# 4.11 NOISE AND VIBRATION

This section presents definitions of common noise descriptors; descriptions of applicable noise regulations, acoustic fundamentals, and existing ambient noise conditions; and an analysis of potential short- and long-term noise impacts associated with implementation of the project.

## 4.11.1 Environmental Setting

### CHARACTERISTICS OF ENVIRONMENTAL NOISE

Prior to discussing the noise setting for the project, background information on sound, noise, vibration, and common noise descriptors is needed to provide context and a better understanding of the technical terms and regulations referenced throughout this section.

#### Sound, Noise, and Acoustics

Sound can be described as the mechanical energy of a vibrating object transmitted by pressure waves through a liquid or gaseous medium (e.g., air) to a hearing organ, such as a human ear. Noise is defined as loud, unexpected, or annoying sound.

In the science of acoustics, the fundamental model consists of a sound (or noise) source, a receiver, and the propagation path between the two. The loudness of the noise source and obstructions or atmospheric factors affecting the propagation path to the receiver determines the sound level and characteristics of the noise perceived by the receiver. The field of acoustics deals primarily with the propagation and control of sound.

#### Frequency

Continuous sound can be described by frequency (pitch) and amplitude (loudness). A low-frequency sound is perceived as low in pitch. Frequency is expressed in terms of cycles per second, or hertz (Hz) (e.g., a frequency of 250 cycles per second is referred to as 250 Hz). High frequencies are sometimes more conveniently expressed in kilohertz, or thousands of hertz. The audible frequency range for humans is generally between 20 Hz and 20,000 Hz.

#### Sound Pressure Levels and Decibels

The amplitude of pressure waves generated by a sound source determines the loudness of that source. Sound pressure amplitude is measured in micro-Pascals (mPa). One mPa is approximately one hundred billionth (0.00000000001) of normal atmospheric pressure. Sound pressure amplitudes for different kinds of noise environments can range from less than 100 to 100,000,000 mPa. Because of this huge range of values, sound is rarely expressed in terms of mPa. Instead, a logarithmic scale is used to describe sound pressure level (SPL) in terms of decibels (dB).

#### Addition of Decibels

Because decibels are logarithmic units, SPL cannot be added or subtracted through ordinary arithmetic. Under the decibel scale, a doubling of sound energy corresponds to a 3-dB increase. In other words, when two identical sources are each producing sound of the same loudness, the resulting sound level at a given distance would be 3 dB higher than if only one of the sound sources was producing sound under the same conditions. For example, if one automobile produces an SPL of 70 dB when it passes an observer, two cars passing simultaneously would not produce 140 dB; rather, they would combine to produce 73 dB. Under the decibel scale, three sources of equal loudness together produce a sound level 5 dB louder than one source.

## A-Weighted Decibels

The decibel scale alone does not adequately characterize how humans perceive noise. The dominant frequencies of a sound have a substantial effect on the human response to that sound. Although the intensity (energy per unit area) of the sound is a purely physical quantity, the loudness or human response is determined by the characteristics of the human ear.

Human hearing is limited in the range of audible frequencies as well as in the way it perceives the SPL in that range. In general, people are most sensitive to the frequency range of 1,000–8,000 Hz, and perceive sounds within that range better than sounds of the same amplitude in higher or lower frequencies. To approximate the response of the human ear, sound levels of individual frequency bands are weighted, depending on the human sensitivity to those frequencies. Then, an "A-weighted" sound level (expressed in units of A-weighted decibels [dBA]) can be computed based on this information.

The A-weighting network approximates the frequency response of the average young ear when listening to most ordinary sounds. When people make judgments of the relative loudness or annoyance of a sound, their judgment correlates well with the A-scale sound levels of those sounds. Thus, noise levels are typically reported in terms of A-weighted decibels or dBA. Table 4.11-1 describes typical A-weighted noise levels for various noise sources.

**Table 4.11-1 Typical A-Weighted Noise Levels**

| Common Outdoor Activities | Noise Level (dBA) | Common Indoor Activities |
|---|---|---|
| | — 110 — | Rock band |
| Jet fly-over at 1,000 feet | — 100 — | |
| Gas lawn mower at 3 feet | — 90 — | |
| Diesel truck at 50 feet at 50 miles per hour | — 80 — | Food blender at 3 feet, Garbage disposal at 3 feet |
| Noisy urban area, daytime, Gas lawn mower at 100 feet | — 70 — | Vacuum cleaner at 10 feet, Normal speech at 3 feet |
| Commercial area, Heavy traffic at 300 feet | — 60 — | |
| Quiet urban daytime | — 50 — | Large business office ,Dishwasher next room |
| Quiet urban nighttime | — 40 — | Theater, large conference room (background) |
| Quiet suburban nighttime | — 30 — | Library, Bedroom at night |
| Quiet rural nighttime | — 20 — | |
| | — 10 — | Broadcast/recording studio |
| Lowest threshold of human hearing | — 0 — | Lowest threshold of human hearing |

Source: California Department of Transportation (Caltrans) 2013a: Table 2-5

## Human Response to Changes in Noise Levels

As discussed above, the doubling of sound energy results in a 3-dB increase in sound. However, given a sound level change measured with precise instrumentation, the subjective human perception of a doubling of loudness will usually be different from what is measured.

Under controlled conditions in an acoustical laboratory, the trained, healthy human ear is able to discern 1-dB changes in sound levels when exposed to steady, single-frequency ("pure-tone") signals in the mid-frequency (1,000–8,000 Hz) range. In typical noisy environments, changes in noise of 1–2 dB are generally not perceptible. However, it is widely accepted that people are able to begin to detect sound level increases of 3 dB in typical noisy environments. Further, a 5-dB increase is generally perceived as a distinctly noticeable increase, and a 10-dB increase is generally perceived as a doubling of loudness. Therefore, a doubling of sound energy (e.g., doubling the volume of traffic on a highway) that would result in a 3-dB increase in sound would generally be perceived as barely detectable.

## Vibration

Vibration is the periodic oscillation of a medium or object with respect to a given reference point. Sources of vibration include natural phenomena (e.g., earthquakes, volcanic eruptions, sea waves, landslides) and those introduced by human activity (e.g., explosions, machinery, traffic, trains, construction equipment). Vibration sources may be continuous, (e.g., operating factory machinery) or transient in nature (e.g., explosions). Vibration levels can be depicted in terms of amplitude and frequency, relative to displacement, velocity, or acceleration.

Vibration amplitudes are commonly expressed in peak particle velocity (PPV) or root-mean-square (RMS) vibration velocity. PPV and RMS vibration velocity are normally described in inches per second (in/sec) or in millimeters per second (mm/s). PPV is defined as the maximum instantaneous positive or negative peak of a vibration signal. PPV is typically used in the monitoring of transient and impact vibration and has been found to correlate well to the stresses experienced by buildings (Federal Transit Administration [FTA] 2006:7-5, Caltrans 2013b:6).

Although PPV is appropriate for evaluating the potential for building damage, it is not always suitable for evaluating human response. It takes some time for the human body to respond to vibration signals. In a sense, the human body responds to average vibration amplitude. The RMS of a signal is the average of the squared amplitude of the signal, typically calculated over a 1-second period. As with airborne sound, the RMS velocity is often expressed in decibel notation as vibration decibels (VdB), which serves to compress the range of numbers required to describe vibration (FTA 2006:7-5). This is based on a reference value of 1 micro inch per second.

The typical background vibration-velocity level in residential areas is approximately 50 VdB. Ground vibration is normally perceptible to humans at approximately 65 VdB. For most people, a vibration-velocity level of 75 VdB is the approximate dividing line between barely perceptible and distinctly perceptible levels (FTA 2006:7-7).

Typical outdoor sources of perceptible ground vibration are construction equipment, steel-wheeled trains, and traffic on rough roads. If a roadway is smooth, the ground vibration is rarely perceptible. The range of interest is from approximately 50 VdB, which is the typical background vibration-velocity level, to 100 VdB, which is the general threshold where minor damage can occur in fragile buildings. Construction activities can generate sufficient ground vibrations to pose a risk to nearby structures. Constant or transient vibrations can weaken structures, crack facades, and disturb occupants (FTA 2006:7-5).

Construction vibrations can be transient, random, or continuous. Transient construction vibrations are generated by blasting, impact pile driving, and wrecking balls. Continuous vibrations result from vibratory pile drivers, large pumps, and compressors. Random vibration can result from jackhammers, pavement breakers, and heavy construction equipment. Table 4.11-2 describes the general human response to different ground vibration-velocity levels.

**Table 4.11-2 Human Response to Different Levels of Ground Noise and Vibration**

| Vibration-Velocity Level | Human Reaction |
|---|---|
| 65 VdB | Approximate threshold of perception. |
| 75 VdB | Approximate dividing line between barely perceptible and distinctly perceptible. Many people find that transportation-related vibration at this level is unacceptable. |
| 85 VdB | Vibration acceptable only if there are an infrequent number of events per day. |

Notes: VdB = vibration decibels referenced to 1 µ inch/second and based on the root mean square (RMS) velocity amplitude.

Source: FTA 2006:7-8

## Common Noise Descriptors

Noise in our daily environment fluctuates over time. Some fluctuations are minor, but some are substantial. Some noise levels occur in regular patterns, but others are random. Some noise levels fluctuate rapidly, but others fluctuate slowly. Some noise levels vary widely, but others are relatively constant. Various noise descriptors have been developed to describe time-varying noise levels. The following are the noise descriptors used throughout this section.

**Equivalent Continuous Sound Level ($L_{eq}$):** $L_{eq}$ represents an average of the sound energy occurring over a specified period. In effect, $L_{eq}$ is the steady-state sound level containing the same acoustical energy as the time-varying sound that actually occurs during the same period. The 1-hour A-weighted equivalent sound level ($L_{eq[h]}$) is the energy average of A-weighted sound levels occurring during a 1-hour period and is the basis for noise abatement criteria used by Caltrans and Federal Highway Administration (FHWA).

**Percentile-Exceeded Sound Level ($L_{xx}$):** $L_{xx}$ represents the sound level exceeded for a given percentage of a specified period (e.g., $L_{10}$ is the sound level exceeded 10 percent of the time, and $L_{90}$ is the sound level exceeded 90 percent of the time).

**Maximum Sound Level ($L_{max}$):** $L_{max}$ is the highest instantaneous sound level measured during a specified period.

**Day-Night Level ($L_{dn}$):** $L_{dn}$ is the energy average of A-weighted sound levels occurring over a 24-hour period, with a 10-dB "penalty" applied to A-weighted sound levels occurring during nighttime hours between 10 p.m. and 7 a.m.

**Community Noise Equivalent Level (CNEL) or Day-Evening-Night Level ($L_{den}$):** Similar to $L_{dn}$, CNEL or $L_{den}$ is the energy average of the A-weighted sound levels occurring over a 24-hour period, with a 10-dB penalty applied to A-weighted sound levels occurring during the nighttime hours between 10 p.m. and 7 a.m. and a 5-dB penalty applied to the A-weighted sound levels occurring during evening hours between 7 p.m. and 10 p.m.

**SEL (single-event (impulsive) noise level) –** A receiver's cumulative noise exposure from a single impulsive-noise event, which is defined as an acoustical event of short duration and which involves a change in sound pressure above some reference value.

## Sound Propagation

When sound propagates over a distance, it changes in level and frequency content. The manner in which noise reduces with distance depends on the following factors.

### Geometric Spreading

Sound from a localized source (i.e., a point source) propagates uniformly outward in a spherical pattern. The sound level attenuates (or decreases) at a rate of 6 dB for each doubling of distance from a point source. Roads and highways consist of several localized noise sources on a defined path and hence can be treated as a line source, which approximates the effect of several point sources, thus propagating at a slower rate in comparison to a point source. Noise from a line source propagates outward in a cylindrical pattern, often referred to as cylindrical spreading. Sound levels attenuate at a rate of 3 dB for each doubling of distance from a line source.

### Ground Absorption

The propagation path of noise from a source to a receiver is usually very close to the ground. Noise attenuation from ground absorption and reflective-wave canceling adds to the attenuation associated with geometric spreading. Traditionally, the excess attenuation has also been expressed in terms of attenuation per doubling of distance. This approximation is usually sufficiently accurate for distances of less than 200 feet. For acoustically hard sites (i.e., sites with a reflective surface between the source and the receiver, such as a parking lot or body of water), no excess ground attenuation is assumed. For acoustically absorptive or soft sites (i.e., those sites with an absorptive ground surface between the source and the receiver, such as soft dirt, grass, or scattered bushes and trees), an excess ground-attenuation value of 1.5

dB per doubling of distance is normally assumed. When added to the cylindrical spreading, the excess ground attenuation results in an overall drop-off rate of 4.5 dB per doubling of distance. This would hold true for point sources, resulting in an overall drop-off rate of up to 7.5 dB per doubling of distance.

#### Atmospheric Effects

Receivers located downwind from a source can be exposed to increased noise levels relative to calm conditions, whereas locations upwind can have lowered noise levels, as wind can carry sound. Sound levels can be increased at large distances (e.g., more than 500 feet) from the source because of atmospheric temperature inversion (i.e., increasing temperature with elevation). Other factors such as air temperature, humidity, and turbulence can also have significant effects.

#### Shielding by Natural or Human-Made Features

A large object or barrier in the path between a noise source and a receiver can substantially attenuate noise levels at the receiver. The amount of attenuation provided by shielding depends on the size of the object and the frequency content of the noise source. Natural terrain features (e.g., hills and dense woods) and human-made features (e.g., buildings and walls) can substantially reduce noise levels. Walls are often constructed between a source and a receiver specifically to reduce noise. A barrier that breaks the line of sight between a source and a receiver will typically result in at least 5 dB of noise reduction. Taller barriers provide increased noise reduction. Vegetation between the source and receiver is rarely effective in reducing noise because it does not create a solid barrier.

