# APPENDIX H
# Noise Study

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# Environmental Noise Study for the Proposed Indian Wells Valley Water District Water Supply Improvement Project in Kern County, California

**Project File 10.052.00**
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# 1 Introduction/Project Description

The purpose of this study is to identify and assess the potential noise impacts associated with the construction and operation of the Indian Wells Valley Water District (IWVWD) Water Supply Improvement Project in the County of Kern. The Project is generally located west of the City of Ridgecrest, southeast and east of Inyokern, and south of Naval Air Weapons Station (NAWS) China Lake in Kern County, California. Refer to Figure 1-1 for the location of the study area for the Project, as well as the locations of the existing and proposed well site.

IWVWD draws its water supply solely from groundwater. The IWVWD's domestic water system is divided into five separate pressures zones and consists of eleven well pumping plants, nine booster stations, ten water storage reservoirs, over one million linear feet of transmission and distribution pipelines, and approximately 12,000 service connections.

This study evaluates the Preferred Project as well as three Project Alternatives and a No Project ("status quo") Alternative. Each of the alternatives is described briefly below:

## 1.1 Preferred Project

The Preferred Project consists of two phases. In Phase I, the pumping capacity at existing Wells 18 and 34 would be increased by refitting them with new pumping units and related power/control equipment. The new pumping units would require new electric motors of 350-400 HP each. Both well sites would require a new chlorine dosing pump and a higher capacity standby generator to replace the existing equipment. Existing Wells 18 and 34 are located east and west of Brown Road and south of Bowman Road. Phase II would involve the construction of proposed Well 35 on two parcels (totaling 3.92 acres) on the south side of Bowman Road between Moon Place and Star Place. An approximately 400'-long, 12- to 16-inch pipeline would also be laid to connect proposed Well 35 to the existing pipeline in Bowman Road.

## 1.2 Alternative 1

Under this alternative, new Well 35 would be constructed, and pumping would be increased at existing Wells 30 and 34. New well construction and improvements to existing wells would be the same as described for the Preferred Project. Existing Well 30 is located south of State Route 178 (Inyokern Road) and east of North Victor Street. Existing Well 34 is located east of Brown Road and south of Bowman Road. Alternative 1 would be constructed in two phases. Phase I (2012) would improve existing Well 34 and construct new Well 35. Phase II (2015) would improve existing Well 30.

## 1.3 Alternative 2

Under this alternative, new Well 35 would be constructed, and pumping would be increased at existing Wells 30 and 31. New well construction and improvements to existing wells would be the same as described for the Preferred Project. Existing Well 30 is located south of State Route 178 (Inyokern Road) and east of North Victor Street. Existing Well 31 is located west of North Victor

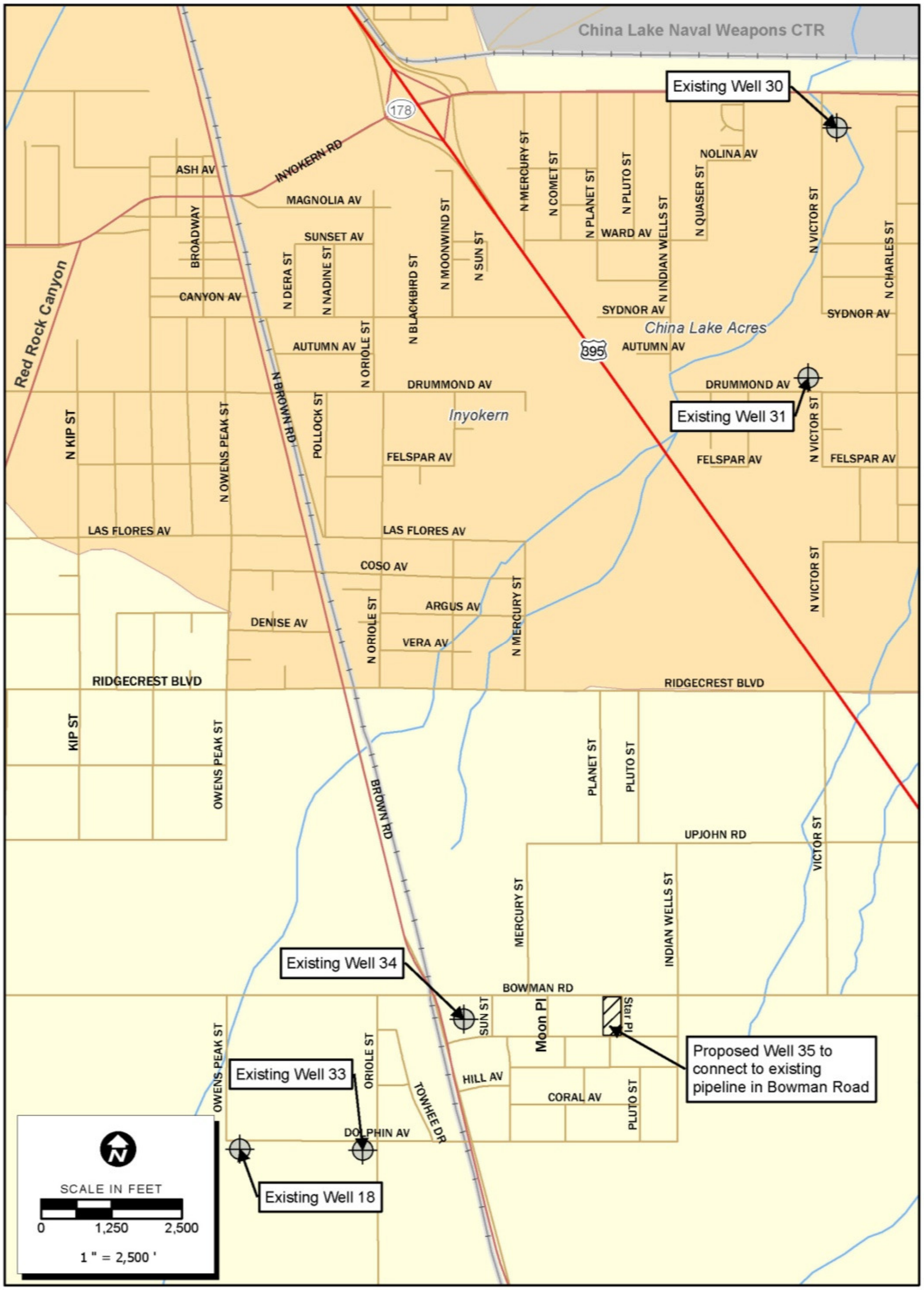



***Figure 1-1. Location of the Study Area and Well Sites***

Street and north of Drummond Avenue. Alternative 2 would be constructed in two phases. Phase I (2012) would construct new Well 35. Phase II (2015) would improve existing Wells 30 and 31.

## 1.4 Alternative 3

Under this alternative, water from existing wells on NAWS China Lake would be transferred to IWVWD in the summer months to provide additional capacity during high demand days. The water would be pumped from the existing Navy wells to the existing IWVWD 30-inch pipeline located between the NAWS China Lake boundary and Highway 178. The water transfer would begin in 2012. Water would be transferred according to the following schedule (Krieger and Stewart 2011):

**Beginning in 2012**

- June 15 to September 15: 2.2 million gallons per day (MGD)
- September 15 to October 15: 1.0 MGD

**Beginning in 2014**

- May 15 to June 15: 1.0 MGD
- June 15 to September 15: 3.7 MGD
- September 15 to October 15: 2.5 MGD

**Beginning in 2018**

- May 15 to June 15: 1.5 MGD
- June 15 to September 15: 4.7 MGD
- September 15 to October 15: 3.4 MGD

## 1.5 "No Project" Alternative

The No Project Alternative consists of an analysis of the circumstance under which the Project does not proceed. With the No Project Alternative, existing pumping rates at the existing wells would be continued. No well improvements would be made, an additional well would not be constructed, and no water would be transferred from NAWS China Lake. The No Project Alternative would not meet the objectives of the Proposed Project or the IWVWD Water General Plan.

# 2 Fundamentals of Sound

Sound may be thought of as mechanical energy of a vibrating object transmitted by pressure waves through a medium to the human ear. The medium of main concern for environmental noise is air. Noise is most simply defined as unwanted sound.

In its most basic form a sound can be described by its frequency and its amplitude. As a sound wave propagates past a point in the air it causes the air to alternate from a state of compression to a state of rarefaction. The number of times per second that the wave passes from a state of maximum compression through a state of rarefaction and back to a state of maximum compression is the frequency. The amplitude describes the maximum pressure disturbance caused by the wave; that is, the difference between the "resting" pressure in the air when no sound is present and the pressure during the state of maximum compression or rarefaction caused by the sound wave.

Frequency is expressed in cycles per second, or Hertz (Hz). One Hertz equals one cycle per second. High frequencies are sometimes more conveniently expressed in units of kilohertz (kHz) or thousands of Hertz. The extreme range of frequencies that can be heard by the healthiest human ear spans from 16 to 20 Hz on the low end to about 20,000 Hz on the high end. Frequencies are heard as the pitch or tone of sound. High frequencies produce high-pitched sounds; low frequencies produce low-pitched sounds. Very-low frequency airborne sound of sufficient amplitude may be felt before it can be heard, and can be confused with ground-borne vibration.

For any given frequency, an increase in amplitude correlates to an increase in loudness and a decrease in amplitude correlates to a decrease in loudness. The measurement and description of amplitude is discussed further in Section 3.

# 3 Noise Descriptors

The following sections describe the noise descriptors that will be used throughout this study:

## 3.1 Decibels

The magnitude of a sound is typically described in terms of sound pressure level (SPL) which refers to the root-mean-square (rms) pressure of a sound wave and can be measured in units called microPascals (µPa). However, expressing sound pressure levels in terms of µPa would be very cumbersome since it would require a very wide range of numbers. For this reason, sound pressure levels are stated in terms of decibels, abbreviated dB. The decibel is a logarithmic unit that describes the ratio of the actual sound pressure to a reference pressure (20 µPa is the standard reference pressure level for acoustical measurements in air). Specifically, a sound pressure level, in decibels, is calculated as follows:

$$SPL = 20\log_{10}\left(\frac{X}{20\mu Pa}\right),$$

where *X* is the actual sound pressure and 20 µPa is the reference pressure.

Since decibels are logarithmic units, sound pressure levels cannot be added or subtracted by ordinary arithmetic means. For example, if one automobile produces a sound pressure level of 70 dB when it passes an observer, two cars passing simultaneously would not produce 140 dB. In fact, they would combine to produce 73 dB.

## 3.2 A-Weighting

While sound pressure level defines the amplitude of a sound, this alone is not a reliable indicator of loudness. Human perception of loudness depends on the characteristics of the human ear. In particular, the frequency or pitch of a sound has a substantial effect on how humans will respond. Human hearing is limited not only to the range of audible frequencies, but also in the way it perceives sound pressure levels within that range. In general, the healthy human ear is most sensitive to sounds between 1,000 Hz and 5,000 Hz, and perceives both higher and lower frequency sounds of the same magnitude as being less loud. In order to better relate noise to the frequency response of the human ear, a frequency-dependent rating scale, known as the A-Scale, is used to adjust (or “weight”) the sound level measured by a sound level meter. The resulting sound pressure level is expressed in A-weighted decibels or dBA. When people make relative judgments of the loudness or annoyance of most ordinary everyday sounds, their judgments correlate well with the A-weighted sound levels of those sounds. A range of noise levels associated with common indoor and outdoor activities is shown in Figure 3-1.

