

## 4.13 Noise

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This section evaluates potential noise and vibration impacts from development facilitated by the proposed 2022 RTP/SCS.

### 4.13.1 Setting

#### a. Overview of Noise and Vibration

The following discussion describes the characteristics of noise and vibration. These characteristics are used to assess potential impacts at sensitive land uses. Noise- and vibration-sensitive land uses include locations where people reside or where the presence of unwanted sound could adversely affect the use of the land. Residences, senior facilities, schools, hospitals, guest lodging, libraries and some passive recreation areas are examples of typical noise- and vibration-sensitive land uses.

#### Noise

Sound is a vibratory disturbance created by a moving or vibrating source, which is capable of being detected by the hearing organs. Noise is defined as sound that is loud, unpleasant, unexpected, or undesired and may therefore be classified as a more specific group of sounds. The effects of noise on people can include general annoyance, interference with speech communication, sleep disturbance, and, in the extreme, hearing impairment (California Department of Transportation [Caltrans] 2013a).

Noise levels are commonly measured in decibels (dB) using the A-weighted sound pressure level (dBA). The A-weighting scale is an adjustment to the actual sound pressure levels so that they are consistent with the human hearing response, which is most sensitive to frequencies around 4,000 Hertz and less sensitive to frequencies around and below 100 Hertz (Kinsler, et. al. 1999). Decibels are measured on a logarithmic scale that quantifies sound intensity in a manner similar to the Richter scale used to measure earthquake magnitudes. A doubling of the energy of a noise source, such as doubling of traffic volume, would increase the noise level by 3 dBA; reducing the energy in half would result in a 3 dBA decrease (Crocker 2007).

Human perception of noise has no simple correlation with sound energy: the perception of sound is not linear in terms of dBA or in terms of sound energy. Two sources do not “sound twice as loud” as one source. It is widely accepted that the average healthy ear can barely perceive changes of 3 dBA, increase or decrease (i.e., twice the sound energy); that a change of 5 dBA is readily perceptible (8 times the sound energy); and that an increase (or decrease) of 10 dBA sounds twice (half) as loud ([10.5x the sound energy] Crocker 2007).

Sound changes in both level and frequency spectrum as it travels from the source to the receiver. The most obvious change is the decrease in level as the distance from the source increases. The manner in which noise reduces with distance depends on factors such as the type of sources (e.g., point or line, the path the sound will travel, site conditions, and obstructions). Noise levels from a point source typically attenuate, or drop off, at a rate of 6 dBA per doubling of distance (e.g., construction, industrial machinery, ventilation units). Noise from a line source (e.g., roadway, pipeline, railroad) typically attenuates at about 3 dBA per doubling of distance (Caltrans 2013a). The propagation of noise is also affected by the intervening ground, known as ground absorption. A hard site, such as a parking lot or smooth body of water, receives no additional ground attenuation and the changes in noise levels with distance (drop-off rate) result from simply the geometric spreading

of the source. An additional ground attenuation value of 1.5 dBA per doubling of distance applies to a soft site (e.g., soft dirt, grass, or scattered bushes and trees) (Caltrans 2013a). Noise levels may also be reduced by intervening structures; the amount of attenuation provided by this “shielding” depends on the size of the object and the frequencies of the noise levels. Natural terrain features such as hills and dense woods, and man-made features such as buildings and walls, can significantly alter noise levels. Generally, any large structure blocking the line of sight will provide at least a 5-dBA reduction in source noise levels at the receiver (Federal Highway Administration [FHWA] 2011). Structures can substantially reduce exposure to noise as well. The FHWA’s guidelines indicate that modern building construction generally provides an exterior-to-interior noise level reduction of 20 to 35 dBA with closed windows.

The impact of noise is not a function of loudness alone. The time of day when noise occurs, and the duration of the noise are also important factors of project noise impact. Most noise that lasts for more than a few seconds is variable in its intensity. Consequently, a variety of noise descriptors have been developed. One of the most frequently used noise metrics is the equivalent noise level ( $L_{eq}$ ); it considers both duration and sound power level.  $L_{eq}$  is defined as the single steady A-weighted level equivalent to the same amount of energy as that contained in the actual fluctuating levels over time. Typically,  $L_{eq}$  is summed over a one-hour period.  $L_{max}$  is the highest root mean square (RMS) sound pressure level within the sampling period, and  $L_{min}$  is the lowest RMS sound pressure level within the measuring period (Crocker 2007).

Noise that occurs at night tends to be more disturbing than that occurring during the day. Community noise is usually measured using Day-Night Average Level ( $L_{dn}$ ), which is the 24-hour average noise level with a +10 dBA penalty for noise occurring during nighttime (10:00 p.m. to 7:00 a.m.) hours; it is also measured using Community Noise Equivalent Level (CNEL), which is the 24-hour average noise level with a +5 dBA penalty for noise occurring from 7:00 p.m. to 10:00 p.m. and a +10 dBA penalty for noise occurring from 10:00 p.m. to 7:00 a.m. (Caltrans 2013a). Noise levels described by  $L_{dn}$  and CNEL usually differ by about 1 dBA. The relationship between the peak-hour  $L_{eq}$  value and the  $L_{dn}$ /CNEL depends on the distribution of traffic during the day, evening, and night. Quiet suburban areas typically have CNEL noise levels in the range of 40 to 50 dBA, while areas near arterial streets are in the 50 to 60-plus CNEL range. Normal conversational levels are in the 60 to 65-dBA  $L_{eq}$  range; ambient noise levels greater than 65 dBA  $L_{eq}$  can interrupt conversations (Federal Transit Administration [FTA] 2018).

## **Vibration**

Groundborne vibration of concern in environmental analysis consists of the oscillatory waves that move from a source through the ground to adjacent structures. The number of cycles per second of oscillation makes up the vibration frequency, described in terms of Hz. The frequency of a vibrating object describes how rapidly it oscillates. The normal frequency range of most groundborne vibration that can be felt by the human body starts from a low frequency of less than 1 Hz and goes to a high of about 200 Hz (Crocker 2007).

While people have varying sensitivities to vibrations at different frequencies, in general they are most sensitive to low frequency vibration. Vibration in buildings, such as from nearby construction activities, may cause windows, items on shelves, and pictures on walls to rattle. Vibration of building components can also take the form of an audible low frequency rumbling noise, referred to as groundborne noise. Groundborne noise is usually only a problem when the originating vibration spectrum is dominated by frequencies in the upper end of the range (60 to 200 Hz), or when foundations or utilities, such as sewer and water pipes, physically connect the structure and the

vibration source (FTA 2018). Although groundborne vibration is sometimes noticeable in outdoor environments, it is almost never annoying to people who are outdoors. The primary concern from vibration is that it can be intrusive and annoying to building occupants and vibration-sensitive land uses.

Vibration energy spreads out as it travels through the ground, causing the vibration level to diminish with distance away from the source. High-frequency vibrations diminish much more rapidly than low frequencies, so low frequencies tend to dominate the spectrum at large distances from the source. Discontinuities in the soil strata can also cause diffractions or channeling effects that affect the propagation of vibration over long distances (Caltrans 2013b). When a building is impacted by vibration, a ground-to-foundation coupling loss will usually reduce the overall vibration level. However, under rare circumstances, the ground-to-foundation coupling may actually amplify the vibration level due to structural resonances of the floors and walls.

Vibration amplitudes are usually expressed in peak particle velocity (PPV) or RMS vibration velocity. The PPV and RMS velocity are normally described in inches per second. PPV is defined as the maximum instantaneous positive or negative peak of a vibration signal. PPV is often used in monitoring of blasting vibration because it is related to the stresses that are experienced by buildings (Caltrans 2013b).

## **b. Noise and Vibration Sources**

The principal noise generators in the SJCOG region are associated with transportation (i.e., major roads, airports, and rail lines). Local collector streets are not typically significant noise sources as traffic volume and speeds are generally much lower than for freeways and arterial roadways.

