EXHIBIT X
NOISE

OAR 345-02100010(1)(x)

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X.1 INTRODUCTION

OAR 345-021-0010(1)(x)*:* *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.*

Response: Archway Solar Energy LLC (Applicant) proposes to construct the Archway Solar Energy Facility (Facility) in Lake County, Oregon, with generating capacity of up to 400 megawatts (MW). The Facility may also contain a battery energy component with storage capacity of up to 400 MW and discharge capacity of up to 1,600 megawatt-hours. This Exhibit presents a noise assessment consistent with the requirements of OAR 345-021-0010(1)(x). The evidence provided in this Exhibit demonstrates that the Applicant has a reasonable likelihood of designing and operating the Facility in compliance with the Oregon Department of Environmental Quality's (DEQ's) noise control standards in OAR 340-035-0035, Noise Control Regulations for Industry and Commerce.

X.2 BACKGROUND INFORMATION ABOUT NOISE

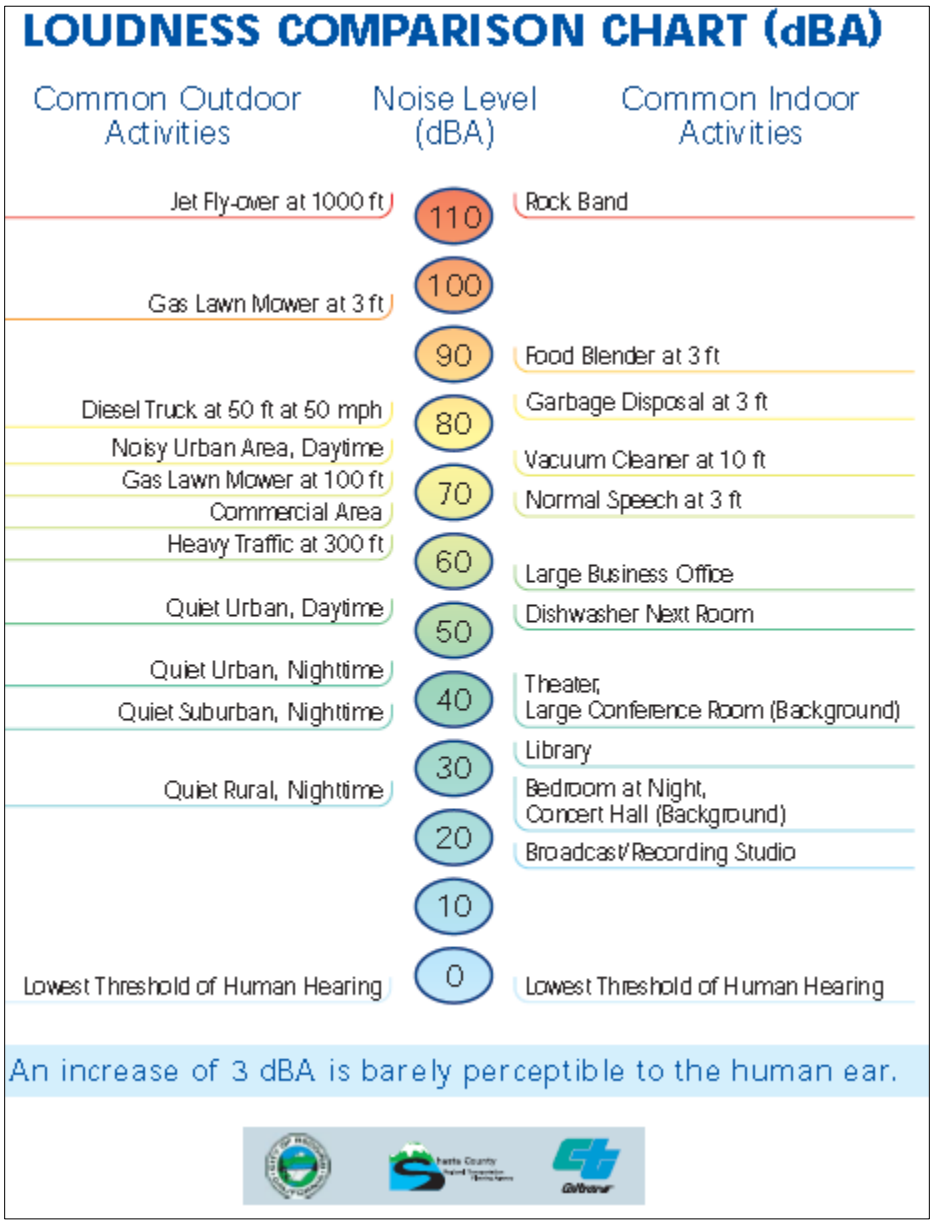
An understanding of how noise is defined and measured provides useful background for this Exhibit. Noise is defined as unwanted sound. Airborne sound is a rapid fluctuation of air pressure above and below atmospheric pressure. There are several different ways to measure noise, depending on the source of the noise, the receiver, and the reason for the noise measurement. Table X-1 summarizes the technical noise terms used in this Exhibit.

