Exhibit Y

Noise

Sunstone Solar Project
May 2024

Prepared for

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Table of Contents

List of Tables

List of Graphs

List of Figures

List of Attachments

Acronyms and Abbreviations

Applicant	Sunstone Solar, LLC, a subsidiary of Pine Gates Renewables, LLC
BESS	battery energy storage system
BPA	Bonneville Power Administration
CadnaA	computer aided noise abatement
Council	Oregon Energy Facility Siting Council
dB	decibel
dBA	A-weighted decibel
EFSC	Energy Facility Siting Council
Facility	Sunstone Solar Project
Hz	hertz
ISO	International Organization for Standardization
L_{10}	intrusive noise level
L_{50}	median sound level
L_{90}	residual sound level
L_{eq}	equivalent sound level
L_{max}	maximum sound level
L_n	statistical sound level
L_w	sound power level
NSR	noise sensitive receptor
OAR	Oregon Administrative Rule
ODEQ	Oregon Department of Environmental Quality
UTM	Universal Transverse Mercator

1.0 Introduction

Sunstone Solar, LLC, a subsidiary of Pine Gate Renewables, LLC (Applicant), proposes to construct and operate the Sunstone Solar Project (Facility), a solar energy generation facility and related or supporting facilities in Morrow County, Oregon. This Exhibit Y was prepared to evaluate potential sound impacts relative to the applicable noise limits prescribed by the Oregon Department of Environmental Quality (ODEQ) noise rules and to meet the submittal requirements in Oregon Administrative Rules (OAR) 345-021-0010(1)(y).

1.1 Acoustic Terminology

Airborne sound is described as the rapid fluctuation or oscillation of air pressure above and below atmospheric pressure, creating a sound wave. Sound is characterized by properties of the sound waves, which are frequency, wavelength, period, amplitude, and velocity. Noise is defined as unwanted sound. A sound source is defined by a sound power level (L_w), which is independent of any external factors. The acoustic sound power is the rate at which acoustical energy is radiated outward and is expressed in units of watts. Sound energy travels in the form of a wave, a rapid fluctuation or oscillation of air pressure above and below atmospheric pressure. A sound pressure level is a measure of this fluctuation and can be directly determined with a microphone or calculated from information about the source sound power level and the surrounding environment through predictive acoustic modeling. While the sound power of a source is strictly a function of the total amount of acoustic energy being radiated by the source, the sound pressure levels produced by a source are a function of the distance from the source and the effective radiating area or physical size of the source. In general, the magnitude of a source's sound power level is always considerably higher than the observed sound pressure level near a source since the acoustic energy is being radiated in various directions.

Sound levels are presented on a logarithmic scale to account for the large pressure response range of the human ear and are expressed in units of decibels (dB). A dB is defined as the ratio between a measured value and a reference value usually corresponding to the lower threshold of human hearing defined as 20 micropascals. Conversely, sound power is commonly referenced to 1 picowatt, which is one trillionth of a watt. Broadband sound includes sound energy summed across the frequency spectrum. In addition to broadband sound pressure levels, analysis of the various frequency components of the sound spectrum is often completed to determine tonal characteristics. The unit of frequency is hertz (Hz), which corresponds to the rate in cycles per second that sound pressure waves are generated. Typically, a sound frequency analysis examines 11 octave bands (or 33 1/3 octave) ranging from 20 Hz (low) to 20,000 Hz (high). This range encompasses the entire human audible frequency range. Since the human ear does not perceive every frequency with equal loudness, spectrally varying sounds are often adjusted with a weighting filter. The A-weighted filter is applied to represent the frequency response of the human auditory system. Sound exposure in acoustic assessments is commonly measured and calculated as A-weighted dB (dBA). Unweighted sound levels are referred to as linear. Linear dB are used to determine a sound's tonality and to engineer solutions to reduce or control noise as techniques are different for low and high frequency noise.

Sound levels can be measured, modeled and presented in various formats. The sound metrics that were employed in the following noise assessment have the following definitions:

- L_{eq}: Conventionally expressed in dBA, the L_{eq} is the energy-averaged, A-weighted sound level for the complete time period. It is defined as the steady, continuous sound level over a specified time, which has the same total sound energy as the actual varying sound levels over the specified period;
- L_n: This descriptor identifies the sound level that is exceeded "n" percent of the time over a measurement period (e.g., L_{90} = sound level exceeded 90 percent of the time). The sound level exceeded for a small percent of the time, L_{10}, closely corresponds to short-term, higher-level, intrusive noises (such as vehicle pass-by noise near a roadway). The sound level exceeded for a large percent of the time, L_{90}, closely corresponds to continuous, lower-level background noise (such as continuous noise from a distant industrial facility). L_{50} is the level exceeded 50 percent of the time and is typically referred to the median sound level over a given period;
- L_{max}: The maximum sound level (L_{max}) can be used to quantify the maximum instantaneous sound pressure level over a given measurement period or maximum sound generated by a source.

2.0 Analysis Area

The analysis area for noise impacts is defined in OAR 345-021-0010 as including those noise sensitive receptors within 1 mile of the site boundary.

3.0 Regulatory Environment

A review was conducted of noise regulations applicable to the Facility at the federal, state, county, and local levels. There are no federal environmental noise requirements specific to the Facility. Morrow County does not have any noise requirements with numerical limits that would be applicable to the Facility. The ODEQ noise control standards in OAR 340-035-0035 (ODEQ Noise Rules) are discussed in Section 3.2. The ODEQ Noise Rules are incorporated by reference in the Oregon Energy Facility Siting Council's (EFSC, or Council) rule regarding the contents of Exhibit Y (OAR 345-021-0010(1)(x)).

3.1 Required Contents of Exhibit Y

In accordance with OAR 345-021-0010(1)(y), Exhibit Y must include the following:

> *Information about noise generated by construction and operation of the proposed facility, providing evidence to support a finding by the Council that the proposed facility complies with the Oregon Department of Environmental Quality's noise control standards in OAR 340-035-0035. The applicant must include:*
>
> *(A) Predicted noise levels resulting from construction and operation of the proposed facility;*
>
> *(B) An analysis of the proposed facility's compliance with the applicable noise regulations in OAR 340-035-0035, including a discussion and justification of the methods and assumptions used in the analysis;*
>
> *(C) Any measures the applicant proposes to reduce noise levels or noise impacts or to address public complaints about noise from the facility;*
>
> *(D) Any measures the applicant proposes to monitor noise generated by operation of the facility; and*
>
> *(E) A list of the names and addresses of all owners of noise sensitive property, as defined in OAR 340-035-0015, within one mile of the proposed site boundary.*

3.2 ODEQ Noise Rules

The ODEQ Noise Rules relevant to the Facility are provided in OAR 340-035-0035 and provide an antidegradation standard and maximum permissible statistical noise levels for new industrial or commercial noise sources on a previously unused site.[1]

> *OAR 340-035-0035(1)(b)(B)(i)*
>
> *No person owning or controlling a new industrial or commercial noise source located on a previously unused industrial or commercial site shall cause or permit the operation of that noise source if the noise levels generated or indirectly caused by that noise source increase the ambient statistical noise levels, L_{10} or L_{50}, by more than 10 dBA in any one hour, or exceed the levels specified in Table 8, as measured at an appropriate measurement point, as specified in subsection (3)(b) of this rule, except as specified in subparagraph (1)(b)(B)(iii).*
>
> *OAR 340-035-0035(1)(b)(B)(ii)*
>
> *The ambient statistical noise level of a new industrial or commercial noise source on a previously unused industrial or commercial site shall include all noises generated or indirectly caused by or attributable to that source including all of its related activities. Sources exempted from the requirements of section (1) of this rule, which are identified in subsections (5)(b) - (f), (j), and (k) of this rule, shall not be excluded from this ambient measurement."*

[1] A "previously unused industrial or commercial site" is defined in OAR 340-035-0015(47) as property which has not been used by any industrial or commercial noise source during the 20 years immediately preceding commencement of construction of a new industrial or commercial source on that property.