## SENSITIVE LAND USES

Noise-sensitive land uses are generally considered to include those uses where noise exposure could result in health-related risks to individuals, as well as places where quiet is an essential element of their intended purpose. Residential dwellings are of primary concern because of the potential for increased and prolonged exposure of individuals to both interior and exterior noise levels. Additional land uses such as parks, schools, historic sites, cemeteries, and recreation areas are also generally considered sensitive to increases in exterior noise levels. Places of worship and transient lodging, and other places where low interior noise levels are essential, are also considered noise-sensitive. Those noted above are also considered vibration-sensitive land uses in addition to commercial and industrial buildings where vibration would interfere with operations within the building, including levels that may be well below those associated with human annoyance. In addition, buildings of older age are more prone to vibration-induced damage.

Existing residents and other sensitive land uses located in the vicinity of the project include: the Hyatt Place UC Davis, Solano Park Apartments, Aggie Village Cottages, residential clusters along 1st Street and downtown Davis, Davis Mobile Estates, and The Lexington Apartments. Solano Park Apartments are the closest sensitive land uses to the Nishi project site along the north-western border of the Nishi project site. Refer to Figure 4.11- 1 for specific locations.

## REGIONAL SETTING

Regional noise sources include traffic-related noise on roadways and highways, airplanes flying overhead, and noise associated with typical residential development (e.g., people talking, dogs barking, children playing, yard maintenance equipment).

As discussed above, sound is affected by distance from the source, surrounding obstacles, and atmospheric properties. Thus, regional noise sources would not typically interfere or combine with noise sources within or in close proximity to the project site. Therefore, noise sources and levels that would affect the project or nearby sensitive receptors are discussed below in “Local Setting.”

## LOCAL SETTING

The sound levels in most communities fluctuate, depending on the activity of nearby and distant noise sources, time of the day, or season of the year. To characterize the existing environment, noise measurements were taken at various locations within the Nishi project site, West Olive Drive, and surrounding areas. A total of six short-term (15-minute) and two long-term (24 hour) measurements were taken at seven separate sites. Two measurements were taken at the West Olive Drive site to capture ambient noise levels with and without train horn events from the nearby Union Pacific Railroad (UPRR) line that passes along the project site. The location of each measurement is shown in Figure 4.11-1. Measurement location numbers identified in Figure 4.11-1 correspond to the measurement location numbers indicated in Table 4.11-3, which presents the results of the short-term and long-term ambient noise measurements. As shown in Table 4.11-3, the noise measurements captured sound generated from a variety of sources, including: roadway traffic, railway traffic and train horn events, vehicle repair operations, and landscaping equipment. These nose sources are typical in the project area.

Noise level measurements were conducted in accordance with American National Standards Institute standards using a Larson Davis Laboratories (LDL) Model 820 precision integrating sound level meter. The sound level meter was calibrated before and after use with an LDL Model CAL200 acoustical calibrator. Meteorological conditions during the measurement period were adequate for reliable noise measurements, with clear skies, temperatures ranging from 48 degrees Fahrenheit (°F) to 75°F, average relative humidity of between 53 and 62 percent, and winds averaging 4 to 7 miles per hour (mph), and no precipitation.

**Table 4.11-3 Summary of Sound Level Noise Measurements**

| Site | Date | Time/Duration | Primary Noise Sources | $L_{eq}$ | $L_{min}$ | $L_{max}$ | CNEL |
|---|---|---|---|---|---|---|---|
| ST-1 | 3/18/2015 | 3:09 p.m./15 min | Traffic along Olive Dr. and Richards Blvd., Passing Trains, Train Horn Blasts | 68.4 | 48.4 | 91.0 | NA |
| | 3/18/2015 | 3:24 p.m./15 min | Traffic along Olive Dr. and Richards Blvd. No Train Activity | 56.8 | 48.9 | 74.5 | NA |
| ST-2 | 3/18/2015 | 4:35 p.m./12 min | Traffic along Old Davis Rd. | 49.8 | 43.9 | 56.2 | NA |
| ST-3 | 3/18/2015 | 11:12 a.m./12 min | Parking Lot Traffic | 46.0 | 42.6 | 55.1 | NA |
| ST-4 | 3/18/2015 | 3:56 p.m./15 min | I-80 Traffic | 55.5 | 48.0 | 68.8 | NA |
| ST-5 | 3/18/2015 | 11:40 a.m./15 min | Traffic along Olive Dr. and Driveway | 52.6 | 46.1 | 69.6 | NA |
| 24Hr-A | 3/18/2015 | 10:00 a.m./24-Hour | I-80 Traffic, Passing Trains, Train Horn Blasts | 59.9 | 50.2 | 79.8 | 66.5 |
| 24Hr-B | 3/25/2015 | 8:00 a.m./24-Hour | I-80 Traffic, Passing Trains, Train Horn Blasts | 60.3 | 48.1 | 84.8 | 70.8 |

Notes: Data presented in this table for the Long-term 24-hour measurement are average values recorded over the entire 24-hour period. Computation of the CNEL based on 1-hour Leq measurements for each hour of a day are based on equation 2-27 on pg. 2-57 of Caltrans 2009. CNEL's not available for short term measurements.

NA = Not Available

CNEL = Community Noise Equivalent Level

Source: Measurements conducted by Ascent Environmental in 2015

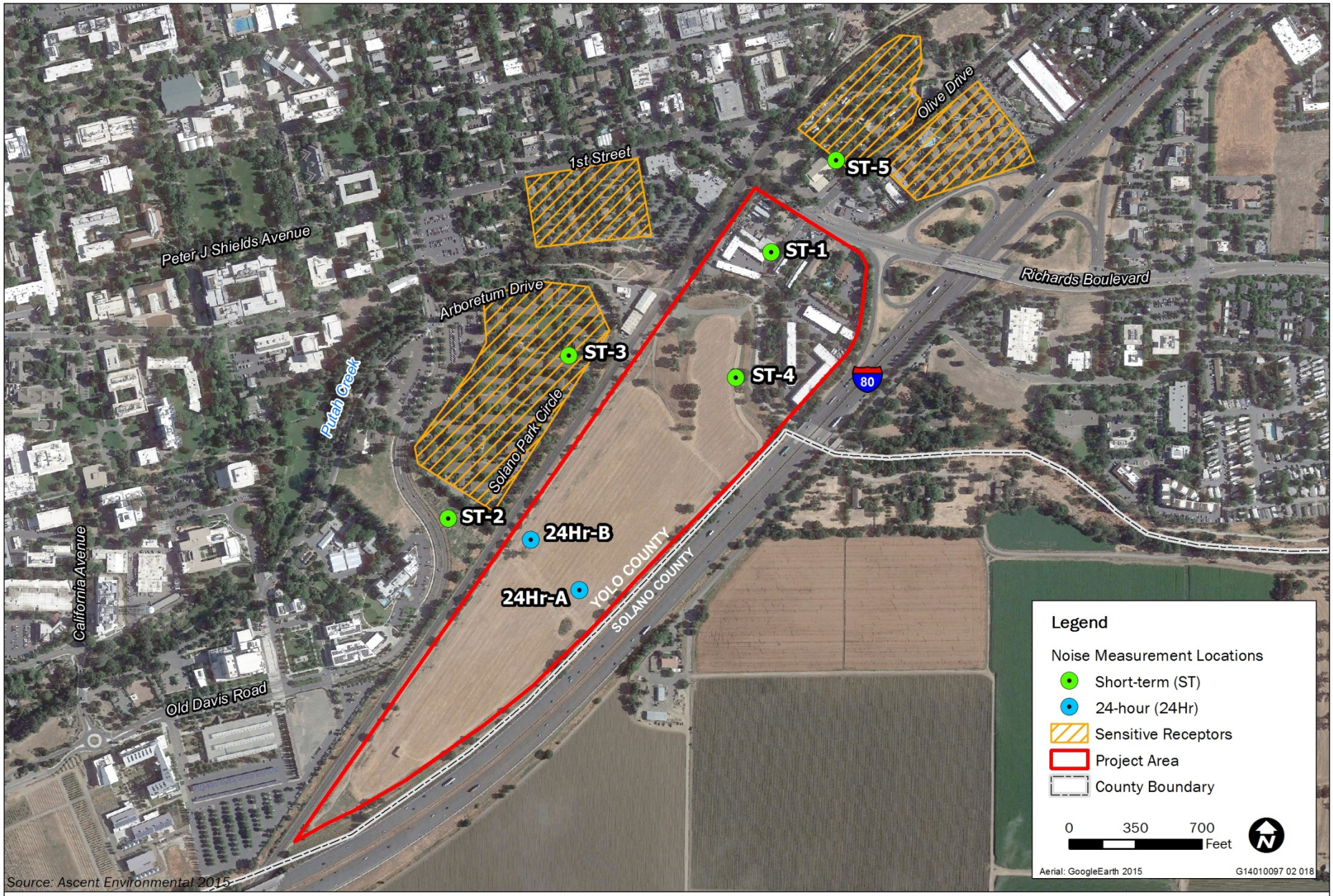



**Figure 4.11-1** **Noise Measurement Locations**

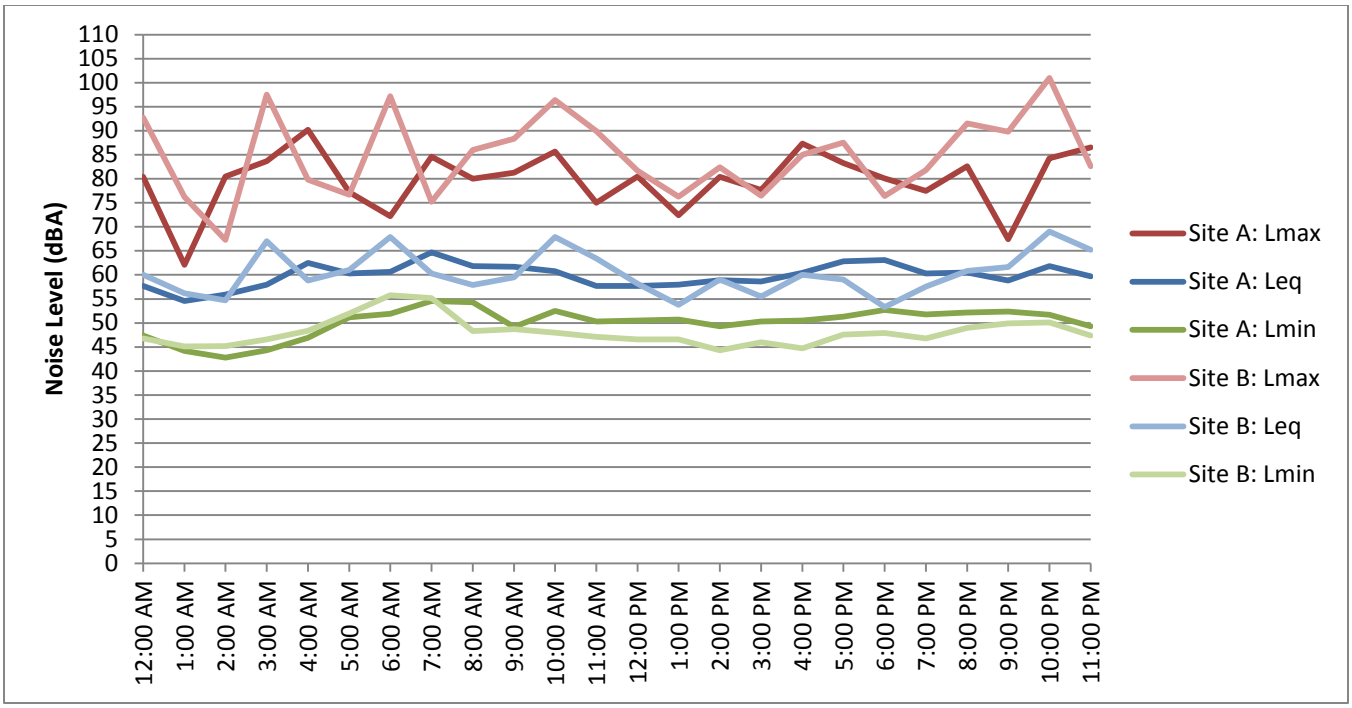



**Figure 4.11-2 Summary of Long-term (24-hour) Noise Measurement at Sites A and B**

Table 4.11-4 below summarizes the modeled existing traffic noise levels at 100 feet from the centerline of each major roadway in the project vicinity and lists distances from each roadway centerline to the 65-dB, 60-dB, and 55-dB CNEL/$L_{dn}$ traffic noise contours. Based on the distances listed in Table 4.11-4, the Richards Blvd contours would extend into a portion of West Olive Drive, but no other local roadway contours extend onto the project site. As shown in Figure 4.11-3, the 65-dB contour for I-80 covers half of the project site, with the two remaining I-80 contours fully covering the project site. The contours shown in Figure 4.11-3 do not reflect reductions in ambient noise levels from topography, structures, or vegetation. Traffic noise modeling results are based on existing peak average daily traffic (ADT) volumes and were obtained from the project-specific traffic analysis conducted by Fehr and Peers and summarized in Section 4.14, "Transportation and Circulation," and Appendix I of this EIR. The peak is defined as the 7$^{th}$ busiest winter day and, for the summer, a Friday in August (see Section 4.14 "Transportation and Circulation" for details). Modeling assumes roadway speeds specific to each roadway with no natural or human-made shielding (e.g., vegetation, berms, walls, buildings). The extent to which existing land uses in the project vicinity are affected by existing traffic noise depends on their respective proximity to the roadways and their individual sensitivity to noise.

**Table 4.11-4 Summary of Modeled Existing Traffic Noise Levels**

| Roadway Segment/Segment Description | CNEL/$L_{dn}$(dB) at 100 feet from Roadway Centerline | Distance (feet) from Roadway Centerline to CNEL/$L_{dn}$(dB) | | |
|---|---|---|---|---|
| | | 65 | 60 | 55 |
| Old Davis Road, between I-80 and Hutchinson Drive | 53.3 | 17 | 36 | 77 |
| Richards Blvd, East of Research Park Drive | 58.3 | 36 | 77 | 167 |
| I-80, Between Old Davis Road and Mace Boulevard | 75.8 | 522 | 1,125 | 2,424 |
| 1st Street, East of D Street | 56.0 | 25 | 54 | 116 |

Notes: CNEL = Community Noise Equivalent Level; dB = A-weighted decibels; $L_{dn}$ = day-night average noise level

All modeling assumes average pavement, level roadways (less than 1.5% grade), constant traffic flow and does not account for shielding of any type or finite roadway adjustments. All levels are reported as A-weighted noise levels. For additional details, refer to Section 4.14, "Transportation and Circulation," and Appendix I for detailed traffic data, and traffic-noise modeling input data and output results.

