Chapter 7 Noise

1 How is noise perceived by the human ear?

The human ear can perceive a range of noise levels. The range of perceptible magnitudes is so large that noise levels are generally expressed on a logarithmic scale in units called decibels (dB). Noise levels are affected by a number of variables, including elevation, terrain, distance from the source, and weather. A break in the line of sight (e.g., buildings, hilly terrain) between a source and receiver generally reduces sound levels by 5 dBA. In addition, noise levels decrease with distance from a noise source. The change in noise level depends on the type of terrain (e.g., hard or soft), as well as the type of source (e.g., roadway, transit center). Weather conditions alter both noise levels and the transmission of noise from a source to where it is received.

The human ear perceives changes in sound levels more effectively than absolute sound levels. While a 3-dB increase is barely perceptible to the human ear, a 5-dB increase sounds as if the noise is about one and a half times as loud. A 10-dB increase is perceived as a doubling in noise level to most listeners. Exhibit 7-1 shows examples of noise levels from common transportation and other sources.

Which elements of Washington Administrative Code (WAC) 197-11-444 are addressed in this chapter?

This chapter addresses:

Section (2)(a)(i) Noise

What is a decibel?

A decibel is one unit on the decibel scale, which is a logarithmic scale. The name means one-tenth of a bel—a bel being a unit named for Alexander Graham Bell and used to compare intensity of sound.

What does the abbreviation dBA stand for?

The human ear can best perceive frequencies or pitches between 1,000 and 5,000 Hertz (Hz). Environmental sounds consist of many frequencies. Frequency weighting combines all of the frequencies into one sound level that simulates how an average person hears sounds. The commonly used frequency weighting for environmental sounds is A-weighted decibels (dBA).

Exhibit 7-1
Typical Noise Levels

Transportation Sources	Noise Level (dBA)	Other Sources	Description
Jet takeoff (200 feet)	130		Painfully loud
	120		
Car horn (3 feet)	110		Maximum vocal effort
	100	Shout (0.5 feet)	Very annoying
Heavy truck passby (50 feet)	90	Jack hammer (50 feet)	Loss of hearing with
		Home shop tools (3 feet)	prolonged exposure
Train on a structure passby (50 feet)	85	Backhoe (50 feet)	
City bus passby (50 feet)	80	Bulldozer (50 feet)	Annoying
		Vacuum cleaner (3 feet)	
Train passby (50 feet)	75	Blender (3 feet)	
Freeway traffic (50 feet)	70	Lawn mower (50 feet)	
Train in station (50 feet)	65	Washing machine (3 feet)	Intrusive
	60	TV (10 feet)	
Light traffic (50 feet)		Talking (10 feet)	
Light traffic (100 feet)	50	Refrigerator (3 feet)	Quiet
	40	Library	
	30	Soft whisper (15 feet)	Very quiet

Sources: FTA, 1995; EPA, 1971, 1974

2 What decibel levels are appropriate for human comfort and safety?

At high intensities, environmental noise directly affects human health by contributing to or causing hearing loss. Although the science is currently inconclusive, noise is also suspected of causing and aggravating other health problems. Environmental noise affects general human welfare by interfering with thought, sleep, and conversation. According to the U.S. Environmental Protection Agency (EPA), environmental sound levels below 55 dBA should protect human health and welfare with a margin of safety for areas with outdoor uses. However, this level is not a standard. Rather, it identifies a safe level of noise exposure without consideration of other factors, such as cost of mitigation (EPA, 1974). Environmental sound levels in most urban environments are greater than 55 dBA. Sound levels typical of various environments are shown in Exhibit 7-2.

Exhibit 7-2
Examples of Typical Outdoor Sound Levels in Various Environments

Description of Environment	dBA
City (Downtown Major Metropolis)	75–80
Very Noisy Urban	70
Noisy Urban	65
Urban	60
Suburban	55
Small Town and Quiet Suburban	45–50

Source: EPA (1974)

3 How is noise regulated?

For most activities in an urban area, noise control is primarily the responsibility of state and local governments, with maximum noise limits established by local ordinances and state regulations. While transportation activities can be a major source of noise in urban environments, they are typically exempt from local noise ordinances. The Federal Highway, Federal Aviation, and Federal Transit Administrations provide criteria for evaluating noise impacts from transportation sources. EPA also offers guidance for evaluating noise impacts from a wider array of sources. During project-level environmental review, the ability of the projects included in the Transportation 2040 alternatives to meet these and other applicable criteria will be evaluated.

