NOISE IMPACT ANALYSIS

SOLAR 33 PROJECT

SAN BERNARDINO COUNTY, CALIFORNIA

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NOISE SETTING

Sound is mechanical energy transmitted by pressure waves in a compressible medium such as air. Noise is generally considered to be unwanted sound. Sound is characterized by various parameters that describe the rate of oscillation of sound waves, the distance between successive troughs or crests, the speed of propagation, and the pressure level or energy content of a given sound. In particular, the sound pressure level has become the most common descriptor used to characterize the loudness of an ambient sound level.

The decibel (dB) scale is used to quantify sound pressure levels. Although decibels are most commonly associated with sound, "dB" is a generic descriptor that is equal to ten times the logarithmic ratio of any physical parameter versus some reference quantity. For sound, the reference level is the faintest sound detectable by a young person with good auditory acuity.

Since the human ear is not equally sensitive to all sound frequencies within the entire auditory spectrum, human response is factored into sound descriptions by weighting sounds within the range of maximum human sensitivity more heavily in a process called "A-weighting," written as dB(A). Any further reference in this discussion to decibels written as "dB" should be understood to be A-weighted.

Time variations in noise exposure are typically expressed in terms of a steady-state energy level equal to the energy content of the time varying period (called LEQ), or alternately, as a statistical description of the sound pressure level that is exceeded over some fraction of a given observation period. Finally, because community receptors are more sensitive to unwanted noise intrusion during the evening and at night, state law requires that, for planning purposes, an artificial dBA increment be added to quiet time noise levels in a 24-hour noise descriptor called the Ldn (day-night) or the Community Noise Equivalent Level (CNEL). The CNEL metric has gradually replaced the Ldn factor, but the two descriptors are essentially identical.

CNEL-based standards are generally applied to transportation-related sources because local jurisdictions are pre-empted from exercising direct noise control over vehicles on public streets, aircraft, trains, etc. The County of San Bernardino therefore regulates the noise exposure of the receiving property through land use controls.

For "stationary" noise sources, or noise sources emanating from private property, such as a HVAC equipment, the County does have legal authority to establish noise performance standards designed to not adversely impact adjoining uses. These standards are typically articulated in the jurisdictional County Code. These standards recognize the varying noise sensitivity of both transmitting and receiving land uses. The property line noise performance standards are normally structured according to land use and time-of-day.

NOISE COMPATIBILITY GUIDELINES

Siting standards for noise exposure for sources that are pre-empted from local control are articulated in the Noise Element of the County Development Code. Industrial uses are not considered noise-sensitive. Guidelines consider most non-residential uses to be "compatible with noise environments up to 65 dB(A) CNEL. Sensitive receptors such as residential uses are recommended to achieve a 60 dB CNEL or lower thresholds.

Table 1

Table 83-3
Noise Standards for Adjacent Mobile Noise Sources

Land Use		Ldn (or CNEL) dB(A)	
Categories	Uses	Interior (1)	Exterior (2)
Residential	Single and multi-family, duplex, mobile homes	45	60 (3)
Commercial	Hotel, motel, transient housing	45	60 (3)
	Commercial retail, bank, restaurant	50	N/A
	Office building, research and development, professional offices	45	65
	Amphitheater, concert hall, auditorium, movie theater	45	N/A
Institutional/Public	Hospital, nursing home, school classroom, religious institution, library	45	65
Open Space	Park	N/A	65

Notes:

(1) The indoor environment shall exclude bathrooms, kitchens, toilets, closets and corridors.

(2) The outdoor environment shall be limited to:

- Hospital/office building patios
- Hotel and motel recreation areas
- Mobile home parks
- Multi-family private patios or balconies
- Park picnic areas
- Private yard of single-family dwellings
- School playgrounds

(3) An exterior noise level of up to 65 dB(A) (or CNEL) shall be allowed provided exterior noise levels have been substantially mitigated through a reasonable application of the best available noise reduction technology, and interior noise exposure does not exceed 45 dB(A) (or CNEL) with windows and doors closed. Requiring that windows and doors remain closed to achieve an acceptable interior noise level shall necessitate the use of air conditioning or mechanical ventilation.