Source: Data modeled by Ascent Environmental, Inc. in 2015

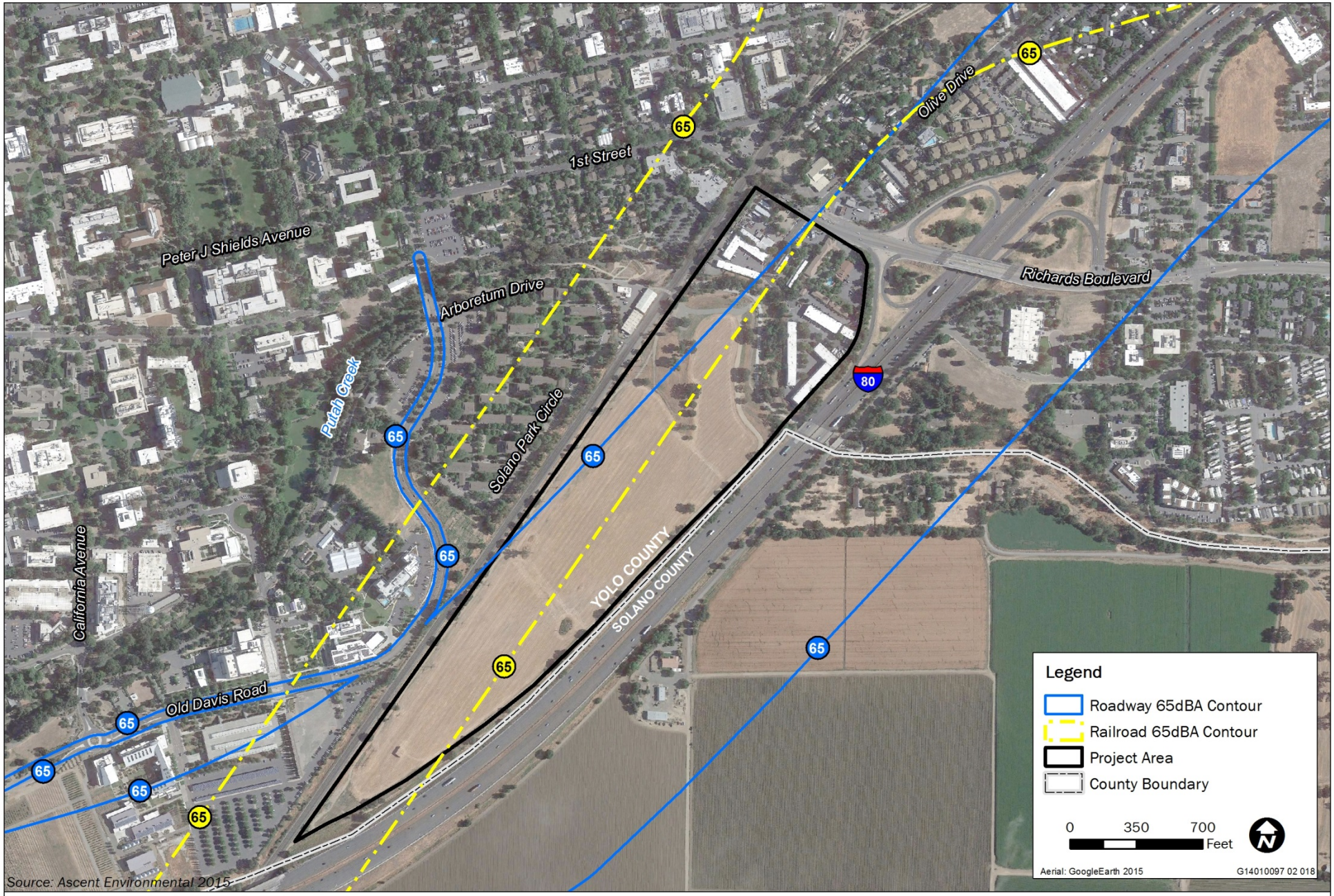



**Figure 4.11-3**

**Noise Contours**

In considering the existing noise environment and, later in this section, the impacts of the project, it is important to recognize the unique nature of both the traffic data and the peak nature of the noise analysis. The CNEL metric is generally intended to reflect average year-round conditions, and translates various noise events into a singular number. It can also reflect noise over a single day, but this is not its typical use. However, year-round traffic data are not available for the project area. By focusing on the peak traffic days, the noise levels represent the busiest days of the year, rather than average traffic throughout the year. Thus, while the CNEL data reflect expected noise levels in the project area that would be experienced a number of days in the year, these noise levels are marginally higher than what would be experienced on the majority of days in the project area, when traffic volumes are much lower than the peak days.

## 4.11.2 Regulatory Setting

### FEDERAL

The U.S. Environmental Protection Agency (EPA) Office of Noise Abatement and Control was originally established to coordinate Federal noise control activities. After its inception, EPA's Office of Noise Abatement and Control issued the Federal Noise Control Act of 1972, establishing programs and guidelines to identify and address the effects of noise on public health, welfare, and the environment. In 1981, EPA administrators determined that subjective issues such as noise would be better addressed at more local levels of government. Consequently, in 1982 responsibilities for regulating noise control policies were transferred to state and local governments. However, noise control guidelines and regulations contained in EPA rulings in prior years remain in place by designated Federal agencies where relevant.

#### Occupational Health and Safety Act of 1970

This act covers all employers and their employees in the United States and US territories. Administered by the Occupational Safety and Health Administration (OSHA), the act assigns OSHA two regulatory functions—setting standards and conducting inspections to ensure that employers are providing safe and healthful workplaces. Employers must become familiar with the standards applicable to their establishments and eliminate hazards. Included in this act is a regulation for worker noise exposure at 90 dBA over an 8-hour work shift. Areas where exposure exceeds 85 dBA must be designated and labeled as high-noise-level areas and hearing protection is required.

#### Federal Aviation Administration

The Federal Aviation Administration establishes 65 dBA CNEL as the maximum noise exposure limit associated with aircraft noise measured at exterior locations in noise-sensitive land uses (e.g., land uses where quiet environments are essential such as residential areas, churches, and hotels). This standard is also generally applied to railroad noise.

### STATE

The State of California has adopted noise standards in areas of regulation not preempted by the Federal government. State standards regulate noise levels of motor vehicles, sound transmission through buildings, occupational noise control, and noise insulation.

Though not adopted by law, the *State of California General Plan Guidelines 2003*, published by the California Governor's Office of Planning and Research (2003), provide guidance for the compatibility of projects within areas of specific noise exposure. Acceptable and unacceptable community noise exposure limits for various land use categories have been determined to help guide new land use decisions in California communities. In many local jurisdictions, these guidelines are used to derive local noise standards and guidance. Citing EPA's "Levels Document" and the State Sound Transmissions Control Standards, the state's general plan guidelines recommend an interior and exterior noise standards of 45 and 60 dB CNEL for residential units, respectively (OPR 2003: 253-254).

## California Department of Transportation

In 2013, Caltrans published the Transportation-and Construction Vibration Manual, which provides general guidance on vibration issues associated with construction and operation of projects in relation to human perception and structural damage. Table 4.11-5 below presents recommendations for levels of vibration that could result in damage to structures exposed to continuous vibration.

**Table 4.11-5 Caltrans Recommendations Regarding Vibration Levels**

| PPV (in/sec) | Effect on Buildings |
|---|---|
| 0.4-0.6 | Architectural damage and possible minor structural damage |
| 0.2 | Risk of architectural damage to normal dwelling houses |
| 0.1 | Virtually no risk of architectural damage to normal buildings |
| 0.08 | Recommended upper limit of vibration to which ruins and ancient monuments should be subjected |
| 0.006-0.019 | Vibration unlikely to cause damage of any type |

Notes: PPV= Peak Particle Velocity

Source: Caltrans 2013b

# LOCAL

## City of Davis General Plan

The Nishi site and West Olive Drive are located in unincorporated area of Yolo County and in the City of Davis, respectively. The Nishi site is, however, within the City's Sphere of Influence. However, the construction of the project would be contingent on voter approval that would include annexation of the unincorporated Nishi parcel into the City of Davis. As a result, the City's standards are considered applicable to this analysis and the project site, as a whole.

The City of Davis General Plan Noise Element (City of Davis 2007) contains noise policies and standards and the City of Davis Municipal Code contains noise limits for sensitive receptors (City of Davis 2007). The City's interior and exterior noise-level performance standards for new and existing projects affected by, or including non-transportation noise sources are presented in Tables 4.11-6 and 4.11-7. Policies and standards contained in the General Plan and Ordinance applicable to the project are summarized below.

GOAL NOISE 1. Maintain community noise levels that meet health guidelines and allow for a high quality of life.

- **Policy NOISE 1.1:** Minimize vehicular and stationary noise sources, and noise emanating from temporary activities.

  Standards

  a. The City shall strive to achieve the "normally acceptable" exterior noise levels shown in Table 4.11-6 and the target interior noise levels in Table 4.11-7 in future development areas and in currently developed areas.

  b. New development shall generally be allowed only in areas where exterior and interior noise levels consistent with Table 4.11-6 and Table 4.11-7 can be achieved.

  c. New development and changes in use shall generally be allowed only if they will not adversely impact attainment within the community of the exterior and interior noise standards shown in Table 4.11-6 and Table 4.11-7. Cumulative and project specific impacts by new development on existing

residential land uses shall be mitigated consistent with the standards in Table 4.11-6 and Table 4.11-7.

d. Required noise mitigation measures for new and existing housing shall be provided with the first stage and prior to completion of new developments or the completion of capacity-enhancing roadway changes wherever noise levels currently exceed or are projected within 5 years to exceed the normally acceptable exterior noise levels in Table 4.11-6.

**Table 4.11-6 City of Davis Standards for Exterior Noise Exposure**

| Use | COMMUNITY NOISE EXPOSURE ($L_{dn}$ or CNEL, dBA) | | | |
|---|---|---|---|---|
| | Normally Acceptable[1] | Conditionally Acceptable[2] | Normally Unacceptable[3] | Clearly Unacceptable[4] |
| Residential | Under 60 | 60-70* | 70-75 | Above 75 |
| Transient Lodging - Motels, Hotels | Under 60 | 60-75 | 75-80 | Above 80 |
| Schools, Libraries, Churches, Hospitals, Nursing Homes | Under 60 | 60-70 | 70-80 | Above 80 |
| Auditoriums, Concert Halls, Amphitheaters | Under 50 | 50-70 | N/A | Above 70 |
| Sports Arenas, Outdoor Spectator Sports | N/A | Under 75 | N/A | Above 75 |
| Playgrounds, Neighborhood Parks | Under 70 | N/A | 70-75 | Above 75 |
| Golf Courses, Riding Stables, Water Recreation, Cemeteries | Under 70 | N/A | 70-80 | Above 80 |
| Office Buildings, Business Commercial and Professional | Under 65 | 65-75 | Above 75 | N/A |
| Industrial, Manufacturing, Utilities, Agriculture | Under 65 | 70-80 | Above 80 | N/A |

Notes: N/A=Not applicable

1 Specified land use is satisfactory assuming all buildings involved are of conventional construction, without special noise insulation requirements.

2 New construction or development should be undertaken only after a detailed analysis of the noise reduction requirements is conducted, and needed noise attenuation features are included in the construction or development.

3 New construction or development should be discouraged. If new construction or development does proceed, a detailed analysis of the noise reduction requirements must be conducted and needed noise attenuation features shall be included in the construction or development.

4 New construction or development shall not be undertaken.

* The City Council has discretion within the "conditionally acceptable" range for residential use to allow noise levels in outdoor spaces to go up to 65 dBA if cost effective or aesthetically acceptable measures are not available to reduce noise levels in outdoor use spaces to the "normally acceptable" levels. Outdoor spaces which are designed for visual use only (for example, streetside landscaping in an apartment project), rather than outdoor use space, may be considered acceptable up to 70 dBA.

Source: City of Davis 2007: Table 19

**Table 4.11-7 City of Davis Standards for Interior Noise Exposure**

| Use | Noise Level ($L_{dn}$ or CNEL, dBA) |
|---|---|
| Residences, schools through grade 12, hospitals and churches | 45 |
| Offices | 55 |

Source: City of Davis 2007: Table 20

### Actions

e. Explore options, such as distributing educational materials, to encourage Davis residents and businesses to use alternatives to gas powered garden tools to reduce noise and air pollution, reduce costs, and be courteous of neighbors.

f. Continue to enforce the noise-control ordinance. g. Revise the City's Noise Ordinance (Chapter 16B, "Noise Regulations" of the City of Davis Municipal Code) to reflect construction criteria that can be met by typical construction activities.

g. Revise the City's Noise Ordinance (Chapter 16B, "Noise Regulations" of the City of Davis Municipal Code) to reflect construction criteria that can be met by typical construction activities.

h. Require an acoustic study for all proposed projects that would have noise exposure that may exceed City Noise Ordinance standards for construction activities or impacts after development that would be greater than normally acceptable as indicated by Figure 37 [Available in Appendix H] of the General Plan update.

i. Consider lowering speed limits or installing traffic calming measures adjacent to all residences, schools, hospitals, and libraries that experience noise levels that exceed acceptable noise levels.

j. Develop procedures to address citizen noise complaints and provide remedies that encourage the use of alternative noise mitigation measures over conventional sound walls.

m. The project proponent shall employ noise-reducing construction practices. The following measures shall be incorporated into contract specifications to reduce the impact of construction noise.

- All equipment shall have sound-control devices no less effective than those provided on the original equipment. No equipment shall have an unmuffled exhaust.

- As directed by the City, the contractor shall implement appropriate additional noise mitigation measures including, but not limited to, changing the location of stationary construction equipment, shutting off idling equipment, rescheduling construction activity, notifying adjacent residents in advance of construction work, or installing acoustic barriers around stationary construction noise sources.

