
Background Information

The project consists of a proposed industrial research campus on the southwest end of Pullman, southeast of the intersection of S.R.-195 and Old Wawawai Road. The site will be a combination of several land uses including Light Industrial (I1) and Neighborhood Commercial (C1) zoning. Connecting to Old Wawawai Road allows for the expected truck traffic to enter the site from S.R.-195. The existing site is currently farmland (zoned C1, C3, & R2) and is surrounded by a low-density residential subdivision (zoned R2) to the east, dryland farming fields to the north and south, and an agricultural processing and storage facility to the northwest (UGA pre-zoned C3). Pullman City Code (PCC) 8.80.010(3) defines the proposed industrial research campus portion as Class "C" for the environmental design for noise abatement (EDNA) classification. The neighborhood commercial portion of the proposed site falls under Class "B" EDNA and the surrounding residential zoned areas fall under Class "A" EDNA. Interpretations of these classifications can be viewed in Pullman City Code 8.80.040.

Noise Impacts

The purpose of this report is to identify the loudest point source from the site and the potential impacts this project will have on the surrounding areas, primarily impacts to the residential subdivision to the east. Potential noise abatement solutions include the construction of a vertical landscape buffer between the residential and the proposed research campus to provide line-of-site obscurement as well as assist in noise reduction.

It is assumed for this noise study that the onsite noise will be a point source, and per table 7-1 from WSDOT's Construction Noise Impact Assessment (CNIA) the closest representation of the onsite noise would be a Heavy truck at 90 dB. The existing location of the research campus is currently hilly and has been used for dryland farming in recent history. Vehicle traffic is expected to be largely small personal vehicles. There is also expected to be a similar amount of heavy truck traffic as there currently exists within the area. In the field, it was noted that the 90 dB point source sound decreased by an average of 15 dB at 50 feet from the source. Therefore, an adjusted measure of 75 dB was used in the calculations at 50 feet. With flat terrain, the distance from 75 dB to decrease to the ambient background noise level (60 dB) would be 281 feet. The closed possible distance of any development within the proposed Research Campus is 200 feet from the property line of the existing Residential Development. Based on these numbers, some noise abatement will be necessary to ensure no changes to the ambient conditions of surrounding neighborhoods. When taking into account the construction of a potential landscape buffer, there is a 123-foot reduction in distance to return to ambient conditions. Calculations for these distances can be found in Appendix 2.

WSDOT's CNIA was used to calculate the noise impacts on the surrounding areas using equivalent equipment and calculation methods. Section 7.1.4.2 provides the equations used to determine the distance from the point source. The equation to find the distance construction noise attenuates to ambient or background was used to emulate the performance of onsite equipment. Table 7-1 identifies common noises for 70 dB as noisy restaurants, freeway traffic, and business offices. It identifies 60 dB as an air conditioning unit and conversational speech. Standard noise level for light

auto traffic is 50 dB. The table in PCC 8.80.020(3)(b) states that the maximum permissible noise level going from an Industrial (Class “C”) noise source going to a Residential (Class “A”) property is 60 dB. The same table can be found in Washington Administrative Code section 173-60-040(2)(a). All references to state code, city code, or WSDOT’s CNIA used can be found in Appendix 3.

Noise Test Results

A noise point source of 90 dB (with a peak of 98 dB) was used to evaluate the potential noise created in a light industrial site to determine the impacts to the surrounding neighborhoods. The point source was located at the proposed access road at the research campus and also accounted for a 10-foot elevation difference between the neighborhoods and the site. The reasoning for this was to determine the potential need for a noise barrier and to accurately determine what levels of noise the completed project would produce. At 50 feet from the source, a reduction of approximately 15 dB was observed. A baseline noise level was tested at the intersection of Old Wawawai Road and Wheat Ridge Drive. An additional baseline noise level was tested at SR-195. These locations are detailed in Appendix 1. Baseline 1 resulted in an average noise level of 73 dB. Baseline 2 resulted in an average noise level of 77 dB.

Table 1 depicts the compared results of ambient and existing noise to the additional noise that would be generated at the source.

Table 1: Existing Noise Level vs. Tested Net Increase

Location	Existing/Ambient Noise Level (dB)	Net Increase (dB)
Point Source (50 feet)	60	15
Testing Location	64	0

The allowed noise level is designated and explained in the City of Pullman Code (Appendix 3).

Conclusion

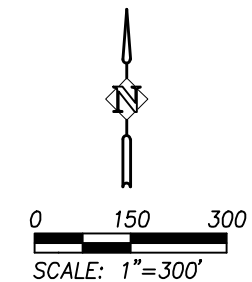
Based on the design and analysis of the possible sound produced by the industrial research campus, there would be minimal impact to the surrounding area. The noise test showed that there would be little to no impacts by the proposed access road due to trucks. The current design proposes the construction of a public park and a vertical landscape buffer between the campus and the subdivision that would provide additional protection against noise impacts, as well as a break in the line-of-sight between the two developments. The proposed design can be seen in Appendix 1. Calculations from the WSDOT CNIA show a minimal amount of noise increase within 200 feet of the existing neighborhood. However, the construction of this buffer does not appear to be required based on the observed data. The Port of Whitman is anticipating constructing a vertical buffer to reduce the possible impacts to the surrounding areas.