## 3.3 Equivalent Sound Level ($L_{eq}$)

Many noise sources produce levels that fluctuate over time; examples include mechanical equipment that cycles on and off, or construction work which can vary sporadically. The equivalent sound level ($L_{eq}$) describes the average acoustic energy content of noise for an identified period of time, commonly 1 hour. Thus, the $L_{eq}$ of a time-varying noise and that of a steady noise are the same if they deliver the same acoustical energy over the duration of the exposure. For many noise sources, the $L_{eq}$ will vary depending on the time of day – a prime example is traffic noise which rises and falls depending on the amount of traffic on a given street or freeway.

## 3.4 Day-Night Sound Level ($L_{dn}$)

It is recognized that a given level of noise may be more or less tolerable depending on the duration of the exposure experienced by an individual, as well as the time of day during which the noise occurs. The day-night sound level ($L_{dn}$) is a measure of the cumulative 24-hour noise exposure that considers not only the variation of the A-weighted noise level but also the duration and the time of day of the disturbance. The $L_{dn}$ is derived from the twenty-four A-weighted 1-hour $L_{eq}$’s that occur in a day, with “penalties” applied to the $L_{eq}$’s occurring during the nighttime hours (10 p.m. to 7 a.m.) to account for increased noise sensitivity during these hours. Specifically, the $L_{dn}$ is calculated by adding 10 dBA to each of the nighttime $L_{eq}$’s, and then taking the average value for all 24 hours. It is noted that various federal, state, and local agencies have adopted $L_{dn}$ as the measure of community noise, including the United States Environmental Protection Agency (EPA). Figure 3-2 indicates the typical outdoor $L_{dn}$ at various locations for typical noise sources.

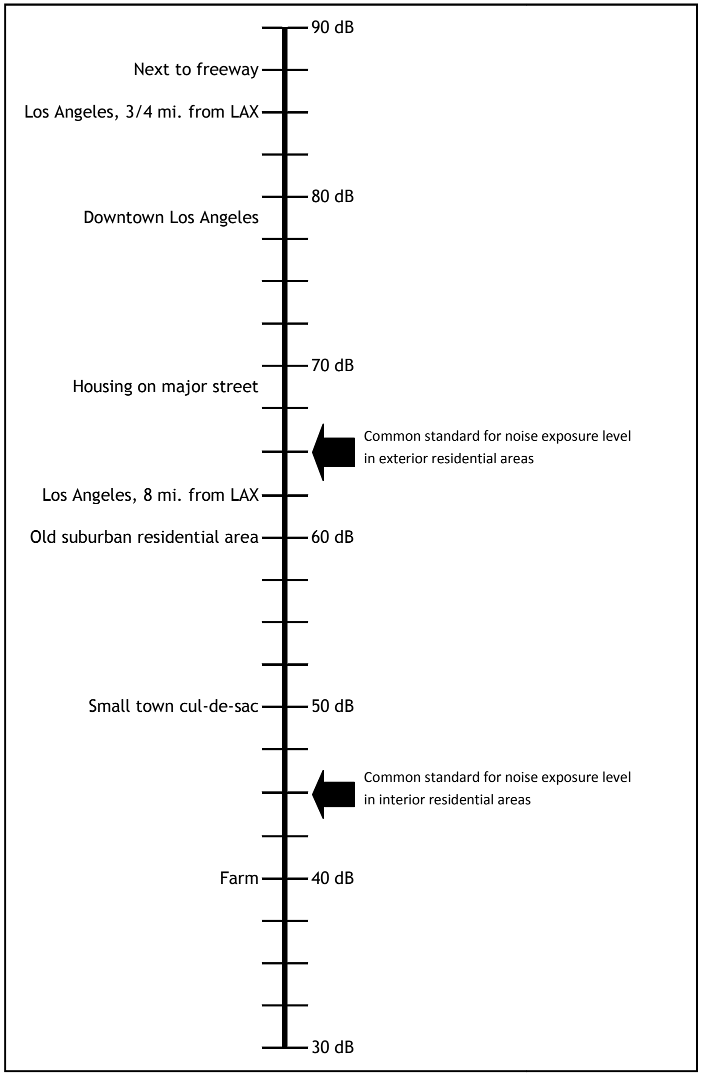



***Figure 3-1. Common Noise Sources and A-Weighted Noise Levels***

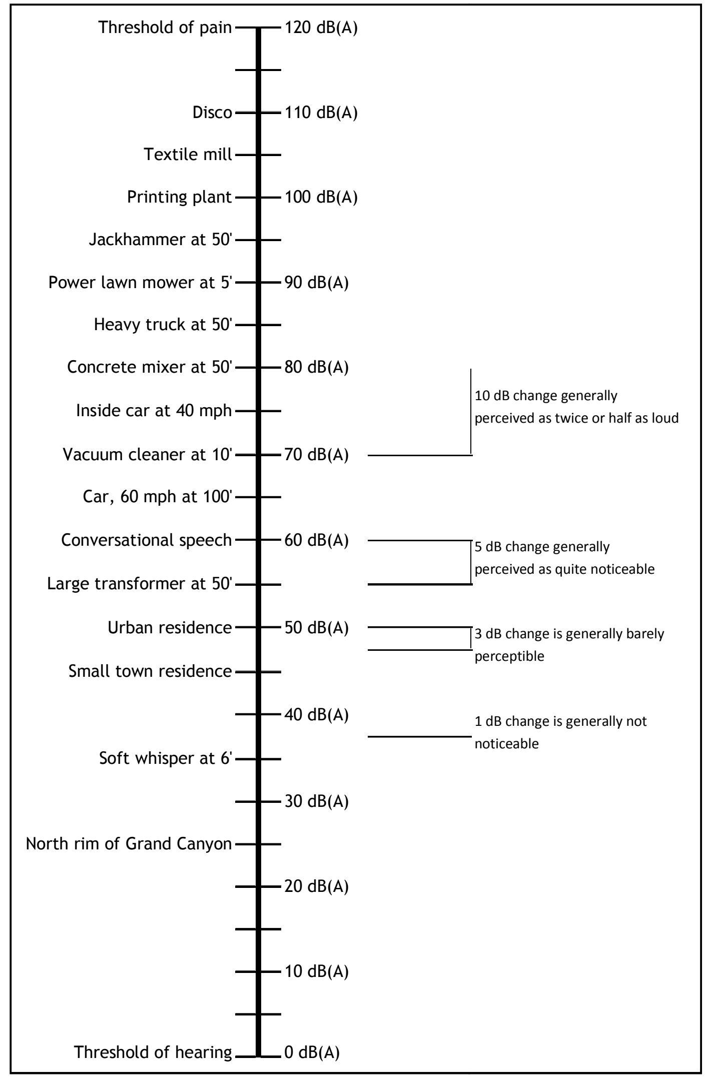



***Figure 3-2. Common $L_{dn}$ Noise Exposure Levels at Various Locations***

# 4 Fundamentals of Ground-Borne Vibration

Ground-borne vibration is an oscillatory motion which can be described in terms of displacement, velocity, or acceleration. Each of these measures can be further described in terms of *frequency* and *amplitude*. Displacement is the easiest descriptor to understand; it is simply the distance that a vibrating point moves from its static position (i.e., its resting position when the vibration is not present). The velocity describes the instantaneous speed of the movement and acceleration is the instantaneous rate of change of the speed.

Although displacement is fundamentally easier to understand than velocity or acceleration, it is rarely used for describing ground-borne vibration, for the following reasons: 1) human response to ground-borne vibration correlates more accurately with velocity or acceleration; 2) the effect on buildings and sensitive equipment is more accurately described using velocity or acceleration; and, 3) most transducers used in the measurement of ground-borne vibration actually measure either velocity or acceleration. For this study velocity is the fundamental measure used to evaluate the effects of ground-borne vibration; the precise vibration descriptors used are described in Section 5.

# 5 Vibration Descriptors

The following sections describe the vibration descriptors that will be used throughout this study:

## 5.1 Peak Particle Velocity (PPV)

Vibration consists of rapidly fluctuating motions with an average motion of zero. The peak particle velocity (PPV) is defined as the maximum instantaneous positive or negative peak amplitude of the vibration velocity. The accepted unit for measuring PPV in the USA is inches per second (in/s); therefore, this is the unit that is used throughout this report. PPV is only applicable to this Project in the assessment of potential building damage due to ground-borne vibration from construction activities (PPV is related to the stresses that are experienced by buildings subjected to ground-borne vibration); it is not used in the assessment of train-generated vibration.

## 5.2 Vibration Velocity Level

Although PPV is appropriate for evaluating the potential for building damage, it is not suitable for evaluating human response to ground-borne vibration. It takes some time for the human body to respond to vibration signals. In a sense, the human body responds to an “average” vibration amplitude. However, the actual average level is not a useful measure of vibration because the net average of a vibration signal is zero. Instead, vibration velocity level ($L_v$) is used for evaluating human response. $L_v$ describes the root mean square (rms) velocity amplitude of the vibration. This rms value may be thought of as a “smoothed” or “magnitude-averaged” amplitude. The rms of a signal is typically calculated over a 1 second period. The maximum $L_v$ describes the maximum rms velocity amplitude that occurs during a vibration measurement.

$L_v$ can be measured in inches per second (in/s). However, expressing these levels in terms of in/s would be very cumbersome since it would require a very wide range of numbers. For this reason, $L_v$ is stated in terms of decibels. Although it is not a universally accepted notation, the abbreviation "VdB" is used throughout this report to denote vibration velocity level decibels in order to reduce the potential for confusion with sound level decibels. The VdB is a logarithmic unit that describes the ratio of the actual rms velocity amplitude to a reference velocity amplitude. The accepted reference velocity amplitude is $1\times10^{-6}$ in/s in the USA; therefore, this is the reference amplitude that is used throughout this report (it is noted that the accepted reference level varies globally and much confusion can arise if the reference is not clearly stated). Specifically, a vibration velocity level ($L_v$), in decibels (VdB), is calculated as follows:

$$L_V = 20\log_{10}\left(\frac{V}{1\times10^{-6}\,in./s}\right),$$

where *V* is the actual rms velocity amplitude and $1\times10^{-6}$ in/s is the reference velocity amplitude.

Since decibels are logarithmic units, vibration velocity levels cannot be added or subtracted by ordinary arithmetic means.

# 6 Noise Criteria

## 6.1 County of Kern General Plan

The following summarizes those policies from the General Plan for the County of Kern that are relevant to the Project with regard to noise:

1. Review discretionary industrial, commercial, or other noise-generating land use projects for compatibility with nearby noise-sensitive land uses.
2. Utilize good land use planning principles to reduce conflicts related to noise emissions.
3. Prohibit new noise-sensitive land uses in noise-impacted areas unless effective mitigation measures are incorporated into the project design. Such mitigation shall be designed to reduce noise to the following levels:
   a. 65 dB $L_{dn}$ or less in outdoor activity areas;
   b. 45 dB $L_{dn}$ or less within interior living spaces or other sensitive interior spaces.
4. Ensure that new development in the vicinity of airports will be compatible with existing and projected airport noise levels as set forth in the ALUCP (Airport Land Use Compatibility Plan).
5. Employ the best available methods of noise control.

