TECHNICAL MEMORANDUM

To:	Mike Micheels, Senior Project Manager (Cartwright NorCal)
From:	Mark Storm, INCE Bd. Cert. (#8003)
Subject:	**Maverik (Sheldon Road and W. Stockton Blvd.) Noise Study**
Date:	October 2, 2023
cc:	Daniel Hoffman, Dudek
Attachments:	Attachment A – Figures 1-5; Attachment B – Construction Noise Prediction Worksheets; Attachment C – Roadway Traffic Noise Prediction Worksheets; and Attachment D – Stationary Noise Source Modeling Inputs

This technical memorandum provides a noise and vibration study to evaluate the existing outdoor ambient sound environment and predict potential environmental noise and vibration impacts from the proposed Maverik convenience store and fuel dispensing project (Project) to the surrounding communities of the City of Sacramento and the City of Elk Grove.

1 Executive Summary

1.1 Project Overview

The Project proposes to build a convenience store, associated parking stalls, and a canopy for twenty fuel dispensers on a lot at the northeastern corner of Sheldon Avenue and W. Stockton Boulevard. The site is located at the southern-most tip of the City of Sacramento, California. Offsite noise-sensitive receptors south and east of the Project site are located within the City of Elk Grove. Figure 1 illustrates the regional geography of the proposed Project site, and Figure 2 depicts the Project site plan with its layout of associated structures and features.

1.2 Environmental Noise Impacts

In summary, the proposed Project is expected to generate construction activity noise that is compliant with FTA guidance and groundborne vibration from construction that is less than Caltrans-based guidance thresholds of significance. The added Project trips to the surrounding network of roadway traffic is expected to result in a negligible increase (i.e., less than 0.1 dB change) in roadway traffic noise as received by studied samples of existing NSR in the vicinity. Aggregate noise emission from Project onsite sources, even at peak hour levels of activity, are predicted to be compliant with nighttime hourly noise level standards for both the City of Sacramento and the City of Elk Grove.

For these reasons, the proposed Project is expected to comply with relevant local noise standards and policies and without the need for additional noise attenuation features not already featured in the Project design and site layout.

2 Assessment Framework

The following subsections provide the reader a summary of acoustical terminology and concepts that the foregoing analyses will use to evaluate potential noise exposures associated with the Project.

2.1 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 receptor, and the propagation path between the two. The loudness of the noise source and obstructions or atmospheric factors affecting the propagation path to the receptor determine the sound level and characteristics of the noise perceived by the receptor. The field of acoustics deals primarily with the propagation and control of sound.

2.1.1 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 (kHz), or thousands of Hertz. The audible frequency range for humans is generally between 20 Hz and 20,000 Hz.

2.1.2 Sound Pressure Levels, Sound Power 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). The threshold of hearing for people is about 0 dB, which corresponds to 20 mPa.

Sound power level is the acoustic power radiated from a source and expressed in decibels with respect to a reference quantity of 10^{-12} watts. Unlike sound pressure (L_p) dB that will vary with environmental conditions and the distance between the source and a detection point, sound power level (L_w) depends only on the characteristics of the sound-emitting source. By way of analogy, a light bulb may be rated for 100 watts of light when operating in a room, but the measured luminosity (akin to L_p) will vary with detector distance and the light-absorbing properties of the room surfaces and contents.

2.1.3 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 one source 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.

2.1.4 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 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 judgments correlate well with the A-scale sound levels of those sounds. Other weighting networks have been devised to address high noise levels or other special problems (e.g., B-, C-, and D-scales), but these scales are rarely used in conjunction with community noise management, including major stationary sources and highway-traffic noise. Noise levels for community/environmental noise reports are typically reported in terms of A-weighted decibels or dBA. Table 1 describes typical A-weighted noise levels for various noise sources.

Table 1. Typical A-Weighted Noise Levels for Common Indoor and Outdoor Sources

Common Outdoor Activities	Noise Level (dBA)	Common Indoor Activities
Diesel truck at 50 feet at 50 mph	85	Food blender at 3 feet
	80	Garbage disposal at 3 feet
Noisy urban area, daytime	75	—
Gas lawn mower, 100 feet	70	Vacuum cleaner at 10 feet
Commercial area	65	Normal speech at 3 feet
Heavy traffic at 300 feet	60	—
	55	Large business office
Quiet urban daytime	50	Dishwasher next room
	45	—
Quiet urban nighttime	40	Theater, large conference room (background)
Quiet suburban nighttime	35	—
	30	Library

Table 1. Typical A-Weighted Noise Levels for Common Indoor and Outdoor Sources

Common Outdoor Activities	Noise Level (dBA)	Common Indoor Activities
Quiet rural nighttime	25	Bedroom at night, concert hall (background)

Source: Caltrans 2013.

2.1.5 Human Response to Changes in Noise Levels

As discussed above, doubling 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 than 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 Hz–8,000 Hz) range (Caltrans 2013). In typical noisy environments, changes in noise of 1 to 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, such as outdoors in an urban area. 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.

2.1.6 Noise Descriptors

Noise in our daily environment fluctuates over time at varying rates. Various noise descriptors have been developed to describe time-varying noise levels. The following are the noise descriptors are utilized in this analysis.

- **Equivalent Sound Level** (L_{eq}): L_{eq} represents an energy average of the sound level occurring over a specified period. Note that L_{eq} is not an arithmetic average of varying dB levels over a period of time, it accounts for greater sound energy represented by higher decibel contributions.
- **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% of the time, and L_{90} is the sound level exceeded 90% of the time).
- **Maximum Sound Level** (L_{max}): L_{max} is the highest instantaneous sound level measured during a specified period.
- **Minimum Sound Level** (L_{min}): L_{min} is the lowest 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 hourly L_{eq} sound levels occurring during nighttime hours between 10 p.m. and 7 a.m.
- **Community Noise Equivalent Level** (CNEL): Similar to L_{dn}, CNEL is the energy average of the A-weighted sound levels occurring over a 24-hour period, with a 10-dB penalty applied to hourly L_{eq} 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 hourly L_{eq} A-weighted sound levels occurring during evening hours between 7 p.m. and 10 p.m.

2.1.7 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., an ideal point source) propagates uniformly outward in a spherical pattern (or hemispherical when near the ground surface). The sound level attenuates (or decreases) at a rate of 6 decibels for each doubling of distance from a point source. Roadways 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. 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 decibels for each doubling of distance from a line source.
- **Ground Absorption** – The propagation path of noise from a sound emission source to a receptor is usually horizontal and proximate to the ground. Under these conditions, noise attenuation from ground absorption and reflective-wave canceling can add to the attenuation associated with geometric spreading. For acoustically “hard” paths over which sound may traverse (i.e., sites with a reflective surface between the source and the receptor, 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 receptor, such as fresh-fallen snow, soft dirt, or dense vegetative ground cover), an additional ground-attenuation value of +1.5 decibels per doubling of distance is normally assumed. When added to cylindrical spreading for line source sound propagation, the excess ground attenuation results in an overall drop-off rate of 4.5 decibels per doubling of distance.
- **Atmospheric Effects** – Receptors located downwind from a source can be exposed to increased noise levels relative to calm conditions, whereas locations upwind can have lowered noise levels. Sound pressure levels can also be increased at large distances (e.g., more than 500 feet) due to atmospheric temperature inversion (i.e., increasing temperature with elevation). Other factors such as air temperature, humidity, and turbulence can also have significant effects when distances between a source and receptor are large.
- **Shielding by Natural or Human-Made Features** – A large object or barrier in the path between a noise source and a receptor can substantially attenuate noise levels at the receptor. 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 receptor specifically to reduce noise. A barrier that breaks the line of sight between a source and a receptor will typically result in at least 5 dB of noise reduction. Taller barriers provide increased noise reduction. While a line of trees may visually occlude the direct line between a source and a receptor, its actual noise-reducing effect is usually negligible because it does not create a solid barrier. Deep expanses of dense wooded areas, on the other hand, can offer noise reduction under the right conditions.

2.2 Vibration

Vibration is similar to noise in that it is a pressure wave traveling through an elastic medium involving a periodic oscillation relative to a reference point. Vibration is most commonly described in respect to the excitation of a structure or surface, such as in buildings or the ground. Human and structural response to different vibration levels is influenced by a number of factors, including ground type, distance between source and receptor, duration, and the number of perceived vibration events. 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, impacts). 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), which is defined as the maximum instantaneous positive or negative peak of a vibration signal, or the quantity of displacement measured from peak to trough of the vibration wave in units of inches per second (in/sec or ips). 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 (FTA 2018). The California Department of Transportation (Caltrans) also uses it as guidance for evaluating potential human annoyance for occupants of structures that receive groundborne vibration.

Typical outdoor sources of perceptible ground borne vibration comes from vehicles on the nearby highway and local street. Although the effects of vibration may be imperceptible at low levels, effects may result in detectable vibrations and slight damage to nearby structures at moderate and high levels, respectively. At the elevated levels of vibration, damage to structures is primarily architectural (e.g., loosening and cracking of plaster or stucco coatings) and rarely results in damage to structural components.

2.3 Environmental Setting

The Project site is near a major state highway interchange connecting SR-99 with Sheldon Road and W. Stockton Boulevard. Consequently, the outdoor ambient noise environment is already characterized by dominant roadway traffic sound, and at estimated levels of at least 70 dBA Ldn as indicated by the current general plans of both the City of Sacramento (City of Sacramento 2015b) and the City of Elk Grove (City of Elk Grove 2022). Figure 3 reproduces a noise contour map from the latter reference.

2.4 Regulatory Setting

2.4.1 Federal Guidance

In its Transit Noise and Vibration Impact Assessment guidance manual, the Federal Transit Administration (FTA) recommends a daytime construction noise level threshold of 80 dBA L_{eq} over an 8-hour period (FTA 2018) when detailed construction noise assessments are performed to evaluate potential impacts to community residences surrounding a project. Although this FTA guidance is not a regulation, it can serve as a quantified standard in the absence of such limits at the state and local jurisdictional levels.

2.4.2 State Standards

2.4.2.1 California Code of Regulations

California Government Code Section 65302(f) mandates that the legislative body of each county and city adopt a noise element as part of its comprehensive general plan. The local noise element must recognize the land use compatibility guidelines established by the State Department of Health Services. The guidelines rank noise land use compatibility in terms of "normally acceptable", "conditionally acceptable", "normally unacceptable", and "clearly unacceptable" noise levels for various land use types. Single-family homes are "normally acceptable" in exterior noise environments up to 60 dBA CNEL and "conditionally acceptable" up to 70 dBA CNEL. Multiple-family residential uses are "normally acceptable" up to dBA 65 CNEL and "conditionally acceptable" up to dBA 70 CNEL. Schools, libraries, and churches are "normally acceptable" up to 70 dBA CNEL, as are office buildings and business, commercial, and professional uses.