Port of Whitman Agriculture
Advancement Campus Noise Study

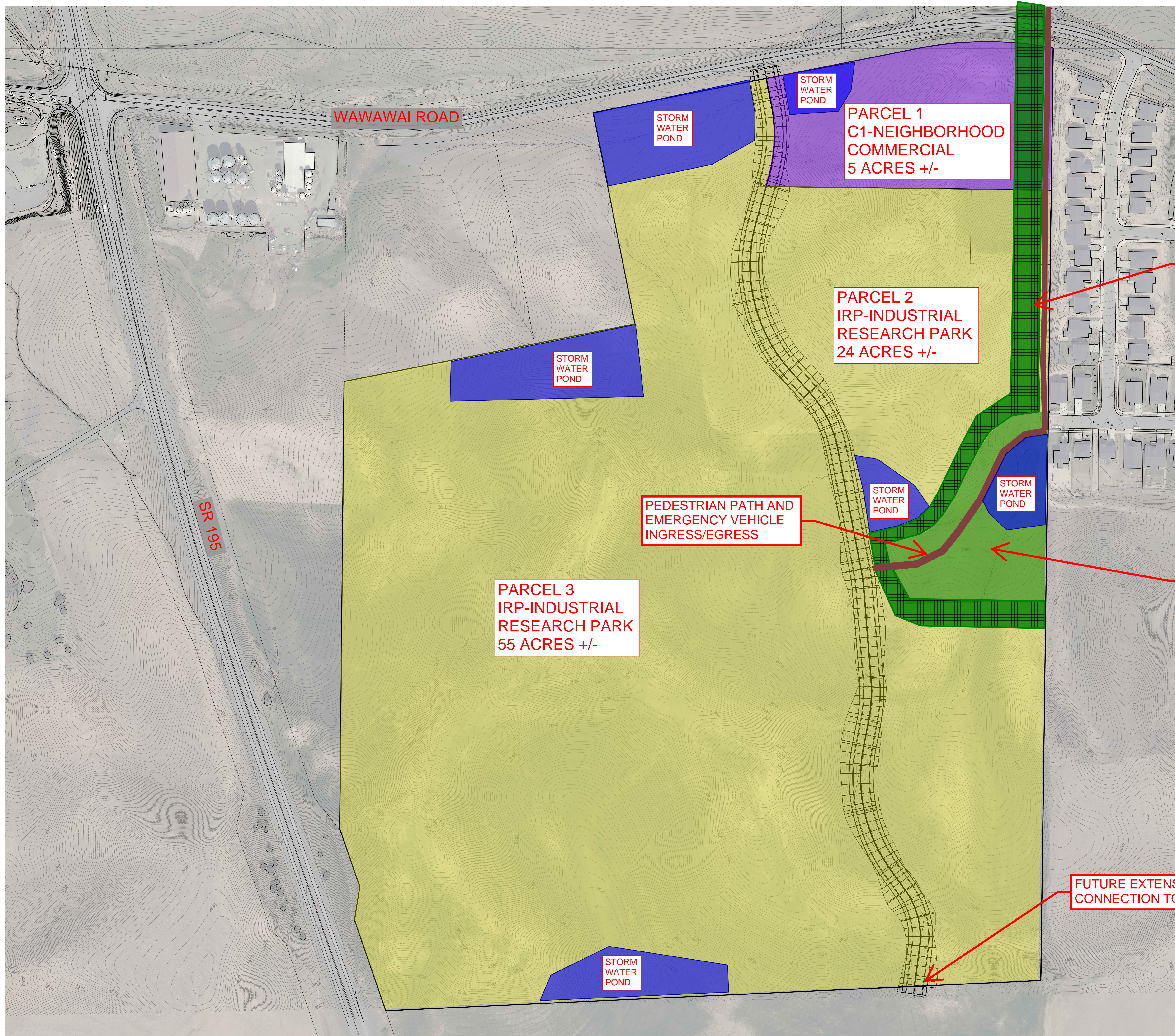


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APPENDIX 1 – SITE EXHIBITS



SITE TESTING LOCATION EXHIBIT



DRAWING NOT TO SCALE

ELEVATED LANDSCAPE BERM WITH PEDESTRIAN PATHWAY

PUBLIC PARK AND STORM WATER POND PARK AREA IS SIMILAR TO REANEY PARK. APPROXIMATELY 2 ACRES TOTAL

FUTURE EXTENSION WITH CONNECTION TO SR195

PARCEL 1
C1-NEIGHBORHOOD
COMMERCIAL
5 ACRES +/-

PARCEL 2
IRP-INDUSTRIAL
RESEARCH PARK
24 ACRES +/-

PARCEL 3
IRP-INDUSTRIAL
RESEARCH PARK
55 ACRES +/-

PEDESTRIAN PATH AND
EMERGENCY VEHICLE
INGRESS/EGRESS

STORM
WATER
POND

STORM
WATER
POND

STORM
WATER
POND

STORM
WATER
POND

STORM
WATER
POND

STORM
WATER
POND

WAWAWAI ROAD

SR 195



APPENDIX 2 – CALCULATIONS

Estimation of Distance Industrial Noise Attenuates to Ambient

$Source_{sound} := 90$	The tested sound equivalent for a heavy truck originating at the source (dB).
$L_{max} := 75$	Average maximum noise level measured at 50 feet from the source (dB) (Measured in the Field).
$D_0 := 50 \text{ ft}$	Distance from equipment to where noise level was measured, 50 feet standard
$L := 60$	Noise Level in interest (dB) Required for Industrial Source to Residential Property (City of Pullman Code 8.80.020(3)(b))
$\alpha := 20$	Ground Hardness Factor based on construction/equipment noise as determined based on the localized presence of trucks on-site with minimal gross speeds to depict onsite equipment used in industrial areas
$D := D_0 \cdot 10^{\left(\frac{(L_{max} - L)}{\alpha}\right)}$	Equation for determining the distance noise attenuates to ambient (WSDOT CNIA 2020 7.20)
$D = 281 \text{ ft}$	Calculated distance needed to attenuate noise to ambient conditions
if ($D \geq 200 \text{ ft}$, “Mitigation Required”, “Mitigation Not Required”) = “Mitigation Required”	

Adjustment to L_{max} due to earthen berm (5 dB decrease)

$L_{berm} := 5$	
$L_{adjusted} := L_{max} - L_{berm} = 70$	Adjusted L_{max} with vertical buffer compensation
$D_{adjusted} := D_0 \cdot 10^{\left(\frac{(L_{adjusted} - L)}{\alpha}\right)}$	Equation for determining the distance noise attenuates to ambient (WSDOT CNIA 2020 7.20)
$D_{adjusted} = 158 \text{ ft}$	New calculated distance needed to attenuate noise to ambient conditions
if ($D_{adjusted} \geq 200 \text{ ft}$, “Mitigation Required”, “Mitigation Not Required”) = “Mitigation Not Required”	



APPENDIX 3 – REFERENCES

Chapter 8.80

NOISE REGULATION

Sections:

- 8.80.005 Declaration of policy.**
- 8.80.010 Definitions.**
- 8.80.020 Public disturbance noise.**
- 8.80.050 Exemptions.**
- 8.80.060 Variances.**
- 8.80.070 Enforcement.**
- 8.80.080 Violations – Penalties – Enforcement.**
- 8.80.090 Ordinance additional to other law.**
- 8.80.100 Severability.**

8.80.005 Declaration of policy.

(1) It is declared to be the policy of the City of Pullman to minimize the exposure of citizens to the harmful physiological and psychological effects of excessive noise and to protect, promote and preserve the public health, safety and welfare. It is the express intent of the City Council to control the level of noise permitted in the City of Pullman in a manner which promotes commerce; the use, value, and enjoyment of property; the protection of sleep and repose; and the quality of the environment.

(2) It is also the express intent of the City Council that noise be prohibited when it is in excess of specified decibel levels, as well as when it unreasonably disturbs the peace, comfort and quiet repose of others. The City of Pullman hereby declares “public disturbance noise” as defined in subsection [8.80.020](#) of this ordinance to be a public nuisance. (Ord. 05-8 §1, 2005; Ord. 82-20 §1, 1982).