- **Policy NOISE 1.2** Discourage the use of sounds walls whenever alternative mitigation measures are feasible, while also facilitating the construction of sound walls where desired by the neighborhood and there is no other way to reduce noise to acceptable exterior levels shown in Table 4.11-6.

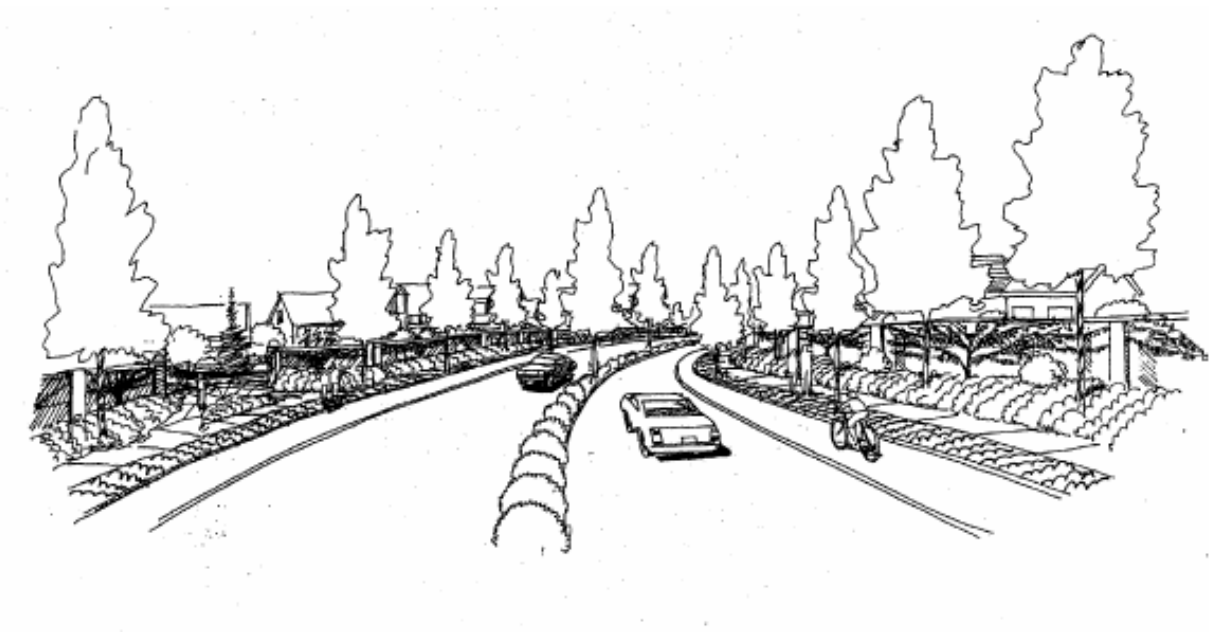
### Standards

a. Where sound walls are built, they should include dense landscaping along them to mitigate their visual impact, as illustrated in Figure 4.11-4.

b. Where sound walls are built, they should provide adequate openings and visibility from surrounding areas to increase safety and access, as illustrated in Figure 38 [as shown in Figure 4.11-4 of this report]. Openings should be designed so as to maintain necessary noise attenuation.

c. Review sound walls and other noise mitigations through the design review process.

Minimal Landscaping and Inadequate Openings for Access



Dense Landscaping and Adequate Openings for Access

*Source: City of Davis 2007: Figure 38*

**Figure 4.11-4** **Sound Wall Design Concepts.**

**GOAL NOISE 2.** Provide for indoor noise environments that are conducive to living and working.

- **Policy NOISE 2.1** Take all technically feasible steps to ensure that interior noise levels can be maintained at the levels shown in Table 4.11-7.

  **Standards**

  a. New residential development or construction shall include noise attenuation measures necessary to achieve acceptable interior noise levels shown in Table 4.11-7.

  b. Existing areas that will be subjected to noise levels greater than the acceptable noise levels shown in Table 4.11-7 as a result of increased traffic on existing city streets (including streets remaining in existing configurations and streets being widened) shall be mitigated to the acceptable levels in Table 4.11-7. If traffic increases are caused by specific projects, then the City shall be the lead agency in implementing cumulative noise mitigation projects. Project applicants shall pay their fair share for any mitigation.

## City of Davis Municipal Code

### 24.02.020 (a) (b) (c) Noise limits.

Section 24.02.020 of the Davis City Code identifies the permissible noise levels that would be produced, suffered by, or allowed for any public or private property. Sound levels at multifamily residential properties would be those that are measured inside any dwelling unit or twenty feet from the outside of the dwelling unit where the noises source(s) might be located.

Daytime (7 a.m. – 9 p.m.) maximum noise levels for residential uses are limited to 55 dBA; nighttime (9 p.m. – 7 a.m.) maximum noise levels are limited to 50 dBA. Daytime (7 a.m. – 10 p.m.) maximum noise levels for commercial uses are limited to 60 dBA; nighttime (10 p.m. – 7 a.m.) maximum noise levels are limited to 55 dBA. Land uses within 100 feet of high noise traffic corridors are limited to 65 dBA. High noise traffic corridors include Highway 113 and I-80.

### 24.02.030 Maximum noise limit.

Section 24.02.030 of the Davis City Code prohibits sound levels greater than 20 dBA above the limits specified in Section 24.02.20 and no greater than 80 dBA when measured at the property plane, with the exception of special provisions listed in Section 24.02.040.

### 24.02.040 Special provisions.

Section 24.02.040 of the Davis City Code list special provisions applicable to the project with respect to increased sound levels.

(b) **Construction and landscape maintenance equipment**. Notwithstanding any other provision of Chapter 24 in the Davis Municipal Code, between the hours of 7:00 a.m. and 7:00 p.m. on Mondays through Fridays, and between the hours of 8:00 a.m. and 8:00 p.m. on Saturdays and Sundays, construction, alteration, repair or maintenance activities which are authorized by valid city permit or business license, or carried out by employees of contractors of the city shall be allowed if they meet at least one of the following noise limitations:

(1) No individual piece of equipment shall produce a noise level exceeding 83 dBA at a distance of 25 feet. If the device is housed within a structure on the property, the measurement shall be made outside the structure at a distance as close to 20 feet from the equipment as possible.

(2) The noise level at any point outside of the property plane of the project shall not exceed 86 dBA.

(3) The provisions of subdivisions (1) and (2) of this subsection shall not be applicable to impact tools and equipment; provided, that such impact tools and equipment shall have intake and exhaust mufflers recommended by manufacturers thereof and approved by the director of public works as best accomplishing maximum noise attenuation, and that pavement breakers and jackhammers shall also be equipped with acoustically attenuating shields or shrouds recommended by the manufacturers thereof and approved by the director of public works as best accomplishing maximum noise attenuation. In the absence of manufacturer's recommendations, the director of public works may prescribe such means of accomplishing maximum noise attenuation as he or she may determine to be in the public interest.

(4) Construction projects located more than two hundred feet from existing homes may request a special use permit to begin work at 6:00 a.m. on weekdays from June 15th until September 1st. No percussion type tools (such as ramsets or jackhammers) can be used before 7:00 a.m. The permit shall be revoked if any noise complaint is received by the police department.

(5) No individual powered blower shall produce a noise level exceeding 70 dBA measured at a distance of fifty feet.

(6) No powered blower shall be operated within 100 feet radius of another powered blower simultaneously.

(7) On single-family residential property, the 70 dBA at 50 feet restriction shall not apply if operated for less than ten minutes per occurrence.

(c) **Air conditioners and similar equipment**. Air conditioners, pool pumps and similar equipment are exempt from this chapter, provided they are in good working order.

(d) **Work required for the public health and safety.** Work performed by city, city franchises, persons under contract with the city for repairs or maintenance of roads, water wells, water service lines, trees and landscape, as well as street sweeping, garbage removal, and similar activities are exempt from this chapter.

(e) **Safety devices.** Aural warning devices which are required by law to protect the health, safety and welfare of the community shall be exempt from the provisions of this chapter.

(f) **Emergencies**. Emergencies are exempt from this chapter. (Ord. 1700 § 1; Ord. 1854 §§ 7—10; Ord. 1955, 1998; Ord. 2017, 2000; Ord. 2037, 2000; Ord. 2221, 2005)

40.24.040 Specified.

(b) **Vibration.** No vibration shall be permitted which is discernible without instruments at the points of measurement specified in Section 40.24.030.

## 4.11.3 Impacts and Mitigation Measures

### SIGNIFICANCE CRITERIA

Based on the Appendix G of the State CEQA Guidelines, noise policies and standards in the City of Davis General Plan and Davis Municipal Code, and Caltrans and FTA vibration standards, the project would result in a significant impact related to noise or vibration if it would:

- 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;
- exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels;

- a substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project;
- a substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without project;
- for a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, expose people residing or working in the project area to excessive noise levels;
- for a project within the vicinity of a private airstrip, expose people residing or working in the project area to excessive noise levels; or
- conflict, or create an inconsistency, with any applicable plan, policy, or regulation adopted for the purpose of avoiding or mitigating environmental effects related to noise and vibration.

## METHODS AND ASSUMPTIONS

### Components of the Nishi Sustainability Implementation Plan That Could Affect Project Impacts

The following goals and objectives from the Nishi Sustainability Plans are applicable to the evaluation of noise impacts:

**Goal 2:** Provide low-carbon transportation choices and enhance mobility and connectivity through the use of innovative designs, technologies, and programs.

- **Objective 2.1:** Reduce automobile dependency and reduce vehicle trips generated within the District by 10 percent compared to original project trip generation forecasts [3], working towards the communitywide goal of achieving 50 percent non-single-occupancy-vehicle (SOV) mode share for residential and commercial development by 2035.

**Goal 5:** Create synergy with other project design goals and existing community sustainability initiatives.

- **Objective 5.1:** Preserve and promote the health of future project residents and employees and the local ecosystem

### Impact Analysis Methodology

As noted in Chapter 3, "Project Description," this EIR evaluates development of the Nishi site at a project level and potential redevelopment that may occur within West Olive Drive as a result of rezoning/redesignation at a programmatic level. This evaluation takes into consideration impacts of the project on noise levels at off-site receptors, as well as the effect of noise levels on the potential receptors to be located at the project site.

To assess potential short-term (construction-related) noise and vibration impacts, sensitive receptors (including on-site receptors during Phase 2 of construction) and their relative level of exposure were identified. Project-generated construction source noise and vibration levels were determined based on methodologies, reference emission levels, and usage factors from FTA's *Guide on Transit Noise and Vibration Impact Assessment* methodology (FTA 2006) and FHWA's *Roadway Construction Noise Model User's Guide* (FHWA 2006). Reference levels are noise and vibration emissions for specific equipment or activity types that are well documented and the usage thereof common practice in the field of acoustics.

With respect to non-transportation noise sources (e.g., stationary) associated with project implementation, the assessment of long-term (operational-related) impacts was based on reconnaissance data, reference noise emission levels and measured noise levels for activities and equipment associated with project operation (e.g., HVAC units), and standard attenuation rates and modeling techniques.

To assess potential long-term (operation-related) noise impacts due to project-generated increases in traffic, modeling was conducted for affected roadway segments based on Caltrans' traffic noise analysis protocol and the technical noise supplement (Caltrans 2011, 2013a) and project-specific traffic data (Appendix I). The analysis is based on the reference noise emission levels for automobiles, medium-duty trucks, and heavy-duty trucks, with consideration given to vehicle volume, speed, roadway configuration, distance to the receiver, and ground attenuation factors. Truck usage and vehicle speeds on study area roadways were estimated from field observations and the project-specific traffic report. Note that the modeling conducted does not account for any natural or human-made shielding (e.g., the presence of vegetation, berms, walls, or buildings) and; consequently, represents worst-case noise levels.

In addition, a threshold of 65 dBA SEL is applied to determine whether train horn events associated with passing trains along the UPRR line result in sleep disturbance at residential dwellings, including on-site residences.

With respect to vibration, CEQA states that the potential for any excessive ground noise and vibration levels must be analyzed; however, it does not define the term "excessive" vibration. Numerous public and private organizations and governing bodies have provided guidelines to assist in the analysis of ground noise and vibration; however, the Federal, state, and local governments have yet to establish specific ground noise and vibration requirements. Publications of the FTA and Caltrans are two of the seminal works for the analysis of ground noise and vibration relating to transportation and construction-induced vibration.

With respect to structural damage, Caltrans recommends that a level of 0.2 in/sec PPV not be exceeded for the protection of normal residential buildings, and that 0.1 in/sec PPV not be exceeded for the protection of old or historically significant structures (Caltrans 2013b).

To address the human response to groundborne vibration, FTA has guidelines for maximum-acceptable vibration criteria for different types of land uses that depend on the frequency in which the vibration-generating activity occurs. For instance, FTA recommends a limit of 75 VdB (referenced to 1 microinch per second) for residences exposed to 30 to 70 vibration events of the same source per day (FTA 2006:8-3).

## ISSUES NOT EVALUATED FURTHER

**Excessive Noise Associated with Operation of an Airport, Private Airstrip, or Heliport**

The project site is not located within two miles of an active private airstrip or heliport. The University Airport, a public use airport, is located approximately 2 miles to the west of the project site. The project would not include a heliport as part of the planned development. Further, the project is not anticipated to increase air traffic and, based on noise monitoring conducted at the site, would not expose on-site receptors to excessive noise levels associated with airport operations, associated with the existing University Airport (located approximately two miles west of the project site). This issue is not discussed further.

## PROJECT-SPECIFIC IMPACTS AND MITIGATION MEASURES

### Impact 4.11-1: Generate short-term, construction-related noise on nearby sensitive land uses.

*Nishi Site*

Project construction activities would involve the use of heavy-duty construction equipment. Construction noise impacts would occur over a 5-year period for off-site sensitive receptors and a 2- to 3-year period for planned on-site receptors. Although construction activities would be conducted in accordance with Davis Municipal Code 24.02.040 (b), construction activities may result in a substantial increase in ambient noise levels, especially to on-site residences during Phase 2 of construction thereby resulting in a **significant** impact.