2.4.2.2 California Department of Transportation

In its Transportation and Construction Vibration Guidance Manual, Caltrans recommends a vibration velocity threshold of 0.2 ips PPV (Caltrans 2020) for assessing annoying vibration impacts to occupants of residential structures. Although this Caltrans guidance is not a regulation, it can serve as a quantified standard in the absence of such limits at the local jurisdictional level. Similarly, thresholds to assess building damage risk due to construction vibration vary with the type of structure and its fragility, such as 0.3 ips PPV for typical "older" residential structures (Caltrans 2020).

2.4.3 Municipal Regulations and Policies

2.4.3.1 City of Sacramento

The Project site is located within the City limits of Sacramento and would thus need to comply with local noise regulations and general plan policies, goals, and actions. Offsite sensitive receptors north and west of the Project would also be subject to exterior noise exposure limits and guidance set by the City and as summarized in the following paragraphs.

Noise Ordinance

Section 8.68.060.A from the Sacramento municipal code defines the following exterior noise standards (interpreted to be hourly L_{eq} values) for sensitive receptors (residential and agricultural) with respect to sound received: 55 dBA during daytime hours (7:00 a.m. to 10:00 p.m.) and 45 dBA at night (10:00 p.m. to 7:00 a.m.). Section 8.68.060.B allows higher limits, in successive increments of 5 dB, for partial hour periods but capped at +20 dB for "any time per hour." With respect to noise that are tonal, impulsive, repetitive, or consist primarily of speech or music, these limits would be reduced by 5 dB per Section 8.68.060.C. Section 8.68.060.D permits higher standards, if the measured outdoor ambient level exceeds the default thresholds, as follows: "if the ambient noise level exceeds that permitted by any of the first four noise limit categories specified in subsection B of this section, the allowable noise limit shall be increased in five dBA increments in each category to encompass the ambient noise level. If the ambient noise level exceeds the fifth noise level category, the maximum ambient noise level shall be the noise limit for that category." (City of Sacramento 2023)

Per Section 8.68.080.D, construction noise is exempt "between the hours of seven a.m. and six p.m., on Monday, Tuesday, Wednesday, Thursday, Friday and Saturday, and between nine a.m. and six p.m. on Sunday; provided, however, that the operation of an internal combustion engine shall not be exempt pursuant to this subsection if such engine is not equipped with suitable exhaust and intake silencers which are in good working order. The director of building inspections, may permit work to be done during the hours not exempt by this subsection in the case of urgent necessity and in the interest of public health and welfare for a period not to exceed three days. Application for this exemption may be made in conjunction with the application for the work permit or during progress of the work."

General Plan Noise Element

Policies from the Environmental Constraints chapter of the Sacramento General Plan that would apply to the Project are as follows:

EC 3.1.1: Exterior Noise Standards. The City shall require noise mitigation for all development where the projected exterior noise levels exceed those shown in Table EC 1, to the extent feasible.

For a commercial enterprise such as the proposed Project, Table EC 1 indicates that the highest level of noise exposure regarded as "normally acceptable" is 70 dBA CNEL (City of Sacramento 2015a).

EC 3.1.2: Exterior Incremental Noise Standards. The City shall require noise mitigation for all development that increases existing noise levels by more than the allowable increment shown in Table EC 2, to the extent feasible.

For a commercial enterprise such as the proposed Project, and because the proposed Project would be located within a noise contour where an Ldn of 70 dBA is expected near SR-99 at Sheldon Road per Appendix C (Noise Contours) of the General Plan (City of Sacramento 2015b), Table EC 2 indicates that the allowable increase above ambient attributed to the proposed Project would be 1 dB (City of Sacramento 2015a).

2.4.3.2 City of Elk Grove

Although the proposed project is located in the City of Sacramento and would be subject to its noise regulations, land use compatibility guidance, and policies as summarized in the preceding Section 2.4.3.1, noise-sensitive receptors located to the south and east of the project are located in the City of Elk Grove. Construction noise and operation noise exposures from the proposed project would therefore need to comply with relevant standards of that municipality, as summarized in the following paragraphs.

Noise Ordinance

Section 6.32.080.A from the City of Elk Grove municipal code defines the following exterior noise standards for sensitive receptors with respect to sound received from stationary noise sources: 55 dBA during daytime hours (7:00 a.m. to 10:00 p.m.) and 45 dBA at night (10:00 p.m. to 7:00 a.m.). For "stationary sources which are tonal, impulsive, repetitive, or consist primarily of speech or music," these limits would be reduced by 5 dB. (City of Elk Grove 2023)

Section 6.32.080.C from the Elk Grove municipal code allows measured pre-existing outdoor sound levels to upgrade the default thresholds of 6.32.080.A under the following conditions:

1. Where the ambient noise level is less than sixty (60) dB but greater than the threshold from 6.32.080.A, a maximum increase of five (5) dB above the ambient noise level is allowed.

2. Where the ambient noise level is between sixty (60) dB and sixty-five (65) dB, inclusive, a maximum increase of three (3) dB above the ambient noise level is allowed.

3. Where the ambient noise level is greater than sixty-five (65) dB, a maximum increase of one and one-half (1.5) dB above the ambient noise level is allowed.

Per Section 6.32.100.E, construction noise is exempt from the Section 6.32.080.A "provided said activities only occur between the hours of 7:00 a.m. and 7:00 p.m. when located in close proximity to residential uses. Noise associated with these activities not located in close proximity to residential uses may occur between the hours of 6:00 a.m. and 8:00 p.m. However, when an unforeseen or unavoidable condition occurs during a construction project and the nature of the project necessitates that work in progress be continued until a specific phase is completed, the contractor or owner shall be allowed to continue work after 7:00 p.m. and to operate machinery and equipment necessary until completion of the specific work in progress can be brought to conclusion under conditions which will not jeopardize inspection acceptance or create undue financial hardships for the contractor or owner." Construction noise is then listed as a prohibited activity per Section 6.23.140.A.

Despite addressing stationary noise sources in Section 6.32.080.A, Section 6.32.110.C from the Elk Grove municipal code caps lawful noise emission from mechanical equipment (e.g., HVAC systems) at "a maximum limit of 55 dBA." (City of Elk Grove 2023)

General Plan Noise Element

Table 8-3 from Chapter 8 (Services, Health, and Safety) of the City of Elk Grove General Plan sets 60 dBA Ldn as a limit for transportation noise exposures at the outdoor activity areas of typical noise-sensitive receptors such as residential, transient lodging, hospitals, nursing homes, churches, and meeting halls. If the outdoor activity area location is unknown, then this exterior noise level threshold would be applied at the property line of the receiving land use. In situations where it is not possible to reduce noise in outdoor activity areas to less 60 dBA Ldn, an exposure level of up to 65 dBA Ldn is allowed provided that noise level reduction measures have been implemented and interior standards have been met. Furthermore, "in cases where the existing ambient noise level exceeds 60 dBA Ldn, the maximum allowable project-related permanent increase in ambient noise levels shall be 3 dBA." (City of Elk Grove 2022)

Goals and policies from Chapter 8 of the Elk Grove General Plan that would apply to the project are as follows:

<u>Policy N-1-3</u>: Use the noise contour mapping identified in Figure 8-7 to inform land use decisions. Figure 3 that appears in Attachment A reproduces this noise map and shows clearly that the proposed project is within the 70 dBA Ldn contour attributed primarily to State Route 99 highway traffic.

3 Impact Assessment

3.1 Approach and Methodology

3.1.1 Construction Noise

Short-term, construction-related noise effects attributed to implementation of the Project were assessed with respect to nearby noise-sensitive receptors and their relative exposure (accounting for intervening, barriers, distance, etc.), based on application of an FHWA Roadway Construction Noise Model (RCNM) emulator and its reference noise level data and acoustical usage-factors (AUF). The AUF value refers to what portion of time that a piece of heavy equipment is actually working under full load conditions and thus emitting noise at a maximum noise level (L_{max}). When diluted over a defined period, the L_{eq} may be calculated from the AUF and the equipment L_{max} value at a reference distance of 50 feet. For purposes of this assessment, construction noise was evaluated with two different approaches as follows:

- The two loudest pieces of equipment associated with an anticipated Project construction phase are studied and operating as close as five feet from the Project boundary. This is akin to the Federal Transit Administration (FTA) "general assessment" method and considered most appropriate for phases where limited quantities of equipment would be at this nearest distance to an offsite noise-sensitive receptor.

- All equipment from the geographic center (a.k.a. "acoustic centroid") of the Project construction site, which serves as the time-averaged location of active construction equipment for the phase under study. This is also comparable to the aforementioned FTA assessment technique, in that it accounts for the uncertain location of individual equipment at any given moment operating within the defined construction area.

Table 2 summarizes these two distances (i.e., between the apparent closest offsite noise-sensitive receptor and the Project boundary for the former, and between the same offsite receptor and the acoustic centroid) for each of the five sequential construction phases.

Table 2. Estimated Distances between Construction Activities and the Nearest Noise-sensitive Receptors

Construction Phase	Distance from Nearest Noise-Sensitive Receptor to Construction Site Boundary (Feet)		Distance from Nearest Noise-Sensitive Receptor to Acoustical Centroid of Site (Feet)	
	V1F1	V1F4	V1F1	V1F4
Site Preparation	155	155	265	415
Grading	155	155	265	415
Building construction	155	155	265	415
Paving	155	155	265	415
Architectural Coating	155	155	265	415

Notes: V1F1 = Vasari Apartment Homes, first floor, number 1 (see Figure 5); V1F4 = Vasari Apartment Homes, first floor, number 4 (see Figure 5).

