3.7 NOISE AND VIBRATION

This section describes the existing noise levels found within the study area and evaluates the effects of the proposed project on the noise environment. The analysis of noise impacts in the proposed project area is based on a comparison of the noise caused by the proposed project relative to the existing noise levels. Mitigation measures are discussed, where necessary and appropriate, to avoid or reduce potential noise impacts. Detailed information can be found in the *Noise Study* (Parsons Brinckerhoff, 2004) prepared for this project.

3.7.1 Background and Characteristics of Noise

Sound is created when objects vibrate, resulting in a minute variation in surrounding atmospheric pressure called sound pressure. The human response to sound depends on the magnitude of a sound (how loud) as a function of its frequency (pitch) and time pattern (duration). Magnitude measures the physical sound energy in the air. The range of magnitude from the faintest to the loudest sound the ear can hear is so large that sound pressure is expressed on a logarithmic scale in units called decibels (dB). Loudness, compared to physical sound measurement, refers to how people subjectively judge a sound and varies from person to person. Magnitudes of typical sound levels are presented in Table 3.7-1. Noise is defined as unwanted sound.

Humans respond to a sound's frequency or pitch. The human ear is very effective at perceiving sounds with a frequency between approximately 1,000 and 5,000 cycles per second, or Hertz (Hz), with the efficiency decreasing outside this range. Environmental noise is composed of many frequencies, each occurring simultaneously at its own sound pressure level. Frequency weighting, which is applied electronically by a sound level meter, combines the overall sound frequency into one sound level that simulates how an average person hears sounds. The commonly used frequency weighting for environmental noise is an A-weighted decibel (dBA), which is most similar to how humans perceive sounds of low to moderate magnitude. The faintest sound a person with good hearing can perceive is approximately 0 dBA in a silent environment. Even short exposure to levels greater than 120 or 130 dBA is painful and will result in temporary ringing in the ear.

Because of the logarithmic decibel scale, a doubling of the number of noise sources, such as the number of buses operating within a specified area, increases noise levels by 3 dBA. A tenfold increase in the number of noise sources will add 10 dBA. As a result, a noise source emitting a noise level of 60 dBA combined with another noise source of 60 dBA yields a combined noise level of 63 dBA, not 120 dBA.

Noise levels from traffic and transit sources depend on volume, speed and the type of vehicle. Generally, an increase in volume, speed or vehicle size increases traffic noise levels. Vehicular noise is a combination of noises from the engine, exhaust, and tires or wheels. Among conditions affecting traffic noise are defective mufflers, steep grades, terrain, vegetation, distance from the roadway, and shielding by barriers and buildings.

Noise levels decrease with distance from the noise source. For a line source such as a roadway, noise levels decrease 3 dBA over hard ground (concrete, pavement) or 4.5 dBA over soft ground (grass) for every doubling of distance between the source and the receptor, such as going from 50 to 100 feet from the source. For a point source such as a transit center, noise levels will decrease between 6 and 7.5 dBA for every doubling of distance from the source.

TABLE 3.7-1
TYPICAL NOISE LEVELS

Noise Level (dBA)	Description	Transportation Sources	Other Sources
130	Painfully loud		
120		Jet takeoff (200 feet)	
110	Maximum vocal effort	Car horn (3 feet)	
100			Shout (.5 feet)
90	Very annoying; loss of hearing with prolonged exposure	Heavy truck (50 feet)	Jack hammer (50 feet) Home shop tools (3 feet)
85		Freight train on a structure (50 feet)	Backhoe (50 feet)
80	Annoying	City bus (50 feet)	Bulldozer (50 feet) Vacuum cleaner (3 feet)
75		Freight train (50 feet) City bus at stop (50 feet)	Blender (3 feet)
70		Freeway traffic (50 feet)	Lawn mower (50 feet) Large office
65	Intrusive	Freight train in station (50 feet)	Washing machine (3 feet)
60			TV (10 feet)
55		Light traffic (50 feet)	Talking (10 feet)
50	Quiet	Light traffic (100 feet)	
45			Refrigerator (3 feet)
40			Library
30	Very quiet		Soft whisper (15 feet)

Sources: FTA, 1995; U.S. EPA, 1971; U.S. EPA, 1974.

Noise Level Descriptors

A widely used descriptor for environmental noise is the equivalent sound level (L_{eq}). The L_{eq} can be considered a measure of the average noise level during a specified period of time. It places more emphasis on occasional high noise levels that accompany general background noise levels. L_{eq} measured over a one-hour period is the hourly L_{eq} (L_{eq}(h)), which is used for highway noise impact and abatement analyses and transit noise analysis in non-residential areas. For residential areas, a descriptor called day/night level (L_{dn}) is used to assess transit noise impacts. It is a daily averaged noise level that ranks noise that occurs during the evening or night more heavily. The L_{dn} adds 10 dBA to noise levels that occur between 10 p.m. and 7 a.m. L_{dn} is used for transit in noise impact and abatement analyses for residential uses. In California, the C_{nel} is often reported for aircraft and community noise impacts, which is an L_{dn} with an additional noise penalty of 5 dBA between 7 pm and 10 pm. The C_{nel} is generally within 1 dBA of the L_{dn}.

Short-term noise levels, such as those from a single bus pass-by, can be described by either the total noise energy or the highest instantaneous noise level that occurs during the event. The sound exposure level (SEL) is a measure of total sound energy from an event and is useful in determining what the L_{eq} would be over a period in time when several noise events occur. The maximum noise level (L_{max}) is the highest short-duration noise level that occurs during an event.

Effects of Noise

Environmental noise at high intensities directly affects human health by causing the disease of hearing loss. Although scientific evidence currently is not conclusive, noise is suspected of causing or aggravating other diseases. Environmental noise indirectly affects human welfare by interfering with sleep, thought and conversation.

3.7.2 Regulatory Setting

Applicable noise regulations and guidelines provide a basis for evaluating potential noise impacts. Federal regulations pertaining to environmental impacts, including noise, from transit systems are codified in 23 Code of Federal Regulations 771. The Federal Transit Administration (FTA) has developed guidelines and criteria to assess noise impacts from transit systems under the regulations established in 23 Code of Federal Regulations 771.