What is the difference between plan-level and project-level environmental review?

This FEIS is a plan-level (rather than a project-level) EIS. Accordingly, alternatives are defined and environmental effects are evaluated at a relatively broad level. More detailed project-specific environmental review will be developed as appropriate in the future for projects identified in the Transportation 2040 plan. These would be projects that are selected for implementation by their respective sponsors; for example, Washington State Department of Transportation (WSDOT), transit agencies, and local jurisdictions.

Federal Highway Administration Noise Impact Criteria

For roadway projects, noise impacts occur when predicted traffic noise levels approach or exceed the Federal Highway Administration's noise abatement criteria or substantially exceed existing noise levels (23 Code of Federal Regulations [CFR] Part 772.5). The Federal Highway Administration noise abatement criteria specify different noise levels for different land use categories (Exhibit 7-3). For receptors where serenity and quiet are of extraordinary significance, such as National Parks and National Monuments, the noise criterion is 57 dBA. For residences, parks, schools, churches, and similar areas, the

noise criterion is 67 dBA. Mitigation is considered when the noise abatement criteria are approached or exceeded.

Exhibit 7-3
Federal Highway Administration Noise Abatement Criteria

Activity Category	dBA	Description of Activity Category
A	57 (Exterior)	Lands on which serenity and quiet are of extraordinary significance and serve an important public need, and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B	67 (Exterior)	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals.
C	72 (Exterior)	Developed lands, properties, or activities not included in Categories A or B.
D	— — — —	Undeveloped lands.
E	52 (Interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums.

Source: 23 CFR Part 772

Federal Transit Administration Noise Impact Criteria

Under Federal Transit Administration transit criteria, a noise impact occurs when a proposed project would cause overall noise to increase between 1 and 10 dBA, depending on the existing noise level and land use (FTA, 1995). In general, the greater the existing noise level, the less a project may increase the overall noise level.

Federal Aviation Administration Noise Impact Regulations

The Federal Aviation Administration (FAA) procedures for regulating potential noise impacts from aviation sources are based on the provisions of 49 United States Code (USC) (The Aviation Safety and Noise Abatement Act) and 14 CFR Part 150. FAA's programs include noise compatibility plans for individual airports, which consider impacts and noise management measures at a master planning level rather than on a project-by-project basis. Under this approach, FAA considers the compatibility of land uses adjacent to airports. FAA measures can include noise abatement treatments for existing uses and restricting future development of uses that would be considered most sensitive to high noise levels. FAA also sets standards for noise emissions for different classes of aircraft,

with increasingly strict requirements for aircraft occurring over time.

U.S. Environmental Protection Agency regulations

EPA has a broad range of responsibilities for noise control, as established under the Noise Control Act of 1972 (42 USC 4910), which focuses on noise control issues related to commerce. EPA also has a broader oversight role through its responsibilities under Section 309 of the Clean Air Act to review and publicly comment on the environmental impacts of major federal actions.

4 What are existing sources of noise in the central Puget Sound region?

Although a number of human activities contribute to noise exposure levels, transportation sources are the largest contributor to ambient noise in urban and suburban areas. Noise levels from transportation sources vary with the volume, speed, and type of vehicle. Typically, an increase in any of these factors increases traffic noise levels.