3.1.2 Offsite Roadway Traffic Noise

Existing and existing-plus-project traffic noise emission levels were predicted from roadway segments studied in the Transportation Operations Review memorandum (Fehr & Peers 2022) and include the following (with estimated speeds shown in miles per hour [mph]):

- Sheldon Road west of project site (45 mph);
- Sheldon Road east of project site (45 mph);
- SR 99 ramps south of Sheldon Road (35 mph); and
- W. Stockton Blvd. north of Sheldon Road (50 miles per hour)

Offsite roadway traffic noise predictions were performed with the Federal Highway Administration (FHWA) RD-77-108 traffic noise model using California Vehicle Noise ("Calveno") Reference Energy Mean Emission Level (REMEL) curves (Caltrans 1998). Although varyingly distant from noise-sensitive receivers nearest to the Project site, predicted traffic noise contribution from California State Route 99 (SR99) has been included and logarithmically added to the estimated traffic noise from studied local roadway segments. From calculations appearing in Attachment C, Roadway Traffic Noise Prediction Worksheets, key model inputs and assumptions are as follows:

- Caltrans traffic volume data for 2019 (i.e., pre-COVID conditions) reports an AWT volume of 159,000 on the SR99 Sacramento Stockton Boulevard segment nearest to the Project site. (Caltrans 2019)
- Medium and heavy truck percentages of studied local roadway average weekday traffic (AWT) volumes were conservatively assumed to match those of the nearby SR99 highway segment that connects to the local roadway network of the Project vicinity via ramps south of Sheldon Road; and
- Meteorological conditions are 68 degrees Fahrenheit air temperature and 50% relative humidity.

3.1.3 Onsite Project Operations Noise

A Datakustik CadnaA model was prepared to model aggregate noise emission from a variety of anticipated onsite acoustical contributors associated with Project operation. CadnaA sound propagation software is a leading three-dimensional noise modeling tool for such applications and is based on aforesaid International Organization of Standardization (ISO) 9613-2 standard techniques and reference information. The studied sound sources included in the CadnaA-based prediction model are detailed in the following paragraphs.

3.1.3.1 Convenience Store Rooftop HVAC

Per worksheets appearing in Attachment D, this predictive analysis assumes the proposed convenience store will require approximately 6,300 cubic feet per minute (cfm) of minimum outside air entrainment for appropriate indoor air quality and comfort and be provided by a rooftop air handling unit (AHU) or component of a packaged heating, ventilating, and air-conditioning (HVAC) system. This AHU is expected to emit 72 dBA sound power level (PWL). Cooling load has been estimated as approximately 14.5 tons of refrigeration that would be supplied by other HVAC system components connected to a rooftop-mounted air-cooled condenser (ACC) with fans. While the refrigeration compressors may be located indoors as part of a split-system, or enclosed within an insulated cabinet, the heat transfer fan array would remain exposed to the outdoors; hence, the ACC is expected to emit 78 dBA PWL.

3.1.3.2 Parking Lot Movements

An hourly average noise level generated by parking lot movements may be estimated with the following expression:

Hourly L_{eq} = 70+10*LOG(N) – 35.6

where 70 dBA is the mean Sound Exposure Level (SEL) at a reference distance of 50 feet for an automobile parking lot arrival or departure, N is the number of parking lot operations in a given hour, and 35.6 is ten times the logarithm of the number of seconds in an hour (BAC 2020). The reference SEL is comparable to measurements that Dudek has performed for previous project studies. Table 1 of the F&P report indicates the quantity of morning peak hour trips is 66 (total of in and out), which would represent N in the above expression. Converted to sound power level (PWL) and applied across the Project area as a single area source, this hourly L_{eq} value serves as a reference input from which noise exposure levels at the nearest noise-sensitive receptors offsite can then be estimated after application of distance propagation and other natural attenuation factors such as air absorption and ground absorption consistent with ISO 9613-2 algorithms and reference data.

3.1.3.3 Fuel Pump Operation

The Project site will feature twenty fuel pumps, which for purposes of this assessment are assumed to resemble Gilbarco GPU90 model dispensers with "vane" type pumps that emit 83 dBA SPL (Gilbarco undated). The predictive analysis also assumes that the individual pumps will be operational up to a cumulative thirty minutes during the busiest morning hour associated with the aforementioned 66 total hourly customer trips in and out of the Project site.

3.1.4 Construction Vibration

Groundborne vibration attenuates rapidly, even over short distances. The attenuation of groundborne vibration as it propagates from source to receptor through intervening soils and rock strata can be estimated with expressions found in FTA and Caltrans guidance. By way of example, an operating bulldozer on site and as close as the northern project boundary (i.e., approximately 155 feet from the nearest occupied offsite property) the estimated vibration velocity level would be 0.006 ips per the equation as follows (FTA 2018):

$PPV_{rcvr} = PPV_{ref} * (25/D)^{1.5} = 0.006 = 0.089 * (25/155)^{1.5}$

In the above equation, PPV_{rcvr} is the predicted vibration velocity at the receiver position, PPV_{ref} is the reference value at 25 feet from the vibration source (the bulldozer), and D is the actual horizontal distance to the receiver. Therefore, at this predicted PPV, the impact of vibration-induced annoyance to occupants of nearby existing homes would be less than significant.

3.2 Prediction Results

3.2.1 Construction Noise

Attachment B displays the usage of a Microsoft Excel–based noise prediction model emulating and using reference data from the RCNM (FHWA 2008) to predict per-phase construction noise exposure levels at the two sample receptors appearing in Table 3 for each of the two evaluation techniques (i.e., nearest distance or acoustic centroid). Consistent with assumptions used in the air quality assessment for the Project, the predictive model also considers how many hours that equipment may be on site and operating (or idling) within an established work shift. Conservatively, no topographical was assumed in the modeling; however, the model does account for existing offsite residential land uses represented by receptors V1F1 and V1F4 in Figure 5 that are within communities featuring sound-occluding six-foot or eight-foot-tall concrete masonry unit (CMU) walls. The RCNM has default AUF values for the various pieces of equipment, derived from an extensive FHWA study of typical construction activity patterns, which were used for this noise analysis and yield prediction results presented in Table 3.

Table 3. Predicted Construction Noise Levels per Activity Phase

Construction Phase	8-Hour L_{eq} at Nearest Noise-Sensitive Receptor to Construction Site Boundary (dBA)		8-Hour L_{eq} at Nearest Noise-Sensitive Receptor to Acoustical Centroid of Site (dBA)	
	V1F1	V1F4	V1F1	V1F4
Site Preparation	56.1	64.2	64.0	58.6
Grading	57.9	65.9	64.5	59.1
Building construction	51.6	59.7	60.5	55.1
Paving	51.0	59.0	62.2	56.8
Architectural Coating	47.8	55.9	52.0	46.6

Notes: V1F1 = Vasari Apartment Homes, first floor, number 1 (see Figure 5); V1F4 = Vasari Apartment Homes, first floor, number 4 (see Figure 5).

All predicted construction noise levels, per phase and at the indicated sample nearest NSR, are expected to be less than the FTA-based guidance criterion of 80 dBA 8-hour Leq and are comparable to or less than the outdoor daytime ambient noise levels due to the acoustical dominance of pre-existing proximate roadway traffic. On these bases, environmental noise attributed to construction activity would be considered a less than significant impact.

3.2.2 Offsite Roadway Traffic Noise

Attachment C presents the inputs and calculation results for the following two studied scenarios (Existing and Existing plus Project) that yield results for the set of four studied offsite noise-sensitive receptors (NSR) appearing in Figure 4 and are displayed in the following Table 4.

Table 4. Predicted Traffic Noise Exposures (CNEL) at Onsite Sensitive Receptors

Studied Noise-Sensitive Receptor (Figure 4 tag)	Modeled Onsite CNEL (dBA)		
	Existing Conditions	Existing plus Project	Change due to Project (dB)
Vasari Apartment Homes at 8163 Sheldon Road (NSR1)	71.7	71.7	0.02
8364 Sheldon Road (NSR2)	72.5	72.6	0.06
Homes west of Sheldon Terrace Lane near Zenia Lane (NSR3)	67.3	67.3	<0.01
Vasari Apartment Homes at 8728 W. Stockton Blvd. (NSR4)	74.8	74.9	0.04

Source: Dudek 2023
Notes: dBA = A-weighted decibels; L_{eq} = energy-equivalent level.

The predicted changes to traffic noise level exposures appearing in Table 4 are all less than 1 dB; hence, the project would not cause a significant traffic noise impact to the surrounding community.

3.2.3 Onsite Project Operations Noise

Figure 5 illustrates that the aggregate noise emission from onsite Project sound sources that include the convenience store rooftop HVAC unit(s), parking lot movements, and fuel dispenser pumps would be less than 40 dBA hourly Leq at the nearest offsite residential receptors. The predicted level at a representative receptor location at the San Joaquin Cemetery to the east of W. Stockton Boulevard would experience Project operation noise less than 45 dBA hourly L_{eq}. Based on these predicted levels being less than the nighttime City of Elk Grove threshold of 45 dBA, Project operation noise would be a less than significant impact.

3.2.4 Construction Vibration

The most vibratory of anticipated heavy construction equipment for implementing the proposed Project is a roller during the paving phase, which has a reference PPV of 0.21 ips at a distance of 25 feet (FTA 2018). Using the expression shown in Section 3.1.4, the groundborne vibration propagated through local soils and received by the nearest existing offsite residential building is predicted to be less than 0.014 ips per the following calculation:

$PPV_{rcvr} = PPV_{ref} * (25/D)^{1.5} = 0.21 * (25/155)^{1.5} = 0.0136$ ips

This predicted worst-case groundborne vibration level does not surpass either the Caltrans guidance-based limit of 0.2 ips PPV for annoyance or the 0.3 ips PPV for building damage risk to older residential structures. On these bases, the impact significance attributed to Project construction activity is considered less than significant.

Once operational, the proposed Project would not be expected to feature major producers of groundborne vibration. Anticipated mechanical systems like heating, ventilation, and air-conditioning units are designed and manufactured to feature rotating (fans, motors) and reciprocating (compressors) components that are well-balanced with isolated vibration within or external to the equipment casings. On this basis, potential vibration impacts due to proposed Project operation would be less than significant.

4 Conclusions and Recommendations

In summary, the proposed Project is expected to generate construction activity noise that is compliant with FTA guidance and groundborne vibration from construction that is less than Caltrans-based guidance thresholds of significance. The added Project trips to the surrounding network of roadway traffic is expected to result in a negligible increase (i.e., less than 0.1 dB change) in roadway traffic noise as received by studied samples of existing NSR in the vicinity. Aggregate noise emission from Project onsite sources, even at peak hour levels of activity, are predicted to be compliant with nighttime hourly noise level standards for both the City of Sacramento and the City of Elk Grove.

For these reasons, the proposed Project is expected to comply with relevant local noise standards and policies and without the need for additional noise attenuation features not already featured in the Project design and site layout.