The following summarizes those implementation measures from the General Plan that are relevant to the Project with regard to noise:

1. Review discretionary development plans, programs and proposals, including those initiated by both the public and private sectors, to ascertain and ensure their conformance to the policies outlined in this element.
2. Review discretionary developments to ensure compatibility with adopted Airport Land Use Compatibility Plans.
3. Require proposed commercial and industrial uses or operations to be designed or arranged so that they will not subject residential or other noise sensitive land uses to exterior noise levels in excess of 65 dB $L_{dn}$ and interior noise levels in excess of 45 dB $L_{dn}$.
4. At the time of any discretionary approval, such as a request for a General Plan Amendment, zone change or subdivision, the developer may be required to submit an acoustical report indicating the means by which the developer proposes to comply with the noise standards. The acoustical report shall:
    a. Be the responsibility of the applicant.
    b. Be prepared by a qualified acoustical consultant experienced in the fields of environmental noise assessment and architectural acoustics.
    c. Be subject to the review and approval of the Kern County Planning Department and the Environmental Health Services Department. All recommendations therein shall be complied with prior to final approval of the project.
5. Noise analyses shall include recommended mitigation, if required, and shall:
    a. Include representative noise level measurements with sufficient sampling periods and locations to adequately describe local conditions.
    b. Include estimated noise levels for existing and projected future (10-20 years hence) conditions, with a comparison made to the adopted policies of the Noise Element.
    c. Include recommendations for appropriate mitigation to achieve compliance with the adopted policies and standards of the Noise Element.
    d. Included estimates of noise exposure after the prescribed mitigation measures have been implemented. If compliance with the adopted standards and policies of the Noise Element will not be achieved, a rationale for acceptance of the project must be provided.
6. Develop implementation procedures to ensure that requirements imposed pursuant to the findings of an acoustical analysis are conducted as part of the project permitting process.

## 6.2 County of Kern Municipal Code

The Municipal Code for the County of Kern does not provide quantitative standards for noise intrusion from one property onto another (such as from a well site to a nearby residence), nor does it provide quantitative standards for controlling noise from construction activities. With regard to construction noise, Section 8.36.020 of the Municipal Code provides the following qualitative standards:

*It is unlawful for any person to do, or cause to be done, any of the following acts within the unincorporated areas of the county: …*

*H. To create noise from construction, between the hours of nine (9:00) p.m. and six (6:00) a.m. on weekdays and nine (9:00) p.m. and eight (8:00) a.m. on weekends, which is audible to a person with average hearing faculties or capacity at a distance of one hundred fifty (150) feet from the construction site, if the construction site is within one thousand (1,000) feet of an occupied residential dwelling except as provided below:*
*1. The resource management director or his designated representative may for good cause exempt some construction work for a limited time.*
*2. Emergency work is exempt from this section.*

## 6.3 County of Kern Airport Land Use Compatibility (ALUC) Plan

The County's ALUC Plan states that the maximum CNEL[1] considered normally acceptable for residential uses outside the influence area of the airports covered by the Plan is 65 dB. For other types of land uses in an airport's vicinity, the Plan identifies the following examples of acceptable noise levels:

[1] Community Noise Equivalent Level (CNEL), like $L_{dn}$, is a measure of the cumulative 24-hour noise exposure that considers not only the variation of the A-weighted noise level but also the duration and the time of day of the disturbance. CNEL differs from $L_{dn}$ in that it also applies a "penalty" of 5 dB to the hourly average noise levels that occur during the evening hours (7 p.m. to 10 p.m.). For many common noise sources, the levels measured in CNEL are very similar to those measured in $L_{dn}$. In this study it has been assumed that CNEL and $L_{dn}$ are interchangeable.

***Table 6-1. ALUC Noise Compatibility Criteria***

| Land Use Category | CNEL, dB | | | | |
|---|---|---|---|---|---|
| | 50-55 | 55-60 | 60-65 | 65-70 | 70-75 |
| Residential | CA | NA | MA | NU | CU |
| Schools, libraries, hospitals, amphitheaters | NA | MA | NU | CU | CU |
| Churches, auditoriums, concert halls | NA | MA | MA | NU | CU |
| Transportation, parking, cemeteries | CA | CA | CA | NA | MA |
| Offices, retail trade, livestock breeding | CA | NA | MA | MA | NU |
| Service commercial, wholesale trade, warehousing, light industrial, golf courses, riding stables, water | CA | CA | NA | MA | MA |
| General manufacturing, utilities, extractive industry | CA | CA | CA | NA | NA |
| Nursing homes | CA | CA | NA | NU | NU |
| Cropland | CA | CA | CA | CA | NA |
| Parks, playgrounds, zoos, outdoor spectator sports | CA | NA | NA | MA | NU |

**CA**: Clearly acceptable. The activities associated with the specified land use can be carried out with essentially no interference from the noise exposure.
**NA**: Normally acceptable. Noise is a factor to be considered in that slight interference with outdoor activities may occur. Conventional construction methods will eliminate most noise intrusions upon indoor activities.
**MA**: Marginally acceptable. The indicated noise exposure will cause moderate interference with outdoor activities and with indoor activities when windows are open. The land use is acceptable on the conditions that outdoor activities are minimal and construction features which provide sufficient noise attenuation are used. Under other circumstances, the land use should be discouraged.
**NU**: Normally unacceptable. Noise will create substantial interference with both outdoor and indoor activities. Noise intrusion upon indoor activities can be mitigated by requiring special noise insulation construction. Land uses which have conventionally constructed structures and/or involve outdoor activities which would be disrupted by noise should generally be avoided.
**CU**: Clearly unacceptable. Unacceptable noise intrusion upon land use activities will occur. Adequate structural noise insulation is not practical under most circumstances. The indicated land use should be avoided unless strong overriding factors prevail and it should be prohibited if outdoor activities are involved.

Flight patterns for each airport should be considered in the review process. Acoustical studies or on-site noise measurements may be required to assist in determining the compatibility of sensitive uses.

# 7 Vibration Criteria

Neither the General Plan nor the Municipal Code for the County of Kern provide guidance on acceptable vibration criteria. Therefore, the following sections discuss the various vibration criteria that have been considered for this study.

## 7.1 Perceptibility

Criteria developed by the Federal Transit Administration **[1]** indicate that when ground-borne vibration exceeds 72 to 80 VdB, it is usually perceived as annoying to occupants of residential buildings.

## 7.2 Vibration Safety Limits for Buildings

General vibration damage criteria developed by the Federal Transit Administration **[1]** are summarized as follows:

***Table 7-1. FTA Construction Vibration Damage Criteria***

| Building Category | PPV (in/s) |
|---|---|
| Reinforced concrete, steel or timber (no plaster) | 0.5 |
| Engineered concrete and masonry (no plaster) | 0.3 |
| Non-engineered timber and masonry buildings | 0.2 |
| Buildings extremely susceptible to vibration damage | 0.12 |

Caltrans **[2]** uses the following criteria to evaluate the severity of problems associated with vibration:

***Table 7-2. Caltrans Vibration Damage Criteria***

| Building Category | PPV (in/s) | |
|---|---|---|
| | Continuous Sources | Transient Sources |
| Extremely fragile historic buildings, ruins, ancient monuments | 0.08 | 0.12 |
| Fragile buildings | 0.1 | 0.2 |
| Historic and some old buildings | 0.25 | 0.5 |
| Older residential structures | 0.3 | 0.5 |
| New residential structures | 0.5 | 1.0 |
| Modern industrial/commercial buildings | 0.5 | 2.0 |

# 8 Thresholds of Significance

Based on the criteria discussed above, and the CEQA guidelines, a significant impact will be assessed if any of the following conditions occur:

- Exposure of persons to, or generation of, noise levels in excess of standards established in the General Plan or Noise Ordinance of the County of Kern, or applicable standards of other agencies. This impact would occur if:

  Project operational noise sources were to subject residential or other noise-sensitive land uses to exterior noise levels in excess of 65 dB $L_{dn}$; or

  Project construction was to occur during nighttime hours (9:00 p.m. to 6:00 a.m. weekdays; 9:00 p.m. to 8:00 a.m. weekends), be within 1,000 feet of a residence, and be audible at a distance of 150 feet from the construction site.

- Exposure of persons to, or generation of, excessive ground-borne vibration or ground-borne noise levels. This impact would occur if any construction activity caused the vibration velocity level ($L_v$) to exceed 72 to 80 VdB at an adjacent residential building. Because of the potential for damage, a significant impact would also be assessed if the PPV exceeded 0.20 in/s at any existing building.

- A substantial temporary or periodic increase in ambient noise levels in the Project vicinity above levels existing without the Project. This impact would occur if:

The existing ambient noise level is less than 65 dB $L_{dn}$ at any off-site sensitive receptor and Project construction activities increase the $L_{dn}$ above 65 dB; or

The existing ambient noise level is 65 dB $L_{dn}$ or greater at any off-site sensitive receptor and Project construction activities increase the $L_{dn}$ by 3 dB or more.

- A substantial permanent increase in ambient noise levels in the Project vicinity above levels existing without the Project. This impact would occur if:

  The existing ambient noise level is less than 65 dB $L_{dn}$ at a residential or other noise sensitive land use, and noise generated by the Project's operation increases the noise levels above an $L_{dn}$ of 65 dB; or

  The existing ambient noise level is 65 dB $L_{dn}$ or greater at a residential or other noise sensitive land use, and noise generated by the Project's operation increases the ambient noise level by 3 dB or more.

- The Project would expose people residing or working in the Project area to excessive noise levels as a result of activities at an airport or private airstrip.

# 9 Existing Noise Environment

The sensitive land uses within the study area consist of scattered single-family homes. Existing sources of noise that currently affect the study area are traffic and aircraft operations at NAWS China Lake and Inyokern Airport. Traffic noise has not been considered in this study because: (a) the Project would not alter the traffic volumes on any of the local streets; and (b) the proposed Project is not noise-sensitive and, therefore, would not be affected by traffic noise.

## 9.1 Noise Measurements

With the exception of occasional aircraft overflights, the ambient noise level at the residences in the study area is generally very quiet. For this reason, it was determined that a single measurement would be sufficient to document the ambient noise level throughout the study area. This measurement was obtained at the location shown in Figure 9-1. The results of the noise measurement are provided in Appendix I and indicate an average ambient noise level of about 34.5 dBA.

The instrumentation used to obtain the noise measurement consisted of an integrating sound level meter (Model 824) and an acoustical calibrator (Model CAL200) manufactured by Larson Davis Laboratories. The accuracy of the calibrators is maintained through a program established by the manufacturer, and is traceable to the National Bureau of Standards. All instrumentation meets the requirements of the American National Standards Institute (ANSI) S1.4-1971.