Table X-1. Definitions of Acoustical Terms

Term	Definition
Ambient noise level	The composite of noise from all sources near and far. The normal or existing level of environmental noise at a given location.
Decibel (dB)	A unit describing the amplitude of sound, equal to 20 times the logarithm to the base 10 of the ratio of the measured pressure to the reference pressure, which is 20 micropascals.
A-weighted sound pressure level (dBA)	The sound pressure level in decibels as measured on a sound level meter using the A-weighted filter network. The A-weighted filter de-emphasizes the very low and very high frequency components of the sound in a manner similar to the frequency response of the human ear and correlates well with subjective reactions to noise. All sound levels in this report are A-weighted.
Statistical noise level (L_n)	The noise level exceeded during n percent of the measurement period, where n is a number between 0 and 100 (for example, L_{50} is the level exceeded 50 percent of the time).

Table X-2 shows the relative A-weighted noise levels of common sounds measured in the environment and in industry for various sound levels.

Table X-2. Typical Sound Levels Measured in the Environment and Industry



Source: Caltrans 2017.

An understanding of the difference between a sound *pressure* level (or noise level) and a sound *power* level also can be useful. A sound power level (commonly abbreviated as PWL or Lw) is analogous to the wattage of a light bulb; it is a measure of the acoustical energy emitted by the source and is, therefore, independent of distance. A sound pressure level 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. Sound pressure levels always should be specified with a location or distance from the noise source.

Sound power level data are used in acoustic models to predict sound pressure levels. This is because sound power levels take into account the size of the acoustical source and account for the total acoustical energy emitted by the source.

It is also important to note that decibels cannot be directly added arithmetically, that is, 50 dBA + 50 dBA does not equal 100 dBA. When two sources of equal level are added together the result will always be 3 dB greater; that is 50 dBA + 50 dBA = 53 dBA and 70 dBA + 70 dBA = 73 dBA. If the difference between the two sources is 10 dBA, the level (when rounded to the nearest whole decibel) will not increase; that is 40 dBA + 50 dBA=50 dBA and 60 dBA + 70 dBA=70 dBA.

The decrease in sound level caused by distance from any single sound source normally follows the inverse square law; that is, the sound pressure level changes in inverse proportion to the square of the distance from the sound source. 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 sound pressure level from a single source of sound drops off at a rate of 6 dB with 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. This attenuation can be up to 2 dB over 1,000 feet. The drop-off rate will also vary based on terrain conditions and the presence of obstructions in the sound's propagation path. These factors are considered in the development of the acoustical model.

X.3 SITE BOUNDARY AND ANALYSIS AREA

The approximately 4,470-acre Facility site boundary encompasses exclusively private land and is either vacant and unused or used for occasional cattle grazing. The Applicant has negotiated a long-term lease for land within the site boundary. The analysis area consists of any area within the vicinity of the Facility site boundary that could be affected by noise from Facility construction or operation.

X.4 REGULATORY REQUIREMENTS

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,*

Response: Noise standards promulgated by DEQ are contained in OAR 340-035-0035, Noise Control Regulations for Industry and Commerce (DEQ Noise Rules). The DEQ Noise Rules provide two types of noise limits for new industrial or commercial noise sources on a previously unused site.[1] Specifically, OAR 340-035-0035(1)(b)(B)(i) limits the increase over existing ambient levels to 10 dBA while ensuring that a given project does not exceed the levels identified in Table 8 of the OAR.

Table X-3 contains the "Table 8" statistical noise limits referenced in the DEQ Noise Rules. The L_{50} is the median sound level (50 percent of the measurement interval is above this level and 50 percent is below).

