4.0 NOISE AND VIBRATION

In this chapter the Section of Environmental Analysis (SEA) presents the results of the new noise and vibration study that SEA conducted for the preparation of this Supplemental Draft Environmental Impact Statement (SDEIS). SEA compares the potential noise and vibration impacts of the following eight alternatives studied here: Proposed Route; Alternative 1; Alternative 2; Alternative 3; the No-Action Alternative; the Eastern Bypass Route; the MCEAA[1] Medina Dam Alternative; and Southwest Gulf Railroad's (SGR) Modified Medina Dam Route. The new noise and vibration study assessed all seven rail line alternatives that SEA is studying as part of the environmental review of SGR's proposed rail line construction and operation project, plus potential impacts from the No-Action Alternative. Appendix C-3 of this SDEIS contains SEA's detailed technical report that summarizes the noise and vibration study.

SEA decided to conduct a new noise and vibration study of all seven rail alignments and the No-Action Alternative rather than performing a limited study comparing the Eastern Alternatives to the noise and vibration studies conducted for the Draft Environmental Impact Statement (DEIS).[2] This new study considered horn noise, as well as the updated operational information provided by SGR after issuance of the DEIS (i.e., that trains may operate during nighttime hours) and ensured that seasonal noise sources would not affect the ambient noise measurements of the Eastern Alternatives compared to the alternatives studied in the DEIS (e.g., insect noise; see Section 3.8 of the DEIS). SEA also considered the comments received on the DEIS regarding noise and vibration; however, responses to specific comments will be included in the Final Environmental Impact Statement (FEIS). Where appropriate in this chapter, SEA references information gathered for the DEIS noise and vibration studies (specifically, the analysis for the No-Action Alternative and the side track).

[1] MCEAA is the acronym for the Medina County Environmental Action Association, the citizen's group that proposed the MCEAA Medina Dam Alternative.

[2] SEA notes that the Notice of Intent to prepare the SDEIS did not indicate that SEA would include a discussion of additional vibration analysis in the SDEIS. However, because SEA conducted this additional vibration analysis in conjunction with the new noise study, and because this additional vibration analysis is necessary for comparing the Eastern Alternatives to the alternatives studied in the DEIS, SEA is including discussion of this additional vibration analysis here.

SEA has organized this chapter into the following sections:

- Section 4.1 provides a brief description of SEA's new field study and the existing ambient noise and vibration environment.
- Section 4.2 outlines SEA's methodology for the noise and vibration analysis. Section 4.2.1 describes SEA's methodology for the noise assessment, including the criteria SEA used for determining whether SGR's proposed rail operations could potentially cause adverse noise impacts. Section 4.2.2 describes SEA's methodology for the vibration assessment, including the criteria SEA used for determining whether adverse vibration impacts could result from SGR's proposed rail operations. Section 4.2.3 describes the methodology used for the noise and vibration assessment of truck operations under the No-Action Alternative. Section 4.2.4 describes the methodology used to assess potential noise and vibration impacts from construction activities.
- Section 4.3 presents the results of SEA's noise analysis, comparing all eight alternatives being studied (the seven rail alignments and the No-Action Alternative), and using data from the new and the DEIS noise studies, as appropriate.
- Section 4.4 provides the results of SEA's vibration analysis, comparing all eight alternatives and using data from the new and DEIS vibration studies, as appropriate.
- Section 4.5 discusses SEA's analysis of potential indirect and cumulative vibration impacts.
- Section 4.6 sets forth SEA's conclusions regarding potential noise and vibration impacts from project alternatives and SEA's recommendations for mitigation.
- Section 4.7 outlines the differences between the noise and vibration study and analysis undertaken for this SDEIS and the noise and vibration studies and analysis presented in the DEIS.

SEA uses several technical terms associated with the measurement and description of noise environments in this chapter that may be unfamiliar to readers. SEA encourages the reader to refer to the glossary included in Appendix A-1 of the technical report (see Appendix C-3) for definitions of noise terms, and Appendix A-2 of the technical report for a brief discussion of noise science. This is important for several reasons. For example, the basic units of sound measurement are decibels, abbreviated dB. However, because SEA is assessing the potential effect of the project on people, we apply a frequency filter called A-weighting to the decibel values that corresponds to the way humans hear different frequencies. Thus, all decibels in this SDEIS are A-weighted and stated as dBA. Also, decibels may not be added or subtracted directly because they are logarithmic quantities. Therefore, the acoustic sum of adding two identical noise sources together is three decibels more than just one source alone (i.e., 60 dBA + 60 dBA = 63 dBA). Additionally, a measured 24-hour Average Day-Night Sound Level (abbreviated DNL or L_{dn}) that has a built-in nighttime penalty[3] may not be directly compared to a 24-hour measurement or predicted noise level that does not contain the penalty, even though the numerical value of each is in units of dBA. Other similar issues and terms are peculiar to acoustics, and SEA provides more detailed information in Appendix C-3.

SEA selected the methodologies used in this document to model railroad noise and vibration and to assess potential environmental effects based upon what SEA believes are the most appropriate models, methods, and standards for characterizing the potential future noise and vibration emissions and the potential impacts from the rail line construction and operation. SEA used an identical evaluation process to evaluate the potential environmental noise and/or vibration effects from the No-Action Alternative and each of the seven rail routes under consideration. The Board's noise impact criterion was used for assessing the potential for SGR's construction and operation to cause noise impacts (see 49 CFR 1105.7 (e)(6)). Thus, the No-Action Alternative, the Proposed Route and all alternative rail alignments were evaluated on the same basis to determine if they would result in the following conditions:

- An increase of 3 A-weighted decibels (dBA) or more in community noise exposure as measured by Day-Night Average Sound level (Ldn); and
- An increase to a noise level of 65 dBA Ldn or greater.

A number of Federal guidelines exist to assess ground transportation noise and vibration impacts. These include:

- National Environmental Policy Act (42 United States Code [U.S.C.] 4321, *et seq*.).
- Noise Control Act of 1972 (42 U.S.C. 4901).
- Federal Transit Administration (FTA) Guidelines (FTA-VA-90-1003-06, May 2006; supersedes DOT-T-95-16, April 1995).

[3] To account for increased sensitivity to noise at night (10 p.m. to 7 a.m.), 10 dBA is added as a penalty to the measured sound level of all sound that occurs during the nighttime period.

- Federal Railroad Administration (FRA) Guidelines (Final Report No. 293630-4, October, 2005; supersedes Report No. 293630-1, December, 1998).
- Occupational Health and Safety Administration Occupational Noise Exposure, Hearing Conservation Amendment (29 Code of Federal Regulations [CFR] 1910.95).
- U.S. Environmental Protection Agency (USEPA) Railroad Noise Emission Standards (40 CFR Part 201).
- FRA Railroad Noise Emission Compliance Regulations (49 CFR Part 210); FRA Final Rule on the Use of Locomotive Horns at Highway-Rail Grade Crossings (49 CFR Part 222); and FRA Railroad Locomotive Safety Standards (49 CFR Part 229).

