Noise and Vibration Technical Report

Perris Valley Line Commuter Rail

Riverside County, California

Prepared for:
Riverside County Transportation Commission

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I. PROJECT OVERVIEW

The Riverside County Transportation Commission (RCTC) proposes to establish a commuter rail service on the portion of the San Jacinto Branch Line (SJBL) between Riverside and South Perris as an extension of the SCRRA/Metrolink 91 commuter rail service from Los Angeles. As this project would introduce new transit noise sources in areas where they do not now exist, this *Noise and Vibration Technical Report* presents forecasted noise and vibration levels that are expected to be generated by the proposed project for its opening year of 2012. Applicable standards and criteria used to assess future environmental noise impacts for a rail project are described along with the methodologies used in the assessments. Where noise or vibration impacts were predicted, mitigation measures are identified and discussed.

This technical report supports the Environmental Impact Report (EIR) prepared for the Perris Valley Line (PVL) project in accordance with the National Environmental Policy Act (NEPA) and CEQA. In addition to NEPA, the Federal Transit Administration (FTA) guidelines (*Transit Noise and Vibration Impact Assessment,* 2006) were followed to conduct the detailed noise and vibration impact assessments presented in this report.

Noise Overview

In the case of the PVL project, the commuter rail would be the primary source of noise. Noises associated with commuter rail are primarily generated from the following system elements:

- Diesel exhaust and cooling fans, which are part of a function of the rate of acceleration and speed. These elements are more audible during slow speeds or when the train is in a stationary position. Also, locomotive noise tends to increase approximately two dBA for each increase in throttle setting. A typical locomotive has eight throttle settings, which means that at full power locomotives are about 16 dBA louder than when they are idle.

- Wheel/rail interaction (a function of the condition of wheels and type [e.g., welded or jointed], truck suspension and condition of the rails). Noise levels typically increase with increasing speed of the train. Other factors that increase levels of wheel/rail noise are wheel squeal on tight radius curves (< 900 feet), wheel impact at rail joints and poor condition of the wheel or rail operating surface.

- Train horns and grade crossing bells, at and approaching grade crossings. These sources are probably the major source of noise-related impacts. For the PVL, it was assumed that horn noise would dominate over the grade crossing bells. As per the Federal Railroad Administration (FRA), regulations require that all freight and commuter rail trains sound an audible warning in a long-long-short-long pattern starting 20 seconds before all public grade crossings. FRA regulations stipulate that the train horn be a minimum of 96 dBA at a distance of 100 feet from the front of the lead locomotive and a maximum of 110 dBA.

Commuter rail noise, as perceived by an individual at a given location and time, is a function of several factors, including:

- the distance from the noise source to the receiver,
- intervening terrain between a receiver and a noise source,
- the existence of natural or constructed noise barriers, and
- the combination of railroad-related noise levels and other local sources of noise.

Vibration Overview

Vibration is a type of movement that rapidly fluctuates back and forth, potentially causing "feelable" and audible sensations for humans. For rail projects, Ground-borne vibration (GBV) is usually caused by train operations and construction activities such as blasting, pile-driving, and operating heavy earth-moving equipment. With trains, GBV is a result of the interaction of wheels and rails, which can cause windows, pictures on walls, or items on shelves to rattle. A rumbling sound can also accompany GBV, known as ground-borne noise (GBN) or noise that radiates from the motion of building surfaces.

Although GBV effects usually go unnoticed outdoors, it can be a significant annoyance to people inside buildings. Though GBV is almost never of sufficient magnitude to cause even minor cosmetic damage to buildings, the primary consideration is whether GBV would be intrusive to building occupants or interfere with interior activities or machinery.

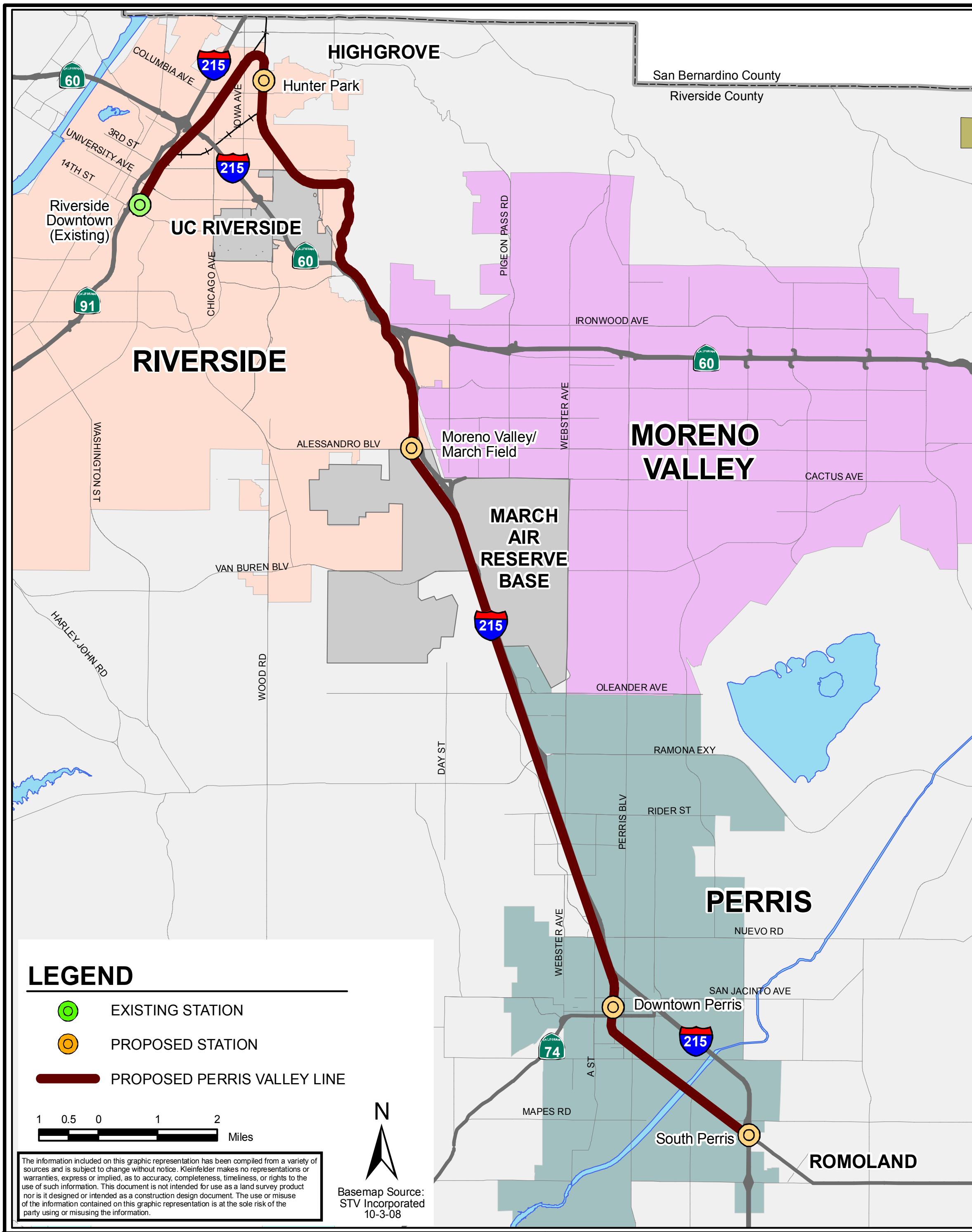
II. NOISE ASSESSMENT

A. INVENTORY OF NOISE SENSITIVE SITES

Site and Study Area

The site and study area for this project is an existing rail freight corridor located in western Riverside County, part of the Inland Empire region of Southern California. Situated approximately 70 miles east of Los Angeles, the corridor extends approximately 24 miles southeast from the City of Riverside toward the City of Perris. Three incorporated cities in the study area include Riverside, Moreno Valley, and Perris. A map of the study area is shown on Figure 1.

Figure 1: Study Area Map



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PROJECT NO.	92666	STUDY AREA MAP	FIGURE
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Locations of Noise Sensitive Receptors

Shown on Figure 2 is an overview of the PVL alignment with the general locations of noise sensitive properties separated into receptor "Areas." Below is a summary of the types of sensitive land uses found in each of these receptor "Areas."

Area A: Consists primarily of commercial and industrial uses along the BNSF alignment from the Riverside Downtown Station to the Citrus Connection. One small residential neighborhood exists along the inbound side of the BNSF alignment from Down Street north to where the alignment crosses Marlborough Street.

Area B: Residential neighborhood exists along the southern portion of Transit Avenue with several houses abutting the alignment near Citrus Street.

Area C: Residential neighborhood exists north of the University of California, Riverside (UCR) campus between Spruce Street and Mount Vernon Avenue. The majority of the sensitive receptors are single-family residences north of the SJBL along Kentwood, Highlander, West Campus View, and East Campus View Drives. In addition there are some multi-family residences along Watkins Drive. Institutional uses include St. George's Episcopal Church at Watkins Drive and Spruce Street, Highland Elementary School, UCR Daycare Center and Crest Community Baptist Church.

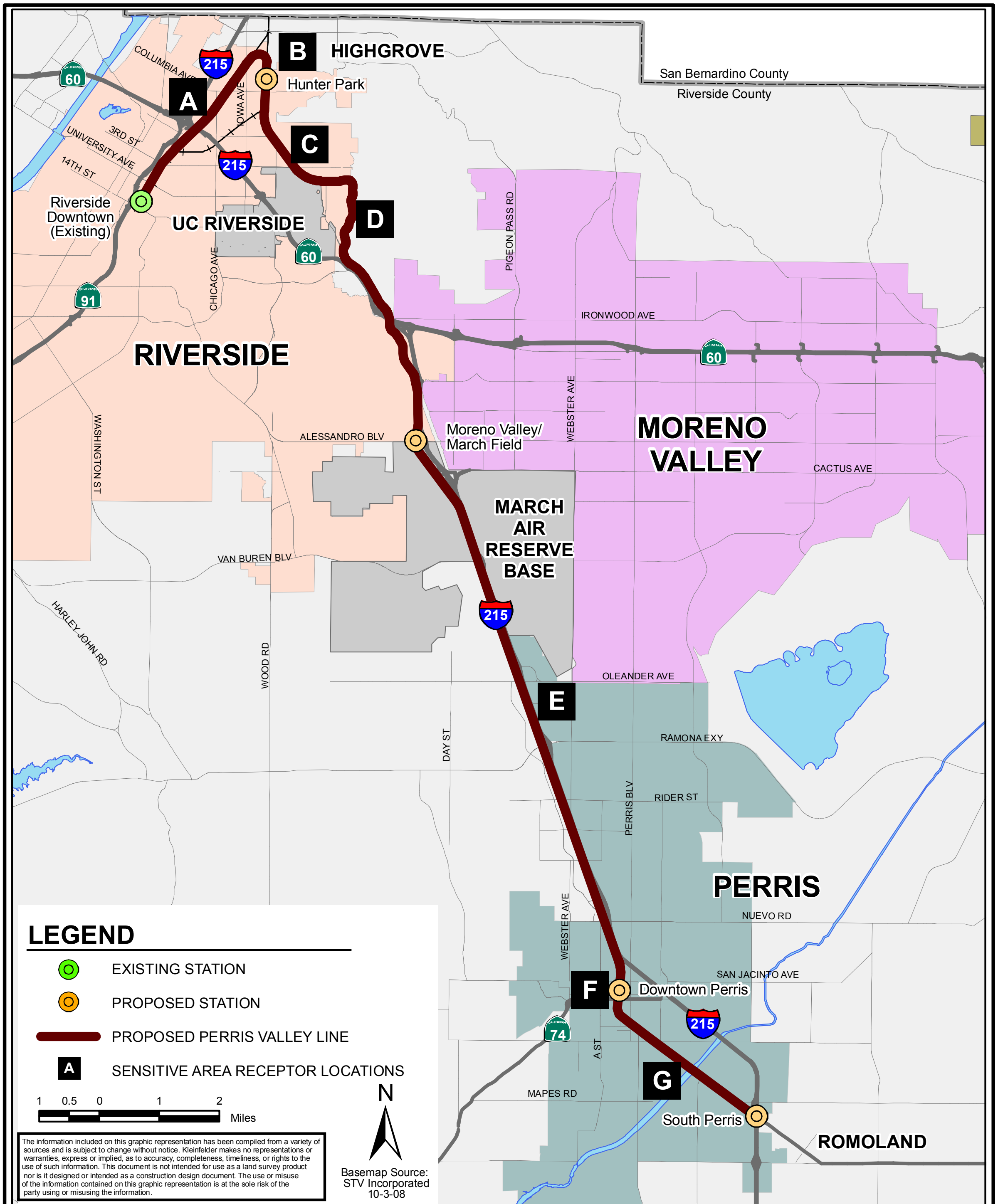
Area D: Residential neighborhoods exist west of the PVL alignment and east of the UCR campus. Some of the streets in this area are Big Springs Road, Quail Road, Swain Road, and East Manfield Street. This area also includes Hyatt Elementary School.

Area E: Predominantly low density open land with commercial and office type uses. However, the landscape of the area is dominated by I-215 which parallels the PVL alignment going into Perris. The closest residential areas to the PVL are blocked by I-215 in the area of Edgemont. The March Air Reserve Base exists in the Moreno Valley area. This section also includes some former March Air Reserve Base housing. However, this housing is no longer used for residential purposes.

Area F: Residences in Perris from San Jacinto Avenue to 10th Street. The area includes residences and commercial uses both west and east of the PVL alignment in addition to Nan Sanders Elementary School to the north and St. James Church and School farther south. The last noise sensitive receptor is an apartment complex on Case Road just east of Perris Boulevard.

Area G: A small number of single- and multi-family residences exist after the alignment turns to parallel Case Road in the southern section of Perris. The terminus of the PVL would not be located near any noise sensitive receptors.

Figure 2: Receptor Area Map



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B. MEASUREMENT OF EXISTING NOISE CONDITIONS

Noise Environmental Setting

Noise sensitive land use areas within the proposed PVL project area were identified by screening GIS data for buildings with residential or institutional uses nearby the PVL corridor. Then, field observations were also made to identify and confirm noise sensitive land use locations within the corridor and the larger study area.

The proposed PVL project area would include portions of the existing BNSF alignment, between the Downtown Riverside Station and the Highgrove area, as well as the SJBL alignment between the areas of Highgrove and Perris. These two active railways would be connected by the proposed new Citrus Connection.

The noise environment conditions for each segment are described below.

- The noise environment along the Riverside to Highgrove BNSF Main Line segment is dominated by an extremely heavy volume of rail activity; between 60 and 80 trains travel along it during a typical 24-hour period. The majority of these trains (about 80 percent) are freight trains, which generally operate with three to four diesel locomotives and about 50 to 100 freight cars. Typical speeds are approximately 30 mph. The remaining rail traffic consists of mostly SCRRA/Metrolink, and a few Amtrak trains. The SCRRA/Metrolink trains have a single diesel locomotive and about three passenger cars and travel at average speeds of approximately 50 mph. The Amtrak trains have two to three diesel locomotives and about 15 cars, traveling at about 50 mph. Train traffic occurs during both day and night hours. ~~Vibration along the BNSF would be dominated by the existing train activity.~~ In addition to rail activity, vehicles traveling on I-215 and SR 60 make a significant contribution to the noise environment, as do local streets.

- The SJBL corridor from Highgrove to Perris currently has about two freight trains traveling on it daily. These trains typically consist of three diesel locomotives and about 25 freight cars, and travel at maximum speeds of 20 mph. In those portions of the rail segment that have at-grade rail crossings (where the majority of the corridor's noise sensitive receptors are located), horn noise is a significant contributor to the existing noise environment. Noise from automobile traffic becomes significant along the corridor from Moreno Valley to Perris, where the I-215 freeway parallels the SJBL, and at-grade rail crossings are limited. However, this portion of the SJBL corridor contains very few sensitive noise receptors. ~~Vibration along the SJBL would be dominated by the existing train activity.~~

As a result of the train activity, the existing alignment contains grade crossings areas where warning bells would be required for passing trains. At most crossings, these devices are represented by electro-mechanical railroad warning gongs. At a point 10 feet from the gong and in increments of 20 degrees, the sound level should not be more than 105 dBA and not less than 85 dBA. The gongs typically operate between 30 to 60 seconds per normal through train movement. Whenever a train is physically occupying the space where the railroad and roadway intersect, the gongs will be active.

The current CPUC requirements for audible warning devices at grade crossings dictate that bells or other audible warning devices shall be included in all automatic warning device assemblies and shall be operated in conjunction with the flashing light signals. (American Railway Engineering and Maintenance of Way Association's *Communications and Signals Manual of Recommended Practices*, 2007)

Existing Noise Levels

To assist in the assessment of potential impacts, noise measurements were conducted at several selected sensitive receptors along the corridor. The measurement sites were selected on the basis of several factors, the most important of which was the site's potential sensitivity to changes in noise levels. Since the initial Draft EA measurement program (2002), subsequent measurements were taken in 2005 and again in 2008/2009 to update and enhance the data.

For all noise measurements, each site was either representative of a unique noise environment, or of nearby, similarly situated receptors. Along the BNSF, the primary land uses are industrial and commercial; however, noise monitoring was conducted at several residential properties along the corridor. As the Citrus Connection and the existing SJBL corridor pass through predominately residential neighborhoods, most of the sensitive receptors monitored along these segments are residential in nature. Several non-residential land uses also exist along these segments and, as such, were included in the monitoring program; these sites include schools, churches and senior centers. For noise, both long-term (24-hour) and short-term (20 minutes to one hour) measurements were conducted.

All noise measurements were taken with a Type I sound level meter. A windscreen was placed over the microphone for all measurements. The meter was properly calibrated before and after all measurements using a calibrator. In accordance with FTA procedures, monitored noise levels resulting in an equivalent hourly noise level (Leq) were, according to the time of day they were monitored, adjusted in some cases to obtain the resulting Ldn noise level for Category 2 receptors. No adjustments were required for monitored noise levels at Category 3 receptors, because Leq is the appropriate noise descriptor.

Summary of the 2002 Noise Measurement Program

All locations were monitored during a three-day period (May 14-16, 2002), typically during the peak morning or afternoon traffic hours. No long-term measurements were taken at any of the sensitive locations. The descriptor recorded during field measurements was Leq. These measured values were used to derive a calculated Ldn value. A tabulation of the results of the calculations of existing noise levels at potentially sensitive, monitored locations is provided in Table 1. Monitoring locations are shown on Figures 3A and 3B.