Short-Term Construction Noise Levels

Construction noise levels in the vicinity of the project site would fluctuate depending on the particular type, number, and duration of usage for the varying equipment. The effects of construction noise largely depend on the type of construction activities occurring on any given day, noise levels generated by those activities, distances to noise-sensitive receptors, and the existing ambient noise environment in the receptor's vicinity. Construction generally occurs in several discrete stages with varying equipment type, quantity, and intensity. These variations in the operational characteristics of the equipment change the effect they have on the noise environment of the project site and in the surrounding community for the duration of the construction period.

To assess noise levels associated with the various equipment types and operations, construction equipment can be considered to operate in two modes, mobile and stationary. Mobile equipment sources move around a construction site performing tasks in a recurring manner (e.g., loaders, graders, dozers). Stationary equipment operates in a given location for an extended period of time to perform continuous or periodic operations (e.g., stationary crane, generator). Operational characteristics of heavy-duty construction equipment are additionally typified by short periods of full-power operation followed by extended periods of operation at lower power, idling, or powered-off conditions. A majority of large equipment used would involve operation of all-terrain heavy-duty diesel equipment.

Construction equipment would vary day-to-day depending on the project phase and the activities occurring, but would be limited to daytime hours (between 7:00 a.m. and 7:00 p.m. on weekdays and between 8:00 a.m. and 8:00 p.m. on weekends) as allowed by City of Davis Municipal Code 24.02.040 (b). Typical construction activities would include demolition and removal of existing pavement and structures, grubbing/clearing of on-site areas, excavation and relocation of soil/rock on the site, backfilling and compaction of soils, construction of utilities (i.e., potable and non-potable water conveyance, wastewater conveyance, storm water drainage facilities, and electrical and natural gas infrastructure), and construction of proposed buildings, solar panels, and roadways. Typical noise levels generated by various types of construction equipment likely to be used are identified in Table 4.11-8.

**Table 4.11-8 Noise Levels from Typical Construction Equipment**

| Equipment Type | Noise Level (dBA $L_{max}$) @ 50 feet |
|---|---|
| Aerial Lifts | 85 |
| Air Compressors | 80 |
| Concrete Saws | 90 |
| Cranes | 85 |
| Excavators | 85 |
| Generator Sets | 82 |
| Graders | 85 |
| Pavers | 85 |
| Plate Compactors | 80 |
| Pumps | 77 |
| Rollers | 85 |
| Dozers | 85 |
| Scrapers | 85 |
| Tractors/Loaders/Backhoes | 80–84 |
| Trucks | 74–88 |

Notes: Assumes all equipment is fitted with a properly maintained and operational noise control device, per manufacturer specifications. Noise levels listed are manufacture-specified noise levels for each piece of heavy construction equipment.

Source: FTA 2006: Table 1

As shown in Table 4.11-9, typical on-site construction-related activities could reach noise levels of 90 dBA $L_{eq}$ and 95 dBA $L_{max}$ at 50 feet from the acoustical center of the construction site. Acoustical center is approximated as the geometric centroid of the project site. These noise levels assume that one of each type of construction equipment in Table 4.11-8 is being operated in the same day. Assuming no barriers, construction noise levels could reach noise levels of between 64 dBA $L_{eq}$ and 68 dBA $L_{max}$ at the closest point along the project boundary to the project acoustical center, 375 feet away. The closest residential receptors to the project site are part of Solano Park Apartments, approximately 500 feet from the project center and 170 feet from the northwestern project boundary. These residences could experience noise levels between 67 dBA $L_{eq}$ and 72 dBA $L_{max}$, during construction.

**Table 4.11-9 Levels of Noise Exposure at Nearby Noise-Sensitive Receptors during Nishi-Gateway Project Construction**

| Location of Noise-Sensitive Receptor | Maximum Noise Level (dBA $L_{max}$)[2] | Distance from Acoustical Noise Center (ft)[3] | Average Hourly Noise (dBA $L_{eq}$)[1] |
|---|---|---|---|
| On project site | 95 | 50 | 90 |
| Distance at which Section 24.02.040 (b)(2) is exceeded | Not Applicable | 73 | 86 |
| At project boundary | 72 | 375 | 67 |
| Solano Park residences | 68 | 500 | 64 |

Notes: Noise levels reflect the operation of 48 construction equipment pieces and are calculated using methodology from FHWA's Roadway Construction Noise Model (FHWA 2006). See Appendix A for list of equipment assumed. See Appendix A for calculation details.

[1] $L_{eq}$ values reflect average hourly noise levels assuming typical load factors from Table 9.1 of FHWA's Roadway Construction Noise Model (FHWA 2006).

[2] $L_{max}$ values reflect maximum hourly noise levels assuming all equipment are being operated at 100% capacity.

[3] Acoustical center is approximated as the geometric centroid of the area of construction activity.

Source: FTA 2006: Table 1. Adapted by Ascent Environmental in 2015

The UPRR line that runs along the border between the Solano Park residences and Nishi may serve as a physical barrier that would further attenuate construction noise levels experienced by residences at Solano Park during project construction (or operation).The approximately 6-foot-high railroad berm effectively serves as a sound barrier between the Nishi site and the Solano Park Apartments. Additional noise attenuation may be provided by the existing line of trees between the railroad and Solano Park; however, its effect is expected to be marginal because the trees do not fully block the line of sight between the Solano Park residences and the Nishi property.

As noted above, construction noise levels are regulated under the City of Davis Municipal Code 24.02.040 (b). Section 24.02.040 (b) lists special provisions for the operation of construction equipment that would not be subject to the maximum noise limits elsewhere in the municipal code. However, this section of the code stipulates that construction of a project shall not exceed 86 dBA at a project site boundary. Based on the noise measurements collected on the Nishi site (and summarized in Table 4.11-3), the existing daytime noise level at Solano Park residences is 46 dB $L_{eq}$. Construction of the project would result in an increase of 18 dB to 64 dB $L_{eq}$, as shown in Table 4.11-9, at nearby Solano Park residences. While this increase may be noticeable, it would not exceed standards established by the City and is not considered substantial.

However, construction activities, especially during Phase 2 of construction, would occur in proximity to on-site residences. On-site residents may experience exterior noise levels of up to 95 dB, as shown in Table 4.11-9, or greater depending on the relative location of construction equipment to the residences. At these levels, on-site residents would experience periodic disruption of their day-to-day activities, depending on on-site construction activities. The loudest construction noise would most likely occur during grading and paving phases when excavators, graders, pavers, and rollers may be used. Although construction activities, as limited by Section 24.02.040 (b), would only take place during daytime hours, they may still disrupt daytime activities such as studying or caring for young children. See Appendix G for calculation details.

*Although construction of the project would only occur during daytime hours and would result in noise levels below 86 dBA at the project boundary, consistent with Davis Municipal Code 24.02.040 (b), the project would result in a clearly noticeable increase in ambient noise at nearby on-site sensitive receptors. This impact would be* ***significant***

## Mitigation Measures

**Mitigation Measure 4.11-1:** The City shall require the applicant to implement the following noise reduction measures during project construction as directed by the City:

- All construction equipment and equipment staging areas shall be located as far as possible from nearby noise-sensitive land uses, and/or located such that existing or constructed topography blocks line-of-site between affected noise-sensitive land uses and construction staging areas.

- All construction equipment shall be properly maintained and equipped with noise-reduction intake and exhaust mufflers and engine shrouds, in accordance with manufacturer recommendations. Equipment engine shrouds shall be closed during equipment operation.

- Individual operations and techniques shall be replaced with quieter procedures (e.g., using welding instead of riveting, mixing concrete off-site instead of on-site) where feasible and consistent with building codes and other applicable laws and regulations.

- All construction equipment with back-up alarms shall be equipped with either audible self-adjusting backup alarms or alarms that only sound when an object is detected. The self-adjusting backup alarms shall automatically adjust to 5 dBA over the surrounding background levels. All non-self-adjusting backup alarms shall be set to the lowest setting required to be audible above the surrounding noise levels. In addition to the use of backup alarms, the construction contractor shall consider other techniques such as observers and the scheduling of construction activities so that alarm noise is minimized.

- The applicant or construction contractors shall post visible signs along the perimeter of the construction site that disclose construction times and duration. A contact number for a City of Davis enforcement officer shall be included where noise complaints can be filed and recorded. The applicant will be informed of any noise complaints and responsible for investigating complaints and implementing feasible and appropriate measures to reduce noise levels at receiving land uses. Such measures may include but are not limited to:

  - Noise-reducing enclosures and techniques shall be used around stationary noise-generating equipment (e.g., concrete mixers, generators, compressors).

  - Install temporary noise curtains that meet the following parameters:

    - temporary noise curtains shall be installed as close as possible to the boundary of the construction site within the direct line of sight path of the nearby sensitive receptor(s).

    - temporary noise curtains shall consist of durable, flexible composite material featuring a noise barrier layer bounded to sound-absorptive material on one side. The noise barrier layer shall consist of rugged, impervious, material with a surface weight of at least one pound per square foot.

**Significance after Mitigation**

Implementation of Mitigation Measure 4.11-1 would reduce construction noise for the entire construction area. However, as on-site receptors may be elevated above construction activities on the project site, the efficacy of on-site noise barriers may be reduced. As the efficacy of Mitigation Measure 4.11-1 cannot be

quantified, it is undetermined as to how much construction noise levels could be reduced at on-site residences during Phase 2 of construction. This impact would be **significant and unavoidable**.

*West Olive Drive*

Demolition of existing building and construction of new facilities within the West Olive Drive redevelopment area would comply with City noise policies and would likely be intermittent, be market driven, and would not likely to occur all at once. As a result, construction associated with on-site redevelopment would not be considered substantial, and this impact would be **less than significant.**

The potential redevelopment of uses within West Olive Drive may result in various construction activities with a potential net increase of approximately 55,000 sf of mixed use commercial space. Redevelopment would involve demolition of existing buildings and construction of new buildings and facilities or the rebuilding or remodeling of existing structures. Demolition may involve the use of short-term, high-impact demolition activities such as bulldozing and material handling. Construction on these parcels may occur at different times and the timing of which cannot be predicted. The timing of these construction and redevelopment would likely be driven by market conditions. These activities and their resulting noise impacts would occur within the limits defined by Davis Municipal Code 24.02.040 (b) and Davis General Plan Policy Noise 1.1 Action m.

Construction noise levels are regulated under the City of Davis Municipal Code 24.02.040 (b). Section 24.02.040 (b) lists special provisions for the operation of construction equipment that would not be subject to the maximum noise limits elsewhere in the municipal code. Per these exemptions, the City allows construction if it meets at least one of the noise limitations listed in 24.02.040 (b)(1) through (7). Consistent with the noise limitation describe in 24.02.040 (b)(4), construction of this project would be located more than 200 feet from existing single family homes. As redevelopment would comply with the conditions of the City's Noise Ordinance and would not generate noise levels in excess of 86 dBA at nearby receptors, construction noise would not be considered substantial.

*As construction activities within West Olive Drive would be conducted in accordance with the City's Noise Ordinance and would not result in noise levels in excess of 86 dBA at nearby sensitive receptors, this impact would be* ***less than significant***

### Mitigation Measures

No mitigation measures are required.

## Impact 4.11-2: Generate short-term, construction-related vibration effects on nearby sensitive land uses.

*Nishi Site*

Site preparation and grading activities would likely require the use of construction equipment that would generate ground vibration. However, based on the anticipated equipment for construction of the project and the distance to nearby sensitive land uses, potential impacts to off-site existing residences or on-site proposed residences in use during construction would not be substantial. This impact would be **less than significant**.

Construction activities generate varying degrees of temporary ground vibration, depending on the specific construction equipment used and activities involved. Ground vibration generated by construction equipment spreads through the ground and diminishes in magnitude with increases in distance. Construction-related ground vibration is normally associated with impact equipment such as pile drivers, jackhammers, and the operation of some heavy-duty construction equipment, such as bulldozers and trucks. Blasting activities also generate relatively high levels of ground vibration. The effects of ground vibration may be imperceptible at

the lowest levels, result in low rumbling sounds and detectable vibrations at moderate levels, and high levels of vibration can cause sleep disturbance in places where people normally sleep or annoyance in buildings that are primarily used for daytime functions.

As described above (see Impact 4.11-1), development of the project would include construction activities that require the use of various types of equipment. Construction of the project may result in varying degrees of temporary ground vibration and noise, depending on the specific construction equipment used and activities involved. As shown in Table 4.11-10, pile driving and blasting are the typical construction activities that generate the greatest ground vibration. Pile driving and blasting are not proposed and therefore the maximum ground vibration and noise levels would be associated with the use of dozers during site preparation and grading activities.

**Table 4.11-10 Representative Ground Vibration and Noise Levels for Construction Equipment**

| Equipment | PPV at 25 feet (in/sec)[1] | Approximate $L_v$ (VdB) at 25 feet[2] |
|---|---|---|
| Impact Pile Driver | 1.518 | 112 |
| Blasting | 1.13 | 109 |
| Sonic Pile Driver | 0.734 | 104 |
| Large Dozer | 0.089 | 87 |
| Caisson Drilling | 0.089 | 87 |
| Loaded Trucks | 0.076 | 86 |
| Rock Breaker | 0.059 | 83 |
| Jackhammer | 0.035 | 79 |
| Small Dozer | 0.003 | 58 |

PPV = peak particle velocity; $L_V$ = the root mean square velocity expressed in vibration decibels (VdB), assuming a crest factor of 4

Source: FTA 2006

According to FTA, vibration levels associated with a dozer are 0.089 in/sec PPV and 87 Vdb at 25 feet. The use of a large dozer would not exceed the Caltrans recommended level of 0.2 in/sec PPV with respect to structural damage as the noted vibration level at 25 feet is substantially below 0.2 in/sec PPV. With respect to human disturbance, the use of a large dozer would exceed the FTA maximum acceptable level of 80 VdB within 40 feet of dozing activity. Grading activities would not occur this close to existing structures. Although on-site residences occupied after the completion of Phase 1 may be exposed to continued construction activities for another two to three years after moving in, grading and site preparation activities for the entire site would have already been completed before the construction of the first set of residential land uses under Phase 1.