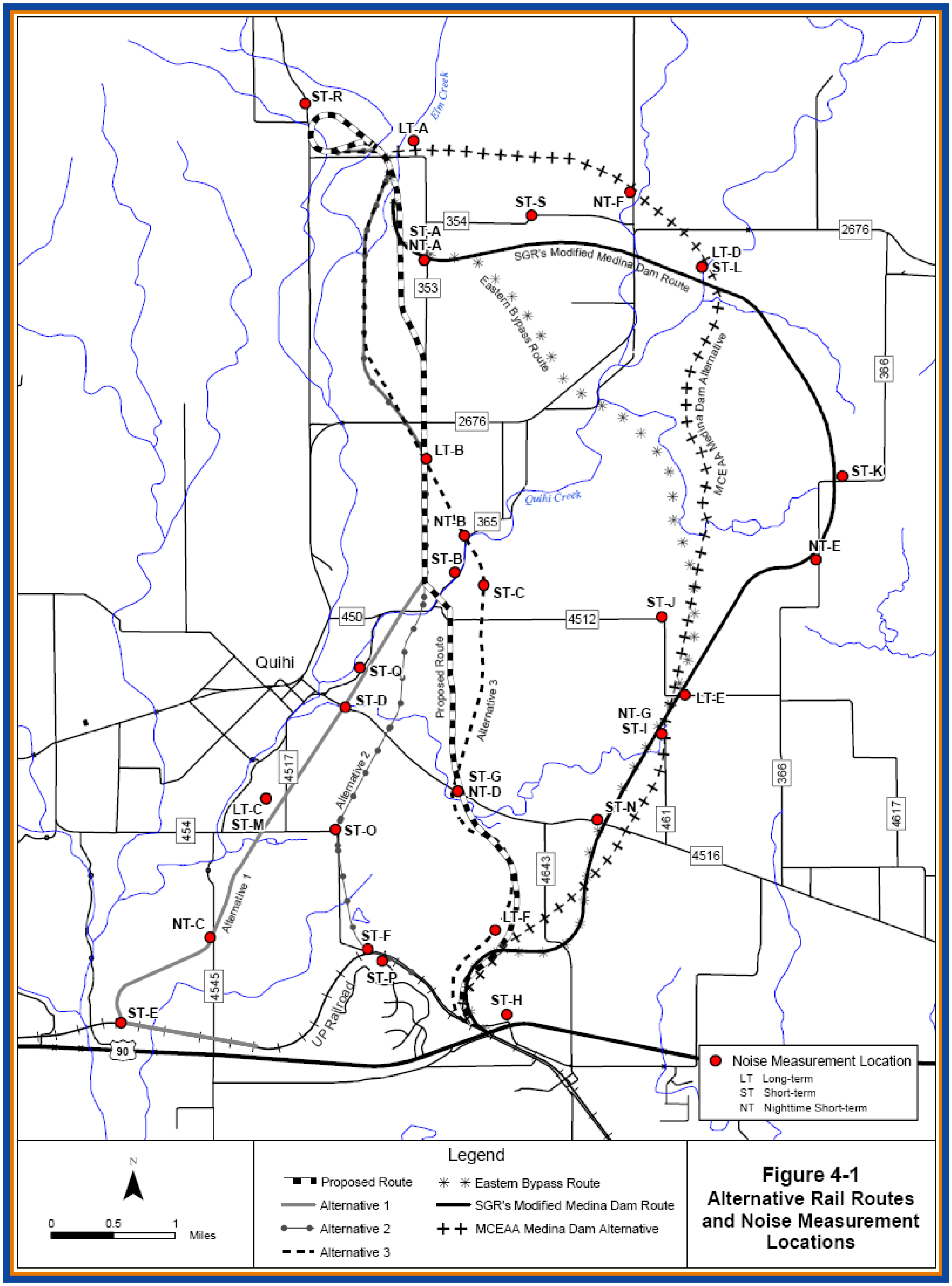
SGR's rail line would be located in Medina County, Texas. The state of Texas and Medina County have no general noise ordinances, planning guidelines, or restrictions regarding noise from railroad operations or construction activities. However, pursuant to state law (Texas Administrative Code, Title 43, Part 1, Chapter 7, Subchapter D, Rule §7.31 (c)(9)), all railroads operating within the state must comply with Federal regulations regarding the sounding of locomotive horns near at-grade crossings of railroads and public highways. These Federal regulations are codified at 49 CFR, Parts 222 and 229. The final revision to these regulations, adopted in 2005, requires that locomotive horns be sounded to provide for safety at public highway-rail grade crossings except in quiet zones.[4]

4.1 Description of the Field Study and Existing Environment

SEA selected representative noise measurement locations for each rail alternative that provided a geographical distribution of measurements, were close to potentially-affected noise-sensitive receivers, and were accessible for measurements. Potential measurement sites and sensitive receptor locations were obtained from project design layouts, aerial photographs, and field observations by the study team. Figure 4-1 shows all of the alternative rail routes, the county roads, and the locations of the measurements that SEA conducted. The measurement location identifiers shown in the figure (LT, ST, and NT) are defined in the next paragraph.

[4] A quiet zone is a segment of a rail line that contains one or a number of consecutive public highway-rail crossings at which horns are not routinely sounded. 49 CFR 222.9. FRA has specific rules for the establishment of quiet zones. See 49 CFR Part 222.

Figure 4-1. Alternative Rail Routes, Highways and Noise Measurement Locations



SEA measured the existing exterior[5] noise levels from Wednesday, April 6 through Tuesday, April 11, 2006. SEA conducted daytime (ST) (i.e., 7:00 am to 10:00 pm), and nighttime (NT) (i.e., 10:00 pm to 7:00 am), short-term (i.e., less than 1 hour) measurements. SEA used unattended automatic equipment to obtain long-term (LT) (typically 24 hours) noise measurements. SEA conducted 19 attended ST and 7 attended NT short-term sound level measurements at various outdoor locations along all seven alternative rail line alignments. SEA conducted six unattended outdoor LT sound level measurements for the purpose of determining the fluctuations in noise levels along the alternative alignments throughout a typical 24-hour period. SEA used Precision grade (Type 1) Sound Level Meters (SLM) and Community Noise Analyzers (CNA) to measure sound. Type 1 represents the most accurate field instruments designed for field noise measurements.

SEA set the instruments to apply the “A” weighting filter network that most closely approximates the hearing characteristics of the human ear; thus, all decibels presented in SEA’s analyses are A-weighted decibels (dBA).

SEA field-checked the laboratory calibration of the instruments before and after each measurement period using an acoustical calibrator. For the short-term measurements, SEA mounted the SLM on a tripod. For the long-term measurements, the CNA was locked in a small steel weather enclosure attached to either a tree or fence post at the measurement site. In all cases, the microphone height was five feet above the ground and the microphone was equipped with a windscreen.

SEA used additional equipment to collect meteorological information during each short-term measurement and at the beginning of each long-term measurement. The detailed technical report contains the full list of instrumentation used, the calibration records, and information on each measurement performed.

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[5] Consistent with Board precedent and industry standards, measurements of the difference in sound level (noise reduction) between the outside of a residence (exterior) compared to the level inside of the residence (interior) were not conducted as part of this study.

The existing community noise levels for each potential rail line alignment and the No-Action Alternative from the long-term measurements are provided in Table 4-1. Tables containing the daytime and nighttime short-term measurement data for the rail alternatives are included in the technical report in Appendix C-3.

