4.13 NOISE AND VIBRATION

4.13.1 INTRODUCTION

This section updates the noise information presented in Section 4.13 of the FEIR and as updated in Section 4.12 of the SEIR-1. The information provided in this section is based on a series of noise and vibration studies prepared between 2007 and 2010,[1,2,3] including a technical memorandum prepared by Wilson, Ihrig and Associates in 2010,[4] which addressed the potential noise and vibration impacts of the design changes evaluated in this SEIR-2. These and additional studies are listed in **Chapter 10, Bibliography**, and are available at VTA offices upon request.

Short-term noise and vibration impacts as they relate to construction are discussed in **Section 4.19, Construction**, of this SEIR-2.

4.13.2 ENVIRONMENTAL SETTING

The discussion of noise descriptors and noise impact criteria, as presented in subsection 4.13.2 of the FEIR and as updated in Section 4.12 of the SEIR-1, remains applicable to Phase 1, which is evaluated in this SEIR-2.

Information related to vibration concepts, such as groundborne noise and vibration descriptors related to transit structures and vibration impact criteria, and the existing noise conditions has been updated since certification of the SEIR-1. This section provides an updated discussion of these conditions.

4.13.2.1 Groundborne Noise and Vibration Descriptors

The SEIR-1 noted that the Federal Transit Administration (FTA) had developed additional guidance for addressing transit vibration since the FEIR. However, the elements of the updated FTA guidelines were not mentioned. This section provides an updated discussion of these guidelines pertaining to vibration.

Common sources of groundborne vibration include trains; buses traveling on rough roads; and construction activities such as blasting, pile-driving, and operation of heavy earth-moving equipment. The effects of groundborne

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[1] ATS Consulting, Noise Study Yard & Shops, 2007.

[2] Wilson, Ihrig and Associates, Inc., Central Area Guideway Groundborne Noise and Vibration Report, January 2008.

[3] Wilson, Ihrig and Associates, Inc., Northern Area Berryessa Extension Project Alignment Options Noise and Vibration Report, February 2008.

[4] Wilson, Ihrig and Associates, Inc., Memorandum, Berryessa Extension Design Changes – SEIR-2, Noise and Vibration Impacts and Mitigation, September 2010.

vibration include the movement of building floors, rattling of windows, shaking of items on shelves or hanging on walls, and rumbling sounds. The rumbling sound caused by the vibration of room surfaces is called groundborne noise.

The basic concepts of groundborne vibration and noise are illustrated for a rail system in **Figure 4.13-1**. The action of train wheels rolling on rails creates vibration energy that is transmitted through the track support system into the transit structure. The amount of energy transmitted into the transit structure depends strongly on factors such as the smoothness of the wheels and rails and the resonance frequencies of the vehicle suspension and track support systems.

The vibration of the transit structure creates vibration waves that propagate through the various soil and rock strata to the foundations of nearby buildings. The vibration propagates from the foundation throughout the building structure. The maximum vibration amplitudes of the floors and walls of a building often will be at the resonance frequencies of various components of the building.

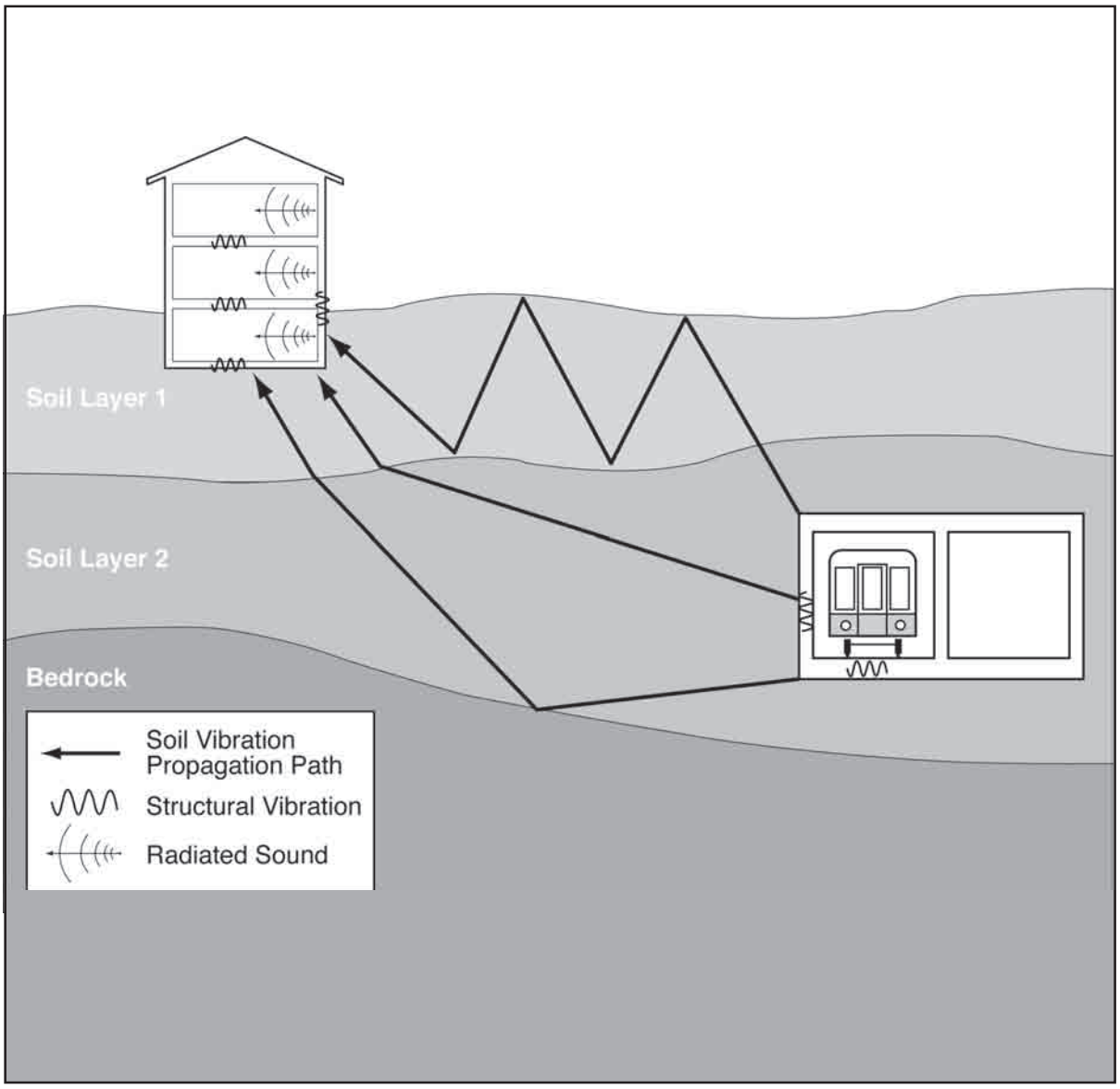
Freight trains along the railroad corridor and heavy truck traffic on nearby roadways are the primary contributors to the existing vibration environment along the alignment.

4.13.2.2 Vibration Impact Criteria

The vibration impact criteria have been updated since certification of the SEIR-1. For residential land uses, the FTA criterion for groundborne vibration is 72 VdB re 10^{-6} inches per second. For buildings that are primarily used for offices, the FTA criterion for groundborne vibration is 84 VdB re 10^{-6} inches per second. Except for special cases, such as concert halls, recording studios, theaters, etc., the FTA does not recognize commercial or industrial land uses as sensitive receptors and therefore has no vibration criteria for these land uses. There are no such special cases within the vicinity of Phase 1. The FTA also has criteria for vibration sensitive manufacturing facilities where the maximum allowed vibration levels are dependent on specific activities and equipment. No vibration sensitive manufacturing facilities were identified along the Phase 1 alignment.

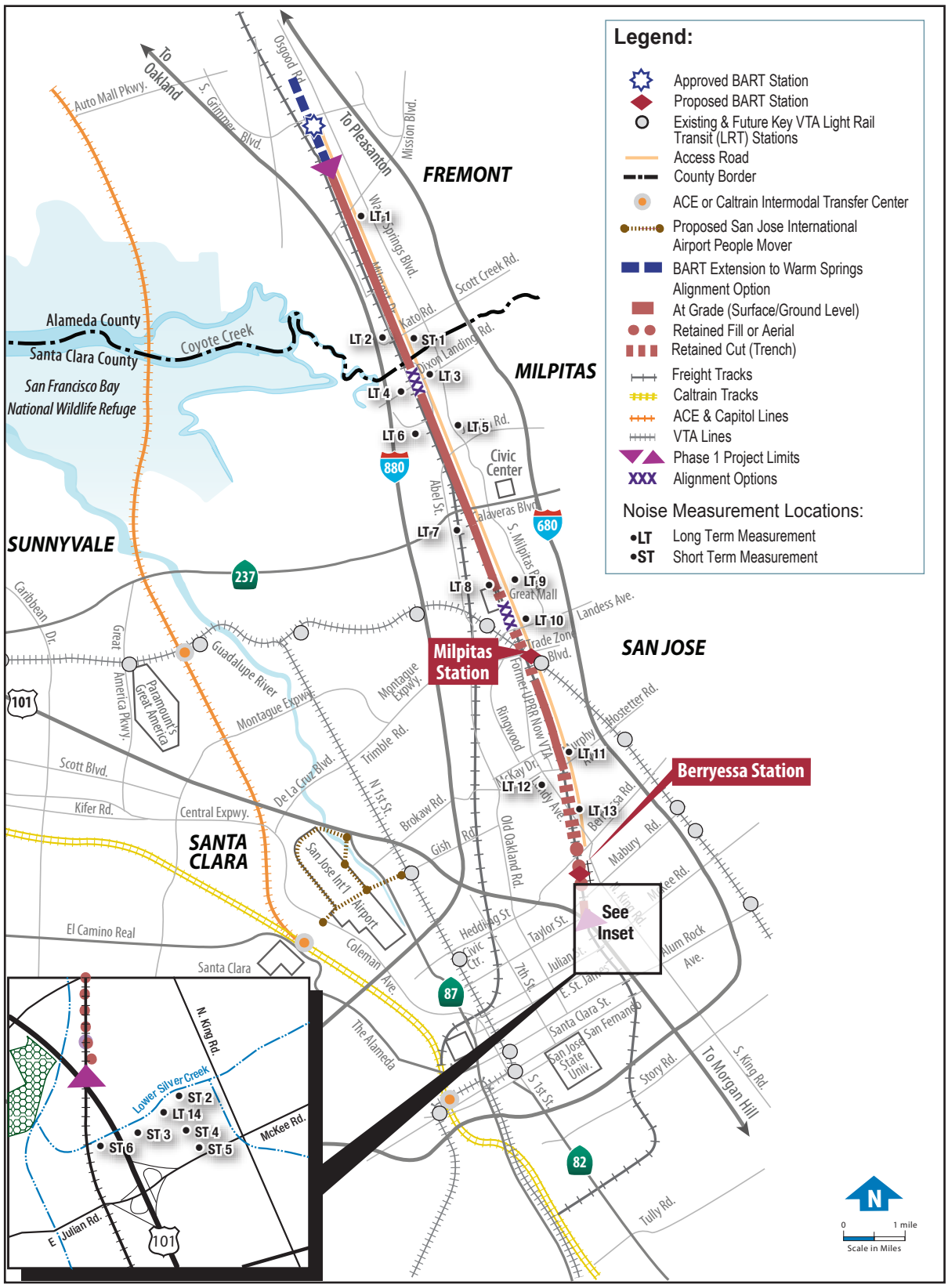
4.13.2.3 Existing Noise Conditions

Updated noise measurement results since certification of the FEIR and SEIR-1 are shown in **Table 4.13-1**. Updated noise measurements were taken in fall 2004 following certification of the FEIR; however, several of these updated noise measurements were not presented in the SEIR-1 and are therefore shown in **Table 4.13-1**. Existing noise conditions along the alignment were also updated with field measurements taken in fall 2007 following certification of the SEIR-1. The locations of these sites where ambient noise measurements were taken in fall 2007 are shown in **Figure 4.13-2** and are further described below.



Source: Wilson Ihng, 2008

Figure 4.13-1: Propagation of Groundborne Vibration into Buildings



Source: VTA, 2010.

Figure 4.13-2: Ambient Noise Measurement Locations

Table 4.13-1: Summary of Ambient Noise Measurement Results

Site No.	Measurement Location Description	Source of Ambient Noise	Start Date of Measurement	Measurement Time (hours)	Noise Exposure[a] (dBA)
LT1	47651 Westinghouse Drive	Union Pacific Railroad (UPRR) trains, distant vehicle traffic	12/08/04	24	65
LT2	Milmont Drive	UPRR trains, vehicle traffic along Milmont Drive	10/01/04	24	63
LT3	S.F. Res. at 899 Erie Circle	-	12/08/04	24	62
LT4	102 Pescadero Street	UPRR trains, vehicle traffic on Abel Street, railroad activity in UPRR Milpitas Yard	09/27/04	24	56
LT5	46 Meadowland Drive	Railroad activity in UPRR Milpitas Yard, vehicle traffic on North Milpitas Boulevard	10/01/04 and 12/15/04	24	69
LT6	580 Berryessa Street	UPRR trains, railroad activity in UPRR Milpitas Yard, vehicle traffic along Abel Street and North Milpitas Boulevard	12/09/04	24	59
LT7	Parc Metropolitan Condominium	-	09/27/04	24	60
LT8	Courtyard	UPRR trains, vehicle traffic along Montague Expressway, local activity at the Great Mall	12/15/04	24	62
LT9	The Crossing Luxury Apartments	Vehicle traffic on Capitol Avenue, UPRR trains, horn noise from railroad grade crossing, VTA light rail vehicles	09/27/04	24	67
LT10	North Star Circle	UPRR trains, vehicle traffic on Trade Zone Boulevard, and local activity	10/01/04	24	58
LT11	1435 Rue Avati	-	09/27/04	24	56
LT12	1698 Sierra Road	-	12/15/04	24	65
LT13	Heavenly Bamboo Court	-	10/01/04	24	60
LT14	North 33rd Street/Melody Lane	Vehicle traffic on US 101, aviation noise from San Jose International Airport	10/10/07	24	60

Table 4.13-1: Summary of Ambient Noise Measurement Results (continued)

Site No.	Measurement Location Description	Source of Ambient Noise	Start Date of Measurement	Measurement Time (hours)	Noise Exposure[a] (dBA)
ST1	Mobilodge RV Storage at 1515 North Milpitas Boulevard	UPRR trains, vehicle traffic on Dixon Landing Road	10/13/04	0.5	61
ST2	1603 Melody Lane	Vehicle traffic on US 101, aviation noise from San Jose International Airport	10/10/07	1	53
ST3	1505 Marburg Apartments	Vehicle traffic on US 101, aviation noise from San Jose International Airport	10/10/07	1	66
ST4	North 33rd Street	Vehicle traffic on US 101, aviation noise from San Jose International Airport	10/10/07	0.25	63
ST5	Berrywood Drive/North 33rd Street	Vehicle traffic on US 101, aviation noise from San Jose International Airport	10/11/07	0.25	51
ST6	399 East Court	Vehicle traffic on US 101, aviation noise from San Jose International Airport	10/10/07	1	76

[a] Long-term noise exposure ("LT" site numbers) is provided in terms of Ldn; short-term noise exposure ("ST" site numbers) is provided in terms of Leq.

