Attachment B7
Noise Impact Assessment Technical Memorandum,
April 23, 2018

Memo

Date:	Monday, April 23, 2018
Project:	NRG Rattlesnake Flat Wind Farm
To:	Nicholas Benjamin, NRG Renew, LLC
From:	Ben Copenhaver, HDR Inc.
Subject:	Noise Impact Assessment Technical Memorandum

The Applicant, Rattlesnake Flat, LLC (Applicant), a subsidiary of NRG Renew LLC, is proposing to construct and operate a commercial-scale wind energy generation facility called the Rattlesnake Flat Wind Project (Project). The Project Area spans approximately 27,000 acres southeast of the town of Lind in Adams County (county), Washington. The Project would also include Project and interconnect substations, connected via an approximately 10-mile-long gen-tie line. This technical memorandum describes the noise impact assessment for the Project.

Noise Concepts

Sound is made up of tiny fluctuations in air pressure. Sound is characterized by its amplitude (how loud it is), frequency (or pitch), and duration. Sound, within the range of human hearing, can vary in amplitude by over one million units. Therefore, a logarithmic scale, known as the decibel (dB) scale, is used to quantify sound intensity and to compress the scale to a more manageable range. Noise is defined as unwanted sound; the terms noise and sound are often used interchangeably.

The human ear does not hear all frequencies equally. In fact, the human hearing organs of the inner ear deemphasize low and very high frequencies. The most common weighting scale used to reflect this selective sensitivity of human hearing is the A-weighted sound level (dBA). The range of human hearing extends from approximately 3 dBA to around 140 dBA (all sound pressure levels in this report are relative to 20 micropascals).

Most sounds are made up of a wide range of frequencies, and are termed broadband sounds. Sounds that are focused in a particular frequency range are tonal sounds. Sound sources can be constant or time-varying. Environmental sound levels are often expressed over periods of time, allowing time-varying signals to be represented by sound levels averaged over intervals (for example, a one-hour period). One metric used to describe environmental sound is the equivalent average sound level (L_{eq}). The L_{eq} represents a constant sound that, over the specified time period, has the same acoustic energy as the time-varying signal.

Noise Regulations

Construction and operation of the Project would be subject to the noise regulations of the state of Washington and Adams County. The Adams County Code (ACC) Section 17.70.070 (3) requires compliance with the state of Washington noise emission limits (WAC 173-60). ACC 17.74.060(F) adopts the exemptions to noise standards in WAC 173-60-050, which exempts construction noise during daytime hours (7:00 AM to 10:00 PM).

For operations, WAC 173-60 has established environmental noise limits based on the Environmental Designation for Noise Abatement (EDNA) of the property that contains the noise source and the receiving property. Table 1 summarizes the WAC 173-60 limits which say: No person shall cause or permit noise to intrude into the property of another person which noise exceeds the maximum permissible noise levels set forth below in this section. In this manner, these noise limits regulate sound intrusion (sound from a noise source traveling to a noise receiver). These are not all-inclusive, overall noise limits. Rather, they limit the noise from a specific source when it is received on a different parcel; therefore, noise modeling is an appropriate way to evaluate the compliance status of noise sources that do not exist yet.

Table 1. State of Washington Environmental Noise Limits

EDNA of Noise Source	Noise Limit by EDNA of Receiving Property, dBA			
	Class A Daytime	Class A Nighttime	Class B	Class C
Class A	55	45	57	60
Class B	57	47	60	65
Class C	60	50	65	70

Source: Washington Administrative Code (2000), Chapter 173-60, “Maximum Environmental Noise Levels”
Notes:
EDNA Class A = Lands where people reside and sleep (e.g., residences, hospitals, and campgrounds)
EDNA Class B = Lands involving uses requiring protection against noise interference with speech (e.g., commercial, retail, office, educational, and religious buildings)
EDNA Class C = Lands involving economic activities of a nature that have noise levels higher than those experienced in other areas (e.g., warehouse, industrial, agricultural, and silvicultural)
Daytime = 7:00 AM to 10:00 PM
Nighttime = 10:00 PM to 7:00 AM

At any hour of the day or night the applicable noise limitations in Table 1 may be exceeded for any receiving property by no more than:

- 5 dBA for a total of 15 minutes in any one-hour period
- 10 dBA for a total of 5 minutes in any one-hour period
- 15 dBA for a total of 1.5 minutes in any one-hour period.