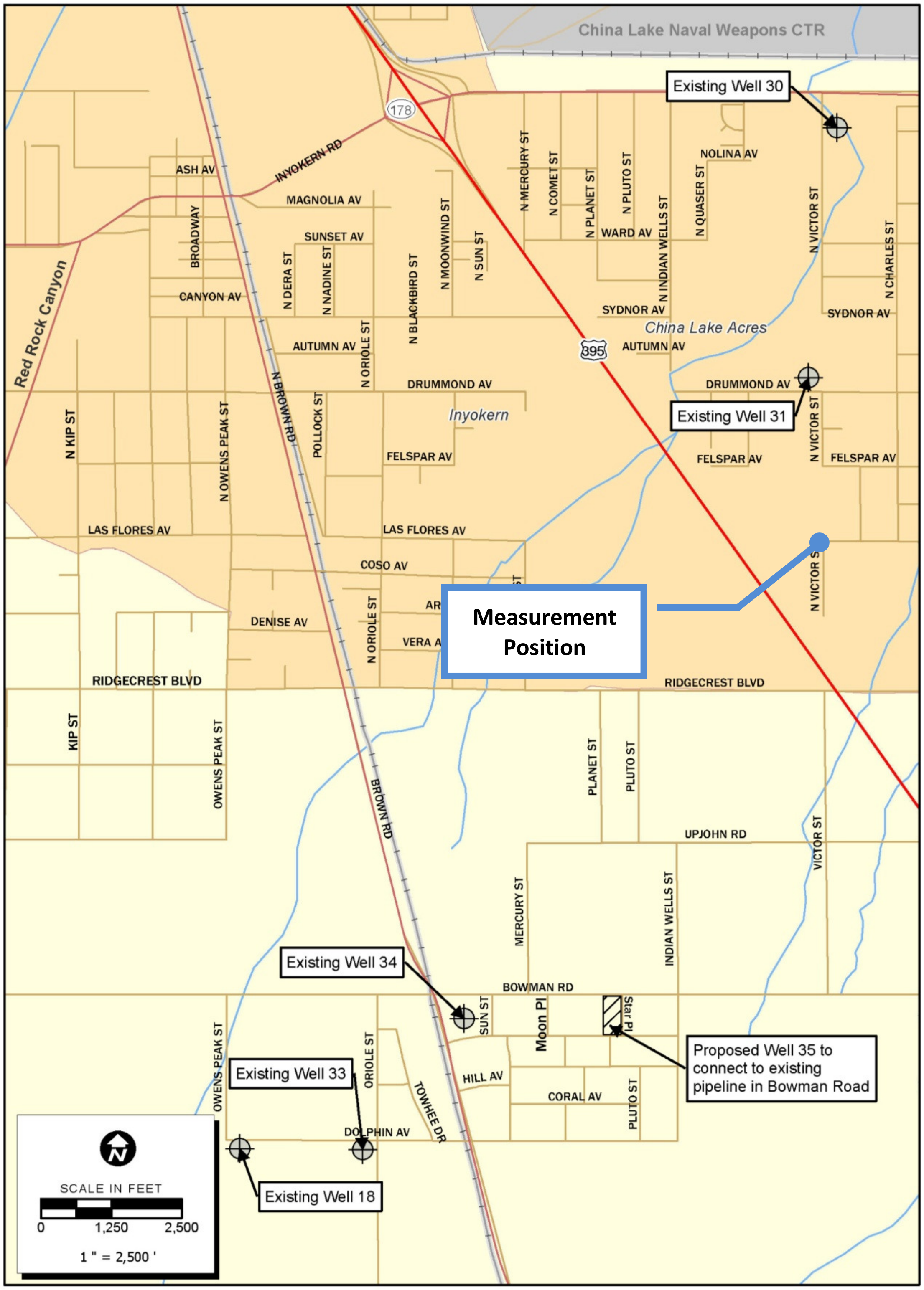



*Figure 9-1. Ambient Noise Measurement Position*

## 9.2 NAWS China Lake

The Naval Air Weapons Station (NAWS) China Lake, located northeast of the study area, includes Armitage Airfield, from which most aircraft operations originate, and the Baker Range, which is used primarily for military test and evaluation and training for air-to-surface weapon systems. In additional to three runways, Armitage Airfield contains aircraft maintenance facilities, aircraft hangars, ordnance handling and storage facilities, ground support equipment maintenance facilities, and extensive research, development, test, and evaluation facilities.

In April 2011, NAWS China Lake updated their Air Installations Compatible Use Zones (AICUZ) Study. This study, among other things, identifies the noise exposures generated in the surrounding communities by operations at the Station. Figure 9-2 provides the noise contour map developed for NAWS China Lake as part of the AICUZ Study. Referring to the figure, it can be seen that the CNEL is less than 60 dB throughout the study area. Assuming that the $L_{dn}$ generated by Station operations is essentially the same as the CNEL, the aircraft noise exposure in the study area is less than the County's $L_{dn}$ standard of 65 dB.

## 9.3 Inyokern Airport

Inyokern Airport is a local airfield owned by the Indian Wells Valley Airports District – Kern County, and located northwest of the Project's study area. There are approximately 31,200 aircraft operations per year at the airport; approximately 38.5% of these operations are associated with local aircraft, with the remainder associated with itinerant aircraft.

On September 23, 2008 the County of Kern adopted its *Airport Land Use Compatibility Plan* which, among other things, identifies the noise exposures generated in the surrounding communities by operations at every public airport in the county. Figure 9-3 provides the noise contours identified in the Plan for Inyokern Airport. Referring to the figure, it is noted that the nearest well site (Well 30) to the airport is located about 2.8 miles outside of the 60 dB CNEL contour. Assuming that the $L_{dn}$ generated by airport operations is essentially the same as the CNEL, the aircraft noise exposure in the study area is much less than the County's $L_{dn}$ standard of 65 dB.