*Therefore, construction associated with development of the Nishi site would not result in the exposure of any sensitive receptors or structure to excessive vibration levels. This impact would be* ***less than significant****.*

### Mitigation Measures

No mitigation measures are required.

#### *West Olive Drive*

Potential redevelopment of West Olive Drive may require the use of construction equipment that may generate limited vibration. However, construction activities are not anticipated to result in substantial vibration such that damage to existing structures may occur. Impacts would be **less than significant**.

Redevelopment within West Olive Drive may include the use of various construction equipment, similar to the anticipated equipment associated with Nishi site development. Similar to the evaluation of the Nishi site above, pile-driving and blasting are not anticipated. As noted above, the use of a large dozer would not exceed the Caltrans recommended level of 0.2 in/sec PPV with respect to structural damage as the reference level at 25 feet is substantially below 0.2 in/sec PPV. With respect to human disturbance, the use of a large dozer would exceed the FTA maximum acceptable level of 80 VdB within 40 feet of dozing activity, however, no residential receptors are or would be located within 40 feet of West Olive Drive. Further, based on the existing uses within West Olive Drive, any perceived vibration would likely be similar to existing auto-related operations currently occurring within this portion of the project site. As construction activities are not anticipated to occur within 25 feet of existing structures, construction vibration associated with redevelopment of West Olive Drive is not anticipated to be substantial.

*Construction activities that may occur within West Olive Drive would not result in the exposure of any sensitive receptors or structures to excessive vibration levels. This impact would be* ***less than significant****.*

### Mitigation Measures

No mitigation measures are required.

## Impact 4.11-3: Exposure of existing sensitive receptors to operational project-generated stationary noise.

*Nishi Site*

Development of the Nishi site would result in the operation of various new stationary noise sources (e.g., mechanical HVAC equipment, emergency electrical generators, parking lots, and noise from outdoor activity areas). Specific locations for these noise sources are not known at this time. Thus, considering the proposed high density of land development in close proximity to existing sensitive receptors (e.g., the existing Solano Park Apartments), it is possible that new proposed HVAC units and emergency generators could create a noticeable increase from existing noise levels. Consequently, a substantial permanent increase in ambient noise levels (i.e., 5 dB) could occur. This would be a **significant** impact.

This impact assesses the long-term exposure of existing sensitive receptors to increased operational-source noise levels from proposed land use development. This impact analysis evaluates non-transportation noise sources that would occur as a result of project operation. Transportation generated noise is addressed separately below in the discussion of Impact 4.11-5. For purposes of this analysis, all noise sources considered here are evaluated against the City of Davis noise limits for noise exposure to sensitive receptors as defined above and summarized below for residential and commercial land uses.

- Residential
  - Daytime (i.e., 7:00 a.m. to 9:00 p.m.) noise standards of 55 dBA $L_{eq.}$
  - Nighttime (i.e., 9:00 p.m. to 7:00 a.m.) noise standards of 50 dBA $L_{eq.}$

- Commercial
  - Daytime (i.e., 7:00 a.m. to 10:00 p.m.) noise standards of 60 dBA $L_{eq.}$
  - Nighttime (i.e., 10:00 p.m. to 7:00 a.m.) noise standards of 55 dBA $L_{eq.}$

In addition, although air conditioners and similar equipment as well as emergency operations are exempt from the City's noise limit standards (Section 24.02.040 of the Davis City Code), actual impact on sensitive receptors are still discussed below.

The project would result in the development of various land uses (e.g., residential, commercial, and retail). Noise sources associated with these land uses include Heating Ventilation and Air Conditioning (HVAC) units, back-up emergency generators, vehicular and human activity in parking lots, and activities at outdoor

recreational land uses. Noise from each of these sources is discussed separately. For details on noise propagation calculations and noise level estimates for this impact discussion, refer to Appendix G.

**Mechanical HVAC Equipment**

HVAC equipment could be a primary noise source associated with new residential, commercial, and retail land uses. The noise sources could take the form of fans, pumps, air compressors, chillers, or cooling towers. Noise levels from HVAC equipment vary substantially depending on unit efficiency, size, and location, but generally range from 45 to 70 dB $L_{eq}$ at a distance of 50 feet (EPA 1971). Although the operation of air conditioning equipment is exempt from the noise standards outlined in the City's Ordinance (Section 24.02.040 (c) of the Davis City Code), operation of such equipment could result in noticeable increases from existing noise levels (beyond a 3 dB increase).

Specific location of new HVAC units on the proposed structures is not known at this time. Assuming HVAC equipment are located at ground-level on the northwestern edge of proposed residential buildings approximately 300 feet from the nearest existing sensitive receptors to the project site (e.g., Solano Park Apartments), noise levels from HVAC equipment at Solano Park could be between 24 and 49 dB $L_{eq}$. Given that existing noise levels at Solano Park Apartments are 46 dB $L_{eq}$, a potential increase in 3 dB may be noticeable in outdoor areas in Solano Park (See Measurement Location 3 in Table 4.11-3). In spite of this potential increase, improvements in HVAC efficiency since the release of the EPA reference noise levels and the physical berm created by the existing rail line that separates the Nishi site from Solano Park would likely result in actual noise levels that are less than anticipated.

However, if HVAC units are placed on roofs of the proposed residential land uses, which are designed to be 4 to 5 stories high, noise levels may reach as high as 52 dB $L_{eq}$. This would be a noticeable increase from existing noise levels at Solano Park (greater than 5 dB), especially without attenuation barriers blocking the line of sight between receptors and an HVAC system situated 50 feet above receptors. Because specific location of new HVAC units are still undetermined, noise levels from operation of HVAC units on the Nishi site could potentially have a significant impact on existing sensitive receptors.

**Emergency Electrical Generators**

Emergency generators may be used to supply necessary power requirements to vital systems within facilities constructed on the commercial and mixed-use land uses. Emergency generators are typically operated under two conditions: loss of main electrical supply or preventive maintenance/testing. Although the operation of mechanical equipment associated with emergency operations is exempt from the noise standards outlined in the City's Ordinance (Section 24.02.040 (f) of the Davis City Code), operation of such equipment could result in noticeable increases from existing noise levels (beyond a 3 dB increase).

Reference noise-level measurements of emergency generators with rated power outputs from 50 to 125 kilowatts (kw) result in noise levels ranging from 61 to 73 dB $L_{eq}$ and 63 to 84 dB $L_{max}$ at a distance of 45 feet (EPA 1971, FHWA 2006). Assuming the higher, more conservative value of these reference noise levels, emergency electrical generators could increase existing noise levels at the nearest sensitive receptors 300 feet from the closest planned building on the Nishi site from 46 dB $L_{eq}$ to 62 dB $L_{eq}$ Although this increase in noise levels could be noticeable, the increase would be temporary and last only as long as needed during emergency scenarios.

Although specific location of stationary equipment such as emergency electrical generators is not known at this time, considering the density of development and proximity to existing sensitive receptors, it is possible that new emergency electrical generators could be located within 300 feet of existing sensitive receptors and result in a noticeable increase in ambient noise levels at those receptors.

**Parking Lot Activities**

The project would result in new at-grade and podium parking beneath and alongside the residential, a new large parking structure on the southeastern side of the site attached to a proposed commercial building, and smaller miscellaneous surface lots throughout the site to serve recreational access and other commercial facilities.

Noise levels from parking lots can vary depending on the number of vehicles at any given time in the parking lot, the speed at which vehicles are traveling, and the types of vehicles present. Typical noise sources include car engines running/idling, doors slamming, car alarms going off, cars honking, and people talking.

Closest to the existing sensitive receptors as Solano Park, current site plans show at-grade parking lots located between the existing UPRR line and planned residential land uses. According to a previous analysis done for a similar residential and commercial development, noises from typical noise levels from parking lot activities could reach 59.8 $L_{eq}$ and 78.1 $L_{max}$ at 15 feet from the noise source (i.e., car slamming door). This reference noise level would be applicable to the proposed parking lots because it represents similar parking lot type, activities, and vehicle types that would result from construction of the project. Based this reference noise level, noise from at-grade parking lots could exceed the City's daytime and nighttime noise standards within 170 feet of proposed parking lots.

With regards to the proposed structure and podium parking, noise exposure to off-site sensitive receptors would be essentially nonexistent as these parking facilities would be enclosed as part of building podiums and structure. This topic is not addressed further in this analysis, which focusses on new surface lots close to existing receptors.

Although the nearest sensitive receptors could be exposed to parking lot noise from the Nishi site, exceeding City standards, the southeastern edge of Solano Park is already occupied by an existing active parking lot that would exhibit similar types and levels of noise. Thus, noise levels from parking activity that would result from the Nishi development would not have a significant impact on nearby existing sensitive receptors.

#### Research and Development Activities

Proposed on-site commercial land uses also include facilities that may support future R&D activities. Noise levels from these activities would vary depending on the type of research, equipment, and other activities. Although any noises would likely be contained indoors, noise generated by research and development facilities have the potential to significantly increase existing noise levels at nearby sensitive receptors.

#### Outdoor Activity Areas

The proposed development would include several acres of open space and parkland located at the northern and southern ends of the site. Typical noise sources from this type of land use include people talking and congregating, casual sport activities, and children playing. These types of activities currently take place at the existing Solano Park Apartments and along the Arboretum. The proposed outdoor land uses are designed to be used for frequent large gatherings involving amplified sound. Noise generated by outdoor activities would be minimal and intermittent and are not anticipated to significantly increase existing noise levels.

*As discussed above, development of the project would result in the operation of various new stationary noise sources (e.g., mechanical HVAC equipment, emergency electrical generators, parking lots, and noise from outdoor activity areas). Specific locations for these noise sources are not known at this time. Thus, considering the proposed high density of land development in close proximity to existing sensitive receptors (e.g., the existing Solano Park Apartments), it is possible that new proposed HVAC units and emergency generators could create a noticeable increase from existing noise levels. Consequently, a substantial permanent increase in ambient noise levels (i.e., 5 dB) could occur. This would be a* ***significant*** *impact.*

## Mitigation Measures

**Mitigation Measure 4.11-3:** The project applicant shall implement the following measures to reduce the effect of noise levels generated by on-site stationary noise sources:

- All electrical generators shall be equipped with noise control (e.g., muffler) devices in accordance with manufacturers' specifications.

- External mechanical equipment, including HVAC units, associated with buildings shall incorporate features designed to reduce noise emissions below the stationary noise source criteria. These features may include, but are not limited to, locating equipment within equipment rooms or enclosures that incorporate noise reduction features, such as acoustical louvers, and exhaust and intake silencers. Equipment enclosures shall be oriented so that major openings (i.e., intake louvers, exhaust) are directed away from nearby noise-sensitive receptors.

- Should R&D tenants require outdoor testing/activities, tenants shall submit exterior noise estimates for long-term and short-term research and development activities to the City for review and approval prior to implementation. Exterior noise levels shall be estimated for receptor distances equivalent to distances from on-site and off-site residential land uses and shall demonstrate compliance with City of Davis noise limits, as applicable.

**Significance after Mitigation**

Implementation of Mitigation Measure 4.11-3 would require that all stationary noise sources are oriented, located, and designed in such a way that reduces noise exposure to ensure that stationary noise sources would comply with City noise standards for sensitive receptors and limit increases to existing noise levels to below significant levels (less than 5 dB increase), reducing this impact to a **less-than-significant** level.

*West Olive Drive*

Unless future redevelopment would result in a three-fold increase or more from existing stationary noise sources (e.g. tripling the number of current HVAC systems), the increase in stationary noise levels would be barely discernable at the closest sensitive receptors. As a result, this impact is considered **less than significant**.

Potential redevelopment of uses within West Olive Drive could result in the operation of new or additional stationary noise sources (e.g. mechanical HVAC equipment, emergency electrical generators, and parking lots). Specific locations for these new or additional noise sources are not known at this time. The closest sensitive receptors to the West Olive Drive redevelopment area are approximately 350 feet north of the redevelopment (e.g., Aggie Village Cottages).

Current activities along West Olive Drive already include operation of HVAC equipment, parking lots, and delivery/loading activity. Redevelopment could increase the intensity of these land uses and may require larger HVAC equipment or even result in the construction of parking structures to accommodate serving a growing population. These activities would be limited by the footprint of the West Olive Drive redevelopment area. As discussed under Environmental Settings above, a doubling in sound energy would correspond to an increase in 3-dB and a tripling in sound energy would correspond with a 5-dB increase, which is a generally perceived as a distinctly noticeable increase.

*Thus, unless future redevelopment would result in a three-fold increase or more from existing stationary noise sources (e.g. tripling the number of current HVAC systems), the increase in stationary noise levels would be barely discernable at the closest sensitive receptors. Therefore, this impact is considered **less than significant**.*

## Mitigation Measures

No mitigation measures are required.

## Impact 4.11-4: Exposure of proposed sensitive receptors to operational project-generated stationary noise sources.

*Nishi Site*

The proposed development of the Nishi site would include commercial and residential mixed-use land uses including new sensitive receptors (e.g., residential uses). Proposed residential uses (i.e. sensitive receptors) could be located in close proximity to new, on-site, stationary noise sources (e.g., HVAC units, electrical generators, outdoor activity areas, and parking lots), which could expose these receptors to noise in excess of allowable noise levels. This impact would be **potentially significant**.

The proposed development would result in the construction and operation of mixed-use residential, R&D, and retail commercial land uses, with additional recreational areas and parking facilities. As discussed in Impact 4.11-3, the project would include various stationary noise sources such as HVAC units, emergency generators and equipment, noise from parking lots/structures, and noise from outdoor activities. As mentioned, noise from HVAC equipment generally ranges from 45 to 70 dB $L_{eq}$ at a distance of 50 feet, emergency generators range from 61 to 73 dB $L_{eq}$ and 63–84 dB $L_{max}$ at a distance of 45 feet, and parking lot activities could reach 59.8 $L_{eq}$ and 78.1 $L_{max}$ at 15 feet. Noise from outdoor activities is expected to be minimal.