8.80.010 Definitions.

As used in this Chapter:

- (1) “Distribution facilities” means any facility used for distribution of commodities to final consumers, including facilities of utilities that convey water, waste water, natural gas, and electricity.
- (2) “dBA” means the sound level in decibels measured using the ‘A’ weighting network on a sound level meter.
- (3) “EDNA” means the environmental designation for noise abatement, being an area or zoning designation within which maximum permissible noise levels are established and to which the provisions of this Chapter are applied. For the purposes of this Chapter:

- (a) Class "A" EDNA includes all residential districts zoned as RT, R1, R2, R3, R4, MHP, RVP and PRD uses and certain residential areas of the WSU district as designated by the Washington State University Chief of Police.
- (b) Class "B" EDNA includes commercial districts zoned for C1, C2, and C3 uses.
- (c) Class "C" EDNA includes industrial districts zoned for I1, I2, and IRP uses.
- (4) "Emergency work" means work required to restore property to a safe condition following a public calamity, work required to protect persons or property from imminent exposure to danger, or work by private or public utilities to immediately provide or restore necessary utility service.
- (5) "Enforcement officer" means any law enforcement officer commissioned by the City of Pullman to enforce the provisions of this Chapter.
- (6) "Equipment" means any stationary or portable device or any part thereof capable of generating sound.
- (7) "Existing" means a process, event, or activity in an established area, producing sound subject to or exempt from this Chapter prior to the effective date of this Chapter.
- (8) "Motorcycle" means any motor vehicle having a saddle for the use of a rider and designed to travel on not more than three wheels in contact with the ground, except farm vehicles.
- (9) "Motor vehicle" means any vehicle which is self-propelled, used primarily for transporting persons or property upon public highways and required to be licensed under RCW [46.16.010](#). Aircraft, watercraft, and vehicles used exclusively on stationary rails or tracks are not motor vehicles as that term is used herein.
- (10) "Muffler" means a device consisting of a series of chambers or other mechanical designs for the purpose of receiving exhaust gas from an internal combustion engine and effective in reducing noise resulting therefrom.
- (11) "Noise" means the intensity, duration, and character of sounds from any and all sources.
- (12) "Off highway vehicle" means any self-propelled vehicle not used primarily for transporting persons or property upon public highways, nor required to be licensed under RCW [46.16.010](#).
- (13) "Person" means and includes any individual, firm, partnership, corporation, fraternity, sorority and any association of natural persons, or any other entity, public or private.
- (14) "Property boundary" means the surveyed line at ground surface, which separates the real property owned, rented, or leased by one or more persons from that owned, rented, or leased by one or more other persons, and its vertical extension. For the purposes of enforcement of this Chapter, the property boundary of multifamily units, including, but not limited to, duplexes, triplexes, apartment houses and condominiums, shall include the walls, ceilings, and floors of each unit.
- (15) "Public highway" means the entire width between the boundary lines of every way publicly maintained by the Washington State Department of Transportation, or any county or city, when any part thereof is generally open to the use of the public for purposes of vehicular travel as a matter of right.

(d) Noise made at any time that is received at any school, institution of learning, court, hospital, nursing, or convalescent facility, or other area where exceptional quiet is necessary; provided, signs are displayed in adjacent or contiguous streets indicating that the area is a quiet zone.

(3) *Maximum Permissible Sound Levels.*

(a) For the purposes of the regulation of public disturbance noises, pursuant to [8.80.020](#) (2), the Environmental Designation for Noise Abatement (EDNA) for the City of Pullman is as defined in [8.80.010](#)(3).

(b) For noise sources located within the City of Pullman, the maximum permissible sound levels are as follows:

EDNA Designation of Noise Source	EDNA Designation of Receiving Property Within City		
	Residential "A"	Commercial "B"	Industrial "C"
Residential	55 dBA	57 dBA	60 dBA
Commercial	57 dBA	60 dBA	65 dBA
Industrial	60 dBA	65 dBA	70 dBA

(c) Decibel levels may be measured by the enforcement officer, with a sound meter from the complaining party's property. Nothing in this section shall prevent the issuance of a notice of infraction based solely on the provisions of [8.80.020](#)(1).

(4) "Public disturbance noise" shall not apply to such sounds from sanctioned public events or activities at public recreational facilities, including but not limited to, crowd noise, public address systems for park and game events or concerts or similar publicly sanctioned park or recreation activities. (Ord. 11-13 §1, 2011; Ord. 05-8 §3, 2005; Ord. 99-26 §2, 1999; Ord. 98-16 §1, 1998; Ord. 97-8 §1, 1997; Ord. 93-16 §1, 1993; Ord. 88-4 §2, 1988; Ord. 87-8 §1, 1987; Ord. 82-20 §1, 1982).

8.80.050 Exemptions.

(1) The following noises are exempt from the provisions of this Chapter at all times:

- (a) Noises caused by natural phenomena;
- (b) Noises originating from aircraft in flight;
- (c) Noises that originate at airports which are directly related to flight operations;
- (d) Noises created by surface carriers engaged in commerce by railroad;

WAC 173-60-040 Maximum permissible environmental noise levels.

(1) No person shall cause or permit noise to intrude into the property of another person which noise exceeds the maximum permissible noise levels set forth below in this section.

(2)(a) The noise limitations established are as set forth in the following table after any applicable adjustments provided for herein are applied.

EDNA OF NOISE SOURCE	EDNA OF RECEIVING PROPERTY		
	Class A	Class B	Class C
CLASS A	55 dBA	57 dBA	60 dBA
CLASS B	57	60	65
CLASS C	60	65	70

(b) Between the hours of 10:00 p.m. and 7:00 a.m. the noise limitations of the foregoing table shall be reduced by 10 dBA for receiving property within Class A EDNAs.

(c) At any hour of the day or night the applicable noise limitations in (a) and (b) above may be exceeded for any receiving property by no more than:

- (i) 5 dBA for a total of 15 minutes in any one-hour period; or
- (ii) 10 dBA for a total of 5 minutes in any one-hour period; or
- (iii) 15 dBA for a total of 1.5 minutes in any one-hour period.

[Order 74-32, § 173-60-040, filed 4/22/75, effective 9/1/75.]

- USFWS has issued a spreadsheet to aid in the analysis of underwater sound effects on bull trout and diving marbled murrelets that is available on-line at the WSDOT website listed immediately above.

Noise from project activities can adversely affect wildlife in various ways. This chapter provides guidance on identifying construction-related noise and noise impacts in both terrestrial and aquatic settings. Basic acoustic concepts are covered, including noise generation, transmission, and reduction. Identifying background sound levels for comparison with anticipated project-related noise can assist the project biologist in more accurately identifying the extent of project-related noise and potential impacts on listed species.

The terms noise and sound should not be used interchangeably. *Noise* is characterized as unwanted sound, and because *ambient* and *background* sound are not considered adverse, they are not classified as noise. The ambient sound level is the total of all sound sources excluding anthropogenic sources. The background sound level is a composite of sound from all sources including anthropogenic sources. Ambient or background sound levels are the starting point for analyzing construction noise impacts such that the analysis measures and compares project-related noise to either ambient or background sound based on which best applies to existing site conditions. Most transportation projects will use background sound.

Three other terms used in this chapter are *source*, *path*, and *receiver*. The source is where a sound comes from, the path is the intervening terrain and factors that help to reduce the noise, and the receiver is the targeted recipient of the noise (such as human, eagle, microphone, etc.).