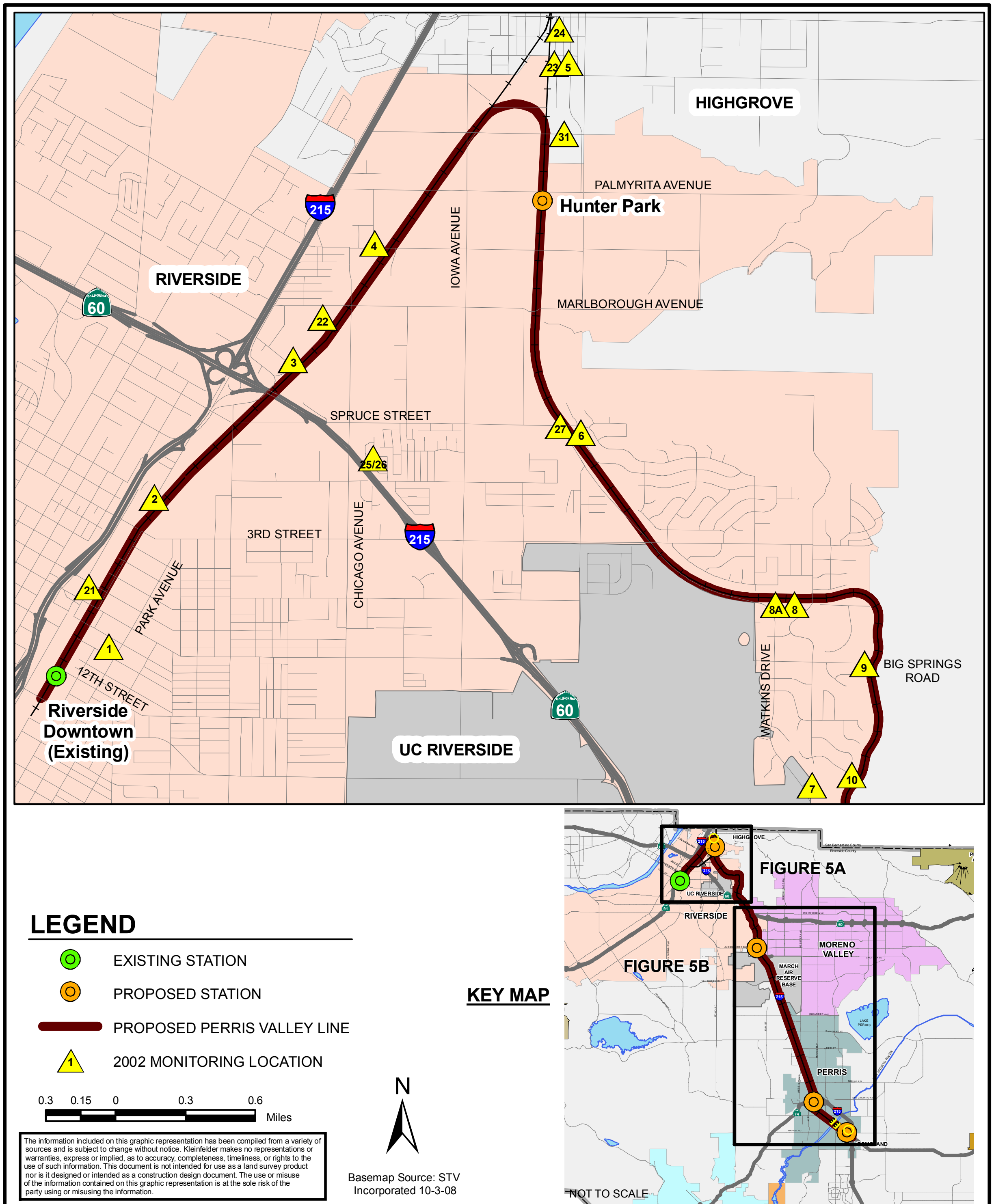
The 2002 existing noise levels at sensitive receptors along the BNSF Main Line portion of the corridor are high and in the "downtown city" noise range. The 2002 existing noise levels at residential areas of Riverside and Perris adjacent to the SJBL are in the "'very noisy' urban residential areas" range as shown later in this report in Table 1.

Table 1: Summary of Noise Measurements (2002)

Site No.	Land Use	Description	Dist. from Tracks (ft)	Existing Noise Level (Ldn)
1	SFR	3015 9th St	450	74
2	SFR	3112 1st St	180	79
3	SFR	1901 Thornton Ave	80	82
4	SFR	1148 Ardmore St	340	76
5	SFR	Transit & Villa Streets	330, 20 [1]	78
6	SFR	890 Kentwood Dr	55	70
7	MFR	10 Watkins Dr	125	68
8	SFR	121 Nisbet Way	80	68
8A	SFR	277 Nisbet Way	50	70
9	SFR	396 E Big Springs Road	125	54
10	SFR	298 E Manfield St	110	56
11	SFR	20511 Claremont	560	61
12	SFR	7005 Old Frontage Rd	500	60
13	SFR	California & Wade Streets	240	68
14	School	Nan Sanders Elementary School	140	60*
15	SFR	234 Bowen St	230	59
16	SFR	30 C St	210	66
17	SFR	10^{th} St & Perris Blvd	75	69
18	SFR	124 8th St	250	64
19	Hotel	27272 SR-74	130	75
20	SFR	25688 Sherman Rd	330	54
21	Commercial	Old Spaghetti Factory	250	72*
22	SFR	Marlborough Avenue (bet Catania Dr & PVL)	320	76
23	SFR	Villa St (bet Transit Ave & PVL)	330,125 [1]	76
24	SFR	Transit Ave (near Fountain St)	200,30 [1]	79
25/26	SFR	Trailer park (274 Sir Belvidere Dr)	50	72
27	Church	St Georges (Spruce St & Watkins Dr)	180	67*
27A	MFR	Box Spring & Morton	125	57
28	Cemetery	Riverside National	100	61*
29	Senior Center	San Jacinto & D St	95	70*
30	SFR	C St & 7th St	60	71
31	SFR	1021 Citrus Street	60	70

Notes:
* Noise levels presented as Leq
SFR = Single-family residence, MFR = Multi-family residence
(1) BNSF & SJBL Tracks
Source: STV Incorporated, 2002

Figure 3A: 2002 Noise Monitoring Locations



KLEINFELDER Bright People. Right Solutions. www.kleinfelder.com	PROJECT NO.	92666	**2002 NOISE MONITORING LOCATIONS**	FIGURE
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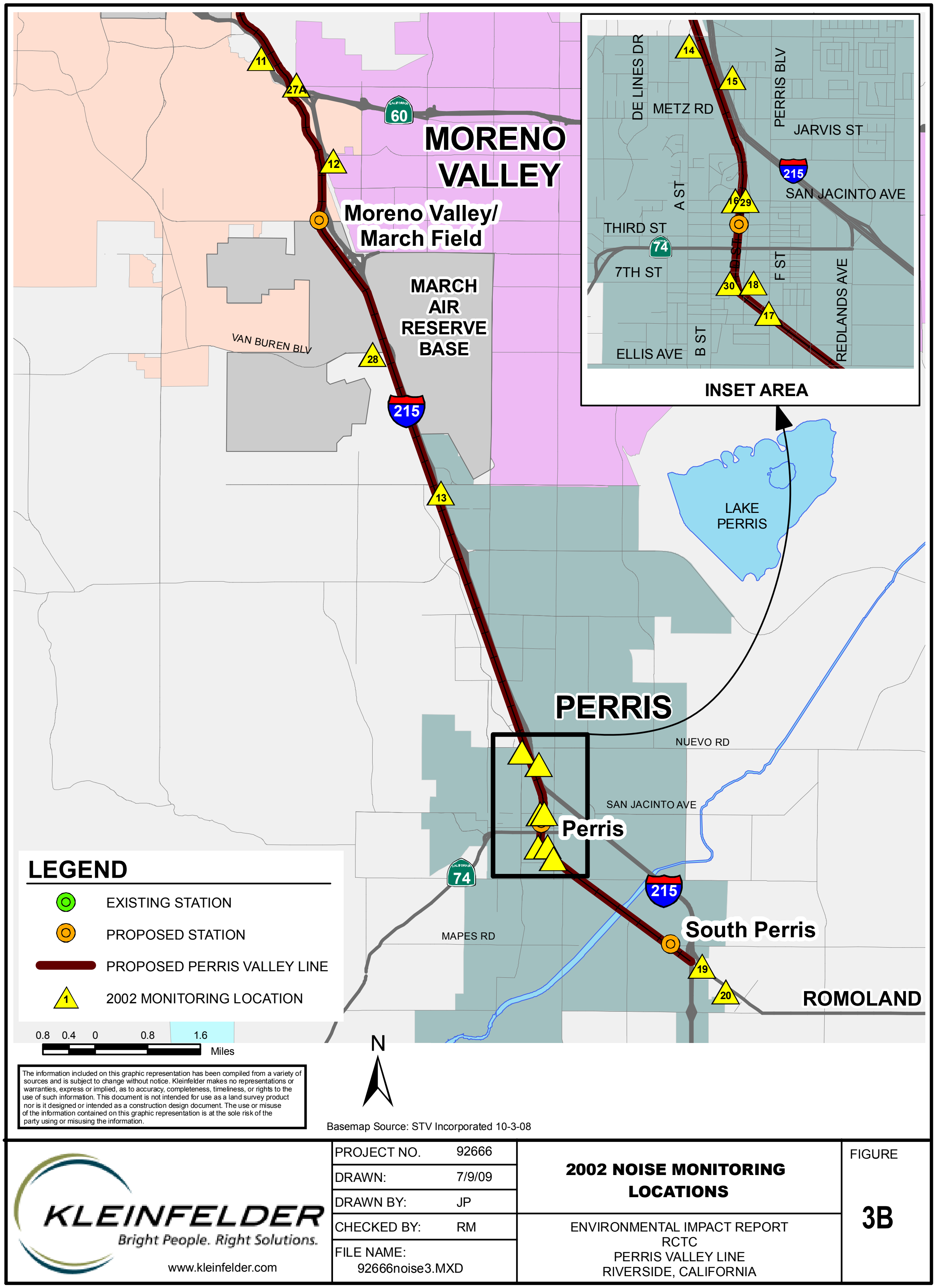
Figure 3B: 2002 Noise Monitoring Locations



Summary of the 2005 Measurement Program

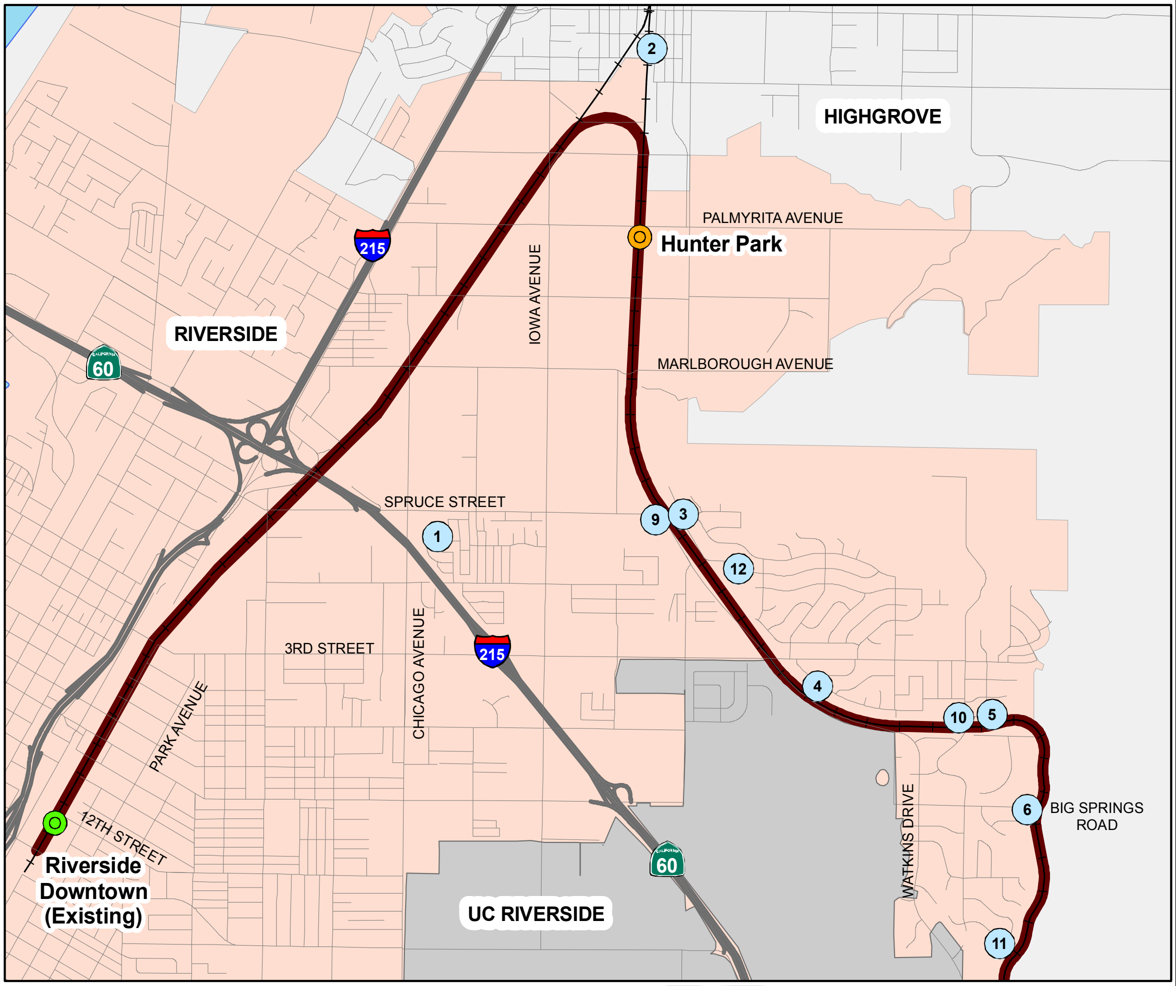
In 2005, several additional noise measurement locations were identified, including locations suggested by public comment on the Draft EA. In all, the 2005 measurement program included additional monitoring at twelve noise sensitive sites along the SJBL alignment. A tabulation of these monitored locations is provided in Table 2 and monitoring locations are mapped on Figures 4A and 4B.

Table 2: Summary of Noise Measurements (2005)

Site No.	Description	Measure Type(1)	Dist. from Tracks (ft.)	L_{dn}, dBA		No. of Trains(43)
				With Trains	Without Trains(2)	
1	103 Sir Dames Dr, Riverside	LT	35	63	62	3
2	441 Transit Avenue, Highgrove	LT	35	67	67	3
3	2294 Kentwood/Spruce, Riverside	LT	100	67	59	8
4	518 W. Campus View, Riverside	LT	83	66	57	8
5	232 E. Campus View, Riverside	LT	62	65	49	2
6	396 E. Big Springs Rd., Riverside	LT	90	62	54	2
7	228 C Street, Perris	LT	240	67	67	2
8	81W. 8th Street, Perris	LT	300	--	59	0
9	Church at Spruce & Watkins, Riverside	ST	150	--	61	0
10	Church at Mt. Vernon Crossing, Riverside	ST	50	--	49	1
11	Hyatt Elementary School/E. Manfield Rd., Riverside	ST	50	--	50	1
12	Highland Park off Kentwood, Riverside	ST	50	--	56	0

Notes: (1) LT = long term (24 hours or more), ST = short term (30 minutes to one hour).
(2) For measurements that included one or more train events, this column shows what the Ldn would have been without the train noise. No trains passed during the short term noise measurements.
(3) Average train vibration level when locomotives passed measurement position.
(43) Total number of trains passing measurement position during measurements. Measurement period may be for more than 24 hours.
(5) Train vibration measurements were performed at a different time than the short-term noise measurements. Shown are the train vibration levels at 50 feet from track center.
Source: ATS Consulting, 2005

Figure 4A: 2005 Noise Monitoring Locations



LEGEND

- EXISTING STATION
- PROPOSED STATION
- PROPOSED PERRIS VALLEY LINE
- 2005 MONITORING LOCATION

0.3 0.15 0 0.3 0.6 Miles

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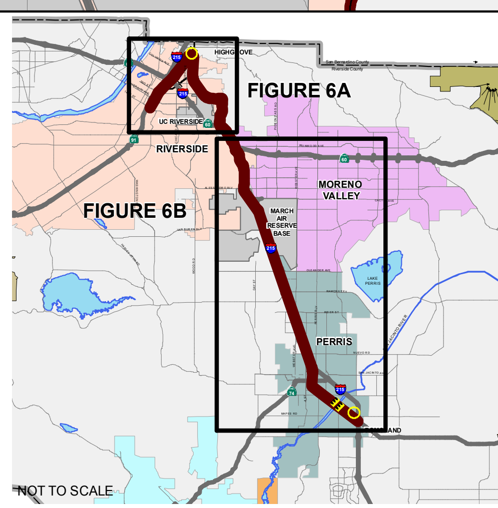
Basemap Source: STV Incorporated 10-3-08

KEY MAP



KLEINFELDER Bright People. Right Solutions. www.kleinfelder.com	PROJECT NO. 92666	**2005 NOISE AND VIBRATION MONITORING LOCATIONS**	FIGURE 4A
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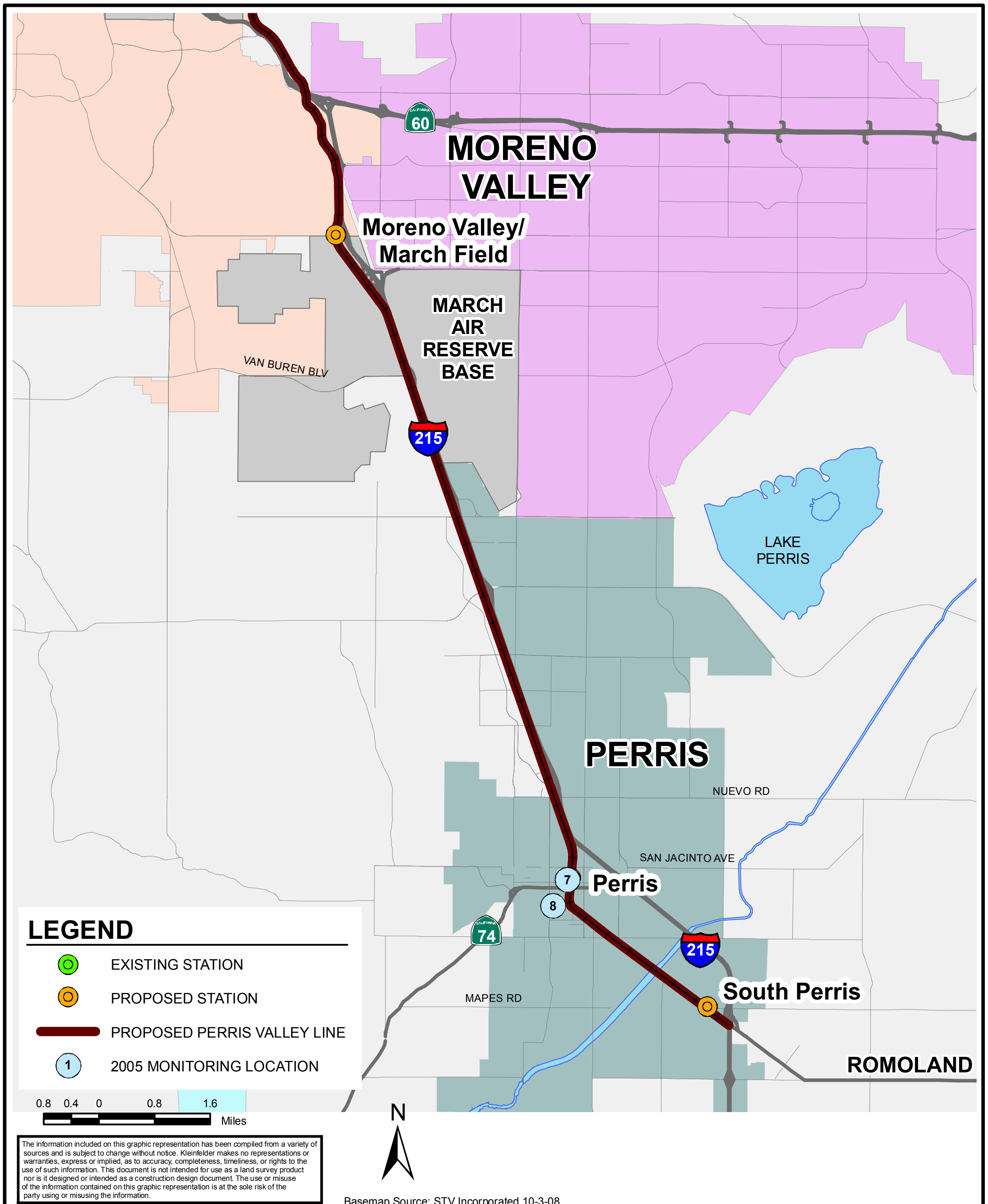
Figure 4B: 2005 Noise Monitoring Locations



KLEINFELDER Bright People. Right Solutions. www.kleinfelder.com	PROJECT NO. 92666 DRAWN: 7/9/09 DRAWN BY: JP CHECKED BY: RM FILE NAME: 92666noise3.MXD	**2005 NOISE AND VIBRATION MONITORING LOCATIONS** ENVIRONMENTAL IMPACT REPORT RCTC PERRIS VALLEY LINE RIVERSIDE, CALIFORNIA	FIGURE **4B**

Following is an overview of the existing noise and vibration environment in each major section of the corridor from the 2005 monitoring program:

- ***Residential areas north of UCR:*** Three long-term measurements (at Sites 3, 4 and 5) and three short-term measurements (at Sites 9, 10, and 12) were performed in this area. The measured Ldn, including freight train noise, was up to 16 dBA higher than the Ldn with the train noise removed. As discussed below, much of the track in this area is older, jointed rail, another source of the noise from rail operations.