The proposed residential uses could potentially be located in close proximity to the stationary noise sources described above and could experience noise levels in excess of aforementioned City standards.

Further, due to the nature of the proposed mixed-use development, there would be various portions of the site where sensitive receptors would be located in close proximity, adjacent to, or directly above first floor commercial or entertainment uses (e.g., bars, restaurants) that could result in various noise levels during the night when these types of uses are typically the busiest. Considering that many of these types of events operate past 9:00 p.m., noise generated at these bottom level uses could result in exceedances of the City's night time noise standards in the nearby residential uses.

*Due to the potential for proposed sensitive land uses to be exposed to noise levels from stationary sources that could disturb residents and exceed City of Davis noise standards. This impact would be considered* ***potentially significant****.*

### Mitigation Measures

Implement Mitigation Measure 4.11-3 (Reduce On-site Stationary Noise Sources).

**Significance After Mitigation**

Implementation of Mitigation Measure 4.11-3 would limit noise generation from stationary sources, reduce outdoor ambient noise levels, and limit activities to the less sensitive times of the day such that people would be less likely to be disturbed while sleeping. Implementation of this mitigation would reduce this impact to a **less-than-significant** level.

*West Olive Drive*

Potential redevelopment within West Olive Drive is not currently anticipated to include residential uses, and as a result, potential exposure of new residential uses to stationary source noise within West Olive Drive would not occur. There would be **no impact.**

Potential redevelopment of West Olive Drive would be primarily mixed use commercial and residential uses are not currently anticipated. As a result, the potential for project implementation to affect new sensitive receptors (i.e. residential uses) within West Olive Drive would not occur.

*As no residential uses are proposed within West Olive Drive, potential stationary source noise associated with redeveloped uses would not expose on-site sensitive receptors to substantial noise. **No impact** would occur.*

### Mitigation Measures

No mitigation measures are required.

## Impact 4.11-5: Exposure of proposed and existing sensitive receptors to transportation noise sources.

*Nishi Site*

Development of the Nishi site would result in increased traffic volumes along affected roadways and would increase roadway noise levels in the vicinity of the project site. Additionally, the proposed on-site residential and R&D structures would act as both receptors and barriers or reflectors of transportation noise sources. Existing receptors could experience louder train warning horn and pass-by events due to reflection from proposed Nishi residential buildings. Proposed sensitive receptors at the planned residential land uses would be exposed to exterior traffic noise levels that are conditionally acceptable under the City's noise standards, but could also be exposed to significant noise events (i.e. horn blasts) from passing trains that could disturb sleep. Commercial land uses along I-80 would also experience noise levels that would be normally unacceptable under the City's noise standards. Because transportation noise could cause noise disturbances to both new and existing receptors, this impact is considered **significant**.

Development of the Nishi site would increase traffic volumes along affected roadway segments and potentially generate an increase in traffic source noise levels. Construction of the Nishi development would also place new noise-sensitive receptors as close as 300 feet from I-80 and as close as 120 feet from the UPRR line. In addition, two access alternatives are currently being considered in terms of connection of on-site roadways to adjacent off-site roads: Access Scenarios 1 and 2, described further in the project description. Access Scenario 2 has the potential to concentrate additional vehicle trips along Richards Boulevard as compared to Access Scenario 1. The noise levels associated with the operation of these noise-generating activities and how they affect both new and existing sensitive receptors are described separately below.

Generally, a doubling of a noise source (such as twice as much traffic) is required to result in an increase of 3 dB, which is perceived as barely noticeable by people (Egan 2007, p. 21). As mentioned above, a 5-dB increase in a noise sources is considered a substantial noise increase. Thus, in regards to traffic noise specifically, an increase in 5 dB or more in traffic noise would be considered substantial. To assess this impact, traffic noise levels associated with the proposed development under existing and existing plus project conditions were predicted for affected roadway segments. For further details on traffic counts and conditions, see Section 4.14, "Transportation and Circulation."

#### Impacts on Existing Sensitive Receptors

##### Traffic Noise from Roadways

Table 4.11-11 summarizes the average annual daily traffic calculated based on peak hour traffic for selected roadways that would be most affected by the project.

As shown in Table 4.11-11, under both Access scenarios, the additional traffic generated by the project would increase existing roadway volumes by a maximum of 6 percent. With no potential to double traffic volumes on affected roadways, the proposed Nishi development would not generate a perceptible increase in traffic noise levels at existing receptors along roadways affected by operation of the Nishi development. Due to the additional arterial that Access Scenario 1 would create for vehicles, the development is even anticipated to reduce traffic volumes. Thus, increases in roadway noise levels generated by the proposed development would not be discernable by existing sensitive receptors.

**Table 4.11-11 Summary of Average Annual Daily Traffic under Existing and Existing Plus Project Conditions by Access Scenario**

| Roadway Segment/Segment Description | AADT | | Percent Change from Existing |
|---|---|---|---|
| | Existing Conditions | Existing (Plus Project) Conditions | |
| Access Scenario 1[1] | | | |
| Old Davis Road, between I-80 and Hutchinson Drive | 7,105 | 7,421 | 4% |
| Richards Blvd, East of Research Park Drive | 10,526 | 8,632 | -18% |
| I-80, Between Old Davis Road and Mace Boulevard | 96,737 | 96,842 | <1% |
| 1st Street, East of D Street | 13,158 | 11,789 | -10% |
| Access Scenario 2[2] | | | |
| Old Davis Road, between I-80 and Hutchinson Drive | 7,105 | 7,526 | 6% |
| Richards Blvd, East of Research Park Drive | 10,526 | 9,684 | -8% |
| I-80, Between Old Davis Road and Mace Boulevard | 96,737 | 98,421 | 2% |
| 1st Street, East of D Street | 13,158 | 12,842 | -2% |

Notes: AADT = Average Annual Daily Traffic. Estimates are based off of peak hour traffic volumes, based on roadway segment traffic volume estimates provided by Fehr and Peers.

The percent change may not be exact due to rounding.

[1] Access Scenario 1 has two vehicle project access points via (1) an extension to the existing West Olive Drive and (2) a new connection to Old Davis Road on the UC Davis campus, via a new underpass under the UPRR line.

[2] Access Scenario 1 has one vehicle project access point via an extension to the existing West Olive.

Refer to Section 4.14, "Transportation and Circulation" and Appendix G for detailed traffic data, and traffic-noise modeling input data and output results.

Source: Data modeled by Ascent Environmental, Inc. in 2014 based on data from Fehr and Peers 2015.

#### Passing Trains and Train Warning Horn Events

Discussed further below, the UPRR line separating the Nishi site and Solano Park apartments carries over 60 passing trains per day. These trains are required to sound warning horns in advance of an unsignalized crossing at the northern end of the Nishi site. Planned residential multifamily buildings on the Nishi site are oriented and shaped in such a way that buildings could act as a reflector or amplify train horn blasts towards sensitive receptors northwest of the Nishi site, such as the Solano Park Apartments and guests staying at the Hyatt Place UC Davis. In addition, the planned residential buildings would be up to 5 stories high which, while creating a sound barrier for the southeastern side of the Nishi site, would also reflect and amplify train horn events from passing trains towards Solano Park Apartments. According to Caltrans' Technical Noise Supplement, and infinite line-source and noise barrier would result in amplified noise levels from the line sources that increase with distance (Caltrans 2013a:5-29 – 5-32). For example, barrier reflections for a typical eight-lane freeway would increase roadway noise levels by 1.3 dBA at 50 feet, 2.0 dBA at 200 feet, and 2.4 dBA at 400 feet.

### Impacts on New Sensitive Receptors

#### Traffic Noise from Roadways Surrounding Nishi and on the Nishi Site

Roadway traffic noise sources that would affect new sensitive receptors on the Nishi site include traffic along I-80, Old Davis Road, and the planned arterial running through the Nishi site. Traffic on I-80 is the predominant sources of noise at the project site. Analyzing a worst-case scenario, traffic volumes on the segment of I-80 that passes by the project site are expected to increase over time from an average annual daily traffic (AADT) volume of approximately 97,000 vehicles per day to an AADT of approximately 147,000 vehicles per day under cumulative-plus-project conditions to accommodate regional travel demand, as estimated by the transportation analysis prepared for the project (Fehr & Peers 2015). Traffic noise levels under cumulative-plus-project conditions were estimated in accordance with the U.S. Department of

Transportation Federal Highway Administration (FHWA) Traffic Noise Model (FHWA 2006) and are summarized in Table 4.11-12 below for Access Scenario 2. Access Scenario 2 was chosen for analysis because it has a higher estimated AADT on I-80 than Access Scenario 1 and would provide a worst-case scenario.

**Table 4.11-12 Summary of Future Traffic Noise Levels with the Project along Interstate 80 between Old Davis Road and Richards Boulevard (without any intervening barriers)**

| Land Use Type and Distance from Roadway Edge (feet) | Cumulative-Plus-Project | |
|---|---|---|
| | AADT (Access 2) | CNEL/$L_{dn}$ (dB) |
| Residential Building 300 feet from edge of I-80 | 147,444 | 72.4 |
| Community Gardens 350 feet from edge of I-80 | | 72.0 |
| Research & Development Building at 100 feet from edge of I-80 | | 79.8 |

Notes: CNEL = Community Noise Equivalent Level; dB = A-weighted decibels; $L_{dn}$ = day-night average noise level.

Refer to Appendix H for detailed modeling input data and output results.

Source: Data modeled by Ascent Environmental in 2015, based on traffic volumes from Fehr & Peers

In regards to new residential land uses, as shown in Table 4.11-12, cumulative future I-80 traffic noise levels would attenuate to approximately 72.4 dB CNEL at the nearest outdoor activity area of a residential building[1] based on distance alone. Cumulative noise levels represent the highest potential noise levels that may occur at the project site; because mitigation typically requires construction measures (window treatments, noise barriers, etc.), it is important to evaluate the full potential for noise impact and mitigation requirements in the project analysis. The intervening 3-story-tall research and development (R&D) buildings are anticipated to provide a minimum reduction of 3 dB according to Caltrans guidance (Caltrans 2013a:2-35). Additional noise reduction in the outdoor recreation areas would result from the fact that the residential buildings would be situated between the outdoor residential areas and I-80. According to FHWA guidance regarding sound barrier design, a sound barrier that is just tall enough to block the line of sight between a noise source and receptor provides a reduction of 5 dB plus an additional reduction of 1 dB for every 2 feet higher than the line of sight (FHWA 2010:56). Assuming that the R&D buildings are able to attenuate 5 dB, traffic noise level experienced at residences could be reduced to 67.4 dB CNEL.

In addition, new planned residences along the southwestern end of the Nishi site would be located approximately 200 feet from the nearest existing roadway, Old Davis Road. Under Access Scenario 2 cumulative-plus-project conditions, traffic levels are estimated to reach 14,158 AADT. Assuming vehicles are travelling 25 mph, residences within 298 feet of Old Davis Road would experience noise levels exceeding 50 dB (See Appendix G). In addition, the anticipated traffic volumes along the planned on-site arterial are not definitively known, but are anticipated to be similar to Old Davis Road traffic volume levels. However, due to the anticipated traffic volumes, noise levels from Old Davis Road and on-site arterials would be minimal (approximately 1 percent of I-80 traffic) compared to the effect of I-80 traffic.

As mentioned previously, I-80 traffic could generate 67.4 dB CNEL at planned residences. The City considers this noise level as a "conditionally acceptable" community noise exposure level, as shown in Table 4.11-6. This means that the City would accept this exposure level and allow construction of new residences only after a detailed analysis of the noise reduction requirements is conducted, and necessary noise attenuation features are included in the construction or development. With respect to interior noise standards, the new buildings could provide an exterior-to-interior noise reduction of 25 to 30 dBA, which is the range typical of masonry-constructed buildings (Caltrans 2013a:7-17). Thus, interior noise levels could be reduced to 37.5 to 42.5 dBA, which would be below the City of Davis' standard for residential interior noise. However, specific designs of building walls for the proposed structures have not been determined yet.

[1] Refers to a garden area located on the eastern side of the second from the north-most residential building, according to Figure 3-3.

New commercial land uses would experience traffic noise levels from I-80 and be located as close as 100 feet from the I-80 fence line. At this distance the nearest edge of the building would be exposed to a noise level of 79.8 dBA CNEL. The City considers this exterior noise level at proposed commercial buildings to be "normally unacceptable" under the City's noise standards, as shown in Table 4.11-6. The City discourages new construction exposed to these levels, but allows development provided a detailed analysis of the noise reduction requirements are conducted and necessary noise attenuation features are included in the construction or development of the planned commercial land uses. It is assumed that these buildings would also provide an exterior-to-interior noise reduction of 25 to 30 dBA typical of masonry-constructed buildings (Caltrans 2013a:7-17), and; therefore, interior noise levels at the commercial land uses would range from 49.8 to 54.8 dB CNEL. Thus, the interior noise levels of the R&D buildings would not exceed the City's 55 dB CNEL standard for interior noise exposure it established for office buildings.

#### Passing Trains and Train Warning Horn Events

In addition to increases in average daily traffic noise, intermittent single-event noise levels (SELs) and increases in the frequency of occurrence of such levels is also of concern, particularly during the more noise-sensitive nighttime hours. Although the average daily noise descriptors (i.e., $L_{dn}$ and CNEL) incorporate a nighttime weighting or "penalty" that is intended to reflect the expected increased sensitivity to noise at night, $L_{dn}$ and CNEL standards do not fully protect residents from sleep disturbance. The SEL describes a receiver's cumulative noise exposure from a single impulsive noise event (e.g., train warning horn, passing train), which is a rating of a discrete noise event that compresses the total sound energy of the event into a 1-second time period, measured in decibels (Caltrans 2011). These noise events can be more startling to receptors if they occur when ambient noise levels are quieter such as during nighttime hours.