CNEL = (Community Noise Equivalent Level). The average equivalent A-weighted sound level during a 24-hour day, obtained after addition of approximately five decibels to sound levels in the evening from 7 p.m. to 10 p.m. and 10 decibels to sound levels in the night from 10 p.m. to 7 a.m.

NOISE STANDARDS

San Bernardino County, in Section 87.0905 of the County Code, has developed noise performance standards for a variety of land uses that are designed to achieve acceptable interior and/or exterior noise exposures for the affected use. These guidelines for exposure from stationary sources are designed to regulate the level of sound that one use may broadcast across the property line of an adjacent use. Source regulations most commonly use the energy-weighted noisiest single hour called "Leq". The applicable one-hour allowable maximum property line exposures in San Bernardino County for stationary sources are shown below. If the background already exceeds any of the specified levels in the table below, the allowable thresholds are adjusted upward to equal the background. The industrial property line standard is 70 dB(A) Leq. The residential standard is 55 dB(A) by day, and 45 dB(A) Leq at night.

Table 2
County of San Bernardino Noise Ordinance Limits – Stationary Sources

Affected Land Uses (Receiving Noise)	7 a.m. to 10 p.m. Leq[1] dB(A)[2]	10 p.m. to 7 a.m. Leq[1] dB(A)[2]
Residential	55	45
Professional Services	55	55
Other Commercial	60	60
Industrial	70	70

[1]Leq=(Equivalent Energy Level): The sound level corresponding to a steady-state sound level containing the same total energy as a time-varying signal over a given sample period, typically 1.8 or 24 hours.
[2]dB(A)=(A-weighted Sound Pressure Level): The sound pressure level, in decibels, as measured on a sound level meter using the A-weighting filter network. The A-weighting filter de-emphasizes the very low and very high frequency components of the sound, placing greater emphasis on those frequencies within the sensitivity range of the human ear.

Source: County of San Bernardino General Design Standards, Section 87.0905.

Noise from temporary construction activities is exempt from the above ordinance levels if the construction activities are between the hours of 7 a.m. and 7 p.m., Monday through Saturday, with no activity on Sundays or Federal Holidays.

A solar installation project would not likely create stationary noise sources governed by County Code standards except in very close proximity to electrical equipment such as transformers or inverters. Any code-restricted noise generation would possibly derive from construction. However, the Ordinance restricts hours of construction with heavy equipment to hours of lesser noise sensitivity as noted above and exempts such activities from performance standards compliance during permitted hours.