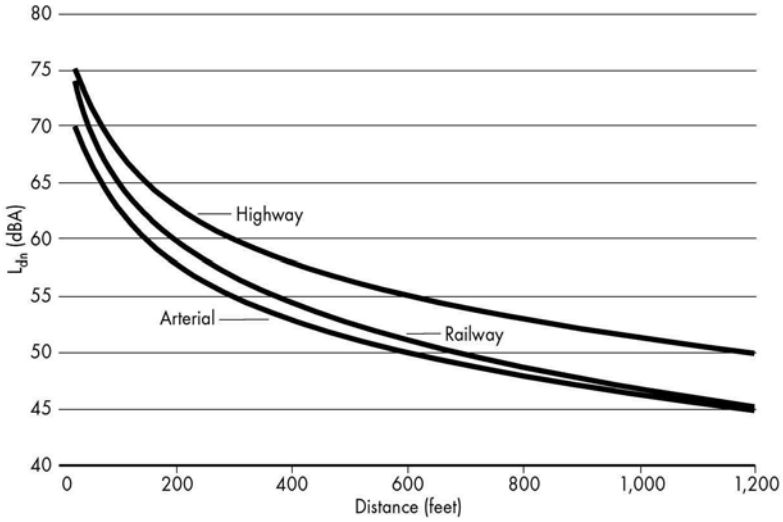
Roadway Noise

Noise from mobile sources consists of noises from the engine, tires, and exhaust. Ambient noise levels can generally be estimated based on distance to transportation sources. Typical L_{dn} noise levels, as a function of distance from highways, arterials, and rail lines, are shown in Exhibit 7-4.

What does the abbreviation L_{dn} stand for?

L_{dn}, or the day/night noise level, describes the daily noise environment, with an added penalty for higher noise levels at night.

Exhibit 7-4
Typical L_{dn} Noise Levels Near Transportation Facilities



Source: FTA, 1995

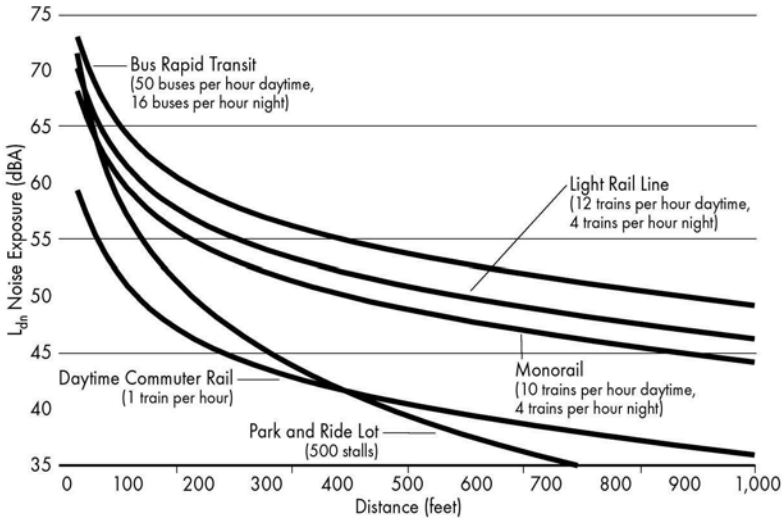
The noise level on a city street with typical volumes of automobiles, buses, and trucks ranges between 80 and 100 decibels.

Source: Parametrix, Inc.

Transit Noise

Existing transit noise sources in the central Puget Sound region include buses, light rail, and commuter rail. Typical noise exposure levels from transit vary based on the mode or facility (Exhibit 7-5). For example, typical noise levels for a commuter rail system operating one train per hour during the day at 50 miles per hour would be approximately 55 dBA at 50 feet from the track. If trains idle for long periods of time at stations, the noise exposure levels in the vicinity of the stations would increase. Noise exposure levels from a 500-stall surface-level park-and-ride lot operating with 10 buses per hour during the day would be about 64 dBA at 50 feet from the lot.

Exhibit 7-5
Typical L_{dn} Noise Levels Near Transit Facilities



Source: Sound Transit, 2005

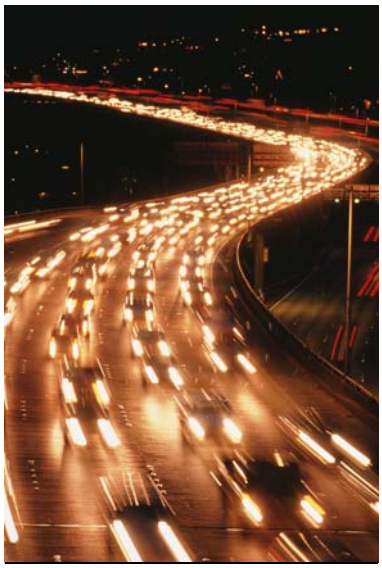
5 What noise effects are common to all alternatives?

