3.7 NOISE

This section describes the existing setting for ambient noise levels and potential impacts of the Project's noise emissions resulting from construction, operation, and decommissioning. This section evaluates the potential impacts of the Project on ambient noise levels and identifies mitigation measures to reduce or avoid the impacts. The analysis in this section also considers comments received from the public during the DEIS scoping process. In general, comments from local organizations and private citizens related to noise focused on the following key issues:

- Concern that construction activities will create audible noise disturbance
- Concern that WTGs will create audible noise disturbance.

3.7.1 Study Methodology

Existing noise levels were estimated based on data collected in similar rural environments. Potential impacts to ambient noise were assessed using industry standard noise estimation models. Construction noise levels were calculated based on the typical noise levels for typical construction equipment and assuming free field conditions. Noise from the proposed WTGs was modeled using the environmental noise analysis program Cadna-A. Cadna-A is based on ISO 9613, "Attenuation of Sound during Propagation Outdoors."

The noise study area is the area within 2 miles of the proposed WTG locations and the area within 1,000 feet of construction areas. The construction areas include the WTG sites, access roads, Project substation (located near WTG S20), gen-tie line, the interconnect to the existing Tono substation (at the west end of the gen-tie line), and the O&M Facility.

3.7.1.1 Noise Terminology

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. 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.

The existing level of environmental noise at a given location is the composite of noises from multiple noise sources located at varying distances from the location where a noise measurement is made. Noise levels are generally measured using a sound level meter using the A-weighted filter network. The A-weighted scale is also used in most noise ordinances and standards, including the applicable noise standards used in Lewis and Thurston counties.

Table 3.7-1 lists some sound levels for typical daily activities (Beranek 1988).

Table 3.7-1. Typical Sound Levels Measured in the Environment and Industry

Noise Source at a Given Distance	A-Weighted Sound Level in Decibels	Noise Environments	Subjective Impression
Shotgun (at shooter's ear)	140	Carrier flight deck	Painfully loud
Loud Civil defense siren (100 feet)	130		
Jet takeoff (200 feet)	120		Threshold of pain
Loud rock music	110	Rock music concert	
Pile driver (50 feet)	100		Very loud
Ambulance siren (100 feet)	90	Boiler room	
Pneumatic drill (50 feet)	80	Noisy restaurant	
Busy traffic; hair dryer	70		Moderately loud
Normal conversation (5 feet)	60	Data processing center	
Light traffic (100 feet); rainfall	50	Private business office	
Bird Calls (distant)	40	Average living room, library	Quiet
Soft whisper (5 feet); rustling leaves	30	Quiet bedroom	
	20	Recording studio	
Normal Breathing	0		Threshold of hearing

Occasionally noise can be measured in the C-weighted (dBC) scale. The dBC scale includes low-frequency ranges that the ear does not detect well. Low-frequency noise is generally associated with sources such as compressors, pumps, and diesel engines. Very high levels of low-frequency noise may result in noise-induced vibrations that can generate secondary noise, such as a rattling window. It is not uncommon for dBC and dBA levels to result in different values when measured concurrently at the same location for the same noise source. For example, levels of noise measures within an office building can result in 40 dBA using the A-weighted scale and 60 dBC using the C-weighted scale.

The dB scale is logarithmic; therefore, a relative increase of 10 dB represents a 10 times increase in energy or pressure. However, humans do not perceive a 10-dB increase of similar sounds as 10 times louder. Instead, they perceive it as twice as loud. For the same reason decibels cannot be "added" to assess the impact of two sources relative to one receptor. Also because of this logarithmic nature of the dB scale, when noise levels from two equal sources are experienced together, the total result will only be 3 dBA greater. For example 50 dBA + 50 dBA = 53 dBA, not 100 dBA. If the difference between two sources is only 10 dBA, the cumulative noise level will not increase. For example 30 dBA + 40 dBA = 40 dBA and 50 dBA + 60 dBA = 60 dBA.

Environmental noise levels can be constant or can vary over time. 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. Another metric is the Percentile Noise Level (denoted as L_n); it represents an A-weighted noise level exceeded during n% of the measurement period, with n ranging from 0 to 100. For example L_{25} represents the noise level that is exceeded during 25 percent of a measurement period, such as 15 minutes over an hourly interval.