Parcels on which the Project proposes to construct and operate wind turbines upon (the primary noise source) are considered EDNA Class C. While the WAC does not specifically address residences (a Class A use) located on agricultural lands (a Class C area), for agricultural parcels it is reasonable to assess the residential structure as a Class A receiver and the property line as a Class C receiver. Because parcels with project turbines are Class C, this yields worst-case limits of 50 dBA at the residential structure and 70 dBA at the property line. A 60-dBA limit would apply at residential structures during daytime hours.

Existing Noise Environment

The noise study area is the area within 2 miles of the proposed turbine locations and the area within 1,000 feet of construction areas, as shown in Figure 1 below. The construction areas include the wind turbine sites, access roads, Project substation, and O&M Facility (located near turbine B15), gen-tie line, collector lines, and interconnect substation (at the west end of the gen-tie line).

Figure 1 also shows the modeled receivers, which are discussed further below. No Class A parcels were identified within the study area, so these all represent occupied buildings.

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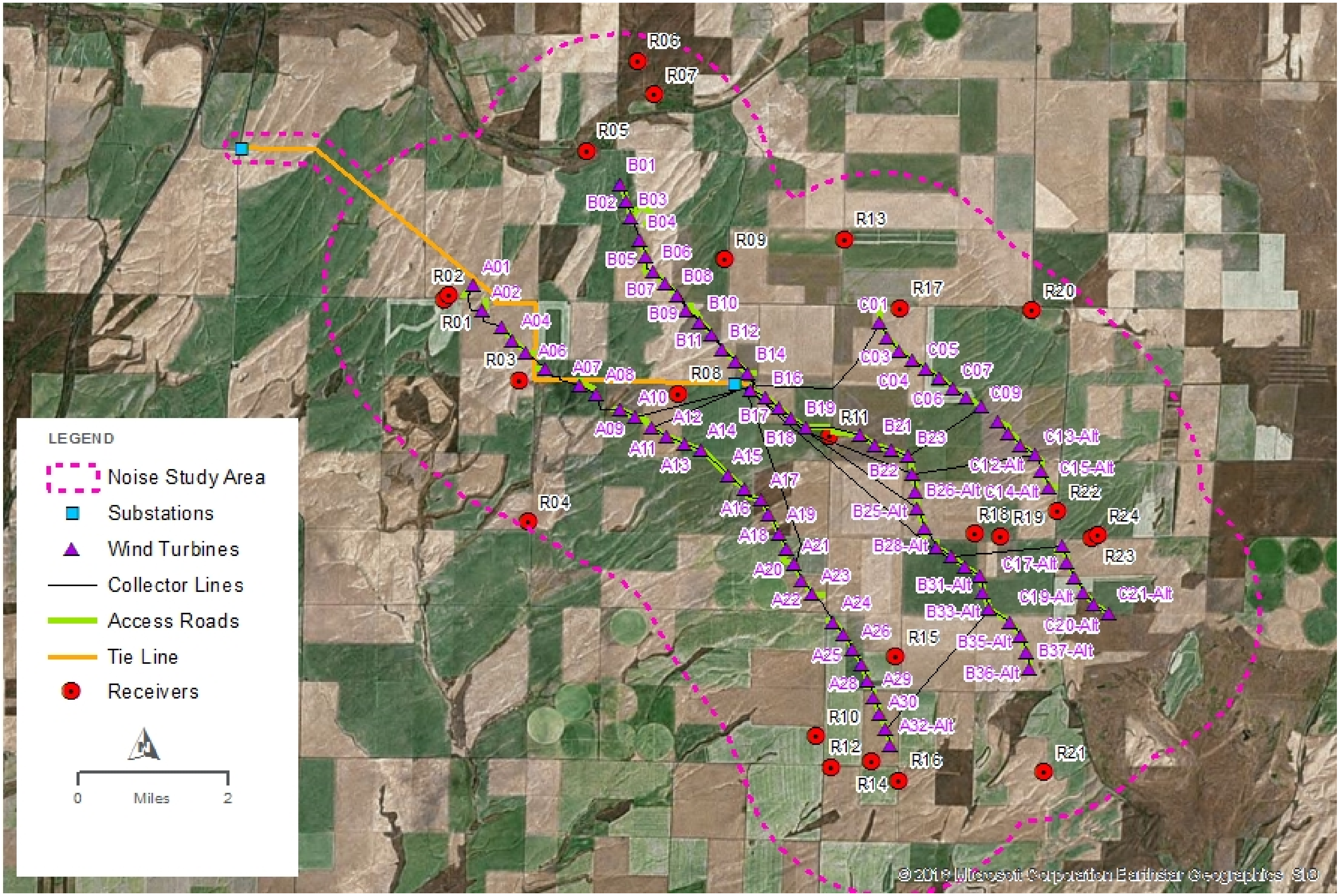
Figure 1. Noise Study Area