Specific noise effects would be determined during the project-level environmental review for the projects included in the Transportation 2040 alternatives. The following sections provide a sampling of possible effects.

Long-Term Effects

Projects in the Transportation 2040 alternatives would likely affect traffic patterns in the Puget Sound region. For example, widening a highway would likely increase traffic and associated noise levels on the highway and on nearby feeder roads. The effect of transportation-generated noise depends on the proximity of noise-sensitive land uses to the noise source.

Because of the logarithmic nature of the decibel scale, increases in traffic volumes do not cause proportional increases in noise levels. A doubling of traffic, for example, would result in only a 3-dB increase in noise levels. Traffic would need to triple to result in a readily perceivable (5 dB) noise increase (CDOT, 2004).



Road-widening projects would increase traffic volumes on local roads and highways.

Source: PhotoDisc, 1994

All Transportation 2040 alternatives contain new transportation facilities that would generate noise. Future project-level review would determine if these noise sources would have an adverse effect on noise receptors in their proximity. Refer to the response to Question 8 for methods to mitigate noise effects.

Construction Effects

Noise during construction could be bothersome to nearby residents and businesses. Construction workers also would be subject to construction noise while working on the site. Construction noise would vary widely both in its range and hours over the course of implementation of the program. Individual projects would generate disturbances in their general vicinity during construction. Specific impacts would be determined during future project-level planning and environmental review.

Construction noise can be bothersome to nearby residents and businesses.

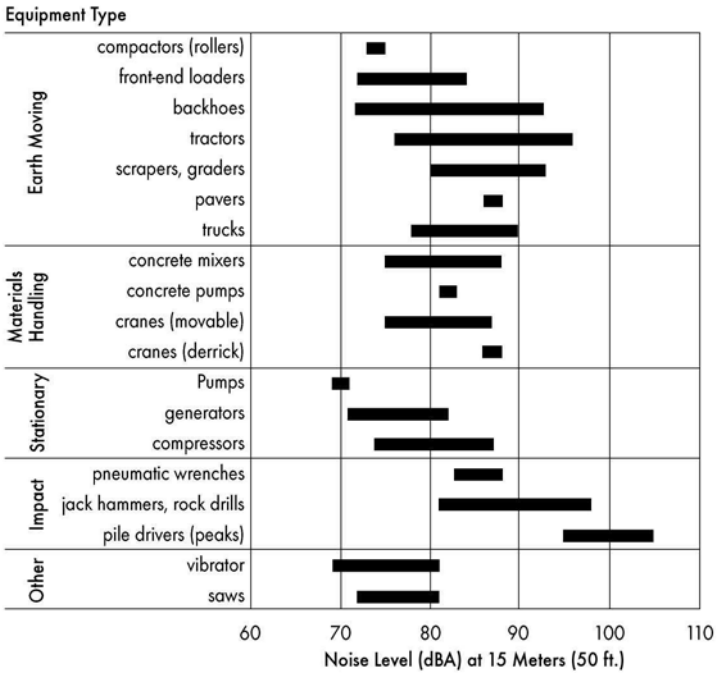
Source: PhotoDisc, 1992

The most prevalent noise source at most construction sites would be internal combustion engines. Earth-moving equipment, material-handling equipment, and stationary equipment are all engine-powered. Because trucks would be present during most phases and would not be confined to the project site, noise from trucks could affect more receptors. Other noise sources would include impact equipment and tools such as pile drivers. Impact tools could be pneumatic, hydraulic, or electric.

Construction noise associated with any project element would be intermittent, occurring at different times during the construction and at various locations in the project area. Construction noise levels would depend on the type, amount, and location of construction activities. The maximum noise levels of construction equipment for individual projects would be similar to the typical maximum construction equipment noise levels presented in Exhibit 7-6.

