Madera High-Speed Rail Station Full-Build Project Phase 3

APPENDIX C
NOISE AND VIBRATION
TECHNICAL REPORT

April 2025

Noise and Vibration Technical Memorandum

Madera High-Speed Rail Station Full-Build Project Phase 3

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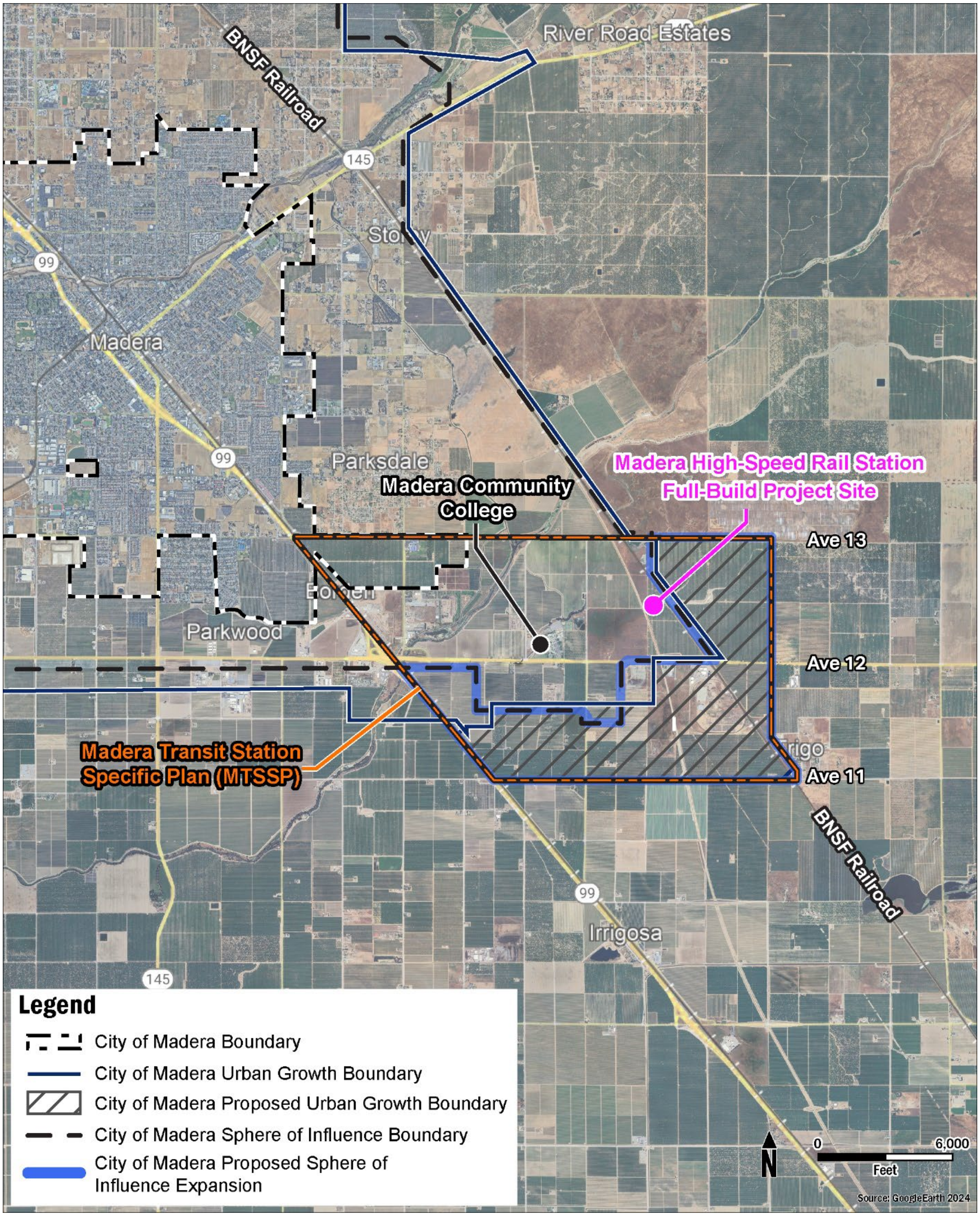
1. INTRODUCTION

1.1 Project Location

The proposed location for the Madera High Speed Rail (HSR) Full-Build Station site lies southeast of the city of Madera and is located within the Madera Transit Station Specific Plan (MTSSP) boundary, approximately 1-mile east of the Madera Community College Center (**Figure 1-1**). This adopted Specific Plan includes a passenger rail station on the BNSF line near Avenue 12, which is one of the primary existing transit corridors in Madera County. The location has connectivity to SR-99, with the recent completion of a new SR-99/Avenue 12 interchange and further improvements to Avenue 12 being implemented.

Figure 1-1: Project Location



Source: AECOM, 2024

1.2 Project Description

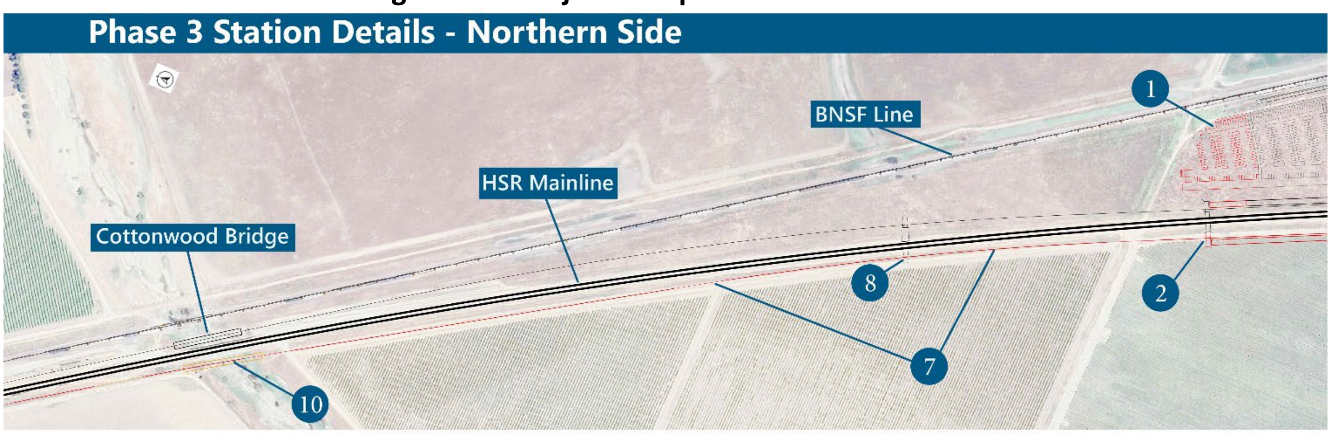
The Project would be designed to serve as the key connection for Madera County and portions of Fresno County to the intercity rail network, supporting expanded HSR operations and service levels (beyond the EOS) associated with HSR Service (north to the Bay Area, south to Southern California, or both) and subsequently Phase 1 HSR service (San Francisco to Los Angeles) at the proposed Madera HSR Station. The Project would include improvements in addition to those previously cleared for Phases 1 and 2 in the 2021 IS/MND, and the 2025 IS/MND Addendum.

1.2.1 Project Components

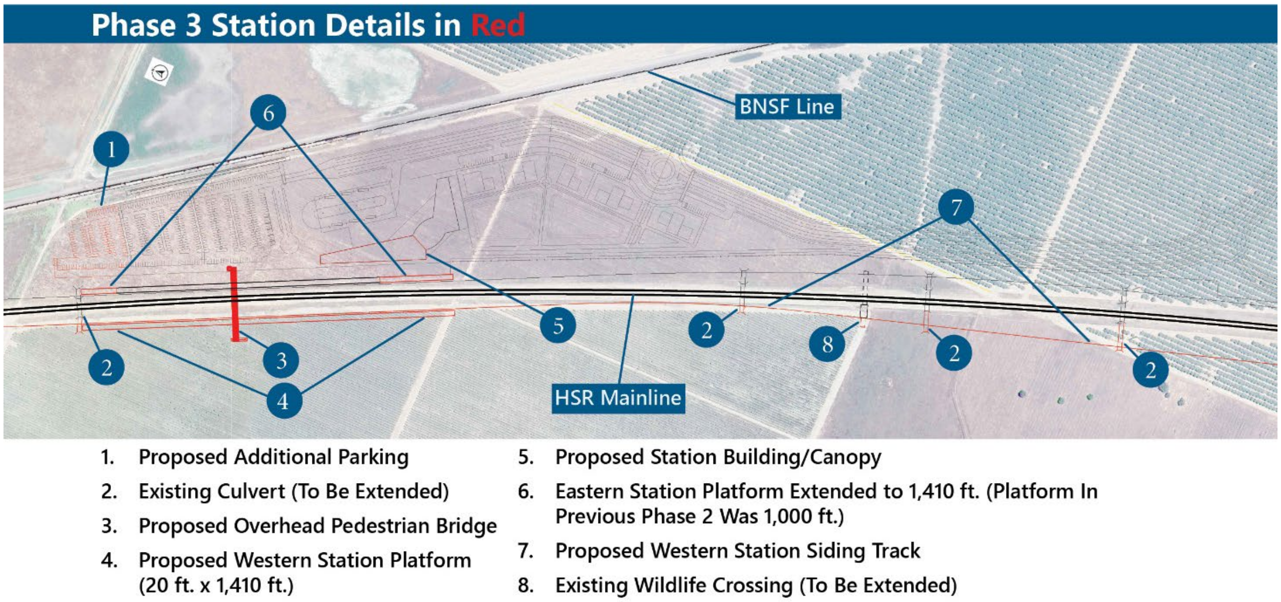
The components of the proposed Project include platforms, trackwork, bridges, overhead contact system, substations, grade separations, station and parking expansions, and culverts. These are shown in red **Figure 1-2** and the components approved earlier in Phase 1 and Phase 2 are shown in black. More detailed figures for the Project and the permanent right-of-way (ROW) needed are provided in Appendix G (Engineering Plans) of the Draft EIR.

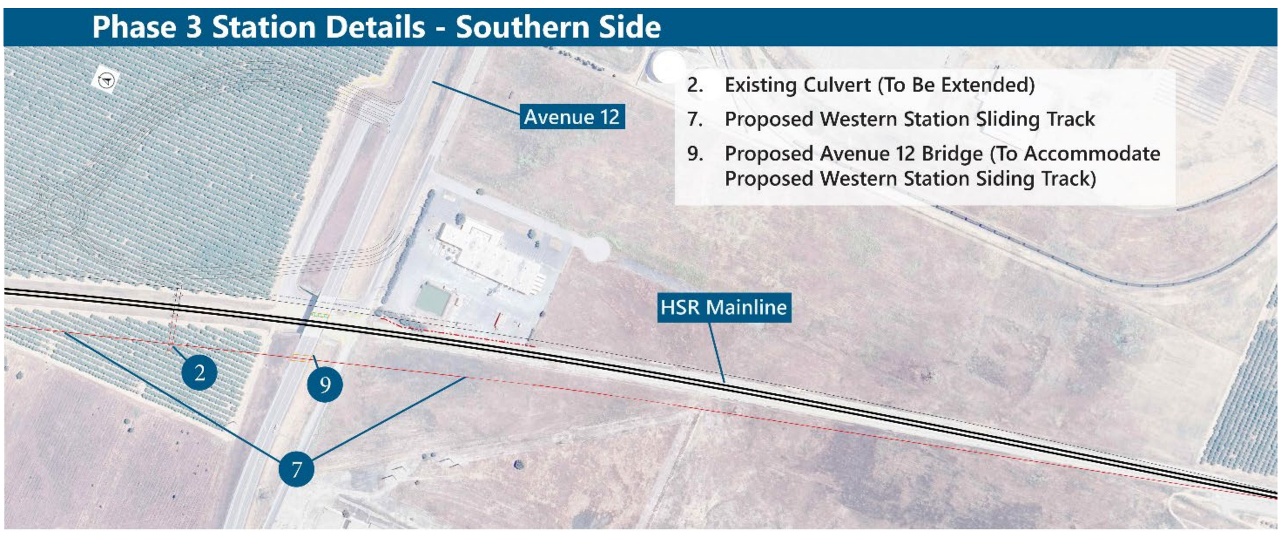
Design, construction, and operation of the Project's rail components would comply with applicable standards from the Federal Railroad Administration, California Public Utilities Commission, and CHSRA. Design, construction, and operation of Project site access improvements, including the modifications to the access road, would adhere to applicable standards such as the California Manual on Uniform Traffic Control Devices and local design guidelines and specifications. Design approval for specific components would be sought from the appropriate agencies as part of the detailed design and subsequent stages of the Project. Specific components of the Project are described in more detail in the following subsections.

Figure 1-2: Project Components - Station Overview



1. Proposed Additional Parking
2. Existing Culvert (To Be Extended)
7. Proposed Western Station Sliding Track
8. Existing Wildlife Crossing (To Be Extended)
10. Proposed Cottonwood Bridge





Source: (Kerns and West, 2024)

1.2.2 Platforms

The Project would include a 1,410-foot platform along the westside of the station to accommodate the full length of the HSR trainsets. The Project also includes the extension of the eastside platform by 410 feet to 1,410 feet, matching the new westside platform. The platform height would be designed to accommodate the trainsets selected for the HSR system. Canopies would be provided on the new westside platform and on the extended portions of the eastside platform to protect passengers from the environmental elements.