[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.

Table X-3. New Industrial and Commercial Noise Source Standards

Statistical Descriptor	Daytime (7 a.m. – 10 p.m.) (dBA)	Nighttime (10 p.m. – 7 a.m.) (dBA)
L_{50}	55	50
L_{10}	60	55
L_1	75	60

Source: OAR 340-35-0035, Table 8.
http://arcweb.sos.state.or.us/pages/rules/oars_300/oar_340/340_035.html

In addition, OAR 340-035-0035(1)(f) establishes standards that regulate octave band sound pressure levels and audible discrete tones. Such standards can be applied by DEQ when it believes the limits discussed above do not adequately protect the health, safety, or welfare of the public.[2]

OAR 340-035-0035(5) provides exemptions for emergency equipment, warning devices not operating continuously for more than 5 minutes, sounds that originate on construction sites, and sounds created in construction or maintenance of capital equipment.

The noise limits apply at "appropriate measurement points" on "noise-sensitive property." The "appropriate measurement point" is defined in the DEQ Noise Rules under OAR 340-35-0035(3)(b) as whichever of the following is farther from the noise source:

- 25 feet (7.6 meters) toward the noise source from that point on the noise-sensitive building nearest the noise source
- That point on the noise-sensitive property line nearest the noise source

"Noise-sensitive property" is defined in OAR 340-35-0015(38) 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 foregoing criteria in more than an incidental manner."

Residences near the Facility are shown on Figure X-1.

X.5 NOISE ANALYSIS METHODOLOGY

This Exhibit analyzes potential noise impacts from construction and operation of the proposed solar array and associated inverters as well as related or supporting facilities consisting of a battery energy storage system, substation transformer, and 500-kilovolt (kV) transmission line.

Very few sources of noise are associated with solar facilities and they are generally minor compared to other energy facilities. The primary noise sources are associated with the cooling systems of the battery storage component, inverters, and transformers. The current produced by solar modules is in the form of direct current (DC). This power can be stored in battery energy storage systems or sent on to the electrical grid. In order to be sent to the electrical grid, the DC current must be converted into alternating current (AC) power, and inverters serve this function. Transformers increase the voltage to ensure the power is efficiently transmitted to the grid.

[2] Impulse noise is also regulated in OAR 340-35-0035(1)(d), but solar facilities do not generate impulsive sounds such as those associated with blasting, gunfire, pile-driving, riveting, hammering, or stamping.

X.6 IMPACTS OF THE PROPOSED FACILITY

The applicant must include: **OAR 345-021-0010(1)(x)(A)** *Predicted noise levels resulting from construction and operation of the proposed facility.*

OAR 345-021-0010(1)(x)(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.*

Response:

X.6.1 Construction

OAR 340-035-0035(5)(g) specifically exempts construction activity. Therefore, by regulatory definition, there will be no construction noise impacts. Regardless, this Exhibit presents potential construction noise levels at the residential receptors nearest to the Facility.

Table X-4 documents the results of a U.S. Environmental Protection Agency (EPA) Office of Noise Abatement and Control analysis of noise from construction equipment, power plant construction sites, and other types of facilities (EPA 1971). Data from the EPA study have been used as a basis for Facility analysis in the absence of specific information about types, quantities, and operating schedules of construction equipment. The EPA data are conservative because the evolution of construction equipment has generally been toward quieter design. Use of these data is reasonable for estimating noise levels, given that they are still widely used by acoustical professionals.

Table X-4. Average Noise Levels from Common Construction at a Reference Distance of 50 feet

Construction Equipment	Typical Average Noise Level at 50 feet (dBA)
Air compressor	81
Backhoe	85
Concrete mixer	85
Concrete pump	82
Crane, mobile	83
Dozer	80
Generator	78
Grader	85
Loader	79
Paver	89
Pile driver	101
Pneumatic tool	85
Pump	76
Rock drill	98
Saw	78
Scraper	88
Shovel	82
Truck	91

Source: EPA 1971.

Table X-5 shows the total composite noise level at a reference distance of 50 feet as well as additional distances, based on typical equipment operating during each phase of construction and the typical usage factor for each piece of equipment. The predicted construction noise levels at 1 and 2 miles are also shown. The calculated levels are likely conservative, because the only attenuating mechanism considered was geometric spreading, which results in an attenuation rate of 6 dBA per doubling of distance; attenuation related to the presence of structures, trees or vegetation, ground effects, and terrain is not considered.