Federal Criteria

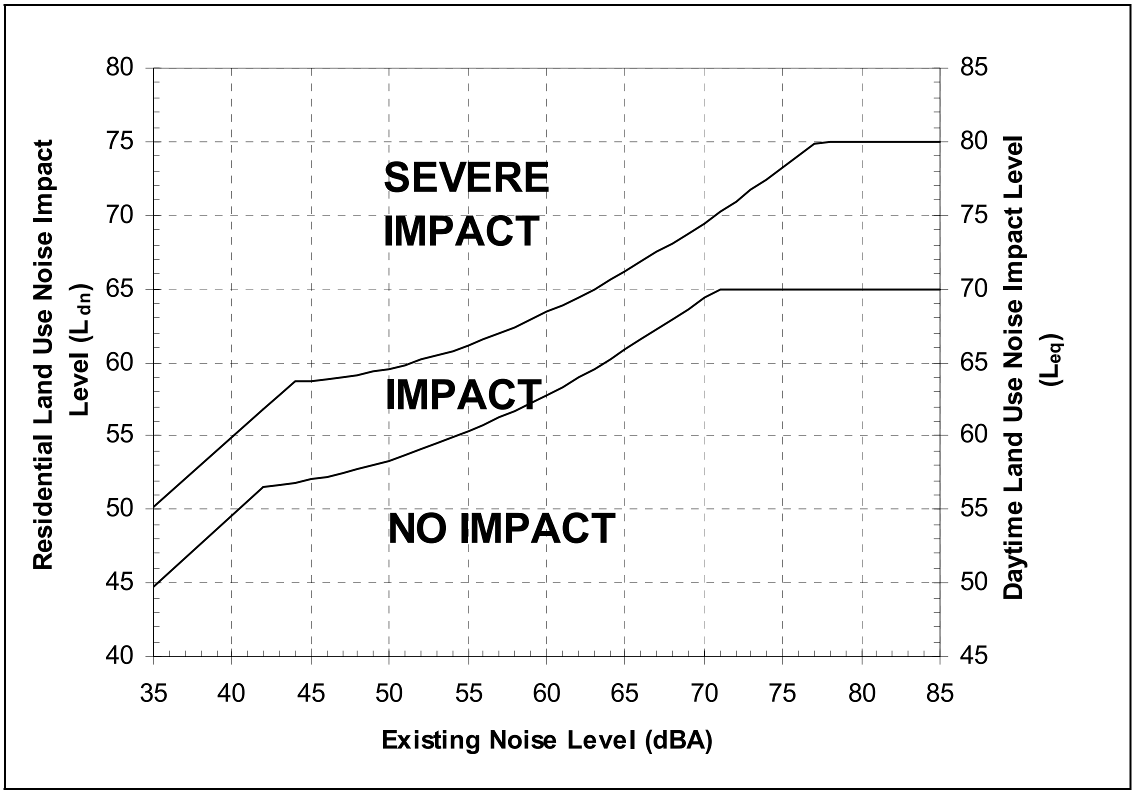
Proposed rail lines, transit stations and park-and-ride facilities are evaluated for impact using the FTA project noise exposure impact criteria (Figure 3.7-1), while express bus service or other transit sources operating on public highways is evaluated using the Federal Highway Administration (FHWA) noise impact criteria (Table 3.7-2).

For federally funded or approved transit projects there are two sets of criteria depending on the nature of the project. For fixed guideway projects, such as passenger rail, noise impacts occur when predicted noise levels caused by the project increase the overall noise more than a certain amount, which ranges between 1 and 10 dBA, depending on the land use and existing noise level (FTA, 1995). The project noise exposure levels that define impacts from transit facilities are presented in Figure 3.7-1. For example, if a project is located in a residential area with an average L_{dn} of 50 dBA, the project can generate up to 54 dBA L_{dn} without causing any impact and up to 59 dBA L_{dn} without causing a severe impact. For daytime noise sensitive areas, impacts are determined by peak hour L_{eq}, so if the average L_{eq} is 50 dBA, the project can generate up to 59 dBA L_{eq} without causing any impact and up to 64 dBA L_{eq} without causing a severe impact. Daytime noise sensitive uses include parks, school, libraries and noise sensitive commercial uses.

For highway transit sources, such as bus rapid transit, FTA has adopted the FHWA's noise abatement criteria (NAC) (see Table 3.7-2) to define impact. Under the FHWA criteria, an impact occurs when predicted L_{eq}(h) noise levels approach or exceed NAC, or substantially exceed existing noise levels (23 CFR 772). These criteria are used to assess the Express Bus Alternative in Chapter 4. The FHWA NAC specifies exterior L_{eq}(h) noise levels for various land activity categories. For residences, parks, schools, churches, and similar areas, the noise criterion is 67 dBA. For other developed lands, the noise criterion is 72 dBA. For projects that add roadway capacity or substantially change the roadway alignment (FHWA Type 1 projects), the NAC defines levels that if approached (within 1 dBA) or exceeded mitigation needs to be considered.

The Federal Rail Administration (FRA) has adopted the FTA noise impact criteria and developed additional guidance on assessment of rail horn noise. FRA has developed a horn-noise assessment model to determine the distance around each grade crossing where the noise exposure from train horns would exceed the impact and severe impact criteria (Figure 3.7-1). The code of federal regulations mandates that audible warning devices shall be activated in accordance with railroad rules regarding the approach to both public and private roadway grade crossings. Standard practice is to begin sounding the horn 0.25 miles before the crossing in a long-long-short-long pattern and continue sounding until the train reaches the crossing.

FIGURE 3.7-1
PROJECT NOISE EXPOSURE IMPACT CRITERIA FOR TRANSIT PROJECTS



Source: FTA, 1995.

Note: Project noise exposure levels that fall within the impact area are less than significant impacts, while levels that fall in the severe impact area are significant.

TABLE 3.7-2
FHWA NOISE ABATEMENT CRITERIA

Activity Category	L_{eq}(h) [dBA]	Description of Activity Category
A	57 (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 (exterior)	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals.
C	72 (exterior)	Developed lands, properties, or activities not included in Categories A or B above.
D	-	Undeveloped lands.
E	52 (interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums.

Source: U.S. Department of Transportation, 1973.

Local Regulations

In California, local plans establish exterior noise levels that are compatible with residential development. The general plans for each city and county along the project corridor have adopted state guidelines for residential noise compatibility. With the exception of Cotati, each jurisdiction considers exterior noise levels of 60 dBA L_{dn} acceptable for outdoor uses in residential areas. Cotati establishes a level of 65 dBA L_{dn} as acceptable in Chapter 17.30 of its municipal code. Generally, the plans state than an exterior noise level greater than 70 dBA L_{dn} is unacceptable for residential development and new development is required to include acoustic insulation or other means of noise reduction. The noise levels established in local plans are not a limit or criteria on noise generated by transportation sources, but a designation of what areas are appropriate for residential development, based on the noise environment. A number of local jurisdictions also establish maximum noise levels that may be generated in residential areas; however, transportation noise sources operating on a public right of way are exempt form all maximum noise level standards because the regulation of noise sources such as traffic on public roadways, railroad line operations and aircraft in flight is preempted by federal and/or state regulations. Allowable noise emissions from individual vehicles are regulated by the California Vehicle Code.