Access between the platforms and the station would be provided by a new Americans with Disabilities Act-compliant accessible pedestrian crossing (i.e., footbridge) over the HSR mainline and station tracks.

1.2.3 Trackwork

In conjunction with the new westside platform, the Project would construct a new station siding track on the westside of the station. Together with the station siding track on the eastside of the station completed under Phase 2, the Project would provide the Madera HSR Station with a total of four tracks. These would be arranged in a typical "local" station layout: two through tracks in the center (for faster trains not stopping at the station) and one siding track on either side (for slower trains stopping at the station).

The entire length of the new siding track, from the turnout locations at the north and south, would be approximately 14,600 feet. The turnouts would be designed for speeds up to 110 miles per hour.

1.2.4 Bridges

Three new bridge structures (one track bridge, one roadway bridge, and one pedestrian bridge) are included in the Project as follows:

- Track bridge at Cottonwood Creek. The western siding track would include a new single-track, five-span continuous cast-in-place, reinforced concrete slab structure over Cottonwood Creek. This bridge would match the span arrangement and hydraulic conveyance capacity of the existing double-track bridge constructed as part of the CHSRA Project.
- Pedestrian bridge at the station. A pedestrian overpass would be provided to allow passengers to access the new westside platform from the eastside of the station. The pedestrian bridge would include a shade structure, stairs, and two elevators.
- Roadway bridge at Avenue 12. The southern portion of the new western siding track would traverse Avenue 12 below the roadway surface. The existing Avenue 12 berm would be modified by creating a new penetration to accommodate the alignment of the proposed station siding track and constructing a new roadway bridge to span the single siding track below.

1.2.5 Overhead Contact System and Traction Power Substation

In conjunction with the proposed station siding track that would serve the proposed western platform, an overhead contact system (OCS) would be constructed along its entire length to provide electrical power to electrified trainsets. The OCS would consist of poles at intervals matching the OCS poles being constructed as part of the CHSRA Project. These OCS poles are expected to be approximately 30 feet tall and would have foundations extending approximately 6 to 10 feet below the ground surface. To provide power to the OCS, a small traction power substation (TPSS) may be needed, though there is a possibility that electrical power could be drawn from the OCS planned to be constructed in association with the CHSRA Project's adjacent mainline tracks. If a TPSS is required, it would be located in an area in the vicinity of the northern end of the western platform.

1.2.6 Parking Expansion

The surface parking lot that is being constructed as part of Phase 2 would be extended north in this Project and utilize unused space between the HSR corridor and the BNSF Stockton Subdivision. The expanded parking lot would result in a net increase of approximately 542 parking spaces above the 401 parking spaces cleared for Phase 2, for a new total of 943 parking spaces as shown in **Table 1-1**. Parking calculations for this Project are based on the highest forecasted ridership at the Madera HSR Station related to the implementation of the Project (i.e. ridership based on the Phase 1 HSR Service, which will run from San Francisco and Los Angeles). See Section 1.3.2 for ridership information.

Table 1-1: Summary of Proposed Parking Spaces by Phase for Madera HSR Station

Project Phase	Number of Parking Spaces by Phase	Total Parking Spaces
Phase 1	98	98
Phase 2	303	401
Phase 3	542	943

Source: (AECOM, 2024)

1.2.7 Station Building Expansion

The Project includes construction of an expanded or new separate station building, which would expand upon the station support services provided with the Phase 2 building identified in the prior IS/MND. The new station structure would also include a large canopy structure or structures that would extend out from the enclosed building portion to provide shaded outdoor plaza/seating areas. This station building (including the canopy) would be located adjacent to the eastern edge HSR platform (southern portion) and slightly west of the bus plaza. The total indoor building area would be expanded by approximately 5,000 square feet to provide space for enhanced passenger amenities and station support functions to accommodate the increased ridership from additional service, such as ticketing areas and waiting areas. The outdoor canopy could be designed to cover up to 20,000 square feet of outdoor plaza/seating space. A further 20,000 square feet of space would be reserved for expansion of the building/canopy structure in the future (when and if that becomes needed) but is not part of the Project. The Phase 3 building expansion would include a roof height of about 25 feet compared to the Phase 2 building roof height of about 15 feet.

1.2.8 Culverts

There are 10 proposed drainage culverts as part of the Project, all of which would be extensions of culverts originally constructed as part of Phase 2 of proposed Madera HSR Station. These 10 culverts extensions are listed below. The culverts are marked with position measurements (e.g., 41+85 for the northernmost culvert) on the preliminary engineering plans and in the list below. The culvert extensions are listed below with the stationing measurements, from north to south, as follows:

- Proposed Culvert Extension Number (#) 1: 41+85;
- Proposed Culvert Extension #2: 48+22;
- Proposed Culvert Extension #3: 87+46;
- Proposed Culvert Extension #4: 112+55;
- Proposed Culvert Extension #5: 119+57;
- Proposed Culvert Extension #6: 126+96;
- Proposed Culvert Extension #7: 135+05;
- Proposed Culvert Extension #8: 157+85;
- Proposed Culvert Extension #9: 162+51; and
- Proposed Culvert Extension #10: 171+40.

1.2.9 Wildlife Crossings

There are two proposed wildlife crossings as part of the Project; both would be extensions of wildlife crossings facilities originally constructed as part of Phase 2 of the proposed Madera HSR Station. As with the proposed culvert extensions, the wildlife crossing extensions are demarked with stationing measurements on the plans and in the list below. The wildlife crossing extensions are listed below with the stationing measurements, going from north to south as follows:

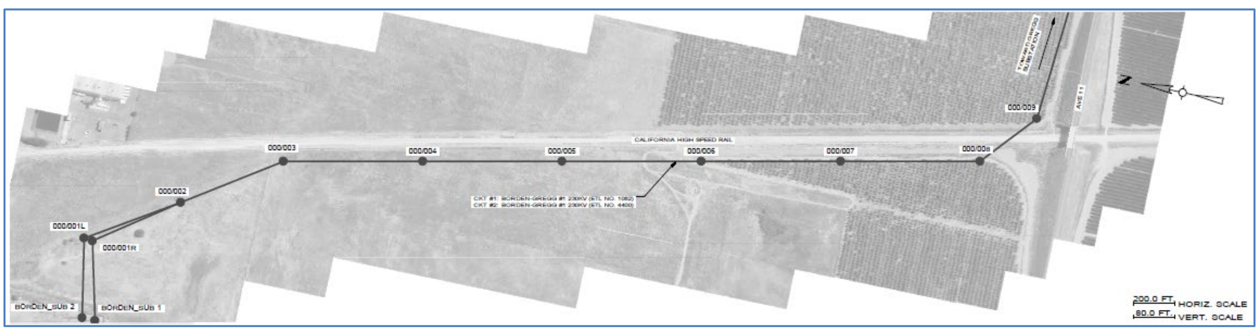
- Proposed Wildlife Crossing Extension #1: 76+41; and
- Proposed Wildlife Crossing Extension #2: 117+20.

1.2.10 Relocation of Pacific Gas and Electric Company Transmission Line

Pacific Gas and Electric Company (PG&E) is currently implementing the Borden-Gregg Transmission Line Re-Alignment Project (BGTLRP) in the vicinity of the Project. The BGTLRP would construct a portion of the re-aligned 230-kilovolt transmission line (including two transmission poles) in the Project Footprint. The BGTLRP is currently in final design and is expected to be completed prior to the construction of the Project.

The BGTLRP conflicts with the location of the southern end of the western side station siding track and with a culvert extension, both of which would be constructed as part of the Project. Identified in **Figure 1-3**, Poles 003 and 004 from the BGTLRP would need to be relocated as part of the Project slightly to the west.

Figure 1-3: Proposed Alignment of PG&E Borden-Gregg Transmission Line Re-Alignment Project



Source: (RailPros, 2024)

1.3 Operations and Maintenance

1.3.1 Conceptual Service Plan

The Project would enable additional HSR trains to serve the proposed Madera HSR Station and express HSR services that would bypass the Madera HSR Station by expanding capacity through the construction of a second platform and second station siding track. Phase 2 of the proposed Madera HSR Station would be able to accommodate only the Merced–Bakersfield EOS, which would consist of 18 trains (round trips) per day as (or a total of 36 trains per day) described in the CHSRA's 2024 Business Plan (CHSRA, 2024a) with all trains stopping at the Madera HSR Station. The additional capacity from the Project would allow an increase in the number of HSR trains serving the proposed Madera HSR Station and enable express HSR services to bypass the Madera HSR Station for both the planned HSR Service (north to the Bay Area, south to Southern California, or both) and subsequently the Phase 1 HSR Service (San Francisco to Los Angeles). This report analyzes Phase 1 HSR Service, which has the highest potential impacts.

The Phase 1 HSR Service plan, as outlined in the CHSRA in its 2024 Business Plan, delineates stopping patterns and service levels, and would include the following:

- 32 trains per direction per day (total of 64 trains per day) serving the Madera HSR Station; and
- An additional 66 express trains skipping the Madera HSR Station (i.e., passing through, but not stopping) (CHSRA, 2024b).

1.3.2 Ridership

As shown in **Table 1-2**, forecasted annual ridership in 2050 at the Madera HSR Station with the Project and with the Phase 1 HSR Service (San Francisco to Los Angeles) operating is between 715,600 and 835,500 ons and offs. This is compared to between 291,700 and 306,700 ons and offs without the Project and with only the EOS Service operating.

Table 1-2: Summary of Ridership Forecasts for Madera HSR Station

Madera HSR Station Phase	Phase of High-Speed Rail Service	Forecast Year	Estimated Annual Ridership Range (Ons and Offs at the Madera HSR Station)
Phase 2 (approved)	Early Operating Segment Service (Merced to Bakersfield)	2030 2050	247,000–259,600 291,700–306,700
Phase 3 (proposed)	Phase 1 HSR Service (San Francisco to Los Angeles)	2050	715,600–835,500

Source: (AECOM, 2024)

1.3.3 Energy Consumption

Construction of the Project would require the temporary use of fuels and energy needed to power construction equipment, machinery, tools, trucks, and worker vehicles for commuting to and from the Project site. Use of these fuels and energy would be limited to the duration of the construction period. Diesel fuel would primarily be needed for road-hauling trips and off-road construction diesel equipment (e.g., scrapers, blades, dozers, and backhoes). In addition, materials such as steel, concrete, and asphalt would require energy for the manufacturing process and transport to the Project site. The Project also would use energy for temporary electric power from a generator(s) or tie into existing electrical lines during construction for lighting and electric equipment (such as computers inside of temporary construction trailers, and heating, ventilation, and air conditioning system).

The CHSRA intends to utilize renewable energy for operations of the trains. If this proposed sustainability goal is not available for the initial operation of the trains, the Project would be connected to the overall power structure and supply for the entire HSR project. Operational energy for other elements of the Project such as safety lighting, building lighting, and other similar uses would be negligible.

1.3.4 Maintenance Activities

Operational activities of the Project would include standard maintenance and cleaning of the facilities and track. Operational activities would include maintenance work (e.g., the typical storage and periodic application of pesticides and herbicides for pest and vegetation management, as well as the storage and use of fuels, greases, lubricants, and solvents for use in machinery and equipment to ensure continued functionality of the proposed structures and facilities). Access to and within the Project site would be provided by existing and previously planned roadways and infrastructure such that no additional maintenance of such access roads or corridors would be needed.