The specific levels of "Table 8" of OAR 340-035-0035(1)(b)(A) are listed in Table Y-1 for reference. All levels are presented in terms of dBA, which is a weighting scaled for human hearing. The L_{50} is the median sound level (50 percent of the measurement interval is above this level; 50 percent is below). The noise limits apply at "appropriate measurement points" on "noise sensitive property" as defined in OAR 340-035-0035(3)(b). The appropriate measurement point is defined as whichever of the following is farther from the noise source:

- 25 feet toward the noise source from that point on the noise sensitive building nearest the noise source; or
- The point on the noise sensitive property line nearest the noise source.

"Noise sensitive property" is defined in OAR 340-035-0035(3)(b) as "real property normally used for sleeping, or normally used as schools, churches, hospitals or public libraries. Property used in industrial or agricultural activities is not Noise Sensitive Property unless it meets the above criteria in more than an incidental manner."

Table Y-1. New Industrial and Commercial Noise Standards

Statistical Descriptor	Maximum Permissible Statistical Noise Levels (dBA)	
	Daytime (7:00 a.m. – 10 p.m.)	Nighttime (10 p.m. – 7 a.m.)
L_{50}	55	50
L_{10}	60	55
L_{1}	75	60
Source: OAR 340-035-0035, Table 8.		

In accordance with the regulatory definitions in OAR Chapter 340-035, the analysis presented in this assessment assumes that the solar facility will constitute an industrial or commercial use, predominantly located on previously unused sites. Therefore, to demonstrate compliance with OAR 340-035-0035(1)(b)(B)(i), the Facility must demonstrate that, as a result of operation, the ambient statistical noise level must not be increased by more than 10 dBA in any one hour at any identified noise sensitive receptor (NSR)[2].

3.2.1 Exemptions to State Noise Regulations

OAR 340-035-0035(5) specifically exempts construction activity from the state noise standards and regulations, as indicated below. This section also provides an exemption for maintenance of capital equipment, the operation of aircraft (such as helicopters used in Facility construction), and sounds created by activities related to timber harvest.

OAR 340-035-0035(5) Exemptions:

[2] For purposes of this exhibit, "noise sensitive property" is the same as an NSR.

Except as otherwise provided in subparagraph (1)(b)(B)(ii) of this rule, the rules in section (1) of this rule shall not apply to:

[section abridged for brevity]

(b) Warning devices not operating continuously for more than 5 minutes;

(g) Sounds that originate on construction sites.

(h) Sounds created in construction or maintenance of capital equipment;

(j) Sounds generated by the operation of aircraft and subject to pre-emptive federal regulation. This exception does not apply to aircraft engine testing, activity conducted at the airport that is not directly related to flight operations, and any other activity not pre-emptively regulated by the federal government or controlled under OAR 340-035-0045;

(k) Sounds created by the operation of road vehicle auxiliary equipment complying with the noise rules for such equipment as specified in OAR 340-035-0030(1)(e);

(m) Sounds created by activities related to the growing or harvesting of forest tree species on forest land as defined in subsection (1) of ORS 526.324.

In accordance with the allowable exemptions, the Project will claim noise produced during construction as an exemption to the ODEQ Noise Rules.

3.2.2 Exceptions to State Noise Regulations

OAR 340-035-0035(6) allows for some exceptions to the state noise regulations:

OAR 340-035-0035 (6) Exceptions:

Upon written request from the owner or controller of an industrial or commercial noise source, the Department may authorize exceptions to section (1) of this rule, pursuant to rule 340-035-0010, for:

(a) Unusual and/or infrequent events;

(b) Industrial or commercial facilities previously established in areas of new development of noise sensitive property;

(c) Those industrial or commercial noise sources whose statistical noise levels at the appropriate measurement point are exceeded by any noise source external to the industrial or commercial noise source in question;

(d) Noise sensitive property owned or controlled by the person who controls or owns the noise source;

(e) Noise sensitive property located on land zoned exclusively for industrial or commercial use.

3.3 County and Municipal Noise Regulations

There are no quantitative noise limits in Morrow County. Morrow County stipulates that noise shall not be "plainly audible within a dwelling unit one hundred feet (100') or more away from the source of the noise," between 11:00 p.m. and 7:00 a.m., and allows an exception for construction between 6:00 a.m. and 10:00 p.m.

4.0 Existing Conditions

The Facility will be located in a rural area with low population density. Within the Analysis Area, there are a total of 14 NSRs. All NSRs were identified as single-family residential structures. Given the lack of industrial and commercial sound sources, the Applicant expects the existing area of the Facility to have low ambient sound levels.

A wide range of noise settings occur within the acoustic analysis area. The background sound level will vary spatially and is related to various physical characteristics such as topography, land use, proximity to transportation corridors and terrain coverage including extent and height of exposed vegetation. The acoustic environment will also vary due in part to surrounding land use and population density. Areas in proximity to major transportation corridors such as interstate highways and areas with higher population densities and are expected to generally have higher existing ambient sound levels as compared to open and rural lands. Table Y-2 shows the relative A-weighted noise levels of common sounds measured in the environment and industry.

Table Y-2. Sound Pressure Levels and Relative Loudness

Noise Source or Activity	Sound Level (dBA)	Subjective Impression	Relative Loudness (Perception of Different Sound Levels)
Jet aircraft takeoff from carrier (50 feet)	140	Threshold of pain	64 times as loud
50-hp siren (100 feet)	130		32 times as loud
Loud rock concert near stage Jet takeoff (200 feet)	120	Uncomfortably loud	16 times as loud
Float plane takeoff (100 feet)	110		8 times as loud
Jet takeoff (2,000 feet)	100	Very loud	4 times as loud
Heavy truck or motorcycle (25 feet)	90		2 times as loud
Garbage disposal Food blender (2 feet) Pneumatic drill (50 feet)	80	Loud	Reference loudness
Vacuum cleaner (10 feet)	70	Moderate	1/2 as loud
Passenger car at 65 mph (25 feet)	65		

Table Y-2. Sound Pressure Levels and Relative Loudness

Noise Source or Activity	Sound Level (dBA)	Subjective Impression	Relative Loudness (Perception of Different Sound Levels)
Large store air-conditioning unit (20 feet)	60		1/4 as loud
Light auto traffic (100 feet)	50	Quiet	1/8 as loud
Quiet rural residential area with no activity	45		
Bedroom or quiet living room Bird calls	40	Faint	1/16 as loud
Typical wilderness area	35		
Quiet library, soft whisper (15 feet)	30	Very quiet	1/32 as loud
Wilderness with no wind or animal activity	25	Extremely quiet	
High-quality recording studio	20		1/64 as loud
Acoustic test chamber	10	Just audible	
	0	Threshold of hearing	
Adapted from: EPA 1971.			

For the purposes of the acoustic analysis and the regulatory compliance assessment, the Applicant completed a baseline sound monitoring program in the vicinity of the Facility to demonstrate compliance with OAR 340-035-0035(1)(b)(B)(i), which establishes criteria incrementally relative to existing conditions.