The discussion that follows below describes each rail route individually, although all routes begin at the quarry and various routes may overlap at certain portions of their alignments and at the potential tie-in points to the Union Pacific (UP) rail line near U.S. Highway 90. According to the Texas Department of Transportation's San Antonio District Highway Map for 2004, the Annual Average Daily Traffic on U.S. Highway 90 in the study area is 12,900 vehicles per day. Sound is audible from trucks using U.S. Highway 90 and trains using the UP line in the southerly portion of the study area; more so at night when ambient noise is less.

In general, the levels of existing environmental noise measured within the study area are consistent with the type and intensity of the adjacent and nearby land use. Existing sound levels are generally lower in the northerly portions of the study area near the proposed quarry compared to areas along Farm-to-Market Road (FM) 2676 and the portion of the study area closer to U.S. Highway 90 and the UP rail line. Sound levels are higher near frequently traveled area roadways such as FM 2676, and lower near infrequently traveled roads throughout the study area. Sound levels are similar and predominately low to moderate in the large areas of agricultural use with scattered residences located away from the busier roads, U.S. Highway 90, and the UP tracks. Most of the existing noise environment consists of extended periods of relative quiet, punctuated with brief occurrences of noisy events such as a truck, tractor, aircraft flyover, or a freight train. Natural sounds, such as steady and gusting wind, also temporarily elevate the ambient noise level. The existing noise environment is compatible with all present land use, including residential.

The existing vibration environment was not measured, but was characterized by SEA's field team through critical observation of perceptible ground vibration. Ground vibration was not perceived by any team members during the study. This included observation of freight train locomotives operating approximately 115 feet away from the team. SEA concludes, based on the threshold of vibration perception used by the Federal Railroad Administration (FRA) (FRA, 1998), that the general existing vibration environment in the study area is below 65 velocity decibel level (VdB).

4.1.1 Existing Noise Level Summary

Table 4-1 presents a summary of the overall existing LT community noise levels along each of the alternative routes. Note that various alternatives may share LT measurement locations. The routes all start in the north at measurement location LT-A and they proceed in a southerly or southeasterly then southerly direction.

Table 4-1. Existing Community Noise Levels (L_{dn})

	LT-A	LT-B	LT-C	LT-D	LT-E	LT-F
Proposed Route	40	57	-	-	-	50
Alternative 1	40	57	49	-	-	-
Alternative 2	40	57	-	-	-	50
Alternative 3	40	57	-	-	-	50
Eastern Bypass Route	40	-	-	-	51	50
MCEAA Medina Dam Alternative	40	-	-	64	51	50
SGR's Modified Medina Dam Route	40	-	-	64	51	50
No-Action Alternative	40	57	49	-	51	-

4.1.2 Proposed Route

SGR’s Proposed Route begins in the northern portion of the study area at the quarry and extends southerly approximately seven miles to the UP rail line just north of U.S. Highway 90. The route primarily traverses a rural area comprising relatively flat farmland, pastureland, undisturbed areas, and widely scattered residences. The quarry area is predominantly undisturbed with six nearby residences. There is a group of residences at the intersection of County Road 353 and County Road 354 easterly of the Proposed Route. Two additional residences were visible approximately 2.5 miles southerly of the quarry. The remainder of the alignment passes through and is adjacent to farmland, pastureland, and undisturbed areas. SEA conducted 10 sound level measurements along or adjacent to the Proposed Route. Based on the LT measurements, the existing Day-Night Average Sound Level (L_{dn}) ranges from 40 to 57 to 50 dBA from north to south.

4.1.3 Alternative 1

Alternative 1 also begins at the quarry in the north portion of the study area and connects with the UP line just north of U.S. Highway 90, three miles west of the Proposed Route's tie-in. The route primarily traverses a rural area composed of relatively flat farmland, pastureland, undisturbed areas, and widely scattered residences. The quarry area is predominantly undisturbed with six nearby residences. There is a group of residences at the intersection of County Road 353 and County Road 354 easterly of the Proposed Route. Two additional residences were visible approximately 2.5 miles southerly of the quarry. Alternative 1 would pass through a group of approximately eight residences as it crosses County Road 4516 and an additional four residences before connecting with the UP line near a Recreational Vehicle park located just north of U.S. Highway 90 and east of County Road 455. SEA conducted 12 sound level measurements adjacent to and in the vicinity of Alternative 1. The existing L_{dn} ranges from 40 to 57 to 49 dBA, from north to south, based on the LT measurements.

4.1.4 Alternative 2

Alternative 2 also begins at the quarry in the northern portion of the study area and connects with the UP line just north of U.S. Highway 90, at a point 0.3 miles northwest of the Proposed Route's tie-in. This route primarily traverses a rural area comprising relatively flat farmland, pastureland, undisturbed areas, and widely scattered residences. The quarry area is predominantly undisturbed with six nearby residences. There is a group of residences at the intersection of County Road 353 and County Road 354 easterly of Alternative 2. Two additional residences were visible approximately 2.5 miles southerly of the quarry. Alternative 2 would pass through a group of approximately four residences as it crosses County Road 4516 and connects with the current UP line just east of the Creekwood Subdivision that has approximately 69 residences. SEA conducted nine sound level measurements adjacent to and in the vicinity of Alternative 2. Based on the LT measurements, the existing L_{dn} ranges from 40 to 57 to 50 dBA from north to south.

4.1.5 Alternative 3

Alternative 3 begins in the north at the quarry and connects with the UP line just north of U.S. Highway 90 at the same location as the Proposed Route tie-in. The route primarily traverses a rural area comprising relatively flat farmland, pastureland, undisturbed areas, and widely scattered residences. The quarry area is predominantly undisturbed with six nearby residences. There is a group of residences at the intersection of County Road 353 and County Road 354 easterly of Alternative 3. Two additional residences were visible approximately 2.5 miles southerly of the quarry. With the exception of passing within 1,000 feet of one additional residence located approximately 3,000 feet north of County Road 4512, the remainder of the alignment passes through and is adjacent to farmland and pastureland with widely scattered residences and undisturbed areas. SEA conducted 11 sound level measurements along or adjacent to Alternative 3. The existing L_{dn} ranges from 40 to 57 to 50 dBA, from north to south, based on the LT measurements.

4.1.6 The Eastern Bypass Route

The Eastern Bypass Route begins in the northern portion of the study area at the quarry and extends southerly approximately nine miles to the UP railroad tracks tie-in approximately at the same location as the Proposed Route just north of U.S. Highway 90. The route primarily traverses a rural area of relatively flat farmland, pastureland, undisturbed areas, and widely scattered residences. The quarry area is predominantly undisturbed with six nearby residences. There is a group of residences at the intersection of County Road 353 and County Road 354 easterly of the Eastern Bypass Route. There is a residence along the route immediately northwest of FM 2676. South of this residence, the approximate mid-point of the route passes through and is adjacent to farmland, pastureland, and undisturbed areas until passing through a group of approximately 12 residences along County Road 4516. The remainder of the alignment passes through undisturbed land. SEA conducted 11 sound level measurements along or adjacent to the Eastern Bypass Route. Based on the LT measurements, the existing L_{dn} ranges from 40 to 51 to 50 dBA from north to south.