Table X-5. Composite Construction Site Noise Levels

Construction Phase	50 feet (dBA)	100 feet (dBA)	200 feet (dBA)	400 feet (dBA)	1 mile (dBA)	2 miles (dBA)
Clearing	88	82	76	70	48	42
Excavation	90	84	78	72	50	44
Foundation	89	83	77	71	49	43
Erection	84	78	72	66	44	38
Finishing	89	83	77	71	49	43

X.6.2 Operations

A noise model of the proposed Facility will be developed before construction using source input levels derived from data supplied by manufacturers, or information found in the technical literature. The noise levels presented represent the anticipated steady-state level from the Facility with essentially all equipment operating.

Standard acoustical engineering methods will be used in the noise analysis. The noise model, CADNA/A by DataKustik GmbH of Munich, Germany (CADNA 2022) is a sophisticated device that enables one to fully model complex industrial plants. The sound propagation factors used in the model have been adopted from ISO 9613-2 *Acoustics—Sound Attenuation During Propagation Outdoors*. Atmospheric absorption was estimated for conditions of 10 degrees Celsius (°C) and 70 percent relative humidity (conditions that favor propagation) and computed in accordance with ISO 9613-1. The model divides the proposed Facility into a list of individual noise sources representing each piece of equipment that produces a significant amount of noise. The sound power levels representing the standard performance of each of these components are assigned based on data supplied by manufacturers or information found in the technical literature. Using these sound power levels as a basis, the model calculates the sound pressure level that would occur at each receptor from each source after losses from distance, air absorption and other factors are considered. The sum of all these individual levels is the total plant level at the modeling point.

The sound power levels used in the model will be summarized in the final analysis. As is typical at this stage of a project, data are preliminary and detailed vendor specifications will ultimately be developed to ensure the Facility complies with the conditions of certification.

X.6.3 Transmission Line

Corona is the electrical ionization of the air that occurs near the surface of the energized conductor and suspension hardware because of very high electric field strength. Corona may result in audible noise produced by the transmission lines. The amount of corona produced by an overhead transmission line is a function of the voltage of the line, the diameter of the conductors, the locations of the conductors in relation to each other, the elevation of the line above sea level, the condition of the conductors and hardware, and the local weather

conditions. The Applicant is proposing a 500-kV transmission line. The level of corona noise during fair and foul weather conditions is discussed in Exhibit AA.

X.7 PROPOSED MITIGATION MEASURES

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

Response: The Applicant proposes to employ the equipment selection and specification criteria necessary to ensure compliance with the Oregon noise standards (OAR 340-035-0035). While the Facility is anticipated to operate in compliance with the Oregon noise standards without unusual noise mitigation measures, the Applicant has many measures available to ensure compliance is achieved during detailed design. Such measures include specifying quieter equipment (when available) and installing improved acoustical enclosures or barriers. Therefore, no significant noise impacts from the operations are anticipated and no additional mitigation is planned.

X.8 PROPOSED MONITORING MEASURES

OAR 345-021-0010(1)(x)(D) *Any measures the applicant proposes to monitor noise generated by operation of the facility.*

Response: The Applicant intends to monitor noise only in response to a legitimate noise complaint.

X.9 NOISE-SENSITIVE PROPERTIES

OAR 345-021-0010(1)(x)(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.*

Response: The Applicant's consultants reviewed aerial photography to locate potential noise-sensitive properties, as defined in OAR 340-035-0015, within 1 mile of the Facility site boundary. Each noise-sensitive property is a potential residence. Figure X-1 identifies potential noise-sensitive properties within approximately 1 mile of the Facility site boundary.

X.10 SUMMARY

The Applicant is committed to ensuring the Facility's construction and operational sound levels are in accordance with DEQ noise control standards in OAR 340-035-0035. The Applicant will employ reasonable assumptions into its noise modeling analysis to demonstrate that the final Facility is capable of complying with the DEQ noise standard prior to construction. The Applicant is committed to designing and operating the Facility in full compliance with the applicable requirements.