3.7.3 Environmental Setting

The pattern of development in both Sonoma and Marin counties has centered on a series of cities and towns that are generally located along the Northwestern Pacific Railroad (NWP) and Highway 101; the few exceptions include the cities of Sonoma, Sebastopol, Tiburon, and other small towns and unincorporated settlements in both counties (Calthorpe Associates, 1997). The developed urban centers along Highway 101 are generally well defined with large expanses of agricultural lands and open space separating them. The proposed project area is quite large with a variety of land uses. Areas with large residential components near the project alignment are located in San Rafael, Novato, Petaluma, Cotati, Santa Rosa, and Windsor. Distance from the nearest residences to the rail tracks varies from 30 feet to over 100 feet with the majority in the range of 60 to 80 feet.

Some land uses are more sensitive to noise and vibration levels than others. Residences, motels and hotels, schools, libraries, churches, hospitals, nursing homes, auditoriums, and parks and other outdoor recreation areas generally are more sensitive to noise and vibration than are commercial (other than lodging facilities) and industrial land uses. The proposed project's effects were estimated for sensitive uses adjacent to the corridor.

Existing noise levels along the proposed project corridor are generally typical of a suburban environment, while the portion of the corridor north of Healdsburg is more typical of a rural environment. Traffic is currently the dominant noise source throughout the corridor. Traffic noise ranges from very noticeable near Highway 101 to a minor background sound in more remote locations. Other noise sources include aircraft, general neighborhood sounds, and natural sources, such as wind and birds.

Existing Sound Levels

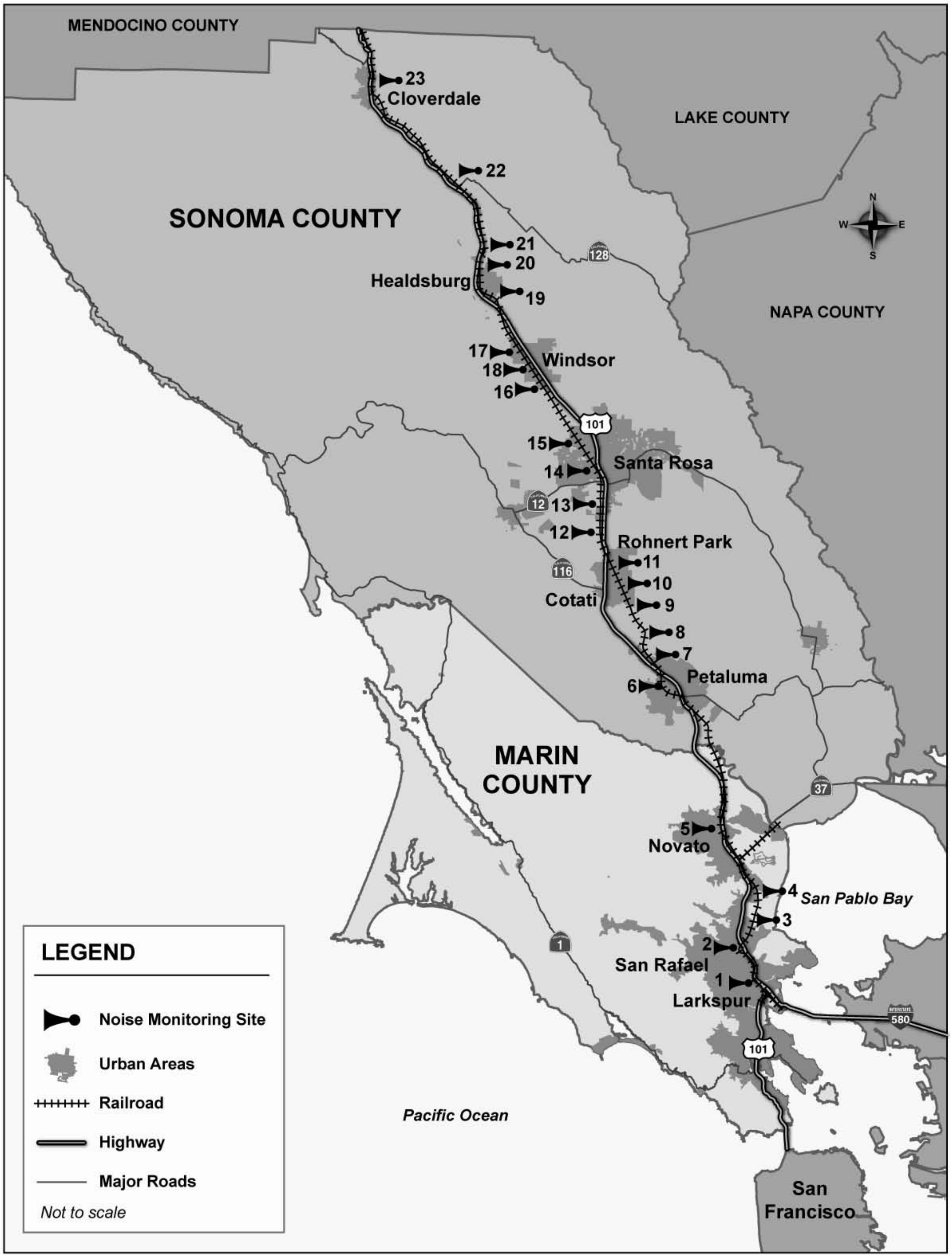
Twenty-four hour noise measurements were taken at 23 sites (see Table 3.7-3 and Figure 3.7-2) along the project corridor to describe the existing acoustical environment. The selected sites represent the noise sensitive land uses closest to the corridor and were selected to be representative of the acoustical environment surrounding each site. The L_{dn} for the 23 sites ranged between 48 and 71 dBA, with the lowest sound levels occurring at Smith Ranch Road at Gallinas Creek in San Rafael and the highest dBA occurring at Whitewood Drive at Hearn Avenue in Santa Rosa.