4.1.7 The MCEAA Medina Dam Alternative

The MCEAA Medina Dam Alternative begins in the north at the quarry and connects with the UP line approximately at the same location as the Proposed Route. It is located in a rural area of relatively flat undisturbed land, farmland, and pastureland. The quarry area is predominantly undisturbed with six nearby residences. This alignment continues easterly from the quarry passing through undisturbed land until crossing County Road 265 where the alignment is within 1,000 feet of a residence. This route then passes between two residences and within 1,000 to 2,500 feet of two additional residences along FM 2676. South of FM 2676, the alignment crosses farmland, pastureland, and undisturbed land until it comes within 1,000 feet of a residence along County Road 461. In addition, the MCEAA Medina Dam Alternative passes through a grouping of 12 residences between County Road 4516 and County Road 4643, continues southerly passing through farmland, pastureland and undisturbed land until finally reaching the tie-in with the UP line just north of U.S. Highway 90 and 1.5 miles west of County Road 4643. SEA conducted 12 sound level measurements along or adjacent to the MCEAA Medina Dam Alternative. The existing L_{dn} ranges from 40 to 64 to 51 to 50 dBA, from north to south, based on the LT measurements.

4.1.8 SGR's Modified Medina Dam Route

SGR's Modified Medina Dam Route begins in the northern portion of the study area at the quarry and connects with the UP rail line at the same location as the Proposed Route tie-in. However, between those two points SGR's Modified Medina Dam Route bows further to the east. This route primarily traverses a rural area composed of relatively flat farmland, pastureland, undisturbed areas, and widely scattered residences. The quarry area is predominantly undisturbed with six nearby residences. There is a group of residences at the intersection of County Road 353 and 354 north of SGR's Modified Medina Dam Route. This alignment also passes within 1,000 feet of a residence along FM 2676. Southeast of this point, the alignment runs through farmland, pastureland and undisturbed land until passing two residences within 1,000 feet of Private Road (PR) 3660. The alignment passes two additional residences further south on County Road 366 and passes through farmland again until coming near another group of approximately 11 residences along County Road 4516. The alignment then passes within 1,000 feet of two residences along County Road 4643 and finally traverses through farmland, pastureland, and undisturbed land until reaching the tie-in with the UP line. SEA conducted 15 sound level measurements along or adjacent to SGR's Modified Medina Dam Route. Based on the LT measurements, the existing L_{dn} ranges from 40 to 64 to 51 to 50 dBA from north to south.

4.1.9 No-Action Alternative

In general, this alternative would involve the movement of approximately 1,700 loaded and empty heavy trucks trips using the public roads County Road 353, FM 2676, and County Road 4516 between the quarry and the UP rail line. Please refer to Section 4.12 of the DEIS for SEA's discussion of truck transport noise. According to the DEIS, the existing noise level along the truck transport route is an L_{dn} of 52 dBA. SEA considers several LT measurements obtained during the new noise study to be suitable for describing the existing noise environment along the potential truck routes for the No-Action Alternative, as shown in Table 4-1. The average of the four pertinent L_{dn} values is 52 dBA, thus confirming the previously determined existing noise level.

4.2 Methodology

SEA used several methods to predict the noise and vibration expected from the construction and operation of the various rail alternatives and the No-Action Alternative, as presented in the following subsections.

4.2.1 Railroad Noise Prediction/Impact Assessment

SEA used the computations in *Assessment of Noise Environments Around Railroad Operations* for modeling heavy rail noise (Swing 1973). This document was developed by Wyle Laboratories for a consortium of regional and national freight rail operators to model noise from freight rail line and classification yard operations. Agencies and consultants have used the calculations and guidance provided in this report for many years to predict noise arising from heavy freight rail operations. This model is based on extensive measurements and includes noise from locomotives, rail cars, and wheel/rail interactions. Locomotives are modeled at throttle notch setting 8, which is appropriate for the required power and speed of the freight trains traveling between the quarry and the UP line.

As discussed earlier in this chapter and summarized here, both Federal and state of Texas regulations require the sounding of the train horn when approaching a public highway-railroad grade crossing.[6] SEA made adjustments to the basic train operations noise prediction where appropriate to account for train horn noise expected in the vicinity of railroad and public road at-grade crossings. SEA modeled train horns using a reference Sound Exposure Level of 109 dBA, representing average train horn sound levels consistent with measurement data published by the Board, train horn noise measurements from previous studies, and other sources.[7]

SEA used the Board's noise impact criterion for assessing the potential for adverse environmental noise effects.[8] Thus, SEA evaluated the No-Action Alternative, the Proposed Route, and all alternative rail alignments on the same basis to determine if they would result in the following conditions:

- An increase of 3 A-weighted decibels (dBA) or more in community noise exposure as measured by L_{dn}; and
- An increase to a noise level of 65 dBA L_{dn} or greater.

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[6] FRA Final Rule on the Use of Locomotive Horns at Highway-Rail Grade Crossings (49 CFR Parts 222 and 229); Texas Administrative Code, Title 43, Part 1, Chapter 7, Subchapter D, Rule §7.31 (c)(9).

[7] See Surface Transportation Board, Section of Environmental Analysis, *San Jacinto Rail Limited and the Burlington Northern and Santa Fe Railway Company, Construction and Operation of a Rail Line from the Bayport Loop in Harris County, Texas*, Draft Environmental Impact Statement, Appendix G: Noise Methodology, STB Finance Docket No. 34079, Washington, DC, 2002; Surface Transportation Board, Section of Environmental Analysis, *Proposed Conrail Acquisition*, Final Environmental Impact Statement Appendix J: Noise Analysis, STB Finance Docket No. 33388, Washington, DC, 1998; Surface Transportation Board, Section of Environmental Analysis, *Dakota, Minnesota & Eastern Railroad Corporation, Construction into the Powder River Basin*, Draft Environmental Impact Statement Appendix F: Noise Analysis, STB Finance Docket No. 33407, Washington, DC, 2000; U.S. Army Corps of Engineers, *West Hayden Island Development Program Environmental Impact Statement*, URS Corporation, Washington, DC, 2000; and URS Corporation, *Independent Technical Review of the Noise and Vibration Impact Analysis for the OCTA Santa Ana Second Main Track Project Draft Environmental Impact Report*, Santa Ana, CA, 2001.

[8] 49 CFR 1105.7 (e)(6).

4.2.2 Railroad Vibration Prediction/Impact Assessment

For modeling freight rail train vibration and performing operational vibration impact analysis, SEA selected the Transit Noise and Vibration Impact Assessment Final Report (DOT-T-95-16) developed for the U.S. Department of Transportation, Federal Transit Administration (FTA) (FTA 1995).[9] Briefly, this method establishes a vibration criterion level based on the number of daily vibration events (i.e., railroad train pass-bys). For an infrequent number of daily events (i.e., less than 70), the impact criterion is a VdB of 80 for Category 2 land uses defined in the FTA report as "residences and buildings where people normally sleep." This impact criterion is applicable for the alternatives under consideration here.