This discussion focuses on identifying the extent of project-related noise, which represents one element of the project action area, and the potential for noise impacts on wildlife. Noise transmission through air, and noise impacts on terrestrial species are addressed first. Next, underwater noise, sound pressure levels, and their effects on fish, diving marine birds, and marine mammals are discussed.

7.1 Terrestrial Noise

Noise is transmitted through air when an object moves, like water flowing over rocks, or air passing through vocal cords. This movement causes air waves, similar to ripples in water. When these waves reach an animal's ears, they are perceived as sound. Sound is measured in decibels. A decibel is a relative measure, not an absolute measure, that is accompanied by a reference scale ($\text{dB} = 20 * \log (P1/Pr)$, where P1 is the measured noise pressure and Pr is the reference pressure) to denote the Sound Pressure Level (SPL).

In-air noise when frequency-weighted to approximate human hearing is measured on an A-weighted scale, denoted as dBA.¹ The A-weighted decibel scale begins at zero, which

¹ For sound pressure in air, the reference pressure is usually 20 micro-Pascal (μPa). One Pascal is the pressure resulting from a force of 1 newton exerted over an area of 1 square meter. Sound measured in air scale is referenced to 20 μPa in this document.

represents the faintest sound level that humans with normal hearing can hear. Decibels are measured on a logarithmic scale so each 10 dB increase doubles the sound; therefore, a noise level of 70 dBA is twice as loud to the listener as a noise of 60 dBA (USDOT 1995). Table 7-1 shows typical noise levels generated by common indoor and outdoor activities, and provides possible human responses.

Table 7-1. Typical noise levels and possible human responses.

Common Noises	Noise Level (dBA)	Effect
Rocket launching pad (no ear protection)	180	Irreversible hearing loss
Carrier deck jet operation Air raid siren	140	Painfully loud
Thunderclap	130	Painfully loud
Jet takeoff (200 feet) Auto horn (3 feet)	120	Maximum vocal effort
Pile driver Rock concert	110	Extremely loud
Garbage truck Firecrackers	100	Very loud
Heavy truck (50 feet) City traffic	90	Very annoying Hearing damage (8 hours of exposure)
Alarm clock (2 feet) Hair dryer	80	Annoying
Noisy restaurant Freeway traffic Business office	70	Telephone use difficult
Air conditioning unit Conversational speech	60	Intrusive
Light auto traffic (100 feet)	50	Quiet
Living room Bedroom Quiet office	40	Quiet
Library/soft whisper (15 feet)	30	Very quiet
Broadcasting studio	20	Very quiet
	10	Just audible
Threshold of hearing	0	Hearing begins

From: <<http://www.nonoise.org/resource/educat/ownpage/soundlev.htm>>.

7.1.1 Noise Generation, Transmission, and Reduction

7.1.1.1 Noise Sources

Noise is a pressure wave that decreases in intensity over distance from the source. Noise attenuation is described as a reduction in decibel level per doubling of distance from the source. Depending on the nature of the noise source, noise propagates at different rates. When reporting the noise level from a source, one should always specify the reference distance from the source for the sound measurement or estimated source. A standard reference distance for source noise levels is 50 feet. The two most common types of noise are point source and line source. These are discussed in more detail below.

Point Source Noise

Point source noise is usually associated with a source that remains in one place for extended periods of time, such as with most construction activities. A few examples of point sources of noise are pile drivers, jackhammers, rock drills, or excavators working in one location. However, noise from a single traveling vehicle is also considered a point source noise.

Construction point source noise is commonly measured by maximum decibel level (L_{max}), or the highest value of a sound pressure over a stated time interval (Harris 1991). Noise from a point source spreads spherically over distance. Think of this as a 3-dimensional model, where the wave spreading creates a dome effect, traveling in all directions equally from the source. The standard reduction for point source noise is 6 dB per doubling of distance from the source.

Line Source Noise

Line source noise is generated by moving objects along a linear corridor. Highway traffic is a good example of line source noise. When assessing line source noise levels the analyst should measure or estimate over longer time periods such as the L_{eq} (Equivalent Continuous Sound Level) rather than in maximum levels such as the L_{max} measured for point source noise. Only when noise comes from a very long continuous noise source such as a very long conveyor belt should the line source be represented by maximum event levels such as (L_{max}).

Noise from a line source spreads cylindrically, spreading outward along the length of a line. The standard reduction for line source noise is 3 dB per doubling of distance from the source (compared to 6 dB for construction point source noise).

Table 7-2 provides an example of noise attenuation of construction point and line source decibel levels based on distance from the source.

Table 7-2. Example of noise reduction over distance from a 95 dBA source showing variation between construction point source and line source.

Distance from Source (feet)	Noise Attenuation	
	Point Source (-6 dB)	Line Source (-3 dB)
50	95 dBA	95 dBA
100	89 dBA	92 dBA
200	83 dBA	89 dBA
400	77 dBA	86 dBA
800	71 dBA	83 dBA
1,600	65 dBA	80 dBA
3,200	59 dBA	77 dBA
6,400	53 dBA	74 dBA

7.1.1.2 Noise Path Reduction Factors

Natural factors such as topography, vegetation, and temperature can further reduce noise over distance. This section covers a few of the common factors and their applicability in increasing the noise reduction per doubling of distance from the source.

Hard Site versus Soft Site

A hard site exists where noise travels away from the source over a generally flat, hard surface such as water, concrete, or hard-packed soil. These are examples of reflective ground, where the ground does not provide any attenuation. The standard attenuation rate for hard site conditions is 6 dB per doubling of distance for point source noise and 3 dB per doubling of distance from line sources.

When ground cover or normal unpacked earth (a soft site) exists between the source and receptor, the ground becomes absorptive of noise energy. Absorptive ground results in an additional 1.5 dB reduction per doubling of distance as it spreads from the source. Added to the standard reduction rate for soft site conditions, point source noise attenuates at a rate of 7.5 dB per doubling of distance, and line source noise decreases at a rate of 4.5 dB per doubling of distance.

Topography, Vegetation, and Atmospheric Factors

A break in the line of sight between the noise source and the receptor can result in a 5 dB reduction. Dense vegetation can reduce noise levels by as much as 5 dB for every 100 feet of vegetation, up to a maximum reduction of 10 dB over 200 feet (USDOT 1995). Atmospheric conditions can also affect the rate of noise attenuation. Noise travels farther during periods of higher humidity and in colder temperatures (USFWS 2003). Wind can reduce noise levels by as much as 20 to 30 dB at long distances (USDOT 1995).

The influences of vegetation, topography, and atmospheric conditions as noise reduction factors can vary greatly so are difficult to include in an analysis. Therefore, these factors are generally

not taken into account in environmental noise analyses over short distances. As a result, such analyses are conservative and likely to predict noise levels that are higher than actual noise levels.