VTA = Santa Clara Valley Transportation Authority

S.F. Res = Single-Family Residential.

Sources: ATS, 2007; Wilson, Ihrig & Associates, Inc., 2010.

The long-term measurements indicate that existing Ldn[5] ranges from 55 to 69 dBA[6] along the SVRTC, which includes the Phase 1 portion of the BART Silicon Valley alignment. These existing noise levels are considered to be generally within FTA acceptability criteria thresholds. These noise measurements were used as the basis for determining existing noise conditions at all noise-sensitive receptors along the Phase 1 alignment.

4.13.3 REGULATORY SETTING

The regulatory setting presented in the FEIR and SEIR-1, which described relevant federal and state laws and regulations related to noise, remains applicable in the SEIR-2. Please refer to subsection 4.12.3 of the SEIR-1 for this discussion.

Construction noise regulations include standards set by local jurisdictions, as discussed in **Section 4.19, Construction**.

4.13.4 PROJECT IMPACTS AND MITIGATION MEASURES

Of the 23 design changes evaluated in this SEIR-2, 11 have been identified as potentially involving noise and vibration impacts. The categories of design changes with potential operational noise and vibration impacts include:

- Milpitas Wye relocation alternatives
- Changes to station and system facility layouts
- Pump station relocations
- Traction Power Substation site relocations
- Storage tracks

The effects of the design changes that fall into these five categories have been incorporated into the following overall discussion of the Phase 1 operational noise and vibration impacts.

4.13.4.1 Modeling Assumptions

The following assumptions were updated from the FEIR and SEIR-1 and were used in the Phase 1 analysis. Please refer to subsection 4.13.2.1 in the FEIR for the full list of modeling assumptions used in this analysis.

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[5] Ldn is the Day-Night Equivalent Sound Level. This is the A-weighted Leq (the equivalent sound levels, which is a steady sound level that represents the same sound as varying sound levels over a specific time period) for a 24-hour period with a 10 dB penalty imposed on noise that occurs during nighttime hours.

[6] dBA is a unit of sound level adjusted by frequency weightings to correspond to human hearing response.

BART Vehicle Noise

Noise emissions from trains would be similar to existing data for BART trains. Thus, depending on train speed, operation on aerial structures would produce noise levels 3 to 5 dBA higher than operations on ballast and tie track.

Freight Train Noise

Noise from adjacent train movements was incorporated into the noise projections.

The noise analysis included three freight trains during the day and two freight trains at night traveling from north of the project to approximately Montague Expressway based on observations of daily movements.

Phase 1 Noise Impacts

Table 4.13-2 summarizes potentially significant noise impacts to ground-level sensitive receptors. The total number of impacted ground-level sensitive receptors affected before mitigation would vary from 80 to 82 depending on whether the Retained Cut or At Grade option at Dixon Landing Road is chosen. After mitigation, the number of noise receptors impacted would total 39 regardless of the option selected. However, none of the impacts are considered severe.

Table 4.13-3 identifies the noise impacts by station number and locations that would exceed the FTA criteria for impact prior to mitigation. As shown in **Table 4.13-3**, all ground level *Severe Impacts* from Phase 1 can be mitigated below the FTA *Severe Impact* threshold. **Table 4.13-4** provides similar information for *Moderate Impacts* and the recommended mitigation to reduce the levels of those impacts.

The discussion of noise impacts relative to electrical facilities, emergency power generators, and traffic noise in the FEIR and SEIR-1 remains applicable to this SEIR-2. The following sections provide updates to the noise impacts associated with the station sites, traction power substations, and Phase 1 alignment.

Station Noise Impacts

The evaluation of station noise impacts regarding the Milpitas Station (formerly the Montague/Capitol Station) in subsection 4.12.4.3 of the SEIR-1 remains applicable to this SEIR-2. No new noise impacts would occur as a result of the design changes relative to the Milpitas Station.

Table 4.13-2: Phase 1 Summary of Noise Impacts to Ground-Floor Residential Units Before and After Mitigation

Alignment Features	No. of *Severe Impacts* to Sensitive Receptors Before Mitigation	No. of *Moderate Impacts*[(a)] to Sensitive Receptors Before Mitigation	No. of *Severe Impacts* to Sensitive Receptors After Mitigation	No. of *Moderate Impacts*[(a)] to Sensitive Receptors After Mitigation
Total Phase 1 Alignment Excluding Options	66	130	0	39
At Grade Option at Dixon Landing	16	0	0	0
Retained Cut Option at Dixon Landing	14	0	0	0
Total	**80 to 82 depending on option**	**130**	**0**	**39**

[(a)] Where the projected increase in noise level due to the project is greater than 5 dBA**.**

Source: Wilson, Ihrig & Associates, Inc., 2008a

The Berryessa Station area has existing noise-sensitive residential uses to the east and commercial uses to the west. Background residential area noise levels were measured at 58 Ldn. BART train operations are projected to increase noise levels by 4.8 dBA for ground-level residences (*Moderate Impact*) and by 6.5 dBA for the second-story and above (*Severe Impact*). Noise from moving buses and bus idling was also modeled; residences near the busbays would be exposed to *Severe Impacts* as a result of bus only operations.

The Berryessa Station includes an 8-foot high community wall along residential areas to the east. This community wall would reduce *Severe Impacts* to a Moderate or less impact, except for the portion between Berryessa Road and the residential area to the north of Salamoni Court. The 8-foot high noise barrier continues northward along the future facility surface parking lot and access road to Berryessa Road to reduce this noise impact to less than severe.

With this community wall, the second-story residences along Salamoni Court and on the eastern boundary to Mabury Road may still be impacted depending on the noise insulation reduction capability of existing residential construction. The need for additional noise insulation of these residences would need to be determined on a residence by residence basis.

Table 4.13-3: Phase 1 Projected *Severe Impacts*

Option	Civil Station	Receiver Location Address (No. and Type)	Track Direction	Speed (mph)	Distance From Near Track	Track Type	Existing Ambient Ldn	Noise Levels Without Mitigation (Total Ldn)	Mitigation Number	Noise Levels With Mitigation (Total Ldn)	Noise Level Increase with Mitigation	Impact Type after Mitigation
N/A	170+00 to 172+40	Castilleja Subdivision (4 single-family)	NB	67 XO	58	FST	61	67	1	62	1.0	NI
At Grade Option at Dixon Landing	180+60 to 182+00	Park Homes at Mayfield Warm Springs Boulevard (1 multi-family)	NB	67	132	FST	57	63	2	62	4.7	NI
At Grade Option at Dixon Landing	182+50	Spinnaker Point Apartments (1 multi-Family)	NB	67	38	FST	57	64	2	62	5.4	MI
At Grade Option at Dixon Landing	184+00	Spinnaker Point Apartments (1 multi-Family)	NB	67	75	FST	57	63	2	61	4.1	MI
At Grade Option at Dixon Landing	184+50 to 186+00	Spinnaker Point Apartments (1 multi-Family)	NB	67	95	FST	57	62	2	62	4.6	MI
At Grade Option at Dixon Landing	186+00 to 188+00	Spinnaker Point Apartments (1 multi-Family)	NB	67	95	FST	57	62	2	62	4.6	MI
At Grade Option at Dixon Landing	189+50 to 191+00	Spinnaker Point Apartments (2 multi-Family)	NB	67	42	FST	59	66	2	64	4.9	MI

Table 4.13-3: Phase 1 Projected *Severe Impacts* (continued)

Option	Civil Station	Receiver Location Address (No. and Type)	Track Direction	Speed (MPH)	Distance From Near Track	Track Type	Existing Ambient Ldn	Noise Levels Without Mitigation (Total Ldn)	Mitigation Number	Noise Levels With Mitigation (Total Ldn)	Noise Level Increase with Mitigation	Impact Type after Mitigation
Retained Cut Option at Dixon Landing	180+60 to 182+00	Park Homes at Mayfield Warm Springs Blvd (1 multi-family)	NB	67	132	FST	57	63	1	62	4.7	NI
Retained Cut Option at Dixon Landing	182+50	Spinnaker Point Apartments (1 multi-family)	NB	67	38	CT	57	65	3	63	6	MI
N/A	246+00 to 247+00	Berryessa Street (1 single-family)	SB	67	230	AG	59	65	3	63	3.9	MI
N/A	247+00 to 248+50	Berryessa Street (2 single-family)	SB	67	255	AG	59	65	3	63	3.7	MI
N/A	248+50 to 250+50	Berryessa Street (3 single-family)	SB	67	280	AG	59	65	3	63	3.6	MI
N/A	330+00 to 332+50	Parc Metropolitan Condos (1 multi-family)	SB	67	340	FST	60	68	10	62	2.4	MI
N/A	332+50 to 336+00	Parc Metropolitan Condos (4 multi-family)	SB	67	94	FST	60	73	10	63	3.2	MI
N/A	409+50 to 410+50	North Star Circle (2 single-family)	NB	67	115	CT	58	63	2	62	4.2	MI
N/A	410+50 to 411+50	North Star Circle (2 single-family)	NB	67	140	CT	58	64	2	62	4.4	MI
N/A	413+50	North Star Place (1 single-family)	NB	67	95	AG	58	65	2	64	5.7	MI
N/A	417+00	Country Brook's Apartments, Canal Way (1 multi-family)	NB	67	150	AG	58	69	2	63	4.9	MI
N/A	424+00	1897 Flickinger Avenue (1 single-family)	NB	67	55	AG	56	63	2	60	4.2	MI

Table 4.13-3: Phase 1 Projected *Severe Impacts* (continued)

Option	Civil Station	Receiver Location Address (No. and Type)	Track Direction	Speed (MPH)	Distance From Near Track	Track Type	Existing Ambient Ldn	Noise Levels Without Mitigation (Total Ldn)	Mitigation Number	Noise Levels With Mitigation (Total Ldn)	Noise Level Increase with Mitigation	Impact Type after Mitigation
N/A	424+50	1891 Flickinger Avenue (1 single-family)	NB	67	57	AG	56	63	2	60	4.2	MI
N/A	424+50 to 426+50	Flickinger Avenue (3 single-family)	NB	67	53	AG	56	65	2	61	4.9	MI
N/A	427+00	1861 Flickinger Avenue (1 single-family)	NB	67	67	AG	56	65	2	60	4.2	MI
N/A	427+50	Flickinger Avenue (1 single-family)	NB	67	65	AG	56	65	2	60	4.2	MI
N/A	427+50 to 437+50	Flickinger Avenue (18 single-family)	NB	67	50	AG	56	65	2	60	4.3	MI
N/A	438+50 to 439+50	Flickinger Avenue (2 single-family)	NB	67	65	AG	56	65	2	60	4.5	MI
N/A	440+50	Silvertree Drive (1 single-family)	NB	67	177	AG	57	62	4	62	4.9	NI
N/A	441+00 to 449+50	Silvertree Drive (15 single-family)	NB	67	56	AG	58	63	4	62	4.2	MI
N/A	449+50 to 450+00	Silvertree Drive (1 single-family)	NB	67	50	FST	58	66	4, 9	63	5.3	MI
N/A	450+00 to 451+50	Silvertree Drive (2 single-family)	NB	67	70	FST	58	65	4, 9	63	4.6	MI
N/A	451+50	Silvertree Drive (1 single-family)	NB	67	63	FST	58	65	4, 9	63	5.4	MI
N/A	459+50 to 461+50	Cleo Springs Court (4 single-family)	SB	67	55	FST	58	65	11	62	3.9	MI
N/A	462+00	Cleo Springs Court (1 single-family)	SB	67	85	FST	58	64	11	61	3.1	MI
N/A	464+00 to 465+00	Gordy Drive (2 single-family)	SB	67	80	FST	56	62	11	59	2.7	MI

Table 4.13-3: Phase 1 Projected *Severe Impacts* (continued)

Option	Civil Station	Receiver Location Address (No. and Type)	Track Direction	Speed (MPH)	Distance From Near Track	Track Type	Existing Ambient Ldn	Noise Levels Without Mitigation (Total Ldn)	Mitigation Number	Noise Levels With Mitigation (Total Ldn)	Noise Level Increase with Mitigation	Impact Type after Mitigation
N/A	471+00 to 472+00	Gordy Drive (5 single-family)	SB	67	48	FST	56	62	11	59	3.1	MI
N/A	473+00	Gordy Drive (1 single-family)	SB	67	32	FST	56	63	11	60	3.6	MI
N/A	466+00	Drumhead Court (1 single-family)	NB	67	55	FST	56	63	11	59	3.5	MI
N/A	471+50 to 478+00	Rue Avati (11 single-family)	NB	67	43	FST	56	62	11	59	3.1	MI
N/A	478+00 to 480+00	Rue Avati (3 single-family)	NB	67	75	FST	56	62	11	59	3.1	MI
N/A	476+50 to 478+50	Tersini Court (4 single-family)	SB	67	44	FST	56	62	11	59	3.5	MI
N/A	480+00	Prelude Drive (1 single-family)	SB	67	55	FST	56	61	11	58	2.4	MI
N/A	480+50 to 484+00	Prelude Drive (7 single-family)	SB	67	37	FST	56	62	11	59	3.2	MI
N/A	495+50	Briar Creek (1 single-family)	SB	67	63	FST	57	62	5, 9	62	5.2	MI
N/A	496+00 to 497+00	Briar Creek (2 single-family)	SB	67	33	FST	57	66	5, 9	62	6	MI
N/A	497+30	Briar Creek (1 single-family)	SB	67	60	FST	57	64	5, 9	63	6	MI
N/A	499+50 to 500+50	Rose Briar Way (2 single-family)	NB	67	43	FST	57	67	2, 9	63	5.9	MI
N/A	500+50	Rose Briar Way (1 single-family)	NB	67	53	FST	57	66	2, 9	63	5.5	MI
N/A	500+70 to 502+00	Rose Briar Way (2 single-family)	NB	67	53	FST	57	66	2, 9	63	5.5	MI

Table 4.13-3: Phase 1 Projected *Severe Impacts* (continued)

