3.9 NOISE AND VIBRATION

Noise is defined as sound that is perceived by humans as unpleasant or excessively loud. Noise of sufficient strength may pose health concerns such as hearing loss or sleep disturbances. Noise impacts are somewhat variable and often depend on land uses. For example, areas where people sleep tend to be more sensitive to noise compared with places where people congregate during the day, such as parks or schools.

Vibration occurs continuously at all times but is typically at levels that are imperceptible to humans. When ground-borne vibration becomes problematic, these levels are strong enough to be noticeable. As with noise, vibration impacts can vary based on land uses. For example, a residence is generally more affected by vibration than a commercial building.

STUDY AREA AND METHODOLOGY

The study area used to analyze impacts of noise on *sensitive receptors* (i.e., residences, schools, etc.) encompasses the area within approximately 1,500 feet of the proposed project site, wetland mitigation site, and Anacortes Subdivision, and extends south along the Bellingham Subdivision to the Skagit/Snohomish county line. The Federal Railroad Administration (FRA) screening level assessment identified that noise impacts were unlikely for noise sensitive receptors located beyond this distance. Additionally, this is a distance consistent with other analyses of crude-by-rail projects currently under review with the Washington State Department of Ecology (Ecology).

Sensitive receptors represent all land use activity categories where the Federal Transit Administration (FTA) has established noise impact criteria for various types of noise sensitivity. Land use activity categories include residences, recreation areas, hotels, schools, churches, libraries, and hospitals.

The study area for vibration is along the same corridor, but represents a narrower zone of potential impact. It encompasses the area within 500 feet of the proposed project site, wetland mitigation site, Anacortes Subdivision, and Bellingham Subdivision to the Skagit/Snohomish county line. The FRA's screening level assessment identified that vibration impacts were unlikely for sensitive receptors located beyond this distance. This is a distance consistent with other analyses of crude-by-rail projects in Washington currently under review with Ecology. The vibration study area includes vibration-sensitive structures that may be affected by the proposed project. Noise impacts to wildlife are discussed in Chapter 3.6 – Vegetation and Terrestrial Wildlife. Additional information on potential impacts to tribal resources can be found in Chapter 3.7 – Cultural Resources.

The cumulative impacts study area includes the areas adjacent to the Anacortes and Bellingham subdivisions within Skagit County. This is the area where new ambient noise and vibration would most likely increase when compared with existing conditions.

Noise and/or vibration impacts may result from construction and operation of the proposed project. "Noise" is defined as unwanted sound and is measured in decibels (dB) on a logarithmic scale. Because human hearing is not equally sensitive to all sound frequencies, certain frequencies are given more weight. This process is known as "weighting" the frequency, and A-weighting (dBA) the frequency corresponds to the human hearing response. The A-weighted scale is used in most noise ordinances and standards. In this noise and vibration analysis, noise metrics were used to describe noise levels: the average energy level (L_{eq}), and the day-night average sound level (L_{dn}). The L_{eq} is the energy-averaged noise level for a period of time—in this case, hourly. The L_{dn} is the average equivalent sound level over a 24-hour period, with a 10 dBA penalty added for noise during nighttime hours from 10 p.m. to 7 a.m., to reflect the impacts on nighttime activities such as sleeping. Common sound levels are provided in Figure 3.9-1.

Figure 3.9-1 Typical A-Weighted (dBA) Sound Levels

Construction and operation of the proposed project would produce vibration levels that may be annoying or disturbing to humans and cause damage to nearby structures. Measurements of vibration are expressed in terms of the peak particle velocity (PPV), the maximum velocity experienced by any point in a structure during a vibration event (defined as an event lasting less than 10 seconds, such as vibration associated with a locomotive passing by a specific location). PPV is often used in determining potential damage to buildings due to blasting and other construction activities.

Because the human body takes some time to respond to vibration signals, the root mean square (rms) amplitude is used to describe the “smoothed” vibration amplitude. Decibel notation is used to compress the range of numbers required to describe vibration expressed as VdB. Typical vibration velocity levels experienced from 50 feet away are provided in Figure 3.9-2.

Figure 3.9-2 Typical Vibration Velocity Levels

Regulatory Framework and Methodology

Select laws, regulations, and guidance applicable to proposed project noise and vibration are summarized in Table 3.9-1. This section describes compliance requirements and the methods used to determine the potential impacts from noise and vibration associated with construction and operation of the proposed project.

Table 3.9-1 Laws, Regulations, and Guidance for Project-Related Noise and Vibration

Laws, Regulations, and Guidance	Description
Federal	
Noise Control Act of 1972 (42 USC 4901)	Establishes a national policy to promote an environment for all Americans free from noise that jeopardizes their health and welfare. The Act establishes a means for effective coordination of federal research and activities in noise control, authorizes the establishment of federal noise emission standards for products distributed in commerce, and provides information to the public respecting the noise emission and noise reduction characteristics of such products.
Federal Transit Administration Transit Noise and Vibration Impact Assessment (FTA-VA-90-1003-06, May 2006)	Presents procedures for predicting and assessing noise and vibration impacts of proposed mass transit projects and updated guidance on noise and vibration impact criteria to assess the magnitude of predicted impacts.
U.S. Environmental Protection Agency (USEPA) Railroad Noise Emission Standards (40 CFR 201) and Noise Control Act of 1972 (Section 17)	Establishes final noise emission regulations for carriers engaged in interstate commerce by railroad.
Federal Railroad Administration (FRA) Railroad Noise Emission Compliance Regulations (49 CFR 210)	Sets the maximum sound levels from railroad equipment and for regulating locomotive horns.
FRA Final Rule on the Use of Locomotive Horns at Highway-Rail Grade Crossings and Railroad Locomotive Safety Standards (49 CFR 222 and 229)	Provides for safety at public highway-rail grade crossings by requiring locomotive horn use at public highway-rail grade crossings except in quiet zones established and maintained in accordance with this part. Prescribes minimum federal safety standards for all locomotives except those propelled by steam power.

Laws, Regulations, and Guidance	Description
State	
State Environmental Policy Act (SEPA) (RCW 43.21c; WAC 197-11)	Helps state and local agencies in Washington identify possible environmental impacts that could result from a proposed action, alternatives to the proposed action, and potential impact minimization and mitigation measures. Information learned through the review process can be used to change a proposal to reduce likely impacts and inform permitting decisions at the state and local levels.
Maximum Environmental Noise Levels (WAC 173-60 and 173.60.050)	Establishes maximum environmental noise levels permissible in identified environments. However, sounds from surface carriers engaged in interstate commerce by railroad are exempt from these regulations.
Local	
Skagit County Code Noise Control (SCC 9.50)	Noise is regulated in county code to minimize the exposure of citizens to the harmful nuisance, physiological, and psychological impacts of excessive noise and to control the level of noise in a manner that promotes commerce; the use, value, and enjoyment of property; sleep and repose; and the quality of the environment.
Skagit County Code Performance Standards (SCC 14.16.840)	It is intended that all activities and land uses within Skagit County adhere to a common standard of environmental performance criteria. Criteria are listed for noise and vibration.