Similar to the environmental setting for noise, the vibration environment is typically dominated by traffic from nearby roadways and activity on construction sites. Heavy trucks typically operate on major streets and can generate groundborne vibration that varies depending on vehicle type, weight, and pavement conditions. Nonetheless, vibration due to roadway traffic is typically not perceptible. The major noise and vibration sources in the region are described below.

### **Motor Vehicle Traffic**

Motor vehicles, including cars/light trucks, buses, and various types of trucks, are the most substantial source of noise in most of the SJCOG region. This can be attributed to the extensive network of major, primary, and secondary arterials located throughout the region, as well as the large number of vehicle trips that occur each day.

The primary roadway corridor noise sources in the SJCOG region are Interstate 5 and State Route (SR) 99 due to the high traffic volumes and the high traffic speed of these roadways. In 2017, daily traffic on Interstate 5 averaged from 19,000 vehicles north of the Stanislaus-San Joaquin County line to 152,000 vehicles between the junction with SR 205 West and SR 120 East, west of the City of Manteca. In 2017, daily traffic on SR 99 averaged from 76,000 vehicles south of the Sacramento-San Joaquin County line to 116,000 vehicles between Milgeo Avenue and Jack Tone Road, near the southern County line (Caltrans 2017). As a result, noise levels along the entire Interstate 5 and SR 99 corridors in the region exceed 65 dBA CNEL. Levels of highway noise typically range from 70 to 80 dB(A) at a distance of 50 feet from highways (Federal Highway Administration [FHA] 2003).

Traffic on other major transportation corridors in the SJCOG region, such as SR 12, 26, 88, 120, and 132, and Interstate 205 and 580 also generates noise in excess of 65 dBA CNEL within certain

distances from the centerline of the freeway/roadway. Traffic on several roads in the region also generates noise in excess of normally acceptable standards for noise-sensitive uses.

## **Aircraft Operation**

San Joaquin County has six public-use aviation airports, which include the following:

- Kingdon Executive
- Lodi
- Lodi Precissi Airpark
- New Jerusalem
- Stockton Metropolitan
- Tracy Municipal

Of these airports, only the Stockton Metropolitan Airport provides scheduled air carrier service. The Stockton Metropolitan Airport has commercial and general aviation activities. Because of the level of activity at this airport, noise generated is audible in the surrounding communities. Therefore, land uses in the surrounding areas have been planned to ensure that noise levels remain at acceptable levels for the various uses.

Stockton Metropolitan, Tracy Municipal, and New Jerusalem (outside Tracy) are all public airports while Lind's Airport, the Precissi Airpark, and the Kingdon Airpark are privately owned. While these general aviation airports do not generate as much noise as Stockton Metropolitan Airport, flight operations have also had impacts on the nearby residential areas because of their location.

In addition to airplanes, helicopter flights occur throughout the SJCOG region. These flights typically follow major and primary arterials with the exception of police patrol activities. Other flight-related activities include tourist sightseeing and San Joaquin County Sheriff's Department for search and rescue operations. San Joaquin General Hospital in San Joaquin is verified as a Level II Trauma Center and provides helicopter emergency medical services from Oakland to Rancho Murrieta. Although single-event noise exposure resulting from helicopter operations may be considered a nuisance, the relatively low frequency and short duration of these operations do not significantly affect average daily noise levels anywhere in the SJCOG region.

## **Railroad Operations**

Train operations on the Altamont Corridor Express (ACE) and Amtrak generate noise within proximity to the railroad lines. Noise is generated during rail operations by locomotives starting and stopping, trains braking, the connection and disconnection of cars, train whistles, and track noise (the trains' wheels running on the track). The ACE commuter rail connects Stockton to San Jose. Amtrak originates in the City of Bakersfield and travels north towards Stockton.

The Amtrak San Joaquin is a passenger train. Twelve daily trains run between Bakersfield and Stockton, where the route splits to Oakland (four trains each way) or Sacramento (two trains each way). In the southern part of the County, train tracks are generally located much closer to residences.

Railroad operations generate high, relatively brief, intermittent noise events. These noise events are an environmental concern for sensitive uses located along rail lines and near sidings and switching yards. According to the FTA Transit Noise and Vibration Impact Assessment guidance document (2018), vehicle propulsion rail units generate the following noises: (1) whine from electric control

systems and traction motors that propel rapid transit cars, (2) diesel-engine exhaust noise from locomotives, (3) air-turbulence noise generated by cooling fans and (4) gear noise. Additional noise of motion is generated by the interaction of wheels/tires with their running surfaces. The interaction of steel wheels and rails generates three types of noise: (1) rolling noise due to continuous rolling contact, (2) impact noise when a wheel encounters a discontinuity in the running surface, such as a rail joint, turnout or crossover and (3) squeal generated by friction on tight curves.

When comparing electric- and diesel-powered trains, speed dependence is strong for electric-powered transit trains because wheel/rail noise dominates, and noise from this source increases strongly with increasing speed. On the other hand, speed dependence is less for diesel-powered commuter rail trains, particularly at low speeds where the locomotive exhaust noise dominates. As speed increases, wheel-rail noise becomes the dominant noise source and diesel- and electric-powered trains will generate similar noise levels. For transit vehicles in motion, close-by sound levels also depend upon other parameters, such as vehicle acceleration and vehicle length, plus the type/condition of the running surfaces. For very high-speed rail vehicles, air turbulence can also be a significant source of noise. In addition, the guideway structure can also radiate noise as it vibrates in response to the dynamic loading of the moving vehicle.

Rail operations generate varying noise levels depending on the type of rail activity. Heavier commuter or freight trains, which are diesel-powered, generate more noise than electrically-powered light-rail vehicles. According to the FTA, six commuter trains traveling at 50 miles per hour with a horn blowing generate a noise level of 81 dBA  $L_{eq}$  at 50 feet. This same activity without a horn generates a noise level of 68 dBA  $L_{eq}$  at 50 feet. In comparison, 12 light rail transit trains traveling 40 miles per hour generate a noise level of 65 dBA  $L_{eq}$  at 50 feet. These same light rail transit trains generate a noise level of 57 dBA  $L_{eq}$  at 20 miles per hour at 50 feet (FTA 2018).

## **Industrial and Manufacturing**

Noise from industrial complexes and manufacturing plants are characterized as stationary or point sources even though they may include mobile sources like heavy equipment. Local governments typically regulate noise from industrial, manufacturing and construction equipment and activities through enforcement of noise ordinance standards, implementation of general plan policies and imposition of conditions of approval for building or grading permits.

In general, in the SJCOG region and throughout California, industrial complexes and manufacturing plants are located away from sensitive land uses and, as such, noise generated from these sources has less of an effect on surrounding properties.

## **Construction Noise and Vibration**

Noise and vibration from construction sites are characterized as stationary or point sources even though heavy construction equipment is often mobile. Construction activities typically generate high, intermittent noise and vibration on and adjacent to construction sites and related noise and vibration impacts are short-term, occurring primarily on weekdays and during daylight hours. The dominant source of noise from most construction equipment is their diesel engine. During pile driving or pavement breaking events, impact noise is the dominant source and equipment produces the highest vibration levels. Construction equipment operates in two modes, stationary and mobile. Stationary equipment operates in one location for one or more days at a time and can generate a constant noise level (e.g., pumps, generators, and air compressors) or variable noise levels (e.g., pile drivers and pavement breakers). Mobile equipment moves around the construction site (e.g.,

dozers, tractors). Noise levels vary depending on the power cycle being used. Mobile equipment such as trucks, move to and from the site using adjacent streets/roads.

## 4.13.2 Regulatory Setting

### **a. Federal Laws, Regulations, and Policies**

Relevant federal regulations include those established by the FHWA, FTA, Federal Aviation Administration (FAA), and Department of Housing and Urban Development (HUD).