It also is useful to understand the difference between a sound power level and the sound pressure level (SPL). A sound power level can be compared to the wattage of a light bulb; it is a measure of the acoustical energy emitted by a source and is, therefore, independent of distance. Sound power level data are used in acoustic models to predict SPLs. The SPL is analogous to the brightness or intensity of light experienced at a specific distance from a source and is measured directly with a sound level meter. SPLs, such as noise level measurements or estimates, are therefore always specified with respect to the location or distance from the noise source.

The decrease in sound level due to distance, also called attenuation, from any single sound source normally follows the inverse square law; that is, the SPL changes in inverse proportion to the square of the distance from the sound source. The drop-off rate also varies based on terrain conditions and the presence of obstructions in the sound's propagation path. In a large open area with no obstructive or reflective surfaces, it is a general rule that at distances greater than approximately the largest dimension of the noise emitting surface the SPL from a point source of sound is reduced by 6 dB for each doubling of the distance from the source. Sound energy is absorbed in the air as a function of temperature, humidity, and the frequency of the sound, resulting in attenuation of up to 2 dB over 1,000 feet.

3.7.2 Regulatory Framework

Construction and operation of the Project will be subject to the noise regulations of the state of Washington, Lewis County, and Thurston County. Ecology establishes noise emission regulations in WAC 173-60. WAC 173-60-110 provides a mechanism for local governments to establish local noise abatement ordinances or resolutions.

LCC 17.145.050 requires that development not exceed the maximum environmental noise level established by WAC 173-60, and allows for exceptions consistent with the Ecology regulations. LCC does not establish additional noise emission limitations for development within the zoning districts in which Project facilities will be located (Mineral Resources Lands, Urban Growth Area, Rural Area Industrial, Rural Development District, Forest Resources Lands). Thurston County adopts by reference WAC 173-60 in TCC 21.57.030.A. In addition, the code identifies that Environmental Designation for Noise Abatement (EDNA) A land use classification applies to "all living areas (single-family, multifamily, etc.)" and "all public/institutional areas" (TCC 21.57.030.B). TCC 10.36.020 regulates nuisance noise sources (for example, use of generators, motorized vehicle noise, and noise resulting from the operation of devices designed for sound production or reproduction). TCC 10.36.040 provides exemptions for certain noise-generating activities. TCC does not specify additional noise emission limits for the zoning districts in which the Project will be located (Rural Residential 1/5 and Long Term Forestry).

3.7.2.1 Construction Noise

The state of Washington noise emission limits provide an exemption for construction activities that occur during daytime hours (7:00 AM to 10:00 PM) (WAC 173-60-050(3)(A)). As noted above, the LCC references WAC 173-60 for its local limits; therefore, daytime construction noise is also exempt in Lewis County. Thurston County exempts construction noise during those same daytime hours through its public disturbance noise ordinance (TCC 10.36.040.H), and its acknowledgement of WAC 173-60.

3.7.2.2 Operational Noise

For operational noise, WAC 173-60 has established environmental noise limits based on the EDNA of the property that contains the noise source and the receiving property. WAC 173-60-030(1) provides that the determination of the actual EDNA of a Class A or Class C receiver be based on the following typical uses, taking into consideration the present, future, and historical usage, as well as the usage of adjacent and other lands in the vicinity. The following summarizes the applicable portions of WAC 173-60-030(1):

- Class A: Lands where the principal use is people reside and sleep (such as residential)
- Class B: Lands requiring protection against noise interference with speech (such as commercial/recreational)
- Class C: Lands where the principal activities are of such a nature that higher noise levels are anticipated (such as industrial/agricultural).

The Project Area is located in an area zoned for forestry, and the Project reasonably corresponds to a Class C EDNA designation. Table 3.7-2 summarizes the maximum permissible noise levels originating from and received at the three EDNA designations.

Table 3.7-2. State of Washington Noise Regulations (WAC 173-60-040)

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:
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 3.7-2 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.

The following are exempted from the limits presented in Table 3.7-2 (per WAC 173-60-050):

- Construction noise (including blasting) between the hours of 7:00 AM and 10:00 PM
- Motor vehicles operated on public highways
- Motor vehicles operated off public highways, except when such noise affects residential receivers
- Noise from electrical substations is exempted from the nighttime limits (WAC 173-60- 050[2][a]).