Federal Noise Regulations

The federal regulatory framework is generally tied to the Noise Control Act of 1972 (42 United States Code [USC] 4910), which provided the framework for protecting the public from noise pollution. Other applicable federal regulations provide noise emissions standards for the safe operation of railroads including the Federal Railroad Administration (FRA) Railroad Noise Emissions Compliance Regulations (49 Code of Federal Regulations [CFR] 210), and the Final Rule on the Use of Locomotive Horns at Highway Rail Grade Crossings (49 CFR 222 and 229). Additionally, the FRA has adopted the Federal Transit Administration (FTA) regulations that provide the primary framework for regulating noise and vibration from a proposed project. The FTA provides construction and operational noise and vibration level limits that are applicable to the proposed project.

Construction Noise Limits

The FTA provides criteria (Table 3.9-2) to avoid adverse community reaction.

Table 3.9-2 FTA Construction Noise Criteria

Land Use	Daytime one-hour L_{eq}, dBA	Nighttime one-hour L_{eq}, dBA
Residential	90	80
Commercial	100	100
Industrial	100	100

Source: FTA 2006.

Operational Noise Limits

The FTA provides operational noise impact thresholds for three categories of noise-sensitive land uses. Table 3.9-3 gives descriptions of these categories. Categories 1 and 3 are evaluated with the peak hour energy-averaged equivalent hourly sound level ($L_{eq(h)}$); Category 2 is evaluated using the day-night sound level (L_{dn}). The L_{dn} incorporates 24 consecutive $L_{eq(h)}$ values and applies a 10-dB penalty to the $L_{eq(h)}$ values occurring during nighttime hours (10 p.m. to 7 a.m.).

Table 3.9-3 FTA Noise-Sensitive Land Use Categories

Land Use Category	Noise Metric, dBA	Description
1	$L_{eq(h)}$	Quiet is an essential element (for example, outdoor amphitheaters, outdoor pavilions, outdoor historical landmarks, recording studios, and concert halls)
2	L_{dn}	Residences and buildings where people sleep (for example, homes, hospitals, and hotels)
3	$L_{eq(h)}$	Institutional lands used primarily during the day and evening (for example, schools, libraries, theaters, and churches)

Source: FTA 2006.

In general, the FTA's operational noise criteria are based on existing noise exposures. For example, a lower existing sound level has a lower absolute threshold (a.k.a., fixed impact or impact limit), but the allowable increase (a.k.a., relative impact or impact limit) is greater. Conversely, a higher existing sound level has a higher absolute threshold, but the allowable increase is less. Figures 3.9-3 and 3.9-4 provide the FTA moderate and severe impact criteria curves for operational noise.

Common noise and vibration terms

dB – decibels, the standard unit of measure for noise.

dBA – A-weighted dB, or the human perception of sound.

L_{eq} – equivalent energy averaged sound level for a stated period of time (i.e., hourly, 24-hour, etc.)

L_{dn} – day-night noise level with a 10 dB penalty applied to nighttime sounds.

L_{max} – average maximum sound level.

L_v – the velocity level in dB.

PPV – peak particle velocity is the maximum velocity experienced during a vibration event.

rms – root mean square is the smoothed amplitude of vibration over a given vibratory event.

VdB – rms velocity expressed as vibration dB.

Figure 3.9-3 FTA Noise Impact Criteria for Transit Projects

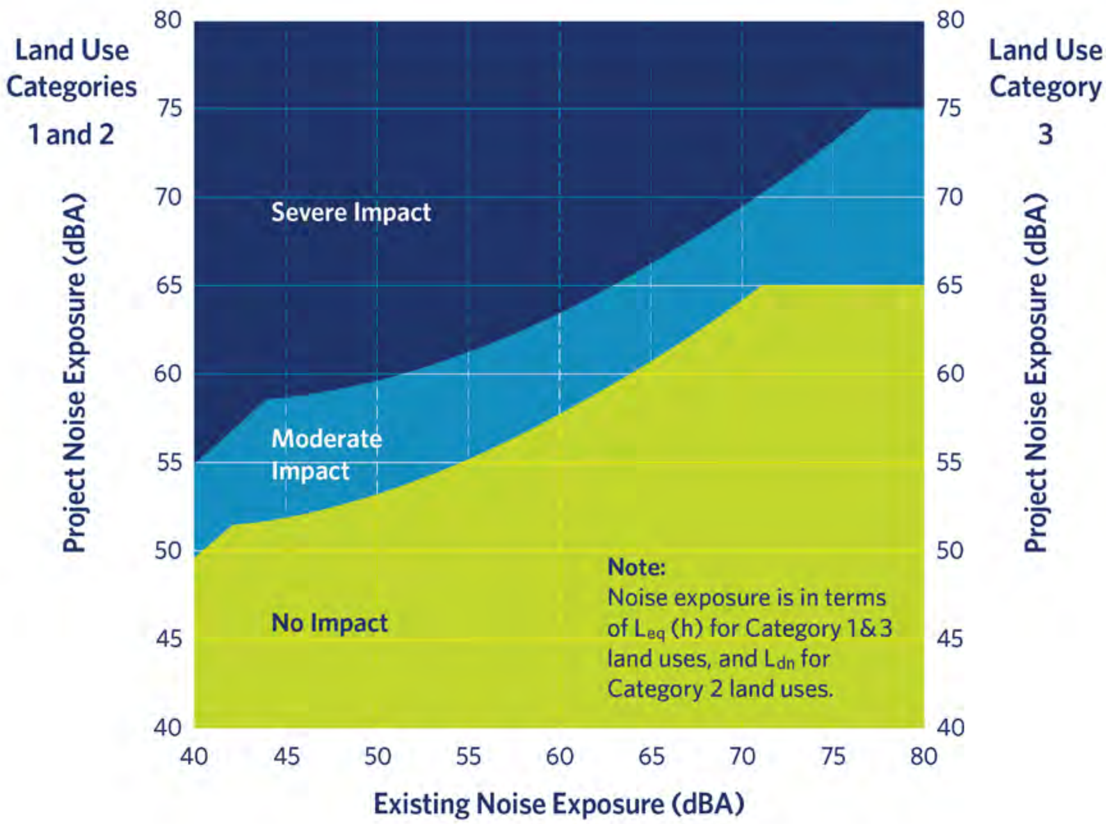
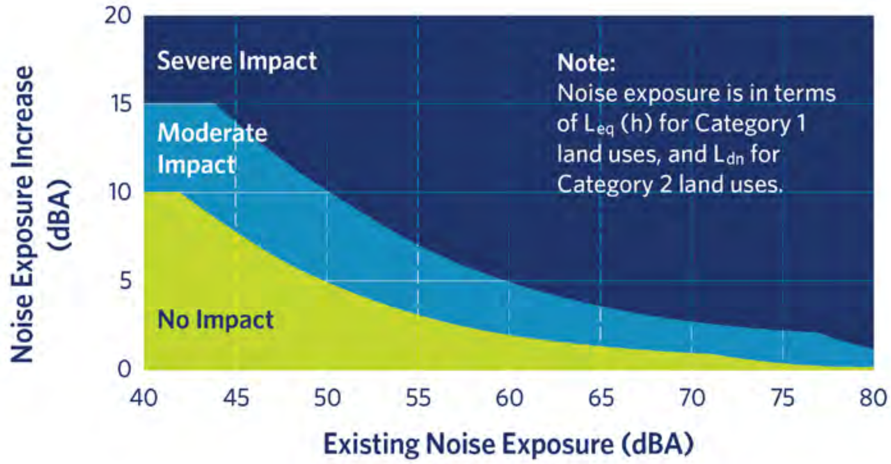