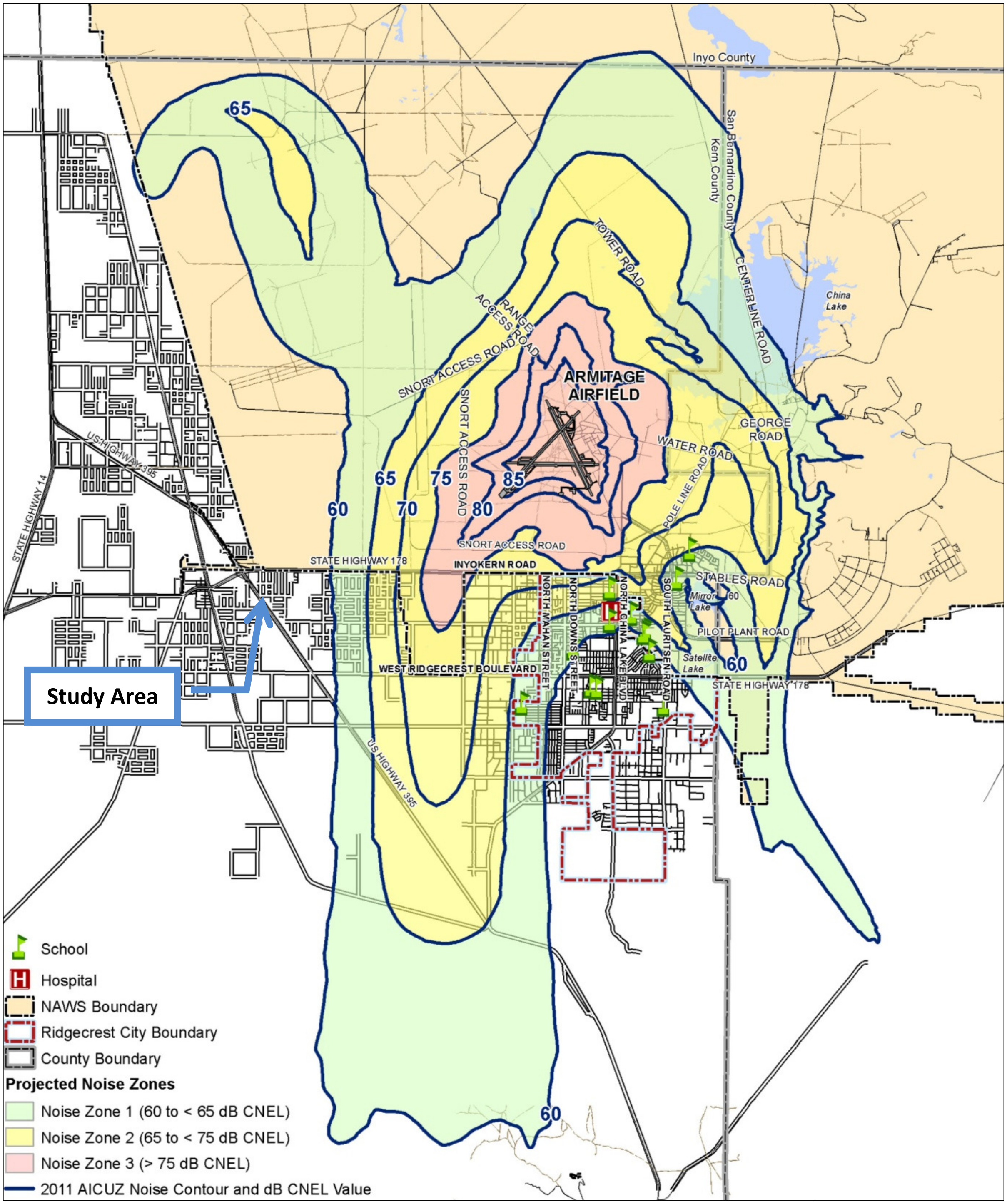



***Figure 9-2. 2011 AICUZ Noise Environment for NAWS China Lake***

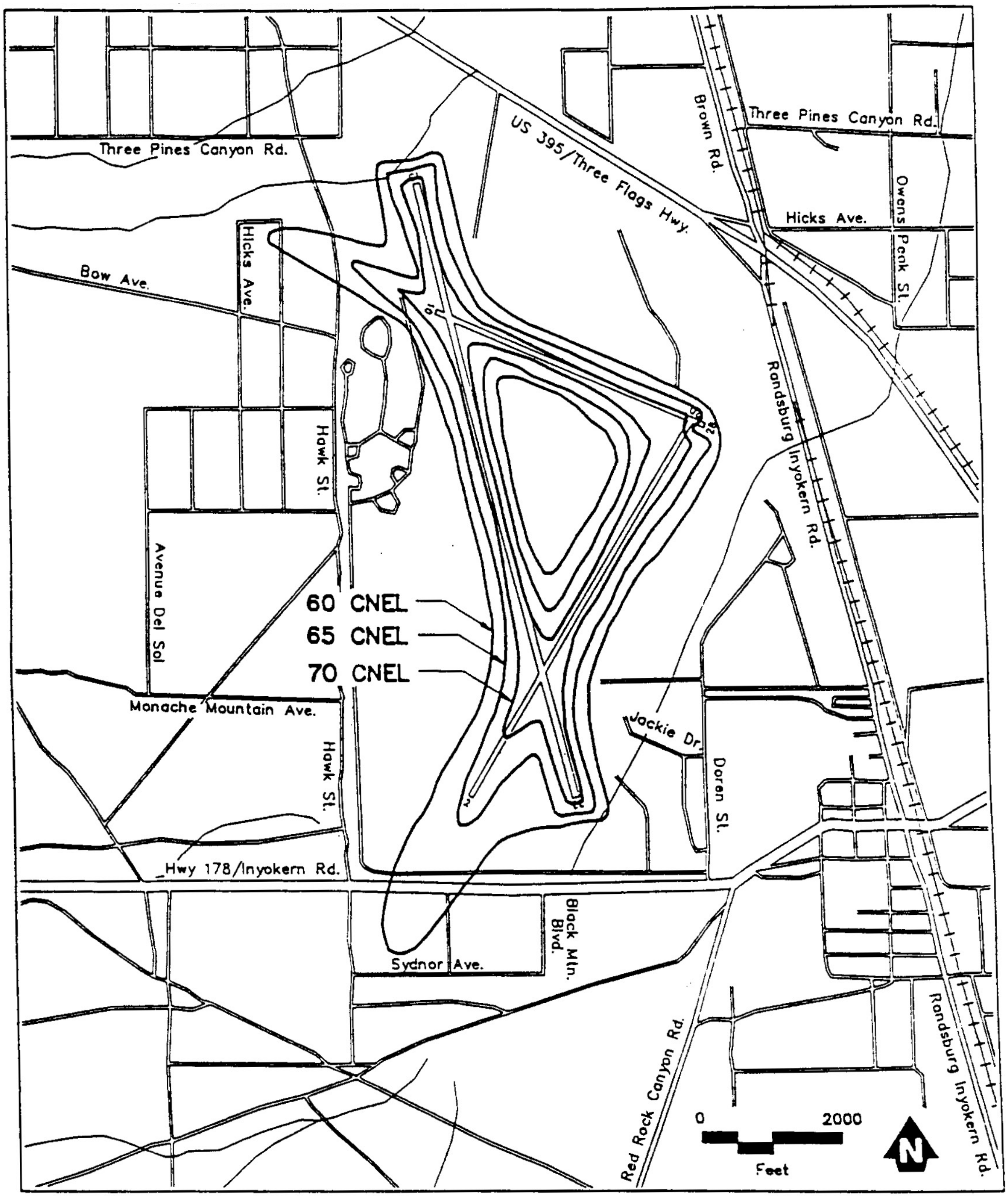



*Figure 9-3. Noise Contours for Inyokern Airport*

# 10 Analysis Methodology for Future Conditions

The Project would introduce a number of new noise and vibration sources into the study area. These sources can be divided into two main categories: construction and operations. Referring to Sections 1.1 through 1.3, a number of the Project Alternatives considered in this study share several common elements. In order to avoid needless repetition in the latter sections of this report, the following subsections describe the various assumptions and/or analysis methodologies that are used for multiple Project Alternatives.

## 10.1 Construction Analyses

A detailed construction schedule was not available at the time this study was prepared. Therefore, it was necessary to make some assumptions about the activities that would occur during the various Project construction phases. A brief summary of these assumptions is provided below:

1. **Improvement of existing wells**. The Preferred Alternative and Alternatives 1 and 2 all include the improvement of existing wells by replacing the existing pump motors with larger motors in order to increase capacity. Depending on the Alternative, this may occur at Wells 18, 30, 31, and/or 34. For each of the potentially-affected wells, it is assumed that the noisiest part of the process would require the use of a crane to lift the motors in and out of the existing pump buildings and a truck to transport the motors to and from the site. It is assumed that all construction would occur during daytime hours only (between 6:00 a.m. and 9:00 p.m. on weekdays, and between 8:00 a.m. and 9:00 p.m. on weekends), and that the crane could be used on site for a full work day of up to 8 hours and that the truck may operate for up to two hours.
2. **Construction of proposed Well 35**. The Preferred Alternative and Alternatives 1 and 2 all include the construction of proposed Well 35 and approximately 400 feet of pipeline to connect it to the existing pipeline in Bowman Road, to the north. It is assumed that the noisiest part of this process would require a drill rig (to drill the new well), a grader (to prepare the site for equipment installation), and an excavator and backhoe (to construct the pipeline trench). It is assumed that the drill rig would operate for up to 24 hours a day but that the grader, excavator, and backhoe would only operate for up to 8 hours during the daytime (between 6:00 a.m. and 9:00 p.m. on weekdays, and between 8:00 a.m. and 9:00 p.m. on weekends).

## 10.2 Operational Analyses

The pipeline constructed as part of the Project would be buried below grade and would not generate noticeable noise levels. The only potentially-significant operational noise sources associated with the Project would be equipment at the upgraded well sites and the new well site. Future well noise levels were estimated based on measurements at the existing wells, as described below:

1. **Noise levels from well buildings**. All of the existing wells considered in this study are enclosed in buildings and the proposed new well would be enclosed in a similar building. Therefore, in order to characterize well noise levels, measurements were obtained outside of the existing Well 34

building. The results of these measurements, provided in Appendix I, indicate that the well generates an average noise level of up to 43 dBA at a distance of 78 feet from the building. This is equivalent to a sound power level of 82 dBA. However, Well 34 is currently powered by a 250 HP electric motor, whereas in the future the new or upgraded motors would be 350 to 400 HP. Assuming the future motors would be 400 HP, and using standard calculation techniques, it is estimated that the increase in HP would increase the well noise levels by approximately 2 dBA. Therefore, it is assumed that all the new or upgraded wells would have a sound power level of 84 dBA. Based on discussions with staff at the Indian Wells Valley Water District, existing wells commonly run continuously for 24 hours or more during the summer months; therefore, all analyses assume 24-hour operation of the wells.

2. **Emergency generators**. In addition to the well buildings themselves, another source of noise at each well site would be the emergency generator. Noise measurements conducted of the existing emergency generator at Well 33 indicate an average noise level of up to 83 dBA at a distance of 50 feet. This is equivalent to a sound power level of 118 dBA. Because it is intended for emergency purposes only, long-term operation of the generator is not included in the analysis of future noise levels. However, routine testing of the generator is included in the analysis based on the assumption that the generator may be run for up to 15 minutes on one test day per month, during the daytime hours of 7:00 a.m. to 10:00 p.m.

## 10.3 Noise Analyses Versus Vibration Analyses

When reviewing the noise and vibration analyses contained in this study, it may be seen that different source-to-receiver distances are used in each case. This is deliberate and necessary for the following reasons:

1. Noise levels are typically assessed at the property line[2] of a sensitive receiver, whereas vibration levels are assessed at the building(s). With large lot sizes, such as exist in the Project study area, the property line may be significantly closer to the noise/vibration source than the corresponding building.

2. Noise levels are assessed based on the $L_{dn}$ metric which is a measure of long-term (24-hour) average noise. Therefore, the receiver distance is measured from the center of the noise source to represent the "average" location. Vibration, on the other hand, is assessed based on short-term (1-second or less) maximum levels that often correspond to when the vibration source (i.e., construction equipment) is operating closest to the affected building. Therefore, the distance is measured from the affected building to the closest vibration source (i.e., the closest point on the construction site).

[2] The typical parcel in the study area is quite large, with the residence and associated structures occupying only a small portion of the parcel. Therefore, the noise levels in this study have been assessed at what appears from aerial photography to be the portion of the parcel that is regularly used. This is not always the same as the property line.

# 11 Future Noise Conditions with Project

The following sections analyze the future noise conditions for each of the five different Project alternatives (including the Preferred and No Project alternatives).

## 11.1 Preferred Alternative

### 11.1.1 Construction Noise

Construction would occur during both phases of the Preferred Alternative. Phase I would consist of improvements to existing Wells 18 and 34, and Phase II would construct proposed Well 35.

Based on the construction assumptions discussed in Section 10.1, Table 11-1 summarizes the analysis of the construction noise levels at the nearest noise-sensitive receivers to the construction activities. A technical explanation of the calculation methodology is provided in Appendix II. Table 11-2 compares the estimated construction noise levels with the existing ambient noise levels and estimates the noise increases due to construction of the Preferred Alternative.

***Table 11-1. Estimated Construction Noise Levels Due to Preferred Alternative***

| Construction Phase / Equipment Item | Maximum Equipment Noise Level @ 50', per unit[a] | Usage Factor[a,b] | Number of Units[c] | Hours of Operation (Per Day/ Per Night) | Distance to Closest Receiver | $L_{dn}$ @ Closest Receiver |
|---|---|---|---|---|---|---|
| ***Phase I - Well 18*** [d] | | | | | | |
| Crane | 83 dBA | 0.16 | 1 | 8 / 0 | 990 ft | 44 dB |
| Truck | 84 dBA | 0.4 | 1 | 2 / 0 | 990 ft | 43 dB |
| *Combined:* | | | | | | **47 dB** |
| ***Phase I - Well 34*** [d] | | | | | | |
| Crane | 83 dBA | 0.16 | 1 | 8 / 0 | 3,200 ft | 34 dB |
| Truck | 84 dBA | 0.4 | 1 | 2 / 0 | 3,200 ft | 33 dB |
| *Combined:* | | | | | | **37 dB** |
| ***Phase II - Well 35*** | | | | | | |
| Drill Rig | 85 dBA | 1 | 1 | 15 / 9 | 3,560 ft | 54 dB |
| Grader | 85 dBA | 0.4 | 1 | 8 / 0 | 3,560 ft | 39 dB |
| Excavator | 85 dBA | 0.4 | 1 | 8 / 0 | 3,560 ft | 39 dB |
| Backhoe | 80 dBA | 0.4 | 1 | 8 / 0 | 3,560 ft | 34 dB |
| *Combined:* | | | | | | **55 dB** |

***Notes:***
a. Maximum noise levels and usage factors obtained or estimated from References 1, 3 and 4.
b. Usage Factor is the percentage of time equipment is operating in noisiest mode while in use.
c. Assumed number of units operating.
d. Although improvements to Wells 18 and 34 would occur during the same phase, they are analyzed separately because they are separated by a distance of over 4,500 feet and the nearest noise-sensitive receiver is different for each well.

***Table 11-2. Estimated Noise Increases Due to Preferred Alternative Construction***

| Construction Phase | Construction $L_{dn}$ @ Closest Receiver | Ambient $L_{dn}$ @ Closest Receiver | Combined $L_{dn}$ | $L_{dn}$ Increase Due to Construction |
|---|---|---|---|---|
| Phase I – Well 18 | 47 dB | 52 dB | 53 dB | 1 dB |
| Phase I – Well 34 | 37 dB | 53 dB | 53 dB | 0 dB |
| Phase II – Well 35 | 55 dB | 53 dB | 57 dB | 4 dB |

Referring to Table 11-2, construction activities are not expected to increase the $L_{dn}$ at the nearest sensitive receptors to a level greater than the 65 dB threshold. Therefore, the impact is less than significant. The only construction activity that would occur during the nighttime hours (9:00 p.m. to 6:00 a.m. weekdays, and 9:00 a.m. to 8:00 a.m. weekends) is associated with the Phase II drilling at new Well 35. However, since the nearest residential property is well over 1,000 feet away there is no significant impact.

### 11.1.2 Operational Noise

Operation of the Preferred Alternative would include noise from Wells 18, 34, and 35. Based on the assumptions and noise levels discussed in Section 10.2, Table 11-3 summarizes the analysis of operational noise levels at the nearest noise-sensitive receivers to the well sites. A technical explanation of the calculation methodology is provided in Appendix II. Table 11-4 compares the estimated noise levels with the existing ambient noise levels and estimates the noise increases due to operation of the Preferred Alternative.