#### **Federal Highway Administration**

##### *Title 23, Part 772 of the Code of Federal Regulations - Traffic Noise*

Traffic noise impacts, as defined in 23 CFR § 772.5, occur when the predicted noise level in the design year approach or exceed the noise abatement criteria (NAC) specified in 23 CFR § 772, or a predicted noise level substantially exceeds the existing noise level (a “substantial” noise increase). A “substantial increase” is defined as an increase of 12 dB  $L_{eq}$  during the peak hour of traffic. For sensitive uses, such as residences, schools, churches, parks, and playgrounds, the NAC for interior and exterior spaces is 57 dB  $L_{eq}$  and 66 dB  $L_{eq}$ , respectively, during the peak hour of traffic noise. Table 4.13-1 summarizes NAC corresponding to various land use activity categories. Activity categories and related traffic noise impacts are determined based on the actual land use in a given area.

##### *Title 40, Part 205, Subpart B of the Code of Federal Regulations – Medium and Heavy Trucks*

Federal regulations establish noise limits for medium and heavy trucks (more than 4.5 tons, gross vehicle weight rating) under 40 CFR Part 205, Subpart B. The federal truck passby noise standard is 80 dB at 15 meters from the vehicle pathway centerline. These controls are implemented through regulatory controls on truck manufacturers. The FHWA regulations for noise abatement apply to federal or federally-funded projects involving the construction of a new highway or significant modification of an existing freeway when the project would result in a substantial noise increase or when the predicted noise levels approach or exceed the NAC.

##### *Title 40, Part 201 and Title 49, Part 210 of the Code of Federal Regulations - Railroad Noise*

Federal regulations for railroad noise are contained in 40 CFR Part 201 and 49 CFR Part 210. The regulations set noise limits for locomotives and are implemented through regulatory controls on locomotive manufacturers.

**Table 4.13-1 Noise Abatement Criteria (NAC)**

Activity Category	Hourly Leq	Hourly L10 <sup>1</sup>	Analysis Location	Description of Activity Category
A	57	60	Exterior	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose
B	67	70	Exterior	Residential
C	67	70	Exterior	Active sport areas, amphitheatres, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings
D	52	55	Interior	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios
E	72	75	Exterior	Hotels, motels, offices, restaurants/bars and other developed lands, properties or activities not included in A-D or F
F				Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical) and warehousing
G				Undeveloped lands that are not permitted

<sup>1</sup> L10 is the level of noise exceeded for 10% of the time.

Source: FHWA 2017

*Title 23, Part 772 of the Code of Federal Regulations – Federal and Federal-Aid Highway Projects*

Title 23 of the Code of Federal Regulations (23 CFR § 772) provides procedures for preparing operational and construction noise studies and evaluating noise abatement for federal and federal-aid highway projects. Under 23 CFR § 772.5, projects are categorized as Type I, II, or III projects.

FHWA defines a Type I project as a proposed federal or federal-aid highway project for the construction of a highway on a new location or the physical alteration of an existing highway which significantly changes either the horizontal or vertical alignment, or increases the number of through-traffic lanes. A Type II project is a noise barrier retrofit project that involves no changes to highway capacity or alignment.

Type I projects include those that create a completely new noise source, increase the volume or speed of traffic, or move the traffic closer to a receiver. Type I projects include the addition of an interchange, ramp, auxiliary lane, or truck-climbing lane to an existing highway, or the widening an existing ramp by a full lane width for its entire length. Projects unrelated to increased noise levels, such as striping, lighting, signing, and landscaping projects, are not considered Type I projects.

Under 23 CFR § 772.11, noise abatement must be considered for Type I projects if the project is predicted to result in a traffic noise impact. In such cases, 23 CFR § 772 requires that the project sponsor “consider” noise abatement before adoption of the environmental document. This process

involves identification of noise abatement measures that are reasonable, feasible and likely to be incorporated into the project as well as noise impacts for which no apparent solution is available.

Type III projects are Federal or Federal-aid highway projects that do not meet the classification of a Type I or Type II project. Noise analysis is not required for Type III projects. Projects unrelated to increased noise levels, such as striping, lighting, signing, and landscaping projects, are considered Type III projects.

## **Federal Aviation Administration**

*Title 14, Part 36 of the Code of Federal Regulations - Aircraft Noise*

Aircraft operated in the U.S. are subject to federal requirements regarding noise emissions levels. These requirements are set forth in Title 14 CFR, Part 36. Part 36 establishes maximum acceptable noise levels for specific aircraft types, taking into account the model year, aircraft weight and number of engines.

## **Federal Transit Administration**

The FTA has developed guidance to evaluate noise impacts from operation of surface transportation modes (i.e., passenger cars, trucks, buses, and rail) in the 2018 FTA *Transit Noise Impact and Vibration Assessment* (FTA 2018). All mass transit projects receiving federal funding must use these guidelines to predict and assess potential noise and vibration impacts. As ambient levels increase, smaller increments of change are allowed to minimize community annoyance related to transit operations.

## **Department of Housing and Urban Development**

*Title 24, Part 51, Subpart B of the Code of Federal Regulations – Noise Abatement and Control*

The mission of HUD includes fostering “a decent, safe, and sanitary home and suitable living environment for every American.” Accounting for acoustics is intrinsic to this mission as safety and comfort can be compromised by excessive noise. To facilitate the creation of suitable living environments, HUD has developed a standard for noise criteria. The basic foundation of the HUD noise program is set out in the noise regulation 24 CFR Part 51 Subpart B, Noise Abatement and Control.

HUD’s noise policy requires noise attenuation measures be provided when proposed projects are to be located in high noise areas. Within the HUD Noise Assessment Guidelines, potential noise sources are examined for projects located within 15 miles of a military or civilian airport, 1,000 feet from a road or 3,000 feet from a railroad.

HUD exterior noise regulations state that 65 dBA  $L_{dn}$  noise levels or less are acceptable for residential land uses and noise levels exceeding 75 dBA  $L_{dn}$  are unacceptable. HUD’s regulations do not contain standards for interior noise levels. The HUD regulations establish a goal of 45 decibels, and the attenuation requirements are focused on achieving that goal. The HUD guidelines assume that with standard construction methods and materials, any building will provide sufficient attenuation so that if the exterior level is 65 dBA  $L_{dn}$  or less, the interior level will be 45 dBA  $L_{dn}$  or less. Noise criteria are consistent with FHWA and related state requirements

## **b. State Laws, Regulations, and Policies**

### **Land Use Compatibility Guidelines**

The Governor's Office of Planning and Research is required to adopt and periodically revise guidelines for the preparation and content of local general plans. The 2017 General Plan Guidelines (Governor's Office of Planning and Research, 2017) establish land use compatibility guidelines. Where a noise level range is denoted as "normally acceptable" for the given land use, the highest noise level in that range should be considered the maximum desirable for conventional construction that does not incorporate any special acoustic treatment. The acceptability of noise environments classified as "conditionally acceptable" or "normally unacceptable" will also depend on the anticipated amount of time that will normally be spent outside the structure and the acoustic treatment to be incorporated in structural design.

With regard to noise-sensitive residential uses, the recommended exterior noise limits are 60 dBA CNEL for single-family residences and 65 dBA CNEL for multi-family residences. The recommended maximum interior noise level is 45 dBA CNEL, which could normally be achieved using standard construction techniques if exterior noise levels are within the levels described above.

### **California Department of Transportation**

Caltrans establishes noise limits for vehicles licensed to operate on public roads (Caltrans 2013a). For heavy trucks, the State passby standard is consistent with the federal limit of 80 dB. The State pass-by standard for light trucks and passenger cars (less than 4.5 tons gross vehicle rating) is also 80 dB at 15 meters from the centerline. For new roadway projects, Caltrans uses the NAC discussed above in connection with FHWA. In addition, Caltrans has published the Traffic Noise Analysis Protocol (May 2011) for assessing noise levels associated with roadway projects (Caltrans 2020a).