3.7.3 Affected Environment

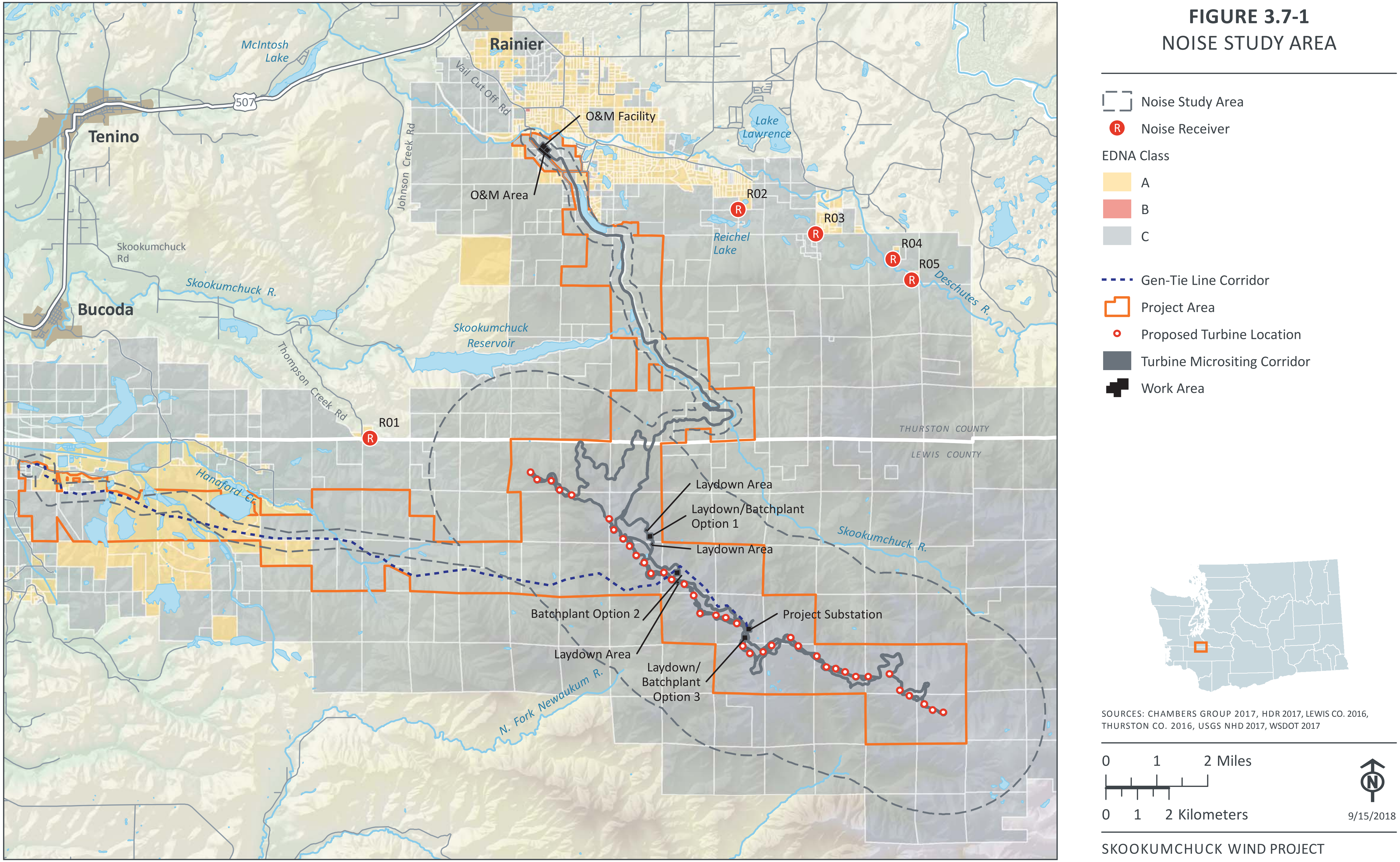
The Project Area is a land use managed for silviculture operations. Sources of noise within the Project Area are typical of similar rural areas, primarily related to forestry activities and traffic on local roads and highways. Background noise levels are always fluctuating, but rural residential areas typically experience daytime noise levels of 40 dBA and nighttime noise levels of 34 dBA (ANSI/ASA S12.9-2013/Part 3). In more remote areas, noise levels could at times drop below 30 dBA or even lower. The existing noise levels are expected to vary with distance from the typical sources, as well as with local wind speeds. When the local wind speed is low or calm, the noise levels are expected to be less than when the winds are elevated.