***Table 11-3. Estimated Operational Noise Levels Due to Preferred Alternative***

| Well / Equipment Item | Average Sound Power Level | Hours of Operation (Per Day/ Per Night) | Distance to Closest Receiver | $L_{dn}$ @ Closest Receiver |
|---|---|---|---|---|
| ***Well 18*** | | | | |
| Well building | 84 dBA | 15 / 9 | 990 ft | 30 dB |
| Generator testing | 118 dBA | 0.25 / 0 | 990 ft | 38 dB |
| *Combined:* | | | | **39 dB** |
| ***Well 34*** | | | | |
| Well building | 84 dBA | 15 / 9 | 3,200 ft | 12 dB |
| Generator testing | 118 dBA | 0.25 / 0 | 3,200 ft | 22 dB |
| *Combined:* | | | | **22 dB** |
| ***Well 35*** | | | | |
| Well building | 84 dBA | 15 / 9 | 3,560 ft | 11 dB |
| Generator testing | 118 dBA | 0.25 / 0 | 3,560 ft | 21 dB |
| *Combined:* | | | | **21 dB** |

***Table 11-4. Estimated Noise Increases Due to Preferred Alternative Operation***

| Well | Operational $L_{dn}$ @ Closest Receiver | Ambient $L_{dn}$ @ Closest Receiver | Combined $L_{dn}$ | $L_{dn}$ Increase Due to Operations |
|---|---|---|---|---|
| Well 18 | 39 dB | 52 dB | 52 dB | 0 dB |
| Well 34 | 22 dB | 53 dB | 53 dB | 0 dB |
| Well 35 | 21 dB | 53 dB | 53 dB | 0 dB |

Referring to Table 11-4, operation of the Preferred Alternative would not increase the estimated exterior $L_{dn}$ above 65 dB at the nearest noise-sensitive receivers. Therefore, there would be no significant noise impacts related to operation of the Preferred Project Alternative.

## 11.2 Alternative 1

### 11.2.1 Construction Noise

Construction would occur during both phases of Alternative 1. Phase I would consist of improvements to existing Well 34 and construction of proposed Well 35, and Phase II would consist of improvements to existing Well 30.

Based on the construction assumptions discussed in Section 10.1, Table 11-5 summarizes the analysis of the construction noise levels at the nearest noise-sensitive receivers to the construction activities. Table 11-6 compares the estimated construction noise levels with the existing ambient noise levels and estimates the noise increases due to construction of Alternative 1.

***Table 11-5. Estimated Construction Noise Levels Due to Alternative 1***

| Construction Phase / Equipment Item | Maximum Equipment Noise Level @ 50', per unit[a] | Usage Factor[a,b] | Number of Units[c] | Hours of Operation (Per Day/ Per Night) | Distance to Closest Receiver | $L_{dn}$ @ Closest Receiver |
|---|---|---|---|---|---|---|
| ***Phase I - Wells 34 & 35*** | | | | | | |
| Crane (Well 34) | 83 dBA | 0.16 | 1 | 8 / 0 | 3,200 ft | 34 dB |
| Truck (Well 34) | 84 dBA | 0.4 | 1 | 2 / 0 | 3,200 ft | 33 dB |
| Drill Rig (Well 35) | 85 dBA | 1 | 1 | 15 / 9 | 3,560 ft | 54 dB |
| Grader (Well 35) | 85 dBA | 0.4 | 1 | 8 / 0 | 3,560 ft | 39 dB |
| Excavator (Well 35) | 85 dBA | 0.4 | 1 | 8 / 0 | 3,560 ft | 39 dB |
| Backhoe (Well 35) | 80 dBA | 0.4 | 1 | 8 / 0 | 3,560 ft | 34 dB |
| *Combined:* | | | | | | **55 dB** |
| ***Phase II - Well 30*** | | | | | | |
| Crane | 83 dBA | 0.16 | 1 | 8 / 0 | 780 ft | 46 dB |
| Truck | 84 dBA | 0.4 | 1 | 2 / 0 | 780 ft | 45 dB |
| *Combined:* | | | | | | **49 dB** |

***Notes:***
a. Maximum noise levels and usage factors obtained or estimated from References 1, 3 and 4.
b. Usage Factor is the percentage of time equipment is operating in noisiest mode while in use.
c. Assumed number of units operating.

***Table 11-6. Estimated Noise Increases Due to Alternative 1 Construction***

| Construction Phase | Construction $L_{dn}$ @ Closest Receiver | Ambient $L_{dn}$ @ Closest Receiver | Combined $L_{dn}$ | $L_{dn}$ Increase Due to Construction |
|---|---|---|---|---|
| Phase I - Wells 34 & 35 | 55 dB | 53 dB | 57 dB | 4 dB |
| Phase II - Well 30 | 49 dB | 63 dB | 63 dB | 0 dB |

Referring to Table 11-6, construction activities are not expected to increase the $L_{dn}$ at the nearest sensitive receptors to a level greater than the 65 dB threshold. Therefore, the impact is less than significant. The only construction activity that would occur during the nighttime hours (9:00 p.m. to 6:00 a.m. weekdays, and 9:00 a.m. to 8:00 a.m. weekends) is associated with the Phase I drilling at new Well 35. However, since the nearest residential property is well over 1,000 feet away there is no significant impact.

### 11.2.2 Operational Noise

Operation of Alternative 1 would include noise from Wells 30, 34, and 35. Based on the assumptions and noise levels discussed in Section 10.2, Table 11-7 summarizes the analysis of operational noise levels at the nearest noise-sensitive receivers to the well sites. Table 11-8 compares the estimated noise levels with the existing ambient noise levels and estimates the noise increases due to operation of Alternative 1.

***Table 11-7. Estimated Operational Noise Levels Due to Alternative 1***

| Well / Equipment Item | Average Sound Power Level | Hours of Operation (Per Day/ Per Night) | Distance to Closest Receiver | $L_{dn}$ @ Closest Receiver |
|---|---|---|---|---|
| ***Well 30*** | | | | |
| Well building | 84 dBA | 15 / 9 | 780 ft | 24 dB |
| Generator testing | 118 dBA | 0.25 / 0 | 780 ft | 34 dB |
| *Combined:* | | | | **34 dB** |
| ***Well 34*** | | | | |
| Well building | 84 dBA | 15 / 9 | 3,200 ft | 12 dB |
| Generator testing | 118 dBA | 0.25 / 0 | 3,200 ft | 22 dB |
| *Combined:* | | | | **22 dB** |
| ***Well 35*** | | | | |
| Well building | 84 dBA | 15 / 9 | 3,560 ft | 11 dB |
| Generator testing | 118 dBA | 0.25 / 0 | 3,560 ft | 21 dB |
| *Combined:* | | | | **21 dB** |

***Table 11-8. Estimated Noise Increases Due to Alternative 1 Operation***

| Well | Operational $L_{dn}$ @ Closest Receiver | Ambient $L_{dn}$ @ Closest Receiver | Combined $L_{dn}$ | $L_{dn}$ Increase Due to Operations |
|---|---|---|---|---|
| Well 30 | 34 dB | 63 dB | 63 dB | 0 dB |
| Well 34 | 22 dB | 53 dB | 53 dB | 0 dB |
| Well 35 | 21 dB | 53 dB | 53 dB | 0 dB |

Referring to Table 11-8, operation of Alternative 1 would not increase the estimated exterior $L_{dn}$ above 65 dB at the nearest noise-sensitive receivers. Therefore, there would be no significant noise impacts related to operation of Project Alternative 1.

## 11.3 Alternative 2

### 11.3.1 Construction Noise

Construction would occur during both phases of the Alternative 2. Phase I would construct proposed Well 35, and Phase II would consist of improvements to existing Wells 30 and 31.

Based on the construction assumptions discussed in Section 10.1, Table 11-9 summarizes the analysis of the construction noise levels at the nearest noise-sensitive receivers to the construction activities. Table 11-10 compares the estimated construction noise levels with the existing ambient noise levels and estimates the noise increases due to construction of Alternative 2.

***Table 11-9. Estimated Construction Noise Levels Due to Alternative 2***

| Construction Phase / Equipment Item | Maximum Equipment Noise Level @ 50', per unit[a] | Usage Factor[a,b] | Number of Units[c] | Hours of Operation (Per Day/ Per Night) | Distance to Closest Receiver | $L_{dn}$ @ Closest Receiver |
|---|---|---|---|---|---|---|
| ***Phase I - Well 35*** | | | | | | |
| Drill Rig | 85 dBA | 1 | 1 | 15 / 9 | 3,560 ft | 54 dB |
| Grader | 85 dBA | 0.4 | 1 | 8 / 0 | 3,560 ft | 39 dB |
| Excavator | 85 dBA | 0.4 | 1 | 8 / 0 | 3,560 ft | 39 dB |
| Backhoe | 80 dBA | 0.4 | 1 | 8 / 0 | 3,560 ft | 34 dB |
| *Combined:* | | | | | | **55 dB** |
| ***Phase II - Well 30*** [d] | | | | | | |
| Crane | 83 dBA | 0.16 | 1 | 8 / 0 | 780 ft | 46 dB |
| Truck | 84 dBA | 0.4 | 1 | 2 / 0 | 780 ft | 45 dB |
| *Combined:* | | | | | | **49 dB** |
| ***Phase II - Well 31*** [d] | | | | | | |
| Crane | 83 dBA | 0.16 | 1 | 8 / 0 | 430 ft | 52 dB |
| Truck | 84 dBA | 0.4 | 1 | 2 / 0 | 430 ft | 51 dB |
| *Combined:* | | | | | | **54 dB** |

***Notes:***
a. Maximum noise levels and usage factors obtained or estimated from References 1, 3 and 4.
b. Usage Factor is the percentage of time equipment is operating in noisiest mode while in use.
c. Assumed number of units operating.
d. Although improvements to Wells 30 and 31 would occur during the same phase, they are analyzed separately because they are separated by a distance of over 4,400 feet and the nearest noise-sensitive receiver is different for each well.

***Table 11-10. Estimated Noise Increases Due to Alternative 2 Construction***

| Construction Phase | Construction $L_{dn}$ @ Closest Receiver | Ambient $L_{dn}$ @ Closest Receiver | Combined $L_{dn}$ | $L_{dn}$ Increase Due to Construction |
|---|---|---|---|---|
| Phase I – Well 35 | 55 dB | 53 dB | 57 dB | 4 dB |
| Phase II – Well 30 | 49 dB | 63 dB | 63 dB | 0 dB |
| Phase II – Well 31 | 54 dB | 59 dB | 60 dB | 1 dB |

Referring to Table 11-10, construction activities are not expected to increase the $L_{dn}$ above 65 dB at the nearest noise-sensitive receivers. Therefore, the impact is less than significant. The only construction activity that would occur during the nighttime hours (9:00 p.m. to 6:00 a.m. weekdays, and 9:00 a.m. to 8:00 a.m. weekends) is associated with the Phase I drilling at new Well 35. However, since the nearest residential property is well over 1,000 feet away there is no significant impact.

## 11.3.2 Operational Noise

Operation of Alternative 2 would include noise from Wells 30, 31, and 35. Based on the assumptions and noise levels discussed in Section 10.2, Table 11-11 summarizes the analysis of operational noise levels at the nearest noise-sensitive receivers to the well sites. Table 11-12 compares the estimated noise levels with the existing ambient noise levels and estimates the noise increases due to operation of Alternative 2.