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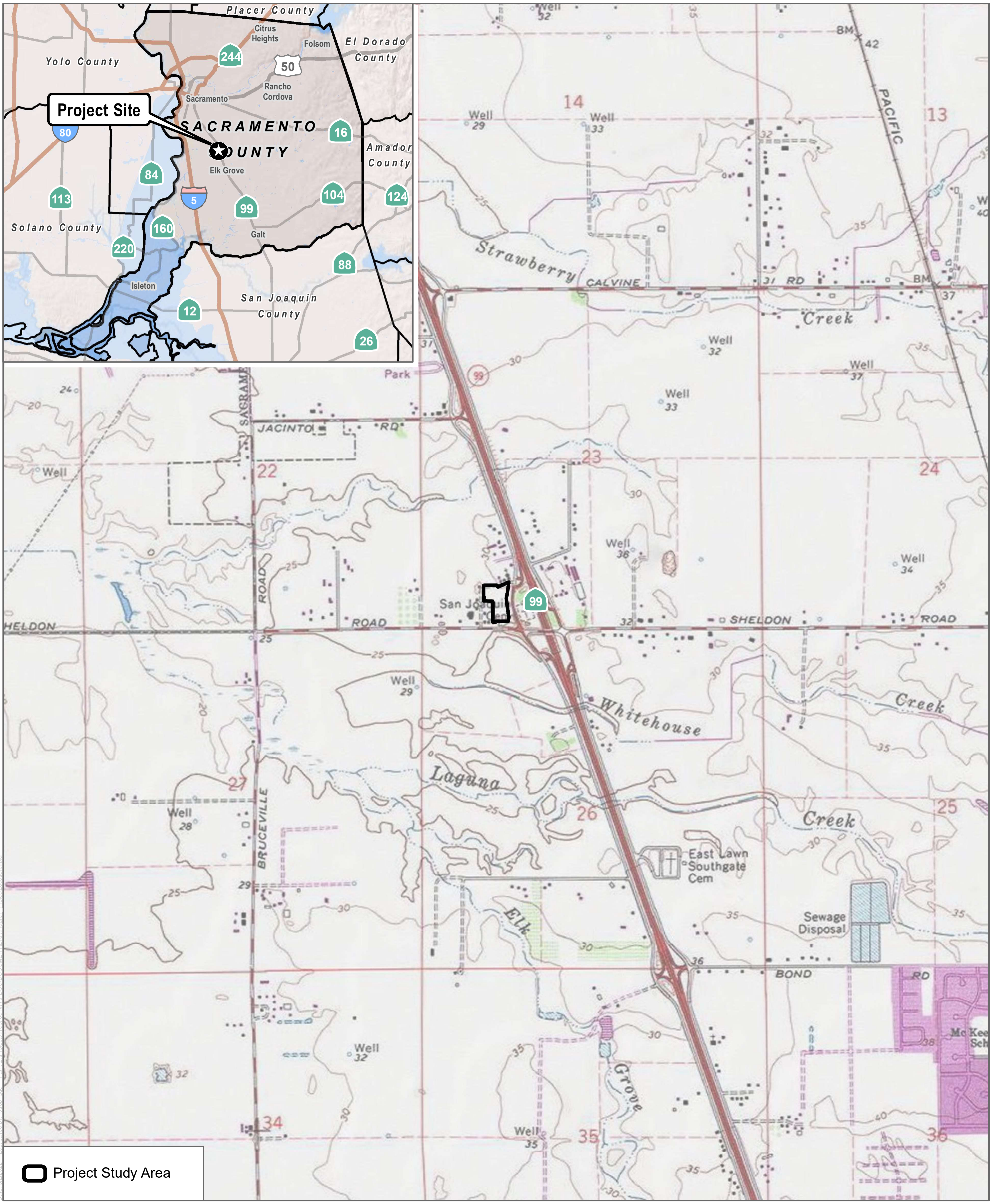
Attachments

A. Figures 1–5

B. Construction Noise Prediction Worksheets

C. Roadway Traffic Noise Prediction Worksheets

D. Stationary Noise Source Modeling Inputs



SOURCE: USGS 7.5-Minute Series Florin Quadrangle

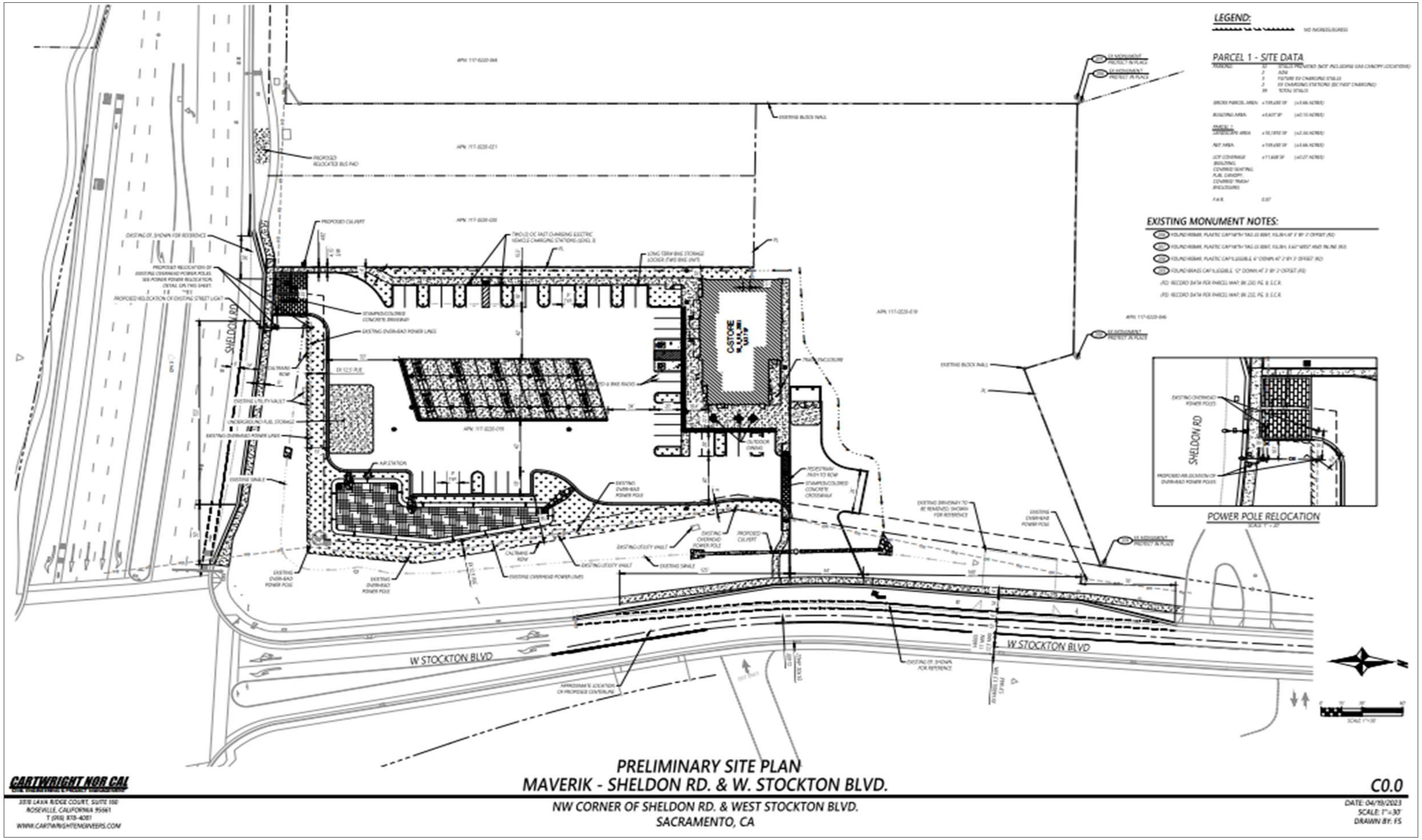
DUDEK

0 1,000 2,000 Feet
0 250 500 Meters
1:24,000

FIGURE 1

Project Location

Biological Resources Assessment for the Maverik Store at Sheldon Road and West Stockton Boulevard



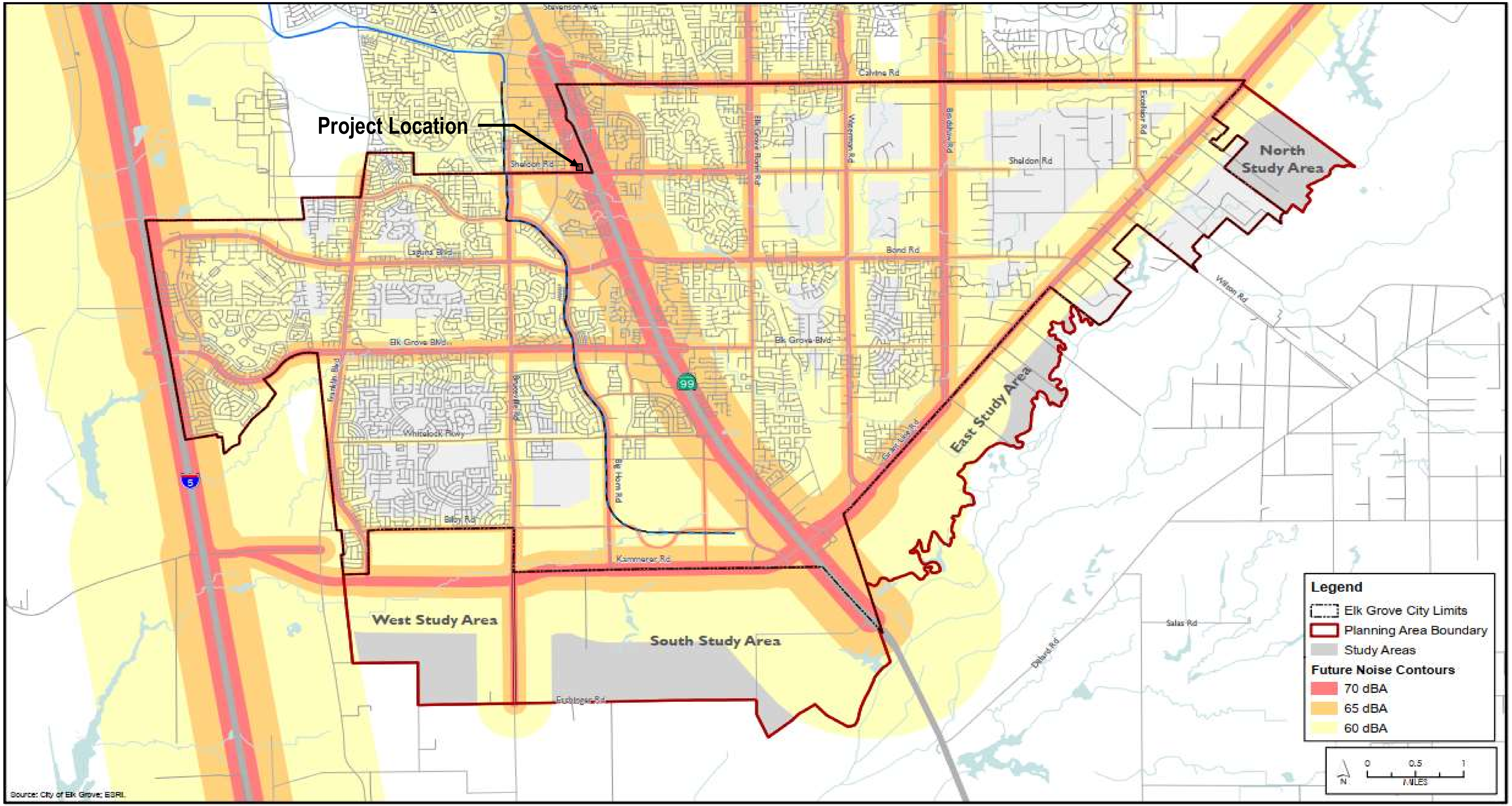
SOURCES: Dudek 2023; Cartwright NorCal 2023