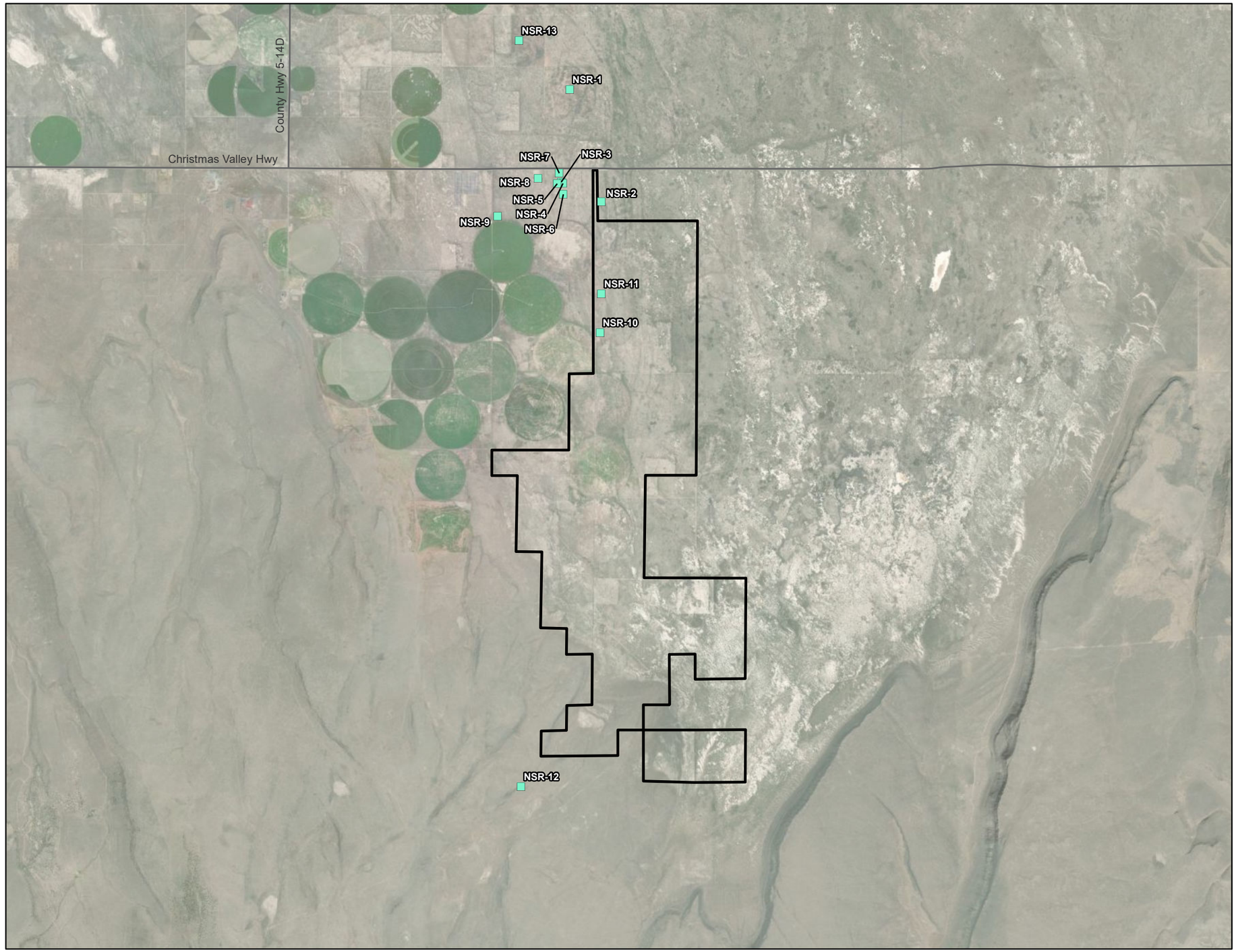
X.11 REFERENCES

CADNA/A Version. 2022. DataKustik, GmbH, Munich, Germany.

California Department of Transportation (Caltrans). 2017. *Loudness Comparison Chart (dBA)*. Accessed June 2022. https://pdf4pro.com/amp/view/loudness-comparison-chart-caltrans-37e726.html.

U.S. Environmental Protection Agency (EPA). 1971. *Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances*.

Figure



Legend

- Facility Site Boundary
- Potential Residence

N

0 0.5 1 2

Miles

Figure X-1
Nearby Residences
Application for Site Certificate
Archway Solar Energy Project
Lake County, Oregon

Jacobs

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