Figure 3.9-4 FTA Increase in Cumulative Noise Levels Allowed by Criteria (Land Use Categories 1 & 2)



Construction Vibration Impact Thresholds

Construction vibration is assessed in terms of building damage and annoyance. Construction damage criteria are provided in Table 3.9-4. The residential construction vibration annoyance criteria limit is 72 VdB according to the FTA.

Table 3.9-4 FTA Construction Vibration Damage Criteria

Building Category	Peak Particle Velocity[1] (inches/second)	Approximate L_v[2]
I. Reinforced concrete, steel or timber (no plaster)	0.5	102
II. Engineered concrete and masonry (no plaster)	0.3	98
III. Nonengineered timber and masonry buildings	0.2	94
IV. Buildings extremely susceptible to vibration damage	0.12	90

Notes:

1. PPV=peak particle velocity.
2. Root mean square (rms) velocity in (VdB) are 1 micro-inch per second.

Source: FTA 2006.

Operational Vibration Impact Thresholds

Operational ground-borne vibration and noise limits are evaluated based on the VdB and A-weighted sound levels, respectively. Ground-borne vibration can be caused by the weight of freight rail operations, such as unit trains traveling on a railway. These vibrations can cause buildings to shake and rumbling sounds to be heard. According to the FTA/FRA, ground-borne vibration is not a common environmental problem. The FTA identifies three vibration land use categories that can be summarized as follows:

- Vibration Category 1 – High Sensitivity: buildings where vibration would interfere with operations such as concert halls.
- Vibration Category 2 – Residential and other uses where people sleep.
- Vibration Category 3 – Institutional uses such as schools and churches.

FTA vibration impact thresholds are also based on how frequent vibration events, such as locomotive pass-bys, would occur, and characterized as follows:

- Frequent Events – More than 70 vibration events per day.
- Occasional Events – Between 30 and 70 vibration events per day.
- Infrequent Events – Fewer than 30 vibration events per day.

Operational ground-borne noise can also be a source of concern for freight rail projects such as the proposed project. The rumbling sound caused by the vibration of room surfaces is sometimes associated with rail operations. Ground-borne noise is focused more in the lower frequencies of the A-weighted spectrum. Because of this, FTA regulatory guidelines for ground-borne noise are lower than those of airborne noise. The FTA regulatory guidelines for ground-borne noise applicable to project area sensitive land uses are 43 dBA for residential lands and 48 dBA for institutional lands.

State of Washington Noise Regulations

The State of Washington regulates noise via the Washington Administrative Code (WAC) 173-60, which provides noise limits for stationary sound sources emanating from one property and received by others. These regulations are not applicable to the proposed project because they do not apply to transportation sound sources such as roadway and railroad noise. Additionally, these regulations exempt construction noise that occurs during daytime hours (7 a.m. to 10 p.m.). If construction is planned for nighttime hours (10 p.m. to 7 a.m.), a noise variance would be required. For operational noise on railroad projects, Washington State defaults to FTA guidelines.

Skagit County Noise and Vibration Regulations

Skagit County provides noise and vibration regulations per the Skagit County Code (SCC 9.50); however, none of these regulations is applicable to railroad operations and will not be discussed further. The County does not provide construction noise limits; therefore, construction noise would be governed by the WAC 173-60 regulation that only applies to nighttime construction noise.

AFFECTED ENVIRONMENT

The affected environment is variable for noise and vibration, with the latter attenuating (weakening) more quickly with distance. Additionally, the affected environment is variable depending on the project component. The following sections describe the affected environment for the proposed project and wetland mitigation site, the Anacortes Subdivision, and the Bellingham Subdivision to the Skagit/Snohomish county line. The noise analysis study area includes noise-sensitive receptors within 1,500 feet; the vibration analysis study area includes vibration-sensitive structures and land uses within 500 feet.

Proposed Project Site

Noise

A variety of land uses occur within the noise analysis study area at the proposed project site, including residential, industrial, commercial, roadways, a railroad, and open space. As a general rule, noise levels tend to be higher in industrial and commercial areas, and near transportation facilities (i.e., roadways and railroads), and lower in rural, open space, or agricultural areas. However, given the proximity of the Anacortes Subdivision, State Route (SR) 20, the Shell Puget Sound Refinery (PSR), and the Tesoro Anacortes Refinery, the existing acoustic environment at the proposed project site, and within 1,500 feet of the site, is generally high. Two baseline noise measurements were conducted to document sound levels in this area: monitoring position (MP) 10 and MP 11 (Table 3.9-5 and Figure 3.9-5). Five residences are within the proposed project site noise analysis study area.

See Appendix D for additional details relating to the field monitoring effort such as field photos, detailed monitoring results, and equipment laboratory calibration sheets.