Noise Impact Assessment Methods

Construction

Construction would occur at the wind turbine sites, access roads, Project substation, gen-tie line, interconnect substation, and O&M Facility. The exact construction equipment that would be used on the Project is unknown at this time. Table 2 contains construction noise levels for representative equipment that could be used for this Project, at distances of 50, 200, 500, and 1,000 feet from the centroid of a construction site.

Table 2. Typical Construction Noise Levels

Construction Activity	Construction Equipment	Usage Factor, %	L_{max} at 50 ft., dBA	Hourly L_{eq} at 50 ft., dBA	Activity Total Hourly L_{eq} at Distance (ft.), dBA			
					50	200	500	1,000
Blasting	N/A	5	94	81	81	69	61	55
Site Preparation	Dozer	40	85	81	82	70	62	56
	Compactor	20	80	73				
Foundation	Dozer	40	85	81	85	73	65	59
	Concrete Mixer Truck	40	85	81				
	Concrete Pump Truck	20	82	75				
Erection	Crane	16	85	77	83	71	63	57
	Man Lift	20	85	78				
	Flat Bed Truck	40	84	80				

Source: U.S. Department of Transportation (2006), "FHWA Highway Construction Noise Handbook"
Notes:
Usage Factor = percentage of time that the equipment is in use
L_{max} = maximum sound level

The construction noise levels shown above were calculated assuming free field conditions, which represents an environment that is free from obstructions that could affect the way sound travels away from the noise source. All equipment is assumed to be operating in the same area. These assumptions, therefore, result in conservative over-estimates of the noise levels that may be experienced by receptors in the vicinity of the construction activities. Areas shielded by terrain or other features could receive lower noise levels. Furthermore, construction noise is temporary in nature and, as a result of applicable state and county regulations, construction noise is exempt from regulation if it occurs during daytime hours. This noise assessment assumes that construction activities would be limited to daytime hours (for practical purposes).

Operation

Noise from the proposed wind turbines was modeled using the environmental noise analysis program Cadna-A. Cadna-A is based on ISO 9613, "Attenuation of Sound during Propagation Outdoors." Table 3 summarizes the noise model parameters.

Table 3. Noise Model Parameters

Parameter	Model Approach
Noise Emissions	Wind turbines were modeled using sound power levels provided by Vestas.
Terrain	Onsite terrain was modeled using publically available 5-meter elevation contours.
Buildings	There are few buildings in the area of the wind turbines, so shielding structures were not included in the model.
Ground Factor	All ground was modeled as 50% absorptive. This value is considered conservative because the area is primarily soft ground; however, the modeled value accounts for other ground conditions, such as icy snow cover in the winter months.
Meteorology	A site-specific wind rose was not included, resulting in conservative downwind noise levels in each direction – at each modeled receiver.
Temperature and Relative Humidity	The modeled temperature of 10 degrees Celsius and relative humidity of 90% generally matched annual average values for the area (Climate Zone 2018).

Due to the range of equipment available and market conditions, the Applicant has not yet selected a final turbine manufacturer, nameplate capacity, or size. The Applicant may select up to two types of turbines, both to be used in the Project. However, there will be no more than 90 turbines in total. Each of the turbine types will have a different nameplate capacity and dimensions. For the purpose of analyzing the impacts of the Project, the wind turbines were modeled as point sources at a conservative height of 82 meters above ground, which is the turbine hub height. For purposes of a conservative analysis, the following model types were considered: the Vestas V120-2.0 MW and the Vestas V126-3.45 MW. In addition to the different models and product options, wind turbine noise emissions depend on the wind speed. Therefore, a hybrid noise spectrum was created using the loudest noise emissions in each octave band across all wind speeds for both wind turbine models. This results in conservatively high modeling results. Table 4 contains the modeled wind turbine noise emissions.