DUDEK

0 44 88 Feet

FIGURE 2

Project Site Plan



SOURCES: Dudek 2023; City of Elk Grove 2022

DUDEK

0 3520 7040 Feet

FIGURE 3

Location of Proposed Project within the 70 dBA Day-Night Sound Level (Ldn) Contour near State Route 99

Maverik - Stockton & Sheldon (Sacramento, CA) Noise Study - 13670

SOURCES: Google 2022; Dudek 2023

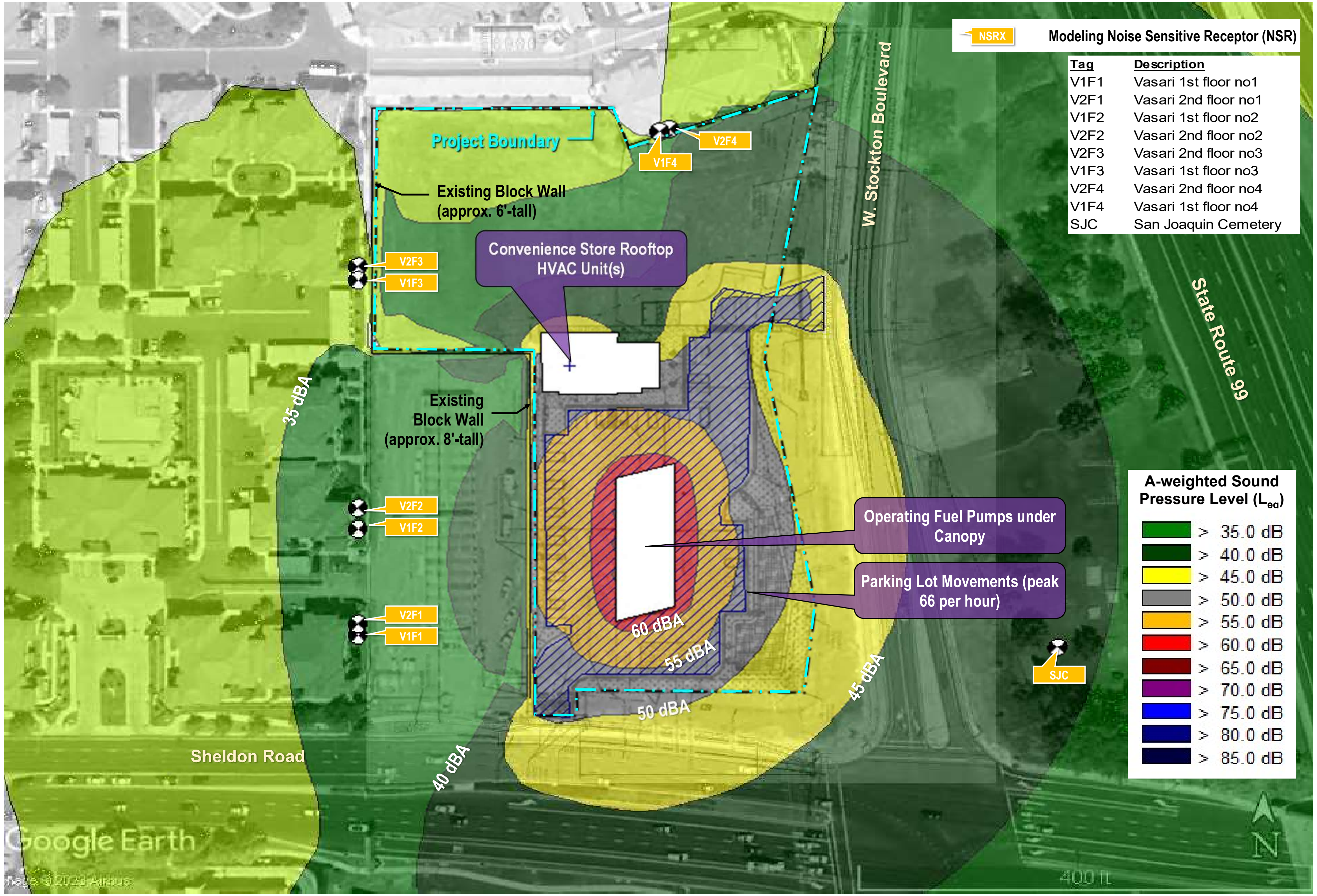
DUDEK

0 129.5 259 Feet

FIGURE 4

Studied Noise Sensitive Receptor Positions for Offsite Traffic Noise Predictions

Maverik - Stockton & Sheldon (Sacramento, CA) Noise Study - 13670



SOURCES: Dudek 2023; Cartwright NorCal 2023

DUDEK

0 48.5 97 Feet

FIGURE 5

Predicted Noise (Hourly L_{eq}) from Operation of Onsite Project Stationary Sources

Maverik - Stockton & Sheldon (Sacramento, CA) Noise Study - 13670

To User: bordered cells are inputs, unbordered cells have formulae

noise level limit for construction phase at residential land use, per FTA guidance = 80
allowable hours over which Leq is to be averaged = 8

[highlighted cell] = highway noise barrier height (of earthen berm plus concrete wall above) between source and receptor

Construction Activity	Equipment	Total Equipment Qty	AUF % (from FHWA RCNM)	Reference Lmax @ 50 ft. from FHWA RCNM	Client Equipment Description, Data Source and/or Notes	Source to NSR Distance (ft.)	*Temporary Barrier Insertion Loss (dB)*	*Additional Noise Reduction*	Distance-Adjusted Lmax	Allowable Operation Time (hours)	Allowable Operation Time (minutes)	Predicted 8-hour Leq
Site Preparation	front end loader	2	40	79		265	2.0		58.2	8	480	57
	dozer	3	40	82		265	2.0		61.2	8	480	62
	backhoe	2	40	78		265	2.0		57.2	8	480	56
									Total for Site Preparation Phase:			**64.0**
Grading	excavator	1	40	81		265	2.0		60.2	8	480	56
	grader	1	40	85		265	2.0		64.2	8	480	60
	dozer	1	40	82		265	2.0		61.2	8	480	57
	front end loader	3	40	79		265	2.0		58.2	8	480	59
									Total for Grading Phase:			**64.5**
Building Construction	crane	1	16	81		265	2.0		60.2	7	420	52
	man lift	3	20	75		265	2.0		54.2	8	480	52
	generator	1	50	72		265	2.0		51.2	8	480	48
	front end loader	3	40	79		265	2.0		58.2	7	420	58
	welder / torch	1	40	73		265	2.0		52.2	8	480	48
									Total for Building Construction Phase:			**60.5**
Paving	concrete mixer truck	2	40	79		265	2.0		58.2	6	360	56
	paver	1	50	77		265	2.0		56.2	8	480	53
	roller	2	20	80		265	2.0		59.2	6	360	54
	front end loader	3	40	79	includes "paving equipment"	265	2.0		58.2	8	480	59
									Total for Paving Phase:			**62.2**
Architectural Coating	compressor (air)	1	40	78		265	2.0		57.2	6	360	52
									Total for Architectural Coating Phase:			**52.0**

Construction Activity	Equipment	Source Elevation (ft)	Receiver Elevation (ft)	Barrier Height (ft)	Source to Barr. ("A") Horiz. (ft)	Rcvr. to Barr. ("B") Horiz. (ft)	Source to Rcvr. ("C") Horiz. (ft)	"A" (ft)	"B" (ft)	"C" (ft)	Path Length Diff. "P" (ft)	Abarr (dB)	Heff (with barrier)	Heff (wout barrier)	G (with barrier)	G (without barrier)	ILbarr (dB)
Site Preparation	front end loader	5	5	8	115	150	265	115.0	150.0	265.0	0.07	3.1	13.0	5.0	0.5	0.7	2.0
	dozer	5	5	8	115	150	265	115.0	150.0	265.0	0.07	3.1	13.0	5.0	0.5	0.7	2.0
	backhoe	5	5	8	115	150	265	115.0	150.0	265.0	0.07	3.1	13.0	5.0	0.5	0.7	2.0
Grading	excavator	5	5	8	115	150	265	115.0	150.0	265.0	0.07	3.1	13.0	5.0	0.5	0.7	2.0
	grader	5	5	8	115	150	265	115.0	150.0	265.0	0.07	3.1	13.0	5.0	0.5	0.7	2.0
	dozer	5	5	8	115	150	265	115.0	150.0	265.0	0.07	3.1	13.0	5.0	0.5	0.7	2.0
	front end loader	5	5	8	115	150	265	115.0	150.0	265.0	0.07	3.1	13.0	5.0	0.5	0.7	2.0
Building Construction	crane	5	5	8	115	150	265	115.0	150.0	265.0	0.07	3.1	13.0	5.0	0.5	0.7	2.0
	man lift	5	5	8	115	150	265	115.0	150.0	265.0	0.07	3.1	13.0	5.0	0.5	0.7	2.0
	generator	5	5	8	115	150	265	115.0	150.0	265.0	0.07	3.1	13.0	5.0	0.5	0.7	2.0
	front end loader	5	5	8	115	150	265	115.0	150.0	265.0	0.07	3.1	13.0	5.0	0.5	0.7	2.0
	welder / torch	5	5	8	115	150	265	115.0	150.0	265.0	0.07	3.1	13.0	5.0	0.5	0.7	2.0
Paving	concrete mixer truck	5	5	8	115	150	265	115.0	150.0	265.0	0.07	3.1	13.0	5.0	0.5	0.7	2.0
	paver	5	5	8	115	150	265	115.0	150.0	265.0	0.07	3.1	13.0	5.0	0.5	0.7	2.0
	roller	5	5	8	115	150	265	115.0	150.0	265.0	0.07	3.1	13.0	5.0	0.5	0.7	2.0
	front end loader	5	5	8	115	150	265	115.0	150.0	265.0	0.07	3.1	13.0	5.0	0.5	0.7	2.0
Architectural Coating	compressor (air)	5	5	8	115	150	265	115.0	150.0	265.0	0.07	3.1	13.0	5.0	0.5	0.7	2.0