Option	Civil Station	Receiver Location Address (No. and Type)	Track Direction	Speed (MPH)	Distance From Near Track	Track Type	Existing Ambient Ldn	Noise Levels Without Mitigation (Total Ldn)	Mitigation Number	Noise Levels With Mitigation (Total Ldn)	Noise Level Increase with Mitigation	Impact Type after Mitigation
N/A	501+90	Rose Briar Way (1 single-family)	NB	67	35	FST	57	68	2, 9	63	6.1	MI
N/A	502+30	Rose Briar Way (1 single-family)	NB	67	53	FST	57	66	2, 9	63	5.5	MI
N/A	502+50 to 506+00	Rose Briar Way (7 single-family)	NB	67	47	FST	57	66	2, 9	63	5.9	MI
N/A	503+35	Rose Briar Way (1 single-family)	NB	67	33	FST	57	68	2, 9	63	5.8	MI
N/A	498+00 to 499+30	Royal Crest Drive (2 single-family)	SB	67	37	FST	57	68	3, 9	63	6.1	MI
N/A	499+30 to 500+00	Royal Crest Drive (2 single-family)	SB	67	37	FST	57	70	3, 9	63	5.6	MI
N/A	500+00 to 501+70	Royal Crest Drive (4 single-family)	SB	67	37	FST	57	70	3, 9	63	5.6	MI
N/A	501+80	Royal Crest Drive (1 single-family)	SB	67	37	FST	57	69	3, 9	63	5.8	MI
N/A	502+20 to 502+50	Royal Crest Drive (3 single-family)	SB	67	35	FST	57	69	2, 8	63	5.8	MI
N/A	504+00	Valley Crest Drive (1 single-family)	SB	67	25	FST	57	65	3, 9	63	6.1	MI
N/A	506+00 to 507+00	Rose Briar Way (3 single-family)	NB	67	47	FST	57	66	2, 9	63	5.9	MI
N/A	507+00 to 508+00	Rose Briar Way (3 single-family)	NB	67	45	FST	57	65	2, 9	65	5.5	MI
N/A	505+50 to 507+30	Aschauer Court (5 single-family)	SB	67	43	FST	57	64	3, 9	63	5.4	MI
N/A	507+50 to 509+50	Taida Street, Berryessa Villa (3 multi-family)	NB	67	87	FST	57	73	2	63	5.5	MI

Table 4.13-3: Phase 1 Projected *Severe Impacts* (continued)

Option	Civil Station	Receiver Location Address (No. and Type)	Track Direction	Speed (MPH)	Distance From Near Track	Track Type	Existing Ambient Ldn	Noise Levels Without Mitigation (Total Ldn)	Mitigation Number	Noise Levels With Mitigation (Total Ldn)	Noise Level Increase with Mitigation	Impact Type after Mitigation
N/A	510+00 to 511+50	Taida Street, Berryessa Villa (2 multi-family)	NB	67	66	FST	57	69	2	63	5.9	MI
N/A	511+50 to 513+00	Taida Street, Berryessa Villa (2 multi-family)	NB	67	90	FST	57	67	2	63	6.1	MI
N/A	513+50 to 515+00	Winston Court, Berryessa Villa (1 Multi-family)	NB	67	42	FST	60	68	6	63	3.2	MI
N/A	516+00	Heavenly Bamboo Court, Regency Park (1 Multi-family)	NB	67	22	FST	60	63	6	62	1.7	NI
N/A	517+00	Fern Pine Court (1 Multi-family)	NB	67	20	FST	60	63	6	62	1.2	NI
N/A	518+50	Fern Pine Court (1 Multi-family)	NB	67	20	FST	60	63	6	62	1.8	NI

Key:
NB = northbound
SB = southbound
XO = cross-over switch with frog
EM = embankment ballast and tie track
AG = at grade ballast and tie track
CT = retained open cut
FST = floating slab track on embankment or at grade track
SI = Severe Impact as defined by the FTA
MI = Moderate Impact as defined by the FTA, but not necessarily greater than a 5-dBA increase
NI = No Impact as defined by the FTA

Mitigation Numbers:
1. A sound wall on the northbound side of the BART track, 13 feet from track centerline and 14 to 15 feet above top of rail would mitigate impacts to ground-level receptors. As an option, increasing the height of the developer's 10-foot wall to 14 to 15 feet would also mitigate Severe impacts.

Table 4.13-3: Phase 1 Projected *Severe Impacts* (continued)

2. At grade sound wall, north side of BART track (13 feet from track centerline).
3. At grade sound wall, south side of BART track (13 feet from track centerline).
4. Top of retaining wall on open cut, north side of BART track (10 feet from track centerline).
5. Top of retaining wall on open cut, south side of BART track (10 feet from track centerline).
6. Top of retaining wall on open cut, north side of BART track (13 feet from track centerline).
7. Bridge sound wall, south side of BART track (10 ft from track centerline).
8. Sound absorptive material.
9. UPRR at grade sound wall, south of UPRR track (16 feet from track centerline).
10. Slab track acoustical absorption.
11. At grade sound wall on the east side of the Las Plumas Yard.

Source: Wilson, Ihrig & Associates, Inc., 2010.

Table 4.13-4: Phase 1 Projected *Moderate Impacts*

Option	Civil Station	Receiver Location Address (No. and Type)	Track Direction	Speed (mph)	Distance From Near Track	Track Type	Existing Ambient Ldn	Noise Levels Without Mitigation (Total Ldn)	Noise Levels With Mitigation (Total Ldn)	Level Increase	Impact Type	Mitigation Number
N/A	172+60	Warm Springs Village (1 single-family)	NB	67 XO	96	FST	58	63	62	4.5	MI	1
N/A	231+00 to 238+00	Pescadero Street (13 single-family)	SB	67	330	AG	56	62	60	4.4	MI	2
N/A	238+50 to 243+00	Pescadero Street (8 single-family)	SB	67 XO	330	AG	56	62	60	4.4	MI	2
N/A	243+50	978 Pescadero Street (1 single-family)	SB	67 XO	330	AG	56	62	60	4.5	MI	2
N/A	244+00	970 Pescadero Street (1 single-family)	SB	67 XO	330	AG	56	62	60	4.5	MI	2
N/A	244+00 to 245+00	Coyote Street (3 single-family)	SB	67 XO	360	AG	56	61	60	4.2	MI	2
N/A	250+50 to 253+00	Berryessa Street (4 single-family)	SB	67	302	AG	59	64	62	2.9	MI	2
N/A	409+50 to 410+50	North Star Circle (2 single-family)	NB	67	115	CT	58	63	62	4.2	MI	1
N/A	410+50 to 411+00	North Star Circle (2 single-family)	NB	67	115	CT	58	63	62	4.4	MI	1
N/A	462+50 to 464+00	Gordy Drive (3 single-family)	SB	67	72	FST	56	62	59	3.3	MI	6
N/A	473+60	Gordy Dr (1 Single-family)	SB	67	55	FST	56	63	59	3.2	MI	6

Table 4.13-4: Phase 1 Projected *Moderate Impacts* (continued)

Option	Civil Station	Receiver Location Address (No. and Type)	Track Direction	Speed (mph)	Distance From Near Track	Track Type	Existing Ambient Ldn	Noise Levels Without Mitigation (Total Ldn)	Noise Levels With Mitigation (Total Ldn)	Level Increase	Impact Type	Mitigation Number
N/A	474+00	Gordy Drive (1 single-family)	SB	67	85	FST	56	61	61	4.9	MI	6
N/A	459+00 to 462+50	Prosperity Court (1 single-family)	NB	67	105	FST	58	62	61	3.0	MI	6
N/A	460+50 to 462+50	Prosperity Court (3 single-family)	NB	67	53	FST	56	63	59	3.2	MI	6
N/A	462+50 to 464+00	Prosperity Court (2 single-family)	NB	67	53	FST	56	63	60	3.6	MI	6
N/A	464+50	Prosperity Court (1 single-family)	NB	67	53	FST	56	63	60	3.6	MI	6
N/A	480+50 to 481+50	Rue Avati (2 single-family)	NB	67	106	FST	56	62	60	4.3	MI	6
N/A	476+00	Tersini Court (1 single-family)	SB	67	83	FST	56	62	60	4.3	MI	6
N/A	478+60	Tersini Court (1 single-family)	SB	67	57	FST	56	61	58	2.1	NI	6
N/A	479+00	Tersini Court (1 single-family)	SB	67	93	FST	56	60	60	4.0	MI	6
N/A	481+50 to 483+00	Rue Avati (3 single-family)	NB	67	57	FST	61	65	65	4.0	MI	6
N/A	484+00 to 485+50	Caloosa (3 single-family)	NB	67	65	FST	61	64	64	2.6	MI	6
N/A	485+50 to 487+50	Caloosa (3 single-family)	NB	67	63	FST	61	64	64	3.3	MI	6
N/A	495+50	Lundy Avenue (1 single-family)	NB	67	53	FST	57	63	62	4.9	MI	3, 5

Table 4.13-4: Phase 1 Projected *Moderate Impacts* (continued)

Option	Civil Station	Receiver Location Address (No. and Type)	Track Direction	Speed (mph)	Distance From Near Track	Track Type	Existing Ambient Ldn	Noise Levels Without Mitigation (Total Ldn)	Noise Levels With Mitigation (Total Ldn)	Level Increase	Impact Type	Mitigation Number
N/A	495+50	Briar Creek (1 single-family)	SB	67	63	FST	57	62	62	4.7	MI	4, 5
N/A	497+50 to 499+50	Rose Briar Way (4 single-family)	NB	67	40	FST	57	62	62	5.3	MI	1, 5

Key:
NB = northbound
SB = southbound
XO = cross-over switch with frog
AG = at grade ballast and tie track
CT = retained open cut
FST = floating slab track on embankment or at grade track
MI = *Moderate Impact* as defined by the FTA, but not necessarily greater than a 5-dBA increase
NI = *No Impact* as defined by the FTA
Mitigation Numbers:
1. At grade sound wall, north side of BART track (13 feet from track centerline).
2. At grade sound wall, south side of BART track (13 feet from track centerline).
3. Top of retaining wall on open cut, north side of BART track (10 feet from track centerline).
4. Top of retaining wall on open cut, south side of BART track (10 feet from track centerline).
5. Sound absorptive material.
6. Slab track acoustical absorption.
Source: Wilson, Ihrig & Associates, Inc., 2010.

Traction Power Substation Noise Impacts

Refer to the discussion below related to Design Change 18, System Facilities at Hostetter Road, for an evaluation of noise and vibration impacts associated with Traction Power Substations.

Phase 1 Alignment Impacts

Six single-family residences located on Berryessa Street and two multi-family buildings located at the Parc Metropolitan Condominium complex would be expected to experience increases in noise levels resulting in a *Severe Impact*. The area of effect due to UPRR trains and warning horns at the Dixon Landing Road crossing currently includes residences at the Spinnaker Apartments and at the Friendly Village Mobile Home Park. Eliminating warning horns from trains would limit the area of effect to within the UPRR ROW.

> **Mitigation Measure NV-1**: Sound walls shall be installed to mitigate noise levels near residences affected by Phase 1. **Table 4.13-5** indicates the location of recommended sound walls. Approximately 12,500 linear feet of sound walls would be needed, with each sound wall ranging in length from 250 to 1,730 feet. Typically, the location of a sound wall is either 10 or 13 feet from the track centerline, depending on the track profile (10 feet for the retained open cut track and the aerial guideway, and 13 feet for the at grade and embankment tracks). In areas where a sound wall is recommended on both sides of the alignment, absorptive sound walls are the recommended noise mitigation. The locations of the sound walls are depicted in **Figures 4.13-3A** through **4.13-3J**.

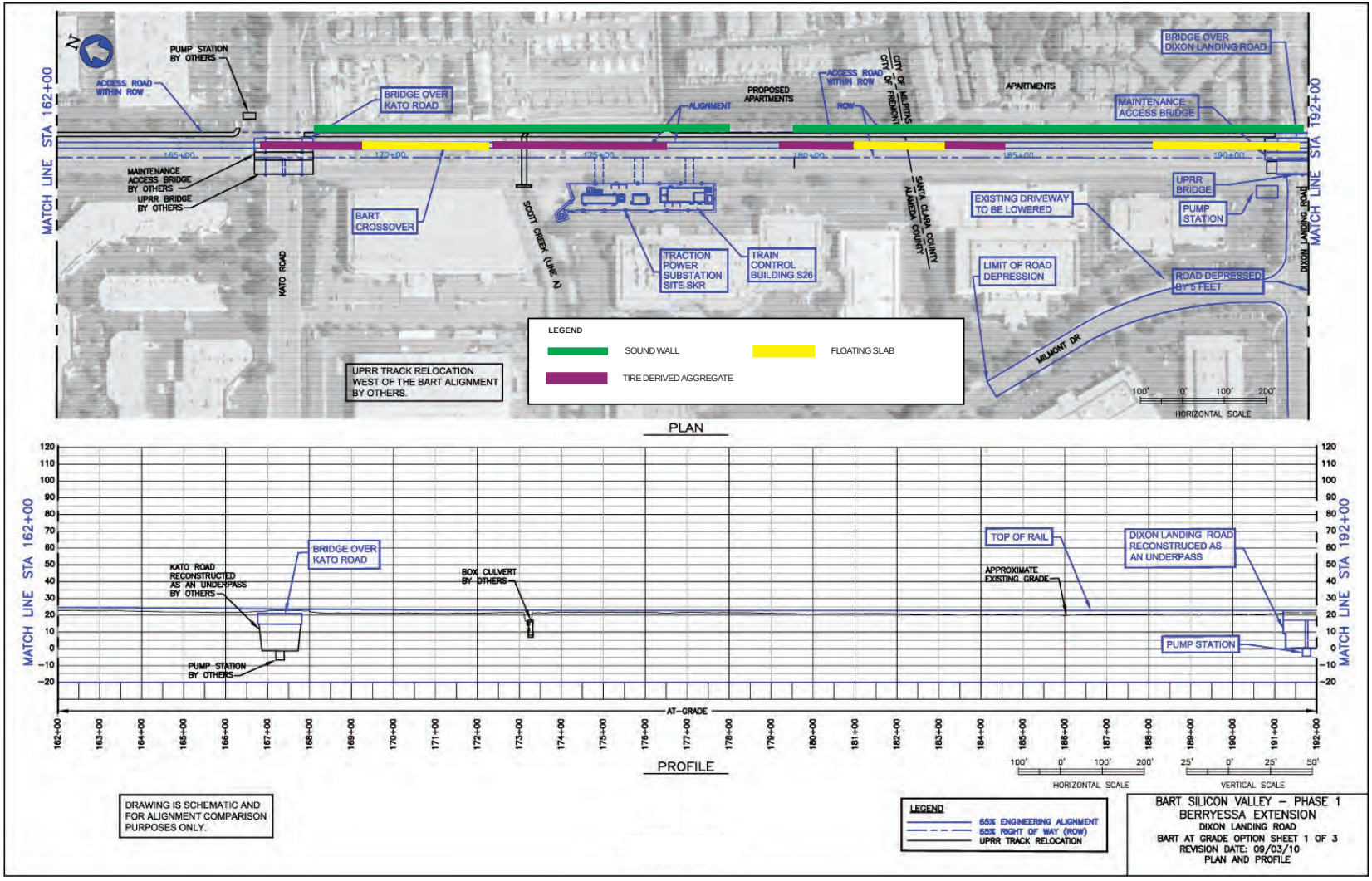
As discussed above, the Berryessa Station would include an 8-foot high community wall near the residential areas to the east, which would reduce noise impacts. The community wall would also extend northward to reduce noise impacts for residences on Salamoni Court and Mabury Road; however, the need for additional noise insulation of at the nearby residences would be determined on an individual basis.