7.1.2 Ambient or Background Sound Conditions

As defined for this manual, ambient sound level is the total of all sound sources in a specific area excluding anthropogenic sources. The background sound level is a composite of sound from all sources including anthropogenic sources. Normally the background sound level is selected as the baseline for evaluating construction noise impacts based on existing site conditions.

7.1.2.1 Existing Conditions

Determining background sound levels is the first step for a noise assessment. It can vary greatly depending on site-specific factors. Environmental factors can elevate background sound near the source, effectively hiding, or masking construction noise. The same environmental factors occurring near the receiver can change the receiver's perception of how loud construction noise is, or hide it completely.

Background and ambient sound levels vary by location even for undisturbed forested areas. WSDOT noise analyses on the San Juan Islands identified an ambient level of about 35 dBA, with regular noise intrusions from traffic and aircraft overflights ranging from 45 to 72 dBA (WSDOT 1994). A study on the Mt. Baker-Snoqualmie National Forest listed forested ambient levels between 52 and 60 dBA (USFS 1996). The environment surrounding transportation projects is often composed of high-speed highways, busy ferry terminals, and urban development. For projects occurring in these areas, background sound levels will include traffic noise and be much higher than that of a forested or undeveloped setting (see Section 7.1.4.1).

Weather conditions such as wind or rainfall can increase ambient sound in undeveloped areas. Locations near rivers or streams have higher ambient sound levels as well. As with the atmospheric conditions described above, environmental factors are so variable that models rarely take them into account.

The WSDOT project biologist should check with the WSDOT project manager to see if ambient or background sound data are available for the project or similar areas. If ambient or background information is not available and noise may be a major concern in the consultation, the biologist should have ambient or background sound within the project area measured by a professional.

7.1.2.2 Traffic Noise

The majority of projects assessed by a project biologist will include traffic noise. Identifying the amount and type of traffic helps to determine traffic noise. The level of highway traffic noise depends upon the traffic volume, the vehicle speeds, and the mix of trucks in the flow of traffic (USDOT 1995). Generally, the loudness of traffic noise is increased when traffic is heavier, when traffic speed is increased, and when a greater proportion of the traffic flow is heavy trucks.

For traffic volume, 2,000 vehicles per hour sounds twice as loud as (or is 10 dBA higher than) 200 vehicles per hour (USDOT 1995). For traffic speed, traffic at 65 miles per hour (mph) sounds twice as loud as traffic at 30 mph (USDOT 1995). In regard to the proportion of heavy truck traffic, one truck at 55 mph sounds as loud as 28 cars at 55 mph (USDOT 1995).

Vehicle noise comes from a combination of sources produced by engines, exhaust, and tires. The loudness of vehicle noise can also be affected by the condition and type of roadway, road grade, and the condition and type of vehicle tires.

Table 7-3 lists typical traffic noise levels for a variety of traffic volumes at various speeds, assuming 4 percent medium trucks, 6 percent heavy trucks, and a sound level modeled at 50 feet from the source. These numbers would be elevated as the percent of truck traffic volume increases. The State Highway Log can be used to find the posted speed for a state route. The Annual Traffic Report can be used to find the traffic volume, where traffic volume in vehicles per hour is equal to 10 percent of the Average Daily Traffic (ADT).

The State Highway Log is available at <http://www.wsdot.wa.gov/mapsdata/roadway/statehighwaylog.htm>; and the Annual Traffic Report is available at <http://www.wsdot.wa.gov/mapsdata/travel/annualtrafficreport.htm>.

7.1.3 Construction Noise

One of the easiest things for the project biologist to identify and one of the hardest things to quantify is noise associated with the actual construction of the project. How much noise will construction generate, how often will it occur, and how long it will last, are all questions that should be answered in the assessment. This section provides an introduction to equipment noise characteristics that the project biologist can use for typical construction projects.

Construction is usually performed in a series of steps or phases, and noise associated with different phases can vary greatly. However, similarities in noise sources allow typical construction equipment to be placed into one of three categories: heavy equipment, stationary equipment, or impact equipment.

Table 7-3. Typical noise levels for traffic volumes at a given speed.

Volume (vehicles/hour)	125	57.3	58.5	59.7	60.9	62.0	63.1	63.8	64.1	64.5	65.1	65.2	66.1	Sound Level (dBA L_{eq} (hour)) at 50 feet
	250	60.2	61.4	62.6	63.8	64.9	66.0	66.7	67.0	67.4	68.0	68.2	69.0	
	500	63.2	64.4	65.6	66.8	67.9	69.0	69.7	70.0	70.4	71.0	71.2	72.0	
	1,000	66.2	67.4	68.6	69.8	70.9	72.0	72.7	73.0	73.5	74.0	74.2	75.0	
	2,000	69.2	70.4	71.6	72.8	73.9	75.0	75.7	76.1	76.5	77.0	77.2	78.0	
	3,000	71.0	72.2	73.4	74.6	75.7	76.8	77.5	77.8	78.2	78.8	79.0	79.8	
	4,000	72.2	73.4	74.6	75.8	76.9	78.0	78.7	79.1	79.5	80.1	80.2	81.0	
	5,000	73.2	74.4	75.6	76.8	77.9	79.0	79.7	80.0	80.4	81.0	81.2	82.0	
	6,000	74.0	75.2	76.4	77.6	78.7	79.8	80.5	80.8	81.2	81.8	82.0	82.8	
		35	40	45	50	55	60	65 / T60	65	70 / T60	70	75 / T60	75	
Speed (miles/hour)														

T is the speed limit for truck traffic when it is posted differently from other vehicle traffic. For traffic volumes exceeding 6,000 per hour, add 1 dB for every 1,000 v/h increase at a particular speed.

7.1.3.1 Heavy Equipment

Analysts can categorize heavy equipment as earth-moving equipment, such as excavating machinery like excavators, backhoes, and front loaders, as well as materials handling equipment like graders, pavers, rollers, and dump trucks. Average maximum noise levels (L_{max}) at 50 feet from heavy equipment range from about 73 to 101 dBA for non-impact equipment (Table 7-4). These numbers were identified from several studies, and represent average maximum noise levels of reported values (FHWA 2011). During a phase of construction using heavy equipment, noise is generated more or less at a constant level. Therefore, noise levels can be quantified based on an average hourly level. Measurements collected on either side of mobile equipment moving in a linear path are referred to as Passby measurements. Measurements collected for stationary equipment that performs work in a repetitive cycle resulting in variations throughout the measurement period are referred to as Cyclical measurements.

Lacking onsite noise level data, the project biologist should use the worst-case scenario of the known equipment noise levels for a noise analysis. Manufacturers may also provide noise levels for their equipment, but the biologist must know the specific make and model of the equipment to be used for the project to obtain that information. Care should be taken to identify the distance at which the manufacturer has measured the equipment and ensure that the sound levels are provided as L_{eq} or L_{max} and not as a sound power level.

Table 7-4. Average maximum noise levels at 50 feet from common construction equipment.