To User: bordered cells are inputs, unbordered cells have formulae

noise level limit for construction phase at residential land use, per FTA guidance = 80
allowable hours over which Leq is to be averaged = 8

= highway noise barrier height (of earthen berm plus concrete wall above) between source and receptor

Construction Activity	Equipment	Total Equipment Qty	AUF % (from FHWA RCNM)	Reference Lmax @ 50 ft. from FHWA RCNM	Client Equipment Description, Data Source and/or Notes	Source to NSR Distance (ft.)	*Temporary Barrier Insertion Loss (dB)*	*Additional Noise Reduction*	Distance-Adjusted Lmax	Allowable Operation Time (hours)	Allowable Operation Time (minutes)	Predicted 8-hour Leq
Site Preparation	front end loader	2	40	79		415	3.1		52.8	8	480	52
	dozer	3	40	82		415	3.1		55.8	8	480	57
	backhoe	2	40	78		415	3.1		51.8	8	480	51
									Total for Site Preparation Phase:			**58.6**
Grading	excavator	1	40	81		415	3.1		54.8	8	480	51
	grader	1	40	85		415	3.1		58.8	8	480	55
	dozer	1	40	82		415	3.1		55.8	8	480	52
	front end loader	3	40	79		415	3.1		52.8	8	480	54
									Total for Grading Phase:			**59.1**
Building Construction	crane	1	16	81		415	3.1		54.8	7	420	46
	man lift	3	20	75		415	3.1		48.8	8	480	47
	generator	1	50	72		415	3.1		45.8	8	480	43
	front end loader	3	40	79		415	3.1		52.8	7	420	53
	welder / torch	1	40	73		415	3.1		46.8	8	480	43
									Total for Building Construction Phase:			**55.1**
Paving	concrete mixer truck	2	40	79		415	3.1		52.8	6	360	51
	paver	1	50	77		415	3.1		50.8	8	480	48
	roller	2	20	80		415	3.1		53.8	6	360	49
	front end loader	3	40	79	includes "paving equipment"	415	3.1		52.8	8	480	54
									Total for Paving Phase:			**56.8**
Architectural Coating	compressor (air)	1	40	78		415	3.1		51.8	6	360	47
									Total for Architectural Coating Phase:			**46.6**

Construction Activity	Equipment	Source Elevation (ft)	Receiver Elevation (ft)	Barrier Height (ft)	Source to Barr. ("A") Horiz. (ft)	Rcvr. to Barr. ("B") Horiz. (ft)	Source to Rcvr. ("C") Horiz. (ft)	"A" (ft)	"B" (ft)	"C" (ft)	Path Length Diff. "P" (ft)	Abarr (dB)	Heff (with barrier)	Heff (wout barrier)	G (with barrier)	G (without barrier)	ILbarr (dB)
Site Preparation	front end loader	5	5	6	410	5	415	410.0	5.1	415.0	0.10	4.0	11.0	5.0	0.6	0.7	3.1
	dozer	5	5	6	410	5	415	410.0	5.1	415.0	0.10	4.0	11.0	5.0	0.6	0.7	3.1
	backhoe	5	5	6	410	5	415	410.0	5.1	415.0	0.10	4.0	11.0	5.0	0.6	0.7	3.1
Grading	excavator	5	5	6	410	5	415	410.0	5.1	415.0	0.10	4.0	11.0	5.0	0.6	0.7	3.1
	grader	5	5	6	410	5	415	410.0	5.1	415.0	0.10	4.0	11.0	5.0	0.6	0.7	3.1
	dozer	5	5	6	410	5	415	410.0	5.1	415.0	0.10	4.0	11.0	5.0	0.6	0.7	3.1
	front end loader	5	5	6	410	5	415	410.0	5.1	415.0	0.10	4.0	11.0	5.0	0.6	0.7	3.1
Building Construction	crane	5	5	6	410	5	415	410.0	5.1	415.0	0.10	4.0	11.0	5.0	0.6	0.7	3.1
	man lift	5	5	6	410	5	415	410.0	5.1	415.0	0.10	4.0	11.0	5.0	0.6	0.7	3.1
	generator	5	5	6	410	5	415	410.0	5.1	415.0	0.10	4.0	11.0	5.0	0.6	0.7	3.1
	front end loader	5	5	6	410	5	415	410.0	5.1	415.0	0.10	4.0	11.0	5.0	0.6	0.7	3.1
	welder / torch	5	5	6	410	5	415	410.0	5.1	415.0	0.10	4.0	11.0	5.0	0.6	0.7	3.1
Paving	concrete mixer truck	5	5	6	410	5	415	410.0	5.1	415.0	0.10	4.0	11.0	5.0	0.6	0.7	3.1
	paver	5	5	6	410	5	415	410.0	5.1	415.0	0.10	4.0	11.0	5.0	0.6	0.7	3.1
	roller	5	5	6	410	5	415	410.0	5.1	415.0	0.10	4.0	11.0	5.0	0.6	0.7	3.1
	front end loader	5	5	6	410	5	415	410.0	5.1	415.0	0.10	4.0	11.0	5.0	0.6	0.7	3.1
Architectural Coating	compressor (air)	5	5	6	410	5	415	410.0	5.1	415.0	0.10	4.0	11.0	5.0	0.6	0.7	3.1

To User: bordered cells are inputs, unbordered cells have formulae

noise level limit for construction phase at residential land use, per FTA guidance = 80
allowable hours over which Leq is to be averaged = 8

= highway noise barrier height (of earthen berm plus concrete wall above) between source and receptor

Construction Activity	Equipment	Total Equipment Qty	AUF % (from FHWA RCNM)	Reference Lmax @ 50 ft. from FHWA RCNM	Client Equipment Description, Data Source and/or Notes	Source to NSR Distance (ft.)	*Temporary Barrier Insertion Loss (dB)*	*Additional Noise Reduction*	Distance-Adjusted Lmax	Allowable Operation Time (hours)	Allowable Operation Time (minutes)	Predicted 8-hour Leq
Site Preparation	front end loader	0	40	79		155	11.6		54.1	8	480	0
	dozer	2	40	82		155	11.6		57.1	8	480	56
	backhoe	0	40	78		155	11.6		53.1	8	480	0
										Total for Site Preparation Phase:		**56.1**
Grading	excavator	0	40	81		155	11.6		56.1	8	480	0
	grader	1	40	85		155	11.6		60.1	8	480	56
	dozer	1	40	82		155	11.6		57.1	8	480	53
	front end loader	0	40	79		155	11.6		54.1	8	480	0
										Total for Grading Phase:		**57.9**
Building Construction	crane	1	16	81		155	11.6		56.1	7	420	48
	man lift	0	20	75		155	11.6		50.1	8	480	0
	generator	0	50	72		155	11.6		47.1	8	480	0
	front end loader	1	40	79		155	11.6		54.1	7	420	50
	welder / torch	0	40	73		155	11.6		48.1	8	480	0
										Total for Building Construction Phase:		**51.6**
Paving	concrete mixer truck	1	40	79		155	11.6		54.1	6	360	49
	paver	0	50	77		155	11.6		52.1	8	480	0
	roller	1	20	80		155	11.6		55.1	6	360	47
	front end loader	0	40	79	includes "paving equipment"	155	11.6		54.1	8	480	0
										Total for Paving Phase:		**51.0**
Architectural Coating	compressor (air)	1	40	78		155	11.6		53.1	6	360	48
										Total for Architectural Coating Phase:		**47.8**

Construction Activity	Equipment	Source Elevation (ft)	Receiver Elevation (ft)	Barrier Height (ft)	Source to Barr. ("A") Horiz. (ft)	Rcvr. to Barr. ("B") Horiz. (ft)	Source to Rcvr. ("C") Horiz. (ft)	"A" (ft)	"B" (ft)	"C" (ft)	Path Length Diff. "P" (ft)	Abarr (dB)	Heff (with barrier)	Heff (wout barrier)	G (with barrier)	G (without barrier)	ILbarr (dB)
Site Preparation	front end loader	5	5	8	5	150	155	5.8	150.0	155.0	0.86	12.3	13.0	5.0	0.5	0.7	11.6
	dozer	5	5	8	5	150	155	5.8	150.0	155.0	0.86	12.3	13.0	5.0	0.5	0.7	11.6
	backhoe	5	5	8	5	150	155	5.8	150.0	155.0	0.86	12.3	13.0	5.0	0.5	0.7	11.6
Grading	excavator	5	5	8	5	150	155	5.8	150.0	155.0	0.86	12.3	13.0	5.0	0.5	0.7	11.6
	grader	5	5	8	5	150	155	5.8	150.0	155.0	0.86	12.3	13.0	5.0	0.5	0.7	11.6
	dozer	5	5	8	5	150	155	5.8	150.0	155.0	0.86	12.3	13.0	5.0	0.5	0.7	11.6
	front end loader	5	5	8	5	150	155	5.8	150.0	155.0	0.86	12.3	13.0	5.0	0.5	0.7	11.6
Building Construction	crane	5	5	8	5	150	155	5.8	150.0	155.0	0.86	12.3	13.0	5.0	0.5	0.7	11.6
	man lift	5	5	8	5	150	155	5.8	150.0	155.0	0.86	12.3	13.0	5.0	0.5	0.7	11.6
	generator	5	5	8	5	150	155	5.8	150.0	155.0	0.86	12.3	13.0	5.0	0.5	0.7	11.6
	front end loader	5	5	8	5	150	155	5.8	150.0	155.0	0.86	12.3	13.0	5.0	0.5	0.7	11.6
	welder / torch	5	5	8	5	150	155	5.8	150.0	155.0	0.86	12.3	13.0	5.0	0.5	0.7	11.6
Paving	concrete mixer truck	5	5	8	5	150	155	5.8	150.0	155.0	0.86	12.3	13.0	5.0	0.5	0.7	11.6
	paver	5	5	8	5	150	155	5.8	150.0	155.0	0.86	12.3	13.0	5.0	0.5	0.7	11.6
	roller	5	5	8	5	150	155	5.8	150.0	155.0	0.86	12.3	13.0	5.0	0.5	0.7	11.6
	front end loader	5	5	8	5	150	155	5.8	150.0	155.0	0.86	12.3	13.0	5.0	0.5	0.7	11.6
Architectural Coating	compressor (air)	5	5	8	5	150	155	5.8	150.0	155.0	0.86	12.3	13.0	5.0	0.5	0.7	11.6