EDNA classes identified based on land use data for Lewis and Thurston counties are shown in Figure 3.7-1. Residential, recreational, camping, and park land uses were identified as EDNA Class A. Commercial and governmental land uses were identified as EDNA Class B. Forest land, manufacturing, transportation infrastructure, utilities, and mining land uses were identified as EDNA Class C. A rural residential neighborhood is located north of the proposed WTG locations and near the O&M Facility; however, the vast majority of the noise study area is more remote. The closest residence is approximately 3.2 miles from the Project Area where WTGs and the Project substation will be located. The closest residences to the O&M Facility are located approximately 0.25 mile to the southeast and to the south.

The westernmost portion of the gen-tie line crosses through rural, agricultural, and mining-related uses; however, there are no residences located adjacent to the gen-tie line alignment. The eastern portions of the gen-tine line alignment are located in land designated for forestry and mining. The next closest residential parcel is located approximately 0.4 mile west of the gen-tie line alignment

Figure 3.7–1 shows receivers modeled for impacts resulting from the operation of WTGs, which are discussed below.

FIGURE 3.7-1
NOISE STUDY AREA



SKOOKUMCHUCK WIND PROJECT

3.7.4 Impacts of the Proposed Action

This section presents the potential construction, decommissioning, and operational noise impacts. Potentially significant adverse noise impacts are defined as noise activities or noise levels that do not comply with the local regulations.

3.7.4.1 Construction

Noise from construction activities associated with the Project will generate short-term impacts at some residences during the construction period. The major construction activities associated with the installation of a wind energy facility include the following:

- Access road construction and collector line trenching
- Site preparation and WTG foundation installation
- Blasting where access roads and WTG foundations are placed in rock outcrops
- WTG erection
- Project substation/switchyard construction
- Erection of gen-tie line towers and stringing of gen-tie line conductors
- Site and construction activity associated with O&M Facility construction.

Construction activities will result in short-term noise impacts due to construction equipment (e.g., trucks, dozers, graders, cranes, portable generators, concrete manufacturing, haul trucks). Table 3.7-3 contains construction noise levels for typical equipment that could be used on this Project at distances of 50, 200, 500, and 1,000 feet from the centroid of a construction site.

Table 3.7-3. 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. 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.

Noise-generating construction activities, including blasting, will be conducted during the hours between 7:00 AM and 6:00 PM to the maximum extent possible. Construction activities conducted between these hours are exempt from the limits per WAC 173-60-050. Nighttime construction is not planned for the Project, provided hauling of components to construction sites may be conducted overnight. All applicable noise standards for non-exempt construction periods will be met.

Traffic volumes will increase on local roadways surrounding the Project Area during the construction phase due to commuting construction workers and the transportation of materials. Haul trucks delivering the WTGs will access the Project area via Vail Loop Road SE and existing private roads and will pass near a few local residences along the route. Noise from the haul route would be consistent with existing noise levels (similar to semi-trucks) both to and from the Port of Tacoma. As a result, noise levels along local roadways will increase temporarily. However, most deliveries and site access trips will occur during daytime hours.

3.7.4.2 Operation

Operational noise generated by the Project will have several sources, including the WTGs, the Project substation, corona noise associated with the proposed 230-kV gen-tie line, noise associated with activities at the O&M Facility, and noise generated by Project-related vehicles, both daily commute trips made by employees and a small number of trips made by maintenance vehicles onsite.

The rotation of the WTG blades will constitute the primary source of noise. As outlined in Appendix 3.7-1, noise levels were modelled at 5 EDNA Class A receptors closest to the proposed WTGs. The WTGs were modeled as point sources at a height of 82 meters, which is the hub height. The Project is considering two WTG models: the Vestas V136-3.45 MW and the Vestas V136-3.6 MW. In addition to the different models and product options, WTG noise emissions depend on the wind speed. Therefore, the loudest noise emissions across the WTG models and wind speeds were modeled; this results in conservatively high modeling results and accounts for the reasonably foreseeable conditions.

The closest EDNA Class A receptor to a proposed WTG is approximately 3.2 miles. The modeled noise levels at this receptor are less than 20 dBA, which is below the 50 dBA nighttime noise limit and will be even lower than anticipated background noise levels. As indicated above, 34 dBA is typical of nighttime background noise levels in rural residential locations. The noise levels at the next closest residences are also less than 20 dBA. Table 3.7-4 summarizes the modeled results at each receiver.