***Table 11-11. Estimated Operational Noise Levels Due to Alternative 2***

| Well / Equipment Item | Average Sound Power Level | Hours of Operation (Per Day/ Per Night) | Distance to Closest Receiver | $L_{dn}$ @ Closest Receiver |
|---|---|---|---|---|
| ***Well 30*** | | | | |
| Well building | 84 dBA | 15 / 9 | 780 ft | 24 dB |
| Generator testing | 118 dBA | 0.25 / 0 | 780 ft | 34 dB |
| *Combined:* | | | | **34 dB** |
| ***Well 31*** | | | | |
| Well building | 84 dBA | 15 / 9 | 430 ft | 29 dB |
| Generator testing | 118 dBA | 0.25 / 0 | 430 ft | 39 dB |
| *Combined:* | | | | **40 dB** |
| ***Well 35*** | | | | |
| Well building | 84 dBA | 15 / 9 | 3,560 ft | 11 dB |
| Generator testing | 118 dBA | 0.25 / 0 | 3,560 ft | 21 dB |
| *Combined:* | | | | **21 dB** |

***Table 11-12. Estimated Noise Increases Due to Alternative 2 Operation***

| Well | Operational $L_{dn}$ @ Closest Receiver | Ambient $L_{dn}$ @ Closest Receiver | Combined $L_{dn}$ | $L_{dn}$ Increase Due to Construction |
|---|---|---|---|---|
| Well 30 | 34 dB | 63 dB | 63 dB | 0 dB |
| Well 31 | 40 dB | 59 dB | 59 dB | 0 dB |
| Well 35 | 21 dB | 53 dB | 53 dB | 0 dB |

Referring to Table 11-12, operation of Alternative 2 will not increase the estimated exterior $L_{dn}$ above 65 dB at the nearest noise-sensitive receivers. Therefore, there would be no significant noise impacts related to operation of Project Alternative 2.

## 11.4 Alternative 3

### 11.4.1 Construction Noise

Since all of the necessary infrastructure (wells and pipelines) are already in place, there is no construction activities associated with Alternative 3. Therefore, no analysis of construction noise impacts is required under this alternative and no significant construction noise impacts are assessed.

### 11.4.2 Operational Noise

There are no operational noise sources associated with Alternative 3. Therefore, no analysis of operational noise impacts is required under this alternative and no significant operational impacts are assessed.

## 11.5 No Project Alternative

Under this Alternative, no construction would take place and no new operational noise sources would be introduced. Therefore, there would be no significant impacts due to the No Project Alternative.

# 12 Future Vibration Conditions with Project

The following sections analyze the future vibration conditions for each of the five different Project alternatives (including the Preferred and No Project alternatives). It is noted that none of the Project operations proposed under any of the Project alternatives would generate noticeable levels of ground-borne vibration; therefore, potential vibration impacts are only analyzed for the proposed construction activities under each alternative and no significant impacts are assessed for any Project operations.

## 12.1 Preferred Alternative

Construction would occur during both phases of the Preferred Alternative. Phase I would consist of improvements to existing Wells 18 and 34, and Phase II would construct proposed Well 35. Phase I construction is not anticipated to generate noticeable levels of ground-borne vibration because it involves only surface construction and does not use a lot of heavy machinery. However, Phase II may generate ground-borne vibration because it involves earthmoving with heavy machinery to grade the new well sites and dig trenches for the associated pipeline. Using standard calculation techniques provided by the Federal Transit Administration **[1]**, Table 12-1 summarizes the analysis of the Phase II construction vibration levels at the nearest buildings. Because the maximum vibration levels are typically associated with a single piece of construction equipment, only one piece of heavy equipment in considered in the analysis .

***Table 12-1. Estimated Construction Vibration Levels Due to Preferred Alternative***

| Construction Phase / Equipment Item | Equipment Vibration Level @ 25’ [a] | | Distance to Closest Receiver | Vibration Level @ Closest Receiver | |
|---|---|---|---|---|---|
| | PPV, in/sec | $L_V$, VdB | | PPV, in/sec | $L_V$, VdB |
| ***Phase II - Well 35*** | | | | | |
| Heavy Equipment (Grader, Excavator, or Backhoe) | 0.089 | 87 | 4,600 ft | 0 | 19 |
| ***Notes:*** a. Vibration levels obtained from Reference 1. | | | | | |

Referring to Table 12-1, there would be no significant vibration impacts associated with the construction of Phases I and II of the Preferred Project Alternative because the vibration velocity level ($L_V$) would not exceed 72 VdB and the PPV would not exceed 0.20 in/s at the nearest sensitive receptor.

## 12.2 Alternative 1

Construction would occur during both phases of Alternative 1. Phase I would consist of improvements to existing Well 34 and construction of proposed Well 35, and Phase II would consist of improvements to existing Well 30. Well improvements during Phases I and II are not anticipated to generate noticeable levels of ground-borne vibration because they involve only surface construction and do not use a lot of heavy machinery. However, construction of Well 35 during Phase I may generate ground-borne vibration because it involves earthmoving with heavy machinery to grade the new well site and dig trenches for the associated pipeline. Using standard calculation techniques provided by the Federal Transit Administration **[1]**, Table 12-2 summarizes the analysis of the Phase I construction vibration levels at the nearest buildings. Because the maximum vibration levels are typically associated with a single piece of construction equipment, only one piece of heavy equipment in considered in the analysis.

***Table 12-2. Estimated Construction Vibration Levels Due to Alternative 1***

| Construction Phase / Equipment Item | Equipment Vibration Level @ 25’ [a] | | Distance to Closest Receiver | Vibration Level @ Closest Receiver | |
|---|---|---|---|---|---|
| | PPV, in/sec | $L_V$, VdB | | PPV, in/sec | $L_V$, VdB |
| ***Phase I - Well 35*** | | | | | |
| Heavy Equipment (Grader, Excavator, or Backhoe) | 0.089 | 87 | 4,600 ft | 0 | 19 |
| ***Notes:*** a. Vibration levels obtained from Reference 1. | | | | | |

Referring to Table 12-2, there would be no significant vibration impacts associated with the construction of Phases I and II of Project Alternative 1 because the vibration velocity level ($L_V$) would not exceed 72 VdB and the PPV would not exceed 0.20 in/s at the nearest sensitive receptor.

## 12.3 Alternative 2

Construction would occur during both phases of Alternative 2. Phase I would construct proposed Well 35, and Phase II would consist of improvements to existing Wells 30 and 31. Phase II construction is not anticipated to generate noticeable levels of ground-borne vibration because it involves only surface construction and does not use a lot of heavy machinery. However, Phase I may generate ground-borne vibration because it involves earthmoving with heavy machinery to grade the new well site and dig trenches for the associated pipelines. Using standard calculation techniques provided by the Federal Transit Administration **[1]**, Table 12-3 summarizes the analysis of the Phase I construction vibration levels at the nearest buildings. Because the maximum vibration levels are typically associated with a single piece of construction equipment, only one piece of heavy equipment in considered in the analysis.

***Table 12-3. Estimated Construction Vibration Levels Due to Alternative 2***

| Construction Phase / Equipment Item | Equipment Vibration Level @ 25' [a] | | Distance to Closest Receiver | Vibration Level @ Closest Receiver | |
|---|---|---|---|---|---|
| | PPV, in/sec | $L_V$, VdB | | PPV, in/sec | $L_V$, VdB |
| ***Phase I - Well 35*** | | | | | |
| Heavy Equipment (Grader, Excavator, or Backhoe) | 0.089 | 87 | 4,600 ft | 0 | 19 |

***Notes:***
a. Vibration levels obtained from Reference 1.

Referring to Table 12-3, there would be no significant vibration impacts associated with the construction of Phases I and II of Project Alternative 2 because the vibration velocity level ($L_V$) would not exceed 72 VdB and the PPV would not exceed 0.20 in/s at the nearest sensitive receptor.

## 12.4 Alternative 3

As discussed in Section 11.4, there is no construction associated with Alternative 3. Therefore, no analysis of construction vibration impacts is required under this alternative and no significant construction vibration impacts are assessed.

## 12.5 No Project Alternative

Under this Alternative, no construction would take place and no new operational activities would be introduced. Therefore, there would be no significant impacts due to the No Project Alternative.

# 13 Summary of Impacts

Using the criteria established in this study, along with the noise and vibration analyses of Sections 11 and 12, Table 13-1 provides a summary of the impacts caused by the proposed Project.

***Table 13-1. Summary of Impacts***

| Alternative | Phase | Construction | | Operation | |
|---|---|---|---|---|---|
| | | Noise | Vibration | Noise | Vibration |
| Preferred | I | Less than significant | No Impact | No Impact | No Impact |
| | II | Less than significant | No Impact | No Impact | No Impact |
| 1 | I | Less than significant | No Impact | No Impact | No Impact |
| | II | Less than significant | No Impact | No Impact | No Impact |
| 2 | I | Less than significant | No Impact | No Impact | No Impact |
| | II | Less than significant | No Impact | No Impact | No Impact |
| 3 | N/A | No Impact | No Impact | No Impact | No Impact |
| No Project | N/A | No Impact | No Impact | No Impact | No Impact |

# 14 Abatement Measures

As indicated in Section 13, there are no significant impacts associated with the construction or operation of the Project or any of its alternatives. However, the following measures are recommended in order to reduce the construction noise levels to the extent practicable and help minimize the potential annoyance at nearby sensitive receivers:

1. Construction activities should be limited to between 6:00 a.m. and 9:00 p.m. Monday through Friday, and between 8:00 a.m. and 9:00 p.m. on weekends. Personnel should not be permitted on the job site, and material or equipment deliveries and collections should not be permitted outside of these hours.
2. To the extent practicable, the quietest available type of construction equipment should be used. Newer equipment is generally quieter than older equipment. The use of electric-powered equipment is typically quieter than diesel, and hydraulic-powered equipment is quieter than pneumatic power. If compressors powered by diesel or gasoline engines are to be used, they should be enclosed or have baffles to help abate noise levels.
3. All construction equipment should be properly maintained. Poor maintenance of equipment can causes excessive noise levels.
4. All construction equipment should be equipped with suitable exhaust and air-intake silencers in proper working order.
5. All construction equipment should be operated only when necessary and would be switched off when not in use.
6. Construction employees should be trained in the proper operation and use of the equipment to minimize noise levels.
7. To the extent practicable, construction equipment should be stored at the well sites while in use in order to eliminate noise associated with repeated transportation of the equipment to and from the site.
8. Stationary noise sources such as generators and compressors should be positioned as far away as possible from noise-sensitive areas.

9. Public notice should be given no less than 30 days prior to construction identifying the location and dates of construction, and the name and phone number of the contractor's contact person in case of complaints. One contact person should be assigned to the Project. The public notice should encourage the residents to contact this person rather than the police in case of complaint. Residents should also be kept informed of any changes to the schedule. The contractor's designated contact person should be on site throughout Project construction with a mobile phone. If a complaint is received, the contact person should take whatever reasonable steps are necessary to resolve the complaint. If possible, a member of the contractor's team should also travel to the complainant's location to understand the nature of the disturbance.
10. Haul routes should be on major arterial roads and should avoid residential areas to the extent possible.

# 15 Unmitigated Impacts

There are no unmitigated impacts associated with the construction and operation of the Project or its alternatives.

# 16 References


1. *Transit Noise and Vibration Impact Assessment*. U.S. Department of Transportation/Federal Transit Administration (FTA-VA-90-1003-06). May 2006
2. *Transportation- and Construction-Induced Vibration Guidance Manual.* Jones & Stokes (J&S 02-039). Contract No. 43A0049 for California Department of Transportation, Noise, Vibration, and Hazardous Waste Management Office, Sacramento, CA. June 2004.
3. *FHWA Roadway Construction Noise Model (RCNM), Version 1.0*. Federal Highway Administration. February 2, 2006.
4. *Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances.* Bolt Beranek and Newman/U.S. Environmental Protection Agency. December 31, 1971
5. *2.0 Project Description_WSIP IWVWD Draft EIR.pdf* – Project description and figures. Provided by ECORP Consulting, Inc. on June 16, 2011.
6. *4.0 Alternatives.doc* – description of Project Alternatives. Provided by ECORP Consulting, Inc. on June 23, 2011.
7. *2010-132 IWVWD WSIP Check Copy IS.doc* – Water Supply Improvement Project Draft Initial Study. ECORP Consulting, Inc. June 2011.
8. *FINAL Air Installations Compatible Use Zones Study, Naval Air Weapons Station China Lake, California*. Ecology and Environment, Inc./United States Department of the Navy. April 2011.
9. *Airport Land Use Compatibility Plan, County of Kern*. Kern County Planning Department. September 23, 2008.