Caltrans has a *Transportation and Construction Induced Vibration Manual* that provides general guidance on vibration issues associated with construction and operation of projects in relation to human perception and structural damage (Caltrans 2020b).

Section 216 of the California Streets and Highways Code relates to the noise effects of a proposed freeway project on public and private elementary and secondary schools. Under this code, a noise impact occurs if, as a result of a proposed freeway project, noise levels exceed 52 dBA Leq in the interior of public or private elementary or secondary classrooms, libraries, multipurpose rooms, or spaces. If a project results in a noise impact under this code, noise abatement must be provided to reduce classroom noise to a level that is at or below 52 dBA Leq. If the noise levels generated from roadway sources exceed 52 dBA Leq prior to the construction of the proposed freeway project, then noise abatement must be provided to reduce the noise to the level that existed prior to construction of the project.

### **California's Airport Noise Standards and Compatibility Planning**

The State of California has the authority to establish regulations requiring airports to address aircraft noise impacts near airports. The State of California's Airport Noise Standards, found in Title 21 of the California Code of Regulations, identify a noise exposure level of 65 dB CNEL as the noise impact boundary around airports. Within the noise impact boundary, airport proprietors are required to ensure that all land uses are compatible with the aircraft noise environment, or the airport proprietor must secure a variance from Caltrans.

## California Noise Insulation Standards

The California Noise Insulation Standards found in Title 24 of the California Code of Regulations set requirements for new multi-family residential units, hotels, and motels that may be subject to relatively high levels of transportation-related noise. For exterior noise, the noise insulation standard is 45 dBA  $L_{dn}$  in any habitable room and requires an acoustical analysis demonstrating how dwelling units have been designed to meet this interior standard where such units are proposed in areas subject to noise levels greater than 60 dBA  $L_{dn}$ .

## California Aeronautics Act

The State Aeronautics Act (Public Utilities Code, Section 21670 et seq.) requires the establishment of Airport Land Use Commissions (ALUCs), which are responsible for developing airport land use compatibility plans (ALUCPs) for noise-compatible land uses in the immediate proximity of a commercial or public airport (Section 21675). ALUCs have two major roles: preparation and adoption of airport land use compatibility plans, which address policies for both noise and safety and review of certain local government land use actions and airport plans for consistency with the land use compatibility plan.

The ALUCP is the major tool for ALUC land use regulation. The intent of the ALUCP is to encourage compatibility between airports and the various land uses that surround them. ALUCPs typically include the development of noise contours to identify excessive airport-related noise levels and measures to reduce noise levels. For example, Monterey Regional Airport encourages noise abatement procedures related to quiet departure techniques.

The Aeronautics Division of Caltrans has published the *California Airport Land Use Planning Handbook* (Caltrans 2011). The purpose of the *California Airport Land Use Planning Handbook* is to provide guidance for conducting airport land use compatibility planning. This handbook includes a section related to noise and states, “The basic strategy for achieving noise compatibility in the vicinity of an airport is to prevent or limit development of land uses that are particularly sensitive to noise. Common land use strategies are ones that either involve few people (especially people engaged in noise-sensitive activities) or generate significant noise levels themselves (such as other transportation facilities or some industrial uses).”

Within the SJCOG region, SJCOG serves as the ALUC and is responsible for protecting public health, safety and welfare by ensuring that vacant lands in the vicinity of airports are planned and zoned for uses compatible with airport operations. The San Joaquin County Airport Land Use Plan was adopted in 1993 (SJCOG 1993).

### c. Regional and Local Laws, Regulations, and Policies

To identify, appraise and remedy noise and vibration problems in local communities, San Joaquin County, and incorporated cities in the SJCOG region are each required to adopt a noise element as part of their General Plan. Local governments use the Governor’s Office of Planning and Research’s General Plan Guidelines (2017), including land use compatibility guidelines, to prepare General Plan noise elements.

Each noise element is required to analyze and quantify current and projected noise levels associated with local noise sources, including, but not limited to: highways and freeways, primary arterials and major local streets, rail operations, air traffic associated with the airports; local industrial plants; and other ground stationary sources that contribute to the community noise environment. Beyond statutory requirements, local jurisdictions are free to adopt their own goals and policies in their

noise elements, although most jurisdictions have chosen to adopt noise/land use compatibility guidelines that are similar to those recommended by the State. Land use compatibility considers both existing noise levels in a community, as well as community attitudes toward dominant noise sources.

In addition to regulating noise through noise element policies, local jurisdictions regulate noise through enforcement of local ordinance standards. These standards generally relate to noisy activities (e.g., use of loudspeakers and construction) and stationary noise sources and facilities (e.g., air conditioning units and industrial activities). The SJCOG region has seven incorporated cities, each of which has its own adopted noise standards. Noise standards for the County and the cities within the County typically apply land-use compatibility criteria of 65 dBA  $L_{dn}$  or less as being the normally acceptable range for new residential developments, and interior noise criteria of 45 dBA  $L_{dn}$ , consistent with the overall State recommendations.

As discussed above, the State Aeronautics Act (Public Utilities Code, Section 21670 et seq.) requires the preparation of an ALUCP for nearly all public-use airports in the State (Section 21675). An Airport Land Use Commission (ALUC) is responsible for preparing the ALUCPs and ensuring compatible land uses in the vicinity of airports within their jurisdiction (Section 21676).

### 4.13.3 Impact Analysis

#### **a. Methodology and Significance Thresholds**

The analysis of noise impacts considers the effects of both temporary construction-related noise and long-term noise associated with proposed transportation system improvements. Temporary construction noise was estimated based upon levels presented in the FTA Transit Noise and Vibration Impact Assessment.

Appendix G of the State CEQA Guidelines identifies the following criteria for determining whether development facilitated by the proposed 2022 RTP/SCS would have a significant noise or vibration impact. SJCOG has added a threshold related to absolute noise increases. Therefore, this analysis evaluates whether or not the 2022 RTP/SCS would:

1. Generate a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies;
2. Generate a substantial absolute increase in ambient noise;
3. Generate excessive groundborne vibration or groundborne noise levels; or
4. For a project located within the vicinity of a private airstrip or 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, would the project expose people residing or working in the project area to excessive noise levels.

Thresholds 1, 2, and 3 are discussed further in this section. Threshold 4 is discussed in Section 4.17, *Effects Considered Less Than Significant*.

San Joaquin County and the seven incorporated cities within the SJCOG region each have their own noise standards. These local noise standards typically apply land-use compatibility criteria of 60-65 dBA CNEL as the normally acceptable range for residential developments, and interior noise criteria

of 45 dBA CNEL, consistent with the overall State recommendations and the recommendations of HUD for residential uses.

The operational and construction noise limits used in this analysis are based on levels at which a substantial noise level increase would occur relative to ambient noise levels. Because these noise limits are tailored to specific uses (e.g., exterior and interior areas), they account for typical ambient noise levels associated with each use such that an increase in ambient noise levels that exceeds these limits would be considered a substantial increase above ambient noise levels. The analysis of potential impacts includes an assessment of all applicable standards, including those established by local jurisdictions, counties, the State of California, and federal agencies, where appropriate.

Since this document analyzes noise impacts on a program level only, project level analyses for various projects within the 2022 RTP/SCS will be necessary in the future.

## **b. Project Impacts and Mitigation Measures**

The following section discusses potential impacts and mitigation measures that may be associated with projects contained within the 2022 RTP/SCS. Section 4.13.3.c summarizes the impacts associated with capital improvement projects proposed in the 2022 RTP/SCS. Due to the programmatic nature of the 2022 RTP/SCS, a precise, project-level analysis of the specific impacts associated with individual transportation and land use projects is not possible at this time. In general, however, implementation of proposed transportation improvements and future projects under the land use scenario envisioned by the 2022 RTP/SCS could result in the impacts as described in the following section.