Table 3.9-5 Baseline Monitoring Results (dBA)

Map ID	FTA Land Use Category	Analysis Area	Baseline Levels		
			L_{eq} (day)	L_{eq} (night)	L_{dn}
MP 1	Category 2	Anacortes Subdivision	63	59	66
MP 2	Category 2	Anacortes Subdivision	67	63	70
MP 3	Category 2	Anacortes Subdivision	58	56	63
MP 4	Category 2	Anacortes Subdivision	57	54	61
MP 5	Category 2	Anacortes /Bellingham Subdivisions	64	61	68
MP 6	Category 2	Bellingham Subdivision	71	72	79
MP 7	Category 2	Bellingham Subdivision	59	60	66

Map ID	FTA Land Use Category	Analysis Area	Baseline Levels		
			L_{eq} (day)	L_{eq} (night)	L_{dn}
MP 8	Category 2	Bellingham Subdivision	63	65	71
MP 9	Category 2	Bellingham Subdivision	67	65	72
MP 10	Category 2	Proposed Project Site	64	60	67
MP 11	Category 2	Proposed Project Site	60	59	66

Existing noise levels at MP 10 and MP 11 were 66 and 67 L_{dn}, with the higher noise level at the residences closer to SR 20 (e.g., MP 10), and the lower noise level at residences located north and adjacent to the Shell PSR (e.g., MP 11).

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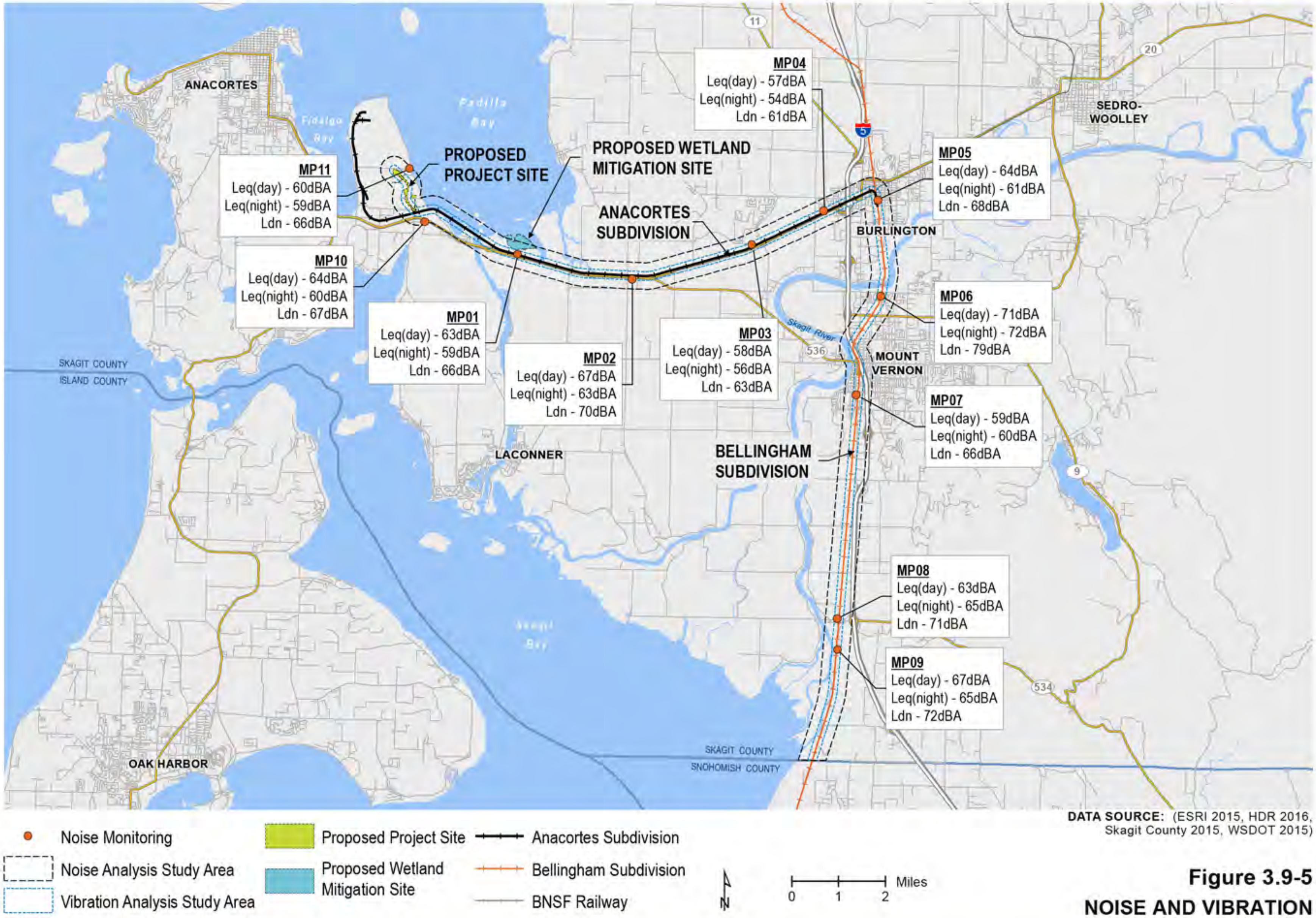

Figure 3.9-5

NOISE AND VIBRATION STUDY AREAS

Figures 3.9-6 through 3.9-10 show land use and noise measurement locations throughout the study area. Figure 3.9-6 shows the locations at the proposed project site. The FTA regulatory limits are based on a sliding scale that is referenced to the existing sound level at a given noise sensitive receptor.

For example, at MP 9 (Figure 3.9-9) the measured baseline sound level was 72 dBA L_{dn}; therefore, referring back to Figure 3.9-3, the fixed limit for identifying moderate impacts to Category 2 land uses (e.g., residential) from the project is 65 dBA L_{dn}; for severe impacts, the fixed limit is 71 dBA L_{dn}. Relative impact thresholds at Category 2 land uses for MP 9 would include a moderate increase of 1 dBA up to the severe increase threshold of 3 dBA or greater. To further illustrate this concept, Table 3.9-6 lists the thresholds for each MP.