Equipment Description ^a	Impact Device?	Actual Measured Average L _{max} ^b at 50 feet
Air-Operated Post Driver	Yes	83
Asphalt Distributor Truck (Asphalt Sprayer)	No	70
Auger Drill Rig	No	70
Backhoe	No	84
Backup / Movement Alarm	No	80
Bar Bender	No	73
Blasting (rock slope production) ^c	Yes	126
Blasting (mitigated rock fracturing)	Yes	94
Boring Jack Power Unit ^c	No	83
Chain Saw	No	83
Chip Spreader	No	77
Clam Shovel (dropping) ^c	Yes	87
Compactor (ground)	No	75
Compressor (air)	No	68
Concrete Batch Plant	No	90
Concrete Grinder (Diamond Grinder)	No	97
Concrete Mixer Truck	No	82
Concrete Pump Truck	No	89
Concrete Saw	No	85
Crane	No	79
Directional Drill Rig	No	76
Dozer	No	86
Drill Rig Truck ^c	No	79
Drum Mixer	No	74
Dump Truck (Cyclical)	No	91
Dump Truck (Passby)	No	73
Excavator	No	87
Flat Bed Truck ^c	No	74
Front End Loader (Cyclical)	No	81
Front End Loader (Passby)	No	71
Generator	No	68
Generator (<25KVA, VMS signs) ^c	No	73
Gradall ^c	No	83
Grader (Passby)	No	79
Grapple (on backhoe)	No	87
Hoe Ram	Yes	97
Horizontal Boring Hydr. Jack	No	88
Impact Pile Driver	Yes	105
Jackhammer (Asphalt / Concrete)	Yes	95
Joint Sealer	No	74
Light Tower	No	63
Mud Recycler	No	74
Man Lift	No	75
Pavement Scarafier	No	84
Paving – Asphalt (Paver + Dump Truck)	No	82
Paving – Asphalt (Paver + MTV + Dump Truck)	No	83
Paving – Concrete (Placer + Slipform Paver)	No	91
Paving – Concrete (Texturing / Curing Machine)	No	74
Paving – Concrete (Triple Roller Tube Paver)	No	89
Pickup Truck	No	75
Power Tools – Air Hose	No	98

Equipment Description ^a	Impact Device?	Actual Measured Average L _{max} ^b at 50 feet
Power Tools – Chipping Gun	No	101
Power Tools – Circular Saw (Cutting metal / wood)	No	77
Power Tools – Grinder (Grinding metal / concrete)	No	73
Power Tools – Hammer Drill	No	75
Power Tools – Impact Wrench	Yes	74
Power Tools – Jig Saw (Cutting steel)	No	95
Power Tools – Nail Gun	Yes	73
Power Tools – Reciprocating Saw (Cutting metal / wood)	No	66
Power Tools – Sander	No	69
Pumps	No	74
Refrigerator Unit ^c	No	73
Rivet Buster/chipping gun	Yes	107
Rock Drill	No	93
Roller	No	82
Rumble Strip Grinding (asphalt)	No	87
Sand Blasting (Single Nozzle)	No	103
Scraper	No	92
Shears (on backhoe)	No	96
Shot Crete 0Pump/Spray	No	86
Slurry Plant	No	78
Slurry Trenching Machine	No	80
Street Sweeper	No	81
Street Sweeper (Vacuum)	No	82
Telescopic Handler (Forklift)	No	88
Tractor ^c	No	84
Vacuum Excavator (Vac-truck)	No	87
Vacuum Street Sweeper ^c	No	82
Ventilation Fan	No	64
Vibrating Hopper ^c	No	87
Vibratory Concrete Mixer	No	80
Vibratory Pile Driver	No	105
Warning Horn	No	102
Water Jet Deleading ^c	No	92
Water Spray Truck	No	72
Welder / Torch	No	75

^a NCHRP 25-49, 2018. Development of a Highway Construction Noise Prediction Model (Database) .

^b L_{max} is the maximum value of a noise level that occurs during a single event.

^c Construction Noise Handbook (FHWA, 2006).

7.1.3.2 Stationary Equipment

Stationary equipment such as pumps, power generators, and air compressors generally run continuously at relatively constant power and speeds. Noise levels at 50 feet from stationary

7.1.4 Determining the Extent of Project Related Noise

This discussion has introduced basic concepts and provided information on construction-related noise, traffic noise, and baseline sound levels. Using this information, the project biologist should be able to identify the extent of project-related noise, which constitutes one element defining the project action area. This section provides instructions for establishing the extent of noise and defining the noise element of the action area.

7.1.4.1 Determining the Background Sound Level

As part of the noise assessment, it is important to identify the background sound level throughout the area where construction noise is expected to extend. For transportation projects, traffic noise frequently exceeds the background sound level in the project area. However, in highly urbanized areas, other sounds may exceed traffic noise levels. Similarly, for projects in rural areas with little or no traffic, background sound levels also may not be defined by traffic noise.

Background sound levels vary depending on the level of development. Urban areas have the highest background sound levels, with daytime levels approximating 60 to 65 dBA (EPA 1978). Suburban or residential areas have background levels around 45 to 50 dBA (EPA 1978), while rural areas are the quietest with sound levels of 35 to 40 dBA (EPA 1978). Cavanaugh and Tocci (1998) identified typical urban residential background sound at around 65 dBA, high-density urban areas at 78 dBA, and urban areas adjacent to freeway traffic at 88 dBA. These sound levels may be important in a project noise assessment if traffic is absent near the project site or if construction noise extends beyond the extent of traffic noise. In this case, the project biologist can use Table 7-9, which lists daytime sound levels, exclusive of traffic, based on population density to determine the background sound level.

Table 7-8. Estimating existing environmental background noise levels.

Population Density (people per square mile)	L_{eq} ^a Daytime Noise Levels Exclusive of Traffic (dBA)
1-100	35
100-300	40
300-1,000	45
1,000-3,000	50
3,000-10,000	55
10,000-30,000	60
30,000 and up	65

Source: FTA (2006).

^a Where L_{eq} is the *equivalent sound pressure level*: the steady noise level that, over a specified period of time, would produce the same energy equivalence as the fluctuating noise level actually occurring.

In urban and developed areas, traffic noise and construction noise attenuate (decline) to background in less distance than in undeveloped or rural areas. For example, it may take 2 miles or more for construction noise to reach background levels in a rural area, but the same noise may attenuate to urban background levels in less than a mile.

A general guideline is:

- If the distance where traffic noise attenuates to background levels is greater than the distance where construction noise attenuates to background levels, then the extent of construction noise is equal to the distance where construction noise attenuates to traffic noise levels. In this scenario, traffic noise from the roadway extends farther than construction noise. The extent of project noise is then calculated to where it attenuates to the traffic noise level, which is the dominant background sound. In this case, traffic noise is louder than background levels, and construction noise is audible until it attenuates to the same level as traffic noise.
- Conversely, if the distance where traffic noise attenuates to background levels is less than the distance where construction noise attenuates to background levels, then the extent of construction noise is equal to the distance where construction noise attenuates to background levels. In this case, construction noise extends farther than traffic noise from the roadway. The extent of project noise is then calculated to where it attenuates to the surrounding background levels. In this case, construction noise dominates until it attenuates to the same level as surrounding background sound.