4.1 Field Measurement Methodology

Collection of field data was necessary to define the existing daytime and nighttime ambient sound levels at NSRs in the analysis area. A total of five short-term (30-minute) sound measurement locations were selected within the analysis area at publicly accessible land in proximity to NSRs. These measurement locations were selected to represent the nearest NSRs to the Facility within the analysis area. The short-term monitors consisted of a sound level analyzer directly mounted to a tripod with the microphone and windscreen at a height of approximately 5 feet above ground.

All measurements were taken with a Larson Davis 831 real-time sound level analyzer, equipped with a PCB model 377B02 ½-inch precision condenser microphone. This instrument has an operating range of 5 dB to 140 dB, and an overall frequency range of 8 to 20,000 Hz and meets or exceeds all requirements set forth in the American National Standards Institute standards for Type 1 sound level meters for quality and accuracy.

Prior to any field measurements, all test equipment was field calibrated with an American National Standards Institute Type 1 calibrator that has accuracy traceable to the National Institute of Standards and Technology. Each sound analyzer was programmed to measure and log broadband A-weighted sound pressure levels in 10- and 1-minute time intervals as well as a number of statistical sound levels (L_n). The statistical sound levels provide the sound level exceeded for that percentage of time over the given measurement period. For example, the L_{10} level is often referred to as the intrusive noise level and is the sound level that is exceeded 10 percent of the measurement period. The equivalent sound level (L_{eq}), L_{10} (intrusive noise level), L_{50} (median), and L_{90} (residual sound level) sound metrics were data-logged for the duration of the monitoring period to fully characterize the ambient acoustic environment. Data were collected for 1/1 and 1/3 octave band data spanning the frequency range of 8 Hz to 20 kilohertz. The locations of monitoring locations were recorded using a global positioning system unit, and photographs were taken to document surroundings. Following the completion of the measurement period all monitored data was downloaded to a computer and backed up on an external hard drive for further analysis.

When sound measurements are attempted in the presence of elevated wind speeds, extraneous noise can be self-generated across the microphone and is often referred to as “pseudonoise.” Air blowing over a microphone diaphragm creates a pressure differential and turbulence. All sound level analyzer microphones were protected from wind-induced pseudonoise by a foam windscreen made of specially prepared open-pored polyurethane. By using this microphone protection, the pressure gradient and turbulence are effectively moved farther away from the microphone, minimizing self-generated wind-induced noise. Weather conditions during the baseline sound survey were conducive for accurate data collection.

Several statistical sound levels were measured by the monitors in consecutive 1-second and 1-minute intervals during each 30-minute measurement period. Of these, the median, or L_{50}, level (the sound level exceeded 50 percent of the time), is considered the most meaningful quantity for this type of survey. It captures the consistently present sound level that exists during each period in the absence of sporadic and extraneous noise events, such as wind gusts or aircraft overflights. The results of the baseline monitoring program were used to establish a range of existing ambient sound levels within the analysis area and assist in determining compliance with OAR 340-035-0035(1)(b)(B)(i), which prescribes an incremental increase limit of 10 dBA over the ambient statistical noise levels of either the L_{10} or L_{50}.

4.2 Sound Survey Analysis and Results

Measurements of the existing sound levels were conducted for both the daytime and nighttime periods. OAR 340-035-0035(1)(b)(A) defines daytime (7:00 a.m. – 10:00 p.m.) and nighttime (10:00 p.m. – 7:0 a.m.) statistical noise limits as summarized in Table Y-1. A solar facility will generate maximum operations primarily during the daytime period; however, the facility will also operate during nighttime hours. Therefore, the baseline measurement data were correlated by daytime and nighttime measurement periods, for purposes of assessing compliance with the ambient degradation test.

Table Y-3 presents a summary of ambient sound survey results at each monitoring location, providing information including Universal Transverse Mercator (UTM) coordinates and distance to the nearest Project fence line (see Exhibit C, Figure C-2 for proposed fence line). In addition, daytime and nighttime L_{eq}, L_{10}, L_{50}, and L_{90} parameters are provided. Figure Y-1 shows the monitoring locations selected for the baseline sound survey. Measurements were collected on publicly accessible land closest to the corresponding NSRs.

Table Y-3. Summary of Ambient Sound Survey Results

Noise Sensitive Location ID	UTM Coordinates		Distance to Nearest Facility Fence Line (feet/meters)	Time Period	Baseline Sound Level Metric			
	Easting (meters)	Northing (meters)			L_{eq}	L_{10}	L_{50}	L_{90}
ML-1	297252	5056509	98/30	Day	64	61	38	31
				Night	38	40	38	36
ML-2	302807	5054564	2,254/687	Day	37	41	32	26
				Night	30	31	29	28
ML-3	304200	5051411	33/10	Day	47	48	38	32
				Night	27	29	25	24
ML-4	303465	5048213	5,381/1,640	Day	29	31	27	24
				Night	28	29	28	27
ML-5	297120	5052437	794/242	Day	57	54	33	29
				Night	28	29	28	27

L_{eq} = equivalent sound level; L_{10} = intrusive sound level; L_{50} = median sound level; L_{90} = residual sound level; UTM = Universal Transverse Mercator.

5.0 Predicted Noise Levels

OAR 345-021-0010(1)(y) Information about noise generated by construction and operation of the proposed facility, providing evidence to support a finding by the Council that the proposed facility complies with the Oregon Department of Environmental Quality's noise control standards in OAR 340-035-0035. The applicant must include:

(A) Predicted noise levels resulting from construction and operation of the proposed facility;

5.1 Construction Noise Assessment

OAR 340-035-0035(5)(g) exempts noise emanating from construction activities from compliance with the state noise regulations. Therefore, the Applicant provides the following information on construction noise sources for reference purposes only.

The Applicant predicted construction noise levels using a semi-qualitative approach based on equipment sound levels provided in the *Federal Highway Administration Roadway Construction Noise Model* (FHWA 2006). This equipment is also used on solar projects, so the Federal Highway Administration's sound levels are applicable to incorporate into the Facility. Construction activities associated with the Facility have the potential for localized sound on a temporary basis, as construction activities progress through certain locations within the Facility area. Construction activities at the Facility can be generally divided into five phases:

- Preparation of the site and staging areas, including grading and on-site access roads;
- Installation of array foundations, conductors, the operations and maintenance buildings, and the control enclosure;
- Assembly of solar panels and electrical connection components;
- Construction of the inverter pad and battery pads, substation, cabling, terminations, and transmission lines; and
- Commissioning of the array and interconnection, revegetation, and waste removal and recycling facilities.

These activities will occur sequentially for discrete groupings of solar arrays, with the potential for overlap. In addition to the solar panels, construction activities will also occur for supporting infrastructure. The inverters and distribution transformers are likely to be completed while respective solar arrays are being constructed; completion of other Facility-related elements, such as the operations and maintenance buildings, will occur independently.

Sound generated by Facility construction is expected to vary depending on the construction phase. Table Y-4 lists the typical sound levels associated with common construction equipment and the composite level per phase at the closest NSR. Periodically, sound levels may be higher or lower; however, the overall sound levels should generally be lower due to excess attenuation.