Exhibit 7-6

Typical Construction Equipment Noise Levels



Sources: EPA, 1971; WSDOT, 1991

The construction activities that would result in the highest levels of ground vibration are demolition, tunneling, and impact pile driving. The use of jackhammers and hoe rams would result in the highest levels of vibration during demolition activities. Analysis of construction vibration impacts would be determined in conjunction with future project-level environmental review for those projects where vibration damage would be likely.

6 Which alternatives would be likely to cause the greatest number of noise effects?

The types of effects described in the response to Question 5 could occur under any of the proposed Transportation 2040 alternatives, including the Baseline Alternative. This question does not seek to identify specific noise effects. Instead, it uses the number of new transportation projects contained in each

Why does this FEIS not list the specific environmental effects caused by each alternative?

Each of the Transportation 2040 alternatives contains hundreds of individual projects. If constructed in the future, these projects could affect the region's built and natural environments.

For some environmental disciplines, such as transportation or air quality, these projects could affect the environment in the vicinity of the project and also could collectively affect the regional environment. For these disciplines, this FEIS contains an analysis to evaluate the potential regional effects of these projects. The localized effects for these environmental disciplines will be identified in a future project-level environmental review.

For other environmental disciplines, such as noise, individual projects could affect the noise receptors in their vicinity, but would not affect noise receptors elsewhere in the region. Therefore, this FEIS does not contain a regionwide analysis for these disciplines. Future project-level environmental review will identify the specific localized effects on these environmental areas.

alternative to compare the possible total noise effect in the region.

As noted in the sidebar, this plan-level FEIS will not list the specific individual effects that could result from all of the projects contained in each Transportation 2040 alternative. In addition, it is not practicable to conduct a regionwide evaluation of the collective regional noise effects from all projects. Therefore, this plan-level FEIS does not contain a regionwide analysis of noise effects.

However, it is possible to provide an approximation of which alternatives could result in the greatest number of noise effects. The Transportation 2040 alternatives contain varying levels of new transportation infrastructure (Exhibit 7-7), and it is likely that the alternatives with the most new infrastructure would result in the greatest number of noise effects.

What is a lane mile?

The term lane mile is used to describe the size of a transportation project because it accounts for the width of a project in addition to its length.

For example, 1 mile of a two-lane highway equals two lane miles. Therefore, a project that widens 4 miles of a two-lane highway to four lanes creates eight new lane miles.

Exhibit 7-7[1]

Miles of New Infrastructure Included in Each Alternative

Facility Type	Base Year 2006	Baseline Alternative	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Preferred Alternative
Systemwide freeway and arterial lane miles	12,806	13,153	13,352	14,013	13,540	13,489	13,329	13,764
New freeway and arterial lane miles	-	348	546	1,208	735	683	523	958
Portion of new lane miles in new corridors	-	30	40	240	218	159	40	248
Light rail miles	2	55	55	82	55	82	82	86
New light rail miles		53	53	80	53	80	80	84
Commuter rail miles	74	82	82	82	82	82	128	128
New commuter rail miles	-	8	8	8	8	8	54	54
Total new miles of road and rail	-	409	607	1296	796	771	657	1096
Percent increase from 2006	-	3%	4%	9%	6%	5%	4%	7%
Nonmotorized facility miles	570	600	747	745	740	745	1058	1123
New nonmotorized facility miles	-	30	177	175	170	175	488	553

[1] This exhibit has changed since the DEIS.

As shown in Exhibit 7-7, all of the alternatives contain similar amounts of new infrastructure, measured as a percentage of the total system (3 to 9 percent). Alternative 2 contains the greatest number of new miles of road and rail, while the Baseline Alternative contains the fewest. Of the action alternatives, Alternative 1 contains the fewest number of new miles of roads and rail. Therefore, Alternative 2 would likely result in the highest number of noise effects and the Baseline Alternative would likely result in the lowest number. Among the action alternatives, Alternative 1 would likely result in the lowest number of noise effects. The number of effects resulting from Alternatives 3, 4, and 5 would likely fall between the overall number of effects expected for Alternatives 1 and 2.

What is VMT?

VMT stands for vehicle miles traveled. For more information about VMT and other transportation modeling results, refer to Chapter 4: Transportation.

All alternatives also increase total vehicle miles traveled (VMT) compared to the 2006 base year. At a regional scale, the VMT increase would increase the relative amount of noise generated by the transportation system.