- ***Residential area east of UCR:*** There was one long-term measurement (Site 6) and one short-term measurement (Site 11) in this area. The measured Ldn at Site 6 was 62 dBA, and 54 dBA with the train noise removed.

- ***Central Section of Perris:*** The measured Ldn at Site 7 on C Street was 67 dBA. There was some train activity during this measurement although the train noise only marginally added to the Ldn.

- ***South Perris:*** One 24-hour noise measurement was performed in this area (Site 8) where the measured Ldn was 59 dBA. The primary noise sources were local traffic and landscaping activities with background noise from traffic on I-215. No freight trains passed during the 24-hour measurement at Site 8.

Summary of the 2008/2009 Measurement Program

The 2008/2009 noise measurement program included measurements of noise sensitive locations previously monitored in 2002 and 2005, in addition to several new locations. They include both long-term (24-hour) and short-term noise measurements. Schools along the SJBL alignment were specifically re-monitored and other residential and institutional (including two schools) uses were added to the monitoring program. In general, the results of the 2008/2009 monitoring program were consistent with the existing noise environment during the monitoring programs for 2002 and 2005. There were however, several sites within the area of UCR which tended to exhibit lower noise levels for the 2008/2009 measurement program. Site 18 represents new residential construction. The overall results of the measurements are summarized in Table 3. Monitoring locations are shown on Figures 5A and 5B.

Table 3: Noise Monitoring Locations for Detailed Noise Assessment - 2008/2009

Site No.	Description	Measure Type[(1)]	Dist. from Tracks (ft.)	Ldn, dBA
1	518 West Campus View Dr	LT	117	59
2	232 East Campus View Dr	LT	65	56
3	228 C Street	LT	244	70
4	St. George's Episcopal Church @ Spruce & Watkins Drive	ST1	190	57*
5	Crest Community Baptist Church	ST1	163	52*
6	Hyatt Elementary School (4466 Mount Vernon Avenue)	ST1	370	60* [2]
7	Highland Elementary School	ST1	88	54* [2]
8	3015 9th Street	ST2	450	69
9	3112 1st Street	LT	210	75
10	1901 Thornton Ave	LT	90	76
11	2970 Watkins Dr	LT	124	66
12	137 Nisbet Way	LT	180	62
13	7005 Old Frontage Rd	ST2	564	62
14	California & Wade Streets	ST2	258	70
15	Nan Sanders Elementary School (1461 N. A Street)	ST1	123	64* [2]
16	234 W. Bowen St	ST2	235	59
17	116 State Street	ST2	80	72
18	New Homes on 9th Street in Perris	ST2	300	66 [3]
19	Old Spaghetti Factory	ST1	280	65*
20	1824 Marlboro Ave	ST2	260	63
21	Senior Citizens Center (146 W. San Jacinto Avenue)	ST1	96	59*
22	1027 Citrus St	LT	62	73
23	842 Kentwood Drive	LT	80	63 [2, 3]
24	St. James Catholic Church/School	ST1	370	64* [2, 3]
25	UCR Day/Childcare (3338 Watkins Drive)	ST1	175	54* [2]

Notes: * Represents a Leq value
(1) LT = long term (24 hours or more), ST1 = short term (30 minutes to one hour), ST2 = short term (measurement adjusted to reflect LT Ldn)
(2) Noise monitoring conducted in 2009
(3) New monitoring site
Source: STV Incorporated, 2008/2009

Figure 5A: 2008/2009 Noise Monitoring Locations

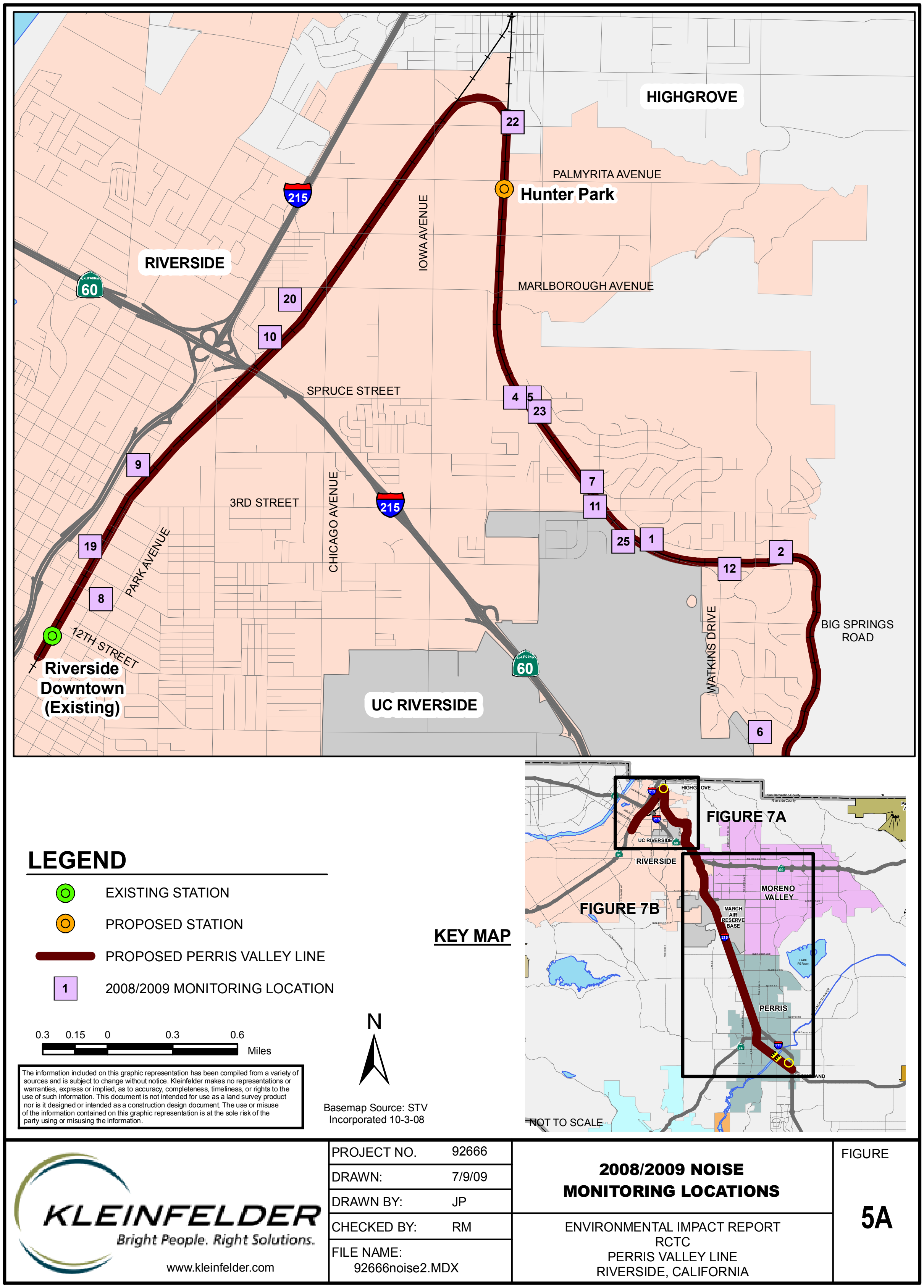
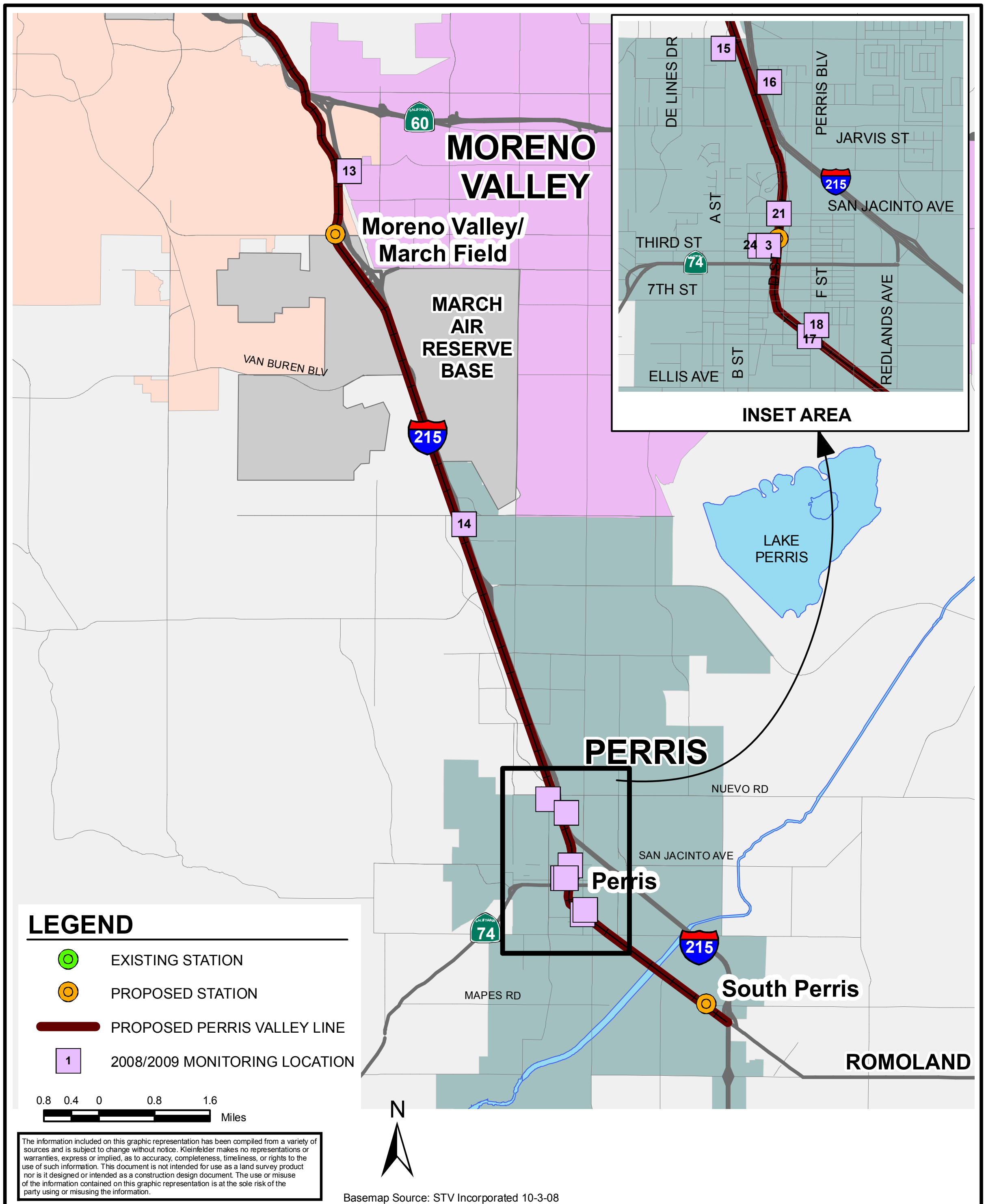


Figure 5B: 2008/2009 Noise Monitoring Locations



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Following is an overview of the existing noise environment in each major segment of the corridor:

- ***Citrus Street, Highgrove:*** This segment has several homes abutting the SJBL where it would join the Citrus Connection. The measured Ldn in this vicinity was 73 dBA.

- ***Residential areas north and northeast of UCR:*** Five long-term measurements (at Sites 1, 2, 11, 12 and 23) and three short-term measurements (at Sites 4, 5, and 7) were performed in this area. Important sources of train noise are train horns sounded at grade crossings, freight locomotives going uphill operating under high power settings, and wheel squeal on curves. Measured Ldn ranged from 56 dBA to 66 dBA.

- ***Residential area east and southeast of UCR:*** This area is similar to the neighborhoods north of UCR, except that there are limited grade crossings so train horns are not the primary noise source at most of the sites. Because of the number of large and small horizontal curves, freight trains that currently operate in this area often generate wheel squeal. There was one short-term measurement (Site 6) in this area, representative of the Hyatt Elementary School. The measurement was 46.3 dBA.

- ***Downtown Perris:*** The SJBL passes through the City of Perris between C and D Streets, turning east to follow Case Road. Freight train operations are less frequent in Perris since many of the BNSF customers served by the SJBL are located north of Perris, in the vicinity of the March Air Reserve Base and the Meridian Business Center. One long-term measurement at Site 3 and five short-term measurements (at Sites 15, 17, 18, 21 and 24) were performed in this area. The dominant noise sources in the central section of Perris are traffic on surface streets along with intermittent emergency vehicle sirens and freight traffic. No freight trains passed during monitoring.

C. PREDICTION OF NOISE FROM THE PROJECT

The specific detailed noise modeling procedures used on each of the major noise sources are discussed below. Noise prediction equations contained in Chapter 6 of the FTA Guidance Manual were used in the analysis.

Train Horns

FRA regulations require that freight and commuter train horns be sounded prior to all public grade crossings unless a "quiet zone" has been established. The horn is required to produce "… a minimum sound level of 96 dBA and a maximum sound level of 110 dBA at 100 feet forward of the locomotive in its direction of travel." The locomotive horn can be blown not more than 25 seconds before the locomotive enters a grade crossing.

With respect to horn use from proposed SCRRA/Metrolink trains, the following is assumed:

- The SCRRA/Metrolink locomotives and cab cars would have roof-mounted air horns
- Based on FTA guidance, the SCRRA/Metrolink horns would be set to an Lmax of 96 dBA. Using Table 6-3 in the FTA Guidance Manual, this translates into a Sound Equivalent Level (SEL – or the cumulative noise exposure from a single noise event) of approximately 99dBA at a reference distance of 50 feet.
- The SEL is assumed to be independent of train speed.

- As much of the proposed rail alignment is near pavement and hard dirt, the ground factor (G) is conservatively assumed to be zero.
- The horn is sounded continuously starting at 1/4 mile prior to a crossing and ending as the train reaches the crossing,

SCRRA/Metrolink - Locomotive Engine Noise / Railcar Noise

Locomotive noise sources include the engine, exhaust, and cooling fans. For the proposed project, SCRRA/Metrolink trains would utilize one locomotive and six railcars. The reference locomotive SEL used in the analysis is 92dBA and was obtained from Table 6-3 of the FTA Guidance Manual.

The noise level from railcars is generally due to the wheel/rail interaction. These levels typically increase with increasing speed of the train. Although noise emissions from this source are significantly less than that of the locomotive horn and engine noise, it was conservatively included in the analysis. The railcar reference SEL used in the analysis was 82dBA and was also obtained from Table 6-3 of the FTA Guidance Manual.

Grade Crossings Bell Noise

Grade crossing bells can be a major source of noise. The degree to which they are a major noise source is dependent upon the volume of train trips. Although the proposed PVL corridor would not include a significant number of daily train trips relative to other major commuter rail lines, their noise contribution was conservatively added to the analysis. It was assumed that the crossing bells would sound for 30 seconds at each crossing. The reference SEL used in the analysis was 109dBA and was obtained from Table 6-7 of the FTA Guidance Manual. Appendix E contains a list of grade crossing locations for the PVL project.

Wheel/Rail Noise

Wheel squeal on tight radius curves (<10 times the SCRRA/Metrolink locomotive wheel base or 900 feet) can contribute to community noise levels. ~~Table 4 lists all short radius curves along the proposed PVL alignment. As wheel squeal noise can be significant, wayside applicators will be installed as part of project implementation in all areas of the corridor with short radius curves. Wayside applicators apply a friction control material to the top of the rail and the gage face to reduce the metal to metal friction that causes wheel squeal. According to the Transit Cooperative Research Program – "Wheel/Rail Noise Control Manual" (Transportation Research Board, 1997) a report which was sponsored by the FTA, the use of a petroleum lubricant would reduce squeal while the use of a water lubricant would eliminate squeal. These steps taken to reduce wheel squeal from the commuter rail operations would also reduce the existing wheel squeal from BNSF freight trains, which do and would continue to operate along the SJBL.~~ The only location at which the construction of new PVL rail would result in a short radius curve would be the "Citrus Connection" (P-1A). The Citrus Connection curve is also the longest curve along the entire extent of the PVL alignment. This length along with the required slower train speeds along the curve would increase the wheel squeal noise exposure time. Therefore, as requested by the FTA, an analysis of wheel squeal noise was conducted at this location. The analysis of the noise contribution from wheel squeal was conservatively performed for nearby sensitive residences. A reference SEL of 136 dBA used in the wheel squeal prediction equation was obtained from the FTA Guidance Manual Table 6-7.