**Threshold 1:** Generate a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies

**Threshold 2:** Generate a substantial absolute increase in ambient noise

**Impact N-1 CONSTRUCTION ACTIVITY ASSOCIATED WITH PROPOSED TRANSPORTATION IMPROVEMENT PROJECTS AND OTHER LAND USE DEVELOPMENT ENVISIONED BY THE 2022 RTP/SCS WOULD GENERATE A SUBSTANTIAL TEMPORARY INCREASE IN AMBIENT NOISE LEVELS IN EXCESS OF STANDARDS ESTABLISHED IN LOCAL GENERAL PLANS OR NOISE ORDINANCES, AND WOULD GENERATE A SUBSTANTIAL ABSOLUTE NOISE INCREASE OVER EXISTING NOISE LEVELS. THIS IMPACT WOULD BE SIGNIFICANT AND UNAVOIDABLE.**

The operation of equipment during the construction of roadway infrastructure, as well as land-use development envisioned in 2022 RTP/SCS would result in temporary increases in noise in the immediate vicinity of individual construction sites. As shown in Table 4.13-2, average noise levels associated with the use of heavy equipment at construction sites typically range from 76 to 88 dBA at 50 feet from the source, depending upon the types of equipment in operation at any given time and the phase of construction. For projects that require pile driving, construction noise levels may reach 101 dBA at 50 feet from the source. For projects that do not require pile driving, the highest noise levels typically occur during excavation and foundation development, which involves the use of such equipment as backhoes, bulldozers, pile drivers, and front-end loaders.

**Table 4.13-2 Typical Noise Levels for Construction Equipment (dBA)**

Equipment	Typical Level 25 feet from the Source	Typical Level 50 feet from the Source	Typical Level 100 feet from the Source
Air Compressor	86	80	74
Backhoe	86	80	74
Concrete Mixer	91	85	79
Dozer	91	85	79
Grader	91	85	79
Jack Hammer	94	88	82
Loader	86	80	74
Paver	91	85	79
Pile-drive (Impact)	107	101	95
Pile-driver (Sonic)	101	95	89
Roller	91	85	79
Saw	82	76	70
Scarified	89	83	77
Scraper	91	85	79
Truck	90	84	78

Source: FTA 2018

Noise generated by construction projects would vary depending on the project and intensity of equipment use. Roadway widening projects and new roadway projects would likely require the operation of multiple pieces of heavy-duty equipment that generate high noise levels. Alternatively, repainting/restriping projects typically requiring minimal use of heavy equipment. This conservative analysis assesses construction noise based on the operation of heavy-duty equipment. Noise levels from point sources such as individual construction sites typically attenuate at a rate of 6 dBA per doubling of distance. Therefore, areas within 800 feet of a construction site with heavy-duty equipment may be exposed to noise levels exceeding 65 dBA. Areas within 3,200 feet of impact pile drivers may be exposed to noise levels exceeding 65 dBA.

Some local agencies in the SJCOG region include specific regulations in their municipal code to reduce construction noise impacts. In most cases, these regulations restrict construction activities to specific times and days. Such local policies serve to reduce the impacts of noise on surrounding communities by prohibiting construction during the night when people are engaged in noise-sensitive activities like sleeping. Nevertheless, this impact is significant because applicable noise standards would be exceeded, or because a substantial temporary increase in ambient noise levels in the project vicinity would occur.

### **Mitigation Measure**

For transportation projects under their jurisdiction, SJCOG shall implement, and transportation project sponsor agencies can and should implement, the following mitigation measure developed for the 2022 RTP/SCS program where applicable for transportation projects that would result in noise impacts, and where feasible and necessary based on project and site-specific considerations. San Joaquin County and incorporated cities in the County can and should implement this measure

where relevant to land use projects implementing 2022 RTP/SCS. Project-specific environmental documents may adjust this measure as necessary to respond to site-specific conditions.

*N-1 Construction Noise Reduction*

To reduce construction noise levels to achieve applicable standards, implementing agencies for transportation and land use projects shall implement the measures identified below where feasible and necessary.

- a. **Compliance with local Construction Noise Regulations.** Implementing agencies shall ensure that, where residences or other noise sensitive uses are located within 800 feet of construction sites without pile driving, appropriate measures shall be implemented to ensure consistency with local noise ordinance requirements relating to construction. Specific techniques may include, but are not limited to, restrictions on construction timing, use of sound blankets on construction equipment, and the use of temporary walls and noise barriers to block and deflect noise.
- b. **Noise Complaint and Enforcement Manager.** Designate an on-site construction complaint and enforcement manager for projects within 800 feet of sensitive receivers. Implementing agencies shall post phone numbers for the on-site enforcement manager at construction sites along with complaint procedures and who to notify in the event of a problem.
- c. **Pile Driving.** For any project within 3,200 feet of sensitive receptors that requires pilings, the implementing agency shall require caisson drilling or sonic pile driving as opposed to pile driving, where feasible. This shall be accomplished through the placement of conditions on the project during its individual environmental review.
- d. **Construction Equipment Noise Control.** Implementing agencies shall ensure that equipment and trucks used for project construction utilize the best available noise control techniques (including mufflers, use of intake silencers, ducts, engine enclosures, and acoustically attenuating shields or shrouds).
- e. **Impact Equipment Noise Control.** Implementing agencies shall ensure that impact equipment (e.g., jack hammers, pavement breakers, and rock drills) used for project construction be hydraulically or electrically powered wherever feasible to avoid noise associated with compressed air exhaust from pneumatically powered tools. Where use of pneumatically powered tools is unavoidable, use of an exhaust muffler on the compressed air exhaust can lower noise levels from the exhaust by up to about 10 dBA. When feasible, external jackets on the impact equipment can achieve a reduction of 5 dBA. Whenever feasible, use quieter procedures, such as drilling rather than impact equipment operation.
- f. **Construction Activity Timing Restrictions.** The following timing restrictions shall apply to 2022 RTP/SCS activities creating noise levels at or above 65 dBA at a nearby dwelling unit, except where timing restrictions are already established in local codes or policies. Construction activities shall be limited to:
  - Monday through Friday: 7 a.m. to 6 p.m.
  - Saturday: 9 a.m. to 5 p.m.
- g. **Placement of Stationary Noise Sources.** Locate stationary noise sources as far from noise-sensitive receptors as possible. Stationary noise sources that must be located near existing receptors will be equipped with the best available mufflers.

## IMPLEMENTING AGENCIES AND TIMING

Implementing agencies for transportation projects are SJCOG and transportation project sponsor agencies. Implementing agencies for land use projects are San Joaquin County and incorporated cities within the County. This mitigation measure shall, or can and should, be applied during project permitting and environmental review and implemented during construction, as applicable.

## Significance After Mitigation

Mitigation Measure N-1 would reduce construction noise impacts to the extent feasible. However, even with application of Mitigation Measure N-1 construction noise from all 2022 RTP/SCS projects may not be reduced below applicable thresholds and impacts would remain significant and unavoidable. No additional mitigation measures to reduce this impact to less than significant levels are feasible.

**Threshold 1:** Generate a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies

**Threshold 2:** Generate a substantial absolute increase in ambient noise

**Impact N-2 PROPOSED TRANSPORTATION IMPROVEMENTS AND LAND USE PROJECTS ENVISIONED BY THE 2022 RTP/SCS WOULD GENERATE A SUBSTANTIAL PERMANENT INCREASE IN AMBIENT NOISE LEVELS IN EXCESS OF STANDARDS OR OVER EXISTING NOISE LEVELS AND GENERATE A SUBSTANTIAL ABSOLUTE NOISE INCREASE OVER EXISTING NOISE LEVELS. THIS IMPACT WOULD BE SIGNIFICANT AND UNAVOIDABLE.**

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## Traffic

Overall traffic levels on highways and roadways in the SJCOG region are projected to increase as a result of regional growth through the year 2046 with or without implementation of the 2022 RTP/SCS (refer to Section 4.14, Transportation). It should be noted that while traffic may increase in certain locations, the expected number of reduced vehicle miles traveled (VMT) per weekday in 2046 would be 220,663 VMT in the RTP/SCS preferred scenario. In general, as the VMT decreases, noise associated with VMT would also decrease.