Table 3.9-6 Noise Impact Thresholds (Limits) by Monitoring Position

	Category 2 (L_{dn})					Category 3 (L_{eq})		
Map ID	Existing	Absolute Limits		Relative Increase Limits		Existing	Absolute Limits	
		Moderate	Severe	Moderate	Severe		Moderate	Severe
MP 1	66	61	67	1	3	63	65	70
MP 2	70	64	69	1	3	67	67	72
MP 3	63	60	65	2	4	58	62	67
MP 4	61	58	64	2	4	57	61	67
MP 5	68	63	68	1	3	64	65	71
MP 6	79	65	75	0	2	71	70	75
MP 7	66	61	67	1	3	59	62	68
MP 8	71	65	70	1	3	63	65	70
MP 9	72	65	71	1	3	67	67	72
MP 10	67	62	67	1	3	64	65	71
MP 11	66	61	67	1	3	60	63	68

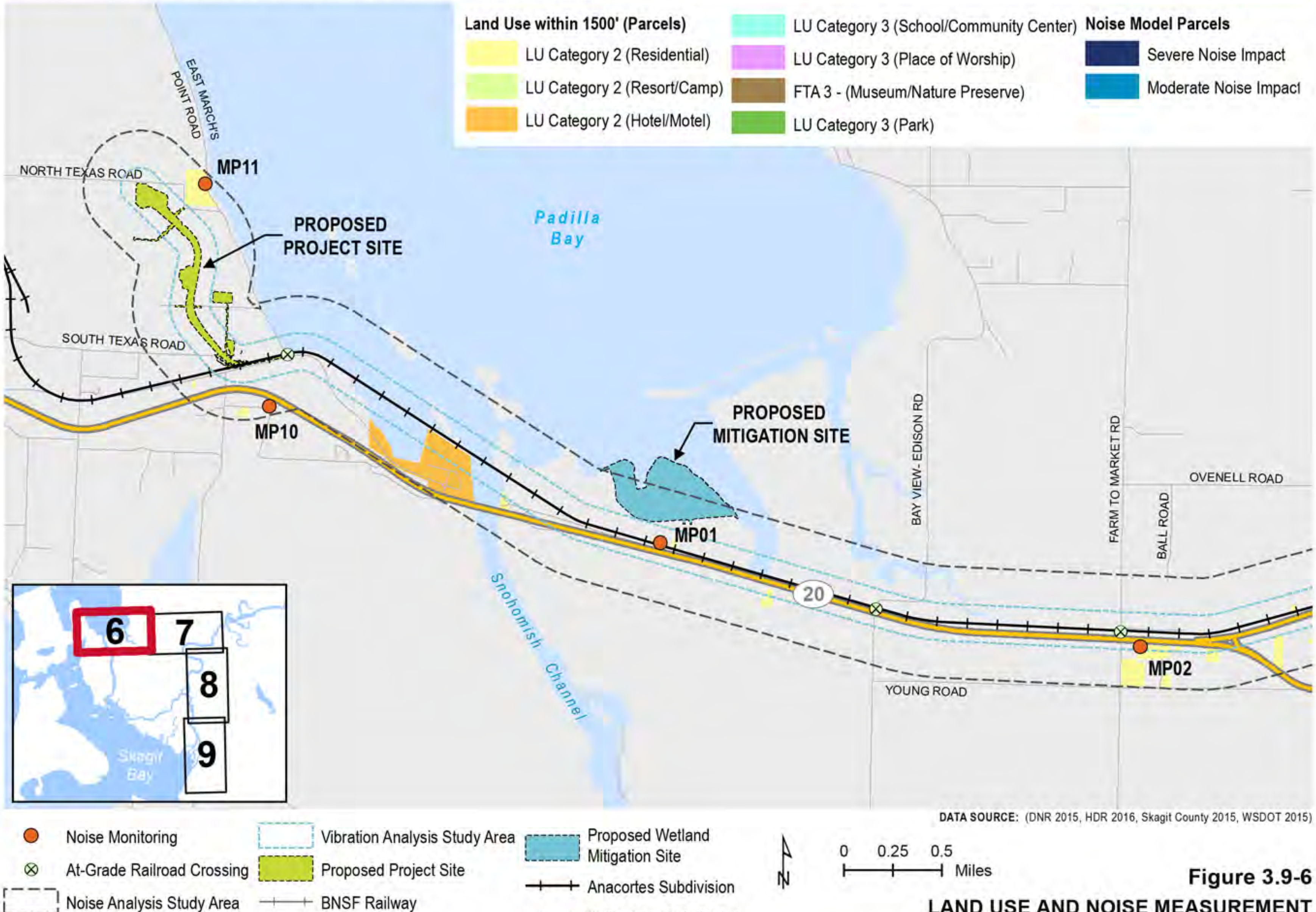

Figure 3.9-6

LAND USE AND NOISE MEASUREMENT LOCATIONS (WESTERN PORTION)

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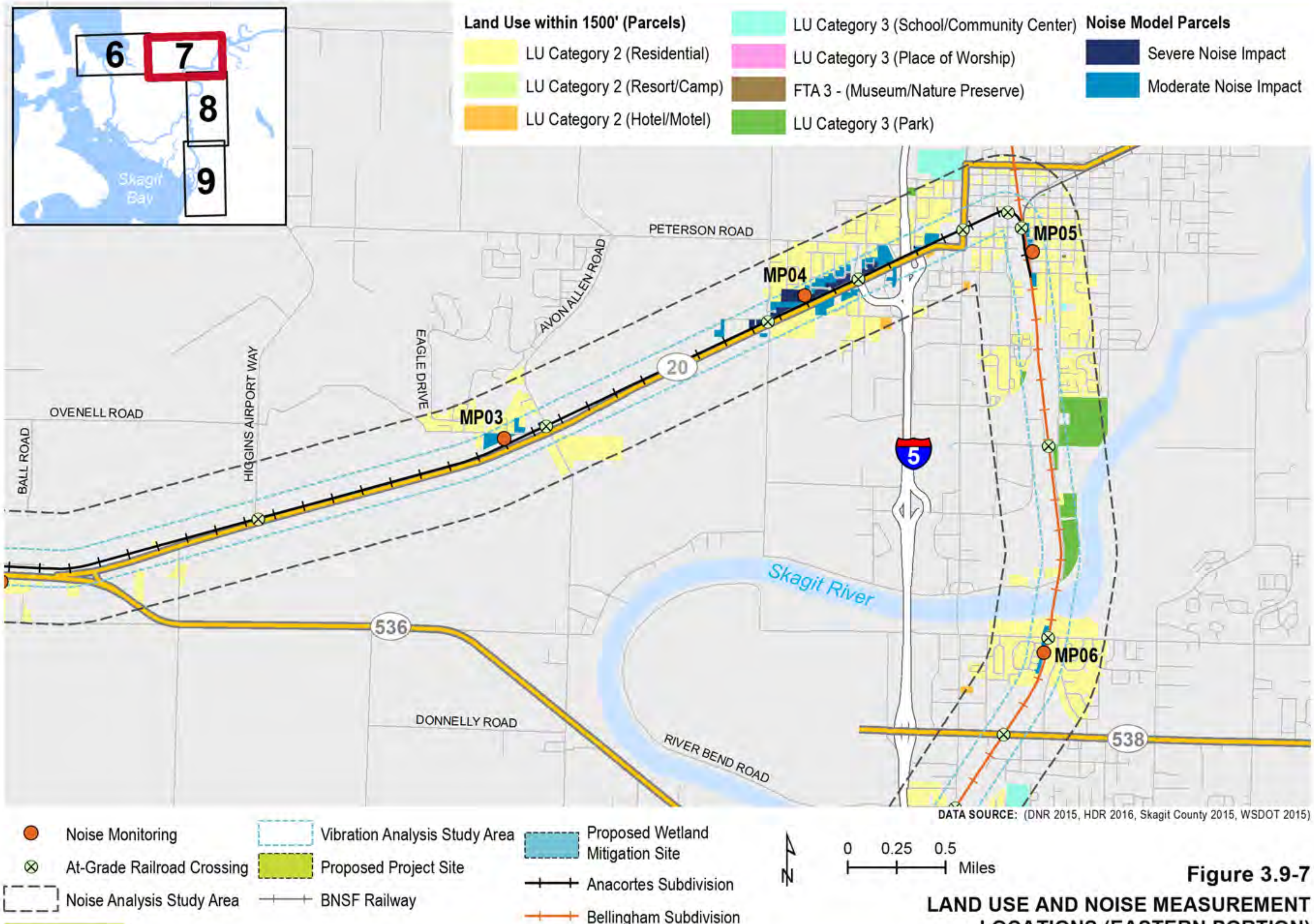