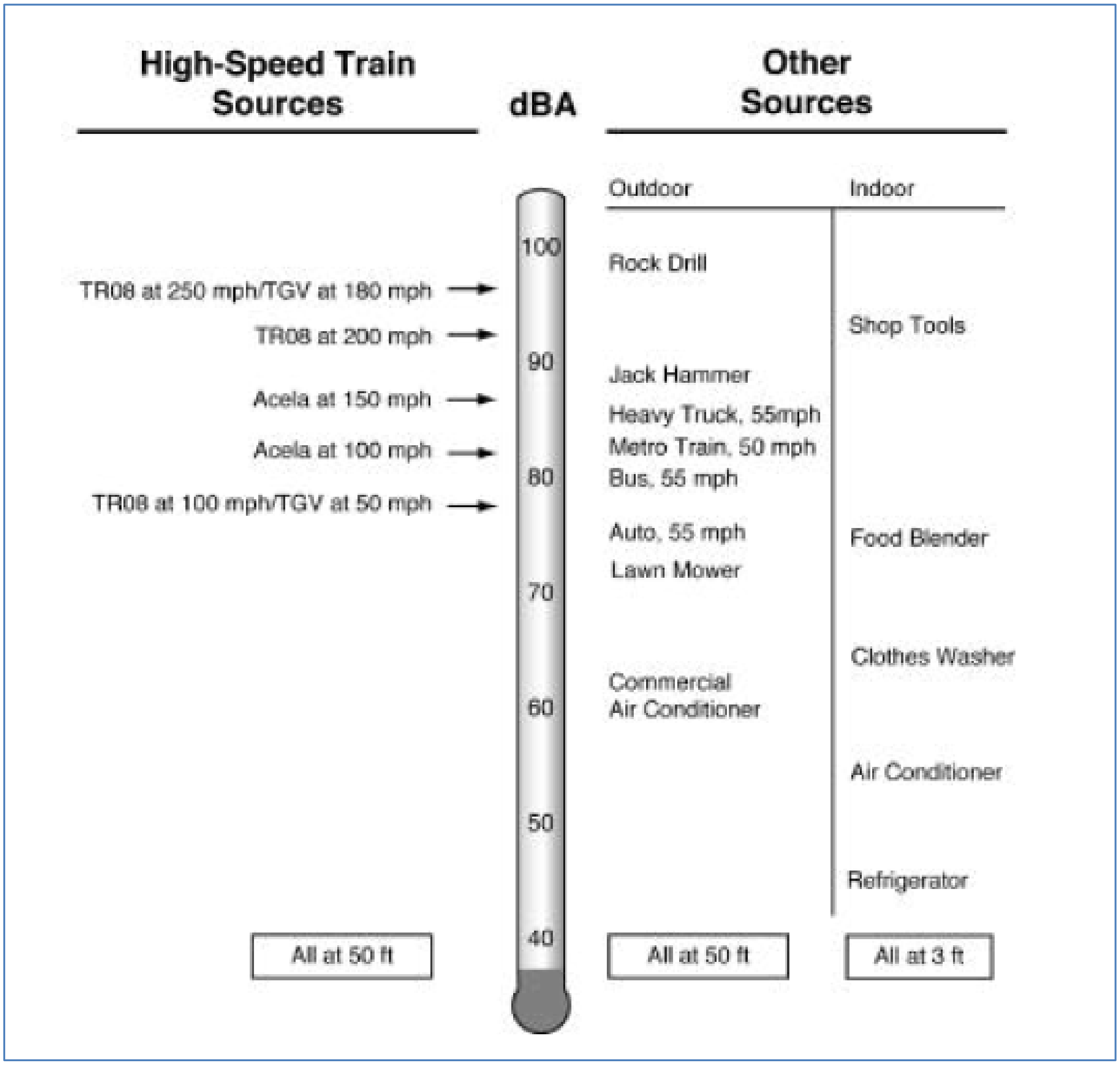
2. ACOUSTIC FUNDAMENTALS

2.1 Noise Fundamentals and Descriptors

Noise from transit systems is generally analyzed in terms of a source, path, and receiver. The source generates acoustical energy that depends on the type of source (e.g., trains, buses, stations, etc.) and its operating characteristics (e.g., vehicle number and speed and type of power used to propel the vehicle). The receiver is the noise-sensitive land use (e.g., residence, hospital, or school) exposed to noise from the source. In between the source and the receiver is the path, where the noise is reduced by distance, intervening buildings, and topography. Environmental noise impacts are assessed at the receiver. Noise criteria are established for the various types of receivers because not all receivers have the same noise sensitivity.

Noise is unwanted sound. Sound is measured in terms of sound pressure level and usually is expressed in decibels (dB). The human ear is less sensitive to higher and lower frequencies than it is to mid-range frequencies. All noise ordinances and this noise analysis use the A-weighted decibel (dBA) system, which measures what humans hear in a more meaningful way because it reduces the sound levels of higher and lower frequency sounds—similar to what humans hear. **Figure 2-1** shows typical maximum A-weighted sound pressure levels (L_{max}) for transit and non-transit sources.

Figure 2-1: Typical A-Weighted Sound Levels (including High Speed Train Sources)



Source: (FRA High-Speed Ground Transportation Noise and Vibration Impact Assessment, 2005)

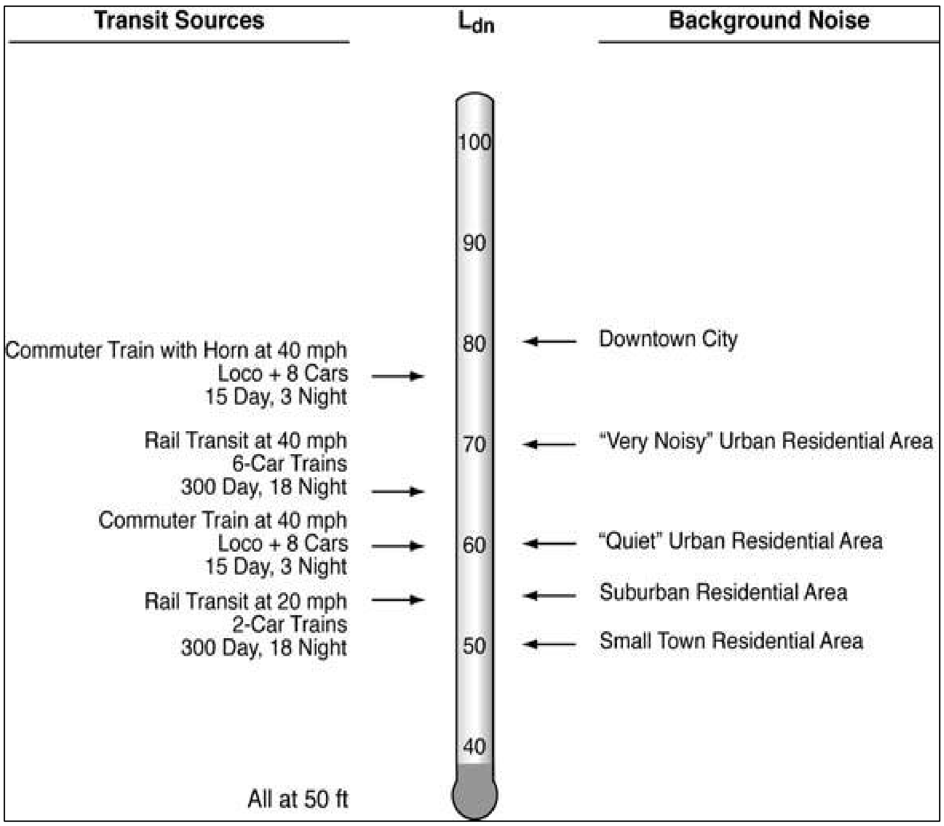
Four primary noise measurement descriptors are used commonly to assess noise impacts from traffic and transit projects. They are the equivalent sound level (L_{eq}), the day-night sound level (L_{dn}), and the sound exposure level (SEL), described as follows:

- **L_{eq}:** The Equivalent Sound Level (L_{eq}) is the equivalent sound level for a specified period of time that has the same sound energy as an actual fluctuating sound over the same period of time. The peak-hour L_{eq} is frequently used for all traffic and rail noise analyses at locations with primarily daytime use, such as schools and libraries.
- **L_{max}** (Maximum Noise Level): The maximum instantaneous noise level during a specific period of time. The L_{max} may also be referred to as the "peak (noise) level."
- **L_{dn}:** The Day-Night Sound Level ($L_{dn)}$ is equivalent to the L_{eq} over a 24-hour period, with 10 dB added to nighttime sound levels (between 10 p.m. and 7 a.m.) to account the greater sensitivity and lower background sound levels during this time. The L_{dn} is the primary noise-level descriptor for rail noise at residential land uses. Figure 2 shows typical L_{dn} noise exposure levels.

- **SEL:** The Sound Exposure Level (SEL) is the primary descriptor of a single sound event (e.g., noise from a train passing a specific location along the track). SEL is an intermediate value in the calculation of both L_{eq} and L_{dn}. It represents a receiver's cumulative sound exposure from an event and the total A-weighted sound during the event normalized to a 1-second interval.

In addition to the L_{eq}, L_{dn}, and SEL, another descriptor is used to describe noise. The loudest sound level over a measurement period, or Maximum Sound Level (L_{max}) is used in many local and State ordinances for noise emitted from private land uses and for construction noise impact evaluations as shown in **Figure 2-2**.

Figure 2-2: Typical Ldn Sound Levels



Source: FTA 2018

2.2 Vibration Fundamentals and Descriptors

Vibration from a transit system also is expressed in terms of a source, path, and receiver. The source is the train rolling on the tracks, which generates vibration energy transmitted through the supporting structure under the tracks and into the ground. After the vibration gets into the ground, it propagates through the various soil and rock strata—the path—to the foundations of nearby buildings—the receivers. Groundborne vibrations generally are reduced with distance, depending on the local geological conditions. A receiver is a vibration-sensitive building (e.g., residence, hospital, or school) where the vibrations may cause perceptible shaking of the floors, walls, and ceilings and a rumbling sound inside rooms. Not all receivers have the same vibration sensitivity. Consequently, vibration criteria are established for the various types of receivers. Groundborne noise occurs as an audible rumble and is caused by the noise radiated from the vibration of room surfaces (which is usually limited to underground vibration sources, like subway tunnels).

Vibration above certain levels can damage buildings, disrupt sensitive operations, and cause annoyance to people in buildings. The response of people, buildings, and equipment to vibration is most accurately described using velocity or acceleration. In this analysis, vibration velocity (VdB) is the primary measure to evaluate the effects of vibration.

Vibration impact assessments typically distinguish between human annoyance and structural damage, using different metrics to quantify each.

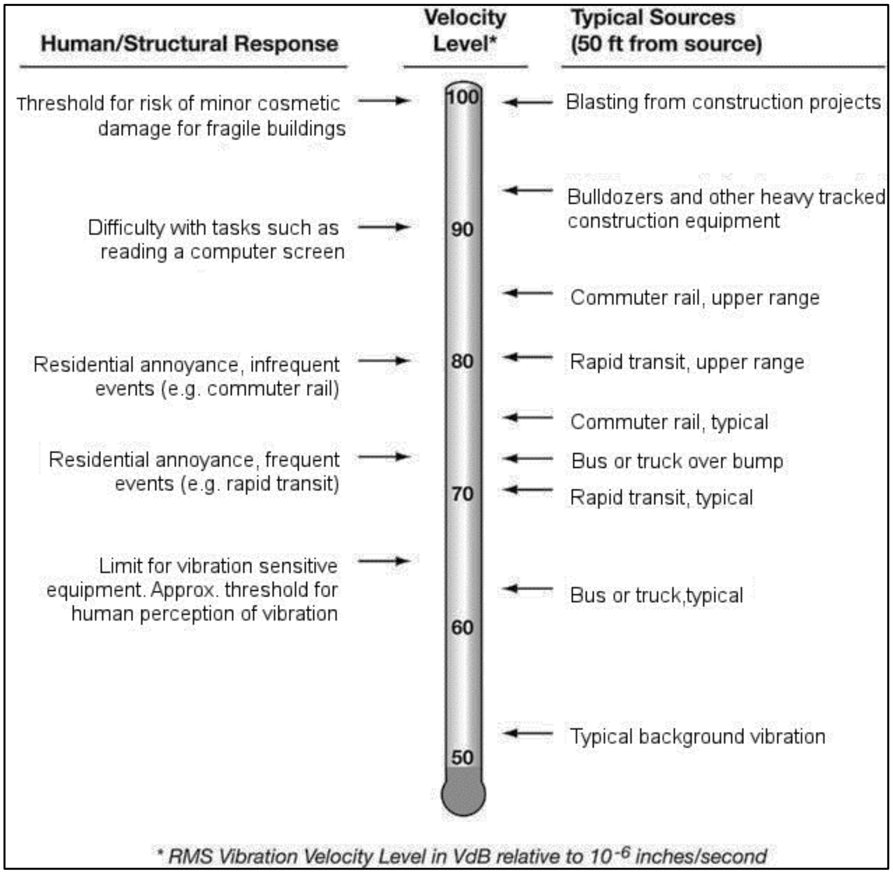
For vibration annoyance, the measure used is VdB (vibration velocity decibels), which represents a logarithmic scale of velocity. This logarithmic measurement is used because human perception of vibration follows a logarithmic pattern—meaning that a tenfold increase in vibration velocity does not result in a tenfold increase in perceived annoyance. Instead, the logarithmic scale allows us to more accurately model how changes in vibration velocity affect perceived annoyance levels.

On the other hand, when assessing the potential for structural damage, the metric used is PPV (Peak Particle Velocity), which measures the maximum instantaneous velocity of a particle in a medium (such as soil or a building component) as it vibrates. Unlike VdB, PPV is expressed in linear velocity units, typically millimeters per second (mm/s) or inches per second (in/s). This linear scale is crucial for understanding potential damage because structural responses to vibration are directly related to the velocity of particles. Higher velocities can cause materials to crack, separate, or fail, depending on their properties and the intensity of the vibration.

Tables 3-1 through **Table 3-4** in Section 3.2, illustrate this distinction by providing data on vibration annoyance (measured in VdB) and potential damage (measured in PPV). **Table 3-3** shows how different levels of VdB correlate with human annoyance thresholds, while **Table 3-4** presents PPV levels that correspond to the onset of minor or major structural damage. By presenting both metrics, both human comfort and safety concerns as well as structural integrity considerations will be addressed.

Figure 2-3 shows typical groundborne vibration velocity levels for common sources and thresholds for human and structural response to groundborne vibration. As shown, the range of interest is from approximately 50 to 100 VdB in terms of vibration velocity level (i.e., from imperceptible background vibration to the threshold of damage). Although the threshold of human perception to vibration is approximately 65 VdB, annoyance usually does not occur unless the vibration exceeds 70 VdB.