# *APPENDIX I*

***Noise Measurements***

*Table I-1. Noise Survey*

Project: IWVWD Water Supply Improvement Project, 10.052.00

Position: At northeast corner of N Victor St and Las Flores Ave

Date: July 28, 2011

Time: Noted

Noise Source: Ambient - Distant traffic, insects, distant aircraft

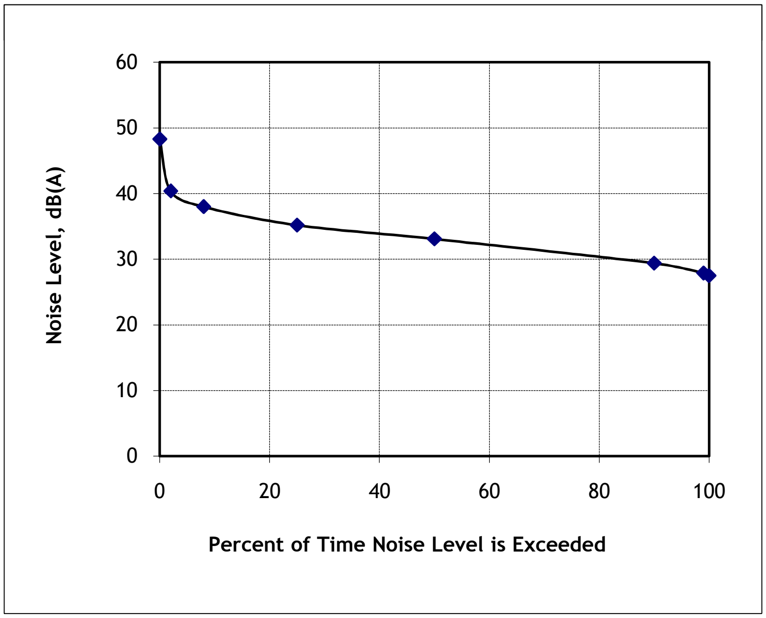
Distance: Varies

SLM Height: 5'

LD 824 S/N: 3536

LD CAL200 Calibrator S/N: 2916

Operator: Jonathan Higginson




| | Measurement Period | | |
|---|---|---|---|
| | 1:31 PM to 1:48 PM | to | to |
| n* | Ln | Ln | Ln |
| | | | |
| 1.67 | 40.4 | | |
| | | | |
| 8.33 | 38.0 | | |
| | | | |
| 25 | 35.2 | | |
| | | | |
| 50 | 33.1 | | |
| | | | |
| 90 | 29.4 | | |
| | | | |
| 99 | 27.9 | | |
| | | | |
| Leq | 34.7 | | |
| Lmax | 48.3 | | |
| Lmin | 27.5 | | |

* Leq is the average sound level during the measurement period.
Ln is the sound level exceeded n% of the time during the measurement period
Lmax and Lmin are the maximum and minimum sound levels during the measurement period

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*Table I-2. Noise Survey*

Project: IWVWD Water Supply Improvement Project, 10.052.00

Position: South of exisiting Well 34 building

Date: July 28, 2011

Time: Noted

Noise Source: Well building (pump)

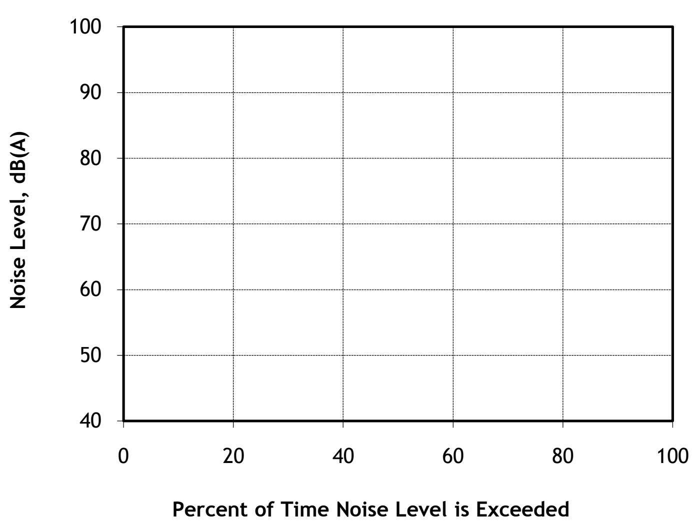
Distance: 78'

SLM Height: 5'

LD 824 S/N: 3536

LD CAL200 Calibrator S/N: 2916

Operator: Jonathan Higginson




| | **Measurement Period** | | |
|---|---|---|---|
| | 11:51 AM to 11:52 AM | to | to |
| **n*** | **Ln** | **Ln** | **Ln** |
| | | | |
| 1.67 | | | |
| | | | |
| 8.33 | | | |
| | | | |
| 25 | | | |
| | | | |
| 50 | | | |
| | | | |
| 90 | | | |
| | | | |
| 99 | | | |
| | | | |
| Leq | 43.1 | | |
| Lmax | | | |
| Lmin | | | |

* Leq is the average sound level during the measurement period.
Ln is the sound level exceeded n% of the time during the measurement period
Lmax and Lmin are the maximum and minimum sound levels during the measurement period

*Table I-3. Noise Survey*

Project: IWVWD Water Supply Improvement Project, 10.052.00

Position: North of emergency generator at existing Well 33

Date: July 28, 2011

Time: Noted

Noise Source: Emergency generator

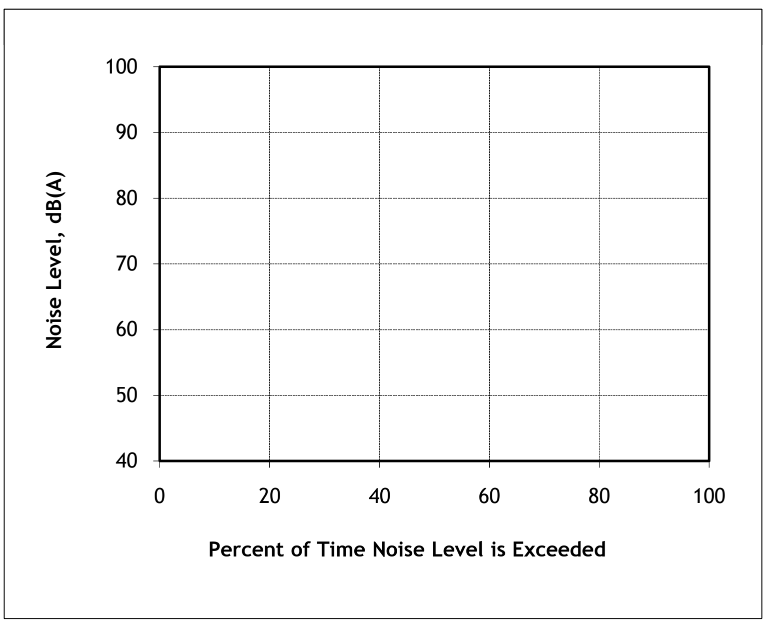
Distance: 50'

SLM Height: 5'

LD 824 S/N: 3536

LD CAL200 Calibrator S/N: 2916

Operator: Jonathan Higginson




| | Measurement Period | | |
|---|---|---|---|
| | 12:48 PM to 12:49 PM | to | to |
| n* | Ln | Ln | Ln |
| | | | |
| 1.67 | | | |
| | | | |
| 8.33 | | | |
| | | | |
| 25 | | | |
| | | | |
| 50 | | | |
| | | | |
| 90 | | | |
| | | | |
| 99 | | | |
| | | | |
| Leq | 83.0 | | |
| Lmax | | | |
| Lmin | | | |

* Leq is the average sound level during the measurement period.
Ln is the sound level exceeded n% of the time during the measurement period
Lmax and Lmin are the maximum and minimum sound levels during the measurement period

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# *APPENDIX II*

## *Calculation Methodology*

**Construction Noise Analysis Methodology**

In order to estimate the noise contribution from a given construction equipment item (such as a crane), we start with the maximum equipment noise level at 50 feet from a single unit of equipment ($Max_{unit}$) as obtained from References 1, 3 and 4. The average noise level for that item ($Ave_{unit}$) is then calculated based on the Usage Factor (U.F., also obtained from References 1, 3 and 4), the fraction of time the equipment is operating in its noisiest mode while in use, as follows:

$$\mathrm{Ave_{unit}} = \mathrm{Max_{unit}} + 10 \times \log(U.F.)$$

This level is then adjusted to account for the total number of units of the same type operating at the construction site to calculate the combined average noise level ($Ave_{units}$) for all units of the same type, as follows:

$$\mathrm{Ave_{units}} = \mathrm{Ave_{unit}} + 10 \times \log(number\ of\ units)$$

This level is then adjusted to account for the number of hours of operation per daytime ($N_d$, 7 A.M. to 10 P.M.) and nighttime ($N_n$, 10 P.M. to 7 A.M.) to calculate the $L_{dn}$ for the units ($LDN_{units}$), as follows:

$$\mathrm{LDN_{units}} = 10 \times \log\left[\frac{\mathrm{N_d} \times 10^{(\mathrm{Ave_{units}}/10)} + \mathrm{N_n} \times 10^{((\mathrm{Ave_{units}}+10)/10)}}{24}\right]$$

This level is then adjusted to account for the distance between the equipment and the noise-sensitive receiver in order to calculate the $L_{dn}$ at the receiver due to the units in question ($LDN_{unitsRec}$), as follows:

$$\mathrm{LDN_{unitsRec}} = \mathrm{LDN_{units}} - 20 \times \log\left(\frac{distance}{50}\right)$$

The $L_{dn}$ from each different type of equipment item is then calculated in the same manner and the values are summed using decibel addition in order to estimate the total $L_{dn}$ at the noise-sensitive receptor due to all construction activity.

**Operational Noise Analysis Methodology**

In order to estimate the operational noise contribution from a given equipment item (such as a pump), we start with the average equipment sound power level ($SWL_{equip}$) derived from the corresponding noise source measurements. This level is then adjusted to account for the distance between the equipment and the noise-sensitive receiver in order to calculate the average noise level at the receiver ($Ave_{equip}$), as follows:

$$\mathrm{Ave_{equip}} = \mathrm{SWL_{equip}} - 20 \times \log(distance) - 0.6$$

This level is then adjusted to account for the number of hours of operation per daytime ($N_d$, 7 A.M. to 10 P.M.) and nighttime ($N_n$, 10 P.M. to 7 A.M.) to calculate the $L_{dn}$ for the equipment ($LDN_{equip}$), as follows:

$$\mathrm{LDN_{equip}} = 10 \times \log\left[\frac{\mathrm{N_d} \times 10^{(\mathrm{Ave_{equip}}/10)}) + \mathrm{N_n} \times 10^{((\mathrm{Ave_{equip}}+10)/10)}}{24}\right]$$

The $L_{dn}$ from each different piece of equipment is then calculated in the same manner and the values are summed using decibel addition in order to estimate the total $L_{dn}$ at the noise-sensitive receptor due to all operational activity.