In the area of the alignment between Hostetter Road and Sierra Road, it was determined that a sound wall would not be a practical noise mitigation measure because receptors in this area have an existing sound wall at their backyard property line. It is estimated that the receptor's sound walls would provide shielding of wayside project noise of 15 dB, which is the maximum reduction of a sound wall recognized by the FTA for a single noise barrier. As shown in **Table 4.13-4**, receptors in this area are projected to encounter a noise level increase of *Moderate Impact*. This is primarily due to the 3 dBA increase in noise levels associated with the FST. Implementation of track-level acoustical absorption would eliminate the increased noise levels.

Table 4.13-5: Noise Wall Mitigation for Phase 1 (Mitigation Measure NV-1)

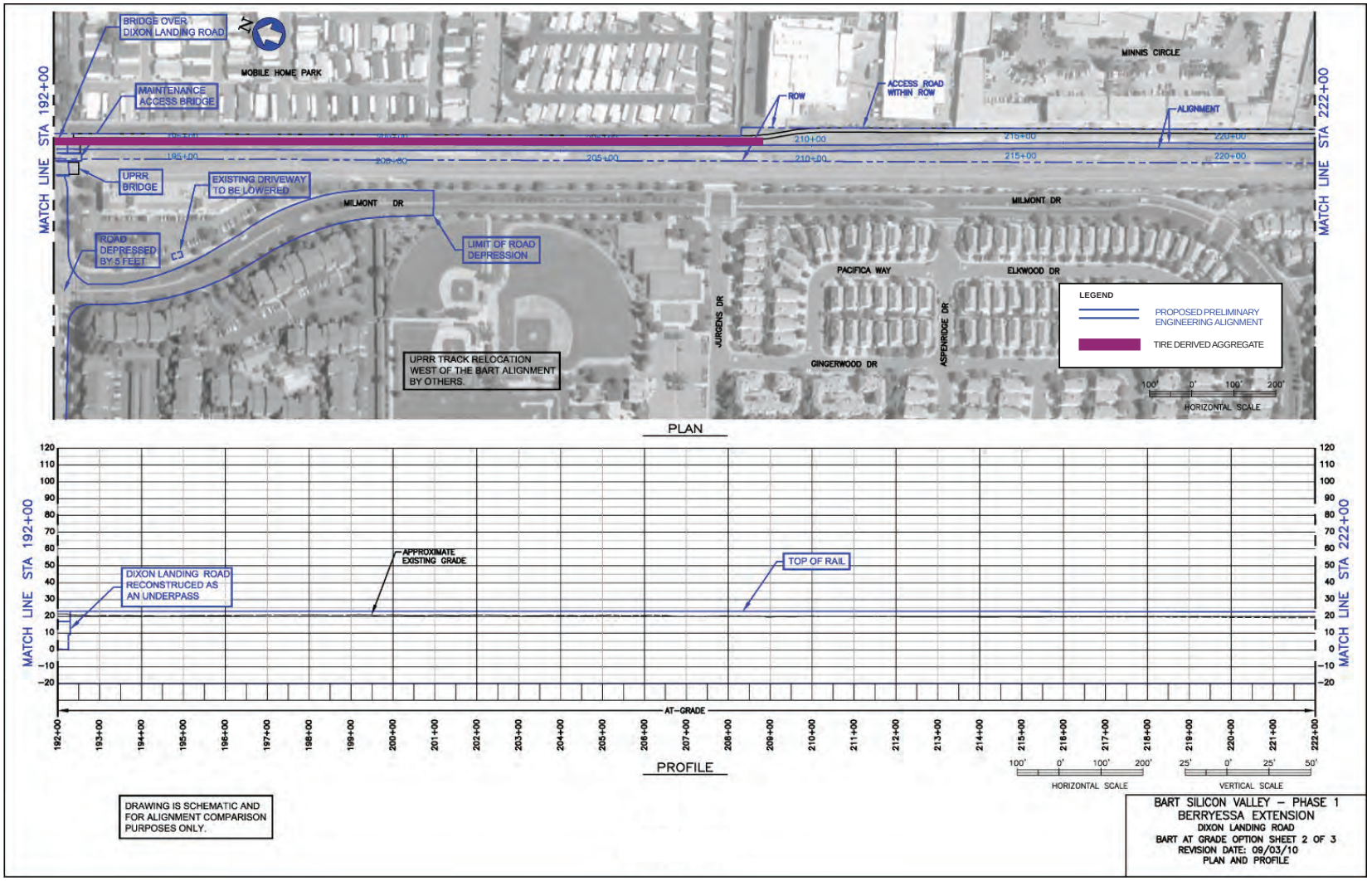
Option	Beginning Civil Station Number	Ending Civil Station Number	Side of Track	Height (feet)	Length (feet)
N/A	168+20	176+50	S2	14-15	830
At Grade Option at Dixon Landing	181+00	184+00	S2	7	300
Retained Cut Option at Dixon Landing	181+00	184+00	S2	8	300
N/A	186+00	192+20	S2	8	620
N/A	230+80	245+00	S1	4[c]	1420
N/A	246+50	254+00	S1	4	750
N/A	330+00	337+50	S1	12[a]	750
N/A	409+00	412+50	S2	7[c]	350
N/A	412+50	423+00	S2	7	1050
N/A	423+00	440+30	S2	9	1730
N/A	440+30	447+50	S2	8[c]	720
N/A	447+50	452+30	S2	10	480
N/A	457+00	461+00	S2	8[c]	Traction Power Substation east, south, and west property line
N/A	493+50	506+00	S1	10[b]	1100
N/A	497+00	506+00	S2	10[b]	900
N/A	506+00	508+50	S1	9[b]	250
N/A	506+00	508+50	S2	10[b]	250
N/A	508+50	512+00	S2	6	350
N/A	512+00	515+50	S2	4	350
N/A	515+00	521+00	S2	4	550

[a] sound wall part of UPRR relocation project
[b] absorptive sound wall
[c] sound wall to mitigate *Moderate Impacts*
S1 = southbound track; S2 = northbound track
Source: Wilson, Ihrig & Associates, Inc., 2008a.