Figure 2-3: Typical Levels of Groundborne Vibration



Source: (FTA, 2018)

3. REGULATORY FRAMEWORK

3.1 Federal

Two United States Federal guidance documents primarily were used for the assessment of noise impacts associated with the project, the Federal Railroad Administration's High-Speed Ground Transportation Noise and Vibration Impact Assessment Manual (FRA 2012), and the Federal Transit Administration's Noise and Vibration Impact Assessment Manual (FTA 2018). The two manuals are complimentary, sharing much of the same basic information and guidance related to rail transportation noise and vibration impacts. The difference is that the Federal Transit Administration (FTA) manual is more comprehensive, addressing all aspects of transit noise (including light rail, commuter rail, substations, maintenance facilities, stations, and highway sources, but not high-speed rail vehicles). The Federal Railroad Administration (FRA) manual is focused specifically on the prediction and assessment of noise and vibration impact from high-speed rail vehicle operations. The thresholds for moderate and severe noise impacts, as discussed below, are identical for both manuals.

Given the Project is a high-speed rail (HSR) related project, both the FTA and FRA noise impact assessment criteria for determining the severity of the noise exposure are applicable as follows:

- For construction of the Project and non-high-speed rail sources of noise (including station noise) , the FTA analysis will apply; and

- For the operations of the high-speed trains associated with Project, the FRA analysis will apply.

3.2 FTA Impact Criteria for Noise for Construction of High-Speed Rail

Table 3-1 shows the FTA noise assessment criteria for construction. The 8-hour L_{eq} noise exposure from construction noise calculations use the noise emission levels of the construction equipment, equipment location, and operating hours. The construction noise limits normally are assessed at the noise-sensitive receiver property line.

Table 3-1: FTA Construction Noise General Assessment Criteria

Land Use	8-hour L_{eq}, dBA	
	Day	Night
Residential	90	80
Commercial	100	100
Industrial	100	100

Notes:
L_{eq} = equivalent sound level
dBA = A-weighted decibel
Source: FTA 2018

3.3 FRA/FTA Operational Noise and Vibration Impact Assessment Criteria

For transit projects, the FTA has prepared a noise and vibration manual that describes the methodology for identifying impacts and criteria in determining the severity of the noise exposure for both construction and operations. The FRA provide a similar manual for high-speed rail projects, but that manual references the more general FTA manual for noise from construction and non-rail sources. Therefore, the following land use categories are summarized from the 2018 manual (FTA, 2018).

FTA provides different thresholds for different land uses. **Table 3-2** lists the three FTA land use categories and the applicable noise metric for each category. For Category 2 land uses, noise exposure is characterized using L_{dn}. In calculating L_{dn}, noise generated during nighttime hours is weighted more heavily than daytime noise to reflect residents' greater sensitivity to noise during those hours. For Category 1 and Category 3 land uses, noise exposure is characterized using the peak hour L_{eq}, which is a time-averaged sound level over the noisiest hour of transit-related activity. Other land uses, such as commercial and industrial land uses not identified, are not considered noise-sensitive by FTA, and thus standards have not been defined for those land uses. Background information on the L_{dn} and L_{eq} noise descriptors are provided in the discussion of "Noise Fundamentals and Descriptors" at the beginning of Section 2.1.

Table 3-2: FTA Land Use Categories and Noise Metrics

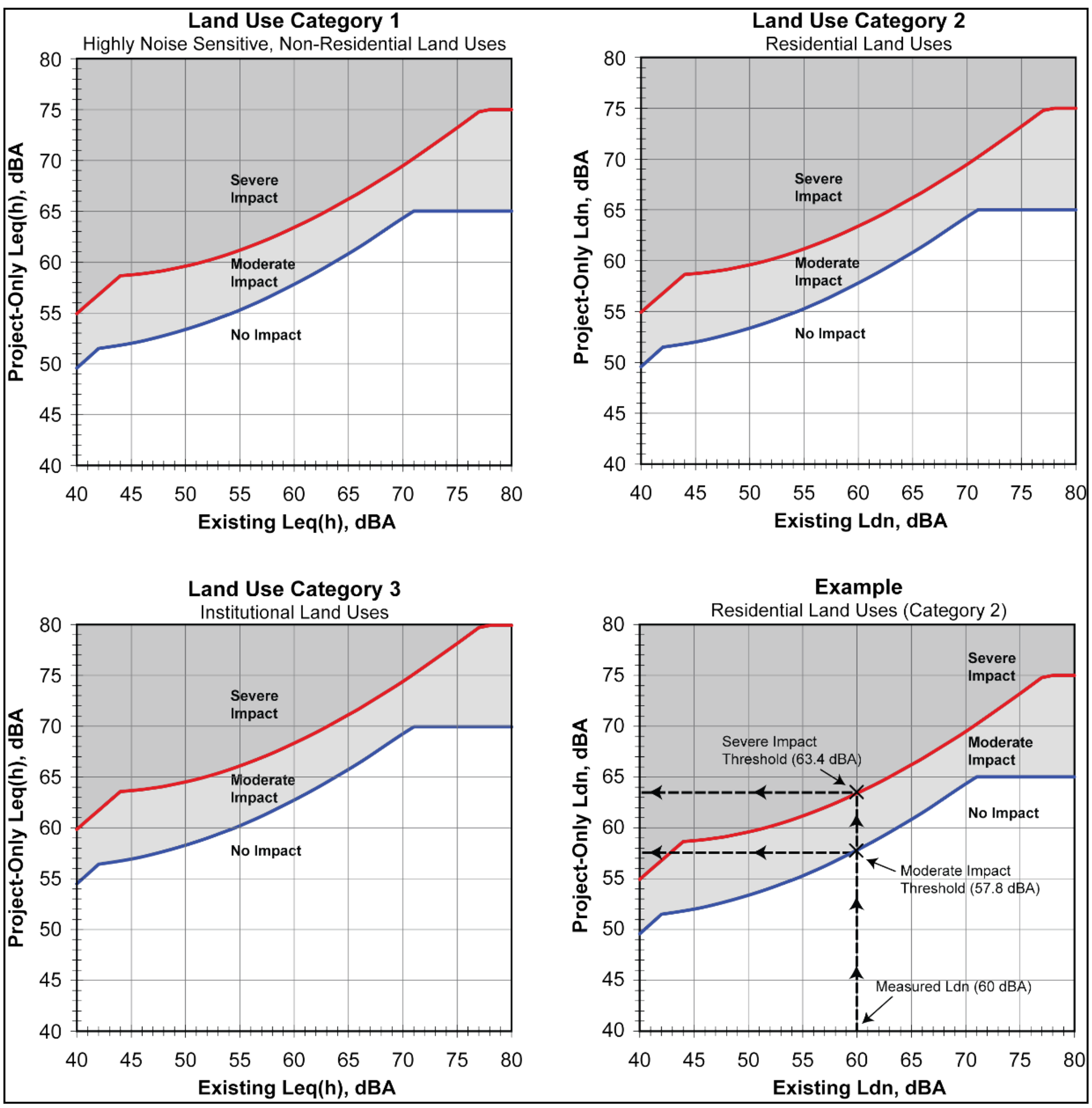
Land Use Category	Noise Metric (dBA)	Description of Land Use Category
1	Outdoor $L_{eq(h)a}$	Land where quiet is an essential element of its intended purpose. Example land uses include preserved land for serenity and quiet, outdoor amphitheaters and concert pavilions, and national historic landmarks with considerable outdoor use. Recording studios and concert halls also are included in this category.
2	Outdoor L_{dnb}	This category is applicable for all residential land use and buildings where people normally sleep, such as hotels and hospitals.
3	Outdoor $L_{eq(h)}$a	This category is applicable to institutional land uses with primarily daytime and evening use. Example land uses include schools, libraries, theaters, and churches, where it is important to avoid interference with such activities as speech, meditation, and concentration on reading material. Places for meditation or study associated with cemeteries, monuments, museums, campgrounds, and recreational facilities also are included in this category.

Notes:
a Leq for the noisiest hour of transit-related activity during hours of noise sensitivity.
b Ldn is a measure that counts for a full 24 hours of noise, with penalties for noise at night, which is defined as being between 10 p.m. and 7 a.m.
Source: (FTA, 2018)

The FRA/FTA noise impact threshold is a sliding scale, based on existing noise exposure and land use of sensitive receivers. In areas where existing noise exposure is higher, the allowable increase above the existing noise exposure decreases. For example, in an area with an existing noise level of 55 dBA, the allowable increase in noise level is 3 dBA, resulting in a total future noise impact threshold of 58 dBA. For an area with an existing noise level of 60 dBA, the allowable increase in noise level is only 2 dBA, resulting in a total future noise impact threshold of 62 dBA. The FTA defines two levels of noise impact: moderate and severe.

The FRA/FTA noise impact criteria are shown graphically in **Figure 3-1** for the different categories of land use, defined in **Table 6-1**, along with an example of how the criteria are applied. The two graphs on the left are for nonresidential land uses where L_{eq}(h) represents the noise exposure metric, and the top right graph is for residential land uses where L_{dn} represents the noise exposure metric. In **Figure 3-1**, the existing noise is shown on the horizontal axis, and the amount of new noise that a project could create is shown on the vertical axis. The lower curve (blue) defines the threshold for moderate impact, and the upper curve (red) defines the threshold for severe impact.

Figure 3-1: FTA Impact Criteria for Noise



Source: (FTA, 2018)

The sample graph in the bottom right corner of **Figure 3-1** clarifies the concept of a sliding scale for noise impact. Assuming that the existing noise has been measured at 60 dBA L_{dn} (i.e., based on the noise measurement, this level represents the total noise from all existing noise sources over a 24-hour period, including traffic, aircraft, lawnmowers, children playing, and birds chirping). Following the vertical line from the measured 60 dBA on the horizontal axis, the intersection with the moderate and severe impact curves identifies the noise thresholds for moderate and severe impacts along the vertical axis: 57.8 dBA L_{dn} for moderate impact and 63.4 dBA L_{dn} for severe impact.

The curves that are shown in **Figure 3-1** are defined in terms of project-only noise (on the vertical axes) and existing noise (on the horizontal axes). The project-only noise is the noise that would be introduced into the environment by a project; it is not the future noise levels with the project. The project-only noise does not include noise from existing noise sources in the area that would not change because of the project, such as automobile traffic and airplanes.

3.4 FTA Impact Criteria for Groundborne Vibration

The potential adverse effects of rail transit groundborne vibration include perceptible building vibration, rattle noises, re-radiated noise (groundborne noise), and cosmetic or structural damage to buildings. The vibration generated by modern passenger and freight rail operations is well below levels that are considered to be necessary to damage buildings. Therefore, the criteria for building vibration caused by transit operations are concerned only with the potential annoyance of building occupants.

The FTA vibration impact criteria are based on the maximum indoor vibration level as a train passes. No impact criteria exist for outdoor spaces, such as parks, because outdoor groundborne vibration does not provoke the same adverse human reaction as indoor vibration. For projects that are in the early design phases, when construction details are based on reasonable assumptions, the FTA manual describes a “general vibration assessment” methodology that identifies impacts using an overall vibration velocity level.

The criteria for groundborne vibration for land use categories 1–3 are shown in **Table 3-3**. The criteria are presented in terms of acceptable indoor groundborne vibration levels, expressed in terms of RMS velocity levels in VdB.

The FTA vibration thresholds do not account for existing vibration specifically. Although substantial volumes of vehicular traffic are in the proposed Project area, rubber-tired vehicles rarely generate perceptible ground vibration unless irregularities occur in the roadway surface, such as potholes or wide expansion joints.

Historic structures that do not fall into the FTA land use categories are not included in the assessment for vibration impact from passenger and freight rail operations. The vibration impact thresholds are based on annoyance, and the primary concern for historic structures is the risk of damage. The recommended limit in the FTA manual for buildings that are extremely susceptible to damage is 90 VdB, which is 18 dB higher than the limit for Category 2 (residential) land uses. Vibration from the new passenger and freight rail operations would be well below the limit for buildings that are extremely susceptible to damage, for all historic resources.

Table 3-3: FTA General Vibration Assessment Impact Criteria for Groundborne Vibration Annoyance

Land Use Category	Groundborne Vibration Impact Levels (VdB re 1 micro Pascals)		
	Frequent Event[a]	Occasional Event[b]	Infrequent Event[c]
Category 1: Buildings where vibration would interfere with interior operations (Typical land uses in this category are vibration-sensitive research and manufacturing facilities.)	65 VdB	65 VdB	65 VdB
Category 2: Residences and buildings where people normally sleep	72 VdB	75 VdB	80 VdB
Category 3: Institutional land uses with primarily daytime use	75 VdB	78 VdB	83 VdB

Notes:

[a] "Frequent Events" is defined as more than 70 vibrations of the same source per day.

[b] "Occasional Events" is defined as between 30 and 70 vibration events of the same source per day.

[c] "Infrequent Events" is defined as fewer than 30 vibration events of the same source per day.

[d] This criterion limit is based on levels that are acceptable for most moderately sensitive equipment, such as optical microscopes. Vibration-sensitive manufacturing or research would require a detailed evaluation to define the acceptable vibration levels.