TABLE 3.7-3
EXISTING MEASURED L_{dn} NOISE LEVELS

Location		L_{dn}
1	Pacheco Street at Stevens Place (San Rafael)	62
2	Las Gallinas Avenue at Corrillo Drive (San Rafael)	53
3	Smith Ranch Road at Gallinas Creek (San Rafael)	48
4	Roblar Drive and Nave Drive (Novato)	58
5	Railroad Avenue and West Orange Avenue (Novato)	64
6	Payran Street (Petaluma)	53
7	North McDowell Boulevard (Petaluma)	66
8	Oak Street at East Street (Penngrove)	67
9	Lacrosse Park (Rohnert Park)	58
10	Windmill Farms Drive (Cotati)	59
11	Seed Farm Road (Rohnert Park)	58
12	Anteeo Way (Santa Rosa)	65
13	Whitewood Drive at Hearn Avenue (Santa Rosa)	71
14	Cleveland Avenue between 10th and 11th Streets (Santa Rosa)	67
15	Barnes Road at Hopper Avenue (Santa Rosa)	55
16	Eagle Drive at 13th Hole Drive (Windsor)	49
17	Park Glen at Windsor Drive (Windsor)	52
18	Bell Road (Windsor)	58
19	University Street (Healdsburg)	51
20	Grove Street at Healdsburg Avenue (Healdsburg)	55
21	Healdsburg Avenue at Lytton Springs Road (Lytton)	51
22	Railroad Avenue at Merril Street (Geyserville)	59
23	McCray Road (Cloverdale)	50

Source: Parsons Brinckerhoff Quade & Douglas, Inc., 2003.

FIGURE 3.7-2
NOISE MEASUREMENT LOCATIONS



Source: Parsons Brinckerhoff Quade & Douglas Inc., 2004.

3.7.4 Significance Criteria

Generally, project-related noise effects are considered significant under the following conditions:

- Exposure of persons to or generation of noise levels in excess of applicable standards established in the local general plan or noise ordinance, or applicable standards of other agencies.
- Exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels. FTA has established a vibration impact criterion of 0.01 inches per second RMS vibration velocity. This vibration velocity is perceptible to humans, but is generally not considered bothersome. Vibration damage to even fragile structures does not occur unless vibration levels are much greater than the levels found bothersome by most people. A vibration velocity less than 0.12 inches per second peak particle velocity (approximately 0.03 inches per second RMS vibration velocity) would not cause damage to even fragile historic buildings.
- A substantial permanent increase in ambient noise levels. For transit noise sources, significant adverse impacts occur when the project generates noise exposures above the FTA Severe Noise Impact Criteria (Figure 3.7-1). Noise exposure levels caused by the project that exceed the FTA Severe Noise Impact Criteria result in a permanent increase in ambient noise levels in the project vicinity. Project noise exposures above the impact level, but below the severe criteria, result in minor impacts (less than significant). The FTA criteria are widely recognized as the appropriate criteria for assessing transit noise impacts. For roadway noise sources, Caltrans has defined a substantial increase of 12 dBA or greater compared to existing conditions that result from a roadway project as a significant impact under CEQA. Exceeding the noise abatement criteria (Table 3.7-2), without also causing a substantial increase, results in a minor impact.
- A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project.
- For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people in the project area to excessive noise levels; or
- For a project within the vicinity of a private airstrip, would the project expose people in the project area to excessive noise levels.

3.7.5 Impact Assessment Methodology

Ambient noise levels were measured at several locations near the proposed project area to characterize the daily environmental noise environment. Noise measurements were taken according to Federal Highway Administration (FHWA) guidelines (1996). Noise measurement locations (Figure 3.7-2) represent a variety of noise conditions and are representative of the various types of receptors near the proposed project. An area extending 1,000 feet from the proposed rail alignment, stations, park-and-ride lots, and maintenance facilities was reviewed for potential impacts.

Project noise exposure levels, along with the quantity of noise that would result from the proposed project, were modeled along the project corridor. Noise exposure was modeled at various distances from the proposed alignment to evaluate project effects at sensitive receptors that potentially would be affected by the proposed project. FTANOISE, the FTA Transit Noise Assessment Spreadsheet Model (HMMH, 1995), was used to calculate noise levels generated by train operations, transit centers and supporting operations that would occur as a result of the proposed project.

Predicted noise levels were based on projected daily transit operations for the forecast year 2025. Operating noise data for diesel multiple unit (DMU) vehicles was provided by Colorado Railcar Manufacturing (Table 3.7-4). Using FTA procedures, the SEL Reference Level was calculated at 82.9 a-weighted decibels (dBA) for 50 mph (throttle notch 5) at 50 feet.

TABLE 3.7-4
MEASURED NOISE LEVELS FOR DMU VEHICLES AND A TYPICAL LOCOMOTIVE

Operating Condition	DMU L_{max} (dBA) at 50 feet	DMU L_{max} (dBA) at 100 feet	L_{max} (dBA) for a Typical Diesel Locomotive at 50 feet
Stationary -- generator only	64.5	63.1	-
Stationary -- all engines idling	72.0	65.5	80
Accelerating from stop at full throttle	82.5	75.5	-
50 mph pass by forward in coast*	76.0	70.8	-
50 mph pass by reverse in coast	76.8	70.1	-
50 mph pass by forward in notch 5*	78.8	73.3	88
50 mph pass by reverse in notch 5	80.2	74.1	88
50 mph pass by forward in notch 8*	80.2	74.8	92
50 mph pass by reverse in notch 8	80.3	75.6	92

Source: Colorado Railcar, 2003, FTA, 1995.
Note: * Locomotives have throttle settings that range from notch 1 for lowest power to notch 8, full throttle. At coast, no traction power is being applied.

Train horn noise was estimated using the FRA train horn noise model. An L_{max} of 100 dBA measured 100 feet in front of the train was used as a typical horn noise level. A worst-case exposure was assumed with horns being used for 0.25 miles as the train approaches each grade crossing.

3.7.6 Impact Summary

Only grade crossing horn noise impacts would be potentially significant. The FTA noise impact criteria (Figure 3.7-1) are a measure of substantial long-term noise increase. Several residences in the vicinity of grade crossings would experience train horn noise exposures that would exceed the FTA Severe Noise Impact Criteria. If the train horn noise is not mitigated by designating the areas Quiet Zones and eliminating the need to sound the train horns, these residents would experience significant adverse noise impacts.

Under CEQA, other noise impacts would not be significant because:

- The general plans state that noise levels less than 60 dBA L_{dn} are acceptable for outdoor uses in residential areas. Except in the vicinity of grade crossings, the noise exposure would not exceed 60 dBA L_{dn} at a distance greater than 25 feet from the tracks.
- Groundborne noise and vibration levels at distances greater than approximately 100 feet from the tracks, would be lower than the level generally perceptible to humans. At distances between 20 feet and 100 feet from the tracks, vibration levels may be perceptible; however, they are expected to be less than the applicable FTA impact significance criteria of 0.01 inches per second RMS vibration velocity.
- Temporary noise increases would occur during construction; however, the increases would be of limited duration and would be shorter than the proposed project's overall construction period in any single location.