Figure 3.9-7

LAND USE AND NOISE MEASUREMENT LOCATIONS (EASTERN PORTION)

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Figure 3.9-8

LAND USE AND NOISE MEASUREMENT LOCATIONS (SOUTHCENTRAL PORTION)

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DATA SOURCE: (HDR 2016, Skagit County 2015, WSDOT 2015, DNR 2015)

Figure 3.9-9

LAND USE AND NOISE MEASUREMENT LOCATIONS (SOUTHERN PORTION)

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Vibration

There are no vibration-sensitive land uses such as residences or historic structures within 500 feet of the proposed project site, although there are some industrial land uses with structures or buildings in this area. None of these structures is a historic site or another type of structure that would be considered vibration sensitive. Regardless, construction and operational vibration impacts were assessed at these industrial facilities to provide context on project vibration. Existing vibration sources consist of rail traffic on the Anacortes Subdivision. Additionally, vibration from the proposed project is not anticipated to result in landslides because there are no areas with the potential for landslides near the project site. Chapter 3.1 – Earth Resources, describes geologic conditions near the project site.

Wetland Mitigation Site

The wetland mitigation site is located about 800 feet north of the Anacortes Subdivision and extends to the north approximately 2,200 feet. The sensitive land uses or structures within the wetland mitigation site noise and vibration study area are already included in the Anacortes Subdivision and Bellingham Subdivision analysis areas (discussed in the next section).

Anacortes and Bellingham Subdivisions

Noise

A variety of land uses occur within the noise analysis study area along the rail corridor, including residential, industrial, commercial, urban, open space, and agriculture. As a general rule, noise levels tend to be higher in industrial, commercial, and urban areas, and lower in rural, open space, or agricultural areas. The existing rail lines are at the center of the study area. Their proximity to major roadway corridors, such as SR 20, SR 536, and I-5, is largely influenced by these sound sources and somewhat elevated. Rail traffic and the use of train horns is experienced throughout Skagit County. Train horn usage in the study area is a result of several at-grade rail crossings on the Anacortes and Bellingham subdivisions. Other common sources of noise include wildlife, such as birds and insects in the warmer months, agricultural equipment used in rural and agricultural areas, and periodic aircraft noise.

Noise monitoring at Monitoring Position 10

There are 3,295 noise-sensitive receptors (i.e., residences, schools, and parks) within 1,500 feet of the Anacortes and Bellingham subdivisions, primarily within the city limits of Mount Vernon and Burlington, or just outside their city limits in the Urban Reserve zoning designation. Most of these receptors are associated with single-family residences (72 percent) or multi-family residences (19 percent), such as apartments and condominiums. In addition, there are some sensitive receptors associated with parks, schools, resorts, hotels, or mobile home parks. A few rural residences are scattered throughout the agricultural areas of unincorporated Skagit County and in the small town of Conway. One casino (Swinomish Casino and Lodge) located near SR 20 outside of Anacortes includes hotel rooms and areas for recreational vehicles that are noise-sensitive.

Existing noise levels were monitored at 11 locations spaced relatively evenly throughout the noise analysis study area. Each monitoring location occurs within, and corresponds to, a cluster of noise-sensitive receptors.

Existing noise levels in the Anacortes and Bellingham subdivisions noise analysis study area (Table 3.9-4) range between 61 and 79 L_{dn}. Noise levels were highest in the northern portion of Mount Vernon (79 L_{dn}), followed by the town of Conway (71–72 L_{dn}), a rural residential area (70 L_{dn}) west of Burlington immediately south of SR 20, and a lumber yard (Sierra-Pacific Industries). Noise levels in the City of Burlington, southern Mount Vernon, and the rural residential communities toward the western end of the study area near Anacortes are intermediate (66–68 L_{dn}) compared with the rest of the study area. Noise levels for the rural residential communities immediately west of Burlington and east of the lumber yard are the lowest (61–63 L_{dn}). Figures 3.9-6, through 3.9-9 are maps that show the measurement locations and noise-sensitive land uses for the Anacortes and Bellingham subdivisions noise analysis study area. These figures also include predicted noise impacts that are described below.

Vibration

Existing vibration sources in the vibration analysis study area consist of rail traffic on the Anacortes and Bellingham subdivisions. There are a number of sensitive vibration uses, with the most sensitive consisting of 660 residences, three hotels, one religious facility, and one school.

ENVIRONMENTAL IMPACTS

No Action Alternative

Because no construction or operation would take place under the no action alternative, there would be no impacts to noise and vibration. Oil suppliers for the refinery would continue using existing delivery methods. Existing sources of noise and vibration in the study area would continue and could evolve over time due to changes in land uses or the regional economy. Regional population growth would also continue with slight increases in sound levels over time. For example, increased regional population would create more vehicles on the road, resulting in higher roadway traffic noise levels.

Proposed Project Site

Noise Impacts

Construction

Construction of the project would be conducted during daytime hours only and be in compliance with the local noise ordinances. As described in Chapter 2 – Proposed Project and Alternatives, the project would be constructed over approximately two years. If it is determined at a later date that nighttime construction is required, a variance to the State’s construction noise regulatory limits would be needed.