Table 4. Modeled Wind Turbine Noise Emissions

Sound Power Level by Octave Band (Hz), dBL (re 1 picowatt)								
31.5	**63**	**125**	**250**	**500**	**1,000**	**2,000**	**4,000**	**8,000**
79.5	88.5	94.1	98.5	103.3	106.7	106.2	100.1	86.6

Source: Vestas “Performance Specification V120-2.0 MW 50/60 Hz (Low HH),” “V120-2.0 MW Third octave noise emission,” “Performance Specification V126-3.45 MW 50/60 Hz (Low HH),” and “V126-3.45 MW Third octave noise emission”

Noise levels from the proposed wind turbines were calculated throughout a Cartesian coordinate grid to develop noise contours; proposed wind turbine noise levels were also calculated at specific receiver points. The receiver points are representative of EDNA Class A receptors. The resulting noise contours represent Project-related noise levels over areas of equal loudness; areas with the same color contour are predicted to experience similar noise levels. The noise contours show the calculated A-weighted L_{eq}.

For this project, potentially significant adverse noise impacts are defined as modeled wind turbine noise levels that exceed the environmental noise limits of Table 1.

Noise Impact Assessment Results

Construction

Project-related construction equipment would operate in any given area for a limited period of time. The transitory, localized, and finite nature of construction activities reduces the potential for noise impacts. Project-related construction activities would occur during daytime hours; therefore, Project construction would be exempt from the local noise regulations. Potentially significant adverse noise impacts are not anticipated during construction.

While mitigation measures are not required, the following measures are best practices that should be considered for reducing construction noise:

- Use the quietest available construction equipment and techniques
- Ensure equipment is properly maintained
- Limit vehicle trips near noise-sensitive receptors
- Limit vehicle idling.

Operation

The gen-tie line and substations have the potential to generate corona noise. Corona noise is a minor noise source and is unlikely to exceed the limits of Table 1. Noise from the O&M Facility is also considered negligible.

The Project and interconnect substations have the potential to generate noise via their transformers, reactors, and inverters. The substation design has not been finalized as of the latest revision of this memo, so the substations are not included in the noise analysis. The closest receptor to the Project substation is 0.75 mile to the west, and the closest receptor to the interconnect substation is 1.2 miles to the south; therefore, substation noise is not expected to exceed the limits of Table 1. Substation equipment will be specified and constructed to comply with WAC 173-60-040.

Figure 2 contains the modeled noise contours for the wind turbines. Table 5 summarizes the modeled results at the modeled receivers.