There are five airports located within two miles of the corridor: Marin County Airport – Gnoss Field, Petaluma Municipal Airport, Sonoma County Airport, Healdsburg Municipal Airport, and Cloverdale Municipal Airport. The proposed project would not substantially increase noise levels in the vicinity of these airports; therefore, it would not expose people to excessive noise levels in the vicinity of the identified airports. No private airstrips have been identified within two miles of the proposed project corridor. If there are any airstrips in the vicinity, the proposed project would still not result in excessive noise levels near the airstrips for the same reasons discussed for the five known airports.

3.7.7 Impacts and Mitigation Measures

Construction-Related Impacts

Impact N-1: The proposed project would temporarily cause increased noise levels associated with construction equipment and activities. *(Less than significant)*

Construction activities for the proposed project would include replacement and reconstruction of track and siding, improvements to or construction of stations and support facilities and construction of park-and-ride lots. While construction would occur along the entire length of the corridor, at most locations construction activities would be minor and of limited duration. Construction noise would be intermittent over the duration of the proposed project, varying with the time of day and stage of construction. Construction noise impacts would depend on the type, amount, location, and duration of construction activities.

The construction noise impacts would be limited to the immediate vicinity of these improvements. The most prevalent noise source at the construction sites would be the internal combustion engine. Engine-powered equipment includes earth-moving equipment, material-handling equipment and stationary equipment. Mobile equipment operates in a cyclic fashion, while stationary equipment, such as generators and compressors, operates at sound levels fairly constant over time. Since trucks would be present during most phases and would not be confined to the proposed project site, noise from trucks could affect more receptors. Other noise sources would include impact equipment and tools such as jackhammers and pile drivers. Impact tools could be pneumatically powered, hydraulic or electric. Maximum noise levels of construction equipment would be similar to typical maximum construction equipment noise levels presented in Figure 3.7-3.

The contractor would be required to comply with applicable local sound control and noise level rules, regulations and ordinances. Because of the localized and temporary nature of these impacts, as well as required compliance with relevant local sound control regulations, the impact would be less than significant. Even though the impact would be less than significant, the following mitigation measure is recommended to further minimize potential noise effects.

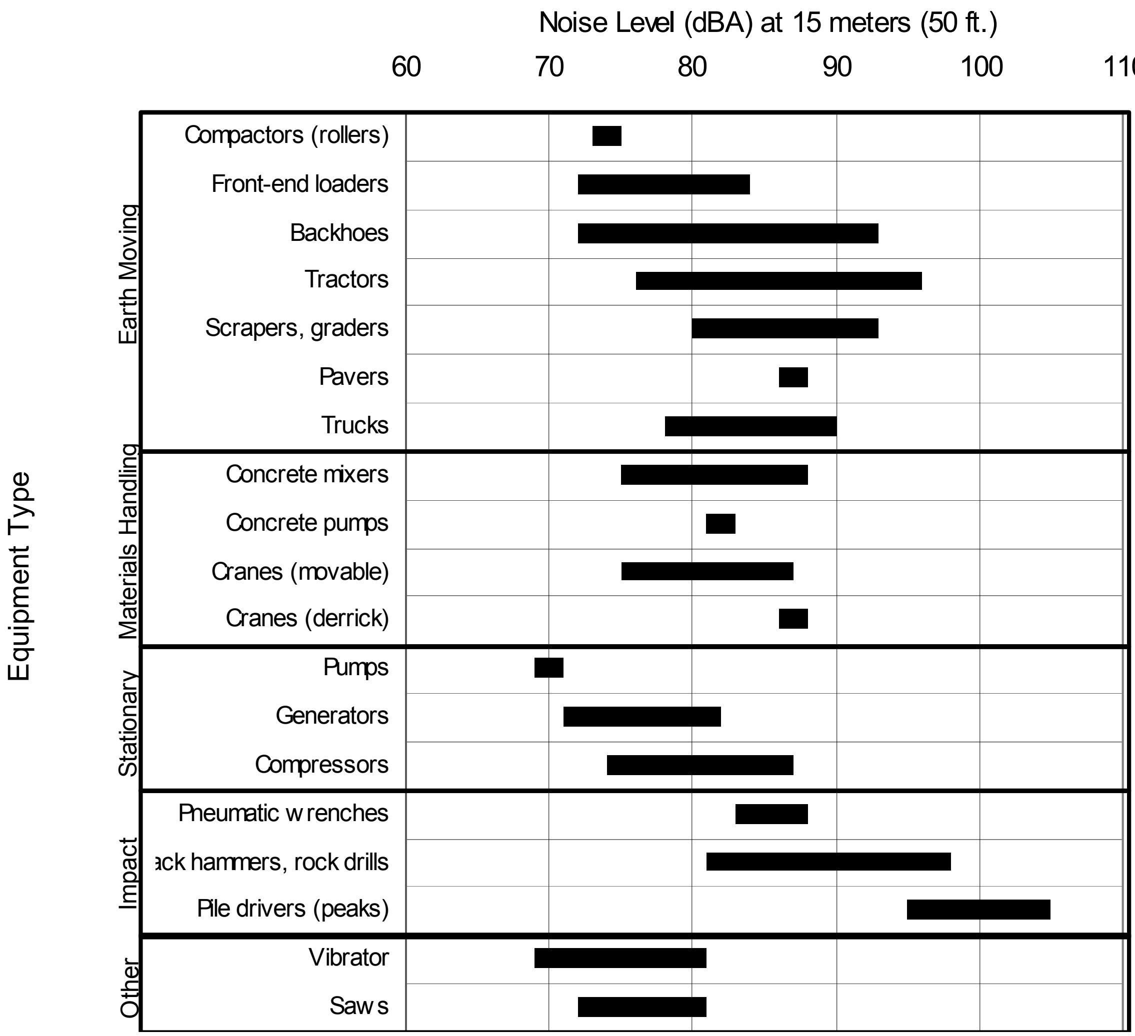
Mitigation Measure N-1: In order to reduce construction noise at nearby receptors, the following noise abatement measures shall be implemented for construction contracts:

- When practical, construction operations shall not occur between 7:00 p.m. and 7:00 a.m. or on weekends or holidays in residential areas.
- Each internal combustion engine shall be equipped with a muffler of a type recommended by the manufacturer.

Other measures to reduce noise levels that may be implemented where appropriate include:

- Turning off construction equipment during prolonged periods of non-use.
- Requiring contractors to maintain all equipment and train their equipment operators to increase efficiency of operation.
- Locating stationary noise-generating equipment away from noise-sensitive receptors such as residences.

FIGURE 3.7-3
CONSTRUCTION EQUIPMANT NOISE RANGES



Source: EPA, 1971 and WSDOT, 1991.