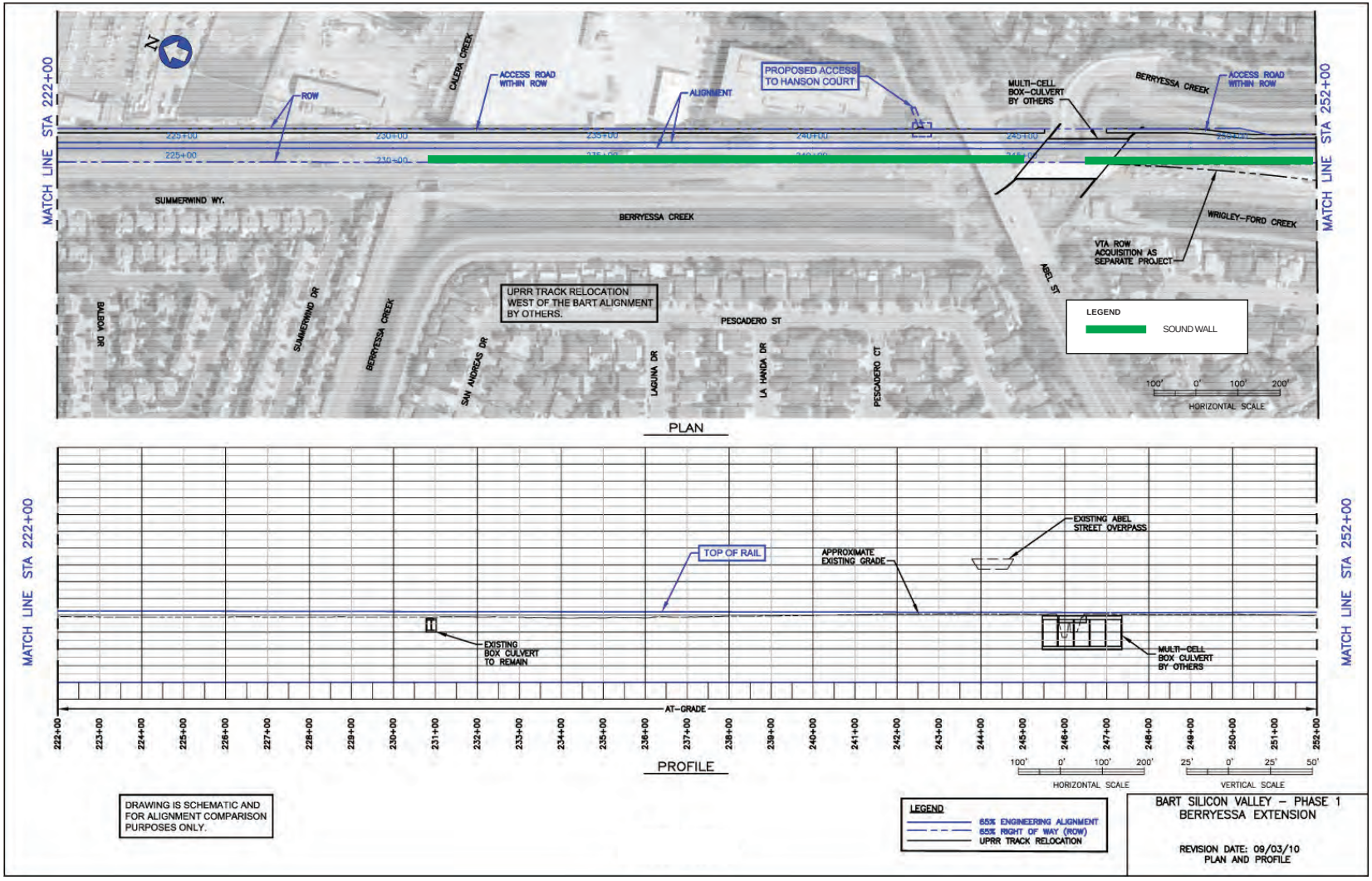
Source Wilson hrig 2008 VTA 2010

Figure 4.13-3A: Noise and Vibration Mitigation Locations



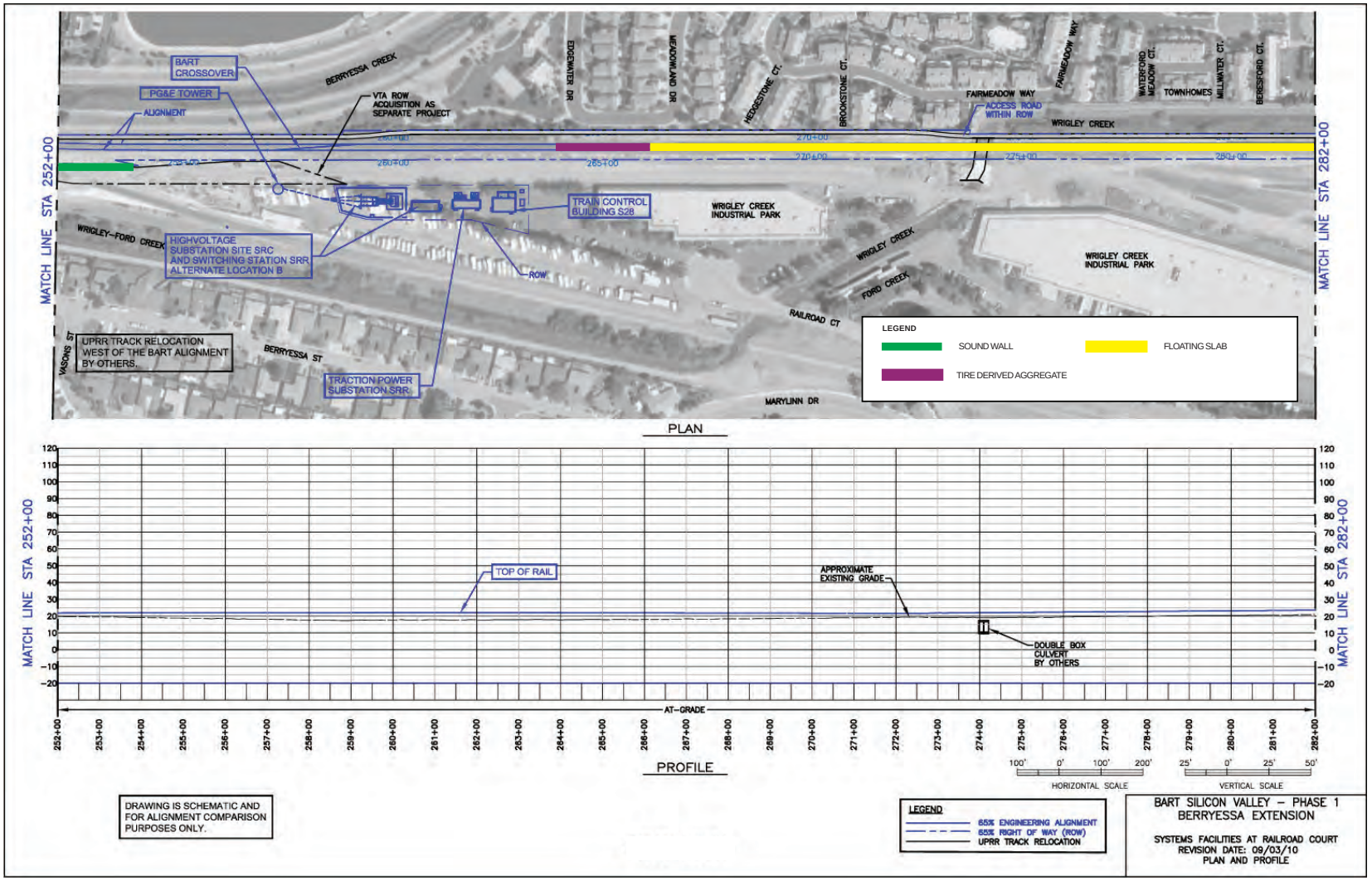
Source Wilson hrig 2008 VTA 2010

Figure 4.13-3B: Noise and Vibration Mitigation Locations



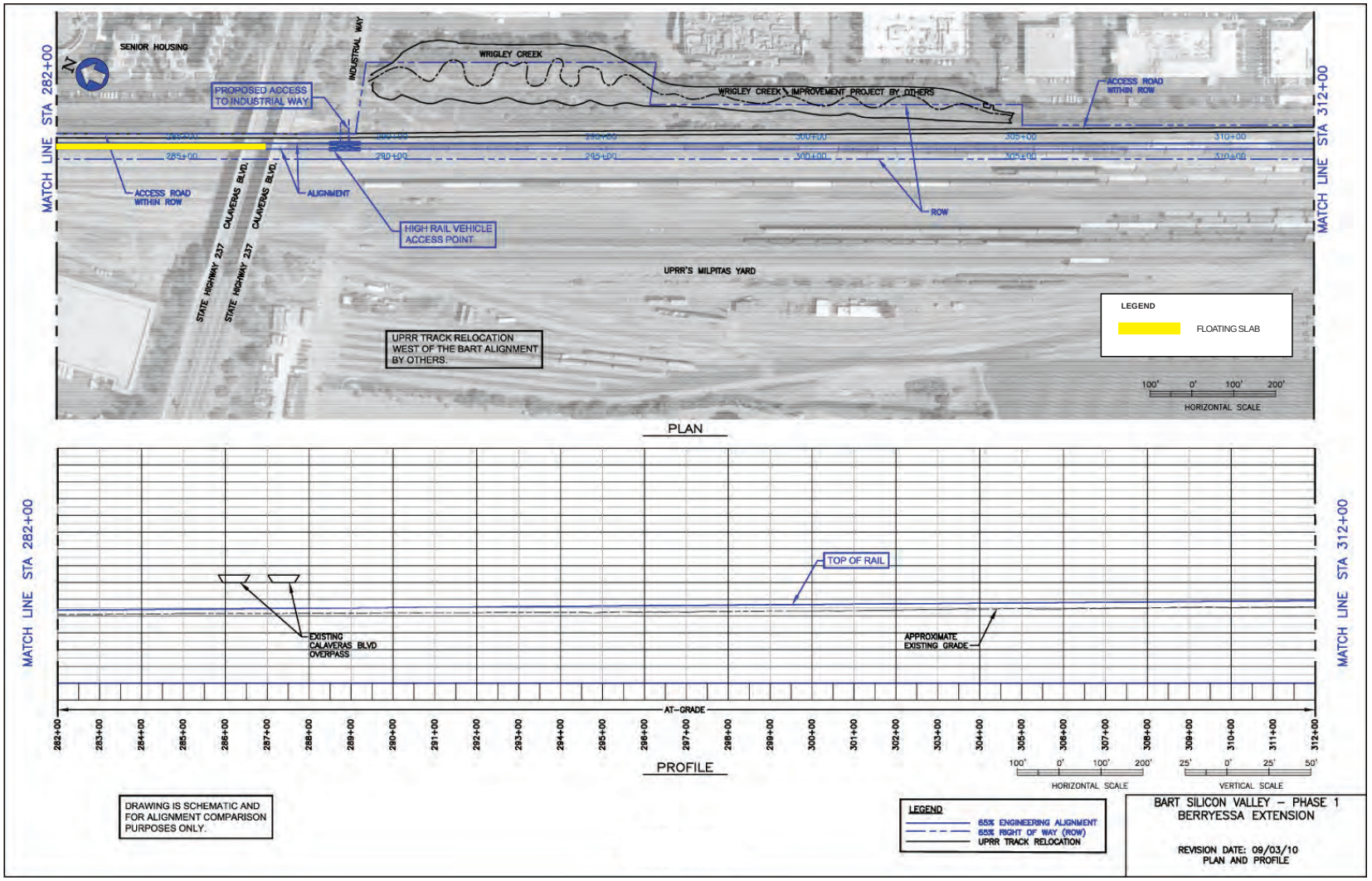
Source Wilson hrig 2008 VTA 2010

Figure 4.13-3C: Noise and Vibration Mitigation Locations



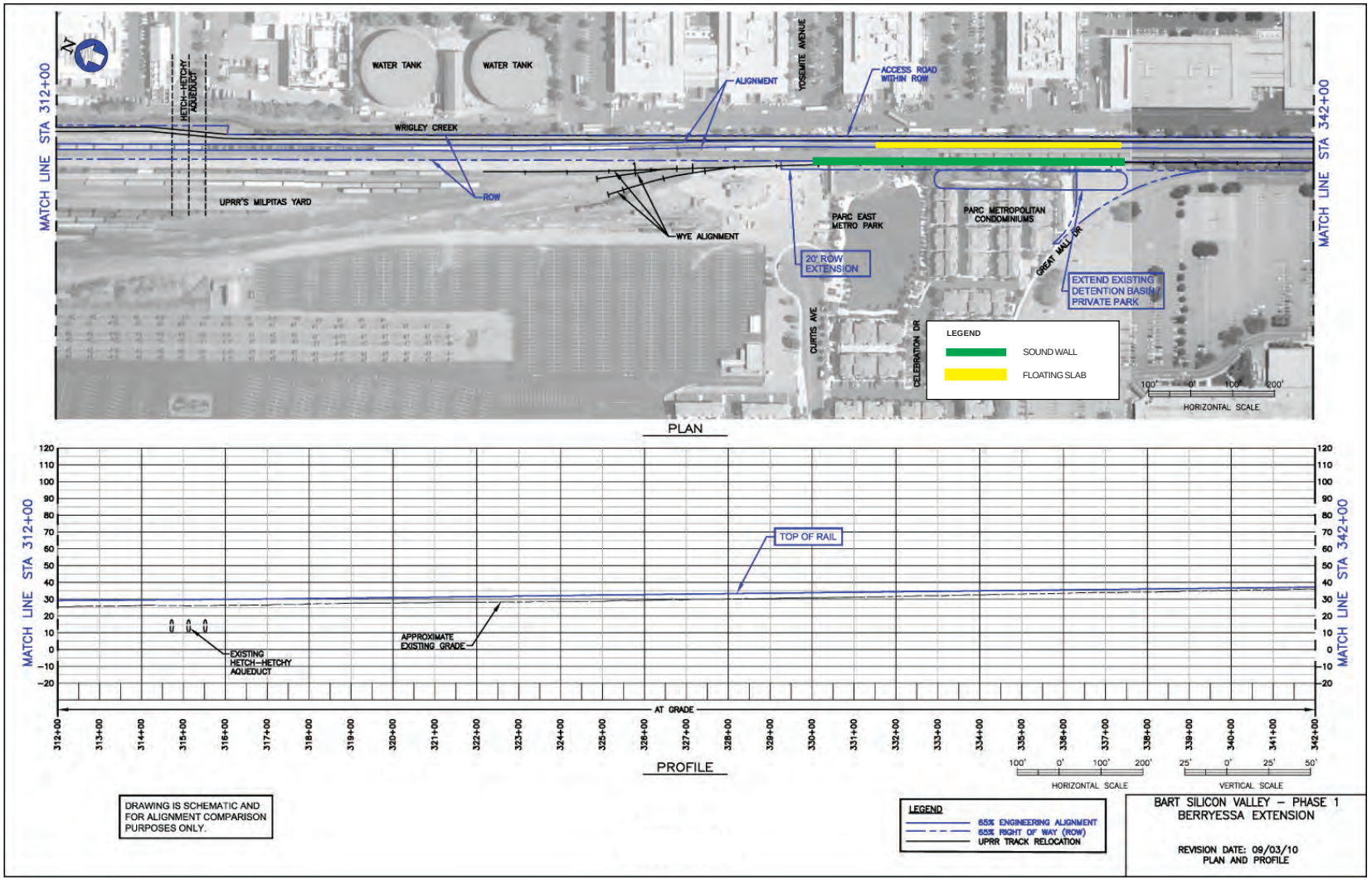
Source Wilson hrig 2008 VTA 2010

Figure 4.13-3D: Noise and Vibration Mitigation Locations



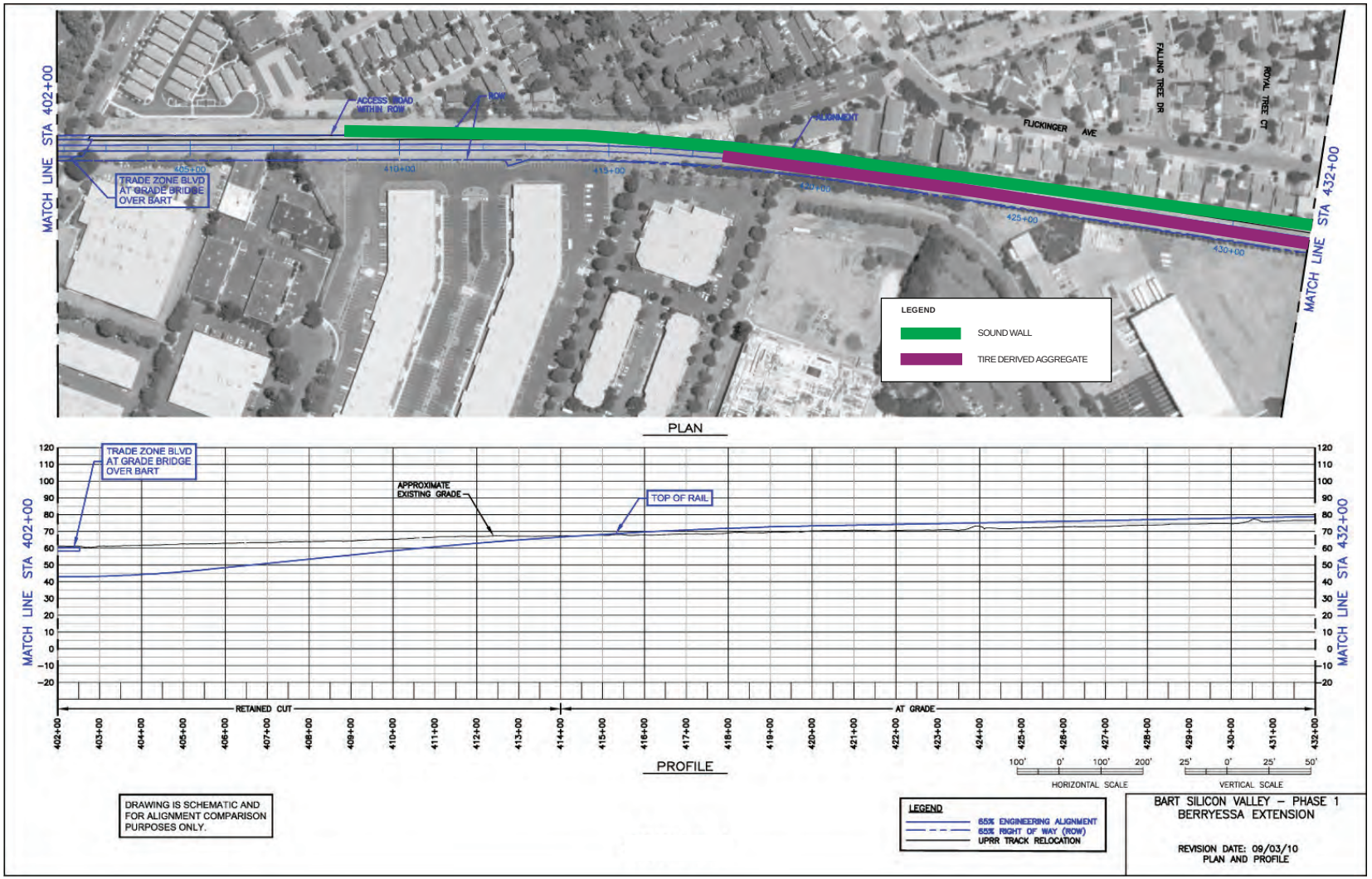
Source Wilson hrig 2008 VTA 2010

Figure 4.13-3E: Noise and Vibration Mitigation Locations



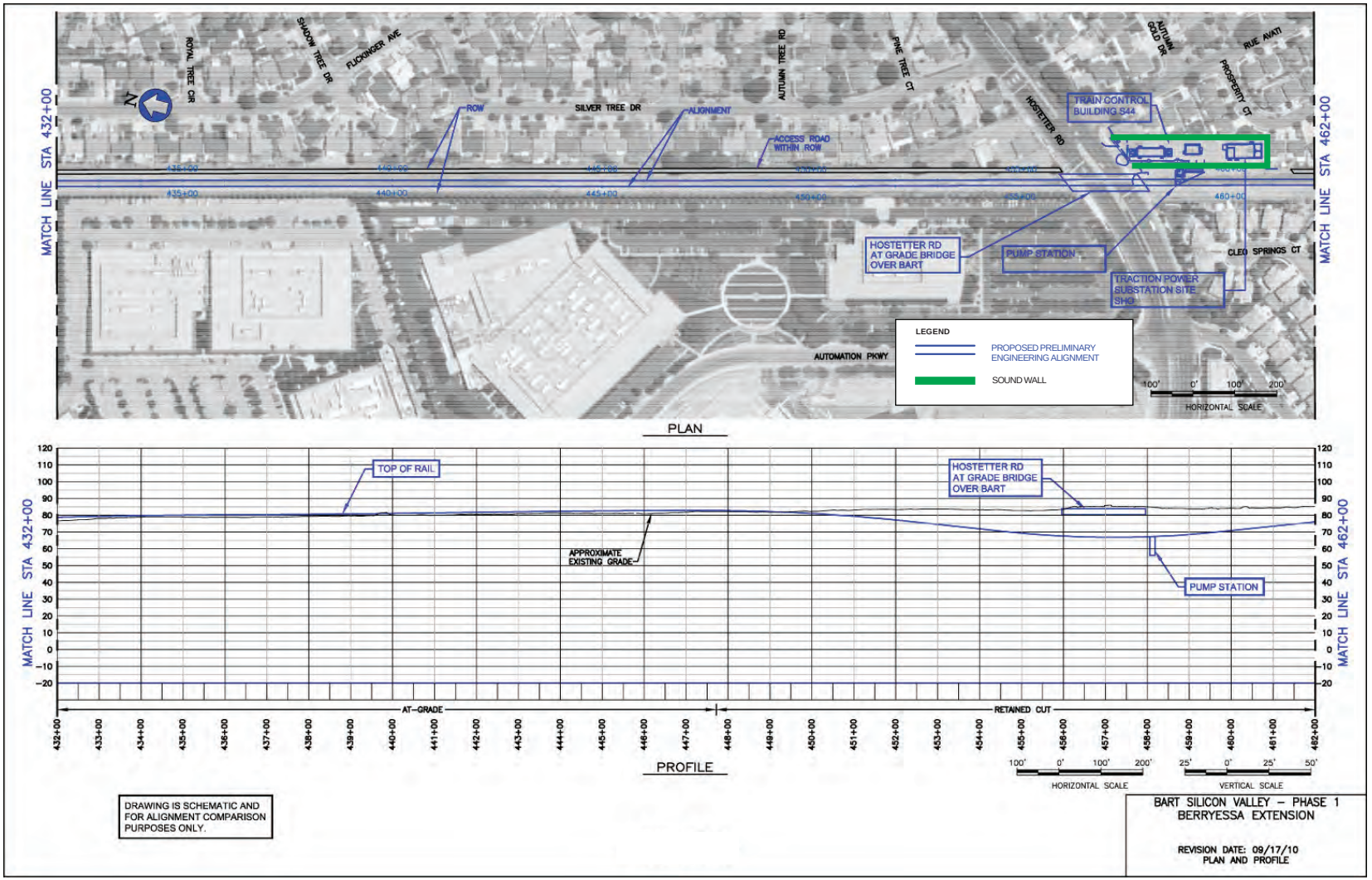
Source Wilson hrig 2008 VTA 2010

Figure 4.13-3F: Noise and Vibration Mitigation Locations



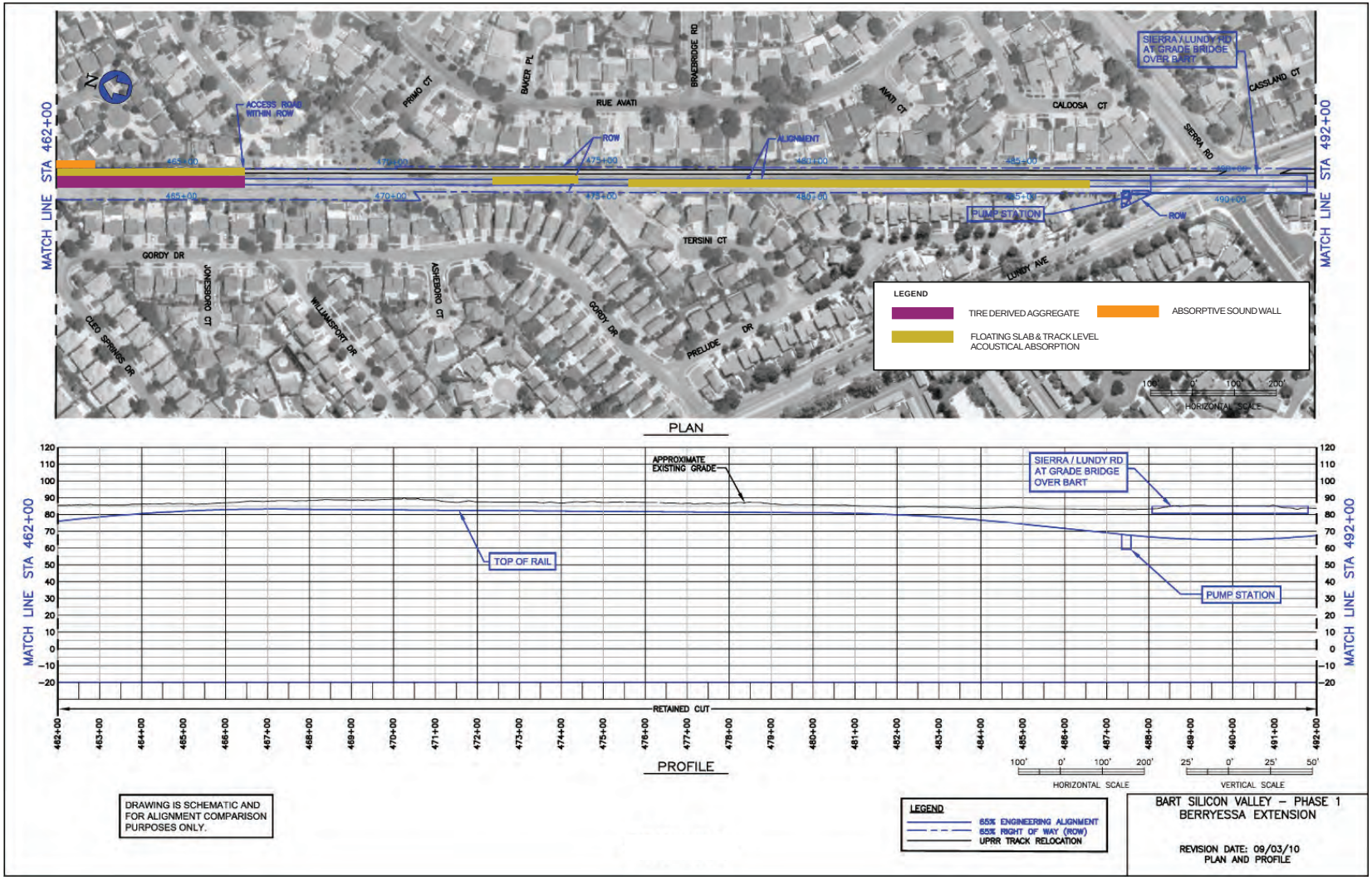
Source Wilson hrig 2008 VTA 2010

Figure 4.13-3G: Noise and Vibration Mitigation Locations



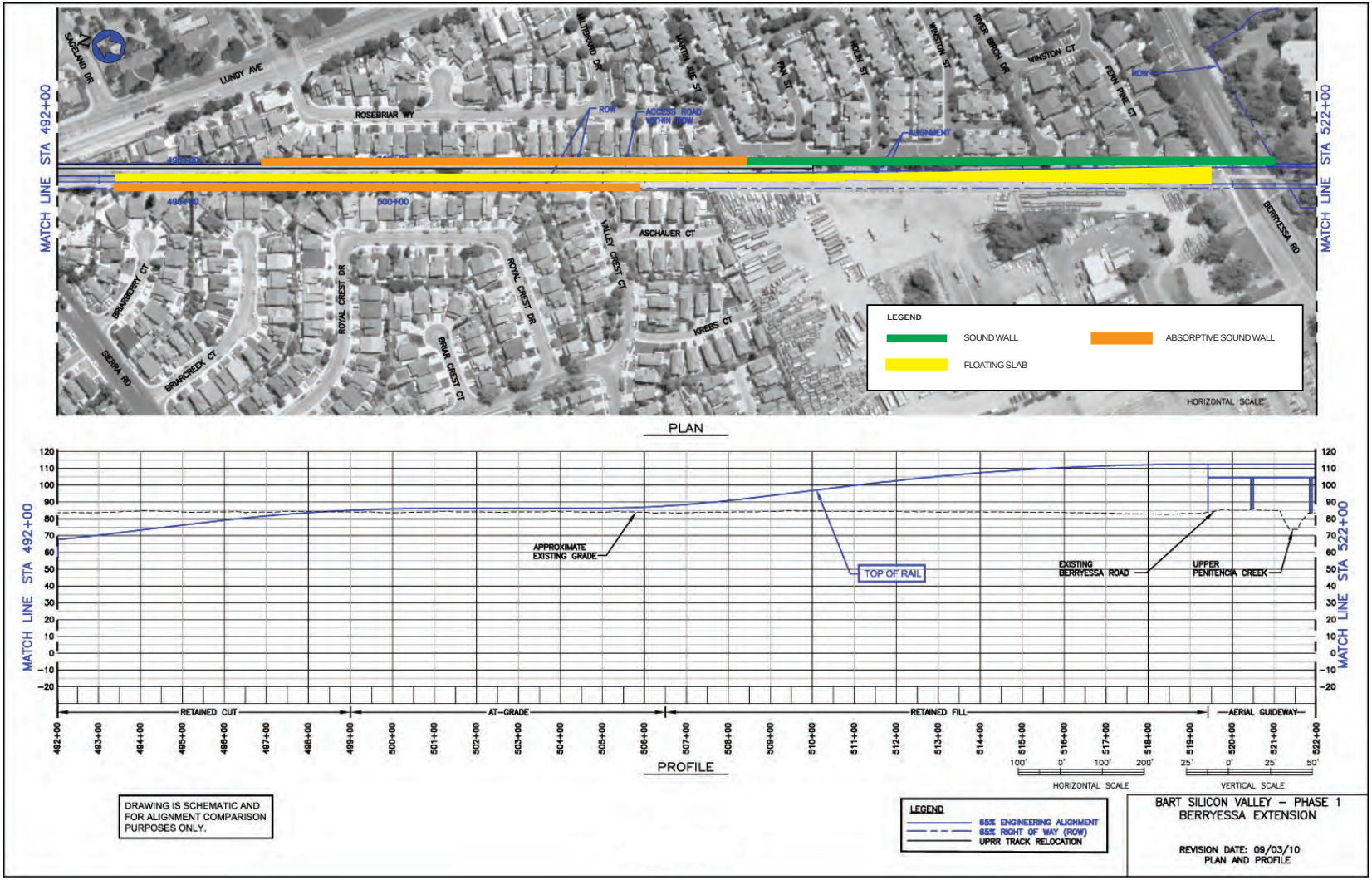
Source Wilson hrig 2008 VTA 2010

Figure 4.13-3H: Noise and Vibration Mitigation Locations



Source Wilson hrig 2008 VTA 2010

Figure 4.13-3l: Noise and Vibration Mitigation Locations



Source Wilson hrig 2008 VTA 2010

Figure 4.13-3J: Noise and Vibration Mitigation Locations

Mitigation Measure NV-2: Approximately 2,000 feet of slab track acoustical absorption at track level shall be used to reduce adverse noise effects in the area of the alignment between Hostetter Road and Sierra Road. This mitigation shall occur between civil station 459+50 and 486+50 as indicated in **Table 4.13-6**.

Table 4.13-6: Locations for Track Level Acoustical Absorption (Mitigation Measure NV-2)

Civil Station	Side of Track	Length (feet)
459+50 to 466+50	S1 & S2	700
472+30 to 474+30	S1 & S2	200
475+50 to 486+50	S1 & S2	1100

Source: Wilson, Ihrig & Associates, Inc., 2008a.

Mitigation Measure NV-3: During the project start-up phase and prior to revenue operations, VTA will carry out noise testing along the civil stations where slab track acoustical absorption is being used as a mitigation measure. The testing is to ensure that the sound absorber is adequately attenuating the increased noise from the slab track. VTA will deliver a technical memo to the FTA on the results of the testing. The testing will also serve to inform the need for additional wayside residential noise mitigation mentioned in Mitigation Measures NV-1 and NV-4.

Residences located on or at the second floor or higher would continue to experience noise levels that exceed the FTA criteria, even with the recommended sound wall mitigation, which is considered to be at the maximum feasible height. Approximately 425 residences (including single-family and individual units in multi-family residences) in 281 buildings would remain exposed to noise in excess of the FTA criteria for a *Severe Impact*. Where needed, these residences would be considered for improved building insulation as an additional mitigation. Individual residence-specific analysis of residual noise impacts would be conducted during final design to determine the noise attenuation provided by the existing windows and exterior walls of each affected residence and the specific upgrades required to achieve an interior noise level of 45 Ldn.

Mitigation Measure NV-4: Noise insulation and other measures shall be provided for residences with second floors or higher that are exposed to noise levels in excess of the FTA criteria. The mitigation will be designed to achieve an interior noise level of 45 Ldn where feasible.