~~Table 4: Summary of PVL Wheel Squeal Locations~~

~~Curve Number~~	~~Description~~	~~Residential Area~~
~~P-1A~~	~~Citrus Connection~~	~~Yes~~
~~P-3B~~	~~Near East Campus Drive~~	~~Yes~~
~~P-3D~~	~~Box Springs Area~~	~~Yes~~
~~P-4A~~	~~Box Springs Area~~	~~Yes~~
~~P-4C~~	~~Box Springs Area~~	~~Yes~~
~~P-4D~~	~~Box Springs Area~~	~~Yes~~
~~P-4E~~	~~Box Springs Area~~	~~Yes~~
~~P-4F~~	~~Box Springs Area~~	~~Yes~~
~~P-4G~~	~~Near Watkins Drive and Pearch Road~~	~~No~~
~~P-6C~~	~~Near Intersection of I-60 and I-215~~	~~No~~
~~P-18A~~	~~Perris~~	~~Yes~~
~~Notes: Based on PVL 30% Engineering Drawings~~		

~~The only location at which the construction of new PVL rail would result in a short radius curve would be the "Citrus Connection" (P-1A). The Citrus Connection curve is also the longest curve along the entire extent of the PVL alignment. This length along with the required slower train speeds along the curve would increase the wheel squeal noise exposure time. Therefore, as requested by the FTA and analysis of wheel squeal noise was conducted at this location. The analysis of the noise contribution from wheel squeal was conservatively performed for nearby sensitive residences. A reference SEL of 136 dBA used in the wheel squeal prediction equation was obtained from the FTA Guidance Manual Table 6-7. The resulting analysis indicated that the wheel squeal noise component would result in impacts to residences in the area of Transit Avenue. Predicted project noise levels would surpass the FTA noise impact criteria by 1 dB. However, as mentioned above, it is important to note that as part of the PVL project, RCTC will include wayside applicators on all short radius curves. These measures would therefore successfully reduce the significance of wheel squeal noise on all segments of the PVL alignment, including the "Citrus Connection" area. As a result, with the wheel squeal noise component successfully reduced no noise impacts would result at residences along Transit Avenue.~~

Noise from Train Stations / Parking Lots and the South Perris Layover Facility

Noise from proposed train stations, parking lots and the Layover Facility were all assessed utilizing noise screening Tables 4-1 and 4-2 found in the FTA Guidance Manual. The FTA noise impact assessment spreadsheet tool was also utilized to adjust the screening parameters based on facility size and train volume. Maps of the proposed train stations, parking lots and the Layover Facility are shown with the applicable noise screening distances in Appendix C. The noise screening assessment determined these facilities would be located beyond the minimum screening distances prescribed by FTA, and that no further analysis of these sites were required.

Using the noise models described above, future train-generated noise levels were estimated and compared against the applicable FTA impact thresholds to identify potential noise impacts.

Night-Time Noise

Because night-time noise is more annoying to humans than day-time noise (e.g., a train horn heard at 3 AM is more annoying than a train horn heard at 1 PM), the FTA prediction formulas applied to the PVL project include an adjustment in the actual noise level to simulate the increased annoyance of night-time activities. Utilizing this adjustment penalty, the noise from project-related night-time activity is effectively increased to account for the increased annoyance level of residents.

Future Noise Level Estimates

As the PVL project proposes new rail operations, criteria applicable to the assessment of potential project-related noise impacts as defined by CEQA would be governed by the FTA impact criteria described later in this report. Based on these criteria, Tables 5, 6 and 7 show the results of the Detailed Noise Impact Assessment. The projected noise impacts are summarized below.

Trains

By 2012, commuter train operations would consist of twelve total train movements per day with the proposed project. These operations would include four trains leaving South Perris for Riverside (to connect to LA Union Station) in the AM, two trains from South Perris to Riverside in the PM, one train from Riverside to South Perris in the AM, and five trains from Riverside to South Perris in the PM.

Trains are assumed to operate with one diesel locomotive and six passenger cars on rail. The PVL would use welded rail throughout, reducing train-rail noise. Free flow train speeds along the study corridor would range from 25 to approximately 60 mph. FRA and CPUC rules currently require that all trains approaching roadway-rail grade crossings blow their horns for one-quarter of a mile prior to reaching the grade crossing. In addition, as trains pass grade crossings, warning devices are sounded.

Under the FTA methodology, noise impacts are projected at several Category 2 land uses (residences and buildings where people normally sleep) located along the SJBL in Riverside, north of the UCR campus. The majority of the predicted impacts would be a result of the train horns being sounded by trains scheduled to pass through areas with sensitive land uses prior to 7 AM, the demarcation between nighttime and daytime in the calculation of Ldn. Noise from grade crossing warning devices would only affect homes nearby the intersection and would be minimal in comparison to the sounding of train horns. Noise impacts are projected at a total of 83 residential locations, all of which would be located in the UCR area. Impacts at 18 of the total 83 residential locations would be characterized as severe. The FTA severe impact designation is analogous to the CEQA potentially significant impact. Tables 5 and 6 present the findings of the noise analysis and its characterization for Category 2 land uses, along the length of the SJBL.

Noise impacts are also predicted for three Category 3 buildings. In the UCR area of Riverside, these impact locations would include the school gymnasium of the Highland Elementary School, St. George's Episcopal Church and Crest Community Baptist Church. None of these impacts would be severe. No impacts on Category 3 buildings were predicted in Perris. Table 7 presents the land use Category 3 noise impact predictions.

Predicted noise impacts for both Category 2 and 3 buildings are also identified on maps in Appendix A.

Stations and Parking Lots

Noise due to the operation of a train station is primarily associated with automobile traffic entering and exiting the station drop-off and parking areas. The noise analysis considered the parking lots at each of the four proposed opening year stations. The proposed station parking lots would range from approximately 440 to 880 cars. However, all noise sensitive receptors are located beyond the FTA screening distances (as shown in Appendix C) for all proposed stations and parking lots. This is significant since screening distances are conservatively based on the lowest FTA threshold of impact as indicated in Chapter 4 of the FTA Guidance Manual. As a result, sensitive receptors located beyond this distance would not experience noise disturbance from station or parking lot operations (see section 4.2 of the FTA Guidance Manual). Noise from station emergency generators would also not result in any impact from stations as they are not considered to be a normal operating component of the project and would only be used in the event of an emergency (e.g., a power outage).

Layover Facility

Trains in the vicinity of the Layover Facility in South Perris would be traveling at low rates of speed and therefore are not expected to be significant sources of noise. In addition, the proposed Layover Facility (for overnight storage and light, routine maintenance of the trains) is located substantially further away from noise sensitive resources than the 1,000-foot FTA noise screening distance for noise sensitive land uses. Graphics depicting the Layover Facility location and the FTA noise screening distance can be found in Appendix C. As a result, noise impacts related to the Layover Facility are not expected.

Wheel Squeal

In addition to noise from train horns, locomotives and crossing bells, wheel squeal on tight radius curves (<10 times the SCRRA/Metrolink locomotive wheel base or 900 feet) can contribute to community noise levels. Table 4 lists all short radius curves along the PVL alignment. As wheel squeal noise can be significant, wayside applicators will be installed as part of project implementation in all areas of the corridor with short radius curves. Wayside applicators apply a friction control material to the top of the rail and the gage face to reduce the metal to metal friction that causes wheel squeal. According to the Transit Cooperative Research Program – "Wheel/Rail Noise Control Manual" (Transportation Research Board, 1997), a report which was sponsored by the FTA, the use of a petroleum lubricant would reduce squeal while the use of a water lubricant would eliminate squeal. These steps, which will be taken to reduce wheel squeal from the commuter rail operations, would also reduce the existing wheel squeal from BNSF freight trains, which do and would continue to operate along the SJBL.

Table 4: Summary of PVL Wheel Squeal Locations

Curve Number	Description	Residential Area
P-1A	Citrus Connection	Yes
P-3B	Near East Campus Drive	Yes
P-3D	Box Springs Area	Yes
P-4A	Box Springs Area	Yes
P-4C	Box Springs Area	Yes
P-4D	Box Springs Area	Yes
P-4E	Box Springs Area	Yes
P-4F	Box Springs Area	Yes
P-4G	Near Watkins Drive and Poarch Road	No
P-6C	Near Intersection of I-60 and I-215	No
P-18A	Perris	Yes
Source: STV Incorporated, ~~Notes: B~~based on PVL 30% Engineering Drawings		

The only location at which the construction of new PVL rail would result in a short radius curve would be the "Citrus Connection" (P-1A). The Citrus Connection curve is also the longest curve along the entire extent of the PVL alignment. This length along with the required slower train speeds along the curve would increase the wheel squeal noise exposure time. Therefore, as requested by the FTA, ~~and~~an analysis of wheel squeal noise was conducted at this location. The analysis of the noise contribution from wheel squeal was conservatively performed for nearby sensitive residences. A reference SEL of 136 dBA used in the wheel squeal prediction equation was obtained from the FTA Guidance Manual, Table 6-7. The resulting analysis indicated that the wheel squeal noise component would result in impacts to residences in the area of Transit Avenue. Predicted project noise levels would surpass the FTA noise impact criteria by 1 dB. However, as mentioned above, it is important to note that as part of the PVL project, RCTC will include wayside applicators on all short radius curves. These measures would therefore successfully reduce the significance of wheel squeal noise on all segments of the PVL alignment, including the "Citrus Connection" area. As a result, with the wheel squeal noise component successfully reduced, no noise impacts would result at residences along Transit Avenue.

Table 5: Detailed Noise Impact Assessment Category 2 Land Uses

Description[1]	Dist. To Track CL, ft	Land Use	No. Dwelling Units	Track Side[2]	Horn	Exist Ldn, dBA	Speed, mph		Predicted Ldn, dBA	Impact Threshold		Impacts			
													No. Dwelling Units		
							IB	OB		Impact	Severe	Type[3]	Impact	Severe	Mitigation[4] / Barrier Reduction
RIVERSIDE															
1st Street	210	SF	4	OB	IB	75	45	45	59.9	65..0	73.2	None			
Thornton Avenue	90	SF	17	OB	OB	76	45	45	58.6	65..0	74.0	None			
Transit Avenue	141	SF	12	IB	OB	67	30	30	56.9	62.2	67.5	None			
Citrus Street 1	62	SF	1	IB	OB	73	30	30	66.3	65.0	71.7	None	1		SI
Citrus Street 2	102	SF	2	IB	OB	73	30	30	58.4	65.0	71.7	None			
Kentwood 1	170	SF	3	IB	OB	67	60	60	54.8	62.2	67.5	None			
Kentwood 2	186	SF	2	IB	OB	67	60	60	54.9	62.2	67.5	None			
Kentwood 3	80	SF	7	IB	IB	63	60	60	63.7	59.6	65.0	Moderate	14		NB / 7dB
Kentwood 4	80	SF	6	IB	IB	63	60	60	62.1	59.6	65.0	Moderate	6		NB / 4dB
Kentwood 5	80	SF	1	IB	Both	63	60	60	65.1	59.6	65.0	Severe		1	SI
Kentwood 6	150	SF	1	IB	OB	67	60	60	62.0	62.2	67.5	None			
Kentwood 7	186	SF	2	IB	OB	67	60	60	59.3	62.2	67.5	None			
Kentwood 8	160	SF	1	IB	Both	67	60	60	62.2	62.2	67.5	Moderate	1		SI
Watkins 1	124	MF	3	OB	IB	66	60	60	60.8	61.5	66.8	None			
Watkins 2	140	MF	6	OB	IB	66	60	60	59.7	61.5	66.8	None			
Watkins 3	140	MF	7	OB	NO	66	60	60	53.9	61.5	66.8	None			
Watkins 4	140	MF	10	OB	OB	66	60	60	55.3	61.5	66.8	None			
Watkins 5	124	MF	9	OB	OB	66	60	60	56.0	61.5	66.8	None			
Watkins 6	124	MF	6	OB	IB	66	60	60	60.2	61.5	66.8	None			
Highlander 1	127	SF	8	IB	OB	59	30	30	57.4	57.2	62.9	Moderate	8		NB / 3dB
Highlander 2	127	SF	1	IB	Both	59	30	30	63.2	57.2	62.9	Severe		1	SI
Highlander 3	152	SF	1	IB	Both	59	30	30	56.7	57.2	62.9	None	1		
W. Campus View 1	127	SF	6	IB	IB	59	30	30	61.9	57.2	62.9	Moderate	6		NB / 5dB
W. Campus View 2	117	SF	7	IB	NO	59	30	30	55.4	57.2	62.9	None			
W. Campus View 3	125	SF	9	IB	OB	62	30	30	61.4	58.9	64.5	Moderate	9		NB / 6dB

Table 5: Detailed Noise Impact Assessment Category 2 Land Uses (Continued)

Description[1]	Dist. To Track CL, ft	Land Use	No. Dwelling Units	Track Side[2]	Horn	Exist Ldn, dBA	Speed, mph		Predicted Ldn, dBA	Impact Threshold		Impacts			
												No. Dwelling Units			
							IB	OB		Impact	Severe	Type[3]	Impact	Severe	Mitigation[4] / Barrier Reduction
RIVERSIDE															
W. Campus View 4	104	SF	8	IB	OB	59	30	30	60.3	57.2	62.9	Moderate	8		NB /5dB
W. Campus View 5	104	SF	6	IB	NO	59	30	30	55.9	57.2	62.9	None			
Nisbet Street 1	137	SF	6	OB	OB	62	30	30	60.9	58.9	64.5	Moderate	6		NB / 3dB
Nisbet Street 2	137	SF	5	OB	OB	62	30	30	60.8	58.9	64.5	Moderate	5		NB / 3dB
Mt. Vernon 1	110	SF	1	OB	OB	62	30	30	65.0	58.9	64.5	Severe		1	SI
Shady Grove	356	SF	11	IB	OB	62	30	30	56.8	58.9	64.5	None			
E. Campus View 1	80	SF	4	IB	IB	56	25	25	65.3	55.7	61.6	Severe		4	NB / 11dB
E. Campus View 2	65	SF	4	IB	IB	62	25	25	67.9	58.9	64.5	Severe		4	NB[5] / 10dB
E. Campus View 3	65	SF	4	IB	IB	56	25	25	66.8	55.7	61.6	Severe		7	NB[6] / 13dB
Big Springs	120	SF	4	OB	No	62	30	30	57.3	58.9	64.5	None			
Quail and Swain	140	SF	5	OB	No	62	30	30	56.7	58.9	64.5	None			
Masters Avenue	170	SF	4	OB	No	62	30	30	55.8	58.9	64.5	None			
E. Manfield Street	130	SF	3	OB	No	62	30	30	57.0	58.9	64.5	None			
Total, SJBL, Riverside													65	18	

Notes:
(1) See Appendix A for graphics showing each receptor cluster on aerial photographs.
(2) IB = inbound side of track, OB = outbound side of tracks.
(3) Represents FTA impact criteria, with respect to CEQA criteria; "impact" = "less than significant", "severe" = "potentially significant impact"
(4) NB = Noise Barrier, SI = Sound Insulation
(5) One home would require insulation at this location. See ~~m~~Mitigation Measure NV-2.~~section.~~
(6) Includes three moderately impacted second row buildings.

Source: STV Incorporated, 2009

Table 6: Detailed Noise Impact Assessment Category 2 Land Uses

Description[1]	Dist. To Track CL, ft	Land Use	No. Dwelling Units	Track Side[2]	Horn	Exist Ldn, dBA	Speed, mph		Predicted Ldn, dBA	Impact Threshold		Impacts No. Dwelling Units			
							IB	OB		Impact	Severe	Type[3]	Impact	Severe	Mitigation[4] / Barrier Reduction
PERRIS															
C Street	220	SF	19	OB	Both	70	46	46	61.8	64.4	69.5	None			
10th Street	120	SF	1	OB	Both	72	30	30	61.2	65.0	70.9	None			
State Street	80	SF	1	OB	Both	72	30	30	63.3	65.0	70.9	None			
9th Street	208	SF	3	IB	Both	66	30	30	53.7	61.5	66.8	None			
Case Road	130	MF	12	OB	IB	72	30	30	61.7	65.0	70.9	None			
Total, SJBL, Perris													0	0	

Notes:
(1) See Appendix A for graphics showing each receptor cluster on aerial photographs.
(2) IB = inbound side of track, OB = outbound side of tracks.
(3) Represents FTA impact criteria, with respect to CEQA criteria; “impact” = “less than significant”, “severe” = “potentially significant impact”
(4) NB = Noise Barrier, SI = Sound Insulation
~~(5) One home would require insulation at this location. See mitigation section.~~

Source: STV Incorporated, 2009

Table 7: Detailed Noise Impact Assessment Category 3 Land Uses

Description	Dist. To Track CL, ft	Track Side[1]	Horn	Exist Leq,[2] dBA	Speed, mph		Predict Leq,	Impact Threshold		Impact	Mitigation
					IB	OB	dBA	Impact	Severe	Type[3]	Type[4]/Barrier Reduction
St George's Episcopal Church	190	OB	IB	57	60	60	61.4	61.2	67.0	Moderate	SI
UCR Day Care	175	OB	IB	54	30	30	57.1	59.9	65.8	None	
Highland Elementary School	88	IB	IB	52	~~30~~60	~~30~~60	60.5	59.9	65.8	Moderate	NB / 3dB
Crest Community Baptist Church	163	IB	OB	52	30	30	63.3	59.1	65.1	Moderate	NB / 6dB
Mt. Vernon Day Care	180	OB	IB	52	25	25	58.7	59.1	65.1	None	
Hyatt Elementary School	370	OB	No	60	35	35	58.1	62.8	68.4	None	
Nan Sanders Elementary School	123	OB	No	64	60	60	55.6	65.2	70.6	None	
Senior Citizens Center	96	IB	OB	59	44	44	60.2	62.2	67.9	None	
St. James School	370	OB	Both	64	46	46	56.2	65.2	70.6	None	

Notes:
(1) IB = inbound side of tracks, OB = outbound side of tracks.
(2) Existing Leq is based on short-term noise measurements or daytime Leq with no freight train noise.
(3) Represents FTA impact criteria, with respect to CEQA criteria; "impact" = "less than significant", "severe" = "potentially significant impact"
(4) NB = Noise Barrier, SI = Sound Insulation

Source: STV Incorporated, 2009

Summary of Results

Utilizing FTA noise criteria, the results of the noise study indicate that both moderate and severe noise impacts would occur at several locations along the SJBL with the proposed PVL. For the 2012 operational year, moderate impacts were predicted at 83 separate Category 2 locations along the alignment. Of these 83 impact locations, 18 were predicted to be severe. The predicted noise impacts were located in the UCR area. Noise predictions at Category 3 locations revealed moderate impacts at three locations which included St. George's Episcopal Church, Crest Community Baptist Church, and Highland Elementary School.

As a result of the noise prediction analysis, an assessment of measures that would mitigate the predicted noise impacts was conducted. The resulting mitigation measures (noise barriers, sound insulation) which would eliminate predicted noise impacts at noise sensitive properties are also shown in Tables 5, 6 and 7.