Table Y-4. Summary of Solar Farm Construction Equipment by Phase

Phase No.	Construction Phase	Construction Equipment	Usage Factor %	Maximum L_{max} Equipment Noise Level at 50 feet (dBA)	Composite Maximum L_{max} Equipment Noise Level at Nearest NSR 1,200 feet (dBA)
1	Demolition	Excavators (168 horsepower [hp])	40	85	59
		Tractors/Loaders/Backhoes (108 hp)	40	80	
		Rough Terrain Forklifts (93 hp)	40	85	
		Dump Truck	40	85	

Phase No.	Construction Phase	Construction Equipment	Usage Factor %	Maximum L_{max} Equipment Noise Level at 50 feet (dBA)	Composite Maximum L_{max} Equipment Noise Level at Nearest NSR 1,200 feet (dBA)
2	Site Preparation and Grading	Graders (174 hp) Rubber Tired Loaders (164 hp) Scrapers (313 hp) Water Trucks (189 hp) Generator Sets	40 40 40 40 50	85 85 85 88 82	61
3	Trenching and Road Construction	Excavators (168 hp) Graders (174 hp) Water Trucks (189 hp) Trencher (63 hp) Rubber Tired Loaders (164 hp) Generator Sets	40 40 40 40 40 50	85 85 88 85 80 82	61
4	Equipment Installation	Crane (399 hp) Forklifts (145 hp) Pile drivers Pickup Trucks/ATVs Water Trucks (189 hp) Generator Sets	16 40 20 40 40 50	85 85 95 55 88 82	63
5	Commissioning	Pickup Trucks/ATVs	40	55	23

5.2 Operational Noise Assessment

The Applicant modeled noise sources from the Facility to demonstrate that operation of the Facility will not exceed the noise levels outlined in the ODEQ Noise Rules. Inputs for the acoustic model included the maximum proposed number of inverters, transformers, and battery storage system components. This analysis presents the noise outputs from the full build out of the Facility.

5.2.1 Acoustic Modeling Software and Calculation Methods

Two programs were used for the Facility acoustic analysis, DataKustik GmbH's computer-aided noise abatement program (CadnaA; DataKustik 2022) and the Corona and Field Effects Program Version 3 (Corona 3; BPA 1991). Further details pertaining to these two programs are given in the following subsections.

5.2.1.1 CadnaA

The acoustic modeling analysis was conducted using the most recent version of CadnaA. CadnaA is a comprehensive three-dimensional acoustic software model that conforms to the International Organization for Standardization (ISO) standard ISO 9613-2 "Attenuation of Sound during Propagation Outdoors" (ISO 1996). The engineering methods specified in this standard consist of full (1/1) octave band algorithms that incorporate geometric spreading due to wave divergence, reflection from surfaces, atmospheric absorption, screening by topography and obstacles, ground effects, source directivity, heights of both sources and receptors, seasonal foliage effects, and meteorological conditions. Topographical information was imported into the acoustic model using the official United States Geological Survey digital elevation dataset to accurately represent terrain in three dimensions. Terrain conditions, vegetation type, ground cover, and the density and height of foliage can also influence the absorption that takes place when sound waves travel over land. The ISO 9613-2 standard accounts for ground absorption rates by assigning a numerical coefficient of G=0 for acoustically hard, reflective surfaces and G=1 for absorptive surfaces and soft ground. If the ground is hard-packed dirt, typically found in industrial complexes, pavement, bare rock or for sound traveling over water, the absorption coefficient is defined as G=0 to account for reduced sound attenuation and higher reflectivity. In contrast, ground covered in vegetation, including suburban lawns, livestock and agricultural fields (both fallow with bare soil and planted with crops), will be acoustically absorptive and aid in sound attenuation (i.e., G=1.0). A mixed (semi-reflective) ground factor of G=0.5 was used in the Facility acoustic modeling analysis. In addition to geometrical divergence, attenuation factors include topographical features, terrain coverage, and/or other natural or anthropogenic obstacles that can affect sound attenuation and result in acoustical screening. To be conservative, sound attenuation through foliage and diffraction around and over existing anthropogenic structures such as buildings was not included in this modeling analysis.

Sound attenuation by the atmosphere is not strongly dependent on temperature and humidity; however, the temperature of 10 degrees Celsius (50 degrees Fahrenheit) and 70 percent relative humidity parameters were selected for this analysis. Over short distances, the effects of atmospheric absorption are minimal. The ISO 9613-2 standard calculates attenuation for meteorological conditions favorable to propagation; i.e., downwind sound propagation or what might occur typically during a moderate atmospheric ground level inversion. Though a physical impracticality, the ISO 9613-2 standard simulates omnidirectional downwind propagation. This conservative assumption does not take into consideration turbulent eddies and micrometeorological inhomogeneities that may form when winds change speed or direction, which can interfere with the sound wave propagation path and increase attenuation effects.

5.2.1.2 Corona and Field Effects Program

Transmission line corona sound levels were evaluated using Corona 3, a DOS-based computer model developed by the Bonneville Power Administration (BPA; BPA 1991). The Corona 3 program uses the algorithms developed by BPA to predict a variety of outputs including electric and magnetic fields and audible noise. The inputs to the Corona 3 model are line voltage, load flow (current), and the physical dimensions of the line (number of phases, conductor diameter, spacing, height, and subconductor configuration) and site elevation.

The BPA method of calculating audible noise from transmission lines is based on long-term statistical data collected from operating and test transmission lines. This method calculates the L_{50} noise level during rainy conditions of 1 millimeter per hour. Long-term measurements show that L_{50} audible noise levels occur at this rain rate. Results during fair weather conditions are also evaluated. Additional details regarding the Corona 3 program are provided in Exhibit AA.

5.3 Input to the Noise Prediction Model

5.3.1 Solar Facilities

The principal sources of noise associated with the solar facilities are the battery storage cooling units, the electrical components of the inverters, the step-up transformer associated with each inverter skid, and the main power transformers distributed throughout the site. The inverter skids and battery storage units are mounted on pads at grade level.

Substations have switching, protection, and control equipment, as well as a main power transformer, which generate the sound generally described as a low humming. There are three chief noise sources associated with a transformer: core noise, load noise, and noise generated by the operation of the cooling equipment. The core is the principal noise source and does not vary significantly with electrical load. The load noise is primarily caused by the load current in the transformer's conducting coils (or windings) and consequently the main frequency of this sound is twice the supply frequency: 120 Hz for 60 Hz transformers. The cooling equipment (fans and pumps) may also be an important noise component, depending on fan design. During air forced cooling method, cooling fan noise is produced in addition to the core noise. The resulting audible sound is a combination of hum and the broadband fan noise. Breaker noise is a sound event of very short duration, expected to occur only a few times throughout the year. Just as horsepower ratings designate the power capacity of an electric motor, a transformer's megavolt amperes rating indicates its maximum power output capacity.

Reference sound power levels for the inverter skid and substation main power transformer inputs to CadnaA were provided by equipment manufacturers, based on information contained in reference documents or developed using empirical methods. The source levels used in the predictive modeling are based on estimated sound power levels that are generally deemed to be conservative. A battery energy storage system (BESS) may be installed (see Exhibit B for details). Current available sound power level estimates for zinc or lithium-ion systems would not be able to achieve compliance at NSRs for the proposed maximum battery system layout. This modeling analysis used sound power levels for the BESS that would be necessary in order to comply with applicable noise regulations. The Applicant understands that if a BESS is installed, an updated analysis using the actual sound power levels to be installed must be developed and provided to ODOE to demonstrate compliance.

The projected operational noise levels are based on Applicant-supplied sound power level data for the major sources of equipment in addition to the BESS analysis above. Table Y-5 summarizes the equipment sound power level data used as inputs to the acoustic modeling analysis. For the purpose of the analysis, it was assumed that all equipment would operate consistently during both daytime and nighttime periods.