The 2022 RTP/SCS includes several projects that would potentially increase traffic noise by increasing traffic levels along and in the vicinity of affected facilities. Such projects include intersection improvements, addition of high occupancy vehicle (HOV) lanes on Interstate 5 and SR 99, widening existing roadways, widening ramps and bridge structures, interchange modifications, and road improvements that would allow increased traffic volumes. These projects would not introduce new traffic but rather are intended to relieve current or projected future traffic congestion or unacceptable safety conditions. However, in some cases, projects that expand roadway capacity would accommodate additional traffic volumes and/or relocate noise sources closer to sensitive receptors. Therefore, this impact is significant because applicable noise standards could be exceeded, or because a substantial permanent increase in ambient noise levels in the project vicinity would occur.

## Airports

The 2022 RTP/SCS does not include any airport improvement projects or programs that would directly or indirectly increase aircraft operations at operating airports in the SJCOG region. Therefore, 2022 RTP/SCS would not increase ambient noise levels associated with airports. No impacts due to aircraft operations would occur.

## Rail Operations

The 2022 RTP/SCS includes investments in passenger rail and train service, such as the construction of new double main tracks, construction of track connections, grade separations, right of way improvements, extension of existing services at various facilities, and maintenance activities at various facilities. The FTA has developed a screening procedure to identify locations where a rail project may cause a noise impact. The screening distances for requiring noise assessments for various types of projects are presented in Table 4.13-3.

**Table 4.13-3 Screening Distances for Noise Assessments – Rail Transit Projects**

Type of Project	Screening Distance (Feet)	
	Unobstructed	Intervening Buildings
Commuter Rail Mainline	750	375
Commuter Rail Station	With Horn Blowing	1,600
	Without Horn Blowing	250
Commuter Rail -Highway Crossing with Horns and Bells	1,600	1,200
Light Rail Transit	350	175
Street car	200	100
Access Roads	100	50
Low- and Intermediate-Capacity Transit	Steel Wheel	125
	Rubber Tire	90
	Monorail	175
Yards and Shops	1,000	650
Parking Facilities	125	75
Access Roads to Parking	100	50
Ventilation Shafts	200	100
Power Substations	250	125

Source: FTA 2018

Rail transit projects included in the 2022 RTP/SCS would be located in urban areas near to facility ridership. Sensitive land uses would be located within proximity to new and expanded rail corridors and would potentially be exposed to noise levels that exceed acceptable standards.

## Bus Operations

The 2022 RTP/SCS includes projects to improve existing bus service, such as improvements at existing transit centers, purchasing of replacement buses, fleet maintenance, bus stop/shelter replacement/improvements, solar charging facilities for electric buses, and construction of a new bus maintenance and storage facility, which could indirectly increase bus operations. The FTA has

developed a screening procedure to identify locations where a bus project may cause a noise impact. The screening distances for requiring noise assessments for various types of projects are presented in Table 4.13-4.

**Table 4.13-4 Screening Distances for Noise Assessments – Bus Transit Projects**

Type of Project	Screening Distance (Feet)	
	Unobstructed	Intervening Buildings
Busway	500	250
BRT on Exclusive Roadway	200	100
Bus Facilities	Access Roads	100
	Transit Center	225
	Storage and Maintenance	350
	Park and Ride Lots with Buses	225

Source: FTA 2018

Increase frequency of bus operations along existing corridors would increase noise for existing sensitive receptors along bus routes. However, the addition of local buses is unlikely to increase noise by significant levels as bus routes would be in urban areas with high ambient noise levels. Overall, sensitive land uses would be located within close proximity to new bus activity and would potentially be exposed to noise levels that exceed acceptable standards. Overall, ambient noise levels will increase in excess of standards or over existing noise levels generating a substantial absolute noise increase over existing noise levels. This impact will be significant and unavoidable.

### Mitigation Measures

For transportation projects under their jurisdiction, SJCOG shall implement, and transportation project sponsor agencies can and should implement, the following mitigation measure developed for the 2022 RTP/SCS program where applicable for transportation projects that would result in traffic noise impacts, and where feasible and necessary based on project and site-specific considerations. San Joaquin County and incorporated cities in the County can and should implement this measure where relevant to land use projects implementing 2022 RTP/SCS. Project-specific environmental documents may adjust this measure as necessary to respond to site-specific conditions.

#### *N-2 Noise Assessment and Control for Mobile and Point Source Reduction*

Implementing agencies shall complete detailed noise assessments using applicable guidelines (e.g., Caltrans Traffic Noise Analysis Protocol) for roadway and rail projects that may impact noise sensitive receptors. The implementing agency shall ensure that a noise survey is conducted that, at minimum:

- Determines existing and projected noise levels
- Determines the amount of attenuation needed to reduce potential noise impacts to applicable State and local standards
- Identifies potential alternate alignments that allow greater distance from, or greater buffering of, noise-sensitive areas

- If warranted, recommends methods for mitigating noise impacts, including:
  - Appropriate setbacks
  - Sound attenuating building design, including retrofit of existing structures with sound attenuating building materials
  - Use of sound barriers (earthen berms, sound walls, or some combination of the two)
  - Locate transit-related passenger stations, central maintenance facilities, decentralized maintenance facilities, and electric substations away from sensitive receptors to the maximum extent feasible

Where new or expanded roadways or transit are found to expose receptors to noise exceeding normally acceptable levels, the individual project lead agency shall implement techniques as recommended in the project-specific noise assessments. The preferred methods for mitigating noise impacts will be the use of appropriate setbacks and sound attenuating building design, including retrofit of existing structures with sound attenuating building materials where feasible. In instances where use of these techniques is not feasible, the use of sound barriers (earthen berms, sound walls, or some combination of the two) will be considered. Long expanses of walls or fences should be interrupted with offsets and provided with accents to prevent monotony. Landscape pockets and pedestrian access through walls should be provided. Whenever possible, a combination of elements shall be used, including open grade paving, solid fences, walls, and landscaped berms. Other techniques such as rubberized asphalt or “quiet pavement” can be used where feasible to reduce road noise for new roadway segments or modifications requiring repaving. The effectiveness of noise reduction measures shall be monitored by taking noise measurements and installing adaptive mitigation measures to achieve applicable standards.

#### **IMPLEMENTING AGENCIES AND TIMING**

Implementing agencies for transportation projects are SJCOG and transportation project sponsor agencies. Implementing agencies for land use projects are San Joaquin County and incorporated cities within the County. This mitigation measure shall, or can and should, be applied during project permitting and environmental review and implemented during construction, as applicable.

#### **Significance After Mitigation**

Implementation of Mitigation Measure N-2 would reduce noise from mobile sources. However, even with implementation of this mitigation measure, mobile source noise from buildout of the 2022 RTP/SCS may continue to exceed acceptable standards. No additional mitigation measures to reduce this impact to less than significant levels are feasible. Therefore, this impact would remain significant and unavoidable.

