO1 turbines for Weaver Wind, V117 turbines for Hancock Wind, and Vestas V100 turbines for Bull Hill Wind. Modeling assumptions are applied to calculate sound levels from the combined projects as described in Section 6.0 of this report. There are 19 Vestas V100 turbines operating at Bull Hill, each with a rotor diameter of 100 meters, a hub height of 95 meters, and a rated sound power output of 105.0 dBA. There are 17 Vestas V117 turbines operating at Hancock Wind, each with a rotor diameter of 117 meters, serrated-trailing edge (STE) turbine blades (Mode 0+), a hub height of 116.5 meters, and a rated sound power output of 106.5 dBA. In the predictive model, the full-rated sound power level of each turbine is increased by 2 dBA for turbine uncertainty and 1 dBA for model accuracy, for an overall adjustment of +3 dBA.[16] Figure II-1 presents a sound level contour map of the combined model predictions for all turbines for these three projects.

Table II-1 summarizes the combined model predictions at the receptor points and compares the results to applicable Maine DEP sound level limits and relevant sound level limits contained in the Eastbrook Wind Energy Facility Ordinance for Weaver Wind and as applied to the Hancock and Bull Hill projects. Table II-1 provides the distance from each receptor point to the nearest turbine proposed for Weaver Wind. In addition to protected locations, the receptor points include W4 located in Eastbrook two miles from a Weaver Wind turbine and the nearest receptor points evaluated for Hancock Wind (H1, H2, H2A, and H3) and Bull Hill Wind (P1 and P2). The results indicate that the combined sound levels will be below both Maine DEP and Eastbrook sound limits at all receptor points.

[16] Bodwell EnviroAcoustics LLC, Bull Hill Wind Project, Sound Level Assessment, Exhibit 17, LUPC Development Permit Application, February, 2011. Three years of Operations Sound Testing at Bull Hill Wind and Year 1 of Operations Sound Testing at Hancock Wind demonstrated that turbine sound levels are below sound model predictions using these model assumptions. Further, occurrences of SDR sound events as defined by Section I of MDEP 375.10 were low and would not result in the application of any penalty under the 2012 Noise Rule applicable to Weaver Wind.

Receptor Point	Description and Approximate Distance to Nearest Weaver Wind Turbine		Predicted Hourly Sound Level and Nighttime Limit, dBA		
	Description	Distance (ft)	Weaver V126 LO1 Only	Combined Projects	Sound Level Limit
W1	Osborn – Dwelling on Private Lot	4,590	37.0	38.0	42
W2	Osborn – Dwelling on Private Lot	6,225	31.5	32.9	42
W3	Eastbrook – Dwelling on Leased Lot	4,390	35.0	35.5	40[a]
W4	Eastbrook – Two Miles from Turbine	10,560	30.5	31.2	35[b]
H1	Osborn – Dwelling on Private Lot	4,830	33.8	38.2	42
H2	Osborn – Dwelling on Private Lot	7,670	30.3	36.9	42
H2A	Osborn – Dwelling on Private Lot	7,510	33.4	37.4	42
H3	T22 - Dwelling on Private Lot	21,970	18.9	36.0	42
P1	Eastbrook - Dwelling on Private Lot	14,570	23.4	36.1	40[a]
P2	Eastbrook - Dwelling on Private Lot	13,955	23.9	37.9	40[a]

[a]Eastbrook nighttime sound limit at protected locations.

[b]Eastbrook two-mile limit as applied in Eastbrook to Bull Hill Wind.

Table II-1. Predicted Sound Levels at Receptor Points from Combined Operation of Weaver Wind, Hancock Wind and Bull Hill Wind

FIGURE II-1: SOUND LEVEL MAP FOR COMBINED OPERATION OF WEAVER, HANCOCK AND BULL HILL WIND PROJECTS