D. NOISE CRITERIA

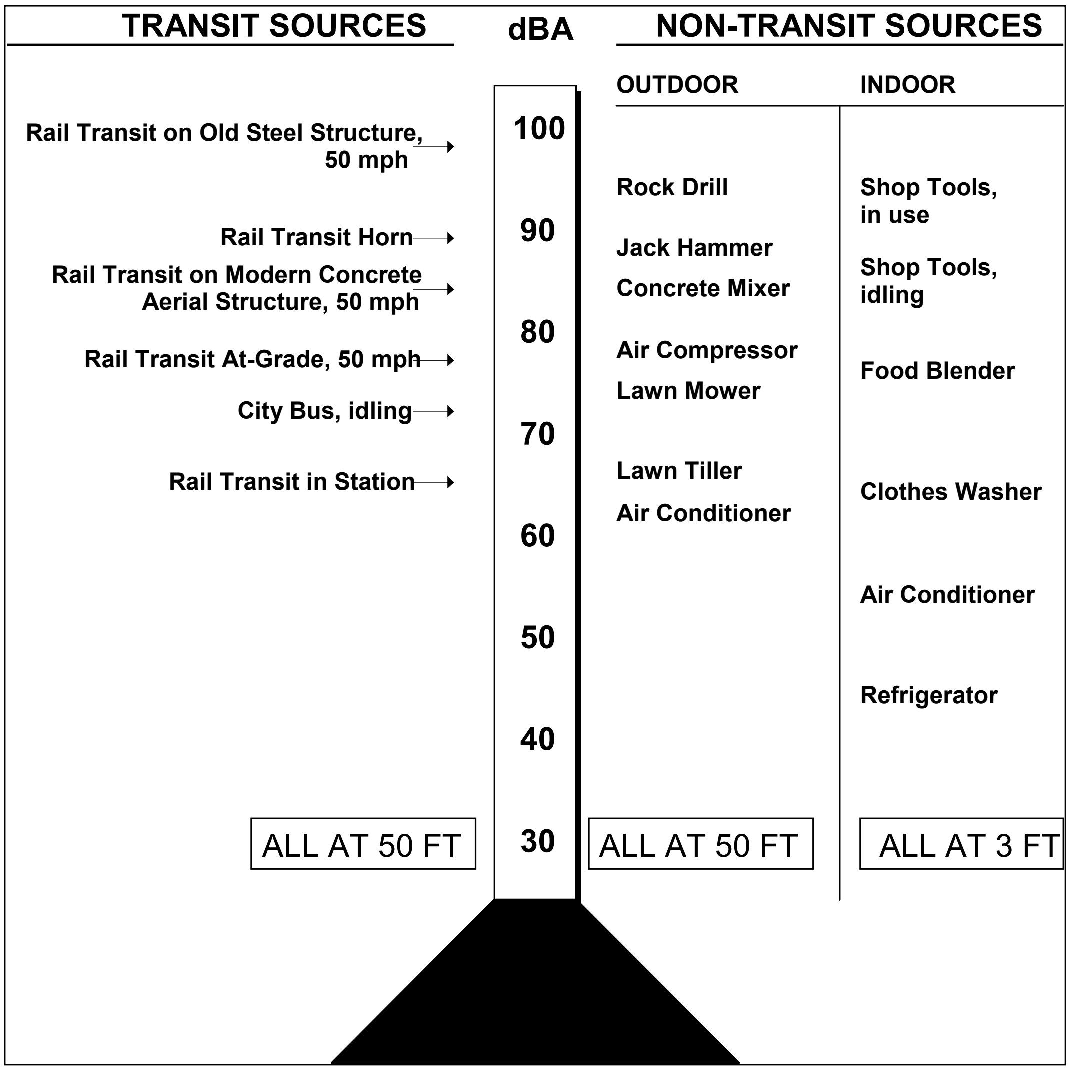
Fundamentals of Noise

Noise, otherwise known as unwanted sound, is what humans hear when exposed to small pressure fluctuations in the air (FTA, 2006). Noise is generated by a source and the magnitude of the noise depends on the type of source and its operating characteristics. When excessive noise interrupts ongoing activities, such as sleeping, conversing, and watching TV, it can create annoyance in communities, especially residential areas. Noise is measured using several descriptors:

- Decibel (dB) - The logarithmic unit used to measure sound.
- A-weighting Sound Level (dBA) –The basic noise unit that measures sound audible to humans. Noises contain sound energy at different frequencies whose range depends on the individual noise source. Human hearing does not register the sound levels of all noise frequencies equally, which reduces the impression of the magnitude of high and low pitched sounds. dBA units are sound levels measured through a process that filters noise levels to predominantly include sounds that are audible to humans. This process reduces the strength of very low and very high pitched sounds, such as low-frequency seismic disturbances and dog whistles, to more accurately measure sounds that affect humans. Normally occurring sounds lie in the range of 40 to 120 dBA. A sample of the dBA of common transit-related and other noise sources is shown on Figure 6.
- Equivalent Sound Level (Leq) – Leq represents a single value of sound level that quantifies the amount of noise in a specific environment for a particular period of time.
- Hourly Equivalent Sound Level (Leq (h)) - A value that accounts for all levels of sound that occur in a particular location for one hour. For example, as a train approaches, passes by, and recedes into the distance, the dBA will rise, reach a maximum level, and eventually fade. The Leq (h) for this event would be a value that measures the cumulative impact of each level of sound that resulted from the train's passing, in addition to any other sounds that occurred during one hour. It is particularly useful when measuring the cumulative noise impact for communities.
- Day-Night Sound Level (Ldn) - A value that accounts for all levels of sound that occur in a particular location for 24 hours. This cumulative value also includes a ten dB penalty imposed on any noise that occurs between 10 PM and 7 AM. Ldn is used to measure

the cumulative noise impact at residential areas primarily because it takes into account the increased sensitivity to noise at night, which is when most people are sleeping. Typical ranges for community noise in various settings are shown in Table 8.

Figure 6: Common Indoor and Outdoor Noise Levels



Source: Transit Noise and Vibration Impact Assessment, FTA, 2006

Table 8: Typical Range of Ldn in Populated Areas

Area	Ldn, dBA
Downtown City	75–85
"Very Noisy" Urban Residential Areas	65-75
"Quiet" Urban Residential Areas	60-65
Suburban Residential Areas	55-60
Small Town Residential Areas	45-55
L_{dn}= cumulative noise exposure	
Source: Transit Noise and Vibration Impact Assessment, FTA, 2006	

A few general relationships may be helpful in understanding the decibel scale:

- An increase of one dBA cannot be perceived by the human ear.
- A three dBA increase is normally the smallest change in sound levels that is perceptible to the human ear.
- A ten dBA increase in noise level corresponds to tenfold increase in noise energy, but a listener would only judge a ten dBA increase as being twice as loud.
- A 20 dBA increase would result in a dramatic change in how a listener would perceive the sound.

Noise Criteria

The FTA has established noise criteria to assess potential impacts that various transit projects have on noise-sensitive land uses (environments particularly sensitive to annoying noises). A graphical depiction of these noise criteria for three categories of land use defined in Table 9 is shown on Figure 7.

Table 9: Land Use Categories and Metrics for Transit Noise

Land Use Category	Noise Metric (dBA)	Description of Land Use Category
1	Outdoor Leq(h)*	Tracts of land where quiet is an essential element in their intended purpose. This category includes lands set aside for serenity and quiet, and such land uses as outdoor amphitheaters and concert pavilions, as well as National Historic Landmarks with significant outdoor use. Also included are recording studios and concert halls.
2	Outdoor Ldn	Residences and buildings where people normally sleep. This category includes homes, hospitals and hotels where a nighttime sensitivity to noise is assumed to be of utmost importance.
3	Outdoor Leq(h)*	Institutional land uses with primarily daytime and evening use. This category includes 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 can also be considered to be in this category. Certain historical sites and parks are also included.

L_{eq} for the noisiest hour of transit-related activity during hours of noise sensitivity

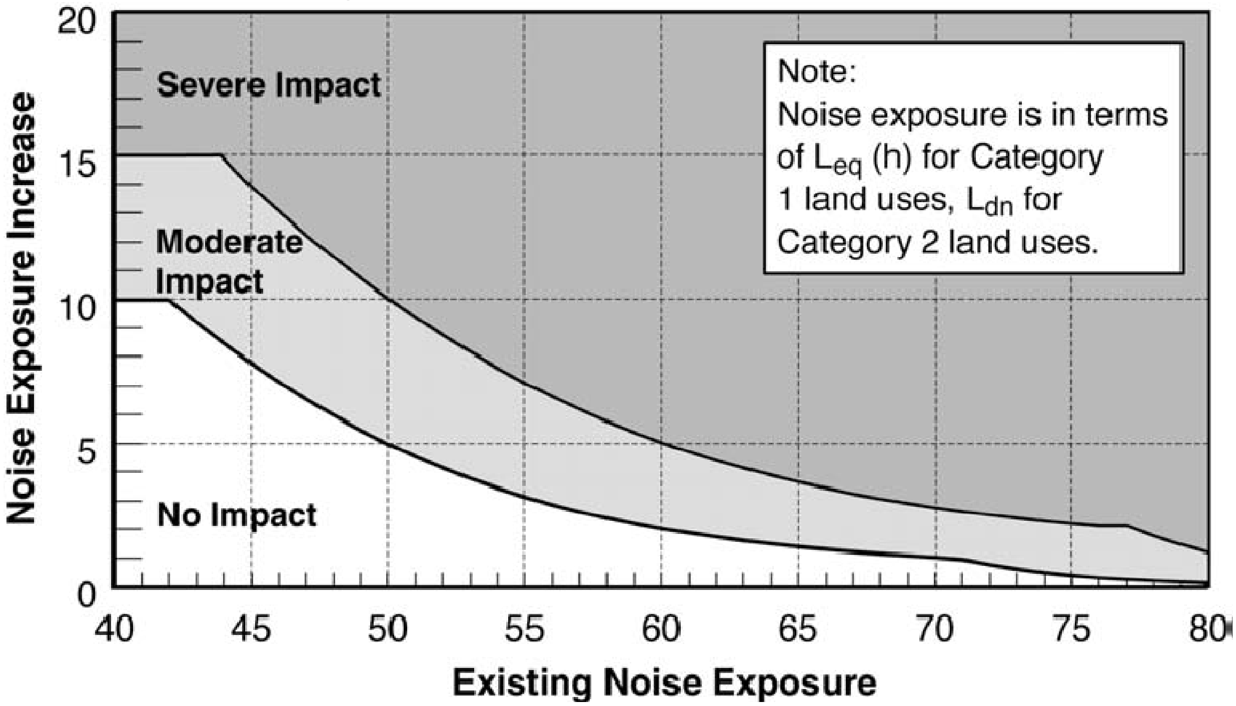
Source: *Transit Noise and Vibration Impact Assessment*, FTA, 2006

For Categories 1 and 3, the Leq noise descriptor is used, while Category 2 properties are assessed utilizing the Ldn descriptor. In most cases, these three categories are the only land uses that would be negatively impacted by high noise levels because industrial or commercial areas are generally compatible with high noise levels.

Noise impacts to these three categories as a result of a proposed project are assessed by comparing the existing and future project-related outdoor noise levels as illustrated in the graph provided on Figure 7. These potential noise impacts fall into three types: "No Impact," "Moderate Impact," and "Severe Impact". These terms correlate well with the CEQA impact terminology (i.e. no impact, less than significant impact and potentially significant impact).

- No Impact - The project, on average, will result in an insignificant increase in the number of instances where people are "highly annoyed" by new noise.
- Moderate Impact - The change in cumulative noise is noticeable to most people, but may not be sufficient to cause strong, adverse community reactions.
- Severe Impact - A significant percentage of people would be highly annoyed by the noise, perhaps resulting in vigorous community reaction

Figure 7: Allowable Transit Noise Increases



Source: *Transit Noise and Vibration Impact Assessment*, FTA, 2006

As the existing level of ambient noise increases, the allowable level of transit noise also increases, but the total amount by which that community's noise can increase without an impact, is reduced. As shown in Table 10, as existing and allowable combined total noise levels increase, the allowable change in noise level decreases.

Table 10: Examples Of Noise Impact Criteria For Transit Projects (Ldn or Leq in dBA)

Existing Noise Levels	Allowable Project Noise Level	Allowable Combined Total Noise Level	Allowable Noise Level Increase
45	51	52	7
50	53	55	5
55	55	58	3
60	57	62	2
65	60	66	1
70	64	71	1
75	65	75	0
Source: *Transit Noise and Vibration Impact Assessment*, FTA, 2006			

Table 11 shows several examples of moderate and severe noise impact criteria levels as they relate to the existing noise level.

Table 11: FTA Noise Impact Criteria

Existing Noise Exposure Leq or Ldn (1)	Project Noise Exposure Impact Thresholds, Ldn or Leq,(1) dBA			
	Category 1 or 2 Uses		Category 3 Uses	
	Moderate Impact	Severe Impact	Moderate Impact	Severe Impact
<43	Amb.+10	Amb.+15	Amb.+15	Amb.+20
43	52	59	57	64
44	52	59	57	64
45	52	59	57	64
46	52	59	57	64
47	52	59	57	64
48	53	59	58	64
49	53	59	58	64
50	53	60	58	65
51	54	60	59	65
52	54	60	59	65
53	54	60	59	65
54	55	61	60	66
55	55	61	60	66
56	56	62	61	67
57	56	62	61	67
58	57	62	62	67
59	57	63	62	68
60	58	63	63	68
61	58	64	63	69
62	59	64	64	69
63	60	65	65	70
64	60	66	65	71
65	61	66	66	71
66	61	67	66	72
67	62	67	67	72
68	63	68	68	73
69	64	69	69	74
70	64	69	69	74
71	65	70	70	75
72	65	71	70	76
73	65	72	70	77
74	65	72	70	77
75	65	73	70	78
76	65	74	70	79
77	65	75	70	80
>77	65	75	70	80

Note: (1) Ldn is used for land uses where nighttime sensitivity is a factor; maximum 1-hour Leq is used for land use involving only daytime activities.
Source: *Transit Noise and Vibration Impact Assessment*, FTA, 2006.

In addition to FTA criteria, CEQA has defined threshold limits which are related to the exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies (such as the FTA). General plans and local noise ordinances exist for municipalities along the project alignment. These statutes define maximum noise limits for community activities and local development projects. However, these ordinances are typically related to construction noise and nuisance noise levels. For the definition of CEQA impact thresholds as they relate to the proposed project, FTA impact criteria described above were used. Further discussion of general plans and local ordinances is included below in the section on Construction Period Noise Impacts.

E. NOISE IMPACT ASSESSMENT

Following is an outline of the approach used to identify potential noise impacts from the proposed PVL commuter rail extension. In general, the approach follows the Detailed Assessment guidelines outlined in the FTA Guidance Manual. The steps taken were:

1. *Identify representative noise sensitive receptors*. Sensitive land uses along the corridor were identified, first by referencing recent aerial photography. Field visits were then conducted to confirm land uses and gather additional relevant information. Sensitive receivers were then grouped together based on their location relative to the tracks, grade crossings, and other geographic and PVL operational factors that might affect noise levels. Within each grouping, a representative receptor was included in the noise model (see step 3 below). The representative locations were developed based on previous studies, additional field review and comments received during the Draft EA process.

2. *Determine existing noise levels*. Measurements of existing noise levels were taken at a number of locations along the corridor as discussed previously. A single noise measurement site was "assigned" to represent each group of receptors. Maps of these receptor groupings are shown in Appendix A. One unusual factor along this corridor is that the BNSF freight operations are the dominant noise source in some sections of the corridor and there can be significant variations in Ldn depending on the number of trains that passed during the measurement period, and how many of these trains passed during nighttime hours. Because access to several sites was prohibited, measured Leq values were in some instances adjusted to produce Ldn values using FTA procedures.

3. *Develop noise prediction models*. Equations and Tables contained in the FTA Guidance Manual were used~~Models were developed~~ to predict future noise levels from the proposed SCRRA/Metrolink PVL operations. The noise predictions were based on the forecasted number of daily trains and the distribution of these trains throughout the day (early morning, daytime, and evening), the distance from the tracks, the train speed, and other site-specific conditions such as acoustic shielding and grade crossings. Specific model inputs and assumptions are discussed above in the section on "Prediction of Noise from the Project."

4. *Estimate future noise levels at the representative receivers*. Using the models described above, future train-generated noise levels were estimated and compared against the applicable FTA impact thresholds to identify potential noise impacts. Predicted noise impacts are discussed below. Two of the key components of the predictions are the planned train schedule and the train speeds. The proposed train schedule for 2012 is shown below in Table 12. If impacts were predicted for Category 2 properties, the next closest row of properties would be assessed for impact. When impacts were predicted at Category 3 sites, no further assessment

was required since the next closest receptors were located too far away from the noise source and their lines of sitesight to the alignment would be blocked by intervening buildings. These two factors eliminated any potential impact at Category 3 locations located further from the alignment.

Noise from wheel squeal (near the tight radius curve at the proposed “Citrus Connection”) was assessed separately since the implementation of the PVL project willoperation of the PVL train corridor would include wayside applicators as part of the design plans, wayside applicators which wouldwill eliminate significantly reduce noise from wheel squeal for all tight radius curves.

5. *Identify noise mitigation*. Noise mitigation can be accomplished by several means, including the construction of noise barriers and the use of building sound insulation. Noise barriers are very effective in eliminating severe and moderate impacts to affected properties; the technique is recognized by FTA as effective, and is used by state agencies such as RCTC and Caltrans. The length of the barrier is important to its effectiveness so that noise generated beyond the ends of the barrier do not compromise the effectiveness of the barrier at noise-sensitive locations. A solid, impervious barrier that is sufficiently high to block the direct view of the noise source would typically reduce community noise levels, at locations within about 200 feet of the track, by five to 15 dBA. At locations where noise barriers are not feasible and/or cannot totally eliminate potential impacts, building sound insulation is recommended for individual residences. Building sound insulation typically involves caulking and sealing gaps in the building envelope and installation of specially designed acoustic windows and solid-core doors. Depending on the quality of the original building façade, especially windows and doors, sound insulation treatments can improve the noise reductions from transit noise by five to 20 dBA.

Table 12: Perris Valley Line - Opening Year (2012) Operations

To Los Angeles		701	703	7X1	7X3	7X5	7X7
91 Line [Perris V, Riverside, Fullerton, Downtown LA]	South Perris	3:48 AM	4:48 AM	5:48 AM	6:18 AM	2:10 PM	3:52 PM
	Downtown Perris	3:53 AM	4:53 AM	5:53 AM	6:23 AM	2:15 PM	3:57 PM
	Moreno Valley/ March Field	4:07 AM	5:07 AM	6:07 AM	6:37 AM	2:29 PM	4:11 PM
	Hunter Park	4:22 AM	5:22 AM	6:22 AM	6:52 AM	2:44 PM	4:26 PM
	Riverside - Downtown	4:30 AM	5:30 AM	6:30 AM	7:00 AM	2:52 PM	4:34 PM
	Riverside – LA Sierra	4:40 AM	5:40 AM	6:40 AM	7:10 AM	3:02 PM	4:44 PM
	North Main Corona	4:48 AM	5:48 AM	6:48 AM	7:18 AM	3:10 PM	4:52 PM
	West Corona	4:54 AM	5:54 AM	6:54 AM	7:24 AM	3:16 PM	4:58 PM
	Fullerton	5:19 AM	6:19 AM	7:19 AM	7:49 AM	3:41 PM	5:21 PM
	Buena Park	5:26 AM	6:26 AM	7:26 AM	7:56 AM	4:07 PM	5:26 PM
	Norwalk/Santa Fe Springs	5:34 AM	6:34 AM	7:34 AM	8:04 AM	4:15 PM	5:34 PM
	LA Union Station	6:00 AM	7:00 AM	8:00 AM	8:30 AM	4:39 PM	6:00 PM

To Perris Valley		700	702	704	706	708	710
91 Line [Perris V, Riverside, Fullerton, Downtown LA]	LA Union Station	6:15 AM	11:30 AM	3:30 PM	4:30 PM	5:30 PM	6:15 PM
	Norwalk/Santa Fe Springs	6:36 AM	11:51 AM	3:51 PM	4:51 PM	5:51 PM	6:36 PM
	Buena Park	6:42 AM	11:57 AM	3:57 PM	4:57 PM	5:57 PM	6:42 PM
	Fullerton	6:49 AM	12:04 PM	4:04 PM	5:04 PM	6:04 PM	6:49 PM
	West Corona	7:12 AM	12:27 PM	4:27 PM	5:27 PM	6:27 PM	7:12 PM
	North Main Corona	7:18 AM	12:33 PM	4:33 PM	5:33 PM	6:33 PM	7:18 PM
	Riverside – LA Sierra	7:27 AM	12:42 PM	4:42 PM	5:42 PM	6:42 PM	7:27 PM
	Riverside - Downtown	7:45 AM	1:00 PM	5:00 PM	6:00 PM	7:00 PM	7:45 PM
	Hunter Park	7:51 AM	1:06 PM	5:06 PM	6:06 PM	7:06 PM	7:51 PM
	Moreno Valley/ March Field	8:06 AM	1:21 PM	5:21 PM	6:21 PM	7:21 PM	8:06 PM
	Downtown Perris	8:20 AM	1:35 PM	5:35 PM	6:35 PM	7:35 PM	8:20 PM

F. NOISE MITIGATION

As shown in Table 13, the locations where noise impacts are predicted to occur and at which mitigation would be needed have been determined through the FTA Detailed Assessment methodology. Mitigation to reduce noise levels are described below, identified as Noise and Vibration (NV) Mitigation Measures NV-1 and NV-2.