Source: (FTA, 2018)

To avoid temporary annoyance to building occupants during construction or construction interference with vibration-sensitive equipment inside special-use buildings, such as that from a magnetic resonance imaging machine, FTA recommends comparing the proposed Project construction-related VdB to the criteria shown in **Table 3-3** for frequent, occasional, and infrequent events. FTA defines frequent events as more than 70 events per day, occasional events as 30–70 events per day, and infrequent events as fewer than 30 events per day. It was conservatively assumed that the construction-related, vibration-generating activities under the proposed Project would fall under occasional events as defined by FTA. The vibration annoyance criteria for vocational events because of construction are shown in **Table 3-3** with 75 VdB for land use Category 1 and 78 VdB for land use Category 2.

The operation of construction equipment for the proposed Project would cause ground vibrations to spread through the ground and would diminish in strength with distance. Buildings founded on the soil near the construction site would respond to these vibrations with varying results, ranging from no perceptible effects at the lowest levels, low rumbling sounds and perceptible vibrations at moderate levels, and slight damage at the highest levels.

Building damage criteria recommended by FTA are shown in **Table 3-4**. These limits were used to estimate potential problems that should be addressed during the final design. The vibration limits that are shown are the levels at which risk for damage would exist for each building category, not the level at which damage would occur. These limits should be viewed as criteria to be used during the impact assessment phase, to identify problem locations.

Table 3-4: FTA Construction Vibration Damage Criteria

Building Category	PPV (inch/second)	Approximate RMS Vibration Velocity Level[a]
I. Reinforced concrete, steel, or timber (no plaster)	0.5	102
II. Engineered concrete and masonry (no plaster)	0.3	98
III. Non-engineered timber and masonry buildings	0.2	94
IV. Buildings extremely susceptible to vibration damage	0.12	90

Notes:
[a]RMS vibration velocity level in VdB relative to 1 micro-inch/second.
PPV = peak particle velocity
RMS = root-mean-square
Source: (FTA, 2018)

3.5 Madera County General Plan

The following Madera County General Plan policies are relevant to the proposed Project.

Transportation Noise Source Policies

- Policy 7.A.2: Noise created by new transportation noise sources, including roadway improvement projects, shall be mitigated so as not to exceed 60 dBA L_{dn} within the outdoor activity areas of existing or planned noise-sensitive land uses and 45 dBA L_{dn} in interior spaces of existing or planned noise-sensitive land uses.

Non-Transportation Noise Source Policies

- Policy 7.A.5: Noise which will be created by new non-transportation noise sources, or existing non-transportation noise sources which undergo modifications that may increase noise levels, shall be mitigated so as not to exceed the noise level standards of Table 7.A.4 (refer to **Table 3-5**, Maximum Allowable Noise Exposure for Non-Transportation Noise Sources), on lands designated for noise-sensitive uses. This policy does not apply to noise levels associated with agricultural operations.

Table 3-5: Madera County - Maximum Allowable Noise Exposure For Non-Transportation Noise Sources[1]

Sound Level	Daytime (7 a.m. to 10 p.m.)	Nighttime (10 p.m. to 7 a.m.)
Hourly Leq, dB	50	45
Maximum level, dB	70	65

Notes:

Each of the noise levels specified above shall be lowered by 5 dB for pure tone noises, noises consisting primarily of speech or music, or for recurring impulsive noises. These noise level standards do not apply to residential units established in conjunction with industrial or commercial uses (e.g., caretaker dwellings).

L_{eq} = equivalent sound level

dBA = A-weighted decibel

dB = decibels

1. As determined at the property line of the receiving land use. When determining the effectiveness of noise mitigation measures, the standards may be applied on the receptor side of noise barriers at the property line.

Source: (Madera County, 1995)

- Policy 7.A.9: Vibration perception threshold: The minimum ground or structure-borne vibrational motion necessary to cause a normal person to be aware of the vibration by such direction means as, but not limited to, sensation by touch or visual observation of moving objects. The perception threshold shall be presumed to be a motion velocity of one-tenth (0.1) inches per second over the range of one to one hundred Hz.

- Policy 7.A.10: Operation or permitting the operation of any device that creates a vibration which is above the vibration perception threshold of an individual at the location where the sensitivity exists such as the property line of a residential development or from the location of residence constructed on agricultural property.

3.6 Madera County Noise Ordinance

The following Madera County Noise Ordinance Chapter 9.58 -Noise Control (Madera County, 2001) sections are relevant to the Project.

- Section 9.58.020 specifically lists the prohibited acts related to noise and vibration.

- Section 9.58.011. - Definitions. "Hz (hertz)" means a unit of measurement for a pitch that describes the number of cycles per second in sound vibration. Speech information usually falls between 200Hz and 6000Hz. "Middle C" on the piano falls at two hundred sixty-two Hz."

- "Vibration perception threshold" means the minimum ground or structure-borne vibrational motion necessary to cause persons of normal sensitivity to be aware of the vibration by such direct means as, but not limited to, sensation by touch or visual observation of moving objects. The perception threshold shall be presumed to be a motion velocity of one-tenth inches per second over the range of one to one hundred Hz. This threshold shall be applied at the location where the sensitivity exists, such as the property lines within a residential development or from the location of a residence constructed an agricultural property.

- Section 9.58.020F of the County's noise ordinance requires that operating or permitting the operation of any device that creates a vibration which is above the vibration perception threshold as defined in Section 9.58 at or beyond the property boundary of the source if on private property or one hundred fifty feet (forty-six meters) from the source if on a public right-of-way will be in violation of this chapter.

- Section 9.58.020FG of the County's noise ordinance, states that construction activities are limited to the hours of seven a.m. and seven p.m. Monday through Friday and nine a.m. and five p.m. on Saturdays. Construction activities will be prohibited on Sundays.

4. METHODOLOGY

Noise conditions were identified for new noise-sensitive developments located within areas with the potential to be affected by substantial existing or future mobile noise sources (e.g., aircraft, automobile, railroad lines) and stationary noise sources (e.g., construction activities).

Existing physical conditions, which constitute the baseline for purposes of determining whether potential impacts are significant, were compared to future anticipated conditions under buildout of the proposed Project. Aerial images of the Project Footprint were used to determine the potential locations of noise-sensitive receptors and noise-generating land uses in the area. Noise-sensitive land uses and major noise sources were identified based on existing documentation (e.g., equipment noise levels and attenuation rates) and site reconnaissance data. Baseline ambient noise levels were based on predictions from traffic noise modeling, and stationary-source noise levels were based on manufacturers' specifications.

To assess noise impacts from construction and operation, sensitive receptors and their relative levels of exposure were identified. Construction and operational noise was predicted using the FTA and FRA Transit Noise and Vibration Impact Assessment methodologies, respectively, for noise prediction (FTA, 2018). The noise emission levels referenced, and usage factors are based on Federal Highway Administration's (FHWA's) Roadway Construction Noise Model (FHA, 2006).

Groundborne vibration impacts were assessed for construction (e.g., vibration levels produced by specific construction equipment operations and the distance of sensitive receptors from a given source), and operational vibration sources, based on FTA methodology.

Noise and vibration levels and resultant levels at the locations of sensitive receptors were calculated and compared to FTA and FRA methods. Also, Project-related noise and vibration were assessed based on Appendix G of the CEQA Guidelines, in which a noise impact is considered significant if implementation of the proposed Project would cause any of the following:

- Generation of 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;

- Generation of excessive groundborne vibration or groundborne noise levels;

- 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 living or working in the project area to excessive noise levels.

5. EXISTING SETTINGS

5.1 Existing Noise Levels

The existing noise environment is dominated by transportation sources, mainly trains in the Project Footprint and local road traffic. Trains that are used for the San Joaquin operations are diesel-based Amtrak trains. Noise and vibration-sensitive receivers were assessed in the area using the FTA transit noise and vibration impact assessment manual's definitions of noise- and vibration-sensitive land uses (FTA, 2018).

Existing noise levels were estimated using the generic noise environment from the FTA Noise and Vibration Manual – Table 6, "Estimating Existing Noise Exposure for General Noise Assessment". **Table 5-1** summarizes the assumed existing noise Environment in the Project corridor.

Table 5-1: Existing Noise Levels in the Project Corridor

Dominant Existing Noise Source	Distance from Major Noise Source, feet*	L_{dn} (dBA)
Interstate Highway**	200–400	60
	400 to 800	55
	800 and up	50
Railway	120–240	60
	240 to 500	55
	500 to 800	50
	800 and up	45

Notes:
* Distances do not include shielding from intervening rows of buildings. Generally, for estimating shielding attenuation in populated areas, assume 1 row of buildings every 100 ft, 4.5 dB for the first row, and 1.5 dB for every subsequent row up to a maximum of 10 dB attenuation.
** Roadways with 4 or more lanes that permit trucks, with traffic at 60 mph. SR-99 for the Project corridor.
dBA = A-weighted decibels
L_{dn} = day-night noise level
Source: (AECOM, 2024)

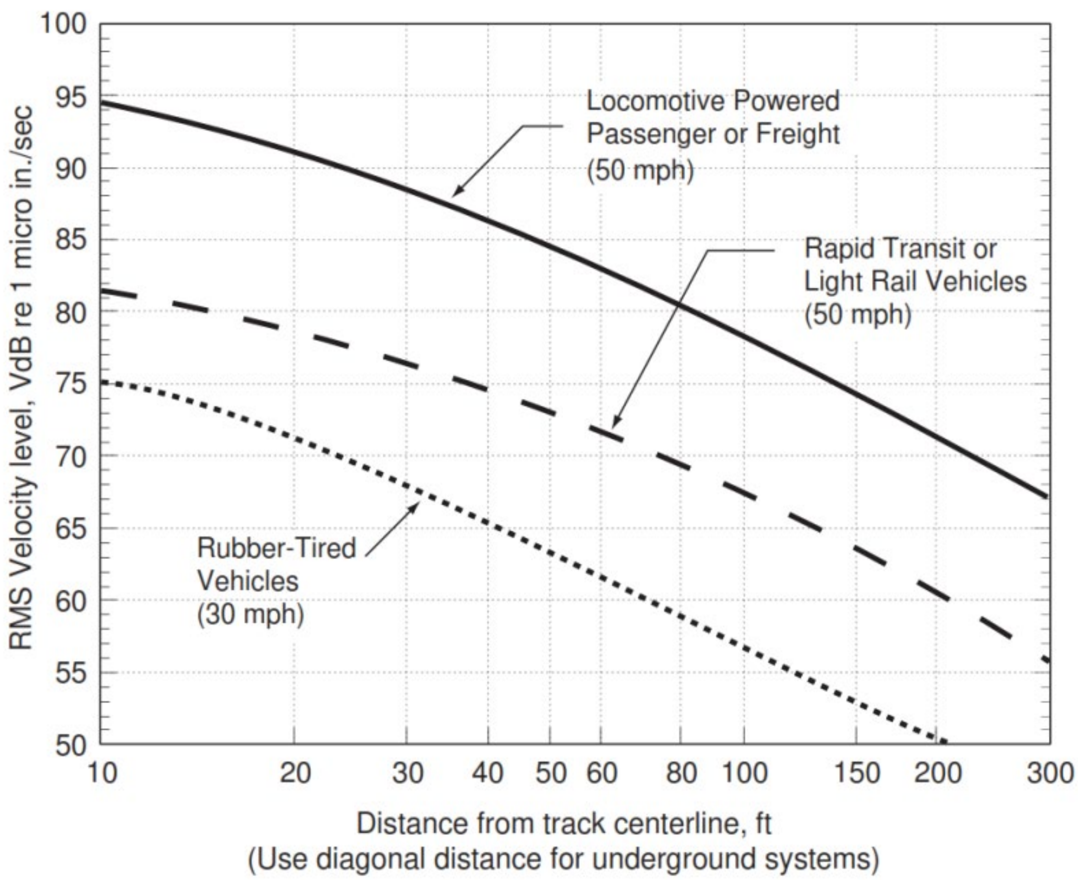
5.2 Existing Vibration Levels

The existing vibration environment, like the noise environment, is dominated by transportation sources. Heavy truck traffic can generate groundborne vibration, which varies considerably depending on vehicle type, weight, and pavement conditions. However, groundborne vibration levels generated from vehicular traffic typically are not perceptible outside the road right-of-way. The other source of groundborne vibration in the Project vicinity is the existing railroad line and some types on construction activity. The existing railroad line is currently used by both Amtrak passenger trains and freight trains.

The closest building to the Project corridor that would be considered vibration-sensitive is the structures within the Project site and also is a rural residential use located approximately 1 mile from the existing railroad tracks to the south along Road 30, between the Project site and SR-99. Vibration levels are not reported in any known Madera County and City of Madera planning or environmental documents in the Project vicinity. In the absence of vibration data from these communities, the FTA manual (FTA, 2018) was used to estimate vibration levels.

Trains (Amtrak passenger trains and freight trains) currently passing through the project area, have an average speed of 50 mph considering station stops and varying track conditions, and due to factors, such as train length, weight, and operational protocols. According to FTA's ground-surface vibration curves, shown in **Figure 5-1**, passenger and freight trains operating at 50 miles per hour (mph) generate groundborne vibration of approximately 85 VdB (0.071 inches/sec. PPV) at a distance of 50 feet. At a distance of 1 mile from the track's centerline, the groundborne vibration levels are approximately 0.0000291 inches/sec (or 2.91 x 10^-5 inches/sec) PPV, and 17.3 VdB.