Table 7-10 displays this relationship.

Table 7-9. Extent of project-related noise based on attenuation to the dominant background level.

If the distance noise attenuates:			The distance noise attenuates:		The distance of the extent of construction noise is based on attenuation:	
From	To		From	To	From	To
Traffic	Background	>	Construction	Background	Then	Construction Traffic
Traffic	Background	<	Construction	Background	Then	Construction Background

7.1.4.2 Equations for Solving Distances

Base 10-Log equations are used to 1) calculate noise levels at a specific distance from the source (such as construction noise levels at a nest located 650 feet from a project), 2) to determine the distance construction noise will travel before it attenuates to the traffic noise level, and 3) to determine the distance at which construction or traffic noise will attenuate to background sound levels.

Distance Construction Noise Attenuates to Ambient or Background

To determine the distance point source construction noise will travel before it attenuates to the ambient sound level; the following equation should be used:

$$D = D_o * 10^{((\text{Construction Noise} - \text{Ambient Sound Level in dBA})/\alpha)}$$

Where D = the distance from the noise source

D_o = the reference measurement distance (50 feet in this case)

α = 25 for soft ground and 20 for hard ground. For point source noise, a spherical spreading loss model is used. These alpha (α) values assume a 7.5 dBA reduction per doubling distance over soft ground and a 6.0 dBA reduction per doubling distance over hard ground.

Example – *Project-related noise is estimated at 84 dBA, with 40 dBA for ambient sound in a forested site (soft site). At what distance will construction noise attenuate to the ambient sound level over soft ground?*

$$D = D_o * 10^{((\text{Construction Noise} - \text{Ambient Sound in dBA})/\alpha)}$$

D_o = the reference measurement distance (50 feet in this case)

$$D = 50 * 10^{((84 - 40)/25)}$$

$$D = 50 * 10^{(44/25)}$$

$$D = 50 * 10^{(1.76)}$$

$$D = 50 * 57.54$$

$$D = 2,877 \text{ feet (about 0.5 miles)}$$

Distance Traffic Noise Attenuates to Ambient or Background

To determine the distance line source traffic noise will travel before it attenuates to the ambient sound level, the following equation should be used:

$$D = D_o * 10^{((\text{Traffic Noise} - \text{Ambient Sound Level in dBA})/\alpha)}$$

Where D = the distance from the traffic noise

D_o = the reference measurement distance (50 feet in this case)

α = 15 for soft ground and 10 for hard ground. For line source noise, a cylindrical spreading loss model is used. These alpha (α) values assume a 4.5 dBA reduction per doubling distance over soft ground and a 3.0 dBA reduction per doubling distance over hard ground.

Example – *Project-related noise is estimated at 84 dBA, and traffic noise is estimated at 66 dBA with 40 dBA for ambient sound in a forested site (soft site). At what distance will traffic noise attenuate to the ambient sound level over soft ground?*

$$D = D_o * 10^{((\text{Traffic Noise} - \text{Ambient Sound in dBA})/\alpha)}$$

D_o = the reference measurement distance (50 feet in this case)

$$D = 50 * 10^{((66 - 40)/15)}$$

$$D = 50 * 10^{(69/15)}$$

$$D = 50 * 10^{(1.733)}$$

$$D = 50 * 53.703$$

$$D = 2,685 \text{ feet (0.5 miles)}$$

Distance Construction Noise Attenuates to Traffic Noise

To determine the distance point source construction noise will travel before it attenuates to the traffic noise level; the following equation should be used:

$$D = D_o * 10^{((\text{Construction Noise} - \text{Traffic Noise in dBA})/\alpha)}$$

Where D = the distance from the noise source
 D_o = the reference measurement distance (50 feet is the standard)
 α = 10. For the equation where you have Construction Noise – Traffic Noise in dBA / alpha; alpha will always be 10. The reason is that construction noise will be 20 for a point source over hard ground or 25 for a point source over soft ground and traffic is a line source which is 10 for hard ground or 15 for soft ground. When you subtract the two, the result is either 25-15 = 10 or 20-10=10. Either way it will always be 10.

Example – Project-related noise is estimated at 84 dBA, and traffic noise is estimated at 66 dBA in a forested site (soft site). At what distance will construction noise attenuate to the same level as traffic over soft ground?

$$D = D_o * 10^{((\text{Construction Noise} - \text{Traffic Noise in dBA})/\alpha)}$$

D_o = the reference measurement distance (50 feet in this case)

$$D = 50 * 10^{((84 - 66)/10)}$$

$$D = 50 * 10^{(18/10)}$$

$$D = 50 * 10^{(1.8)}$$

$$D = 50 * 63$$

$$D = 3,154 \text{ feet (0.6 miles)}$$

Construction Noise Levels at a Specific Distance

To determine construction noise levels at a specific distance, the following equation should be used:

$$L_{\text{max}} = \text{Construction } L_{\text{max}} \text{ at 50 feet} - 25 * \text{Log}(D/D_o)$$

Where L_{max} = highest A-weighted sound level occurring during a noise event during the time that noise is being measured.

At 50 feet = the reference measurement distance (standard is 50 feet)

D = the distance from the noise source

D_o = the reference measurement distance (50 feet in this case)

Example – Project-related noise is estimated at 84 dBA, and traffic noise is estimated at 66 dBA in a forested site (soft site). A spotted owl nest is located 650 feet from the project. What is the expected construction noise level at the nest site?

$$L_{max} = \text{Construction } L_{max} \text{ at 50 feet} - 25 * \text{Log}(D/D_o)$$

Where $L_{max} = 84 \text{ dBA}$

$$D = 650$$

$D_o = \text{the reference measurement distance (50 feet in this case)}$

$$L_{max} = 84 \text{ dBA at 50 feet} - 25 * \text{Log}(650/50)$$

$$L_{max} = 84 \text{ dBA at 50 feet} - 25 * \text{Log}(13)$$

$$L_{max} = 84 \text{ dBA at 50 feet} - 27.85$$

$$L_{max} = 56.15 \text{ dBA}$$

7.1.4.3 Steps for Defining the Extent of Project-Related Noise

The following subsection provides instructions for performing a noise assessment to determine the extent of project-related noise defining the action area. Remember that noise is just one element of the project that must be considered when determining the action area. See Chapter 8 for guidance on other elements that should be considered.

The following information is provided in a step-by-step format with an accompanying example project. The noise assessment outlined below is appropriate for the vast majority of WSDOT projects.