- NV-1: Noise barriers shall be constructed at the following locations (based on 30% Design Drawings). A map of the proposed noise barrier locations is provided in Appendix D.
  - NB 1: 10' high and 530' long between 264+00 and 269+~~00~~30
  - NB 2: 13' high and ~~560~~570' long between Sta. 269+~~00~~30 and Sta. 275+00
  - NB 3: 9' high and 680' long between Sta. 283+00 and Sta. 289+~~00~~40
  - NB 4: 12' high and 600' long between Sta. 289+~~00~~40 and Sta. 295+~~00~~40
  - NB 5: 8' high and ~~500~~530' long between Sta. ~~298~~297+~~00~~70 and Sta. 303+00
  - NB 6: 8' high and 800' long between Sta. 303+00 and Sta. 311+00
  - NB 7: 10' high and ~~700~~800' long between Sta. 322+00 and Sta. 330+00
  - NB 8: 11' high and 320' long between Sta. 331+00 and Sta. 334+~~00~~20
  - NB 9: 13' high and ~~1,100~~950' long between Sta. ~~324~~323+~~00~~40 and Sta. ~~333~~332+~~00~~40
  - NB 10: 13' high and ~~210~~250' long between Sta. ~~333~~332+~~00~~80 and Sta. ~~335~~334+~~00~~80
  - NB 11: 9' high and ~~300~~310' long between Sta. 336+00 and Sta. 339+~~00~~10
  - NB 12: ~~11~~9' high and ~~300~~310' long between Sta. 339+~~00~~10 and Sta. 342+~~00~~20
  - NB 13: ~~10~~13' high and ~~400~~380' long between Sta. 342+~~00~~20 and Sta. 346+00

Table 13: Proposed Noise Barrier Locations to Reduce Noise Impacts at Residential and Institutional Land Uses to Less than Significant Levels

Location	Max Thresh. Exceed, dB(1)	Civil Stations*		Length, ft	Height, ft(2)	Comment
		Start	End			
San Jacinto Branch Line						
1. Watkins Drive (south of Spruce Street, east side of alignment)	4	264+00	269+~~00~~30	530	10	
2. Watkins Drive (south of Spruce Street, east side of alignment)	3	269+~~00~~30	275+00	~~560~~570	13	
3. Highland Elementary School (north of W. Blaine Street, east side of alignment)	<1	283+00	289+~~00~~40	680	9	Includes 40' of barrier segment perpendicular to track.
4. W. Blaine Street (north of Blaine Street, east side of alignment)	<1	289+~~00~~40	295+~~00~~40	600	12	
5. W. Blaine Street (south of Blaine Street, east side of alignment)	5	~~298~~297+~~00~~70	303+00	~~500~~530	8	
6. W. Blaine Street (south of Blaine Street, east side of alignment)	3	303+00	311+00	800	8	
7. Mt. Vernon Avenue (west of Mt. Vernon Avenue, north side of alignment)	3	322+00	330+00	~~700~~800	10	
8. Crest Community Baptist Church @ Mt. Vernon Avenue	4	331+00	334+~~00~~20	320	11	
9. Nisbet Way (west of Mt. Vernon Avenue, south of alignment)	2	~~324~~323+~~00~~40	~~333~~332+~~00~~40	~~1,100~~950	13	Includes 50' of barrier segment perpendicular to track.
10. Nisbet Way (west of Mt. Vernon Avenue, south of alignment)	2	~~333~~332+~~00~~80	~~335~~334+~~00~~80	~~210~~250	13	Includes 50' of barrier segment perpendicular to track.
11. East Campus View (East of Mt. Vernon Avenue, north of alignment)	9	336+00	339+~~00~~10	~~300~~310	9	For residences at elevations above the rail elevation, the noise barrier will be located along the ROW.~~should be located at top of slope. This may block views across the rail line for some residences.~~
12. East Campus View (East of Mt. Vernon Avenue, north of alignment)	11	339+~~00~~10	342+~~00~~20	~~300~~310	9	For residences at elevations above the rail elevation, the noise barrier will be located along the ROW.~~Same note as for noise barrier number 12 above.~~
13. East Campus View (East of Mt. Vernon Avenue, north of alignment)	10	342+~~00~~20	346+00	~~400~~380	13	For residences at elevations above the rail elevation, the noise barrier will be located along the ROW.~~Same note as for noise barrier number 12 above.~~

Notes: (1) Maximum amount that the predicted levels exceed the applicable noise impact threshold.
(2) Noise barrier heights are relative to top of ROW boundary elevation. ~~Exact locations of n~~Noise barriers for mitigation may be modified to account for specific field conditions and ~~change based on the~~ PVL final design features.
* Stationing is based upon the 30% engineering drawings; final stationing will be determined during final design and linked to final design drawings.

Source: STV Incorporated, ~~2009~~2010

- NV-2: Sound insulation for seven residences and St. George's Episcopal Church (eight properties total) shall be provided at the following locations:
  - o Northeast corner of the grade crossing at West Blaine Street (619 West Blaine Street)
  - o Northeast corner of the grade crossing at Mount Vernon Avenue (116 East Campus View Drive)
  - o Southwest corner of the grade crossing at Mount Vernon Avenue (first home on Mount Vernon Avenue)
  - o Northeast corner of the grade crossing at Citrus Street (1027 Citrus Street)
  - o Northeast corner of the grade crossing at Spruce Street (first two homes on Kentwood Drive)
  - o Southeast corner of the grade crossing at Spruce Street (first home on Glenhill Drive)
  - o St George's Episcopal Church

Mitigation Summary

Application of the defined mitigation measures would reduce noise levels to below the impact criteria, so that noise impacts would be less than significant when mitigation is implemented.

For the 2012 opening year, there would be no impacts within downtown Riverside. For neighborhoods along the SJBL in the UCR area, noise barriers in the range of eight to 13 feet in height, located along the property lines of the residents and PVL ROW boundaries, would reduce noise levels to less than the FTA impact criteria for all noise-sensitive locations. Noise barrier heights were calculated based on the predicted sound level in the area, local terrain and the amount by which the FTA impact thresholds were exceeded. The barriers were designed so as to reduce the level of noise that a residence is being exposed to a point where there would be no noise impact predicted with the inclusion of the barrier.

Based on the topography and known engineering constraints at seven residential locations and St George's Episcopal Church (eight properties total), the use of noise barriers will not provide adequate noise mitigation. Improving the sound insulation of these properties by replacing windows facing the tracks with new sound rated windows, as well as caulking and sealing gaps in the building envelope, eliminating operable windows and installing specially designed acoustic solid-core doors, will reduce noise to below the FTA impact criteria, and to less than significant levels. In order to be considered cost-effective, a treatment should provide a minimum of 5 dBA reduction in the interior of the building and provide an interior noise level of 65 dBA or less from transit sources. In homes where noise impact from train horns is identified, the sound insulation should provide sufficient noise reduction such that horn noise inside the building is 70 dBA or less.

During subsequent phases of engineering, the mitigation described above is subject to refinement to reflect any changes in design details. For instance, although this analysis assumes the most conservative (i.e., greatest potential impact) position for warning bells, the final location of warning bells at grade crossings is still not final; or a noise barrier in an area might need to be adjusted in height or length as more detailed calculations are done. If there are significant changes in the project design, the determination of final mitigation measure configuration and placement will be made during final design, when the complete design details that affect the noise impact analysis are known. The same type of mitigation measures, as described above, would be used such that impacts are reduced to below the FTA impact criteria and less than significant levels.

Quiet Zones

Although not recommended here as mitigation, as it is not a mitigation that RCTC has the authority to put in place, an additional option to reduce noise includes quiet zones. Since the adoption of the FRA 2005 Train Horn & Quiet Zone Final Rule, public authorities have had the option to maintain and/or establish quiet zones provided certain supplemental or alternative safety measures are in place and the crossing accident rate meets FRA standards. RCTC has previously donated $26,000 to the City of Riverside to study the potential for "quiet zones" at grade crossings in the city. The current Metrolink guidelines for local agencies that wish to establish quiet zones include early coordination with Metrolink followed by diagnostic meetings with the principal stakeholders. In this case the stakeholders would include Metrolink, RCTC, the City of Riverside, the City of Perris, BNSF and the California Public Utilities Commission.

G. CONSTRUCTION NOISE IMPACTS

The construction noise assessment ~~Site-related~~indicates that construction activities would not result in any significant noise impacts at any nearby noise-sensitive receptors. The conclusions of the construction noise assessment are based on the use of the FTA construction noise criteria and they apply to both day- and night-time construction activities. While no significant impacts would be predicted to occur, construction activities may result in ~~occasional and sporadic~~temporary, short-term increases in noise levels, not unlike ~~in noise-sensitive areas adjoining the project alignment. Many of these site related construction activities needed to implement the proposed project are~~those typical of ~~those that occur for~~common street and utility projects. Typical noise emission levels for various pieces of construction equipment are shown in Table 14. However, given the linear configuration of the construction corridor, only small area segments would likely experience construction noise at any given time. Once grade crossing improvements along with the excavation and grading of the track base are completed, specialized track equipment would move continuously along the alignment constructing the new track. The export of soils from the project site may result in increases in noise levels along roadways in the immediate project area. However, because the amount of exported soils from each location along the PVL alignment is finite, the site vehicular access would change frequently as construction moves along the alignment. Therefore, any resulting noise increases would be temporary since no single roadway segment would be affected for more than a few weeks. According to the FTA Manual, this would not constitute a long period of time for a construction-related activity and, thus, would not result in any impact. With respect to noise from the construction of the stations, only the proposed Downtown Perris Station would be located nearby noise sensitive receptors; however, station construction would only last approximately two months. Any potential increase in noise levels ~~impacts~~ would be temporary in nature and would generally only occur between about 6 AM and 7 PM, Monday through Friday. The exact hours when project construction would be allowed are restricted to the hours described in the local construction noise policies below for the individual localities. For all construction activities, standard construction noise control measures would be required to reduce the likelihood of any temporary noise increases.

As mentioned above, s~~S~~ome night-time work may also have to occur, such as track realignment. Because local ordinances~~codes~~ typically allow only day-time construction, ~~only during day-time hours, any project-related night-time construction activity~~this would require prior approval by the locality in which the night-time activity is to take place.~~the project to obtain from the municipality written consent for an exemption, or variance to these codes. With respect to noise from the construction of the stations, only the proposed Downtown Perris Station would be located nearby noise sensitive receptors. However, station construction would only last approximately two months.~~

Table 14: Typical Construction Equipment Noise Emission Levels

Equipment Item	*Noise Level at 50' (dBA)*
Air Compressor	*81*
Asphalt Spreader (paver)	*89*
Asphalt Truck	*88*
Backhoe	*85*
Compactor	*80*
Concrete Spreader	*89*
Concrete Mixer	*85*
Concrete Vibrator	*76*
Crane (derrick)	*88*
Dozer	*87*
Dump Truck	*88*
Front End Loader	*84*
Gas-Driven Vibro-compactor	*76*
Generator	*76*
Hoist	*76*
Impact Wrench (steel bolting)	*88*
Jackhammer (Paving Breaker)	*88*
Motor Crane	*83*
Pick-up Truck (light)	*72*
Pneumatic tools	*85*
Pump	*76*
Roller	*80*
Rock Drill	*98*
Scraper	*88*
Shovel	*82*
Truck (Medium and Heavy)	*88*
Vibratory Pile Driver	*96*

Source: USEPA

Although the overall length of construction for the entire PVL project would be approximately 18 months, disturbances at individual receptor locations would not last for more than several months. As mentioned above, aAny potential construction noise impacts on schools and churches would be less than significant since project construction noise levels would not surpass the FTA construction noise criteria levels; however, both sporadic and temporary increases in construction noise above local construction noise ordinances levels may occur.

Any temporary increases would be based on potential occurrences of atypical events given the inconsistent and transitory nature of some construction activities and equipment usage. Consequently, the contractor would be required use standard construction noise control measures such as ~~sporadic and temporary.~~temporary construction noise barriers, low-noise emission equipment, and the use of acoustic enclosures for particularly noisy equipment to reduce the likelihood of any increases in construction noise above the local noise ordinance maximum levels. The longest sustained construction period near sensitive receptors~~for any one construction activity~~ would likely result from station construction and, as mentioned above, would last approximately two months. However, because of the relative small scale of a typical rail station, the use of heavy construction equipment would only occur during a short segment of that two month period. For mobile construction activities, the delivery of construction materials, such as the rail, rail ties, ballast, and the specialized track equipment, would be accomplished in large part by using the existing rail as opposed to being delivered by truck. Also, staging yards would be located strategically so as to limit the travel time for construction crews. These processes would serve to limit the exposure radius of traffic related construction noise in sensitive areas. However, as brief periods of inconvenience due to construction noise could exist, the public should be informed about any potential for increased noise and, in addition, the existence of any construction plans in relation to local noise codes.

Local Policies and Regulations

The PVL project would be subject to local policies and regulations relative to construction noise and local nuisance noise levels. These statutes define maximum noise limits for existing community activities and future land development projects; however, as they do not contain explicit noise criteria governing future rail operations, they do not pertain to the assessment of these future operations. As a result, for the PVL project, local policies and regulations are applied to potential on-site project construction activities.

Riverside County Ordinance No. 847

Riverside County Ordinance No. 847 establishes countywide standards for regulating noise (Riverside County, 2007). For example, in residential land uses, the maximum dB level allowed from 7 AM to 10 PM is 55, while the maximum dB level allowed from 10 PM to 7 AM is 45. With a few exceptions, no person shall create any sound that causes the exterior sound level on any other occupied property to exceed the stated sound level standards. For construction-related activities that exceed these standards, an application for a construction-related exception must be made to the Director of Building and Safety accompanied by the appropriate filing fee.

In this ordinance, “sensitive receptors” are defined as land uses that are identified as sensitive to noise in the Noise Element of the Riverside County General Plan.

Riverside County Code, Title 15.04.020 (F)

According to the Riverside County Municipal Code, Title 15.04.020 (F), whenever a construction site is within one-quarter mile of an occupied residence or residences, no construction activities may be undertaken between the hours of 6 PM and 6 AM during the months of June through September and between the hours of 6 PM and 7 AM during the months of October through May. Exceptions are allowed only with the written consent of the building official.

Operational noise levels are regulated by the Riverside County Department of Industrial Hygiene to limit the level of noise from industrial and other stationary source operations. Worstcase scenario levels for stationary noise sources projected to the property line of an occupied residential property are to remain below 45 dBA during nighttime hours (10 PM to 7 AM) and are not to exceed 65 dBA during daytime hours (7 AM to 10 PM). Sensitive receptors, such as rest homes, schools, hospitals, mental care facilities, places of worship, and libraries, are described in the Riverside County General Plan. Noise generating uses that result in noise levels greater than 65 dBA are discouraged near these areas of increased sensitivity.

City of Riverside General Plan

The Noise Element in the City of Riverside General Plan includes policies and plans that protect existing and planned land uses from significant noise impacts and ways to minimize noise impacts. Policies N - 4.1 through N - 4.5 specifically address ground transportation-related noise impacts and noise reduction features that should be considered, including earthen berms and landscaped walls.

The Noise Element also refers to the City of Riverside Municipal Code, Title 7 for regulations regarding construction noise.

City of Riverside Municipal Code, Title 7

The City of Riverside Municipal Code, Title 7 sets forth standards and regulations that control unnecessary, excessive, and/or annoying noise in the City (City of Riverside, 2007). It is enforced by the Code Enforcement Division of the Community Development Department and the Riverside Police Department. Based on Table 15, unless a variance has been granted as provided in this chapter, it shall be unlawful for any person to cause or allow the creation of any noise which exceeds the following:

1. The exterior noise standard of the applicable land use category, up to five decibels, for a cumulative period of more than thirty minutes in any hour; or

2. The exterior noise standard of the applicable land use category, plus five decibels, for a cumulative period of more than fifteen minutes in any hour; or

3. The exterior noise standard of the applicable land use category, plus ten decibels, for a cumulative period of more than five minutes in any hour; or

4. The exterior noise standard of the applicable land use category, plus fifteen decibels, for the cumulative period of more than one minute in any hour; or

5. The exterior noise standard for the applicable land use category, plus twenty decibels or the maximum measured ambient noise level, for any period of time.

If the measured ambient noise level exceeds that permissible within any of the first four noise limit categories, the allowable noise exposure standard shall be increased in five decibel increments in each category as appropriate to encompass the ambient noise level. In the event the ambient noise level exceeds the fifth noise limit category, the maximum allowable noise level under said category shall be increased to reflect the maximum ambient noise level.

Table 15: City of Riverside - Exterior Noise Standards

Land Use Category	Time Period	Noise Level
Residential	Night (10 p.m. to 7 a.m.) Day (7 a.m. to 10 p.m.)	45 dBA 55 dBA
Office/commercial	Any time	65 dBA
Industrial	Any time	70 dBA
Community support	Any time	60 dBA
Public recreation facility	Any time	65 dBA
Non-urban	Any time	70 dBA

Source: City of Riverside

Section 7.35.010 specifically addresses construction-related activities. Construction work that exceeds the allowable noise standards in Table ~~13~~15 may not occur between the hours of 7 PM and 7 AM on weekdays, between 5 PM and 8 AM on Saturday, or at any time on Sunday or federal holidays.

City of Moreno Valley Municipal Code

According to the Moreno Valley Municipal Code, section 11.80.020 no person shall maintain, create, operate or cause to be operated on private property any source of sound in such a manner as to create any non-impulsive sound which exceeds the limits set forth for the source land use category (for daytime 60dB residential and 65dB commercial, for nighttime 55dB residential and 60dB commercial) when measured at a distance of two hundred 200 feet or more from the real property line of the source of the sound, if the sound occurs on privately owned property, or from the source of the sound, if the sound occurs on public right-of-way, public space or other publicly owned property. Any source of sound in violation of this subsection shall be deemed prima facie to be a noise disturbance.