Figure 5-1: Generalized Ground Surface Vibration Curves



Source: (FTA, 2018)

Train operations through Madera, California include both passenger and freight services, each operating at different speed ranges. Amtrak's San Joaquins Service has a maximum speed of 79 mph, but due to station stops and track conditions, its average speed is approximately 50 mph. Freight trains in the area generally operate at a maximum speed of 70 mph, while their average speed ranges between 25 and 40 mph, depending on train length, weight, and track conditions. These speed variations are influenced by federal regulations, track classifications, and operational considerations specific to the region.

To estimate vibration levels (VdB) and peak particle velocity (PPV) for train speeds other than 50 mph, we use speed adjustment factors based on Federal Transit Administration (FTA) guidance. The following equations apply:

1. VdB Adjustment for Speed

The FTA empirical speed correction formula for groundborne vibration is:

VdB_new = VdB_ref + 30 * log10(S_new / S_ref)

Where:

- VdB_new = Vibration level at the new speed
- VdB_ref = Reference vibration level at a given speed (e.g., 85 VdB at 50 mph)
- S_new = New train speed (in mph)
- S_ref = Reference train speed (typically 50 mph)

2. PPV Adjustment for Speed

Since PPV is proportional to velocity, we apply a similar logarithmic correction:

PPV_new = PPV_ref * 10^((30 * log10(S_new / S_ref)) / 20)

Where:

- PPV_new = PPV at the new speed
- PPV_ref = Reference PPV at a given speed (e.g., 0.071 in/sec at 50 mph)
- S_new = New train speed (in mph)
- S_ref = Reference train speed (50 mph)

For a train speed of 79 mph, applying the above formulas:

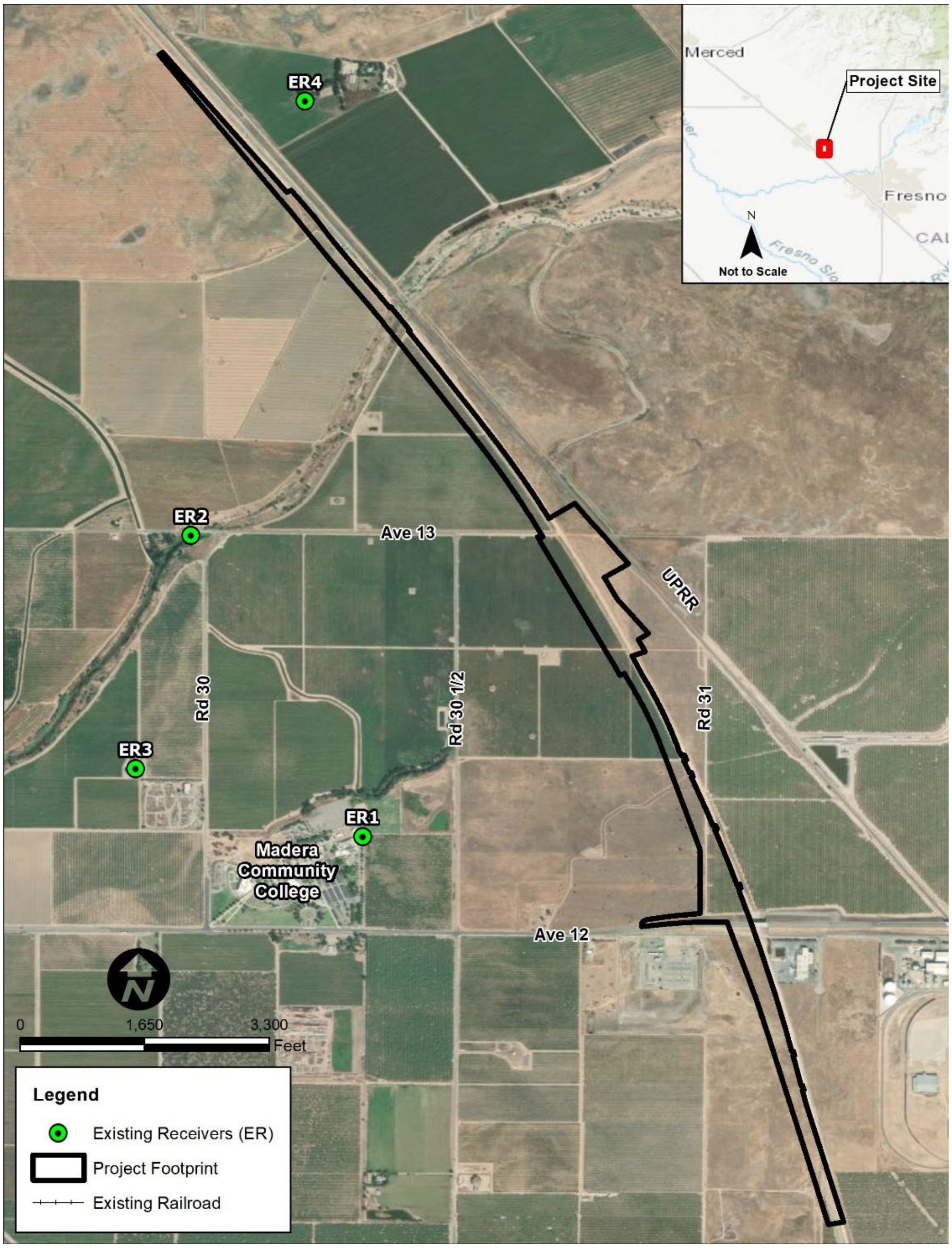
- Vibration level (VdB): 91 VdB
- Peak particle velocity (PPV): 0.0628 in/sec

For a train traveling at 79 mph, the estimated groundborne vibration levels decrease significantly over distance. At a distance of 1 mile (5280 feet) from the track, the vibration level (VdB) is approximately 30.2 VdB, and the peak particle velocity (PPV) is approximately 0.00013 in/sec (1.30×10^{-4} in/sec PPV).

5.3 Noise Sensitive Receivers

Existing land use in the vicinity of the proposed Project is agricultural land. Receivers potentially sensitive to train noise and vibration are not located in the immediate proximity of the proposed Project. As shown in **Figure 5-2**, Madera Community College Existing Receiver 1 (ER1) is located approximately 3,600 feet to the west. The nearest noise-sensitive residential uses are between the Project site and SR-99, located about 880 feet to the northeast (ER4) and 1-mile to the west along Avenue 13 (ER3).

Figure 5-2: Noise-Sensitive Receivers



Source: (AECOM, 2024)

6. IMPACT ANALYSIS

6.1 Construction Noise Analysis

Project construction for the various elements would include basic activities associated with site work and platform work. The local noise ordinances along the proposed Project corridor generally limit construction noise to particular times during weekday, weekend, and holiday daytime hours. Sunday and Nighttime construction work is prohibited.

Table 6-1 summarizes the estimated construction noise levels and residential noise impact screening distances for each of the planned construction activities. The screening distances identify the distance within which the specified land use could be exposed to noise levels above the local or FTA criteria. The impact distances relevant to the FTA criteria from **Table 3-2** reflect the types of equipment anticipated to be used. The potential for noise impact would be greatest during platform work. To be conservative, the impact distance estimates do not assume any topography or ground effects. The results of the analysis indicate that daytime noise could affect residences within approximately 45 feet (there are none within the daytime impact distance). Commercial uses would need to be sited within approximately 18 feet to be affected by construction noise (there are none in the Project corridor). There are no noise-sensitive uses within the impact distances shown in **Table 6-1**.

For CEQA analysis, with respect to generation of a substantial temporary or permanent increase in ambient noise levels in the vicinity of the proposed Project in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies, as shown in **Table 3-5**, construction noise at the nearest residence to the Project Footprint would result in a noise level of 45 to 69 dB Leq. This level of construction noise would be below the existing noise level in the Project Footprint (**Table 5-1**) and the County's thresholds (**Table 3-5**), except for ER4 where the construction noise would be above the existing noise level in the project area and above the County's Threshold. Also, as shown in **Table 6-1**, local noise ordinances generally exempt construction noise. However, the Project would generate 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. Therefore, the Project during construction would have a significant impact.

MM NOI-1: To address construction noise impacts in the vicinity of Environmental Receptor 4 (ER4), where noise levels are expected to exceed existing ambient levels and Madera County's thresholds, the following mitigation measures are recommended for inclusion in the Environmental Impact Report (EIR):

- **Temporary Noise Barriers**: Install temporary noise barriers or sound blankets around active construction areas near ER4. These barriers shall be at least 8 feet tall and provide a minimum noise reduction of 10 dBA, based on site-specific conditions.
- **Use of Quiet Equipment**: Utilize modern, well-maintained construction equipment equipped with noise-reducing devices such as mufflers and enclosures. Remove or retrofit excessively noisy equipment, and consider alternative quieter construction methods where feasible.
- **Construction Hours Limitations**: Restrict construction activities to the hours of 7:00 AM to 7:00 PM on weekdays and Saturdays, with no work on Sundays or legal holidays unless specifically approved by Madera County.
- **Equipment Staging and Stockpiling**: Locate equipment staging areas and material stockpiles as far as practicable from ER4 and other sensitive receptors. These locations must be detailed in the Construction Noise Control Plan for County approval.
- **Community Outreach**: Develop and implement a community outreach program to notify residents near the project, particularly those near ER4, about the construction schedule, expected noise levels, and contact information for a designated liaison. Provide notifications through mail, signage, and regular updates.
- **Noise Monitoring**: Conduct noise monitoring during construction activities near ER4 to ensure compliance with local thresholds. Measure noise levels at representative sensitive receptors and implement additional measures immediately if exceedances are identified.
- **Staggered High-Noise Activities**: Phase construction activities to avoid simultaneous operation of multiple high-noise-generating equipment near ER4. Include a staggered schedule in the Construction Noise Control Plan.

Table 6-1: Noise Impact Assessment for Construction Activities

Construction Activity and Equipment	Noise Level at 50 feet (L_{eq}, dBA)	Threshold (dBA)		Approximate Noise Impact Distance (feet)		Project Construction Noise (dBA), at Noise-Sensitive Use Near the Project							
						ER1		ER2		ER3		ER4	
		Local	FTA	Based on Local Threshold (CEQA)	Based on FTA Threshold	Distance (feet)	Noise Level, dBA	Distance (feet)	Noise Level, dBA	Distance (feet)	Noise Level, dBA	Distance (feet)	Noise Level, dBA
Cotton Bridge Work	**94**	Daytime construction - Exempt Nighttime construction - Exempt.	Residential: Daytime - 90 Nighttime - 80 Commercial: Daytime - 100 Nighttime - 100	Not applicable	Residential: Daytime - 74 Nighttime - 187 Commercial: 30	3600	57	4000	56	5280	54	880	69
Concrete Batch Plant	75												
Concrete Pump Truck	74												
Crane	73												
Compressor (air)	74												
Flat Bed Truck	70												
Generator	78												
Vibratory Pile Driver(and impact hammer daytime only)	94												
Site Work	**85**			Not applicable	Residential: Daytime - 31 Nighttime - 77 Commercial: 12		48		47		45		60
Grader	81												
Excavator	77												
Compactor	76												
Auger/Bore Drill Rig	77												
Backhoe	74												
Platform Work	**89**			Not applicable	Residential: Daytime - 45 Nighttime - 113 Commercial: 18		52		51		49		64
Dozer	88												
Grader	85												
Tamper	85												
Aligner	84												
Swinger	83												
Welders	85												
Crane	85												
Wheel Loader	74												
Paver	84												
Concrete Pump	75												
Ballast Regulator	75												
Rail grinder	83												

Notes: CEQA = California Environmental Quality Act; dBA = A-weighted decibels; FTA = Federal Transit Administration; Leq = equivalent sound level; ER = Existing Receiver.
Source: (AECOM, 2024)

6.2 Operational Noise Analysis

The proposed High-Speed Rail (HSR) system is grade-separated, eliminating the need for crossing signals or transit warning systems. Permanent noise sources during operations would include HSR train operations and station platform waning horns and announcements. The operation of the high-speed trains along this corridor was evaluated under a previous environmental study (*Merced to Fresno Final Environmental Impact Report/Statement, 2012*) and no additional trains would be added as part of this Project; however some of the previously analyzed trains would now stop at the Madera HSR Station. For this analysis it was assumed that trains slowing down, briefly stopping at the station, and accelerating back up to revenue speed would create less noise than trains passing through at high speed without stopping (which generate a significant amount of aerodynamic noise at higher speeds).

The Project noise impact evaluation was performed in accordance with FTA general assessment methodology for station noise evaluation and FRA methodology for assessing high-speed rail operations. The assessment of railroad operation noise considered noise from the type of train, track, and stationary noise sources at intersection locations. Operational noise source that was calculated included high-speed rail transit vehicles, and transit-warning devices. The existing noise level and the Project-calculated noise level were combined to compute the noise exposure at the receiving locations as shown in **Table 6-2**. The Project would have a minimal increase in noise levels over the existing conditions during operation of the proposed stations.

Based on FRA standards, the initial screening distance for the Project is approximately 1,200 feet, while under FTA guidelines, the initial screening distance is approximately 1,600 feet. The initial screening distance is a guideline distance provided by the Federal agencies (FRA and FTA) for the specific project under consideration. It serves as a starting point to determine whether further detailed noise analysis is necessary. If noise-sensitive receivers (such as residences) are located beyond this initial screening distance from the Project's noise sources (high-speed rail train operations), it generally indicates that significant noise impacts are unlikely according to the agency's criteria.