To User: bordered cells are inputs, unbordered cells have formulae

noise level limit for construction phase at residential land use, per FTA guidance = 80
allowable hours over which Leq is to be averaged = 8

= highway noise barrier height (of earthen berm plus concrete wall above) between source and receptor

Construction Activity	Equipment	Total Equipment Qty	AUF % (from FHWA RCNM)	Reference Lmax @ 50 ft. from FHWA RCNM	Client Equipment Description, Data Source and/or Notes	Source to NSR Distance (ft.)	*Temporary Barrier Insertion Loss (dB)*	*Additional Noise Reduction*	Distance-Adjusted Lmax	Allowable Operation Time (hours)	Allowable Operation Time (minutes)	Predicted 8-hour Leq
Site Preparation	front end loader	0	40	79		155	3.6		62.2	8	480	0
	dozer	2	40	82		155	3.6		65.2	8	480	64
	backhoe	0	40	78		155	3.6		61.2	8	480	0
										Total for Site Preparation Phase:		**64.2**
Grading	excavator	0	40	81		155	3.6		64.2	8	480	0
	grader	1	40	85		155	3.6		68.2	8	480	64
	dozer	1	40	82		155	3.6		65.2	8	480	61
	front end loader	0	40	79		155	3.6		62.2	8	480	0
										Total for Grading Phase:		**65.9**
Building Construction	crane	1	16	81		155	3.6		64.2	7	420	56
	man lift	0	20	75		155	3.6		58.2	8	480	0
	generator	0	50	72		155	3.6		55.2	8	480	0
	front end loader	1	40	79		155	3.6		62.2	7	420	58
	welder / torch	0	40	73		155	3.6		56.2	8	480	0
										Total for Building Construction Phase:		**59.7**
Paving	concrete mixer truck	1	40	79		155	3.6		62.2	6	360	57
	paver	0	50	77		155	3.6		60.2	8	480	0
	roller	1	20	80		155	3.6		63.2	6	360	55
	front end loader	0	40	79	includes "paving equipment"	155	3.6		62.2	8	480	0
										Total for Paving Phase:		**59.0**
Architectural Coating	compressor (air)	1	40	78		155	3.6		61.2	6	360	56
										Total for Architectural Coating Phase:		**55.9**

Construction Activity	Equipment	Source Elevation (ft)	Receiver Elevation (ft)	Barrier Height (ft)	Source to Barr. ("A") Horiz. (ft)	Rcvr. to Barr. ("B") Horiz. (ft)	Source to Rcvr. ("C") Horiz. (ft)	"A" (ft)	"B" (ft)	"C" (ft)	Path Length Diff. "P" (ft)	Abarr (dB)	Heff (with barrier)	Heff (wout barrier)	G (with barrier)	G (without barrier)	ILbarr (dB)
Site Preparation	front end loader	5	5	6	150	5	155	150.0	5.1	155.0	0.10	4.1	11.0	5.0	0.6	0.7	3.6
	dozer	5	5	6	150	5	155	150.0	5.1	155.0	0.10	4.1	11.0	5.0	0.6	0.7	3.6
	backhoe	5	5	6	150	5	155	150.0	5.1	155.0	0.10	4.1	11.0	5.0	0.6	0.7	3.6
Grading	excavator	5	5	6	150	5	155	150.0	5.1	155.0	0.10	4.1	11.0	5.0	0.6	0.7	3.6
	grader	5	5	6	150	5	155	150.0	5.1	155.0	0.10	4.1	11.0	5.0	0.6	0.7	3.6
	dozer	5	5	6	150	5	155	150.0	5.1	155.0	0.10	4.1	11.0	5.0	0.6	0.7	3.6
	front end loader	5	5	6	150	5	155	150.0	5.1	155.0	0.10	4.1	11.0	5.0	0.6	0.7	3.6
Building Construction	crane	5	5	6	150	5	155	150.0	5.1	155.0	0.10	4.1	11.0	5.0	0.6	0.7	3.6
	man lift	5	5	6	150	5	155	150.0	5.1	155.0	0.10	4.1	11.0	5.0	0.6	0.7	3.6
	generator	5	5	6	150	5	155	150.0	5.1	155.0	0.10	4.1	11.0	5.0	0.6	0.7	3.6
	front end loader	5	5	6	150	5	155	150.0	5.1	155.0	0.10	4.1	11.0	5.0	0.6	0.7	3.6
	welder / torch	5	5	6	150	5	155	150.0	5.1	155.0	0.10	4.1	11.0	5.0	0.6	0.7	3.6
Paving	concrete mixer truck	5	5	6	150	5	155	150.0	5.1	155.0	0.10	4.1	11.0	5.0	0.6	0.7	3.6
	paver	5	5	6	150	5	155	150.0	5.1	155.0	0.10	4.1	11.0	5.0	0.6	0.7	3.6
	roller	5	5	6	150	5	155	150.0	5.1	155.0	0.10	4.1	11.0	5.0	0.6	0.7	3.6
	front end loader	5	5	6	150	5	155	150.0	5.1	155.0	0.10	4.1	11.0	5.0	0.6	0.7	3.6
Architectural Coating	compressor (air)	5	5	6	150	5	155	150.0	5.1	155.0	0.10	4.1	11.0	5.0	0.6	0.7	3.6

Equipment Description	Impact Device?	Acoustical Use Factor (%)	Lesser of or available Lmax	Spec. 721 Lmax	Measured L_{max} @50ft (dBA, slow)
All Other Equipment > 5 HP	No	50	85	85	-- N/A --
Auger Drill Rig	No	20	84	85	84
Backhoe	No	40	78	80	78
Bar Bender	No	20	80	80	-- N/A --
Blasting	Yes	-- N/A --	94	94	-- N/A --
Boring Jack Power Unit	No	50	80	80	83
Chain Saw	No	20	84	85	84
Clam Shovel (dropping)	Yes	20	87	93	87
Compactor (ground)	No	20	80	80	83
Compressor (air)	No	40	78	80	78
Concrete Batch Plant	No	15	83	83	-- N/A --
Concrete Mixer Truck	No	40	79	85	79
Concrete Pump Truck	No	20	81	82	81
Concrete Saw	No	20	90	90	90
Crane	No	16	81	85	81
Dozer	No	40	82	85	82
Drill Rig Truck	No	20	79	84	79
Drum Mixer	No	50	80	80	80
Dump Truck	No	40	76	84	76
Excavator	No	40	81	85	81
Flat Bed Truck	No	40	74	84	74
Front End Loader	No	40	79	80	79
Generator	No	50	72	72	81
Generator (<25KVA, VMS signs)	No	50	70	70	73
Gradall	No	40	83	85	83
Grader	No	40	85	85	-- N/A --
Grapple (on backhoe)	No	40	85	85	87
Horizontal Boring Hydr. Jack	No	25	80	80	82
Hydra Break Ram	Yes	10	90	90	-- N/A --
Impact Pile Driver	Yes	20	95	95	101
Jackhammer	Yes	20	85	85	89
Man Lift	No	20	75	85	75
Mounted Impact Hammer (hoe ram)	Yes	20	90	90	90
Pavement Scarafier	No	20	85	85	90
Paver	No	50	77	85	77
Pickup Truck	No	40	55	55	75
Pneumatic Tools	No	50	85	85	85
Pumps	No	50	77	77	81
Refrigerator Unit	No	100	73	82	73
Rivit Buster/chipping gun	Yes	20	79	85	79
Rock Drill	No	20	81	85	81
Roller	No	20	80	85	80
Sand Blasting (Single Nozzle)	No	20	85	85	96
Scraper	No	40	84	85	84
Shears (on backhoe)	No	40	85	85	96
Slurry Plant	No	100	78	78	78
Slurry Trenching Machine	No	50	80	82	80
Soil Mix Drill Rig	No	50	80	80	-- N/A --
Tractor	No	40	84	84	-- N/A --
Vacuum Excavator (Vac-truck)	No	40	85	85	85
Vacuum Street Sweeper	No	10	80	80	82
Ventilation Fan	No	100	79	85	79
Vibrating Hopper	No	50	85	85	87
Vibratory Concrete Mixer	No	20	80	80	80
Vibratory Pile Driver	No	20	95	95	101
Warning Horn	No	5	83	85	83
Welder / Torch	No	40	73	73	74
Skid-steer*	No	40	80		

* https://ia.cpuc.ca.gov/Environment/info/ene/mesa/attachment/A1503003%20ED-SCE-01%20Q.PD-01%20Attachment%20(Revised%20Noise%20Levels%20Construction%20Equipment).pdf

Roadway Traffic Noise Prediction (CNEL)
(FHWA RD-77-108, using Calveno curves)

Project: Maverik (Sheldon Rd. & W. Stockton Blvd.)
Scenario: Existing 2023 w/out project

User Inputs (boxed cells)	
Day	80.00%
Evening	10.00%
Nighttime	10.00%

Roadway Segment	Peak Hour Traffic (AM)[A]	Peak Hour Traffic (PM)[A]	Average Weekday Traffic (AWT)[A]	Speed (mph)[A]	NSR distance (feet)	Automobiles (Auto)[B] %	Medium Trucks (MT)[B,C] %**	Heavy Trucks (MT)[B,C] %**	Equivalent Traffic Percentages by Vehicle Type: Auto	MT	HT	Auto Noise (at 50ft)	MT Noise (at 50ft)	HT Noise (at 50ft)	CNEL Total (at 50ft)	CNEL[D] Total (at NSR)
Sheldon Road (west of project site)	2,549	2,768	26585	45	70	94%	2%	4%	198.0%	4.2%	9.4%	69.7	61.2	69.2	72.8	70.6
SR99	15,900	15,900	159000	65	875	94%	2%	4%	198.0%	4.2%	9.4%	82.1	71.5	78.5	83.9	65.2
NSR = 8163 Sheldon Road (Vasari Apartment Homes)															logsum of roadway segment noise:	71.7
Sheldon Road (east of project site)	3,483	3,886	36845	45	70	94%	2%	4%	198.0%	4.2%	9.4%	71.1	62.6	70.7	74.2	72.0
SR99	15,900	15,900	159000	65	1300	94%	2%	4%	198.0%	4.2%	9.4%	82.1	71.5	78.5	83.9	62.7
NSR = 8364 Sheldon Road															logsum of roadway segment noise:	72.5
SR 99 ramps south of Sheldon Road	1,040	1,607	13235	35	175	94%	2%	4%	198.0%	4.2%	9.4%	63.5	56.5	55.7	64.9	56.7
SR99	15,900	15,900	159000	65	675	94%	2%	4%	198.0%	4.2%	9.4%	82.1	71.5	78.5	83.9	66.9
NSR = homes west of Sheldon Terrace Lane near Zenia Lane															logsum of roadway segment noise:	67.3
W. Stockton Blvd. north of Sheldon Road	772	656	7140	50	55	94%	2%	4%	198.0%	4.2%	9.4%	65.3	56.2	64.0	68.0	67.4
SR99	15,900	15,900	159000	65	230	94%	2%	4%	198.0%	4.2%	9.4%	82.1	71.5	78.5	83.9	74.0
NSR = 8728 W. Stockton Blvd. (Vasari Apartment Homes)															logsum of roadway segment noise:	74.8

[A] from Fehr & Peers March 15, 2022 Traffic Operations Analysis

[B] assume distribution on local roadways same as that on neraby SR 99 segment (from Caltrans 2019 data)

[C] medium trucks are 2-axle, heavy trucks are 3-5 axles.