According to the Moreno Valley Municipal Code, section 11.80.030 no person shall operate or cause the operation of any tools or equipment used in construction, drilling, repair, alteration or demolition work between the hours of 8 PM and 7 AM the following day such that the sound there from creates a noise disturbance, except for emergency work by public service utilities or for other work approved by the city manager or designee. This section shall not apply to the use of power tools. With respect to construction, any construction within the city shall only be as follows: Monday through Friday (except for holidays which occur on weekdays), 6 AM to 8PM; weekends and holidays (as observed by the city and described in Chapter 2.55 of this code), 7AM to 8PM, unless written approval is obtained from the city building official or city engineer. (Ord. 759 § 5.5, 2007; Ord. 484 § 3.2 (part), 1995).

City of Perris General Plan

The City of Perris General Plan does not discuss specific noise requirements for railroads, but it does provide goals, policies, and implementation measures that address future land use compatibility with noise from rail traffic (City of Perris, 2006). Implementation Measure III.A.1 of Policy III.A states that the City of Perris will work with BNSF and RCTC to upgrade aging rail with new continuous welded rail (CWR) and to install noise reduction features in residential areas.

City of Perris Municipal Code, Chapter 7.34

Chapter 7.34 of the City of Perris Municipal Code declares that excessive noise levels are detrimental to the health and safety of individuals and are therefore prohibited by the provisions of Ordinance 1082 codified in this chapter (City of Perris, 2000). The maximum noise level allowed during the hours of 10 PM and 7 AM is 60 dBA, and 80 dBA is allowed between 7 AM and 10 PM.

Construction noise is restricted to 80 dBA at residential property lines, and construction is restricted to the hours of 7 AM to 7 PM. Construction is prohibited on Sundays and holidays except for Columbus Day and Washington's Birthday.

Construction Noise Assessment

The construction activity that would create the most noise is pile driving associated with the San Jacinto River bridge replacement~~s~~ which is ~~near~~adjacent to the proposed~~South Perris~~ Layover Facility~~, around the San Jacinto River~~. However, as there are no noise sensitive receptors located~~ions~~ within approximately one mile of ~~nearby~~ the proposed Layover Facility and the pile driving sites,~~or near the two San Jacinto River bridges that would be replaced~~, construction-related noise impacts would not occur. In addition, pile driving would be temporary in nature, and any site specific pile driving would likely be completed in less than a week.

However, other locations along the alignment could also be potentially impacted by construction noise. To determine whether construction of the proposed PVL project would result in any noise impacts to sensitive receptors at these locations, the FTA general assessment procedure for construction noise was conducted at one selected location in Perris (228 C Street). This location was chosen because it would be representative of properties affected by typical track laying construction including activities such as culvert modifications and embankment work as well as track and road crossings construction. In addition, due to the proposed downtown Perris Station, it would also be affected by construction noise from station and parking elements, which include earthwork, utility work and landscaping among others. The FTA general assessment procedure for noise assumes the following:

- full power operation for a time period of one hour
- free-field conditions and hard surface ground conditions
- noise emission levels are taken from Table ~~12~~14
- all pieces of equipment are assumed to operate at the center of the construction site, or centerline in the case of rail projects.
- the predictions include only the two noisiest pieces of equipment expected to be used

Noise levels are predicted using the following equation for each construction piece:

Leq (equip) = E.L. + 10 Log(U.F) - 20 log(D/50) - 10log(d/50)

where,

Leq (equipment = the Leq at a receiver resulting from the operation of a single piece of equipment
E.L. = The noise emission level of a particular piece of equipment
U.F. = The usage factor that accounts for the fraction of time that a piece of equipment is in use over a specified time period

D = distance from the receiver to the piece of equipment
G = accounts for topography and ground effects

Predictions are then compared to Table 16 to determine if the levels are below the recommended FTA construction noise criteria.

Table 16: FTA Construction Noise Criteria

	One-hour Leq (dBA)	
Land Use	**Day**	**Night**
Residential	90	80
Commercial	100	100
Industrial	100	100

Source: *Transit Noise and Vibration Impact Assessment*, FTA, 2006

As a result, based on the use of the construction noise projection shown, the combined noise level for two of the noisiest pieces of construction equipment would result in a construction noise level of 79 dBA at the property line of a residential home. This would be below the FTA construction noise criteria for both day- and night-time. It would also be below the 80 dB noise level set by the Section 7.34.060 of the Perris General Plan. Therefore, although the total project construction period is estimated to last approximately 18 months, because the FTA construction noise criteria level for both day- and night-time construction would not be surpassed, noise impacts due to construction activities are not expected and would be less than significant.~~noise impacts due to construction noise are not expected.~~

III. VIBRATION ASSESSMENT

A. INVENTORY OF VIBRATION SENSITIVE SITES

Locations of Vibration Sensitive Receptors

Shown above on Figure 2 is an overview of the PVL alignment with the general locations of noise and vibration sensitive locations separated into receptor "Areas." Below is a summary of the types of sensitive land uses found in each of these receptor "Areas."

Area A: Consists primarily of commercial and industrial uses along the BNSF alignment from the Riverside Downtown Station to the Citrus Connection. One small residential neighborhood exists along the inbound side of the BNSF alignment from Down Street north to where the alignment crosses Marlborough Street.

Area B: Residential neighborhood exists along the southern portion of Transit Avenue with several houses abutting the alignment near Citrus Street.

Area C: Residential neighborhood exists north of the UCR campus between Spruce Street and Mount Vernon Avenue. The majority of the sensitive receptors are single-family residences north of the SJBL along Kentwood, Highlander, West Campus View, and East Campus View Drives. In addition there are some multi-family residences along Watkins Drive. Institutional uses include St. George's Episcopal Church at Watkins Drive and Spruce Street, Highland Elementary School, UCR Daycare Center and Crest Community Baptist Church.

Area D: Residential neighborhoods exist west of the PVL alignment and east of the UCR campus. Some of the streets in this area are Big Springs Road, Quail Road, Swain Road, and E. Manfield Street. This area also includes Hyatt Elementary School.

Area E: Predominantly low density open land with commercial and office type uses. However, the landscape of the area is dominated by I-215 which parallels the PVL alignment going into Perris. The closest residential areas to the PVL are blocked by I-215 in the area of Edgemont. The March Air Reserve Base exists in the Moreno Valley area. This section also includes some former March Air Reserve Base housing, although this housing is no longer used for residential purposes.

Area F: Residences in Perris from San Jacinto Avenue to 10th Street. The area includes residences and commercial uses both west and east of the PVL alignment in addition to Nan Sanders Elementary School to the north and St. James Church and School farther south. The last noise sensitive receptor is an apartment complex on Case Road just east of Perris Boulevard.

Area G: A small number of single- and multi-family residences exist after the alignment turns to parallel Case Road in the southern section of Perris. The terminus of the PVL would not be located near any vibration sensitive receptors.

B. MEASUREMENT OF EXISTING VIBRATION CONDITIONS

Vibration sensitive land use was identified by screening GIS data for buildings with residential or institutional uses nearby the PVL corridor. Field observations were also made to identify and confirm sensitive land use locations within the PVL corridor and the larger study area.

Vibration Environmental Setting

The proposed PVL project would be located within an existing transit corridor that currently causes GBV and GBN. The vibration environmental conditions for each segment are described below:

- The BNSF alignment is a heavily used rail corridor with 80 to 100 trains traveling along it during a typical 24-hour period. Vibration along the BNSF alignment is dominated by the existing train activity. Heavy-duty vehicle traffic also contributes to "feelable" vibration in the area.

- The SJBL alignment is an infrequently used rail corridor with about two freight trains per day. Vibration along the SJBL is dominated by the existing train activity. In addition, heavy-duty vehicle traffic along I-215 and other local roads contribute to "feelable" vibration in the area.

Subsequently, the BNSF corridor (from the existing Riverside Rail Station to Citrus Street) would be considered a heavily used rail corridor (i.e. more than 12 trains per day, as defined in the FTA guidance). In addition, based on Figure 10-1 contained in the FTA Guidance Manual, vibration from existing trains whose existing vibration levels would exceed the FTA impact criteria. Therefore, based on the expected volume for the proposed PVL relative to the existing large volume of Amtrak and freight trains, future vibration impacts would not be expected to occur at vibration-sensitive locations in the area of the BNSF corridor. With respect to the existing SJBL corridor, train volume is generally limited to two freight trips or fewer per day. Therefore, the SJBL corridor would be considered an infrequently used rail corridor (i.e., fewer than five trains per day, as defined in the FTA guidance). As a result, based on the FTA Guidance Manual, the use of the FTA general vibration curve would be an appropriate method of assessment.

Existing Vibration Levels

To assess the potential vibration impacts as a result of the PVL project, vibration measurements were conducted at 12 selected sensitive receptors in 2005 to determine existing vibration levels.

Summary of the 2005 Measurement Program

FTA's detailed vibration assessment procedure was conducted for the Draft EA analysis, which was circulated in 2006[1]. The existing vibration conditions in the proposed PVL corridor were documented in July 2005 through measurements at the locations shown on Figures 6A and 6B. Vibration measurements were performed at all sites except Sites 7, 9 and 12. There has been no major development within the PVL project area since 2005, and therefore no significant increase in traffic, and the volume and type of freight service on the BNSF and SJBL alignments

[1] ATS Consulting, 2005.

has remained relatively constant. Since the dominant source for ambient vibration levels was and still is the existing freight service on these alignments, the 2005 data is representative of 2009 ambient noise levels.

The 12 measurement sites were selected on the basis of several factors, the most important of which was the site's potential sensitivity to changes in vibration levels. Each site was either representative of a unique vibration environment, or of nearby, similarly situated receptors. Along the BNSF alignment, the primary land uses are industrial and commercial; however, vibration monitoring was conducted at two pockets of residential properties near the alignment. As the Citrus Connection and the existing SJBL alignment pass through predominately residential neighborhoods, most of the sensitive receptors monitored along these segments are residential in nature. Several non-residential land uses also exist along these segments and were included in the monitoring program; these sites include schools, churches and senior centers. Pass-by vibration measurements were taken during existing freight operations

The overall results of the measurements are summarized in Table 17. Monitoring locations are shown on Figures 4A and 4B.

Table 17: Summary of Vibration Measurements (2005)

Site No.	Description	Measure Type[1]	Dist. from Tracks (ft.)	Avg. Train Vib., VdB[2]	No. of Trains [3]
1	103 Sir Dames Dr, Riverside	LT	50	82	3
2	441 Transit Avenue, Highgrove	LT	50	72	3
3	2294 Kentwood/Spruce, Riverside	LT	50	73	8
4	518 W. Campus View, Riverside	LT	50	72	8
5	232 E. Campus View, Riverside	LT	50	70	2
6	396 E. Big Springs Rd., Riverside	LT	50	58	2
7	228 C Street, Perris	LT	50	--	2
8	81W. 8th Street, Perris	LT	50	--	0
9	Church at Spruce & Watkins, Riverside	ST	50	--	0
10	Church at Mt. Vernon Crossing, Riverside	ST	50	78	1
11	Hyatt Elementary School/E. Manfield Rd., Riverside	ST	50	68	1
12	Highland Park off Kentwood, Riverside	ST	50	--	0

Notes:
(1) LT = long term (24 hours or more), ST = short term (30 minutes to one hour).
(2) Average train vibration level when locomotives passed measurement position.
(3) Total number of trains passing measurement position during measurements.

Source: ATS Consulting (2005)

Following is an overview of the existing vibration environment in each major section of the corridor from the 2005 monitoring program:

- ***Residential areas north of UCR:*** Three long-term measurements (at Sites 3, 4 and 5) and three short-term measurements (at Sites 9, 10, and 12) were performed in this area.

The measured levels of train vibration in this area ranged from 70 to 73 VdB. As discussed below, much of the track in this area is older, jointed rail, another source of the vibration from rail operations.

- ***Residential area east of UCR:*** There was one long-term measurement (Site 6) and one short-term measurement (Site 11) in this area. Maximum train vibration levels at Site 6 averaged 58 VdB, significantly lower than the vibration levels measured in the neighborhoods north of the UCR campus. The measurements indicate that the older jointed track in the area west of the Mt. Vernon crossing is causing vibration levels to be higher than along other sections of the SJBL, where newer welded rail is installed.

- ***Perris:*** No vibration measurements were taken in this section.

C. PREDICTION OF VIBRATION FROM THE PROJECT

The FTA impact criteria for ground-borne vibration are based on the amount of vibration generated within living spaces. This means that accurate predictions of ground-borne vibration require accounting for: (1) the forces generated by the interaction of the wheels and rails, (2) the effects that the localized soil conditions have on vibration propagation, and (3) how building structures respond to ground vibration. Assuming that all quantities are given in decibels with a consistent set of decibel reference quantities, the basic relationship used to predict ground vibration is:

Lv = FDL + LSTM + BR

where:

Lv = RMS vibration velocity level of interior building elements.
FDL = Force density level, which represents the vibration forces generated by steel wheels rolling on steel rails. FDL incorporates any effects that the vehicle suspension and track system have on ground vibration.
LSTM = Line source transfer mobility, which represents how the vibration changes as it propagates from the tracks through the soil to building foundations.
BR = Building response to incident ground vibration. There is a wide variation in how building structures respond to ground vibration. General rules of thumb are: heavier, stiffer buildings tend to respond less; lightweight residential buildings tend to respond more to ground vibration than commercial or larger multi-unit residential buildings; and vibration is often amplified on the second floors of residential buildings and in mobile homes.

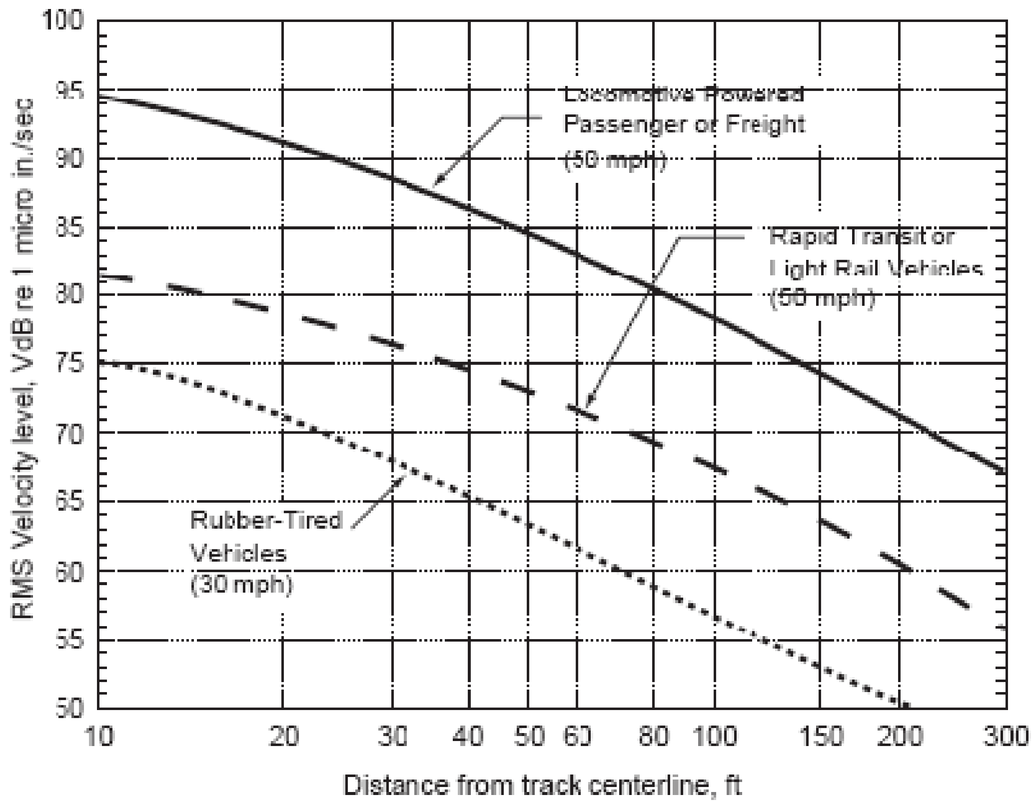
The basic approach used to develop predictions of GBV for the PVL involved applying a generalized curve given in the FTA Guidance Manual, also shown in Figure 8.

The prediction of vibration impacts are based on a single train event. Based on the results, the appropriate vibration criteria are then applied to determine potential impact. The FTA vibration criteria are based on the frequency of operation (less than 30 events per day or “infrequent events” as per the FTA Guidance Manual) along the PVL corridor. The FTA Vibration Prediction Base Curve shown in Figure 8 was used to aid in determining the predicted vibration levels.

The key elements of the vibration projection procedure used for the PVL analysis are:

1. *Distance*: In general, vibration levels tend to decrease with increasing distance between the source and the receiver. The FTA Vibration Prediction Base Curve incorporates this mathematical association. Further adjustments are then applied to the vibration level predicted from this curve.

Figure 8: FTA Vibration Prediction Base Curve



Source: *Transit Noise and Vibration Impact Assessment*, FTA, 2006

2. *Speed Adjustment*: Ground vibration tends to increase with speed at a rate proportional to 20×log (speed). This means that vibration from a 50 mph SCRRA/Metrolink train is expected to be 4.4 VdB higher than at 30 mph.

3. *Building Response Adjustment*: How vibration changes as it propagates from the ground through a building foundation and structure into living spaces will vary widely depending on the building construction. Building response adjustment factors incorporate coupling to foundation, building amplification and floor attenuation. The buildings that could be adversely affected by vibration from the PVL appear to be primarily wood frame construction. Experience demonstrates that vibration on the first floor of this type of building would be about one VdB lower than the exterior ground vibration. There can be amplification when there is a basement or crawl space under the first floor, particularly if there are fewer than the normal number of load-bearing vertical supports. The vibration on the second floors of wood frame buildings tends to be

substantially more variable than for the first floors. There is some indication from recent measurements that buildings with flexible floors tend to vibrate more. The amplification can be at specific resonances of the building and can vary from room to room.

4. *Existing Freight Traffic*: Though freight activity is present along the existing SJBL, their inclusion is not required for the FTA vibration impact assessment, as according to the FTA Guidance Manual, the number of existing daily freight train events is too few to warrant inclusion. As a result, the FTA vibration assessment for the PVL project would only be related to future Metrolink trains traveling along the SJBL.

Using the vibration model described above, future train-generated vibration levels were estimated and compared against the applicable FTA impact thresholds to identify potential vibration impacts.

Future Rail Vibration Estimates

BNSF Alignment

As previously mentioned, the BNSF alignment is a heavily used rail corridor whose existing vibration levels would exceed the FTA vibration impact criteria. Since the expected increase in train trip volume (Infrequent events) for the proposed PVL project would be insignificant in relation to the existing volume, future vibration impacts would not be expected to occur at vibration sensitive locations in the area of the BNSF alignment.

SJBL Alignment

As previously mentioned, the SJBL alignment is an infrequently used freight rail corridor. Therefore further analysis was needed to determine the potential noise impacts of the proposed PVL project.

Details of the vibration predictions are presented in Tables 18 and 19 for residential land uses in Riverside and Perris, respectively. Table 20 presents the vibration predictions for institutional land uses (schools and churches) for the entire SJBL alignment. All vibration levels have been predicted using the procedures outlined above.