SEA also assessed the potential for SGR's train operations to cause vibration impacts to water wells by evaluating data in published scientific papers and government agency reports and guidelines.[10]

4.2.3 Heavy Truck Noise/Vibration Prediction/Impact Assessment

In the DEIS, SEA modeled the existing and predicted noise levels for the truck transport of quarried material that would take place under the No-Action Alternative. Thus, SEA has used those results in this SDEIS to compare potential impacts to the seven rail alternatives using the Board's noise criteria and FTA vibration criteria

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[9] A functionally equivalent version of the FTA methodology was subsequently adopted by the Federal Railroad Administration (FRA, 1998) with a focus on high speed rail systems. The FTA methodology is more relevant to the SGR project than the FRA methodology because FTA contains information regarding noise and vibration from low-speed heavy rail freight trains. The FTA Noise and Vibration Impact Assessment Final Report was updated in May, 2006 (FTA-VA-90-1003-06) with no substantive changes.

[10] FTA 1995; Jones & Stokes 2004, *Transportation-and construction-induced vibration guidance manual*.

4.2.4 Construction Noise/Vibration Prediction/Impact Assessment

SEA predicted construction noise levels using data primarily developed by the USEPA,[11] verified more recently by measurement of typical heavy construction equipment in operation[12] and data provided in the previously cited FTA manual. The FTA manual and additional references were also used for conventional and specialized construction vibration assessment. The criteria for determination of adverse effects are a synthesis of recommendations, guidelines, and criteria used by several agencies to evaluate noise and vibration levels resulting from construction of linear infrastructure projects. For example, the FRA and FTA methodology guidelines offer a recommendation based on a detailed noise assessment that a daytime, eight-hour L_{eq} from construction activities should not exceed 80 dBA to avoid adverse effects. If this limit is exceeded "there may be adverse community reaction."[13]

SEA evaluated the potential for construction vibration damage to residences and cultural resources, including the most sensitive category of extremely fragile historic structures and ruins, and to local water wells. Both FRA and FTA analysis guidelines also call for investigation of the potential for vibration-induced damage to fragile or extremely fragile buildings (FTA, 1995; FRA, 1998). Conventional construction vibration levels are not generally adverse to modern buildings and reasonably sound structures that may be 50 or more years old unless they are located very close to the construction activity. Rail line construction may require special construction techniques, such as pile driving. Pile driving activity during SGR's proposed construction activities may occur in limited locations where bridge construction is necessary to cross streams and washes. SEA calculated the expected ground vibration from a large pile driver and compared the results with published criteria for residences and historic cultural resources that are more conservative than the criteria used by the FTA and FRA.

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[11] USEPA 1971, *Noise from Construction Equipment and Operations, Building Equipment and Home Appliances*.

[12] URS Corporation 2006, *Environmental Impact Report #604 for the Frank R. Bowerman Landfill Implementation*, Volume 2, Technical Appendix H: Noise and Vibration Study.

[13] FTA 1995, at 12-6 and 12-7.

SEA also analyzed the potential for construction vibration damage to water wells that might be located very close to potential rail routes. The potential for construction vibration impact on water wells and other surface and buried structures was assessed by evaluation of data in published scientific papers and government agency reports and guidelines.[14]

4.3 Potential Noise Impacts

SEA assessed the potential for adverse noise effects from SGR's proposed train operations by comparing the predicted noise levels for the several rail routes under consideration with the Board's adverse effects noise criterion of a 3 dBA or greater increase in existing L_{dn} and an increase to 65 dBA L_{dn} or greater. As summarized in Section 4.3.3, operations over Alternative 3 and the Proposed Route would have fewer noise impacts than the other alternatives. Operations over Alternative 2, the Eastern Bypass Route, the MCEAA Medina Dam Alternative, and SGR's Modified Medina Dam Route would cause slightly more adverse noise impacts than the Proposed Route and Alternative 3, but fewer impacts than Alternative 1 or the No-Action Alternative. SEA believes that the least desirable alternatives from a noise impact perspective are Alternative 1 with the second-most impacts, and the No-Action Alternative with the most impacts.

While various factors would affect the noise level at any given location, as discussed in the noise science material found in Appendix A-2 of the technical report (included in Appendix C-3 of this document), it bears comment here that the most important variable factor is the relative distance between the railroad track centerline and the noise-sensitive use.[15] The seven rail alignments are based on preliminary data and are somewhat schematic as presented on the available project alternative maps. SGR has indicated that if a route is approved, the alignment

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[14] FTA 1995; Greene, et. al. 2002, *Comparison of Pile-Driver Noise and Vibration from Various Pile-Driving Methods and Pile Types*; Jones & Stokes 2004; and URS Corporation 2001, *Analysis of Potential Damage Risk to Buried Concrete Pipe (RCP) and Manhole Structure Due to Construction Related Vibration at ExxonMobil, Benecia, California*.

[15] Due to the typically large parcels in the study area, SEA considered a noise sensitive receptor to be the residential structure plus a 200 feet radius buffer zone as an activity area of frequent human use.

would be refined by final engineering (see Appendix B-1, #E1-1664, page 5 and #E1-1439, page 6). Thus, for uniformity of analysis, SEA modeled the potential impacts using the provided map's distance between a sensitive use and the nearest railroad tracks for each rail alternative, notwithstanding that the map alignment may pass very close to or directly through a sensitive use.[16]

4.3.1 Construction Activities

4.3.1.1 Conventional Construction

Noise from construction activity is generated by the broad array of powered noise-producing mechanical equipment needed to construct track bed, install track, and construct loading track and tie-in track facilities for the project. This equipment ranges from hand-held pneumatic tools to scrapers, bulldozers, dump trucks, and tie- and rail-handling equipment. The exact complement of noise-producing equipment that would be in use during any particular period of construction has not yet been determined for the project. Construction activities could be in progress at more than one part of the overall alignment at any given time.

Using the data from USEPA and others,[17] SEA believes that conventional construction noise levels associated with various construction activities from a project construction site would be 89 dBA L_{eq} at a reference distance of 50 feet during the noisiest phases of construction activity. The magnitude of the temporary noise increases above the existing ambient noise level would depend on the type of construction activity, the noise level generated by specific pieces of construction equipment, site geometry (including shielding from intervening terrain or other structures), and the distance between the construction noise source and noise-sensitive areas.

Noise generated by construction equipment decreases at a rate of approximately 6 decibels for every doubling of distance as it leaves the source and travels outward. Intervening structures that block the line of sight between the source and receiver would further decrease the resultant noise level, as would the effects of propagation through air and over rough or vegetated ground. The actual minute-by-minute construction noise level typically varies over time because

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[16] See Section 3.10 of this SDEIS for SEA's discussion of proposed mitigation for this issue.

[17] USEPA 1971; URS Corporation 2006.

construction activity is intermittent, plus the power demands on construction equipment and its resulting noise output are cyclical.[18]

Neither the FRA or FTA manual specifies standardized construction noise impact criteria, but both do provide reasonable guidelines to be used in the absence of, or in conjunction with, local ordinances and noise impact criteria (FRA, 1998; FTA, 1995).[19] Table 4-2 lists these guidelines, which prescribe different levels for daytime and nighttime construction. As explained earlier in this chapter, "daytime" is defined as 7:00 am to 10:00 pm and "nighttime" is defined as 10:00 pm to 7:00 am.