[D] assumes "soft" site propagation.

below from Caltrans 2019 Truck Volumes data:

RTE	RTE_SFX	DIST	CNTY	LEG	POSTMILE	DESCRIPTION	VEHICLE_TOTAL	TRUCK_TOTAL	TRK_PERCENT_T	TRK_2_AXLE	TRK_3_AXLE	TRK_4_AXLE	TRK_5_AXLE	TRK_2_AXLE_	TRK_3_AXLE_	TRK_4_AXLE_	TRK_5_AXLE_PCT
099		03	SAC	B	17.242	Sacramento, Stockton Blvd.	159,000	10,208	6.42	3151	685	343	6029	30.87	6.71	3.36	59.06

Roadway Traffic Noise Prediction (CNEL)
(FHWA RD-77-108, using Calveno curves)

User Inputs (boxed cells)	
Day	**80.00%**
Evening	**10.00%**
Nighttime	**10.00%**

Project:	**Maverik (Sheldon Rd. & W. Stockton Blvd.)**
Scenario:	**Existing 2023 with project**

Roadway Segment	Peak Hour Traffic (AM)[A]	Peak Hour Traffic (PM)[A]	Average Weekday Traffic (AWT)[A]	Speed (mph)[A]	NSR distance (feet)	Automobiles (Auto)[B] %	Medium Trucks (MT)[B,C] %**	Heavy Trucks (MT)[B,C] %**	Equivalent Traffic Percentages by Vehicle Type: Auto	MT	HT	Auto Noise (at 50ft)	MT Noise (at 50ft)	HT Noise (at 50ft)	CNEL Total (at 50ft)	CNEL Total (at NSR)	CNEL[D] Change (dB) at NSR
Sheldon Road (west of project site)	2,565	2,784	26745	45	70	94%	2%	4%	198.0%	4.2%	9.4%	69.7	61.3	69.3	72.8	70.6	
SR99	15,900	15,900	159000	65	875	94%	2%	4%	198.0%	4.2%	9.4%	82.1	71.5	78.5	83.9	65.2	
NSR = 8163 Sheldon Road (Vasari Apartment Homes)														logsum of roadway segment noise:		71.7	0.02
Sheldon Road (east of project site)	3,549	3,926	37375	45	70	94%	2%	4%	198.0%	4.2%	9.4%	71.2	62.7	70.7	74.3	72.1	
SR99	15,900	15,900	159000	65	1300	94%	2%	4%	198.0%	4.2%	9.4%	82.1	71.5	78.5	83.9	62.7	
NSR = 8364 Sheldon Road														logsum of roadway segment noise:		72.6	0.06
SR 99 ramps south of Sheldon Road	1,053	1,627	13400	35	175	94%	2%	4%	198.0%	4.2%	9.4%	63.6	56.5	55.7	64.9	56.8	
SR99	15,900	15,900	159000	65	675	94%	2%	4%	198.0%	4.2%	9.4%	82.1	71.5	78.5	83.9	66.9	
NSR = homes west of Sheldon Terrace Lane near Zenia Lane														logsum of roadway segment noise:		67.3	0.00
W. Stockton Blvd. north of Sheldon Road	810	694	7520	50	55	94%	2%	4%	198.0%	4.2%	9.4%	65.5	56.5	64.2	68.2	67.6	
SR99	15,900	15,900	159000	65	230	94%	2%	4%	198.0%	4.2%	9.4%	82.1	71.5	78.5	83.9	74.0	
NSR = 8728 W. Stockton Blvd. (Vasari Apartment Homes)														logsum of roadway segment noise:		74.9	0.04

[A] from Fehr & Peers March 15, 2022 Traffic Operations Analysis
[B] assume distribution on local roadways same as that on neraby SR 99 segment (from Caltrans 2019 data)
[C] medium trucks are 2-axle, heavy trucks are 3-5 axles.
[D] assumes "soft" site propagation.

below from Caltrans 2019 Truck Volumes data:

RTE	RTE_SFX	DIST	CNTY	LEG	POSTMILE	DESCRIPTION	VEHICLE_TOTAL	TRUCK_TOTAL	TRK_PERCENT_T	TRK_2_AXLE	TRK_3_AXLE	TRK_4_AXLE	TRK_5_AXLE	TRK_2_AXLE_	TRK_3_AXLE_	TRK_4_AXLE_	TRK_5_AXLE_PCT
099		03	SAC	B	17.242	Sacramento, Stockton Blvd.	159,000	10,208	6.42	3151	685	343	6029	30.87	6.71	3.36	59.06

Project parking lot movements

Receiver	Perp. Distance (ft) to Source	Distance dB loss	Air absorption dB loss	Ground abs. dB loss	Est. Barrier Insert. loss dB	SPL Leq at Rcvr	Source (ft)	Rcvr (ft)	Ref dBA	Vehicles (N)	Ref dist	Notes
reference	3.28	-23.7	0.0	0.0	0	76.3	3	5	53	66	50	vehicle count (peak hour AM) is per Table 1 of the Fehr & Peers traffic analysis (March 2022)

AHUs (plenum-type return fan only, no condenser units [see separate worksheet]):

Building Minimum Ventilation

		63	125	250	500	1000	2000	4000	8000
A-weighting adjustments		26	13	9	3	0	-1	-1	1
average of values for the two fan diameter ranges, per Guyer (Table 12)	plug	40	40	38	34	29	23	19	16
average of values for the two fan diameter ranges, per Guyer (Table 12)	tube	47	44	46	47	44	45	38	35
per Guyer (Table 12, presumed based on Bies & Hansen ENC)	prop	46	48	55	53	52	48	43	38

percent GSF actually occupied (and need ventilation): 90

Tag	Building	GSF	Avail. SF	Height (ft)	Avg. minutes to change air*	Volume (ft3)	CFM	m^2	comparable facility function	Pressure (iwg)	Pressure (Pa)	Q (m^3/s)	fantype = plug, tube, or prop	A-weighted PWL (for CadnaA inputs) 63	125	250	500	1000	2000	4000	8000	OA dB
return air fans in building rooftop AHUs:																						
	Retail A	5637	5073	10	8	50733	6341.625	472	retail stores	2	500	3	plug	53	65	66	67	64	57	51	46	**72**

	63	125	250	500	1000	2000	4000	8000
fan or AHU cabinet liner/interior attenuation (excludes inlet/outlet PWL split, already in calcs above:	2	3	4	5	6	8	10	10

*from 3-10 minute range for "retail stores", 2-5 minute range for "residences" per Loren Cook's "Engineering Cookbook", 1999 edition, p. 41

ACCs (air-cooled chillers on rooftops):

Building Interior Comfort

with or without sound insulation? (enter Y/N): n

	tons	LWA	63	125	250	500	1000	2000	4000	8000
			unweighted PWL (dB) per OCBF (Hz) at full load (100%)							
Bryant BH16-018 (no sound blanket)	1.5	68	66.2	66.2	63.8	64.1	64.6	59.9	57.7	53.6
Bryant BH16-024 (no sound blanket)	2	72	63.4	63.4	63.3	63.3	70.4	64.5	59.3	55.5
Bryant BH16-036 (no sound blanket)	3	72	67.7	67.7	66.8	68.1	69.9	62.8	60.3	55.2
Bryant BH16-048 (no sound blanket)	4	73	67.5	67.5	67.8	70.1	70.6	63.1	58.5	53.3
Bryant BH16-060 (no sound blanket)	5	70	61.7	61.7	65.6	68.1	65.8	59.8	58.4	56.1
Daikin AGZ-E 30 (w/out sound insulation)	30	88	92	91	88	87	83	78	73	68
Daikin AGZ-E 40 (w/out sound insulation)	40	89	92	91	90	88	84	79	74	69
Daikin AGZ-E 50 (w/out sound insulation)	50	90	93	93	91	89	85	79	74	69
Daikin AGZ-E 60 (w/out sound insulation)	60	91	94	93	94	89	86	81	76	71
Daikin AGZ-E 70 (w/out sound insulation)	70	92	95	95	94	89	87	81	76	71
Daikin AGZ-E 80 (w/out sound insulation)	80	92	95	95	95	89	87	81	76	71
Daikin AGZ-E 90 (w/out sound insulation)	90	93	94	95	92	91	89	83	81	81
Daikin AGZ-E 120 (w/out sound insulation)	120	95	93	96	92	92	90	84	84	82
Daikin AGZ-E 240 (w/out sound insulation)	241	100	98	98	98	95	96	90	90	86

actual percent of GSF occupied: 90

Phase	Building Tag	GSF	Avail. SF	comparable facility function	Avg. GSF per ton*	tons of refrig.	Approx. Qty. of ACCs	tons per ACC	Approx. Total PWL (dBA)	63	125	250	500	1000	2000	4000	8000
										unweighted PWL (dB) per OCBF (Hz) at full load (100%)							
	Retail A	5637	5073	Department Stores - main floor	350	14.5	3	5	**78**	72	72	73	75	75	68	63	58

*based upon "lo" value per Loren Cook's "Engineering Cookbook", 1999 edition, pp. 59-60

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