To evaluate construction noise impacts, the FTA Noise and Vibration Impact Assessment methodology (FTA 2006) suggests combining the two noisiest pieces of equipment and assume that they are operating continuously. Using this approach, the loudest equipment to be used to construct the proposed project would be two scrapers (89 dBA maximum sound level [L_{max}]), which would generate a combined result of 92 dBA at 50 feet. The nearest sensitive structure is a residence located 500 feet from the proposed construction site. The received sound level at this location under the assumed worst-case condition would be 72 dBA, much less than the applicable construction noise impact threshold provided in Table 3.9-2. Construction noise levels at noise-sensitive receptors located farther away would be lower; therefore, there would be no adverse noise impacts from construction of the proposed project.

Operation

The FTA assessment methodology was used to identify operational noise impact conditions associated with the proposed project. Several data sources and assumptions were used in this analysis. The number of train trips to and from the Shell PSR is assumed to be one round trip daily (e.g., six round trips per week, on average) as described in Chapter 2 – Proposed Project and Alternatives. In Chapter 3.15 – Rail Traffic and Transportation, the following inputs were identified as being applicable to the acoustic modeling:

- One daily round trip by unit train.
- Four locomotives per unit train.
- 102 cars per unit train.
- Variable track speeds.
    - Anacortes Subdivision – 10 miles per hour (mph) (although trains could move as fast as 25 mph, the 10 mph is a conservative assumption because it results in sustained train noise for longer periods of time).
    - Shell PSR spur – 5 mph.
    - BNSF main line – 50 mph.

The following default settings were used in the acoustic modeling analysis, consistent with FTA/FRA regulations or guidelines:

- Train horns would be used at all public at-grade railroad crossings.
- Train horns would begin sounding 0.25 mile from each at-grade railroad crossing.
- Standard FTA/FRA freight locomotive, car, and horn noise level would be at 50 feet.

To implement the FTA/FRA standard for noise modeling, an acoustic model known as DataKustik's CadnaA was used. The noise analysis study area, in total, is large and follows the train route along the Anacortes and Bellingham subdivisions to the Skagit/Snohomish county line.

Noise modeling demonstrates that there would be no impacts to the five residential receptors located within 1,500 feet of the proposed project site. Periodically, there would be some noise associated with coupling and decoupling of unit train cars; however, these sounds would be at a lower level than the train itself and would not represent an impact to the nearby receptors. Sound levels are predicted to range from 43 dBA L_{dn} to 52 dBA L_{dn} at the five residences. No increase is expected over existing conditions in this region. This is largely because of the presence of other sound sources in the area including roadway traffic on SR 20, train traffic to the Tesoro Anacortes Refinery and neighboring industries, and industrial noise emanating from the Shell PSR itself.

Vibration Impacts

Construction

Construction vibration was evaluated to assess the potential for damage to nearby structures and annoyance to people. The vibration damage criteria for the nearest structures located 25 feet from the centerline of the nearest track are 0.2 PPV inches per second. The heaviest piece of machinery that would be implemented in constructing the project would be a bulldozer. The source levels for this piece of equipment are 0.089 PPV inches per second at 25 feet. For damage to occur at the nearest structures, the bulldozer would need to be operating within 15 feet of the structure. Operation of these types of equipment would not be allowed this close to a structure; therefore, structural damage from construction vibration is not anticipated.

Annoyance from construction vibration was also evaluated. As with the structural damage assessment, the annoyance assessment is based on the heaviest piece of construction equipment anticipated for the project—a bulldozer. Ground-borne vibration annoyance is related to the rms velocity level expressed in VdB. The vibration level for a bulldozer at 25 feet is 87 VdB. A construction vibration annoyance impact is assumed to occur if the VdB exceeds 72 VdB at the nearest residence to construction. Vibration from construction would attenuate to 72 VdB within approximately 80 feet. The nearest residence is over 500 feet from project construction; therefore, vibration annoyance is not anticipated.

Operation

According to the FTA screening procedure, operational vibration could be a concern for nearby residential land uses (FTA Category 2). For the vibration impact assessment, the FTA base curve for a locomotive-powered freight train traveling at 50 mph was used. The same speeds implemented in the operational noise analysis were used in the operational vibration analysis. Vibration levels were calculated at the nearest residential land uses to the proposed project site. Adjustments were made to the base curve level to account for the slower speeds that trains would travel on the Anacortes Subdivision (10 mph) and the proposed Shell PSR spur (5 mph). Additional adjustments were made for residential structure types. Specifically, it was conservatively assumed that all residences were wood-framed, single-story houses, which resulted in an adjustment factor of -5 VdB. Calculated vibration levels at the nearest residential structures would be, at most, 65 VdB, which is a level that is much less than the FTA impact threshold for Category 2 land uses of 80 VdB; therefore, no ground-borne vibration impacts are anticipated from operation of the project.

Calculations of ground-borne noise were also conducted. The FTA indicates that ground-borne noise is 35 dB less than ground-borne vibration levels (FTA 2006); therefore, ground-borne noise levels would be, at most, 30 dBA. This is a level that is much less than the FTA impact threshold for Category 2 land uses of 43 dBA; therefore, no ground-borne noise impacts are anticipated from operation of the project.

Wetland Mitigation Site

Noise Impacts

As described in Chapter 2 – Proposed Project and Alternatives, some heavy equipment would be used to grade the wetland mitigation site and construct the setback dike, which means that construction noise could affect nearby noise-sensitive receptors. The nearest noise-sensitive receptor is over 500 feet away from equipment operation; therefore, sound levels would be less than those described in the proposed project construction noise analysis. Because of this, no construction noise impacts would result from creation of the wetland mitigation site.

Trucks hauling material to and from the site would result in some roadway traffic noise at the receptors closest to Josh Green Lane; however, due to the relatively high volume of traffic on SR 20, which is immediately adjacent, this traffic would not result in a perceptible change (e.g., a 3 dB increase) over existing noise levels.

There would be no new noise-generating facilities or activities located at the wetland mitigation site after it is constructed. The existing pump station would be relocated by 25 feet or less and would continue to operate in a similar fashion; therefore, there would be no new operational noise associated with the wetland mitigation site or a change in sound levels.

Anacortes and Bellingham Subdivisions

Noise Impacts

Train speed is a factor in modeling train noise. Proposed project trains were modeled using speeds of 50 mph on the Bellingham Subdivision and 10 mph on the Anacortes Subdivision. While BNSF Railway has indicated unit trains are capable of 50 mph, operational speeds may often be lower, especially in the cities of Mount Vernon and Burlington.

The noise intensity from trains traveling at higher speeds is greater than for slower moving trains; however, slower trains create heightened noise levels for longer periods of time. That means that along the Anacortes Subdivision, sound levels would be sustained for longer periods due to the 10 mph train speeds. By contrast, sound levels along the Bellingham Subdivision would have greater amplitude, but for shorter durations because the train would move through areas faster. Based on noise modeling, operational noise from the proposed project is predicted to result in moderate or severe impacts at residential land uses within the study area (e.g., Category 2 FRA land uses).