Table 4-2. Prescriptive Federal Railroad Administration Construction Noise Impact Guidelines

Receptor Category	One-Hour L_{eq} (dBA)	
	Day	Night
Residential	90	80
Commercial	100	100
Industrial	100	100

Based on the estimated distances from the proposed railroad tracks to noise-sensitive uses, SEA predicts that project construction noise levels on an hourly basis could range from 83 dBA L_{eq} at 100 feet, to less than 65 dBA L_{eq} at 600 feet, and continuing down to inaudibility at great distances. These noise levels would be temporary and would reduce to inaudibility as the project construction activity would progress along a route. Based on the FRA construction noise impact guidelines, and if SEA's recommended mitigation as listed in Section 4.6 is imposed, SEA believes that conventional construction activities for any of the alternatives would not cause adverse noise impacts, except to the few locations that are presently shown as very close to project construction based on the schematic route alignments discussed previously.

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[18] Beranek, L.L. and I.L. Ver, eds. 1992, *Noise and Vibration Control Engineering*, Chapter 18.5.

[19] The two manuals are consistent/identical with respect to the environmental impact assessment of a railroad project's operational and construction noise/vibration.

4.3.1.2 Specialized Construction

Special construction techniques such as pile driving may be required in a few specific locations for bridge construction depending on the selected route. Because the primary source of noise from pile drivers is physically elevated, it does not typically benefit from a reduction in sound energy due to intervening low-height landforms and structures. The noise attenuation (decrease) from other factors, such as propagation distance and air absorption with distance, still applies to noise from pile driving.

SEA reviewed FRA and FTA guidelines and data from other published studies about pile driving noise and determined that the typical L_{eq} produced during pile driving (hammering the pile) ranges from 82 to 100 dBA at a distance of 50 feet. SEA believes that the noise level value of 100 dBA L_{eq} for pile driver noise compared to conventional construction noise levels of 89 dBA L_{eq} would cause a higher degree of temporary disruption if there are noise-sensitive activities in the immediate vicinity of the pile driving activity and may result in localized adverse effects within 500 feet of a residential use.

Allowing for point-source divergence[20] and excess attenuation, SEA calculated the average sound levels that might occur at various larger distances from the pile site during pile driving activity. The resulting L_{eq} sound levels are presented in Table 4-3.

[20] A point source is generally a single noise producing device such as a truck a lawnmower, an air conditioner, or even a factory if one is far away from it. Sound travels away from this type of source as the ripples on a pond move away from a stone tossed into the pond.

Table 4-3. Calculated Sound Levels from Pile Driving

Distance from Construction Area	Calculated Sound Level L_{eq} (dBA) [21]
800 feet	73
1,600 feet	69
2,100 feet	65
2,600 feet	63
3,500 feet	59

SEA's analysis indicates that pile driving noise, although remaining clearly audible at substantial distances from the construction site, would comply with the eight- hour daytime construction noise decibel limits recommended by FRA/FTA at a distance of approximately 300 feet or more from the pile driver, either as an individual source by itself or in combination with other construction noise. Thus, SEA concludes that no widespread noise impacts from special construction activity would occur where this activity is located sufficiently far from sensitive receptors. Nevertheless, SEA is recommending mitigation that would require SGR to conduct pile driving activities only during the daytime (7 a.m. to 7 p.m.) to reduce any potential adverse impacts.

4.3.2 Loading Track and Side Track

Under all alternative rail alignments, multiple tracks would be located close to the loading track at the northern terminus of the line within the quarry area. This area is intended for rail cars to wait to be picked up by the locomotives. The rail line would terminate in the plant site, allowing 1,000 feet of buffer zone from the beginning point of the quarry. Noise would occur during the loading process. However, sound levels from loading would be expected to be consistent with those generated by quarry operation and would not result in off-site effects. If the loading track is in the shape of a loop (the loading track would either be a loop or a series of parallel straight tracks), the curve radius of the loop track could be designed to preclude wheel

[21] Pile driving activity consists of quiet periods alternating with noisy periods for various durations of activity; the calculated L_{eq} would be representative of a one hour period during active pile driving.

squeal noise from occurring.[22] Additionally, the typically higher wheel-rail noise associated with a fixed-point, as opposed to a movable point track crossover (also called a frog)[23] that would be located at the neck of the loop, would not likely cause adverse noise effects due to the large distance to the nearest sensitive receptor.

Additional noise sources that would be associated with either the side track or loop track would be the sound of coupling and uncoupling rail cars, indexing the train to permit loading at a specific point, and the start-up or stopping of a loaded or unloaded train. The noises generated would generally consist of a discrete "banging" noise of short duration (typically less than one second) during which the sound-pressure level would rise rapidly before falling below the level of the background noise, plus a higher pitched, but lower level, sound of the train's brakes. SEA reviewed two studies of this type of rail operations sound. In one study (U.S. Army Corps of Engineers 2000), the maximum sound level (L_{max}) at 50 feet from the train varied from 76 to 91 dBA, with an average maximum sound level of 87 dBA.[24] In the second study, sound-level measurements conducted during railcar coupling at other locations ranged from 79 to 94 dBA L_{max} at 50 feet from the source, with an average maximum sound level of 87 dBA (U.S. Army Corps of Engineers 2003).

As was done for the DEIS, SEA performed acoustical calculations to estimate the sound level from the loading and side track activities at the closest residence located approximately 1000 feet from the loading area. SEA considered the impact noise a point sound source that attenuates (decreases) at a rate of 6 dBA per doubling of distance away from the source. Assuming a direct line-of-sight, the very brief average maximum sound level is calculated to be approximately 60 dBA at the closest residence. Intervening topography, structures, and heavy

[22] Wheel squeal from curved track segments can usually be avoided by designing all turn radii to be greater than 1000 feet, or 10 times the railcar truck wheelbase, whichever is less. SEA is recommending this as mitigation.

[23] A track crossover or "frog" is used to merge two tracks into one and vice versa.

[24] The highest maximum sound level of 91 dBA resulted from a requested test impact at the highest safe speed of coupling, and not from normal operations that yielded a maximum sound level of 87 dBA.

vegetation could further reduce the impact noise level by 5 to 10 dBA. Noise from train-related loading and coupling activity could be periodically audible at the closest residences, but would not appreciably increase the L_{dn}, and thus, would not impact any residence.

SEA also notes that between indexing (moving the train very short distances to align a railcar with a loader) and coupling movements, a stationary, idling locomotive was also measured during one of the studies (U.S. Army Corps of Engineers 2000). The idling locomotive generated a continuous average sound level of 72 dBA L_{eq} at a distance of 50 feet from the locomotive. For SGR's proposed operations, this sound level would decrease to 46 dBA L_{eq} at the nearest residence due to distance. Intervening topography, structures, and heavy vegetation would further reduce the noise level, to the point where an idling locomotive may be inaudible to barely audible while in the loading and side track area. Its noise would not measurably increase the L_{dn} and, thus, would not impact any residence.