To adjust the screening distance for an increased number of train passbys, calculations were made to accommodate the increase in noise level caused by the additional trains (ΔL) and determine the new distance needed for this increase to meet the attenuation rate.

After applying the nighttime penalty and adjusting for increased rail traffic of 58 high-speed rail trains per day and 6 trains per night (one-way operations), 116 trains per day and 12 high-speed rail trains per night (round trip), the screening distances increase significantly.

Per FTA Table 4-7, and after adjustment using Table 4-8, the screening distance increases to approximately 3,900 feet, reflecting the higher cumulative noise effects due to increased high-speed rail train frequency. Additionally, per FRA Table 4-1, and after adjustment using Table 4-2, the screening distance increases to approximately 4,750 feet. There are existing noise-sensitive receptors located within this 3,900-feet and 4,750-feet distance from the Project; and a single residence is located approximately 880 feet to the east of the northern portion of the Project site. However, the Project would have a minimal increase in noise levels over the existing conditions during operation of the proposed stations, therefore, impacts would be less than significant.

The proposed Project noise impact evaluation was performed in accordance with FTA general assessment methodology. The assessment of railroad operation noise considered noise from the type of train, track, and stationary noise sources at intersection locations. Operational noise sources that were calculated included rail transit vehicles, crossing signals, and transit warning devices, which are summarized in Appendix C-1. The existing noise level and the Project calculated noise level were combined to compute the noise exposure at the receiving locations as shown in **Table 6-2**. As shown, no noise impacts would occur due to the proposed stations, under existing and future conditions.

For CEQA purposes, with respect to generation of 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, as shown in **Table 3-5** under CEQA columns, no noise impacts would occur due to the proposed stations, under existing and future conditions. Therefore, operational noise impacts would be less than significant.

Table 6-2: Project Operational Station Noise Levels, dBA

Noise Sensitive Site	Land Use	Noise Level (L_{dn}/L_{eq}[1] dBA)		FTA Noise Level Criteria (dBA)			CEQA (dBA)		
		Existing	Project	Moderate Impact[2]	Severe Impact[2]	Impact[2]	Existing + Project	Increase over Existing	Significant Impact?
ER1	Institutional at 3600 feet	50.0	39.8	58.4	64.6	None	50.4	0.4	Less than significant
ER2	Residential at 4000 feet	50.0	38.2	53.4	59.6	None	50.3	0.3	Less than significant
ER3	Residential at 1-mile	50.0	36.4	53.4	59.6	None	50.2	0.2	Less than significant
ER4	Residential at 880 feet	50.0	40.8	58.4	64.6	None	50.5	0.5	Less than significant

Notes:

CEQA = California Environmental Quality Act; dBA = A-weighted decibels; FTA = Federal Transit Administration; L_{eq} = equivalent sound level; LTS = less than significant; ER = Existing Receiver.

1 L_{dn} is used for Category 2 (residential) land use and L_{eq} is used for Category 3 (institutional) land use.

2 Based on Figure 3.1.

Source: (AECOM, 2024)

6.3 Excessive Noise Levels

The closest airport is Madera Municipal Airport, which is located more than seven miles to the northwest of the Project site. Since the Project site is not located within 2 miles of any airport; and the Project would not expose people residing or working in the Project area to excessive noise levels; no impact would occur.

6.4 Construction Vibration Analysis

Construction activities under the proposed Project would generate vibration levels at 25 feet, as high as 0.0.7 PPV (105 VdB) from pile driving during Cotton Bridge work, 0.2 PPV (94 VdB) from compactors during site work and 0.09 PPV (87 VdB) from bulldozers during rail and platform work. Construction activities would be considered to have a significant impact if they would generate vibration in excess of FTA thresholds. The nearest vibration-sensitive structure is a rural masonry building approximately 880 feet to 1-mile from Project construction activities. The proposed Project construction activities would generate groundborne vibration levels of approximately 0.0002 to 0.0035 PPV (35 to 59 VdB) at the distances of 880 feet to 1-mile. This level of vibration would be below the FTA threshold impact criteria of 0.3 PPV inches/second (**Table 3-4**) for structural damage resulting from vibration. Therefore, construction of the Project would not result in property damage to institutional or residential buildings.

In terms of vibration annoyance effects at vibration-sensitive uses, the closest vibration-sensitive uses (residential uses) to Project construction sites would be approximately 880 feet to 1-mile away. The resulting construction vibration level at these locations would be up to 59 VdB. These levels are below the FTA's impact threshold of 72 VdB. The likely vibration levels during Project construction are shown in **Table 6-3**. Therefore, vibration impacts resulting from construction activities would be less than significant.

Table 6-3: Summary of Construction Vibration Impact Assessment

Sensitive Noise Receivers	Land Use Category	Distance to Near Track (feet)	Annoyance (Vdb)		Damage (in./sec)		Impacts
			Vibration	Criteria	Vibration	Criteria	
ER1	Category 3: Institutional land uses with primarily daytime use	3600	40.2	75	0.0004	0.3	Less than significant
ER2	Category 2: Residences and buildings where people normally sleep	4000	38.9	72	0.0004	0.2	Less than significant
ER3	Category 2: Residences and buildings where people normally sleep	5280	35.3	72	0.0002	0.2	Less than significant
ER4	Category 2: Residences and buildings where people normally sleep	880	59	72	0.0035	0.2	Less than significant

Source: (FTA, 2018; AECOM, 2024)

Similarly, for CEQA analysis, with respect to generation of excessive groundborne vibration levels; the proposed Project construction activities would generate groundborne vibration levels of approximately 0.0002 to 0.0035 PPV (35 to 59 VdB), as shown in **Table 6-3**. These levels of vibration would be below the FTA threshold impact criteria of 0.3 PPV inches/second for structural damage and below 72 VdB for annoyance. Therefore, Project construction vibration impacts would be less than significant.

6.5 Operational Vibration Analysis

Vibration caused by trains is caused by the wheels rolling on the rails. This energy then is transmitted through the track support system into the ballast, through the ground to the foundations of nearby buildings, and finally throughout the remainder of the building structure. The level of vibration received at the building is a function of the type of trains, their speeds, track system, structure, support and condition, distance from the tracks, geological condition, and the receiving structure. Groundborne vibration typically does not annoy people who are outdoors. Impacts were assessed based on a comparison of the predicted Project vibration level with the FTA impact criterion of 75 VdB for Category 2 and 78 VdB for Category 3 land uses. The vibration-sensitive uses adjacent to the proposed stations, along with the likely vibration level during train passage, are shown in **Table 6-4**.

Table 6-4: Summary of Operational Vibration Impact Assessment

Sensitive Noise Receivers	Land Use Category	Distance to Near Track (feet)	Annoyance (Vdb)		Damage (in./sec)		Impacts
			Vibration	Criteria	Vibration	Criteria	
ER1	Category 3: Institutional land uses with primarily daytime use	3600	39.6	75	0.00038	0.3	Less than significant
ER2	Category 2: Residences and buildings where people normally sleep	4000	38.2	72	0.00032	0.2	Less than significant
ER3	Category 2: Residences and buildings where people normally sleep	5280	34.6	72	0.00021	0.2	Less than significant
ER4	Category 2: Residences and buildings where people normally sleep	880	57.9	72	0.00314	0.2	Less than significant

Source: (FTA, 2018; AECOM, 2024)

Based on the vibration significance criterion, vibration-sensitive receptors along the proposed Project would not be exposed to perceptible vibration, and buildings would not be exposed to vibration levels with possible structural effects.

Similarly, for CEQA purposes, the results shown in **Table 6-4** indicate that the vibration criterion would not be exceeded (i.e., vibration impacts would not occur) at vibration-sensitive uses more than 65 feet from the centerline of the nearest HSR rail track. No vibration-sensitive uses are known or expected to be within 65 feet of the proposed Project tracks. Therefore, operational vibration impacts would be less than significant.

7. CONCLUSIONS

Noise and vibration associated with the proposed Project construction and operation would be below the applicable FRA/FTA thresholds. The proposed Project would result in less than significant impacts related to noise and vibration; therefore, no mitigation measures are required.

8. REFERENCES

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Appendix C-1

Noise Modeling Assumptions and Results

Federal Transit Administration
Noise Impact Assessment Spreadsheet

version: 1/29/2019

Project:	**60718942 - Madera Station Environmental**

Receiver Parameters	**Site 1**
Receiver:	**Madera Community College**
Land Use Category:	**3. Institutional**
Existing Noise (Measured or Generic Value):	**50 dBA**

Noise Source Parameters	
Number of Noise Sources:	**4**

Noise Source Parameters		**Source 1**
	Source Type:	Fixed Guideway
	Specific Source:	Diesel Multiple Unit (DMU)
Noisiest hr of Activity During Sensitive hrs	**Number of DMU's/train**	1
	Speed (mph)	30
	Number of Events/hr	6
Distance	**Distance from Source to Receiver (ft)**	3600
	Number of Intervening Rows of Buildings	0
Adjustments		

Noise Source Parameters		**Source 2**
	Source Type:	Fixed Guideway
	Specific Source:	Rail Car
Noisiest hr of Activity During Sensitive hrs	**Number of Rail Cars/train**	5
	Speed (mph)	30
	Number of Events/hr	6
Distance	**Distance from Source to Receiver (ft)**	3600
	Number of Intervening Rows of Buildings	0
Adjustments	**Noise Barrier?**	No
	Embedded Track?	No
	Aerial Structure?	No

Project Results Summary

Existing Leqh:	50 dBA
Total Project Leqh:	40 dBA
Total Noise Exposure:	50 dBA
Increase:	0 dB
Impact?:	None

Distance to Impact Contours

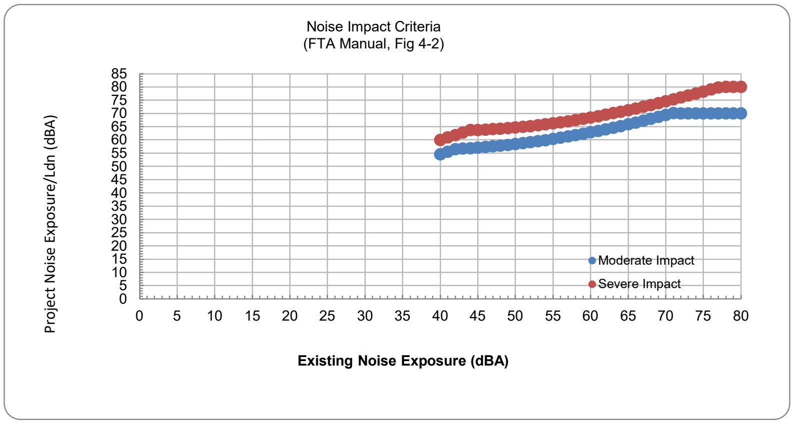
Dist to Mod. Impact Contour:	---
Dist to Sev. Impact Contour:	---

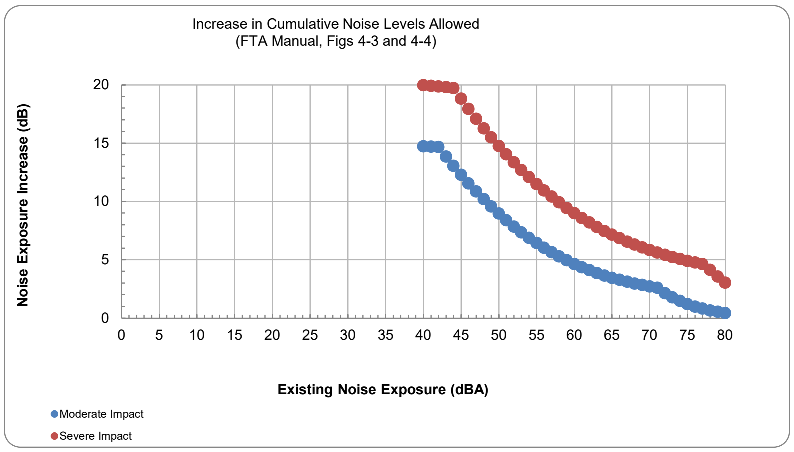
Source 1 Results

Leqh:	29.3 dBA

Source 2 Results

Leqh:	28.9 dBA
Incremental Leqh (Src 1-2):	32.1 dBA


Noise Impact Criteria
(FTA Manual, Fig 4-2)
Project Noise Exposure/Ldn (dBA)
Existing Noise Exposure (dBA)
Moderate Impact
Severe Impact
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85


Increase in Cumulative Noise Levels Allowed
(FTA Manual, Figs 4-3 and 4-4)
Noise Exposure Increase (dB)
Existing Noise Exposure (dBA)
Moderate Impact
Severe Impact
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80

Federal Transit Administration
Noise Impact Assessment Spreadsheet

version: 1/29/2019

Project:	**60718942 - Madera Station Environmental**

Receiver Parameters	Site 2
Receiver:	**12414 Road 30**
Land Use Category:	**2. Residential**
Existing Noise (Measured or Generic Value):	**50 dBA**