In addition to the recommended sound walls and retrofitting of multi-story residences with improved exterior sound isolation, sound absorptive material on the trackway structure would be necessary. This mitigation

would primarily be needed in areas where the alignment runs in a retained cut. To further reduce noise impacts to multi-story residences, a sound wall would be constructed on both sides of the track where the corridor is narrow (50 feet or less). Installation of sound absorptive material on the inside face of retaining walls and sound walls would further reduce sound levels by as much as 2 dBA. Otherwise, potentially significant noise impacts could result in noise levels in excess of the FTA criteria. **Table 4.13-7** identifies the location and length of recommended sound wall absorptive material that would be necessary in addition to the absorptive sound wall specified in **Table 4.13-5**, as required by Mitigation Measure NV-1. **Figures 4.13-3A** through **4.13-3J** show the locations of sound walls and sound absorptive materials.

Table 4.13-7: Locations for Sound Absorptive Material (Mitigation Measure NV-4)

Civil Station	Side of Track	Length (feet)
460+80 to 487+00	S1 & S2	2620
491+80 to 508+50	S1 & S2	1670

Source: Wilson, Ihrig & Associates, Inc., 2008a.

In addition to mitigation measures, the following standard BART practices are performed regularly and would reduce noise levels from Phase 1:

- **Track Maintenance:** Regular track maintenance activities such as rail grinding and track inspection would reduce rail defects that could lead to higher-than-normal noise and vibration levels. Rail grinding smoothes the surface of train tracks by using specialized machines to cut away a thin layer of steel from the top and sides of the railhead. Regular rail grinding helps to minimize wayside noise and vibration generated by train passbys over defects or corrugations on the rail.
- **Vehicle Maintenance:** Regular vehicle maintenance activities such as periodic inspections and tests will help to identify problems and necessary corrective actions to minimize wayside noise and vibration levels. This includes wheel truing. Wheel truing is the process of cutting away a thin layer of steel on a wheel's outer diameter (the "tread") to smooth out rough spots and ensure that the wheels are perfectly round. Because flat spots or rough wheels can cause excessive noise and vibration, wheel truing is a standard BART practice to minimize wayside noise and vibration levels.

4.13.4.2 Phase 1 Groundborne Noise and Vibration Impacts

Table 4.13-8 summarizes the line segment vibration analysis results. The table includes the number of impacts to residences by civil station and receiver location. No other types of land use impacts are expected along the line

segment. A total of 157 to 172 single-family and 36 to 40 multi-family buildings (150 to 171 residences) would be impacted without mitigation along the alignment. Particular areas of interest for vibration impacts are discussed below.

Options at Dixon Landing Road

A total of 60 residences are affected with the At Grade option at Dixon Landing Road as compared to 24 residences with the Retained Cut option at Dixon Landing Road. With the recommended mitigation, there would be no remaining vibration impacts for either option.

Vibration Mitigation

Tire derived aggregate and floating slab track (FST) with a design frequency of 8 Hz are the recommended vibration mitigation for the residences affected for all of the design options. The approximate length of required mitigation varies slightly depending on the option selected.