BASELINE NOISE LEVELS

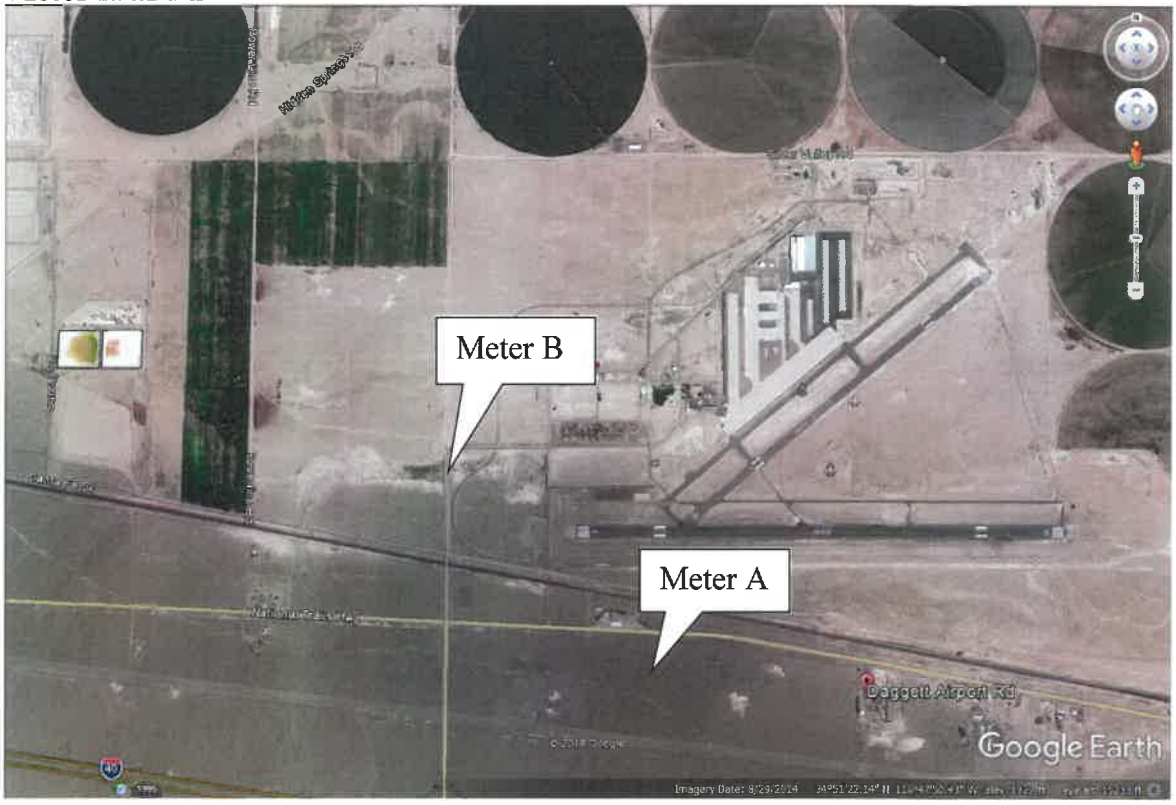
A noise study was conducted by Giroux & Associates on Wednesday, August 1, 2018 with short term noise readings in the project site vicinity. Measurement locations are shown in Figure 1 and are summarized below.

Short-Term Noise Measurements (dB[A])

Meter	Time	Background	Leq	Lmax	Lmin
A	14:10-14:25	Train idling on track	53	65	40
B	14:35-15:50	Two passing pickup-trucks	52	64	38

The major noise source in the project area derives from the adjacent train track. As shown above, trains were idling or slowly passing by during several of the noise measurement periods. Idling trains were fairly quiet and presumably moving trains would create a bit more noise Nevertheless, the ambient noise levels are considered quiet and will not adversely impact the proposed use.

Figure 1 Noise Monitoring Locations
Meter A and B



LAND USE NOISE IMPACTS

THRESHOLDS OF SIGNIFICANCE

According to the current CEQA Appendix G guidelines, noise impacts are considered potentially significant if they cause:

a. Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies. Noise levels exceeding County Noise Standards would be considered significant.

b. Exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels.

c. A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project.

d. A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project.

Two characteristic noise sources are typically identified with land use intensification. Construction activities, especially heavy equipment, will create short-term noise increases near the project site. Such impacts may be important if there are nearby noise-sensitive receptors such as any existing residential uses. Upon completion, project-related traffic will cause an incremental increase in area-wide noise levels throughout the project area. However, for projects like Solar 33, operational project traffic is minimal and limited to occasional security, cleaning and repair.

ADJACENT USES

There are no noise sensitive uses immediately adjacent to the project site. The closest homes to the project site are to the east and are off Hidden Springs Road adjacent to the Daggett Airport runway and are have a separation distance of approximately 1.4 miles.

NOISE SOURCES

PROJECT CONSTRUCTION

In 2006, the Federal Highway Administration (FHWA) published the Roadway Construction Noise Model that includes a national database of construction equipment reference noise emissions levels. In addition, the database provides an acoustical usage factor to estimate the fraction of time each piece of construction equipment is operating at full power during a construction phase. The usage factor is a key input variable that is used to calculate the average Leq noise levels.