Noise Source Parameters	
Number of Noise Sources:	**4**

Noise Source Parameters		Source 1
	Source Type:	Fixed Guideway
	Specific Source:	Diesel Multiple Unit (DMU)
Daytime hrs	**Number of DMU's/train**	1
	Speed (mph)	30
	Avg. Number of Events/hr	6
Nighttime hrs	**Number of DMU's/train**	1
	Speed (mph)	30
	Avg. Number of Events/hr	6
Distance	**Distance from Source to Receiver (ft)**	4000
	Number of Intervening Rows of Buildings	0
Adjustments		

Noise Source Parameters		Source 2
	Source Type:	Fixed Guideway
	Specific Source:	Rail Car
Daytime hrs	**Number of Rail Cars/train**	5
	Speed (mph)	30
	Avg. Number of Events/hr	6
Nighttime hrs	**Number of Rail Cars/train**	2
	Speed (mph)	30
	Avg. Number of Events/hr	6
Distance	**Distance from Source to Receiver (ft)**	4000
	Number of Intervening Rows of Buildings	0
Adjustments	**Noise Barrier?**	No
	Embedded Track?	No
	Aerial Structure?	No

Project Results Summary

Existing Ldn:	50 dBA
Total Project Ldn:	39 dBA
Total Noise Exposure:	50 dBA
Increase:	0 dB
Impact?:	None

Distance to Impact Contours

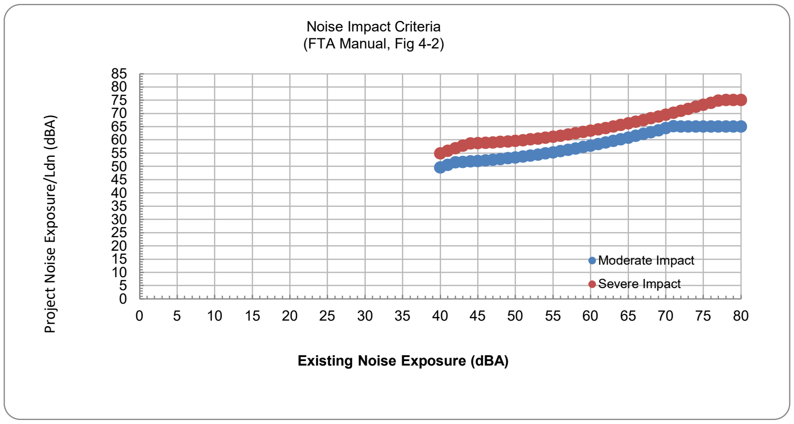
Dist to Mod. Impact Contour:	---
Dist to Sev. Impact Contour:	---

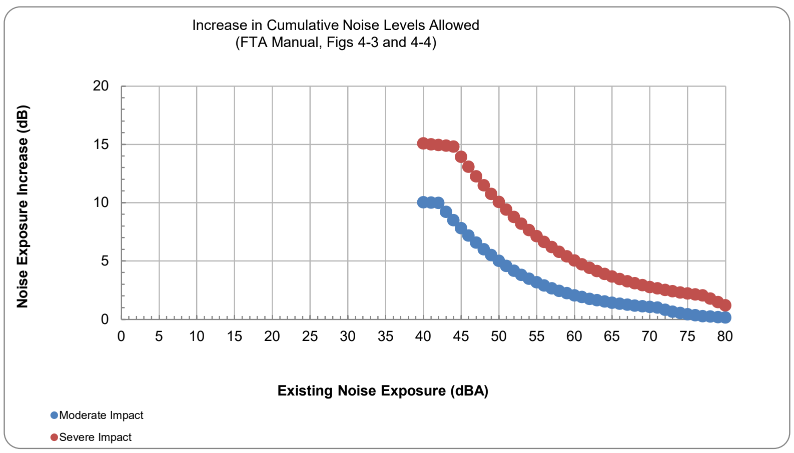
Source 1 Results

Leq(day):	28.6 dBA
Leq(night):	0.0 dBA
Ldn:	26.6 dBA

Source 2 Results

Leq(day):	28.2 dBA
Leq(night):	0.0 dBA
Ldn:	26.2 dBA
Incremental Ldn (Src 1-2):	29.4 dBA


Noise Impact Criteria
(FTA Manual, Fig 4-2)
Project Noise Exposure/Ldn (dBA)
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
Existing Noise Exposure (dBA)
Moderate Impact
Severe Impact


Increase in Cumulative Noise Levels Allowed
(FTA Manual, Figs 4-3 and 4-4)
Noise Exposure Increase (dB)
20
15
10
5
0
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
Existing Noise Exposure (dBA)
Moderate Impact
Severe Impact

Federal Transit Administration
Noise Impact Assessment Spreadsheet

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Project:	**60718942 - Madera Station Environmental**

Receiver Parameters	Site 3
Receiver:	29844 Avenue 13
Land Use Category:	2. Residential
Existing Noise (Measured or Generic Value):	50 dBA

Noise Source Parameters	
Number of Noise Sources:	4

Noise Source Parameters		Source 1
	Source Type:	Fixed Guideway
	Specific Source:	Diesel Multiple Unit (DMU)
Daytime hrs	Number of DMU's/train	1
	Speed (mph)	30
	Avg. Number of Events/hr	6
Nighttime hrs	Number of DMU's/train	1
	Speed (mph)	30
	Avg. Number of Events/hr	6
Distance	Distance from Source to Receiver (ft)	5280
	Number of Intervening Rows of Buildings	0
Adjustments		

Noise Source Parameters		Source 2
	Source Type:	Fixed Guideway
	Specific Source:	Rail Car
Daytime hrs	Number of Rail Cars/train	5
	Speed (mph)	30
	Avg. Number of Events/hr	6
Nighttime hrs	Number of Rail Cars/train	2
	Speed (mph)	30
	Avg. Number of Events/hr	6
Distance	Distance from Source to Receiver (ft)	5280
	Number of Intervening Rows of Buildings	0
Adjustments	Noise Barrier?	No
	Embedded Track?	No
	Aerial Structure?	No

Project Results Summary

Existing Ldn:	50 dBA
Total Project Ldn:	37 dBA
Total Noise Exposure:	50 dBA
Increase:	0 dB
Impact?:	None

Distance to Impact Contours

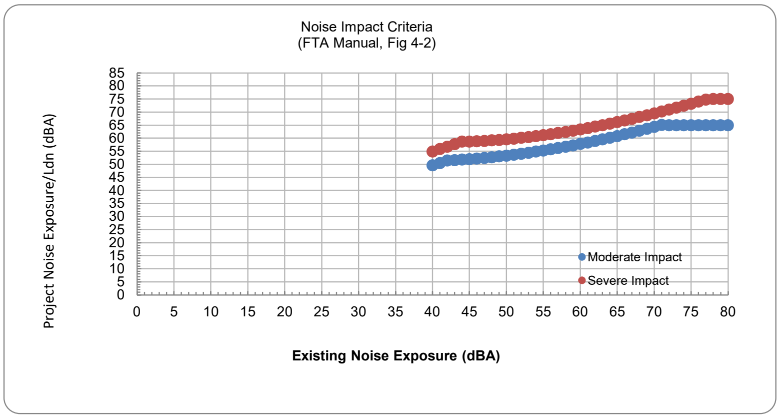
Dist to Mod. Impact Contour:	---
Dist to Sev. Impact Contour:	---

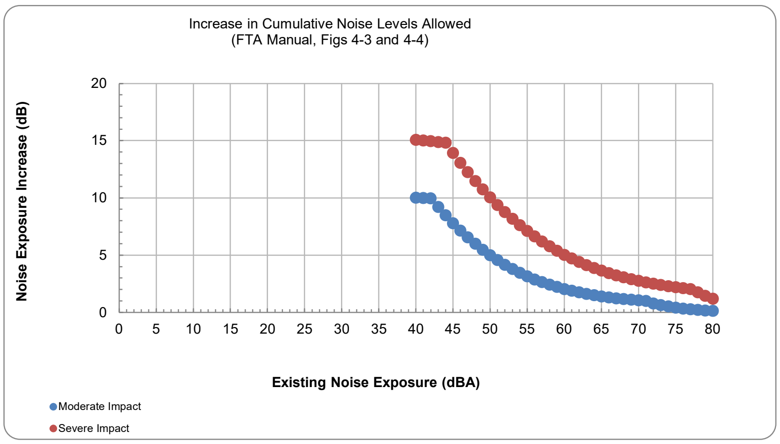
Source 1 Results

Leq(day):	26.8 dBA
Leq(night):	0.0 dBA
Ldn:	24.8 dBA

Source 2 Results

Leq(day):	26.4 dBA
Leq(night):	0.0 dBA
Ldn:	24.4 dBA
Incremental Ldn (Src 1-2):	27.6 dBA


Noise Impact Criteria
(FTA Manual, Fig 4-2)
Project Noise Exposure/Ldn (dBA)
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
Existing Noise Exposure (dBA)
Moderate Impact
Severe Impact


Increase in Cumulative Noise Levels Allowed
(FTA Manual, Figs 4-3 and 4-4)
Noise Exposure Increase (dB)
20
15
10
5
0
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80
Existing Noise Exposure (dBA)
Moderate Impact
Severe Impact

Federal Transit Administration
Noise Impact Assessment Spreadsheet

version: 1/29/2019

Project:	**60718942 - Madera Station Environmental**

Receiver Parameters	**Site 4**
Receiver:	**Madera Community College**
Land Use Category:	**3. Institutional**
Existing Noise (Measured or Generic Value):	**60 dBA**

Noise Source Parameters	
Number of Noise Sources:	**4**

Noise Source Parameters		**Source 1**
	Source Type:	Fixed Guideway
	Specific Source:	Diesel Multiple Unit (DMU)
Noisiest hr of Activity During Sensitive hrs	**Number of DMU's/train**	1
	Speed (mph)	30
	Number of Events/hr	6
Distance	**Distance from Source to Receiver (ft)**	200
	Number of Intervening Rows of Buildings	0
Adjustments		

Noise Source Parameters		**Source 2**
	Source Type:	Fixed Guideway
	Specific Source:	Rail Car
Noisiest hr of Activity During Sensitive hrs	**Number of Rail Cars/train**	5
	Speed (mph)	30
	Number of Events/hr	6
Distance	**Distance from Source to Receiver (ft)**	200
	Number of Intervening Rows of Buildings	0
Adjustments	**Noise Barrier?**	No
	Joint Track/Crossover?	No
	Embedded Track?	No
	Aerial Structure?	No

Project Results Summary

Existing Leqh:	60 dBA
Total Project Leqh:	60 dBA
Total Noise Exposure:	63 dBA
Increase:	3 dB
Impact?:	None

Distance to Impact Contours

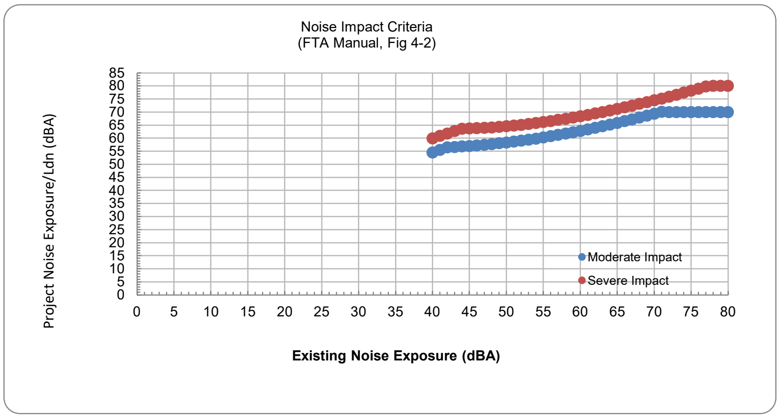
Dist to Mod. Impact Contour:	---
Dist to Sev. Impact Contour:	---

Source 1 Results

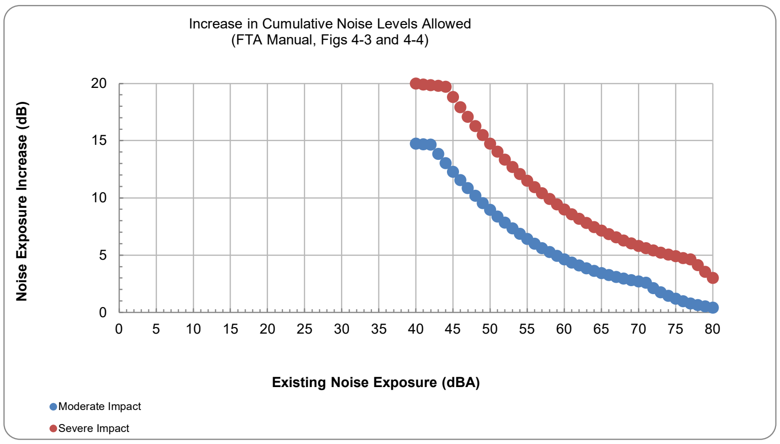
Leqh:	48.2 dBA

Source 2 Results

Leqh:	47.7 dBA
Incremental Leqh (Src 1-2):	50.9 dBA



Noise Impact Criteria
(FTA Manual, Fig 4-2)
Project Noise Exposure/Ldn (dBA)
Existing Noise Exposure (dBA)
Moderate Impact
Severe Impact



Increase in Cumulative Noise Levels Allowed
(FTA Manual, Figs 4-3 and 4-4)
Noise Exposure Increase (dB)
Existing Noise Exposure (dBA)
Moderate Impact
Severe Impact