Table Y-5. Equipment Sound Power Level by Octave Band Center Frequency

Noise Sources	Quantity	Octave Band Sound Power Level by Frequency (Hz) dBL									Broadband (dBA)
		31.5	63	125	250	500	1000	2000	4000	8000	
Inverter Skid	318	83	82	84	83	87	78	77	85	79	89
BESS Unit	14,946	85	69	76	70	63	57	50	43	38	66
Main Power Transformer	6	97	103	105	100	100	94	89	84	77	100

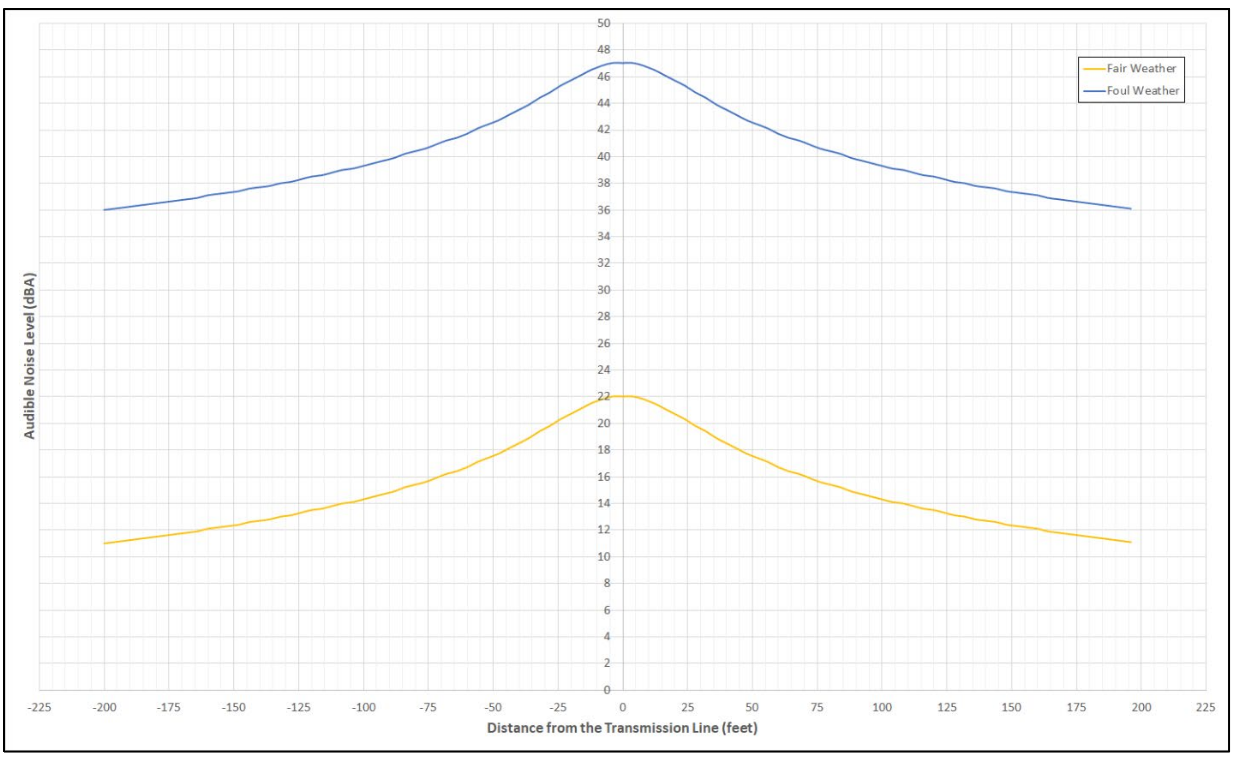
5.3.1.1 Transmission Lines

Transmission line sound sources will primarily consist of corona noise in addition to Aeolian noise, and noise associated with maintenance activities. Transmission line noise (also called corona noise) is caused by the partial electrical breakdown of the insulating properties of air around the electrical conductors and overhead power lines. Audible noise generated by corona on transmission lines is composed of two major components. The higher frequencies of the broadband component distinguish it from more common outdoor environmental noise. The random phase relationship of the pressure waves generated by each corona source along a transmission line results in a characteristic sound commonly described as crackling, frying, or hissing. The second component is a lower-frequency sound that is superimposed over the broadband noise. The corona discharges produce positive and negative ions that, under the influence of the alternating electric field around alternating current conductors, are alternately attracted to and repelled from the conductors. This motion establishes a sound-pressure wave having a frequency twice that of the voltage (i.e., 120 Hz for a 60-Hz system). Higher harmonics (e.g., 240 Hz) may also be present, but they are generally of lower significance (EPRI 2015). Corona activity increases with increasing altitude, and with increasing voltage in the line, but is generally not affected by system loading. The relative magnitude of hum and broadband noise may be different depending on weather conditions at the line. According to EPRI, when the line is wet (such as during rainy weather conditions), the broadband component typically dominates; however, under icing conditions, the lower frequency components may be more prevalent.

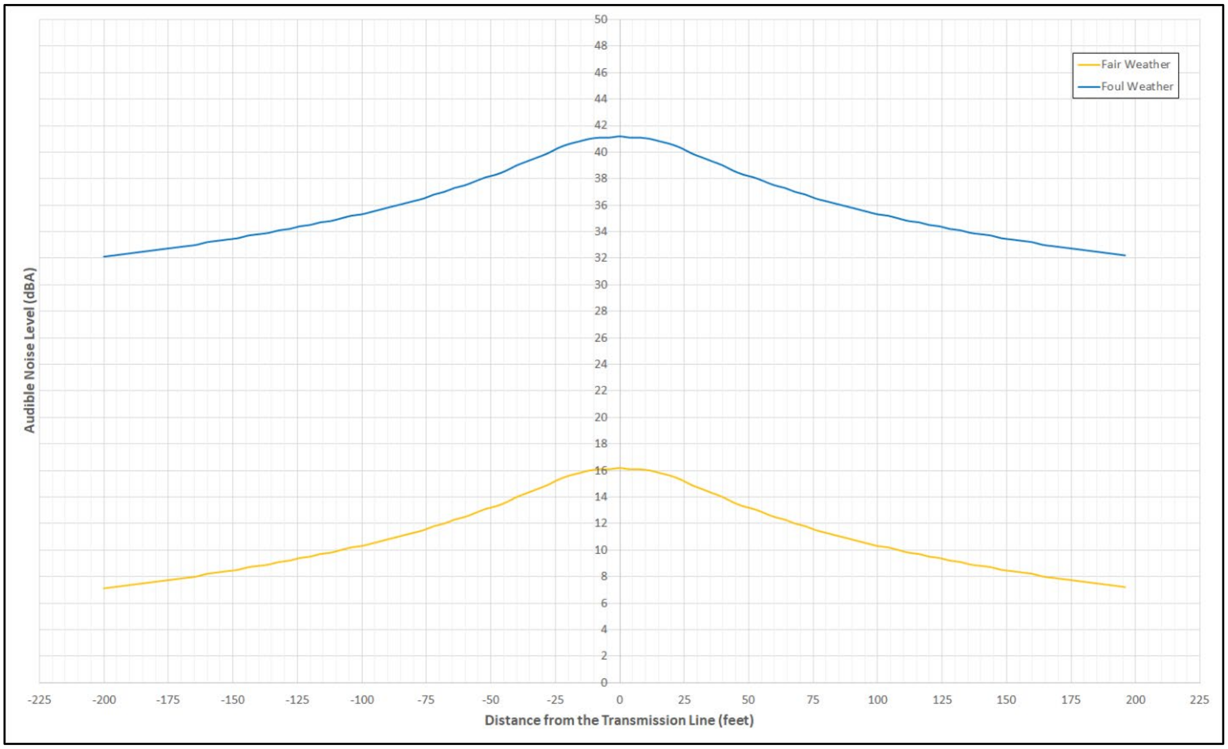
Corona noise levels during precipitation may vary over a wide range. During the initial stages, when the conductors are not thoroughly wet, there may be considerable fluctuation in the noise level as the precipitation intensity varies. When the conductors are thoroughly wet, the noise fluctuations will often be less significant, because even as the intensity of precipitation diminishes the conductors will still be saturated, which can result in corona discharge. The variation in noise levels during rain depends greatly on the condition of the conductor surface and on the voltage gradient at which the conductors are operating. At high operating gradients, the audible noise is less sensitive to rain rate than at low gradients. Consequently, the variation in noise levels is less for the higher gradients. In different weather conditions the relative magnitudes of random noise and hum may be different. Noise levels in fog and snow usually do not attain the same magnitude as compared to rain, and elevated noise levels during fog and snow are usually for a shorter duration in proportion to the event (EPRI 1982).