**Threshold 3:** Generate excessive groundborne vibration or groundborne noise levels

**Impact N-3 CONSTRUCTION ACTIVITIES ASSOCIATED WITH TRANSPORTATION PROJECTS AND LAND USE PROJECTS WOULD GENERATE EXCESSIVE GROUNDBORNE VIBRATION LEVELS. NEW TRUCK AND BUS TRAFFIC RESULTING FROM THE 2022 RTP/SCS WOULD GENERATE EXCESSIVE VIBRATION LEVELS. THESE IMPACTS WOULD BE SIGNIFICANT AND UNAVOIDABLE.**

## Construction

Construction-related vibration has the potential to damage structures, cause cosmetic damage (e.g., crack plaster), or disrupt the operation of vibration-sensitive equipment. Vibration can also be a source of annoyance to individuals who live or work close to vibration-generating activities. Heavy construction operations can cause substantial vibration near the source. Table 4.13-5 shows vibration levels associated with typical construction equipment. Similar to construction noise, vibration levels would be variable depending on the type of construction project and related equipment use.

**Table 4.13-5 Vibration Source Levels for Construction Equipment**

Equipment	Approximate Vibration Level (VdB)			
	25 feet from Source	50 feet from Source	100 feet from Source	200 feet from Source
Caisson Drilling	87	78	69	60
Jackhammer	79	70	61	52
Large Bulldozer	87	78	69	60
Loaded Truck	86	77	68	58
Pile Driver (impact)	Upper range	112	103	94
	Typical	104	95	86
Pile Driver (sonic)	Upper range	105	96	87
	Typical	93	84	75
Small Bulldozer	58	48	39	30
Vibratory Roller	94	85	76	67

Source: FTA 2018

Typical project construction activities, such as the use of jackhammers, other high-power or vibratory tools, compactors, and tracked equipment, may also generate substantial vibration (i.e., greater than 0.2 inches per second PPV) in the immediate vicinity, typically within 15 feet of the equipment. Through the use of scheduling controls, typical construction activities would be restricted to hours with least potential to affect nearby properties. Thus, perceptible vibration can be kept to a minimum and not result in human annoyance or structural damage.

Some specific construction activities result in higher levels of vibration. Pile driving has the potential to generate the highest vibration levels and is the primary concern for structural damage to nearby structures, especially when near fragile and/or historic structures. Vibration levels generated by pile driving activities would vary depending on project conditions, such as soil conditions, construction methods and equipment used. Depending on the proximity of existing structures to each construction site, the structural soundness of the affected buildings and construction methods, vibration caused by pile driving or other foundation work with a substantial impact component such

as blasting, rock or caisson drilling, and site excavation or compaction may be high enough to be perceptible outside the construction area and potentially damage existing structures.

San Joaquin County and some of the incorporated cities in the SJCOG region include regulations in their municipal code that reduce construction noise and vibration impacts. In most cases, these regulations restrict vibration-generating construction activities to specific times and days. Such local policies reduce the impacts of vibration on surrounding communities by prohibiting construction during the night when people are engaged in vibration-sensitive activities like sleeping. Nevertheless, this impact is significant because transportation or land use project construction would cause excessive groundborne vibration or groundborne noise levels.

## **Operation**

The primary vibration sources associated with transportation system operations include heavy truck and bus traffic along roadways and train traffic along rail lines. However, vehicle traffic, including heavy trucks traveling on a highway, rarely generate vibration amplitudes high enough to cause structural or cosmetic damage, except in rare cases (e.g., where heavy truck traffic passes near fragile older buildings). Heavy trucks traveling over potholes or other pavement irregularities can cause vibration high enough to result in complaints from nearby residents. These conditions are commonly addressed by smoothing the roadway surface. Based on vibration measurements throughout California by Caltrans, worst-case traffic vibrations were shown to drop below the threshold of perception at distances of 150 feet or greater (Caltrans 2013). Given that sensitive receptors are located within 150 feet of transportation facilities within the SJCOG region, and that 2022 RTP/SCS transportation projects include roadway expansion and construction of high occupancy vehicle lanes on Interstate 5, SR 99, or other highways, significant impacts related to vibration associated with truck traffic could occur.

Rail activity is also a source of vibration. Caltrans conducted measurements of vibration levels associated with train activity throughout the State and found a peak vibration level of 0.36 inches per second PPV at ten feet from the track (Caltrans 2004). Based on this reference vibration level, vibrations from train activity drop below the threshold of perception at distances greater than 250 feet. The 2022 RTP/SCS includes additional train maintenance facilities (SJ07-6017), implementation and support of one additional commuter train by 2022 and a second by 2030 (SJ07-6018), improved rail information systems (SJ07-6019), safety upgrades (SJ07-6023), lengthening the platform at the current Lathrop/Manteca Station (SJ18-6001), and lengthening the platform at the current Tracy Station (SJ18-6002). These potential increases in rail activity along existing lines would not be expected to expose nearby sensitive receptors and fragile buildings to significant increases in vibration levels relative to the existing condition. Rail vibration impacts would be less than significant due to the minimal increase in train traffic under 2022 RTP/SCS.

## **Mitigation Measure**

For transportation projects under their jurisdiction, SJCOG shall implement, and transportation project sponsor agencies can and should implement, the following mitigation measures for applicable transportation projects that would result in vibration impacts, and where feasible and necessary based on site-specific considerations. San Joaquin County and incorporated cities in the County should implement these measures where relevant to land use projects implementing 2022 RTP/SCS. Project-specific environmental documents may adjust this measure as necessary to respond to site-specific conditions.

*N-3(a) Vibration Mitigation for Construction of Transportation Projects*

Where local vibration and groundborne noise standards do not apply, implementing agencies of 2022 RTP/SCS projects utilizing heavy construction equipment shall estimate vibration levels generated by construction activities and use the Caltrans vibration damage potential threshold criteria to screen for and screen out projects as to their potential to damage buildings on site or near a project.

**Caltrans Vibration Damage Potential Threshold Criteria**

Structure and Condition	Maximum PPV (in/sec)	
	Transient Sources	Continuous/ Frequent Intermittent Sources
Extremely fragile historic buildings	0.12	0.08
Fragile buildings	0.20	0.10
Historic and some old buildings	0.50	0.25
Older Residential structures	0.50	0.30
New residential structures	1.00	0.50
Modern industrial structures	2.00	0.50

Source: Transportation and Construction Vibration Guidance Manual, April 2020

If construction equipment would generate vibration levels exceeding acceptable levels as established by Caltrans, implementing agencies of the 2022 RTP/SCS shall, or can and should, complete the following tasks:

- Prior to construction, survey the project site for vulnerable buildings, and complete geotechnical testing (preconstruction assessment of the existing subsurface conditions and structural integrity), for any older or historic buildings within 50 feet of pile driving. The testing shall be completed by a qualified geotechnical engineer and qualified historic preservation professional and/or structural engineer.
- Prepare and submit a report to the lead agency that contains the results of the geological testing. If recommended by the preconstruction report implementing agencies shall require ground vibration monitoring of nearby historic structures. Methods and technologies shall be based on the specific conditions at the construction site. The preconstruction assessment shall include a monitoring program to detect ground settlement or lateral movement of structures in the vicinity of pile-driving activities and identify corrective measures to be taken should monitored vibration levels indicate the potential for building damage. In the event of unacceptable ground movement with the potential to cause structural damage, all impact work shall cease, and corrective measures shall be implemented to minimize the risk to the subject, or adjacent, historic structure.
- To minimize disturbance withing 550 feet of pile-driving activities, implement “quiet” pile-driving technology, such as predrilling of piles and the use of more than one pile driver to shorten the duration of pile driving), where feasible, in consideration of geotechnical and structural requirements and conditions as defined as part of the geotechnical testing, if testing was feasible.
- Use cushion blocks to dampen noise from pile driving.
- Phase operations of construction equipment to avoid simultaneous vibration sources

*N-3(b) Vibration Mitigation for Operation of Transportation Projects*

Where local vibration and groundborne noise standards do not apply, implementing agencies of 2022 RTP/SCS projects shall comply with all applicable local vibration and groundborne noise standards, or in the absence of such local standards, comply with guidance provided by the FTA in *Transit Noise and Vibration Impact Assessment* (FTA 2018) to assess impacts to buildings and sensitive receptors and reduce vibration and groundborne noise. FTA recommended thresholds shall be used except in areas where local standards for groundborne noise and vibration have been established. Methods that can be implemented to reduce vibration and groundborne noise impacts include, but are not limited to:

- Bus and Truck Traffic
  - Constructing of noise barriers
  - Use noise reducing tires and wheel construction on bus wheels
  - Use vehicle skirts (i.e., a partial enclosure around each wheel with absorptive treatment) on freight vehicle wheels

**IMPLEMENTING AGENCIES AND TIMING**

Implementing agencies for transportation projects are SJCOG and transportation project sponsor agencies. Implementing agencies for land use projects are San Joaquin County and incorporated cities within the County. These mitigation measure shall, or can and should, be applied during project permitting and environmental review and implemented during construction, as applicable.