Long-Term Impacts

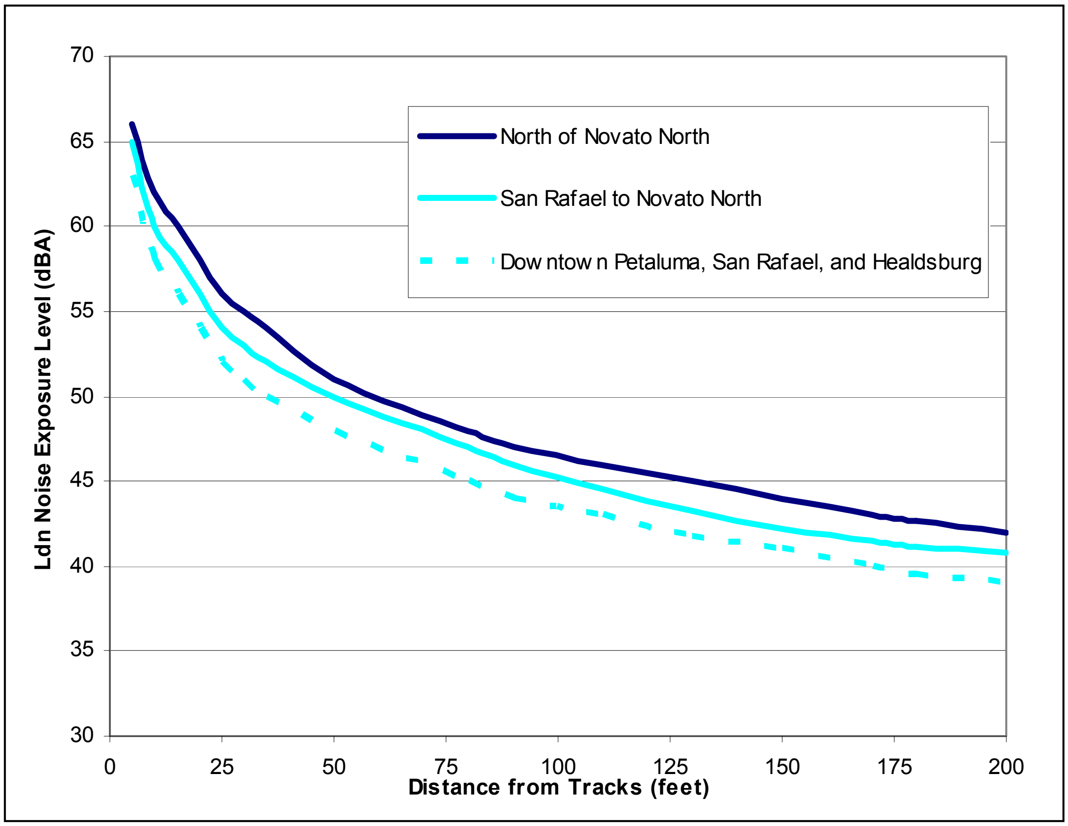
Noise impacts on nearby noise sensitive uses could result from train operations, operations at rail stations, operations at support facilities and from new park-and-ride lots.

DMUs are the proposed vehicles for the rail system. Because they are self-propelled, DMUs do not require large locomotive engines. DMUs are rail cars which contain both passenger accommodations and propulsion (diesel engines located below the passenger compartment). Noise measurements indicate that DMUs generate noise levels approximately 10 dBA less than diesel locomotives (Table 3.7-4). To most people, a DMU would sound about one-half as loud as a diesel locomotive.

The noise evaluation was based on a maximum train travel speed of 80 mph north of Novato North Station. From the North Novato Station to San Rafael, an average travel of 50 mph was evaluated. An average travel speed of 25 mph was evaluated for downtown Petaluma, Santa Rosa and Healdsburg. There would be few noise impacts from operation of the train because of the limited schedule of twelve round-trips per day in the most-traveled portion of the corridor; all trips would occur between 5:00 a.m. and 8:00 p.m.; and train speeds would be low in developed areas. Maximum noise levels during train pass-bys could be bothersome to residents near the alignment, however they would be limited to twenty-four occurrences (twelve round trips) or fewer and generally occur during daytime hours.

The predicted daily noise exposure from passenger rail operations away from grade crossings is shown in Figure 3.7-4. As shown in the future, daily noise exposure would be between 47 and 54 dBA L_{dn} at 50 feet and between 43 and 49 dBA L_{dn} at 100 feet, depending on where in the corridor the noise is being evaluated. The values in Figure 3.7-4 do not include the effects of train horns, which are used near railroad grade crossings. Noise exposure from the proposed passenger rail operations at distances greater than 25 feet from the tracks would be less than 60 dBA L_{dn}, the level considered normally acceptable for outdoor use in residential areas. Noise levels would be greatest north of Novato North because speeds would be highest in that area.

FIGURE 3.7-4
PROPOSED PASSENGER RAIL NOISE EXPOSURE

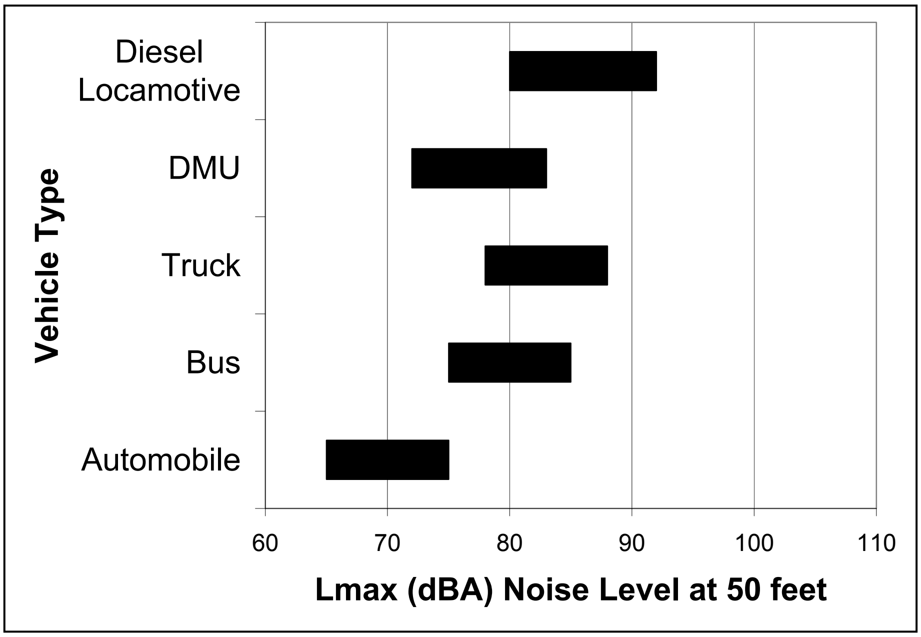


Note: L_{dn} is a measure of the daily sound level that includes a penalty for sound that occurs during the night.