During fair weather conditions, corona occurs only at scratches or other imperfections in the conductor surface or where dust has settled on the line. These limited sources are such that the corona activity is minimal, and the audible noise generated is very low. Generally, the fair-weather audible noise of transmission lines cannot be distinguished from ambient noise at the edge of the right-of-way.

Audible noise levels associated with the transmission line is dependent upon the configuration of the transmission line. Exhibit AA provides the modeling assumptions used as inputs to Corona 3. Graphs Y-1 and Y-2 display the Corona 3 audible noise modeling results for the Project transmission lines in both fair and foul weather conditions. The transmission line is modeled within audible noise levels presents to a distance of 200 feet from the transmission line centerline. Graph Y-1 shows the audible noise profile for the northern transmission line, which indicates during foul weather conditions, when more corona is generated, received sound levels attenuate to approximately 42 to 43 dBA at a distance of 50 dBA from the transmission line centerline. Graph Y-2 shows the audible noise profile for the southern transmission line, which indicates during foul weather conditions, when more corona is generated, received sound levels attenuate to approximately 38 dBA at a distance of 50 dBA from the transmission line centerline.



Graph Y-1. Audible Noise Profile, Northern Transmission Line



Graph Y-2. Audible Noise Profile, Southern Transmission Line

6.0 Assessment of Compliance with Applicable Noise Regulations

OAR 345-021-0010(1)(y)(B) An analysis of the proposed facility's compliance with the applicable noise regulations in OAR 340-035-0035, including a discussion and justification of the methods and assumptions used in the analysis;

Construction activities are categorically exempted under OAR 340-35-0035(5)(g). Construction noise is short term and not expected to result in any significant long-term impacts at any NSRs.

A sound contour plot displaying modeled Facility operational sound levels in color-coded isopleths is provided in Figure Y-2. The resultant noise contour noise contour plots are independent of the existing acoustic environment (i.e., are Facility-generated sound levels only).

Table Y-6 presents the results of the Facility acoustic modeling analysis and includes the feature ID, UTM coordinates, and the received sound levels at each NSR resulting from solar facility operation, transmission line operation, and cumulative sound levels of transmission lines, and the solar facility operating simultaneously. Received sound levels are rounded to the nearest whole decimal for consistency with the ODEQ noise regulations. Modeling results indicate the Facility successfully demonstrates compliance with the applicable ODEQ statistical noise limits (50 dBA L_{50}, 55 dBA L_{10}, 60 dBA L_{10}) and with the OAR 340-035-0035(B)(iii)(III) 10 dBA ambient degradation standard at all NSRs.

The Applicant recognizes that the specifications used to analyze sound emissions from the BESS units are not currently commercially available. In the event that BESS units meeting those specifications are not available prior to construction, the Applicant will obtain a legally effective easement or real covenant for any expected exceedance (if draft rule changes to OAR Ch. 340, Div. 35 are finalized), modify the Project design, or implement noise mitigation measures as necessary to maintain compliance with the applicable ODEQ 50 dBA L_{50} and with the OAR 340-035-0035(B)(iii)(III) 10 dBA ambient degradation standard at all NSRs, and an updated modeling analysis will be provided to ODOE to demonstrate compliance based on the final design and selected technology.

Table Y-6. Acoustic Modeling Results

NSR ID	Time Period	Ambient ML	Ambient Sound Level (dBA, L_{50})	Solar Facility Noise (dBA)	Transmission Line Noise (dBA)	Combined Noise (Ambient +Solar + TL) (dBA)	Change in Noise (dBA)	Compliance with OAR 340-035-0035
1	Day	ML-1	38	39	32	42	4	Yes
	Night		38	39	32	42	4	Yes
2	Day	ML-2	32	17	0	32	0	Yes
	Night		29	17	0	29	0	Yes
3	Day	ML-2	32	26	0	33	1	Yes
	Night		29	26	0	31	2	Yes
4	Day	ML-2	32	30	2	34	2	Yes
	Night		29	30	2	33	4	Yes
5	Day	ML-2	32	31	17	35	3	Yes
	Night		29	31	17	33	4	Yes
6	Day	ML-2	32	31	3	35	3	Yes
	Night		29	31	3	33	4	Yes
7	Day	ML-3	38	35	0	40	2	Yes
	Night		25	35	0	35	10	Yes
8	Day	ML-4	27	21	0	28	1	Yes
	Night		28	21	0	29	1	Yes
9	Day	ML-5	33	19	0	33	0	Yes
	Night		28	19	0	29	1	Yes
10	Day	ML-3	38	29	9	39	1	Yes
	Night		25	29	9	30	5	Yes
11	Day	ML-1	38	32	25	39	1	Yes
	Night		38	32	25	39	1	Yes
12	Day	ML-5	33	26	3	34	1	Yes

NSR ID	Time Period	Ambient ML	Ambient Sound Level (dBA, L_{50})	Solar Facility Noise (dBA)	Transmission Line Noise (dBA)	Combined Noise (Ambient +Solar + TL) (dBA)	Change in Noise (dBA)	Compliance with OAR 340-035-0035
	Night		28	26	3	30	2	Yes
13	Day	ML-5	33	35	16	37	4	Yes
	Night		28	35	16	36	8	Yes
14	Day	ML-5	33	35	15	37	4	Yes
	Night		28	35	15	36	8	Yes

Results show there are no predicted noise exceedances. Figure Y-2 shows sound contour plots displaying broadband sound levels presented as color-coded isopleths. The noise contours are graphical representations of the cumulative noise associated with full operation of the solar facility components and show how the operational noise would be distributed over the surrounding area within a 1-mile radius of the Facility site boundary.

7.0 Measures to Reduce Noise Levels or Impacts to Address Public Complaints

OAR 345-021-0010(1)(y)(C) Any measures the applicant proposes to reduce noise levels or noise impacts or to address public complaints about noise from the facility;

The Applicant has committed to successfully demonstrating compliance with the OAR 340-035-0035 noise regulations through final equipment selection, Facility design, legally effective easements or real covenants (if draft rule changes to OAR Ch. 340, Div. 35 are finalized), or noise mitigation implementation, as applicable and necessary. Therefore, it is not expected that any further noise mitigation measures will be required during Facility operation.

During construction, the following mitigation measures will be considered and incorporated into the Facility's contract specifications, as necessary and appropriate, to minimize Facility noise levels to the extent practicable:

- Construction site and access road speed limits will be established and enforced during the construction period.
- Electrically powered equipment will be used instead of pneumatic or internal combustion powered equipment, where feasible.
- Material stockpiles and mobile equipment staging, parking, and maintenance areas will be located as far as practicable from NSRs.