A side track might be necessary at the transfer point where any of the rail alternatives would connect to the UP line. SEA's analysis of the side track activity noise emission is applicable to the potential tie-in points with the UP line. Precise locations of side tracks have not been developed by SGR for the tie-in areas. However, approximate distances to the tracks near the tie-in points from the closest house are: Proposed Route, 640 feet; Alternative 3, 550 feet; the Eastern Bypass Route, 460 feet; the MCEAA Medina Dam Alternative, 720 feet; and SGR's Modified Medina Dam Route, 470 feet. The resultant sound levels would briefly reach an L_{max} of approximately 66 dBA. The closest residences to an Alternative 2 side track would be the Creekwood Subdivision approximately 250 feet away that could experience a brief L_{max} of 73 dBA. The closest house to an Alternative 1 side track is approximately 200 feet away and the brief sound level would be 74 dBA L_{max}. Note that this location would be impacted by train operations noise from Alternative 1 with or without a side track. The sound level of an idling locomotive on a side track would be 15 dBA lower than the L_{max} values, ranging from 51 to 59 dBA L_{eq} at the nearest receiver. SEA's analysis of the potential noise levels and the likely duration and frequency of use of a side track indicates that this activity alone would likely not cause adverse noise impacts. However, for the reasons explained above, it is remotely possible that operations over a side track near the Creekwood Subdivision for Alternative 2 might cause some adverse noise impacts.

4.3.3 Rail Operations

Table 4-4 shows how many residences near each rail alignment or the No-Action Alternative route would experience a 3 dBA L_{dn} increase. Table 4-5 shows how many residences near each rail alignment or No-Action Alternative route would experience a 3 dBA L_{dn} increase and an increase to an L_{dn} of 65 dBA or greater from SGR's rail operations. Note that all residences where the project would cause an increase in noise to 65 dBA L_{dn} would also experience a 3 dBA increase in L_{dn} compared to existing levels.

Table 4-4. 3 dBA L_{dn} Increase

Route	Number of Houses
Proposed	20
Alternative 1	32
Alternative 2	27
Alternative 3	15
Eastern Bypass	18
MCEAA Medina Dam	17
SGR Modified Medina Dam	20
No-Action Alternative	30

Table 4-5. Increase to 65 dBA L_{dn} or greater and 3 dBA L_{dn} Increase

Route	Number of Houses
Proposed	1
Alternative 1	9
Alternative 2	2
Alternative 3	0
Eastern Bypass	2
MCEAA Medina Dam	2
SGR Modified Medina Dam	2
No-Action Alternative	30

Using the summary information provided in Table 4-5, Alternative 3 and the Proposed Route would have fewer noise impacts from SGR's proposed rail operations than the other alternatives. Operations over Alternative 2, the Eastern Bypass Route, the MCEAA Medina Dam Alternative and SGR's Modified Medina Dam Route would cause slightly more adverse noise impacts than the Proposed Route or Alternative 3, but fewer impacts than Alternative 1 or the No-Action Alternative. The least desirable alternatives from a noise impact perspective are Alternative 1 with the second-most impacts, and the No-Action Alternative with the most impacts.

More detailed information on potential noise impacts to parcels within each rail alternative is provided in Section 9.1.1 of the technical report in Appendix C-3.

4.3.3.1 Indirect and Cumulative Noise Impacts

The project is not expected to create any adverse indirect noise impacts. All noise from existing activities was part of SEA's direct impact assessment of this project. An evaluation of potential cumulative noise effects requires the consideration of existing or reasonably foreseeable future projects resulting from Federal or non-Federal actions, including private actions whose independent noise effects could combine with less than substantial project effects to create an additional adverse effect. The only reasonably foreseeable project that might result in noise of any noteworthy magnitude would be the proposed quarry located in the vicinity of the project's loading and side track in the northeasterly corner of the study area. The two primary noise sources associated with the quarry would be (1) sub-grade blasting activities to fracture the rock formations, and (2) the excavation, transport, and loading of rock onto the project trains.

According to SGR, the blasting activity at the quarry would occur approximately once per day.[25] The below grade explosion is designed to fracture rock into smaller pieces for excavation. The production of fly-rock and dust is purposefully minimized by placing the explosive charges 50 feet below ground level in a grid of holes and using a series of short (a few milli-seconds) time delays between charge holes. This blasting procedure results in a very brief

[25] Appendix B-1 of the SDEIS, #EI-2095.

sound at off-site areas. The sound would be perceived as a thump or short rumble sound like distant thunder because of its predominately low frequency content. The sound would be very audible (but not harmful) in the northerly and perhaps audible in the central portion of the study area. With no shielding the sound could briefly approach a maximum 95 dBA at the nearest residence approximately 1,200 feet distant, and it would be gone within a second.[26] There would not be substantial acoustic energy in this brief blasting noise event and its effect on the overall sound levels combined with any of the project alternatives would be minimal.

The second group of noise sources at the quarry would be very similar to conventional construction noise (please see Section 4.3.1.1). The distances to the limits of quarrying activity, plus the shielding provided by landforms, would act to appreciably reduce blast and quarry operations noise at the nearest sensitive receptors. Thus, quarry noise would not materially contribute to the noise caused by construction and operation of any of the railroad alternatives or the No-Action Alternative noise and no adverse cumulative noise effects are expected.

4.4 Potential Vibration Impacts

Existing vibration levels in the study area were not perceptible to SEA's noise and vibration specialists conducting the field study. This included locations near existing railroad and highway traffic. SEA concludes that the ambient vibration level is below 65 VdB, the human perception level for ground vibration according to FRA and FTA guidelines (FRA 1998; FTA, 1995).

Based on SEA's vibration analysis, SEA concludes that fragile or extremely fragile cultural resources in the study area are unlikely to be affected by the construction and operation of a rail alternative. Please refer to Chapter 5 for a discussion of potential vibration impacts to the cultural resources in the area including impacts from the No-Action Alternative.

Operations over Alternative 1 would cause vibration annoyance impacts to two houses. These locations are identified as house number 41 and house number 25 on Figure 2b of the

[26] URS Greiner Woodward-Clyde, 2000, *Blast Noise Measurements at Dry Creek Rock Plant*.

technical report and discussed in Section 9.2.1 of the report (see Appendix C-3). None of the other rail alternatives would create operations-related vibration impacts.

SEA predicts no vibration impacts during conventional construction phases of the project. Pile driving could cause impacts to water wells. This impact could be mitigated by conducting a pre-construction survey to locate nearby wells and monitoring the vibration levels at these wells to ensure that the peak particle velocity (PPV) limit of 2.72 inches per second in any axis is not exceeded.[27] Thus, SEA is recommending this mitigation in Chapter 6. Please see Section 9.2 of the technical report in Appendix C-3 for SEA's detailed vibration analysis.

4.5 Indirect and Cumulative Vibration Impacts

SEA does not believe that any reasonably foreseeable indirect vibration impacts would result from the project alternatives. In addition, damaging or perceptible quarry-activity-related ground vibration, including blasting vibration, would not propagate outside the quarry boundary. Therefore, SEA expects no cumulative adverse vibration effects to occur.

4.6 Preliminary Conclusions and Mitigation

Based on its additional analysis set forth in this SDEIS, SEA concludes that construction related to any rail alternative would not cause significant adverse noise effects. SEA also concludes that construction vibration would not damage residences and cultural resources, or local water wells as long as SEA's recommended mitigation measures are implemented.

With respect to potential noise impacts from rail operations (summarized in Section 4.3.3), Alternative 3, and the Proposed Route would have no or very low impacts. Operations over Alternative 2, the Eastern Bypass Route, the MCEAA Medina Dam Alternative, and SGR's Modified Medina Dam Route would have slightly greater impacts than Alternative 3 or the Proposed Route, but less than Alternative 1 or the No-Action Alternative. SEA believes that the least desirable alternatives from a noise impact perspective are Alternative 1 with the second-most impacts, and the No-Action Alternative with the most impacts. Please see Table 4-5, above.