Table 3 identifies highest (Lmax) noise levels associated with each type of equipment identified for use, then adjusts this noise level for distance to the closest sensitive receptor and the extent of equipment usage (usage factor), which is represented as Leq. The table is organized by construction activity and equipment associated with each activity

Quantitatively, the primary noise prediction equation is expressed as follows for the hourly average noise level (Leq) at distance D between the source and receiver (dBA):

Leq = Lmax @ 50' – 20 log (D/50') + 10log (U.F%/100) – I.L.(bar)
Where:
Lmax @ 50' is the published reference noise level at 50 feet
U.F.% is the usage factor for full power operation per hour
I.L.(bar) is the insertion loss for intervening barriers

For a construction project such as the proposed project, the construction fleet would include equipment such as shown in Table 3. Table 3 describes the noise level for each individual piece of equipment at a reference 50-foot distance.

Table 3
Construction Equipment Noise Levels

Phase Name	Equipment	Usage Factor[1]	Hours of Operation[2]	Published Noise @ 50 feet (dB)	Actual Measured Noise @ 50 feet (dB)	Average Noise Level @ 50 feet (dB))
Site Prep/Grading	Loader/Backhoe	37%	3.0	80	78	74
	Grader	40%	3.2	85	85	81
	Dozer	40%	3.2	85	82	78
PV Installation	Forklift	20%	1.6	75	75	68
	Dump Truck	40%	3.2	84	76	72
	Post Pounder	20%	1.6	90	90	83
	Loader/Backhoe	37%	3.0	80	78	74

Source: FHWA's Roadway Construction Noise Model, 2006
Estimates the fraction of time each piece of equipment is operating at full power during a construction operation
Represents the actual hours of peak construction equipment activity out of a typical 8-hour day

As discussed, the closest residences are to the east with an approximate 1.4 mile distance separation. Table 4 shows the anticipated construction noise level due to distance attenuation at this home.

Table 4
Construction Equipment Noise Levels at Closest Use

Phase Name	Equipment	Noise Level at Receptor (dB)
Site Prep/Grading	Loader/Backhoe	28
	Grader	35
	Dozer	32
PV Installation	Forklift	22
	Dump Truck	26
	Post Pounder	37
	Loader/Backhoe	28

At the closest residential receiver, noise from heavy equipment operating at the project site would not likely be inaudible even for an outdoor recreational user. The noise levels are lower than the most stringent daytime residential noise standard of 55 dB. Though construction is not expected to occur at night, the nocturnal standard of 45 dB would be met. Therefore, on-site project construction noise would not be considered significant.

CONSTRUCTION ACTIVITY VIBRATION

Construction activities and street traffic are some of the most common external sources of vibration that can be perceptible inside adjacent sensitive uses. Construction activities generate ground-borne vibration when heavy equipment travels over unpaved surfaces or when it is engaged in soil movement. The effects of ground-borne vibration include discernable movement of building floors, rattling of windows, shaking of items on shelves or hanging on walls, and rumbling sounds. Within the "soft" sedimentary surfaces of much of Southern California, ground vibration is quickly damped out. Groundborne vibration is almost never annoying to people who are outdoors (FTA 2006).

Groundborne vibrations from construction activities rarely reach levels that can damage structures. Because vibration is typically not an issue, very few jurisdictions have adopted vibration significance thresholds. Vibration thresholds have been adopted for construction projects, but these relate mostly to structural protection (cracking foundations or stucco) rather than to human annoyance.

Vibration is most commonly expressed in terms of the root mean square (RMS) velocity of a vibrating object. RMS velocities are expressed in units of vibration decibels. The range of vibration decibels (VdB) is as follows:

65 VdB - threshold of human perception
72 VdB - annoyance due to frequent events
80 VdB - annoyance due to infrequent events

94-98 VdB - minor cosmetic damage

To determine potential impacts of the project's construction activities, estimates of vibration levels induced by the construction equipment at various distances are presented below:

	Approximate Vibration Levels (VdB)*		
Equipment	**25 feet**	**50 feet**	**1000 feet**
Pile Driver	93	87	61
Large Bulldozer	87	81	55
Loaded Truck	86	80	54
Jackhammer	79	73	47
Small Bulldozer	58	52	26

* (FTA Transit Noise & Vibration Assessment, Chapter 12, Construction, 2006)

By 1,000 feet project construction vibration would be less than the threshold of human perception even for high impact activities. The closest sensitive use has a 1.6 mile distance separation. Therefore, construction activity vibration impacts are judged as less-than-significant.