Table 18: Predicted Levels of Ground-Borne Vibration, Category 2 (Residential) Land Uses RIVERSIDE, San Jacinto Branch Line

Description	Dist (Ft)	Land Use	No. Dwell Units	Track Side[1]	Speed		Impact Threshold	Predicted Vibration	Impact	No.
					IB	OB	VdB	VdB	Y/N?	
Citrus Street	62	SF	3	IB	30	30	80	78	N	
Kentwood 1	170	SF	5	IB	35	35	80	69	N	
Kentwood 2	140	SF	4	IB	60	60	80	76	N	
Kentwood 3	80	SF	14	IB	60	60	80	81	Y	14
Watkins 2	140	MF	6	OB	60	60	80	76	N	
Watkins 4	140	MF	7	OB	60	60	80	76	N	
Watkins 3	140	MF	10	OB	60	60	80	76	N	
Watkins 1	124	MF	9	OB	60	60	80	78	N	
Watkins 5	124	MF	4	OB	60	60	80	78	N	
Highlander	127	SF	10	IB	30	30	80	72	N	
W. Campus View 1	127	SF	13	IB	30	30	80	72	N	
W. Campus View 2	117	SF	13	IB	30	30	80	73	N	
W. Campus View 3	125	SF	9	IB	30	30	80	72	N	
W. Campus View 4	104	SF	5	IB	30	30	80	74	N	
Nisbet Way	137	SF	11	OB	30	30	80	71	N	
Mt. Vernon 1	110	SF	1	OB	30	30	80	73	N	
Mt. Vernon 2	180	SF	1	OB	30	30	80	68	N	
E. Campus View 1	80	SF	3	IB	25	25	80	73	N	
E. Campus View 2	65	SF	9	IB	25	25	80	75	N	
Big Springs	120	SF	4	OB	30	30	80	73	N	
Quail and Swain	140	SF	5	OB	30	30	80	70	N	
Masters Avenue	170	SF	4	OB	30	30	80	68	N	
E. Manfield Street	130	SF	3	OB	30	30	80	72	N	
Total, SJBL, Riverside										**14**

Notes: [1] IB = inbound side of tracks, OB = outbound side of tracks
Source: STV Incorporated, 2009

Table 19: Predicted Levels of Ground-Borne Vibration, Category 2 (Residential) Land Uses PERRIS, San Jacinto Branch Line

Description	Dist (Ft)	Land Use	No. Dwell Units	Track Side[1]	Speed		Impact Threshold	Predicted Vibration	Impact	No.
					IB	OB	VdB	VdB	Y/N?	
C Street	244	SF	19	OB	46	46	80	67	N	
10th Street	120	SF	1	OB	30	30	80	73	N	
State Street	80	SF	1	OB	30	30	80	75	N	
9th Street	300	SF	5	IB	30	30	80	62	N	
Case Road	130	MF	12	OB	30	30	80	72	N	
Total, SJBL, Perris										**0**

Notes: [1] IB = inbound side of tracks, OB = outbound side of tracks
Source: STV Incorporated, 2009

Table 20: Predicted Levels of Ground-Borne Vibration, Category 3 (Institutional) Land Uses

Description	Dist (Ft)	Land Use	Track Side[(1)]	Speed		Impact Threshold	Predicted Vibration	Impact
				IB	OB	VdB	VdB	Y/N?
St. George's Episcopal Church	190	Church	OB	60	60	83	74	N
UCR Day Care	175	Day Care	OB	30	30	83	69	N
Highland Elementary School	88	School	IB	60	60	83	81	N
Crest Community Baptist Church	163	Church	IB	30	30	83	69	N
Hyatt Elementary School	370	School	OB	35	35	83	63	N
Senior Citizens Center	72	Community Center	IB	44	44	83	81	N
St. James School	370	School	OB	~~60~~46	~~60~~46	83	68	N

Notes: [(1)] IB = inbound side of tracks, OB = outbound side of tracks
Source: STV Incorporated, 2009

Vibration Impacts from Stations and Layover Facility

Trains in the vicinity of stations and the Layover Facility would be traveling at low rates of speed and therefore are not expected to result in any vibration impacts at nearby sensitive receptors. In addition, automobile parking areas would be utilized by rubber-tired vehicles. Rubber-tired vehicles do not generate vibration impacts because of the nature of tire-pavement interaction with respect to vibration impacts. No impacts are expected from these areas.

Summary of Results

Utilizing FTA vibration criteria, the results of the PVL vibration study indicate that future SCRRA/Metrolink rail vibration levels generated under the 2012 operational year would be generally in ranges below the FTA vibration impact thresholds. However, vibration impacts would occur along one residential section of the PVL corridor. Affected homes are located in the UCR area just south of Spruce Street and north of Highland Elementary School along the eastern side of the PVL alignment. A total of fourteen homes extending approximately 1,200 feet along the alignment would be affected. The distances between the PVL alignment and existing homes in this section range from 80 to 90 feet.

A discussion of potential measures that would mitigate the predicted impacts is presented below. However, it should be noted that the exceedance of the vibration impact criteria in the UCR area were surpassed by only 2 dB. Based on the conservative nature of the assessment, it could be determined that actual vibration levels would be below the impact criteria.

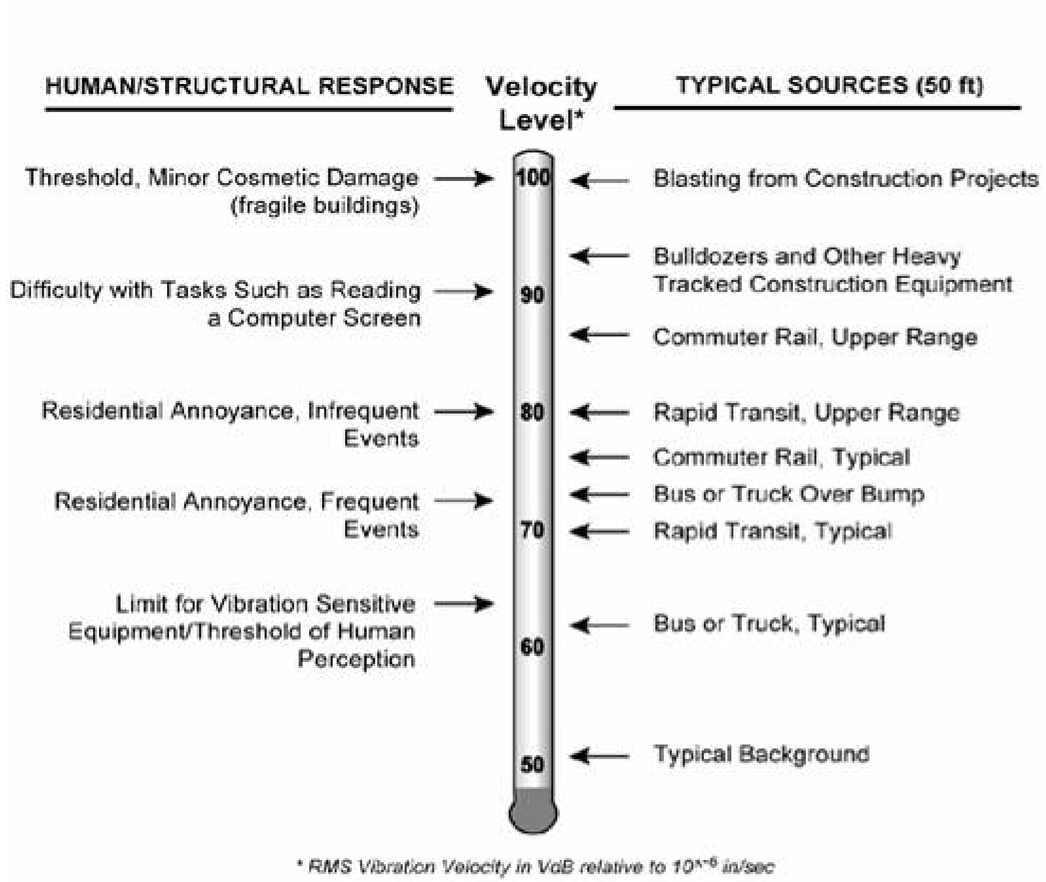
As shown in Table 17, existing freight train vibration was measured in this UCR area near Kentwood Drive and Spruce Street. The reported vibration measurement, which incorporated readings from eight train movements, indicated an average vibration level of only 73 VdB which is below the FTA infrequent events impact criteria of 80 VdB. Since freight locomotives typically create more vibration than commuter train locomotives do under similar operating conditions, it is likely that for soil conditions in the UCR area, future vibration levels would be the same or less for SCRRA/Metrolink trains. In addition, the reported freight train vibration level includes the effect of jointed track with gaps of ¼ inch to ½ inch. According to the FTA Guidance Manual, jointed track adds 5 VdB to vibration levels. As the PVL alignment would be CWR, vibration from SCRRA/Metrolink would be even less. As such, performing a site-specific detailed analysis during final design may show that mitigation measures would not be required.

D. VIBRATION CRITERIA

When evaluating human response, GBV is usually described in terms of root mean square (RMS) vibration velocity and expressed in inches per second. RMS is defined as the average of the squared amplitude of the vibration signal. However, because the range of vibration levels is quite large, decibel notation is often used to compress the range of vibration levels. To avoid confusion with sound decibels, the abbreviation VdB is used for vibration decibels. The vibration decibel level in residential areas is usually 50 VdB or lower, though humans usually begin to perceive vibration effects once the vibration level reaches 65 VdB (FTA, 2006). Beyond 80 VdB, vibration levels are often considered unacceptable by humans. GBN is measured in dBA. This report references all vibration levels expressed in decibel notation to 10^{-6} inches per second.

Figure 9 shows typical vibration levels, sources, and human responses.

Figure 9: Typical Vibration Levels



Source: *Transit Noise and Vibration Impact Assessment*, FTA, 2006

Like the noise impact criteria, the FTA vibration impact criteria are based on the three land use categories, although the categories are somewhat different. One important difference is that outdoor spaces are not included in Category 3 for vibration. This is because human annoyance from GBV requires the interaction of the ground vibration with a building structure. Consequently, the criteria apply to indoor spaces only, and there are no vibration impact thresholds for outdoor spaces such as parks.

Although there has been relatively little research into human and building response to GBV, there is substantial experience with vibration from rail systems. In general, this collective experience indicates that:

- The threshold for human perception is approximately 65 VdB. Vibration levels in the range of 70 to 75 VdB are often noticeable but acceptable. Beyond 80 VdB, vibration levels are often considered unacceptable.
- Human response to vibration is more closely related to the maximum vibration level than to the number of vibration causing events. The FTA guidelines do however have different standards for “frequent” vs. “infrequent” events.

- For human annoyance, there is a relationship between the number of daily events and the degree of annoyance caused by GBV. FTA guidance includes an eight VdB difference in the impact threshold between projects that would result in more than 70 events per day and those that would involve fewer than 30 events per day. This higher threshold is applicable to the PVL project.

Table 21 shows FTA criteria for ground-borne vibration from rail transit systems. For residential buildings (Category 2), the threshold applicable to this project is 80 VdB. The applicable threshold for schools and churches (Category 3) is 83 VdB.

Table 21: Ground-Borne Vibration (GBV) Impact Criteria for General Assessment

Land Use Category	GBV Impact Levels (VdB re: 1 micro-inch/sec)			GBN Impact Levels (dB re: 20 micro Pascals/sec)		
	Frequent Events [1]	Occasional Events [2]	Infrequent Events [3]	Frequent Events [21]	Occasional Events [32]	Infrequent Events [43]
Category 1: Buildings where vibration would interfere with interior operations	65 VdB	65 VdB	65 VdB	N/A [4]	N/A [4]	N/A [4]
Category 2: Residences and buildings where people normally sleep	72 VdB	75 VdB	80 VdB	35 dBA	38 dBA	43 dBA
Category 3: Institutional land uses with primary daytime use	75 VdB	78 VdB	83 VdB	40 dBA	43 dBA	48 dBA

1 "Frequent Events" is defined as more than 70 vibration events per day.
2 "Occasional Events" is defined as between 30 and 70 vibration events per day.
3 "Infrequent Events" is defined as fewer than 30 vibration events per day.
4 N/A means "not applicable." Vibration-sensitive equipment is not sensitive to ground-borne noise.

Source: *Transit Noise and Vibration Impact Assessment*, FTA, May 2006

These FTA vibration criteria do not specifically account for existing sources of vibration. The existing environment may currently cause a significant number of perceptible GBV or GBN events, regardless of the components of a proposed project. Because of this, the FTA established several separate criteria for existing vibration sources and the methods for addressing each, descriptions are below:

- Infrequently-used rail corridor (corridors with fewer than five trains per day). Use the general vibration criteria (Figure 8).
- Moderately-used rail corridor (corridors with five to twelve trains per day). If existing vibration exceeds the general vibration criteria and if estimated vibration levels are at least five VdB less than existing vibration, there would be no impact from the proposed project. For other situations, use the general vibration criteria.

  Heavily-used rail corridor (corridors with more than twelve trains per day). If existing vibration exceeds the general vibration criteria and if the proposed project would double the number of vibration events, the project would cause additional impact. If estimated vibration levels for the proposed project would be three VdB or less than existing vibration, there would be no impact.

E. VIBRATION IMPACT ASSESSMENT

Following is an outline of the approach used to identify potential vibration impacts from the proposed PVL commuter rail extension. The approach follows the conservative General Assessment guidelines outlined in the FTA Guidance Manual. The steps taken were:

1. *Identify representative vibration-sensitive receptors*. Sensitive land uses along the corridor were identified, first by referencing recent aerial photography. Field visits were then conducted to confirm land uses and gather additional relevant information. Sensitive receivers were then grouped together based on their location relative to the tracks and other geographic and PVL operational factors that might affect vibration levels. Within each grouping, a representative receptor was included in the vibration model (see step 3 below). The representative locations were developed based on previous studies, additional field review and comments received during the Draft EA process.

2. *Determine existing vibration levels*. Measurements of existing vibration levels were taken at a number of locations along the corridor as discussed previously. The FTA Guidance Manual does not generally account for existing vibration levels in the prediction of potential vibration impacts. Existing vibration levels were presented into the prediction model for informational purposes only. Additional vibration data from existing SCRRA/Metrolink trains in Irvine can be found in Appendix B.

3. *Develop vibration prediction models*. A vibration model was developed to predict future vibration levels from the proposed SCRRA/Metrolink PVL operations. The vibration predictions were based primarily on the forecasted number of daily trains (which based on the FTA Guidance Manual would be characterized as “infrequent events”), the distance from the tracks, the train speed and the degree to which existing freight trains are present.

4. *Identify vibration mitigation*.

F. VIBRATION MITIGATION

Vibration Mitigation - 2012

Train operations from the proposed PVL project will result in vibration impacts in the UCR area of Riverside from civil stations 263+00 to 275+00. Mitigation measures to reduce vibration to below a significant impact are listed below:. (It should be noted that either one of the two methods would be effective at mitigating the impacts to below a level of significance.

- NV-3: *Ballast Mats:* A ballast mat consists of a rubber (such as shredded rubber tires), cork or other type of resilient elastomer pad that is placed under the normal ballast, ties, and rail. The ballast mat shallgenerally must be placed on a concrete or asphalt layer to be most effective. They will not be as effective if placed directly on the soil or the sub-ballast. Ballast mats can provide 5 to 12 dB attenuation at frequencies above 25 to 30Hz. Noise measurements of SCRRA/Metrolink trains at Irvine indicate that peak vibration levels are within this frequency range (see Appendix B). As a result, this would be an effective measure to reduce project vibration impacts. Installed ballast mats cost approximately $180 per track foot.

- NV-4: *Resiliently Supported Ties (Under-Tie Pads):* This treatment consists of resilient rubber pads placed underneath concrete ties. A resiliently supported tie system, like the one used in the Channel Tunnel between England and France, consists of concrete ties supported by rubber pads. The rails are fastened directly to the concrete ties using standard rail clips. Some measurement data suggest that resiliently supported ties may reduce low-frequency vibration in the 15 to 40 Hz range, which would make them particularly appropriate for rail systems with vibration problems in the 20 to 30 Hz range. This type of treatment would cost approximately the same as ballast mats, $180 per track foot.

Based on the PVL preliminary 30% design plans, implementation by RCTC of either one of the above described vibration mitigation measures (NV-3 or NV-4) willwould need to be applied to the PVL alignment track from civil stations 263+00 to 275+00 to eliminate the two VdB impact predicted in the UCR area of Riverside (affecting a total of 14 homes extending approximately 1,200 feet along the eastern side of the PVL alignment just south of Spruce Street and north of Highland Elementary School).

Vibration impacts that exceed FTA criteria are considered to be significant and to warrant mitigation, if reasonable and feasible. As a result, the mitigation measures described above will be developed at a site-specific detailed level, taking into consideration the vibration frequency, characteristics and soil conditions. In addition, cost effectiveness criteria will be considered by RCTC to determine the need for mitigation. As per guidance from the FTA Guidance Manual, this site-specific assessment will be performed during the final design phase of the project.

G. CONSTRUCTION VIBRATION IMPACTS

2012 – Opening Year

Vibration impacts could occur during construction activities from the operation of equipment at a site. Site related construction elements would include excavation of the rail ROW, the construction of grade crossing areas, the laying of track followed by systems and passenger station construction.

Although the overall length of construction would be approximately 18 months, disturbances at individual receptor locations would not last for more than several months. Any potential construction ~~noise~~ vibration impacts on schools and churches would be less than significant; however, both sporadic and temporary increases in construction noise above local construction ordinances levels could occur. These increases would be based on potential occurrences of atypical events given the inconsistent and transitory nature of some construction activities and equipment usage. Consequently, the contractor would use standard construction vibration control measures to reduce the likelihood of these occurrences.~~sporadic and temporary.~~ The longest sustained period for any one construction activity would likely result from station construction, and, as mentioned above, would last approximately two months. However, because of the relative small scale of a typical rail station, the use of heavy construction equipment would only occur during a short segment of that two month period. The use of pile drivers would not occur for station construction.

According to the Riverside County Code, Title 15.04.020, whenever a construction site is within one-quarter of a mile of an occupied residence or residences, no construction activities shall be undertaken between the hours of 6 PM and 6 AM during the months of June through September and between the hours of 6 PM and 7 AM during the months of October through May.

According to the Moreno Valley Municipal Code, Section 11.80.030, any construction within the city shall only be as follows: Monday through Friday (except for holidays which occur on weekdays), 6 AM to 8PM; weekends and holidays (as observed by the city and described in Chapter 2.55 of this code), 7AM to 8PM, unless written approval is obtained from the city building official or city engineer. (Ord. 759 § 5.5, 2007; Ord. 484 § 3.2 (part), 1995).

According to Section 7.34.060 of the Perris General Plan, construction is restricted to the hours of 7 AM to 7 PM. Construction is prohibited on holidays.

According to the preliminary PVL Construction Staging Plan, some nighttime construction is scheduled to occur specifically for new track layout. Written consent for an exemption, or variance to these codes will be obtained from the municipality should night work become necessary.

The construction activity that would create the most vibration is pile driving associated with the bridge replacements near the South Perris Layover Facility, around the San Jacinto River. However, there are no sensitive receptor locations nearby the proposed Layover Facility. In addition, pile driving would be temporary in nature, and any site specific pile driving would likely be completed in under a week.

As a result, although the total construction period is estimated to last approximately 18 months, not all activities during that time would be significant sources of vibration which could affect vibration sensitive receptors. Therefore, because of the temporary and episodic nature of potential vibration increases, construction activities would not cause significant GBV or GBN impacts.