[27] In other words, in either of the two lateral directions or in the vertical direction.

Because construction and operation of a rail line alternative could cause some adverse noise impacts to sensitive receptors, SEA has developed appropriate noise mitigation measures, as set forth below.

SEA recommends that the mitigation measures listed below be imposed on any decision granting SGR authority to construct and operate its rail line (this mitigation would be applicable to any of the rail alternatives):

1. Southwest Gulf Railroad Company (SGR) shall equip all noise-producing project construction equipment and vehicles using internal combustion engines with mufflers, air-inlet silencers, and other shrouds, shields, or other noise-reducing features in good operating condition that meet or exceed original factory specification. SGR shall equip mobile or fixed package equipment (e.g., arc-welders, air compressors) with shrouds and noise control features that are readily available for that type of equipment.

2. Southwest Gulf Railroad Company shall comply with all applicable local, state, or Federal regulations that control the noise output produced by mobile or fixed noise-producing equipment during rail construction activities.

3. Southwest Gulf Railroad Company shall use electrically-powered equipment instead of pneumatic or internal combustion powered equipment during rail construction activities, where such equipment is available to perform the same function.

4. Southwest Gulf Railroad Company shall minimize noise by locating material stockpiles, mobile equipment staging areas, parking areas, and maintenance areas as far as practicable from noise sensitive receptors.

5. Southwest Gulf Railroad Company shall establish and enforce a 10 mile per hour construction site and 25 miles per hour private construction access road speed limits during the rail construction period.

6. Southwest Gulf Railroad Company shall not engage in rail construction activities between 7:00 p.m. and 7:00 a.m. Monday through Saturday or at any time on Sunday or on Federal holidays. Exceptions may be made for emergency situations.

7. Southwest Gulf Railroad Company shall use noise-producing signals, including horns, whistles, alarms, and bells for safety warning purposes only.

8. Southwest Gulf Railroad Company shall ensure that no project-related fixed, mobile, or portable public address or music system is audible at any adjacent noise sensitive receptor, except for emergency purposes.

9. To minimize wheel squeal, if a loop track is used, Southwest Gulf Railroad Company shall design a loop track with a radius greater than 1000 feet or 10 times the wheelbase of the largest car used on the tracks.

10. Southwest Gulf Railroad Company shall provide a track lubrication system for a loop track to mitigate wheel squeal noise if such noise occurs.

11. Southwest Gulf Railroad Company shall provide a movable point crossover (a crossover designed with a spring loaded piece to eliminate the noise producing gap) to mitigate excess noise from a crossover at the neck of a loop track (where the curved track reconnects with the tangent (straight) track).

Because no vibration impacts are predicted during conventional construction phases of the project, no mitigation measures are recommended or necessary for conventional construction. Pile driving however, could cause impacts to water wells. This impact could be mitigated by conducting a pre-construction survey to locate nearby wells and by monitoring the vibration levels at these wells during pile driving to ensure that the peak particle velocity (PPV) limit of 2.72 inches per second in any axis (see footnote 27, above) is not exceeded during construction.

Other than impacts to two residences along Alternative 1, none of the other rail alternatives would generate vibration impacts from operations, thus no mitigation measures are recommended or necessary for operating any other rail alternatives. It is not practicable to mitigate operational vibration at the two impacted residences along Alternative 1. Refer to Chapter 5 of the SDEIS for more information regarding impacts to cultural resources.

4.7 Comparison of DEIS and SDEIS Noise and Vibration Analysis

Due to SGR's updated operations information – that trains may operate during nighttime hours – SEA decided to conduct a new noise study of all the alternatives. SEA also conducted additional vibration analysis in conjunction with the noise study in this SDEIS. SEA enlarged the field study area to encompass the Eastern Alternatives. As previously stated, the inclusion of previously studied alternative routes allowed SEA to evaluate and compare the potential noise and vibration impacts of all eight alternatives being studied in this environmental review process on an equal basis. Thus, SEA's new noise and vibration study assessed all seven rail line alternatives plus the No-Action Alternative.

Collecting the ambient noise measurement for all the alternatives at the same time allowed SEA to establish comparable baseline measurements for all the rail line alternatives and the No-Action Alternative. Further, the SEA field team was granted permission by several private property owners to conduct measurements closer to their noise-sensitive dwelling areas. These measurement locations were farther away from local traffic noise, allowing SEA to more appropriately describe some of the existing noise levels than was possible during the previous DEIS study. SEA notes that the previous measurements did accurately describe the environmental noise that existed during the measurement period at the locations where they were obtained. For example, the earlier characterization of L_{dn} along the No-Action Alternative route was verified exactly by the new measurements. Also, measurements obtained at roadside and fence line locations during periods of no nearby vehicular traffic, as was done for the DEIS study, are suitable to represent the ambient noise level in a broader area.

SEA used the Wyle methodology (Swing 1973) to model freight train noise in both the DEIS and this SDEIS. SEA discussed the potential effects of train horn noise in the DEIS on a qualitative basis. For the SDEIS, SEA used data from several studies to quantitatively model the sound from train-mounted warning horns because the rules for sounding of the train's horn at crossings of public roads are now clear as a result of new regulations issued by the FRA. The projected train operations noise contours in the SDEIS reflect the increased noise near grade crossings due to the mandated use of the safety warning horns.

In the DEIS study, SEA used Board and FTA criteria for evaluating potential operational noise impacts. SEA believes that the Board criterion is more appropriate for assessing the potential impact of a very low number of freight train operations as compared to the FTA method that was designed to assess the effects of numerous transit trains sharing tracks or routes with high volume freight train service. Therefore, SEA used the Board criterion to determine operational noise impacts in this SDEIS. SEA also draws upon the reference studies of the USEPA, FRA, and FTA, as it did previously in the DEIS analysis of construction noise. However, SEA augmented the information presented in those studies with data from additional sources for the SDEIS analysis.

Additionally in the SDEIS, SEA modeled and evaluated the potential effects of project construction and operation vibration. SEA analyzed vibration using the FTA methods. However, SEA has followed a more conservative approach for the vibration assessment, selecting the higher magnitude source levels, efficient propagation assumptions, the most sensitive of the receiver structure types, and impact criteria from published sources that are more conservative than FTA and FRA criteria. As a result, SEA has updated the mitigation recommendations in the DEIS for reducing construction-related vibration impacts.

SEA also conducted an extensive analysis of potential cumulative noise and vibration impacts from non-railroad quarry activities, including rock blasting, in the SDEIS. As a basis for its analyses, SEA used the data from independently-conducted, published studies of rock blasting at other quarries in addition to information provided by SGR regarding activities anticipated at the proposed quarry.

The results of the SDEIS are consistent with the results in the DEIS for the issues analyzed: construction activities would not cause significant adverse impacts; the recommended mitigation measures are similar, with the addition of requiring the use of best practices for construction noise control. The results of the analysis of potential noise and vibration impacts from proposed rail or truck operations are also consistent, except that the No-Action Alternative may potentially have more adverse impacts.