- The use of noise-producing signals, including horns, whistles, alarms, and bells, will be for safety warning purposes only.
- All noise-producing construction equipment and vehicles using internal combustion engines will be equipped with mufflers, air-inlet silencers where appropriate, and any other shrouds, shields, or other noise-reducing features as per original factory specification and be maintained in good operating condition. Mobile or fixed “package” equipment (e.g., arc-welders, air compressors) will be equipped with shrouds and noise control features that are readily available for that type of equipment.
- All construction noise complaints will be logged within 48 hours of issuance. The construction supervisor will have the responsibility and authority to receive and resolve noise complaints. A clear appeal process to the Applicant will be established prior to the start of construction that will allow for resolution of noise problems that cannot be resolved by the site supervisor in a reasonable period of time.
- Final equipment specifications and noise warranty data will be reviewed by an acoustician to ensure compliance with OAR 340-035-0035.

8.0 Monitoring

OAR 345-021-0010(1)(y)(D) Any measures the applicant proposes to monitor noise generated by operation of the facility; and

Noise monitoring is not proposed for the Facility. No exceedances of the OAR 340-035-0035 anti-degradation rule or the fixed thresholds, or (if draft rule changes to OAR Ch. 340, Div. 35 are finalized) no such exceedances for which Applicant has not obtained a legally effective easement or real covenant, are predicted. Additionally, the legislative authority granted to the Council in OAR 345-026-0010(1) states that under Oregon Revised Statute 469.430, “the Council has continuing authority over the site for which a site certificate is issued and may inspect, direct the Department of Energy to inspect, or ask another state agency or local government to inspect, the site at any time to ensure that the certificate holder is operating the facility in compliance with the terms and conditions of the site certificate.”

9.0 Owners of Noise Sensitive Property

OAR 345-021-0010(1)(y)(E) A list of the names and addresses of all owners of noise sensitive property, as defined in OAR 340-035-0015, within one mile of the proposed site boundary.

Confidential Attachment Y-1 provides the names and addresses, UTM Zone 11 North X and Y coordinates in meters, and a summary of modeled received sound levels at all noise sensitive properties within 1 mile of the site boundary.

10.0 Submittal Requirements and Approval Standards

10.1 Submittal Requirements

Table Y-7. Submittal Requirements Matrix

Requirement	Location
OAR 345-021-0010(1)(y) Information about noise generated by construction and operation of the proposed facility, providing evidence to support a finding by the Council that the proposed facility complies with the Oregon Department of Environmental Quality's noise control standards in OAR 340-035-0035. The applicant must include:	–
(A) Predicted noise levels resulting from construction and operation of the proposed facility;	Section 5.0
(B) An analysis of the proposed facility's compliance with the applicable noise regulations in OAR 340-035-0035, including a discussion and justification of the methods and assumptions used in the analysis;	Section 4.0, Section 5.0, Section 6.0
(C) Any measures the applicant proposes to reduce noise levels or noise impacts or to address public complaints about noise from the facility;	Section 7.0
(D) Any measures the applicant proposes to monitor noise generated by operation of the facility; and	Section 8.0
(E) A list of the names and addresses of all owners of noise sensitive property, as defined in OAR 340-035-0015, within one mile of the proposed site boundary.	Section 9.0, Attachment Y-1

10.2 Approval Standards

OAR 345 Division 22 does not provide an approval standard specific to Exhibit Y.

11.0 References

BPA (Bonneville Power Administration). 1991. Corona and Field Effects Computer Program (Public Domain Software). USDOE: Vancouver, WA.

DataKustik (DataKustik GmbH). 2023. Computer-Aided Noise Abatement Model CadnaA, Munich, Germany.

EPRI (Electric Power Research Institute). 1982. Field Effects of Overhead Transmission Lines and Stations.: Transmission Line Reference Book: 345 KV and Above. Second ed., Palo Alto, California.

EPRI. 2015. The Integrated Grid – a Benefit-Cost Framework. Palo Alto, California.

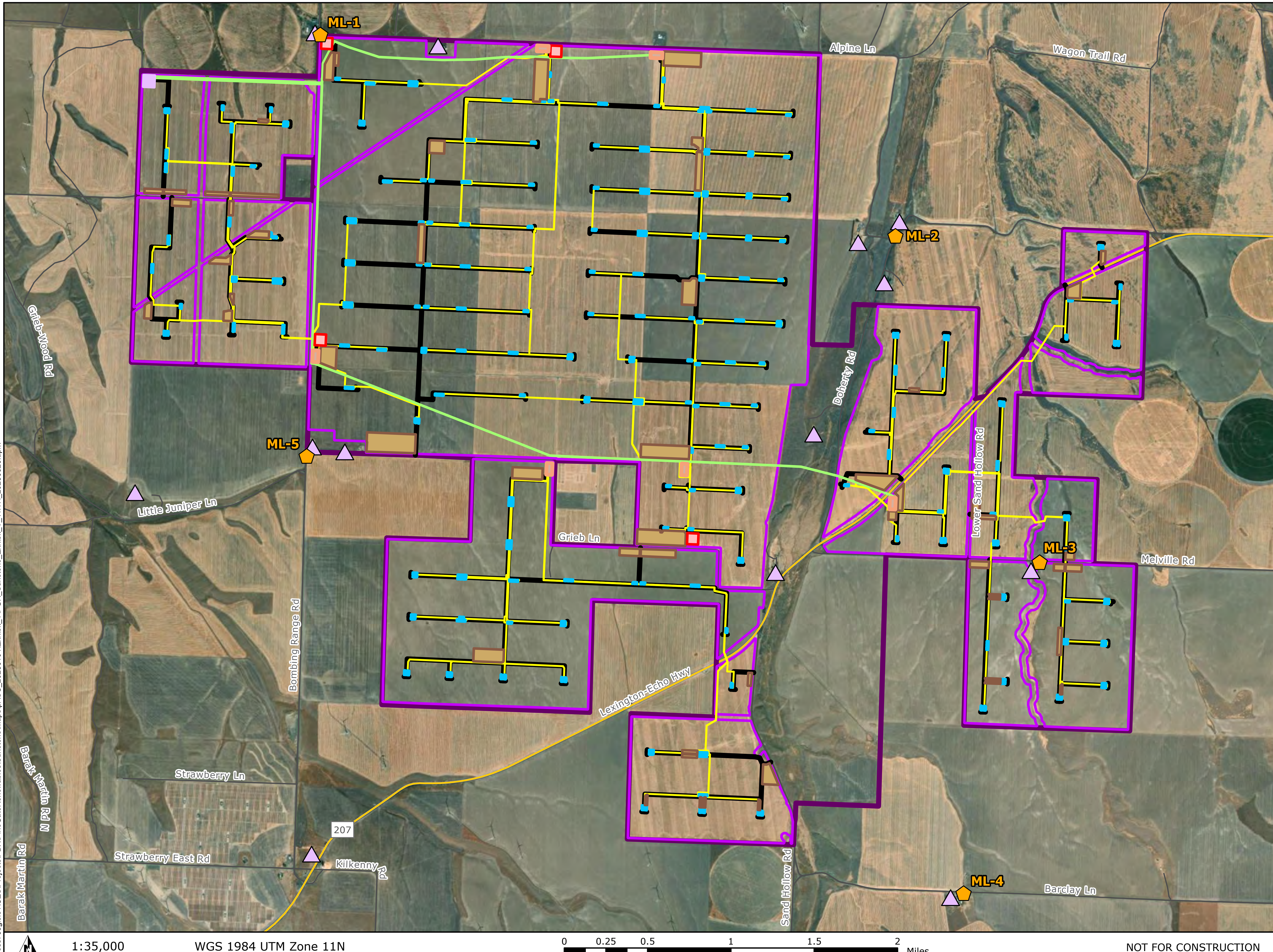
ISO (International Organization for Standardization). 1996. Standard ISO 9613-2 Acoustics – Attenuation of Sound during Propagation Outdoors. Part 2 General Method of Calculation. Geneva, Switzerland.