CONSTRUCTION-RELATED VEHICULAR NOISE IMPACTS

According to the project traffic engineer, project construction could generate up to 16 daily truck trips (including freight trucks, flatbed trucks and water trucks) and 90 passenger vehicle trips per day. Distributed over an 8-hour day the associated noise level would be 50.5 dB for trucks and 48 dB for passenger cars. Distributed over an 8-hour work day, this would equate to a CNEL of less than 48 dB at 50 feet from the roadway centerline which is less than the suggested sensitive use compatibility threshold of 60 dB CNEL.

However, construction vehicles could approach the site from the east or west which would mean that not every vehicle would pass by any single residence. In addition, where possible many vehicles would travel on the I-40 and not National Trails Highway. The variety of travel routes would farther lessen the impact on any single receptor.

Most importantly, homes are typically more than 50 feet from the closest traveled roadway centerline. For example, the closest homes to the east are more than 2,000 feet north of National Trails Highway which would afford an additional -16 dB of noise attenuation. Even without distance attenuation, construction traffic noise levels would be less than the 65 dB CNEL significance threshold for residential use. Consideration of setback from major roadways as well as distribution of vehicles traveling various roadways would provide an even greater degree of security that project construction traffic would not reach levels that would exceed even the most stringent compatibility thresholds.

OPERATIONAL NOISE IMPACT

A solar farm is typically a very quiet operation. Infrequent maintenance would require a visit by a water truck to wash off the PV modules or a few pick-up trucks for security or electrical maintenance. The hum from inverters or transformers may be audible in very close proximity to

the inverter pad, but the distance separation from the source to the nearest receiver's location is very extensive.

Noise decays at a rate of 7.5 dB per doubling of spreading of distance when passing over irregular ground. The apparent loudness of a source reduces to approximately one-half of its original value for each -10 dB reduction in decibels. The decibel level and perceived loudness from a point source such as a large inverter are thus as follows (assuming a 50-foot source-receiver reference distance).

Receiver Distance	Noise Level at 50' (dB)	Perceived Loudness
50-feet	R	1.0
100-feet	R-7.5	-
125-feet	R-10	Half as loud
200-feet	R-15	-
315-feet	R-20	One-fourth as loud
500-feet	R-25	-
800-feet	R-30	One-eighth as loud
1,000-feet	R-32.5	-

Where R is the published reference noise level at 50 feet. The value of R varies with the size of the inverter and the robustness of the electrical cabinet. For example, the solar farm inverters for the Clackamas County Solar Highway Project are rated at R=58 dB per unit at 50-feet. The Borrego 1 Solar Project in San Diego County uses inverters rated at R=45 dB at 50 feet. In the complete absence of sensitive receivers for more than one mile away it was assumed that "standard" inverters would be selected (R=58 dB) for Daggett Solar 33. The daytime County Noise standard of 55 dB Leq for sensitive land uses will be met within 33 feet of any inverter. The nocturnal standard of 45 dB Leq would be met within 166 feet, but since the sun does not shine at night and nobody lives anywhere near that close, that finding is redundant.

High voltage electrical transmission can cause audible hiss around insulators, especially on cool, damp nights. The proposed project will not step up power to high voltage and will transit to the nearest SCE connection only during the daytime. This "Corona Effect" is less noisy than from invertors/transformers and therefore is not an operational noise issue for Solar 33.

SUMMARY AND MITIGATION

Construction activities are mitigated by required compliance with grading/construction permits and are expected to be inaudible at the closest off-site uses. Considerations required for compliance include:

- No construction is to take place between the hours of from 7 a.m. to 7 p.m.
- All construction equipment shall use properly operating mufflers.

Project-related off-site construction traffic noise will not be significant.

Project-related construction vibration will be less than the threshold of perception at the closest sensitive use.

Operational noise levels from electrical transformers and power lines will be inaudible at the closest off-site sensitive uses.