See Figures 3.9-7 and 3.9-8. No impacts are predicted at the parks or schools in the study area. The residential impacts are limited to a few locations:

1. Along the Anacortes Subdivision west of Burlington near an at-grade crossing at Avon Allen Road.
2. Along the Anacortes Subdivision in Burlington near the at-grade crossings of Pulver Road and Garrett Road.
3. Along the Bellingham Subdivision in Burlington adjacent to and south of the at-grade crossing of Greenleaf Avenue.
4. Along the Bellingham Subdivision in Mount Vernon near the at-grade crossing of Hoag Road.
5. Along the Bellingham Subdivision in Mount Vernon south of the at-grade crossing of East Fir Street.
6. Along the Bellingham Subdivision in Mount Vernon near at-grade crossings of Kincaid Street, Section Street, and Blackburn Road.

In consideration of the relative impact thresholds, 168 residential receptors are predicted to exceed the moderate impact threshold; 44 would exceed the severe impact threshold.

Regardless of train speed, the main cause of noise impacts would be the use of train horns at the numerous public at-grade crossings throughout the study area (see Chapter 3.15 – Rail Traffic and Transportation). This data is consistent with what field crews observed and noted from conversations with property owners during the baseline monitoring effort. The second most dominant sound source after train horns is the noise emanating from the operation of the train itself.

Noise and vibration impacts beyond Skagit County

During the scoping process, commenters requested noise and vibration analysis for a variety of locations outside of Skagit County. No construction activities would occur outside of Skagit County as part of the proposed project; therefore, only operational noise and vibration have the potential to result in effects outside of Skagit County.

BNSF Railway is one of the busiest railways in Washington State. For noise-sensitive land uses along the proposed project's train route, noise or vibration levels could increase slightly due to operation of the proposed project; however, any perceptible effects would be similar to freight rail movement and associated noise and vibration currently experienced by those noise-sensitive land uses.

The proposed project would add six train trips per week, on average to an already busy rail corridor; therefore, levels of noise and vibration are not anticipated to change appreciably as a result.

It is important to note that the acoustic model predictions may overestimate noise impacts because of a number of conservative assumptions used in the analysis. For example, exact sound source levels for the train that would be used by Shell are not known. It is possible that the default settings in the FTA/FRA analysis procedures are higher than those that would actually be realized. Additionally, the speeds that the trains would travel along the Bellingham Subdivision may be slightly lower than the 50 mph limit. Lastly, the use of train horns is somewhat variable depending on the preference of the locomotive engineer. The train horn sound source level used in this analysis is the FRA default for freight trains but may be overly conservative. For example, the modeling assumed that the trains would be moving at a speed of 10 mph; however, if they are moving at speeds closer to 25 mph, then sustained train horn noise would result in lower levels because the time horns are used at each crossing would be less.

Another component of rail noise in the area would be attributed to wheel squeal that occurs when trains make relatively sharp turns. During the field reconnaissance effort, only one such curve—located in Burlington where the train would transition from the Bellingham Subdivision to the Anacortes Subdivision—was identified as having the potential for wheel squeal. Although wheel squeal was not observed at this location during the field effort, this location is most likely where such noise could occur. Nevertheless, no specific impacts are predicted at this location.

Vibration Impacts

The same vibration screening procedure was used for analysis of operational vibration in both the Anacortes and Bellingham subdivisions. As with the noise analysis, the vibration analysis assumes that the trains would travel at 50 mph on the Bellingham Subdivision.

Calculated vibration levels at the nearest residential structures would be, at most, 66 VdB, which is a level that is much less than the FTA impact threshold for Category 2 land uses of 80 VdB; therefore, no ground-borne vibration impacts are anticipated from operation of the project.

Calculations of ground-borne noise were also conducted. Generally, ground-borne noise is 35 dB less than ground-borne vibration levels; therefore, ground-borne noise levels would be, at most, 31 dBA. This is a level that is much less than the FTA impact threshold for Category 2 land uses of 43 dBA; therefore, no ground-borne noise impacts are anticipated from operation of the project.

Cumulative Impacts

Past and present actions were considered in the cumulative impacts analysis by evaluating background noise monitoring data performed for this EIS. As described above, noise levels at the proposed project site, and within 1,500 feet of the site, are generally high. Noise levels at the proposed mitigation site and Anacortes and Bellingham subdivisions contain a variety of land uses within the noise analysis study area, including residential, industrial, commercial, urban, open space, and agriculture. As a general rule, noise levels tend to be higher in industrial, commercial, and urban areas, and lower in rural, open space, or agricultural areas.

The Gateway Pacific Terminal project (Gateway Pacific Terminal 2013) would have an additive impact to the average daily noise volumes for receivers along the Bellingham Subdivision when combined with the proposed project and existing train traffic. The Gateway Pacific Terminal project, combined with the proposed project, would add a total of 20 train trips per day on the Bellingham Subdivision. This would increase the number of trains from 21 to 41. According to the FTA *Transit Noise and Vibration and Impact Assessment* (FTA 2006), this doubling of the train traffic would be expected to increase future noise levels on the Bellingham Subdivision by approximately 3 dBA relative to existing L_{dn} sound levels. For context, a 3 dBA increase is considered the minimum amount of change in sound level that is perceptible to humans.

Regardless of train speed, the main cause of noise impacts would be the use of train horns at the numerous public at-grade crossings throughout the study area (see Chapter 3.15 – Rail Traffic and Transportation). Therefore, the proposed project, combined with past, present, and reasonably foreseeable future actions, would result in a cumulative impact on noise levels.

MITIGATION MEASURES

Avoidance and Minimization

Impacts from noise and vibration would be minimized by the implementation of the best management practices (BMPs) that could be required as part of the Skagit County Grading Permit and the Shoreline Substantial Development Permit. For example, a complaint resolution procedure could be developed to address any noise issues that develop during construction.

Mitigation

Noise mitigation was evaluated to identify potential measures that could be implemented to reduce project-related operational noise along the Anacortes and Bellingham subdivisions. As described in Appendix D of this EIS, a number of specific measures were evaluated to mitigate operational noise, including establishment of Quiet Zones, installation of sound barriers, and a combination of both options. The evaluation indicated that the most reasonable option would be the establishment of Quiet Zones.

Skagit County Planning Department staff considered the possibility of implementing Quiet Zones at three at-grade crossings along the Anacortes Subdivision to mitigate for potential noise impacts. However, upon consultation with Skagit County Public Works Department staff, it was determined that the establishment and implementation of such Quiet Zones would not be feasible or recommended by the County Engineer.