Figures

Sunstone Solar Project

Figure Y-1
Ambient Noise Monitoring Locations

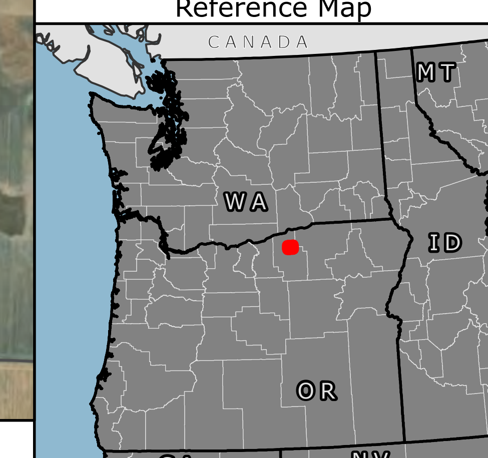
MORROW COUNTY, OR



- Site Boundary
- Fence Line (Maximum)
- Collection Line (34.5-kV)
- Transmission Line (230-kV)
- Access Road
- Inverter/Transformer/BESS Sites
- Laydown Yard
- O&M Area
- Switchyard
- Collector Substation
- Noise-sensitive receptor
- Ambient Noise Monitoring Location
- State Highway
- Local Roads

TETRA TECH PINEGATE RENEWABLES

Reference Map



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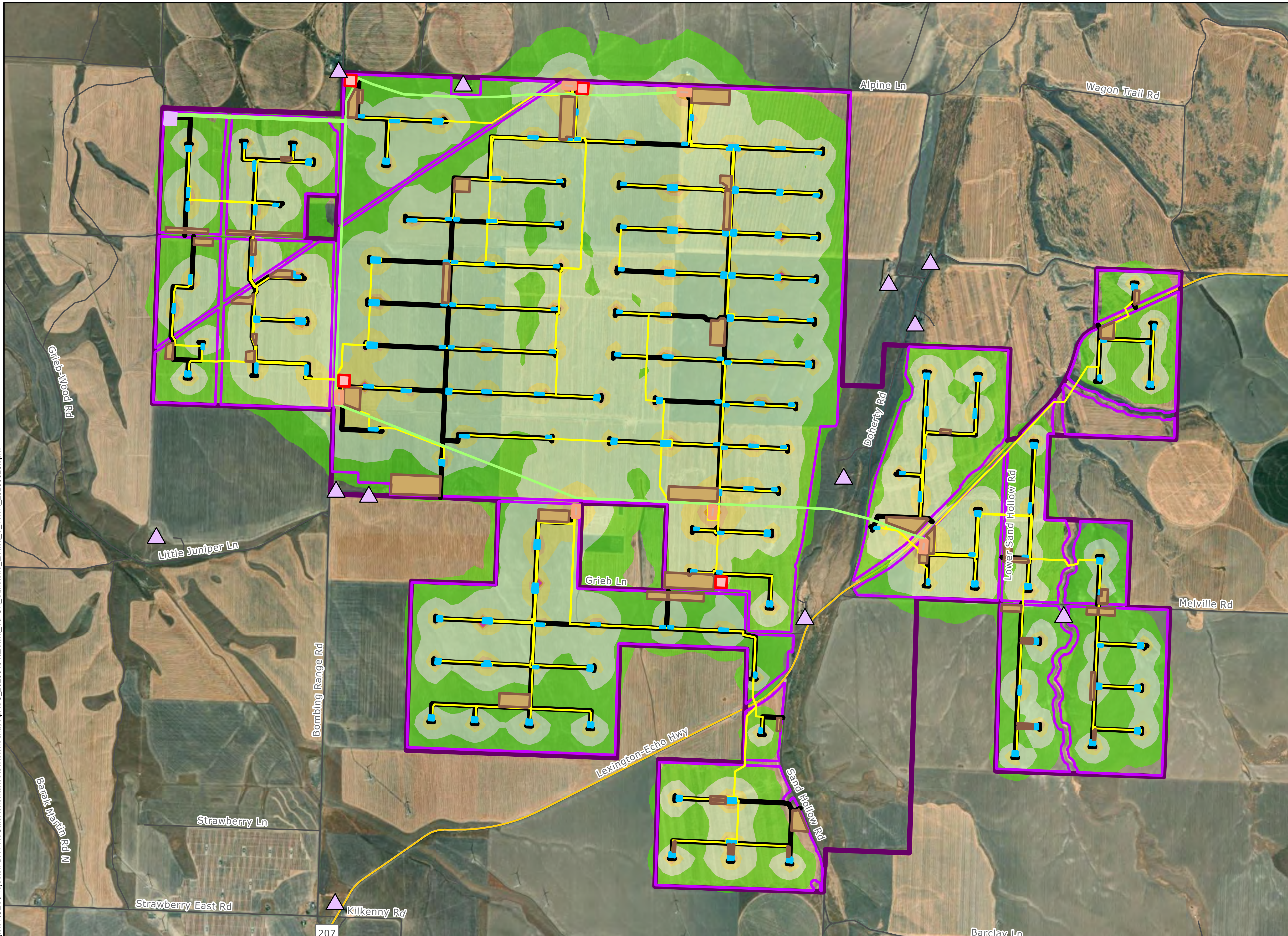
Sunstone Solar Project

Figure Y-2 Operational Received Sound Levels

MORROW COUNTY, OR



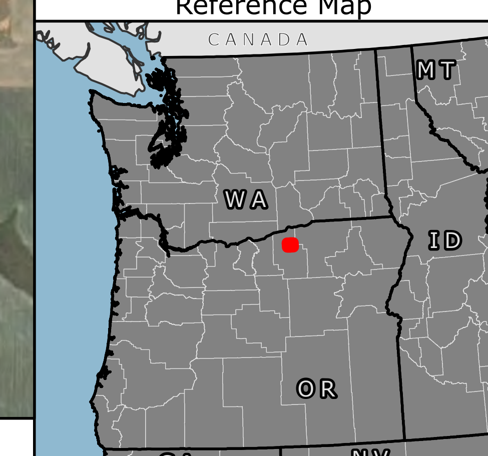
- Site Boundary
- Fence Line (Maximum)
- Collection Line (34.5-kV)
- Transmission Line (230-kV)
- Access Road
- Inverter/Transformer/BESS Sites
- Laydown Yard
- O&M Area
- Switchyard
- Collector Substation
- Noise-sensitive receptor
- State Highway
- Local Roads

Sound Contours (dBA)

- 36-41
- 41-46
- 46-51
- 51-56
- 56-61
- > 61

TETRA TECH PINEGATE RENEWABLES

Reference Map



1:35,000 WGS 1984 UTM Zone 11N

0 0.25 0.5 1 1.5 2 Miles

NOT FOR CONSTRUCTION

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Attachment Y-1. Tabulated Summary of Acoustic Modeling Results by Receptor Location (CONFIDENTIAL)

Provided under Confidential Cover Pursuant to ORS 192.501(2)