**Significance After Mitigation**

Implementation of Mitigation Measure N-3(a) would reduce potential construction vibration impacts. However, even with implementation of Mitigation Measure N-3(a), construction vibration from all 2022 RTP/SCS projects may not be reduced below applicable thresholds and impacts would remain significant and unavoidable. No additional mitigation measures to reduce this impact to less than significant levels are feasible. Implementation of Mitigation Measure N-3(b) would reduce potential operational vibration impacts. However, even with implementation of Mitigation Measure N-3(b), vibration from buildout of the 2022 RTP/SCS may continue to be excessive. No additional mitigation measures to reduce this impact to less than significant levels are feasible. Impacts would remain significant and unavoidable.

<p><b>Threshold 1:</b> Generate a substantial temporary or permanent increase in ambient noise levels in the vicinity of the project in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies</p> <p><b>Threshold 2:</b> Generate a substantial absolute increase in ambient noise</p>
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**Impact N-4 LAND USE PROJECTS ENVISIONED BY THE 2022 RTP/SCS MAY PLACE SENSITIVE RECEPTORS IN AREAS WITH NOISE LEVELS IN EXCESS OF STANDARDS ESTABLISHED IN THE LOCAL GENERAL PLAN OR NOISE ORDINANCE. THIS IMPACT WOULD BE SIGNIFICANT AND UNAVOIDABLE.**

The 2022 RTP/SCS is based on a land use and transportation scenario which defines a pattern of future growth and transportation system investment for the region emphasizing TOD and infill development near transit and other transportation facilities, but development outside these areas could occur as well. Population and job growth is allocated principally within existing urban areas near public transit and existing transit corridors. New noise-sensitive development in infill areas

could be exposed to noise levels exceeding County or incorporated city noise standards for residential land uses, with a lesser potential in more suburban and rural areas. Potential sources of noise exposure include traffic, rail and/or bus operations, commercial activity, and industrial activity. New development in infill areas near transit may also expose existing noise-sensitive uses to noise levels exceeding local noise thresholds. Impacts would be significant because applicable noise standards could be exceeded, or because infill project residents could be exposed to a substantial increase in ambient noise levels.

### **Mitigation Measures**

San Joaquin County and incorporated cities in the County can and should implement the following mitigation measure where relevant to land use projects implementing 2022 RTP/SCS, and where feasible and necessary based on project and site-specific considerations. Project-specific environmental documents may adjust this measure as necessary to respond to site-specific conditions.

#### *N-4 Noise Mitigation for Land Uses*

If a 2022 RTP/SCS land use project is located in an area with exterior ambient noise levels above local noise standards, the implementing agency shall ensure that a noise study is conducted to determine the existing exterior noise levels in the vicinity of the project. If the project would be impacted by ambient noise levels, feasible attenuation measures shall be used to reduce operational noise to meet acceptable standards. In addition, noise insulation techniques shall be utilized to reduce indoor noise levels to thresholds set in applicable State and/or local standards. Such measures may include but are not limited to: dual-paned windows, solid core exterior doors with perimeter weather stripping, air conditioning system so that windows and doors may remain closed, and situating exterior doors away from roads. The noise study and determination of appropriate mitigation measures shall be completed during the project's individual environmental review.

### **IMPLEMENTING AGENCIES AND TIMING**

Implementing agencies for land use projects are San Joaquin County and incorporated cities within the County. This mitigation measure shall, or can and should, be applied during project permitting and environmental review and implemented during construction, as applicable.

### **Significance After Mitigation**

Implementation of Mitigation Measure N-4 would reduce noise for sensitive land uses in areas that exceed noise standards. However, even with implementation of this mitigation measure, noise from buildout of 2022 RTP/SCS may continue to impact nearby noise sensitive receptors and exceed acceptable standards. This impact would remain significant and unavoidable. No additional mitigation measures to reduce this impact to less than significant levels are feasible.

### **c. Specific RTP Projects That May Result in Impacts**

All proposed 2022 RTP/SCS transportation projects listed in Appendix B and summarized in Section 2, *Project Description*, would have the potential to result in noise impacts described in Impacts N-1, N-2, N-3, and N-4. All projects that involve construction activities would result in temporary increases in noise and vibration associated with Impacts N-1 and N-3. The individual projects that would accommodate additional roadway or freeway traffic could create significant noise and

vibration impacts associated with Impact N-2 and N-3. In addition, road widening/extension projects or construction of new roadways have the potential to place roadway traffic noise closer to sensitive receptors. With the number of projects meeting those categories few, this potential impact would be minimal. Land use projects that would include TOD, infill, or other land use development may create significant impacts associated with Impact N-4. Additional specific analysis described in the above mitigation measures would need to be conducted as individual projects are implemented in order to determine the magnitude of project-specific impacts.

#### 4.13.4 Cumulative Impacts

Noise resulting from roadway improvement projects envisioned in the 2022 RTP/SCS could influence ambient noise levels in adjoining counties, if and where the projects are located in proximity to adjoining counties. Therefore, the cumulative impact analysis area for noise consists of the SJCOG region and adjoining counties. Information regarding these adjoining counties can be found in Section 3.1 – Environmental Setting, Table 3-1. Future development in this region that could result in noise impacts is considered in the analysis.

Construction and operation noise and vibration impacts are generally localized and not cumulative in nature. For example, the increase in noise at one location is not worsened by noise created at another location. Rather these effects are independent and the determination as to whether they are adverse is specific to the project and location where they are created. Therefore, this cumulative extent is used to evaluate increases in transportation-related noise and the potential for new sensitive receptors to be located in areas with unacceptable noise levels within the context of regional noise impacts.

Operation of transportation projects would generate noise. Noise would predominantly be from vehicles, such as the noise of engines or the noise generated from the friction between tires and the roadway surface. Generally, these noises affect ambient noise levels near the roadways. However, some of the 2022 RTP/SCS transportation projects would increase inter-regional travel, because the 2022 RTP/SCS addresses accommodating projected growth and because some projects are on regional roadways, such as Interstate 5 or SR 99. Therefore, the 2022 RTP/SCS would contribute to traffic noise outside the region. The cumulative impact would be significant, and the overall contribution of the 2022 RTP/SCS to significant cumulative traffic noise impacts, despite implementation of Mitigation Measures N-2 and N-4, would be cumulatively considerable.

Future land use development within the cumulative impact analysis area would increase travel and associated cumulative transportation noise levels. Land use development in the SJCOG region combined with the growth outside of its region could potentially contribute to a cumulatively considerable increase in noise as a result of increased activity resulting from that combined growth. This activity would include primarily highway and roadway noise. As a result, 2022 RTP/SCS could result in a cumulatively considerable increase in transportation-related noise. Mitigation Measures N-2 and N-4 would reduce the 2022 RTP/SCS's contribution to these impacts, but not to a less-than-cumulatively-considerable level. Therefore, the contribution of the 2022 RTP/SCS to this significant cumulative noise impacts would be cumulatively considerable.