While proposed passenger rail operations would not cause any significant adverse impacts along sections of the corridor without grade crossings, individual train pass-bys would be noticeable and potentially bothersome to nearby residents. L_{max} noise levels for DMU vehicles are similar to levels from heavy trucks or buses (between approximately 70 and 75 dBA at 100 feet from the tracks) but less than freight locomotives. Typical maximum noise levels experienced 50 feet from the pass-by of various types of vehicles are shown in Figure 3.7-5.

As part of the Caltrans project to widen Highway 101 in the San Rafael area, the current soundwall along Highway 101 would be relocated. SMART has recommended that the relocated soundwall be placed to the west of the rail corridor between approximately 500 feet north of Pacheco Street to the vicinity of the Prospect Drive Interchange. Caltrans proposed relocating the soundwall to between the widened Highway 101 and the train tracks. In this proposed Caltrans design, Highway 101 would be located east of the soundwall, while the railroad tracks and residences will be west of the wall. The soundwall would provide the same level of traffic noise reduction for traffic on Highway 101 whether it is placed between the highway and the train tracks or between the tracks and the neighborhood. Train noise impacts in this area would be less than significant whether or not the soundwall is located between the tracks and the freeway or between the tracks and the neighborhood. However, by placing the wall between the tracks and the neighborhood, the noise impacts on nearby residences from individual train pass-bys would be reduced. Because the distance between the soundwalls on opposite sides of Highway 101 would be greater if the wall is placed between the tracks and the neighborhood, the potential for traffic noise reflections off of the parallel barriers would be less with the wall located between tracks and the neighborhood than the Caltrans design. The proposed bicycle/pedestrian pathway may be located on either side of the Caltrans designed soundwall.

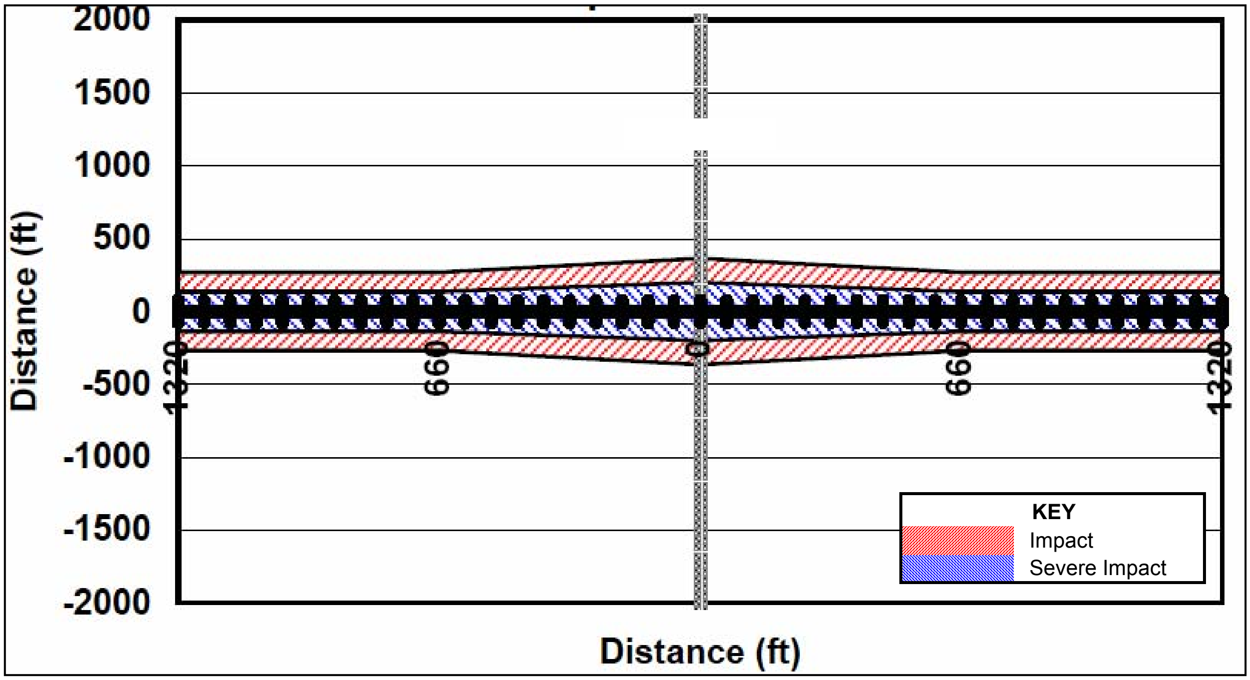
FIGURE 3.7-5
MAXIMUM NOISE LEVELS 50 FEET FROM VARIOUS VEHICLE TYPES



In addition to train pass-bys, noise from train horns would be experienced near grade crossings. Train horns are required to sound at between 96 and 110 dBA measured 100 feet in front of the locomotive. Within 0.25 miles of each grade crossing, the noise exposure from train horns would be substantially greater than the exposure from passenger train pass-bys. Within 0.25 miles of each grade crossing, noise impacts would extend for a distance of between 40 and 600 feet from the tracks, depending on location along the proposed project alignment and nearness to the grade crossing (Figure 3.7-6).

Several parks are located adjacent to the corridor. Because parks have a daytime use, they are evaluated against the daytime use criteria shown in Figure 3.7-1. The highest daytime L_{eq}(h) noise exposure that would be caused by train pass-bys would be less than 60 dBA at a distance of 50 feet from the tracks. Existing Daytime L_{eq}(h) noise levels measured throughout the corridor are generally above 55 dBA, and were above 40 dBA in every instance; therefore, there would be no severe noise impacts to parks and few if any less than severe noise impacts to parks along the corridor. Parks within 0.25 miles of a grade crossing would experience similar impacts from train horns as residences within that distance.

FIGURE 3.7-6
TYPICAL TRAIN HORN NOISE IMPACT DISTANCE FROM GRADE CROSSING



Impact N-2: Train operations would cause a permanent increase in ambient noise levels in the project vicinity. *(Less than significant)*

Approximately 15 residences in the vicinity of Pacheco Boulevard in San Rafael would experience noise impacts from passing trains, but no residences would experience severe noise impacts under the FTA transit noise impact criteria. Therefore, the impact would be less than significant. These residences would experience impacts because they are very close (within 30 feet) to the rail line and up to five trains per day would pass-by before 7:00 a.m. Although not required, the following mitigation measure would further reduce noise impacts.

> **Mitigation Measure N-2:** Limiting train speed between the San Rafael Station and Linden Lane to 25 mph would eliminate the only noise impacts predicted from the operation of DMU vehicles away from grade crossings. This measure would be implemented only if it does not restrict normal train operations.