The Preferred Alternative includes the second-greatest number of new miles of roads and rail. Therefore, the Preferred Alternative would likely result in the second-greatest number of noise effects. However, most of the new miles of roads and rail would be built along existing transportation corridors. New transportation facilities constructed in existing transportation corridors are less likely to result in negative noise effects than those built in new corridors. Conversely, the Preferred Alternative adds the most miles of new freeway and arterial lane miles (248) in new corridors. Therefore, noise effects from the Preferred Alternative in new corridors would likely be higher than other alternatives.

The Preferred Alternative includes the greatest number of miles of nonmotorized facilities, which include bicycle and recreation trails. Projects that expand and enhance nonmotorized travel often result in positive noise effects by providing quieter alternatives to vehicular travel.

The comparisons presented here are intended to approximate the number of effects expected from each alternative and do

not identify specific noise effects. Future project-level environmental review will identify these effects.

7 What cumulative noise effects could occur if the Transportation 2040 actions coincide with other planned actions?

The existing sources of noise in the central Puget Sound region reflect past and present cumulative effects. Future cumulative effects from noise could be influenced by other regional plans and actions. Local jurisdictions throughout the region may revise their existing land use plans to be consistent with VISION 2040 and complement the Transportation 2040 Preferred Alternative. New development resulting from these plans could have both positive and negative effects on the environment.

PSRC has performed an analysis of the development pattern changes that could result from the transportation alternatives (refer to Chapter 5: Land Use, Population, Employment, and Housing) and has concluded that none of the Transportation 2040 alternatives would induce future land use and development pattern changes that are substantively different than the Baseline Alternative. In addition, all of the Transportation 2040 alternatives are consistent with the adopted VISION 2040 Regional Growth Strategy. Therefore, none of the Transportation 2040 alternatives would result in additional cumulative noise effects.

8 How can the noise effects be mitigated?

Evaluation of individual project impacts and the need for mitigation measures would occur during future project-level planning and environmental review. Mitigation is generally required only where frequent human use occurs and a lower noise level would be beneficial. Noise may be controlled at the receptor (e.g., increased insulation in windows, doors, and walls); at the source (e.g., quieter engines and mufflers); and along the noise path (e.g., noise walls, shielding, and increased distance). Noise mitigation at the receptor is generally not consistent with federal or state noise abatement policies.

Quietstone panels can be used to reduce traffic noise.

Source: Wikimedia Commons, 2008

Potential mitigation for roadway and transit projects includes the following measures:

- Acquire land for buffer zones or for construction of noise barriers or berms.
- Align roadways or rail tracks farther from noise-sensitive land uses.
- Design and maintain rail tracks and wheels to reduce squeal, corrugations, and gaps.
- Reduce engine noise by maintaining transit vehicles.
- Use "quiet pavement" materials.
- Discourage the use of studded tires.
- Install noise insulation in transportation maintenance buildings.
- Promote alternative modes of transportation to reduce traffic-generated noise.
- Encourage vehicle trip reductions.
- Require trucks to use designated truck routes.
- Employ traffic management measures (e.g., traffic control devices and signage for prohibition of certain vehicle types, time-use restrictions for certain vehicle types, and modified speed limits).
- Increase vegetation and plant street trees.
- Incorporate noise abatement measures in urban design for transit centers, park-and-ride lots, and other transportation facilities.

Noise from construction activities may be mitigated in the following ways:

- Construct enclosures or walls to surround equipment.
- Install mufflers or other noise-reducing devices or use quieter equipment.
- Maintain equipment.
- Impose time restrictions on equipment use.
- Position stationary equipment away from noise-sensitive receptors.

9 Are there any significant unavoidable adverse noise impacts?

No significant unavoidable adverse impacts from noise are expected for any of the Transportation 2040 alternatives. However, mitigation measures are likely to be necessary in site-specific locations. These mitigation measures would also provide a regionwide benefit. Future project-level environmental review would determine if applicable noise criteria are exceeded at specific locations. Where this occurs, potential mitigation for such impacts would be evaluated and implemented as appropriate to address the impact during project-level environmental review.