The FTA has not approved tire derived aggregate as a groundborne vibration mitigation measure. However, tire derived aggregate installation on the VTA Vasona Line has demonstrated vibration attenuation characteristics in the mid-frequency vibration range. Tire derived aggregate performs the same function as the more expensive ballast mats. The FTA is interested in: (1) finding another use for used tires; and (2) continuing the study of tire derived aggregate as a vibration mitigation measure, and possibly incorporating it in the future as an approved measure. The FTA remains concerned about the durability of tire derived aggregates and whether it will maintain its full attenuation efficacy over time. In this regard, VTA will continue to field test its tire derived aggregate installations and share the technical results with the FTA.

VTA was requested to perform further testing on tire derived aggregate underlayment at its Vasona Light Rail Transit Line to support its vibration attenuation effectiveness and durability.[7] The conclusion of this study were similar to test conclusions in 2005 and 2006 that the use of tire derived aggregate as an underlayment beneath ballast and tie track as a means for reducing wayside groundborne vibration was both practical and viable. The overall performance from the three sets of tests was that the reduction of wayside groundborne vibration due to transit train passbys was generally superior to that of ballast mat, but not as effective as FST. A peer review was also conducted.[8] The peer review concluded that the results of the Wilson, Ihrig & Associates, Inc. reports support the conclusion that the tire derived aggregate installations at VTA are effective in reducing groundborne vibration.

[7] Wilson, Ihrig & Associates, Inc., Final Report, Evaluation of Tire Derived Aggregate as Installed Beneath Ballast and Tie Light Rail Track, 2009.

[8] Harris Miller Miller & Hanson, Inc., Peer Review of Tire Derived Aggregate Vibration Tests at VTA, 2009.

Table 4.13-8: Groundborne Vibration Impacts for Phase 1

Option	Civil Station	Receiver Location	Track Direction	Speed (mph)	Distance to Near Track CL. (feet)	Depth to Top of Rail (feet)	Track Type	FTA Detailed Criteria	Maximum ⅓ Octave Band Without Mitigation	Number of Impacts Without Mitigation	Preliminary Mitigation	Maximum ⅓ Octave Band With Mitigation	Number of Impacts With Mitigation
N/A	168+00 to 170+00	Castilleja Subdivision	NB	67	58	N/A	AG	72	77	8	TDA	71	0
N/A	170+00 to 172+40	Castilleja Subdivision	NB	67	58	N/A	AG XO	72	86	12	FST	69	0
N/A	172+60	Warm Springs Village	NB	67	83	N/A	AG XO	72	76	1	TDA	68	0
N/A	173+50 to 175+60	Warm Springs Village	NB	67	92	N/A	AG	72	73	7	TDA	67	0
N/A	176+00	Warm Springs Village	NB	67	96	N/A	AG	72	73	1	TDA	67	0
At Grade Option at Dixon Landing	180+60 to 182+00	Park Homes at Mayfield	NB	67	132	N/A	AG	72	73	7	TDA	71	0
At Grade Option at Dixon Landing	182+50	Spinnaker Points Apartments	NB	67	38	N/A	AG	72	77	6	FST	67	0
At Grade Option at Dixon Landing	184+00	Spinnaker Points Apartments	NB	67	75	N/A	AG	72	74	4	TDA	72	0
At Grade Option at Dixon Landing	189+50 to 191+00	Spinnaker Points Apartments	NB	67	42	N/A	AG	72	75	10	FST	65	0

Table 4.13-8: Groundborne Vibration Impacts for Phase 1 (continued)

Option	Civil Station	Receiver Location	Track Direction	Speed (mph)	Distance to Near Track CL. (feet)	Depth to Top of Rail (feet)	Track Type	FTA Detailed Criteria	Maximum ⅓ Octave Band Without Mitigation	Number of Impacts Without Mitigation	Preliminary Mitigation	Maximum ⅓ Octave Band With Mitigation	Number of Impacts With Mitigation
At Grade Option at Dixon Landing	192+50 to 194+20	Friendly Village Mobile Homes	NB	67	49	N/A	AG	72	73	4	TDA	71	0
At Grade Option at Dixon Landing	194+20 to 196+20	Friendly Village Mobile Homes	NB	67	49	N/A	AG	72	73	5	TDA	71	0
At Grade Option at Dixon Landing	196+20 to 198+50	Friendly Village Mobile Homes	NB	67	49	N/A	AG	72	73	5	TDA	71	0
At Grade Option at Dixon Landing	198+50 to 200+50	Friendly Village Mobile Homes	NB	67	49	N/A	AG	72	78	5	TDA	72	0
At Grade Option at Dixon Landing	201+50	Friendly Village Mobile Homes	NB	67	49	N/A	AG	72	78	1	TDA	72	0
Retained Cut Option at Dixon Landing	182+50	Spinnaker Points Apartments	NB	67	38	1	CT	72	75	6	FST	67	0
Retained Cut Option at Dixon Landing	198+50 to 200+50	Friendly Village Mobile Homes	NB	67	49	4	CT	72	75	5	FST	63	0

Table 4.13-8: Groundborne Vibration Impacts for Phase 1 (continued)

Option	Civil Station	Receiver Location	Track Direction	Speed (mph)	Distance to Near Track CL. (feet)	Depth to Top of Rail (feet)	Track Type	FTA Detailed Criteria	Maximum ⅓ Octave Band Without Mitigation	Number of Impacts Without Mitigation	Preliminary Mitigation	Maximum ⅓ Octave Band With Mitigation	Number of Impacts With Mitigation
Retained Cut Option at Dixon Landing	201+50	Friendly Village Mobile Homes	NB	67	49	1	CT	72	75	1	FST	63	0
Retained Cut Option at Dixon Landing	202+50 to 204+20	Milpitas Mobilodge, N. Milpitas Boulevard	NB	67	49	N/A	AG	72	78	4	FST	72	0
Retained Cut Option at Dixon Landing	204+20 to 207+00	Milpitas Mobilodge, N. Milpitas Boulevard	NB	67	49	N/A	AG	72	78	7	TDA	72	0
Retained Cut Option at Dixon Landing	207+50 to 208+00	Milpitas Mobilodge, N. Milpitas Boulevard	NB	67	52	N/A	AG	72	77	1	TDA	71	0
N/A	265+00	Edgewater Drive	NB	67	90	N/A	AG	72	73	1	TDA	71	0
N/A	266+00	Meadowland Drive	NB	67	92	N/A	AG	72	72[b]	1	TDA	70	0
N/A	267+50	Meadowland Drive	NB	67	70	N/A	AG	72	76	1	FST	65	0
N/A	268+20	Hedgestone Court	NB	67	90	N/A	AG	72	74	1	TDA	71	0
N/A	269+00	Hedgestone Court	NB	67	40	N/A	AG	72	82	3	FST	63	0
N/A	270+00 to 271+00	Brookstone Court	NB	67	65	N/A	AG	72	79	3	FST	65	0
N/A	271+00 to 273+50	Fairmeadow Way	NB	67	44	N/A	AG	72	80	10	FST	65	0

Table 4.13-8: Groundborne Vibration Impacts for Phase 1 (continued)

Option	Civil Station	Receiver Location	Track Direction	Speed (mph)	Distance to Near Track CL. (feet)	Depth to Top of Rail (feet)	Track Type	FTA Detailed Criteria	Maximum ⅓ Octave Band Without Mitigation	Number of Impacts Without Mitigation	Preliminary Mitigation	Maximum ⅓ Octave Band With Mitigation	Number of Impacts With Mitigation
N/A	273+50 to 275+50	Fairmeadow Way	NB	67	134	N/A	AG	72	73	6	TDA	71	0
N/A	276+00 to 278+00	Fairmeadow Way	NB	67	104	N/A	AG	72	75	4	FST	63	0
N/A	278+00 to 280+50	Millwater Court	NB	67	104	N/A	AG	72	75	6	FST	63	0
N/A	281+00	Terrace Gardens Senior Housing	NB	67	115	N/A	AG	72	78	10	FST	72	0
N/A	283+00 to 286+00	Terrace Gardens Senior Housing	NB	67	143	N/A	AG	72	73	22	FST	67	0
N/A	332+50 to 336+00	Parc Metropolitan Condos	SB	67	94	N/A	AG	72	79	32	FST	62	0
N/A	419+00 to 420+50	BrookTree Square #5, Flickinger Way	NB	67	47	N/A	AG	72	72[b]	10	TDA	70	0
N/A	420+50 to 423+00	BrookTree Square #4, #3, #2, #1 Flickinger Way	NB	67	46	N/A	AG	72	72 [b]	16	TDA	70	0
N/A	424+00	1897 Flickinger Avenue	NB	67	55	N/A	AG	72	77	1	TDA	70	0
N/A	424+50	1891 Flickinger Avenue	NB	67	47	N/A	AG	72	76	1	TDA	70	0
N/A	424+90 to 425+90	Flickinger Avenue	NB	67	66	N/A	AG	72	76	2	TDA	69	0

Table 4.13-8: Groundborne Vibration Impacts for Phase 1 (continued)

Option	Civil Station	Receiver Location	Track Direction	Speed (mph)	Distance to Near Track CL. (feet)	Depth to Top of Rail (feet)	Track Type	FTA Detailed Criteria	Maximum ⅓ Octave Band Without Mitigation	Number of Impacts Without Mitigation	Preliminary Mitigation	Maximum ⅓ Octave Band With Mitigation	Number of Impacts With Mitigation
N/A	426+15	Flickinger Avenue	NB	67	53	N/A	AG	72	77	1	TDA	70	0
N/A	427+00	1861 Flickinger Avenue	NB	67	67	N/A	AG	72	76	1	TDA	69	0
N/A	427+50	Flickinger Avenue	NB	67	66	N/A	AG	72	76	1	TDA	69	0
N/A	428+00	Flickinger Avenue	NB	67	49	N/A	AG	72	76	1	TDA	70	0
N/A	428+20 to 437+50	Flickinger Avenue	NB	67	50	N/A	AG	72	74	17	TDA	67	0
N/A	438+50 to 437+50	Flickinger Avenue	NB	67	65	N/A	AG	72	76	2	TDA	69	0
N/A	441+00 to 449+50	Silvertree Drive	NB	67	54	N/A	AG	72	77	15	TDA	70	0
N/A	449+50 to 450+00	Silvertree Drive	NB	67	50	N/A	AG	72	79	1	FST	63	0
N/A	450+00 to 451+00	Silvertree Drive	NB	67	70	N/A	AG	72	74	2	TDA	70	0
N/A	473+30	Gordy Drive	SB	67	30	5	RC	72	76	1	FST	61	0
N/A	460+50 to 462+50	Prosperity Court	NB	67	40	11	RC	72	73	3	FST	68	0
N/A	462+50 to 464+00	Prosperity Court	NB	67	53	5	RC	72	75	2	FST	70	0
N/A	464+50	Prosperity Court	NB	67	53	4	RC	72	75	1	FST	70	0

Table 4.13-8: Groundborne Vibration Impacts for Phase 1 (continued)

Option	Civil Station	Receiver Location	Track Direction	Speed (mph)	Distance to Near Track CL. (feet)	Depth to Top of Rail (feet)	Track Type	FTA Detailed Criteria	Maximum ⅓ Octave Band Without Mitigation	Number of Impacts Without Mitigation	Preliminary Mitigation	Maximum ⅓ Octave Band With Mitigation	Number of Impacts With Mitigation
N/A	476+50 to 478+50	Tersini Court	SB	67	40	5	RC	72	75	4	FST	62	0
N/A	480+00	Prelude Drive	SB	67	55	5	RC	72	72 [b]	1	FST	63	0
N/A	480+50 to 484+00	Prelude Drive	SB	67	37	5	RC	72	75	7	FST	65	0
N/A	484+00 to 485+50	Prelude Drive	SB	67	37	9	RC	72	74	3	FST	66	0
N/A	494+30	Briar Berry Court	SB	67	37	10	RC	72	73	1	FST	63	0
N/A	496+00 to 497+00	Briar Creek	SB	67	33	N/A	AG	72	74	2	TDA	70	0
N/A	497+30	Briar Creek	SB	67	60	N/A	AG	72	72 [b]	1	TDA	69	0
N/A	497+50 to 499+50	Rose Briar Way	NB	67	40	N/A	AG	72	75	4	TDA	70	0
N/A	499+50 to 500+50	Rose Briar Way	NB	67	43	N/A	AG	72	81	2	FST	64	0
N/A	500+50	Rose Briar Way	NB	67	53	N/A	AG	72	77	1	FST	64	0
N/A	500+70 to 502+00	Rose Briar Way	NB	67	53	N/A	AG	72	81	2	FST	65	0
N/A	501+90	Rose Briar Way	NB	67	35	N/A	AG	72	84	1	FST	65	0
N/A	502+30	Rose Briar Way	NB	67	53	N/A	AG	72	77	1	FST	64	0

Table 4.13-8: Groundborne Vibration Impacts for Phase 1 (continued)

Option	Civil Station	Receiver Location	Track Direction	Speed (mph)	Distance to Near Track CL. (feet)	Depth to Top of Rail (feet)	Track Type	FTA Detailed Criteria	Maximum ⅓ Octave Band Without Mitigation	Number of Impacts Without Mitigation	Preliminary Mitigation	Maximum ⅓ Octave Band With Mitigation	Number of Impacts With Mitigation
N/A	502+50 to 507+00	Rose Briar Way	NB	67	47	N/A	AG	72	80	9	FST	63	0
N/A	503+35	Rose Briar Way	NB	67	33	N/A	AG	72	85	1	FST	66	0
N/A	498+00 to 499+30	Royal Crest Drive	SB	65	37	N/A	AG	72	76	2	TDA	70	0
N/A	499+30 to 500+00	Royal Crest Drive	SB	65	37	N/A	AG	72	79	2	FST	63	0
N/A	500+00 to 501+70	Royal Crest Drive	SB	60	37	N/A	AG	72	74	4	TDA	69	0
N/A	501+80	Royal Crest Drive	NB	67	51[a]	N/A	AG	72	79	1	FST	63	0
N/A	502+20 to 503+50	Royal Crest Drive	SB	60	35	N/A	AG	72	82	3	FST	63	0
N/A	504+00	Valley Crest Drive	SB	50	25	N/A	AG	72	85	1	FST	66	0
N/A	505+50 to 507+30	Aschauer Court	SB	50	43	N/A	AG	72	78	5	TDA	72	0
N/A	507+00 to 508+00	Rose Briar Way	NB	50	45	N/A	AG	72	81	2	FST	64	0
N/A	507+50 to 509+50	Taida Street, Berryessa Villa	NB	65	87	N/A	EM	72	76	4	FST	68	0
N/A	510+00 to 511+50	Taida Street, Berryessa Villa	NB	65	66	N/A	EM	72	78	6	FST	69	0

Table 4.13-8: Groundborne Vibration Impacts for Phase 1 (continued)

Option	Civil Station	Receiver Location	Track Direction	Speed (mph)	Distance to Near Track CL. (feet)	Depth to Top of Rail (feet)	Track Type	FTA Detailed Criteria	Maximum ⅓ Octave Band Without Mitigation	Number of Impacts Without Mitigation	Preliminary Mitigation	Maximum ⅓ Octave Band With Mitigation	Number of Impacts With Mitigation
N/A	511+50 to 513+00	Taida Street, Berryessa Villa	NB	60	90	N/A	EM	72	75	4	FST	67	0
N/A	513+50 to 515+00	Winston Court, Berryessa Villa	NB	65	42	N/A	EM	72	77	4	FST	70	0
N/A	516+00 to 516+50	Heavenly Bamboo Court, Regency Park	NB	50	22	N/A	EM	72	77	1	FST	71	0
N/A	517+00	Fern Pine Court	NB	50	20	N/A	EM	72	78	1	FST	72	0
N/A	518+50	Fern Pine Court	NB	50	20	N/A	EM	72	78	1	FST	72	0

[a] Vibration dominated from trains on far track at indicated receptors

[b] 72 < max ⅓ octave band < 72.5

Key:

NB = northbound; SB = southbound

EM = embankment with ballasted track

AR = aerial structure

FST = 8-Hz floating slab track

AG = at grade ballasted track

CL = centerline

XO =crossover

CT = retained open cut

RC = retained cut

TDA = tire derived aggregate under ballasted truck (assuming subsequent testing validates vibration reductions) or comparable mitigation

Source: Wilson, Ihrig & Associates, Inc., 2006.