Trains running along the UPRR line along the northwestern edge of the Nishi site are also required to produce warning horn blasts between 96 and 110 dB prior to reaching the un-signaled public crossing located at the northern end of the Nishi site, under the federal Train Horn Rule (49 CFR Part 222). Under this rule, locomotive engineers must begin to sound train horns at least 15 seconds, and no more than 20 seconds, in advance of all public at-grade crossings, signalized or not. In addition, eastbound Amtrak passenger trains approaching the Davis Station, located less than half a mile north of the Nishi site, are also known to produce horn blasts in advance of reaching the station. Although train warning horns are intermittent as trains only pass by occasionally, the effect of train horn blasts can increase ambient noise levels within 350 feet of the railroad by between 20 and 40 dB, depending on the level of ambient noise, as shown by measurements taken at Site 1 in Table 4.11-3. Noise levels from warning horns were also shown to increase noise levels up to 91 dB $L_{max}$ at Site 1. Also, the passing of the trains, without sounding of train horns, are also known to produce noise levels of between 75 and 95 dB at receptors 100 feet away, depending on the speed of the locomotive and number of rail cars (FRA 2015).

Approximately 35 freight trains and 31 passenger trains pass along this segment on an average day (Yolo County 2009:HS-40; Amtrak 2015). Approximately four additional freight trains will travel along these tracks per day if the Valero Crude by Rail Project is approved by the City of Benicia (City of Benicia 2014:4.2-32). Passenger trains run between the hours of 4:30am and 9:30pm on weekdays and 9:00am through 12:00am on weekends. Freight trains may run during the day and night.

#### Single Noise Events

Yolo County, Caltrans, the Governor's Office of Research and Planning, and most cities and counties have not established noise level standards for the effects of single-event noise. However, following the court decision in Berkeley Keep Jets Over the Bay Committee v. Board of Port Commissioners of the City of Oakland, 2001 (Berkeley case) there has been increased attention to the evaluation of single-event noise levels and their effects on sleep. Because the Berkeley case involved aircraft, and the action alternatives would involve construction-related haul truck trips, the situations are not entirely the same. Nonetheless, the SELs from train warning horns associated with construction under the action alternatives are evaluated here.

Many studies have been conducted regarding the effects of single-event noise on sleep disturbance, but because of the wide variation in the reaction of test subjects to SELs of various levels no definitive

consensus has been reached with respect to a universal criterion to apply. Upon a review of studies about sleep disturbance and aircraft-generated SELs, the Federal Interagency Committee on Aviation Noise (FICAN) provided estimates of the percentage of people expected to be awakened when exposed to specific SELs inside a home (FICAN 1997). According to the FICAN's review, 10 percent of the population is estimated to be awakened when the SEL interior noise level is 81 dBA. An estimated 5 to 10 percent of the population is affected when the SEL interior noise level is between 65 and 81 dBA, and few sleep awakenings (less than 5 percent) are predicted if the interior SEL is less than 65 dBA. However, FICAN did not recommend a threshold of significance based on the percent of people awakened.

The threshold for sleep disturbance is not absolute because there is a high degree of variability from one person to another. Thus, the means of applying such research to land use decisions is not completely clear. As a result, no government agency has suggested what frequencies of awakenings are acceptable (Caltrans 2011). For these reasons, the Federal Interagency Committee on Noise, the Governor's Office of Research and Planning, and most cities and counties (including Fresno and Madera counties), continue to use $L_{dn}$ or CNEL as the primary tool for the purpose of land use compatibility planning (Caltrans 2011). In fact, the $L_{dn}$ and CNEL represents the cumulative exposure to all single events, that is, the exposure of all SELs taken together, weighed to add penalties for nighttime occurrences, and averaged over a 24-hour period. Thus, it can be argued that the $L_{dn}$ standards established by the City of Davis (shown in Table 4.11-3), already account for the individual impacts associated with the SELs. (Note that CNEL and $L_{dn}$ are often used interchangeably, as there is only a subtle difference in noise level penalties during evening hours used to formulate the two metrics.)

Assuming the average exterior-to-interior noise level reduction of up to 30 dBA provided by masonry-constructed buildings with the windows closed (Caltrans 2011) and using the $L_{max}$ from Site 1 as a reference noise level at 320 feet from the railroad, the maximum SEL in the interior of rooms located closer than 760 feet from a passing train horn would exceed 65 dBA SEL. Because all proposed residential buildings would be located closer than 760 feet to the roadway, these rooms would experience SELs that exceed the threshold of 65 dBA and, therefore, the percentage of people expected to be awakened when inside the affected homes would exceed 5 percent.

Because individual and frequent warning horn soundings would result in clear and substantial periodic increases in ambient noise levels, the potential for adverse public reaction would exist, particularly during nighttime hours. Even with an exterior-to-interior reduction of 30 dB, residents located anywhere on the Nishi site could still be exposed to sudden and substantial increases in ambient noise levels that can disturb sleep.

**Summary**

Development of the Nishi site would result in increased traffic volumes along affected roadways and would increase roadway noise levels in the vicinity of the project site. Additionally, the proposed on-site residential and R&D structures would act as both receptors and barriers or reflectors of transportation noise sources. As discussed above, the anticipated increase in traffic volumes due to the development would be insufficient to cause a discernable increase from existing traffic noise levels at existing receptors. However, the location, height, and orientation of proposed residential building may increase the impact of train horn events on adjacent Solano Park Apartments.

Proposed residential land uses may be exposed to exterior traffic noise levels (67.4 CNEL) that would meet the City's noise standards. Additionally, interior noise levels would not exceed established City noise standards. However, on-site residents would be located adjacent to and exposed to substantial intermittent noise associated with train horn blasts that could cause disturbances during nighttime hours while residents are sleeping.

*Because train-related noise would result in potentially substantial noise levels at proposed new and existing receptors, this impact is considered* ***significant****.*

## Mitigation Measures

**Mitigation Measure 4.11-5a:** Where feasible, locate new sensitive receptors such that the outdoor activity area (e.g., balcony or porch) is on the opposite side of the structure from the UPRR line such that the structure itself would provide a barrier between transportation noise and the outdoor activity areas.

**Mitigation Measure 4.11-5b:** The applicant shall work in conjunction with the City of Davis to pursue and establish a Quiet Zone with the Federal Railroad Administration at Arboretum Drive, adjacent to the Nishi property. Upon confirming the assessing and confirming the feasibility of establishing a Quiet Zone, the applicant and City shall proceed to apply for the Quiet Zone designation.

The application and procedural steps to establish a Quiet Zone adjacent to the project site shall commence concurrent with the start of initial site grading activities. The project applicant shall fund all studies associated with the application for the establishment of the Quiet Zone. The installation and construction of alternative safety measures associated with the Quiet Zone (including, but not limited to: signage, gates, etc.) shall be implemented by the project applicant.

**Mitigation Measure 4.11-5c:** The applicant shall design and construct the residential buildings along the rail line such that train horn events and noise from passing trains would not increase by more than 5dBA SEL from existing SEL levels. These designs can include, but are not limited to:

- Incorporation of acoustically absorptive material, shape, angle, or overall design in building façade facing the railroad.
- Changing the shape of proposed buildings adjacent to the railroad and Solano Park Apartments such that noises from passing trains, including warning horns, are dispersed and not concentrated on sensitive receptors.

### Significance after Mitigation

Implementation of Mitigation Measures 4.11-5a would reduce interior noise from I-80 at new sensitive receptors by ensuring that they are built in such a way as to attenuate interior noise levels to 45 dBA $L_{dn}$, the City's interior noise standard for residential land uses. Successful implementation of Mitigation Measure 4.11-5b would not reduce train horn noise completely, because freight strains travelling eastbound would continue to activate their horns before entering the Davis Station. However, it would reduce the frequency of horn noise. In addition, Mitigation Measure 4.11-5a would not eliminate other noise from trains passing on the UPRR line. Passing trains would still be high noise level events that can reach up to 95dB at 100 feet. Implementation of Mitigation Measure 4.11-5c would reduce impacts on existing receptors, at Solano Park Apartments and any other residences that could be affected by increased noise levels of passing trains reflected and amplified by the proposed Nishi residential buildings.

The implementation of Mitigation Measures 4.11-5a through 5c would reduce most transportation noise impacts, except for disturbances to new receptors on the Nishi site. These receptors would still be exposed to sudden increases in noise levels from passing trains along the UPRR line, which can still occur during nighttime hours while residents are sleeping. As discussed earlier, an exterior-to-interior reduction of 30dB could still allow for more than 5% of residents to be awakened. Thus, this impact would remain **significant and unavoidable**.

*West Olive Drive*

Redevelopment of West Olive Drive would not result in the addition of substantial traffic-generating uses such that roadway noise levels would increase substantially. Further, on-site uses that may occur within West Olive Drive are not currently anticipated to include sensitive receptors that may be exposed to noise levels in excess of established standards. This would be a **less-than-significant** impact.

Potential redevelopment of West Olive Drive is not anticipated to result in residential uses or other sensitive receptors that could be exposed to substantial existing and/or future noise levels (e.g. train horn blasts).

Increased traffic due to redeveloping of West Olive Drive could increase traffic affecting residences along West Olive Drive, east of Richards Boulevard. However, the increase in traffic due to the redevelopment is anticipated to be marginal. Thus, impacts of project-generated transportation noise levels on existing receptors would be less-than-significant.

*Because the redevelopment of uses within West Olive Drive would not include new on-site receptors and would not significantly contribute to existing transportation noise levels, this impact would be* ***less-than-significant.***

### Mitigation Measures

No mitigation measures are required.

## Impact 4.11-6: Expose proposed sensitive receptors to railroad vibrations.

*Nishi Site*

Trains passing along the UPRR may generate groundborne vibration levels than are perceptible on the project site. However, the levels of groundborne vibration exposure at the nearest buildings would not exceed the applicable exposure criteria established by FTA or result in structural damage to the buildings. Therefore, this impact would be **less than significant**.

As stated in Impact 4.11-5, approximately 60 trains pass by the project site per day. It is anticipated that passing freight and Amtrak trains would generate ground vibration levels of approximately 85 VdB at 50 feet from the tracks, which is the upper range of ground vibration typical produced by commuter rail trains (FTA 2006:7-5). Based on FTA's propagation adjustment calculation this vibration level would attenuate to 71 VdB at a distance of 150 feet where the nearest residential building would be located. (This calculation is provided in Appendix I.) Also the buildings proposed on the project site would be no closer to the railroad tracks than the nearest existing residences in the existing Solano Park Apartments complex. Thus, the resultant level of ground vibration exposure at the nearest residential receptor would not exceed the criteria of 72 VdB recommend for residential receptors by FTA for evaluating human annoyance (FTA 2006:8-3). Because the level of ground vibration exposure at the new residential buildings would not exceed FTA's criteria for causing human annoyance, it can also be concluded that they would not cause any structural damage to the buildings (FTA 2006:7-2).

*Because the buildings proposed on the Nishi site would not be exposed to train-generated ground vibration levels that exceed FTA's exposure criteria, this impact would be* ***less than significant.***

### Mitigation Measures

No mitigation measures are required.

*West Olive Drive*

No residential units are anticipated as part of the potential redevelopment of West Olive Drive. As a result, **no impact** to proposed residential development within West Olive Drive as a result of rail operations would occur.

As part of the project, West Olive Drive would be redesignated and rezoned as mixed use commercial. Residential development within West Olive Drive, which could be subject to train-generated vibration, is not anticipated and as a result, the exposure of residential/sensitive uses, to excessive vibration from nearby trains is not anticipated.

*As no residential uses would result from potential redevelopment of West Olive Drive, implementation of the project would not expose residential uses within West Olive Drive to train-generated vibration.* ***No impact*** *would occur.*

### Mitigation Measures

No mitigation measures are required.

## Impact 4.11-7: Conflict, or create an inconsistency, with any applicable plan, policy, or regulation adopted for the purpose of avoiding or mitigating environmental effects related to noise.

*Nishi Site*

Implementation of the project within the Nishi site would be consistent with the policies of the City of Davis General Plan related to noise. This would be a **less-than-significant** impact.

The City of Davis General Plan includes policies to protect residents and businesses in the City of Davis from harmful, disruptive, or disturbing noise levels. The features of the proposed development of the Nishi site and mitigation measures discussed in this document are consistent with the policies of the City of Davis General Plan as shown in Table 4.11-13.

*Development of the Nishi site as part of the project would not conflict with any local policies or ordinances established for noise. Impacts would be* ***less than significant.***

### Mitigation Measures

No mitigation measures are required.

*West Olive Drive*

Redevelopment that could occur as a result of the redesignation/rezoning of parcels located in West Olive Drive would be consistent with the policies of the City of Davis General Plan related to noise. This would be a **less-than-significant** impact.

Similar to what was discussed above, potential redevelopment of West Olive Drive would not create conflicts or result in inconsistencies with the policies of the City General Plan related to noise.

*Potential redevelopment associated with the proposed General Plan Amendment and zoning change of West Olive Drive would not conflict with any regulations established for noise. Impacts would be* ***less than significant****.*

### Mitigation Measures

No mitigation measures are required.

**Table 4.11-13 City of Davis General Plan Policy Consistency**

| Policy | Project Consistency |
|---|---|
| **Policy NOISE 1.1** Minimize vehicular and stationary noise sources, and noise emanating from temporary activities. | The Nishi development would be designed to minimize vehicular noise sources from I-80 exposed to sensitive receptors by situating commercial buildings between the residential land uses and the freeway. All proposed mitigation measures for noise aim to minimize exposure to vehicular and stationary noise sources and noise emanating from temporary activities, such as construction and passing trains. |
| **Policy NOISE 1.2** Discourage the use of sounds walls whenever alternative mitigation measures are feasible, while also facilitating the construction of sound walls where desired by the neighborhood and there is no other way to reduce noise to acceptable exterior levels shown in Table 4.11-6. | No sound walls are proposed as part of either the Nishi development or West Olive Drive redevelopment. |
| **Policy NOISE 2.1** Take all technically feasible steps to ensure that interior noise levels can be maintained at the levels shown in Table 4.11-7. | Mitigation Measures 4.11-3, 4.11-5a, 4.11-5b, and 4.11-5c ensure that all technically feasible steps to ensure that interior noise levels can be maintained at the levels shown in Table 4.11-7. |

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