Table 3.7-4. Modeled Results at Receivers

Receiver	EDNA Class	Limit (Daytime / Nighttime), dBA	Nearest WTG	Distance to Nearest WTG, miles	Modeled Noise Level, dBA	Potential for Impact?
R01	A	60/50	S1	3.2	<20	No
R02	A	60/50	S3	6.5	<20	No
R03	A	60/50	S6	6.9	<20	No
R04	A	60/50	S6	7.6	<20	No
R05	A	60/50	S25	7.4	<20	No

The Project substation will be located centrally within the Project Area, and noise emissions resulting from its operation will attenuate to background long before they reach the closest residences considered in the impact assessment above. Substation transformers and high-voltage switching equipment will be specified and constructed to comply with WAC 173-60-040.

The gen-tie line and interconnect to the existing Tono substation have the potential to generate corona noise. Corona is the electrical ionization of the air that occurs near the surface of the energized conductor and suspension hardware due to very high electric field strength. Corona is typically a design concern at voltages above 345 kV. During wet or foul weather conditions, the conductor will produce the greatest amount of corona noise, generally characterized as a crackling, hissing, or humming sound. However, during heavy rain the noise generated by the falling rain drops hitting the ground will typically be greater than the noise generated by corona and thus will mask the audible noise from the gen-tie line. Corona noise is therefore unlikely to exceed the noise limits identified in Table 3.7-2.

The O&M Facility is proposed to be constructed near the existing Weyerhaeuser Vail office. The O&M Facility will be used for general maintenance activities. Operation-related vehicle trips will occur to and from the O&M Facility during typical business hours. An emergency generator will be located at the O&M Facility and will operate during power outages as well as during maintenance-related testing per manufacturer's recommendations, which will be conducted during day-time hours. Noise emissions from activities at the O&M Facility will be intermittent in nature and will be mostly restricted to daytime hours.

Workers will make daily trips to and from the O&M Facility area in light-duty vehicles and could cause a small increase in noise levels over the existing levels along the roadways. Traffic between the O&M Facility and individual WTGs along access roads will be minimal during operations because multiple WTGs can be maintained by a single individual. This traffic will consist of infrequent trips to WTGs in service vehicles for maintenance and repair activities. Therefore, vehicular noise generated along access roads during routine WTG maintenance activities will be infrequent, minimizing noise effects.

3.7.4.3 Decommissioning

Decommissioning activities will be similar in type but shorter in duration compared to those anticipated for the construction phase. This will result in noise levels similar to those experienced during construction. The same mitigation measures recommended during construction will also be used during the decommissioning phase.

3.7.5 Impacts of the No Action Alternative

Under the No Action Alternative, the Project would not be constructed. There would be no change from current conditions and, therefore, there would be no Project-related impacts. The electrical energy produced by the Project might need to be obtained from another generation source, which may or may not be renewable. Agricultural activity would generate the same type of noise impacts as currently exist.

3.7.6 Mitigation Measures

The Project will comply with all applicable local, state, and federal laws, ordinances, regulations, and standards. Although no specific receivers are identified as being impacted by construction, decommissioning, or operational noise at this time, the following practices are recommended to minimize the effects of construction noise in the Project area:

- Implement construction and maintenance work-hour controls so that most noise- generating activities occur between 7:00 AM and 6:00 PM, which will reduce the impact during sensitive nighttime hours
- Minimize the number of heavy-duty haul trucks traveling through the area during nighttime hours
- Maintain equipment in good working order and use adequate mufflers and engine enclosures to reduce equipment noise during operation
- Limit vehicle idling
- Use the quietest available construction equipment and techniques.

3.7.7 Connected Action

Construction of the interconnection will involve delivery and installation of a step up transformer in the Tono substation yard, and conductoring to interconnect the gen-tie line to the step-up transformer, and the transformer to the remainder of the substation. These activities will not require excavation or significant ground disturbance either inside or outside the developed area of the yard. Large construction equipment may be used to unload and position the step-up transformer,

Noise emissions from the construction activity will be similar to those identified in Section 3.7.4.1 above, and will be temporary in nature. Operation of the transformer within the context of the entire Tono substation will conform to WAC 173-60-040.

3.7.8 Unavoidable Adverse Impacts

Project construction and decommissioning will result in temporary construction noise at the construction sites. Construction traffic will also result in temporary vehicle noise on roads used to access construction sites. The Applicant has proposed mitigation measures to minimize the impacts of temporary construction noise. Operation of the Project WTGs will result in noise emissions; however, receptors are too far removed to perceive any increase from background from the WTG sources. Since there will be no adverse impact, mitigation is not required. With the mitigation measures provided by the Applicant impacts from noise emissions have been reduced to a level of non-significance.

3.7.9 References

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