Mitigation Measure NV-5: Table 4.13-9 summarizes the vibration mitigation necessary to achieve the FTA criteria. The proposed mitigation is tire derived aggregate and 8-Hz FST. The locations of vibration mitigation are depicted on **Figures 4.13-3A** through **4.13-3J**.

Mitigation Measure NV-6: Upon project start-up, VTA will perform further testing on tire derived aggregate underlayment at its Vasona LRT Line. The vibration testing should replicate the testing presented to the FTA in 2009.[9] The technical evaluation will then be presented to the FTA for review and comment.

The mitigation recommendations do not include ballast mat, because ballast mat is mainly effective at frequencies above 25 to 30 Hz. Where vibration is dominated by lower frequencies, such as along the alignment, a ballast mat may only provide an overall reduction of about 1 VdB. The most effective, proven mitigation approach available for the Milpitas and Fremont portions of the project design is an 8-Hz FST. Theoretically, the performance of the FST can be improved by designing it with a lower resonance frequency.

4.13.4.3 Design Change 10. System Facilities Alternate Location B (STA 260+00)

The transformers installed at the Traction Power Substation would be an additional noise source. As part of Phase 1, noise associated with the transformers would be limited to 50 dBA at 50 feet. Where this cannot be achieved by the transformer design itself, the Traction Power Substation facility would incorporate sound walls. Design Change 10, System Facilities Alternate Location B, would locate Traction Power Substation SRR approximately 320 feet from the nearest noise-sensitive land uses on Berryessa Street. At this distance, the continuous noise level from the transformer would be 34 dBA. The addition of the transformer noise to the surrounding noise environment, including BART operations, would result in an insignificant change of less than a 0.1-dBA. No new noise impacts are projected for Design Change 10, System Facilities Alternate Location B, and no mitigation is required.

[9] Wilson, Ihrig & Associates, Evaluation of Tire Derived Aggregate as Installed Beneath Ballast and Tie Light Rail Track, May 2009.

Table 4.13-9: Vibration Mitigation (Mitigation Measure NV-5)

Option	Civil Station	Mitigation
N/A	167+00 to 169+79 [a]	Tire Derived Aggregate
N/A	169+79[a] to 172+80[a]	8-Hz Floating Slab Track
N/A	172+80[a] to 177+00	Tire Derived Aggregate
At Grade Option at Dixon Landing	179+60 to 181+50	Tire Derived Aggregate [b]
At Grade Option at Dixon Landing	181+50 to 183+60	8-Hz Floating Slab
At Grade Option at Dixon Landing	183+60 to 185+00	Tire Derived Aggregate [b]
At Grade Option at Dixon Landing	188+50 to 192+00	8-Hz Floating Slab
At Grade Option at Dixon Landing	192+00 to 209+00	Tire Derived Aggregate [b]
Retained Cut Option at Dixon Landing	181+50 to 183+60	8-Hz Floating Slab Track
Retained Cut Option at Dixon Landing	197+50 to 204+20	8-Hz Floating Slab Track
Retained Cut Option at Dixon Landing	204+20 to 209+00	Tire Derived Aggregate [b]
N/A	264+00 to 266+30	Tire Derived Aggregate [b]
N/A	266+30 to 287+00	8-Hz Floating Slab
N/A	331+50 to 337+40	8-Hz Floating Slab
N/A	418+00 to 432+00	Tire Derived Aggregate [b]
N/A	432+00 to 448+00	Tire Derived Aggregate [b]
N/A	448+00 to 452+00	8-Hz Floating Slab
N/A	459+50 to 466+50	8-Hz Floating Slab
N/A	472+30 to 474+30	8-Hz Floating Slab
N/A	475+50 to 486+50	8-Hz Floating Slab
N/A	493+30 to 506+00	8-Hz Floating Slab
N/A	506+00 to 519+50[c]	8-Hz Floating Slab

[a] extents of proposed crossover

[b] Tire derived aggregates or comparable mitigation will be implemented

[c] north end of bridge structure over Berryessa Road

Source: Wilson, Ihrig & Associates, Inc., 2006a.

4.13.4.4 Design Change 13. Milpitas Wye (STA 355+00)

Phase 1 includes three alternative locations for the redesigned Milpitas Wye: Wye with Spur Connection option; Wye and Industrial Lead option; and No Wye/Industrial Lead Only option. All three options propose changes to the

existing Milpitas Wye on the east side of the SVRT alignment, where no existing noise-sensitive land uses are located. The Wye and Industrial Lead and No Wye/Industrial Lead Only options also proposed changes on the west side of the alignment that would move the freight track west of the location of the current railroad tracks. There are two noise-sensitive receptors on the west side of the alignment that could be affected by this change: the Residence Inn at Marriott and the Towne Place Suites. For the options with the Industrial Lead, the nearest noise-sensitive land use would be 105 feet from the Towne Place Suites, approximately 20 feet closer than the westernmost existing railroad track.

However, the realignment of the wye track and the limited freight rail activity would produce very minor changes in noise levels. If the freight activity on the industrial lead were the same as the existing activity on the main tracks, the change in noise levels associated with movements on the industrial lead would be minimal (1 dBA or less). Furthermore, the number of trains per day using the industrial lead is expected to be lower than current activity on the main tracks. The noise levels due to freight movements on the industrial lead would therefore not significantly increase the levels over what BART train activity would produce. No noise impact is projected for Design Change 13, Milpitas Wye, and no mitigation is required.

4.13.4.5 Design Change 14. System Facility North of Montague Expressway (STA 366+00)

Design Change 14, System Facility North of Montague Expressway, would locate Traction Power Substation SME approximately 165 feet from the nearest noise-sensitive land uses on Falcon Drive. At this distance, the continuous noise level from the transformer would be 41 dBA. The existing ambient noise level is Ldn 62 dBA. The cumulative noise level with BART trains would be 62.6 dBA. The addition of the transformer noise would not be significant (less than a 0.1-dBA change). No new noise impact is projected for Design Change 14, System Facility North of Montague Expressway, and no mitigation is required.

4.13.4.6 Design Change 15. Milpitas Station (STA 372+00)

Design Change 15, Milpitas Station, modifies the proposed parking structure at Milpitas Station to eight levels. The parking structure would be on the north side of the station between Montague Expressway and the extension of South Milpitas Boulevard that would extend through the station site. The location of the proposed parking structure would not significantly change the noise level from the project, and the 12-foot-high sound wall proposed to the south would adequately reduce noise impacts to a less-than-significant level. No new noise impacts are projected for Design Change 15, Milpitas Station, and no mitigation is required.

4.13.4.7 Design Change 17. Pump Station Facilities at Trade Zone Boulevard (STA 401+00)

The pumps at pump station facilities would be used infrequently and would be below grade. Portable generators would be used during power outages. The closest receptor to this pump station at Trade Zone Boulevard is 325 feet away. The noise levels from below grade and at grade pumping would be substantially reduced at this distance and would not result in any significant impacts. No mitigation would be required.

4.13.4.8 Design Change 18. System Facilities at Hostetter Road (STA 460+00)

Design Change 18, System Facilities at Hostetter Road, would locate Traction Power Substation SHO approximately 40 feet from the nearest noise-sensitive land uses on Prosperity Court to the south and to the east, approximately 100 feet from the nearest noise-sensitive land uses on Rue Avanti to the east, and approximately 125 feet from the nearest noise-sensitive land uses on Cleo Spring Court to the west. At this distance, the continuous noise levels from the transformer would be 51 dBA at the residences on Prosperity Court, 46 dBA at the residences on Rue Avanti, and 42 dBA at the residences on Cleo Springs Court. The existing ambient noise level for Prosperity Court, for Rue Avanti, and for Cleo Springs is Ldn 57 dBA, 58 dBA, and 57 dBA respectively. The cumulative noise level with BART trains would be 61 dBA, 63 dBA and 62 dBA for Prosperity Court, Rue Avanti and Cleo Springs Court, respectively. A 12-foot-high sound wall would be designed to ensure compliance with the FTA Noise Impact Criteria in this area to reduce impacts of the BART train noise.

Substation noise alone would not introduce significant noise impacts to these nearby receptors. However, the combined Ldn of the train and the substation would be 61 dBA, 63 dBA, and 62 dBA for Prosperity Court, Rue Avanti, and Cleo Springs Court, respectively. These levels are all above the FTA Noise Impact Criterion of 56 dBA. The incremental increase in noise associated with Design Change 18, System Facilities at Hostetter Road, in combination with the anticipated train noise would result in *Moderate Impacts* at Rue Avanti, Cleo Springs Court, and Prosperity Court. Implementation of Mitigation Measure NV-1 would reduce noise impacts at these locations to a less-than-significant level. As shown in **Table 4.13-5**, an 8-foot high sound wall would be required on the east, south, and west sides of the sites at the Traction Power Substation SHO property line to reduce noise impacts.

4.13.4.9 Design Change 19. Pump Station Facilities at Sierra Road and Lundy Avenue (STA 488+00)

The closet receptor at this site is 105 feet away. The noise levels from infrequent pumping and other sources above ground at this location would also be substantially reduced at this distance and would not result in significant impacts. No mitigation is required.

4.13.4.10 Design Change 20. Berryessa Station (STA 533+00)

The Berryessa Station area has existing noise-sensitive residential uses to the east and commercial uses to the west. Background residential area noise levels were measured at 58 Ldn. BART train operations are projected to increase noise levels by 4.8 dBA for ground-level residences (a *Moderate Impact*) and by 6.5 dBA for the second story and above (a *Severe Impact*). Noise from moving buses and bus idling was also modeled. Residences near the busbays would be exposed to a *Severe Impact* as a result of bus-only operations.

As discussed above, the Berryessa Station would include an 8-foot high community wall near the residential areas to the east, which would reduce noise impacts. The community wall would extend northward to reduce noise impacts for residences on Salamoni Court and Mabury Road; however, the need for additional noise insulation of second story living areas at the nearby residences would be determined on an individual basis.

Design Change 20, Berryessa Station, proposes to shift the Berryessa Station south, along the aerial trackway structure. Traction Power Substation SBE would also be shifted south, and would be located within the BART alignment footprint, under the aerial structure. As a result of the station shift, the two BART crossovers have been relocated from south of the station to one on either side of the station. In addition, the design of the parking facilities at this station has been modified to include an eight-level parking structure on the southern half of the site and to the east of the UPRR right-of-way (ROW).

Assuming that the parking structure would provide the same capacity as the surface parking previously evaluated, the location of the proposed parking structure would not significantly change the noise from Phase 1, and the 8-foot-high sound wall proposed for this area would adequately reduce noise impacts for the first-story residents to a less-than-significant level. As discussed above, the need for additional noise insulation for the second-story residences would be determined on an individual basis.

The relocation of the BART crossovers and Traction Power Substation SBE would also increase noise levels for these residents; however, the increase would be adequately mitigated by the proposed 8-foot-high sound wall and

improved building insulation, where needed. Consequently, no additional noise impacts beyond those identified in the SEIR-1 are projected for Design Change 20, Berryessa Station, and no additional mitigation is required.

4.13.4.11 Design Change 21. Electrical Facilities near Las Plumas Road (STA 525+00)

The proposed high-voltage substation SLP and switching station SSE electrical facilities near Las Plumas Avenue under Design Change 21, Electrical Facilities near Las Plumas Road, do not include equipment that would introduce noticeable sources of noise to the surrounding environment. Land uses in this area are predominantly industrial with background noise dominated by the freeway. The nearest noise-sensitive receptors are over 900 feet away. Consequently, no noise impact is projected for Design Change 21, Electrical Facilities near Las Plumas Road, and no mitigation is required.

4.13.4.12 Design Change 22. Maintenance and Storage of BART Trains for Phase 1

BART vehicles would be maintained at the BART Hayward Yard and a storage track will be included south of the Berryessa Station between Mabury Road and Las Plumas Avenue. Train movements on the storage track at the end of the Berryessa Extension would be slow (35 mph or less) and thus would generate low levels of noise. The area surrounding the tracks is currently industrial and the area is adjacent to the US 101 freeway. The existing noise environment is dominated by freeway noise. The closest sensitive receptors are on the other side of the freeway at a distance of 1,100 feet. Based on these conditions, no noise impact is projected for Design Change 22, Maintenance and Storage of BART Trains for Phase 1, and no mitigation is required.

4.13.5 CONCLUSION

Table 4.13-2 summarizes potentially significant noise impacts to ground-level sensitive receptors. The total number of impacted ground-level sensitive receptors affected before mitigation would vary from 80 to 82 depending on whether the Retained Cut or At Grade option at Dixon Landing Road is chosen. After mitigation, the noise impacts would total 39. However, none of the impacts are considered severe. Mitigation for noise impacts have been added as part of this SEIR-2 to reduce noise impacts associated with the design changes since certification of the SEIR-1.

In regards to vibration, none of the design changes or other updates to vibration impact criteria would result in any new impacts beyond those already identified in the FEIR and SEIR-1. No new mitigation is required.