Impact N-3: The Windsor Station operations may cause a permanent increase in ambient noise levels in the project vicinity. *(Less than significant)*

Noise impacts from park-and-ride facilities associated with the proposed rail stations were predicted for only the Windsor Station, where residences would be directly adjacent to parking facilities. Between two and five residences within 50 feet of the proposed Windsor Station park-an-ride lot would experience noise impacts as a result of park-and-ride lot operations under the FTA transit noise impact criteria. L_{dn} noise exposure experienced at this location would be approximately 54 dBA. The impact would be less than significant because it does not exceed FTA criteria for severe impact. However, the following mitigation measure would further reduce noise impacts.

> **Mitigation Measure N-3:** Install a solid barrier at the Windsor Station to separate the park-and-ride lot from residential uses.

Impact N-4: The proposed maintenance facility would cause a permanent increase in ambient noise levels in the project vicinity. *(Less than significant)*

Of the two options for proposed maintenance facilities, the Windsor facility would not be located near sensitive receptors and therefore would not cause noise impacts on surrounding land uses. However, four residences on McCray Road are located approximately 200 feet from the vehicle lay-up tracks at the proposed Cloverdale maintenance facility at the north end of the proposed project corridor and could experience noise impacts as a result of vehicle maintenance operations under the FTA transit noise impact criteria. The impact would be less than significant because it does not exceed FTA criteria for severe impact. Although not required, the following mitigation measure would further reduce noise at these residences.

> **Mitigation Measure N-4:** Construct a noise barrier or enclosure of the vehicle lay-up area at the Cloverdale Maintenance Facility.

Impact N-5: Train horns would cause a substantial increase in ambient noise levels in the project vicinity. *(Significant unavoidable)*

While noise from train horns and warning devices are not regulated by local ordinance because they are safety-warning devices, the noise can be disturbing to residents near at-grade crossings. Noise exposure levels would exceed the FTA noise impact criteria (Figure 3.7-1) near several grade crossings along the corridor. The number of residences that would experience train horn noise exposures greater than the FTA impact criteria thresholds is listed in Table 3.7-5. Approximately 250 residences and apartments would experience severe noise impacts, and an additional approximately 500 would experience noise impacts that are less than severe as a result of train horns being used at grade crossings. It should be noted that the train horn noise would be temporary and periodic and would be limited to the hours between 5:00 a.m. and 8:00 p.m.

> **Mitigation Measure N-5:** Limit the use of train horns and other audible warning devices by installing crossing controls that meet FRA requirements and obtain Quiet Zone designations for crossings along the corridor. Local jurisdictions may apply to the FRA for designation as a Quiet Zone, where audible warning devices are not required. The application must be a joint application between the local jurisdiction and the rail operator and must include supplementary safety measures to ensure that safety is not compromised by eliminating the sounding of the train horns.

Because FRA has final jurisdiction over Quiet Zone applications, SMART cannot commit to Quiet Zone implementation. SMART has committed to work with any local jurisdictions wishing to be designated Quiet Zones to cooperatively meet the requirements for designation. If Quiet Zones are designated in each of the communities where significant train horn impacts are predicted, no severe noise impacts would remain after mitigation.

TABLE 3.7-5
TRAIN HORN IMPACTS AT GRADE CROSSINGS

Grade Crossing	Residences Experiencing Impacts	Residences Experiencing Severe Impacts
San Rafael, 4th Street to Linden Lane	10 Apartment Buildings and 50 Residences	10 Apartment Buildings and 50 Residences
San Rafael, North San Pedro Road	8	31 Units
San Rafael, Civic Center	15	0
San Rafael, Smith Ranch Road	56	40
Novato, Roblar Drive	33	12
Novato, Grant Avenue	3	13
Novato, Olive Avenue	10	1
Petaluma, West Payran Street	13	0
Petaluma, North McDowell Boulevard	25	16
Petaluma, Corona Road	0	1
Petaluma, Ely Road	0	5
Penngrove, Main Street	8	0
Cotati, Cotati Avenue	10	2
Cotati, Southwest Boulevard	39	5
Rohnert Park Expressway	25	0
Santa Rosa, Bellevue Avenue	7	0
Santa Rosa, Barham Avenue	23	0
Santa Rosa, North Guerneville Rd.	15	11
Santa Rosa, Steele Lane	8	0
Santa Rosa, San Migel Avenue	35	1
Fulton, River Road	6	0
Windsor, Airport Road	3	0
Windsor, Wilson Lane	3	0
Windsor, Windsor River Road	8	0
Windsor, Starr Road	21	4
Healdsburg, Front Street	3	0
Geyserville, Walden Avenue to Woods Lane	19	1
Cloverdale, Airport Road	2	0
Cloverdale, First Street	2	0

Cumulative Impacts

The FTA noise impact criteria were developed to consider the cumulative effect of a proposed project on the acoustical environment. For locations with low background levels, the proposed project may contribute noticeable additional noise to the total environment without causing a significant impact. For locations with higher background levels, the amount of additional noise that a project is allowed to contribute decreases (Figure 3.7-1). While the proposed project would add to the total environmental noise level along the project corridor, it would create severe impacts under the FTA criteria only in the vicinity of grade crossings where trains would be required to sound their horns. The cumulative noise level at grade crossings could increase by a significant amount. This impact would be eliminated at any locations that are designated quiet zones. Mitigation Measure N-5, if it can be implemented, would eliminate the only significant noise impact predicted to occur with the SMART project.

Ambient noise from freight traffic was not considered in the impact analysis for the proposed project because no freight service is currently operating on the corridor. In the future, up to four freight trains in each direction per day are expected to operate north of the Ignacio Wye (south of Novato) independent of the proposed project. Assuming eight train pass-bys per day consisting of one locomotive and 15 rail cars and operating between 7:00 a.m. and 10:00 p.m. at a speed of 60 mph, the freight operations would create an estimated noise exposure of approximately 58 dBA L_{dn} at 50 feet from the tracks and 53 dBA L_{dn} at 100 feet from the tracks. In the section of track where freight trains are anticipated to resume operation, the freight operations are expected to generate substantially more daily noise than the passenger rail operations. Train horn noise would be similar for freight and passenger trains in the vicinity or grade crossings.

In areas where both passenger rail and freight rail would be operating, the cumulative daily noise exposure from all rail operations, based on the above assumptions for freight operations, would be approximately 59 dBA L_{dn} at 50 feet and 54 dBA L_{dn} at 100 feet from the tracks. Cumulative noise exposure from passenger and freight rail operations at distances greater than 50 feet from the tracks would be less than 60 dBA L_{dn}, the level considered normally acceptable for outdoor use in residential areas.