Figure 2. Modeled Noise Contours

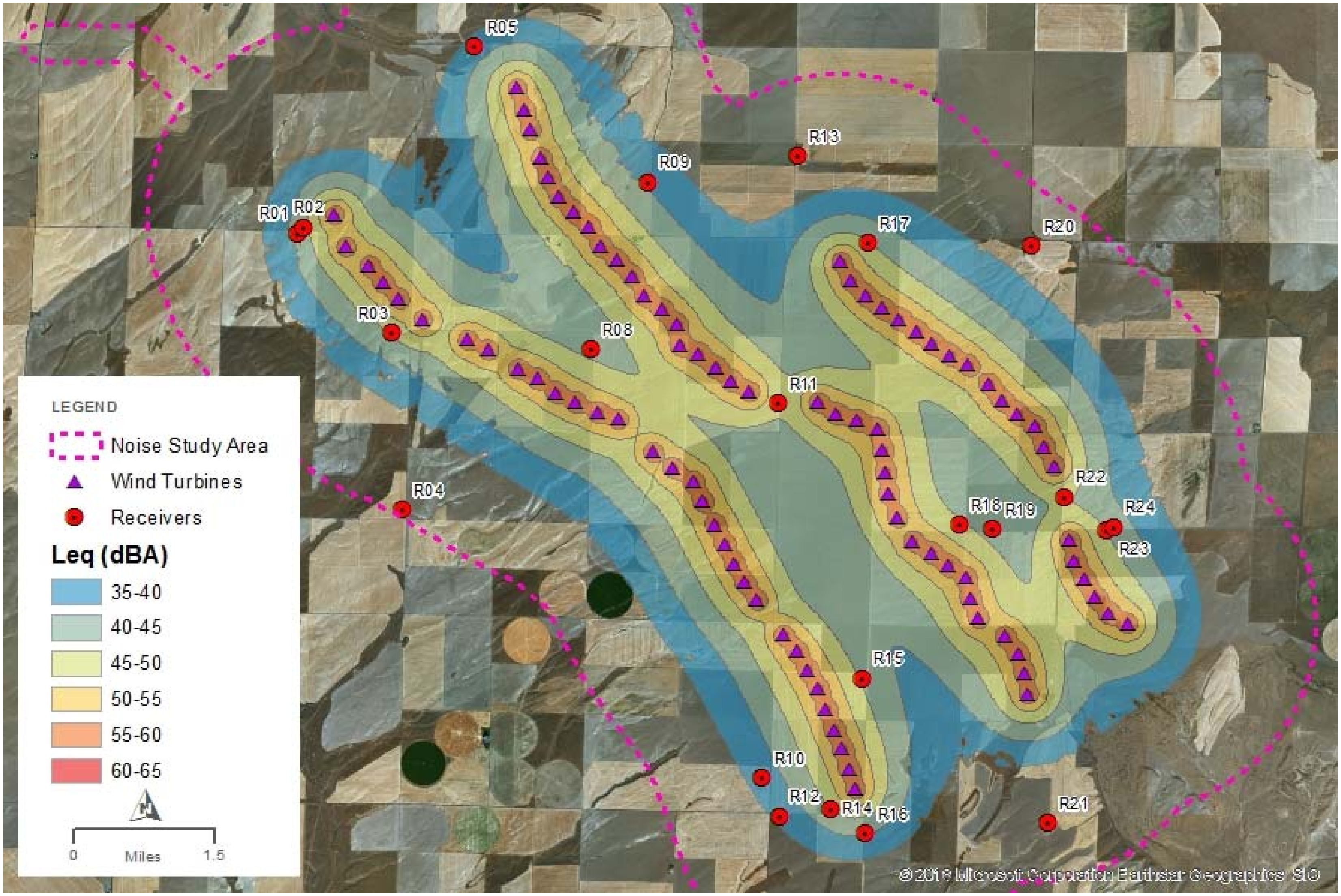


Table 5. Modeled Results at Receivers

Receiver	EDNA Class	Limit (Daytime / Nighttime), dBA	Nearest Turbine	Distance to Nearest Turbine, miles	Modeled Noise Level, dBA	Exceeds WAC Limit?
R01	A	60 / 50	A01	0.43	42	No
R02	A	60 / 50	A01	0.35	44	No
R03	A	60 / 50	A06	0.36	46	No
R04	A	60 / 50	A08	1.93	< 20	No
R05	A	60 / 50	B01	0.62	37	No
R06	A	60 / 50	B01	1.65	20	No
R07	A	60 / 50	B01	1.27	28	No
R08	A	60 / 50	A12	0.58	44	No
R09	A	60 / 50	B08	0.78	39	No
R10	A	60 / 50	A30	0.90	37	No
R11	A	60 / 50	B19	0.34	46	No
R12	A	60 / 50	A32	0.84	36	No
R13	A	60 / 50	C01	1.20	29	No
R14	A	60 / 50	A32	0.34	45	No
R15	A	60 / 50	A27	0.48	44	No
R16	A	60 / 50	A32	0.49	40	No
R17	A	60 / 50	C01	0.35	45	No
R18	A	60 / 50	B29	0.43	46	No
R19	A	60 / 50	B31	0.59	43	No
R20	A	60 / 50	C09	1.44	31	No
R21	A	60 / 50	B37	1.39	26	No
R22	A	60 / 50	C15	0.36	46	No
R23	A	60 / 50	C16	0.42	45	No
R24	A	60 / 50	C16	0.50	43	No

Modeling results show that Project-related noise levels at the nearest receivers are projected to comply with the local noise regulations. Modeled noise levels at the receivers range from less than 20 dBA to as high as 46 dBA, with four receptors showing a modeled level of 46 dBA. In addition, modeled noise did not exceed 65 dBA at any point on the ground, therefore the 70-dBA limit at Class C property lines was never exceeded.

Background noise levels are always fluctuating, but rural residential areas typically experience daytime noise levels of 40 dBA and nighttime noise levels of 34 dBA (ANSI/ASA S12.9-2013/Part 3).

All modeled wind turbine noise levels are more than 3 dB below the applicable environmental noise limits for each receiver. Therefore, adverse noise impacts are not anticipated during operations.

Conclusions

The Project would introduce temporary construction noise and long-term wind turbine noise to the existing noise environment. Construction would occur during daytime hours for a finite period of time. Modeled wind turbine operations noise levels were below the environmental noise limits for the area. Therefore, adverse noise impacts are not predicted, and mitigation measures are not required.

References

American National Standards Institute (ANSI) / Acoustical Society of America (ASA). 2013. ANSI/ASA S12.9-2013/Part 3, Quantities and Procedures for Description and Measurement of Environmental Sound – Part 3: Short-term Measurements with an Observer Present.

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