1. **Estimate the equipment noise level for the project.** To estimate the noise level of project activities, it is imperative to know and understand all equipment that will be used for the specific project. The project biologist should avoid assuming the types of equipment that may be used and ask the project design or engineering office for specific information. Once all project equipment is known, use the decibel levels for common construction equipment found in Table 7-4. This table shows the noise range for similar construction equipment. If specific noise levels are not known, take the noise level shown for at least the three noisiest pieces of equipment listed in the table. Remember to use the rules of decibel addition for the final project noise level. This method provides a conservative estimate, since not all equipment will be operating at the same time and location in most cases.

Example – The equipment used will be an excavator, heavy trucks, finish grader, and paver. The estimated worst-case scenario noise level for the construction equipment is: excavator, 81 dBA; dump trucks, 76 dBA; and paver, 77 dBA. The two pieces of equipment producing the least noise (dump truck at 76 dBA, and paver at 77 dBA) are added together for a difference of 1. Using the rules for decibel addition (see Table 7-8), add the 3 decibels to the highest value between the two (paver at 77 dBA) to get 80 dBA. Continuing

with the rules of decibel addition, add 3 dBA to the piece of equipment with the highest noise level, the excavator at 81 dBA. Therefore, construction noise can be assumed to not exceed 84 dBA at 50 feet.

2. **Estimate the background community or ambient sound level.** In more remote locations, background or ambient sound conditions are likely lower than traffic noise (see Section 7.1.2.1). In urban areas, community background sound may be greater than traffic noise, such as adjacent to airports. For many WSDOT projects, traffic noise will define the background sound level (see Step 3 below). By using the information in Section 7.1.4.1, it is possible to estimate the community background sound level for the project area, based on population density.

***Example** – The project is located on SR 101 in the vicinity of MP 216 in an undeveloped forested area. Based on the Olympic National Forest programmatic biological assessment, estimated ambient sound levels for undisturbed forested areas is 40 dBA (USFWS 2003).*

3. **Estimate the traffic noise level.** A noise discipline report may be available and contain project specific traffic noise levels. If one is not available the information in Section 7.1.2.1, can be used to estimate the traffic noise level for the project area by assessing traffic. The project biologist should define the ADT and the speed limit in the project area. If the ADT and speed limit are not obvious, consult the Annual Traffic Report (<<http://www.wsdot.wa.gov/mapsdata/travel/annualtrafficreport.htm>>) and the Washington State Highway Log (<<http://www.wsdot.wa.gov/mapsdata/roadway/statehighwaylog.htm>>), respectively, for information. Take 10 percent of the ADT to find the approximate worse case number of vehicles per hour. Use the closest fit from Table 7-3 for vehicles per hour and speed to estimate the decibel level of traffic in the project area. Remember that seasonal use of the roadway and the amount of heavy truck traffic can raise or lower typical noise levels. If your project does not fit Table 7-3 or there are significant topographic features in the area, then the project biologist should contact the WSDOT project office they are working with to ask if any acoustical monitoring has occurred in the project vicinity or in similar areas.

***Example** – The project is located on SR 101 in the vicinity of MP 216 in an undeveloped forested area. The speed limit in the project area is 60 mph; traffic levels will be elevated due to seasonal use and will include heavy truck traffic. The Annual Traffic Report lists the ADT on SR 101 at MP 216 at 2,000 vehicles per day. Therefore, vehicles per hour (vph) can be estimated as 10 percent of 2,000 or approximately 200 vph. Table 7-3 lists the noise level as*

66 dBA for a roadway with 250 vph and a 60 mph traffic speed, which is the best fit for the example.

4. **Determine whether hard or soft site conditions exist.** Section 7.1.1.2 describes the difference between hard and soft site conditions. A hard site exists where noise travels away from the source over a generally flat, hard surface such as water, concrete, or hard-packed soil. When ground cover or normal unpacked earth exists between the source and receptor, the ground becomes absorptive to noise energy and soft site conditions are present. Most project areas, other than sites adjacent to water or in developed areas having more than 90 percent concrete or asphalt, exhibit soft site conditions. For soft site conditions, add 1.5 dBA to the standard reduction factor.

Example –Based on the location of the project in a forested setting, it can be assumed that soft site conditions exist. Therefore, add the additional 1.5 dBA reduction to the standard reduction factors.

5. **Determine whether the noise is point source or line source.** Use Section 7.1.1.1 to determine whether construction noise and traffic noise are point or line source. Typically, construction noise has a point source, regardless of the activity. Even moving projects such as pavers attenuate noise in point source dynamics. Although construction activity may move, the noisy activity typically remains in one location.

If multiple noisy activities are occurring at different locations throughout the project area, the extent of project-related noise should be described at each location. For example, pile driving could be occurring at one location in the project corridor, while pavement grinding or rock drilling may be occurring elsewhere.

Traffic noise is almost always line source noise. The standard attenuation rate for point source noise is 6 dBA, and the standard attenuation rate for line source noise is 3 dBA. These standard attenuation rates do not take into account any reduction factors, such as soft site, vegetation, or atmospheric conditions.

Example – All work on the project will occur at one location, and is considered point source noise. Therefore, adding the reduction for soft site conditions, construction noise will attenuate at a rate of 7.5 dBA per doubling of distance. Traffic noise (line source) will attenuate at a rate of 4.5 dBA per doubling of distance. This attenuation rate includes the 1.5 dBA reduction for soft site conditions.

Use the equations for solving distances. Base 10-Log equations are used to calculate noise levels at a specific distance from the source, to determine the distance construction noise will travel before it attenuates to the traffic noise level, and also to determine the distance at which construction or traffic noise will attenuate to background sound levels.

Example with equations for solving for distance – Project-related noise is estimated at 84 dBA, traffic noise is estimated at 66 dBA, and 40 dBA is estimated for ambient sound level. Using the equation in Section 7.1.4.2 the distance construction noise attenuated to ambient levels was to 2,877 feet. Using the equation in Section 7.1.4.2 for a line source noise, the distance traffic noise attenuated to ambient levels was 2,685 feet. In this example project, the extent of project-related noise is 2,877 feet. This is only slightly farther than traffic noise extends before attenuating to ambient levels (40 dBA). Therefore, at approximately 2,700 feet, traffic noise is not distinguishable from ambient sound levels and at approximately 2,900 feet construction noise is not distinguishable from ambient sound levels. Therefore, the extent of project generated noise is approximately 2,900 feet.

If, in the example, traffic noise was high enough to extend past 2,900 feet, then the extent of project generated noise would be to where construction noise and traffic noise attenuated to the same level, but was still above the overall ambient level.

If the project occurs in a developed area, where other background sound exceeds traffic noise, the biologist can also use known background sound levels associated with the level of development, and determine when construction noise drops below the development level to identify the extent of project-related noise.

The distance calculated using the noise assessment method described above is a worst-case scenario and does not take into account naturally occurring ambient sounds such as water and wind, or topography, which can physically block noise.

Examples of two projects that might warrant a more detailed noise assessment are provided below, along with the subsequent extent of noise impacts that was calculated for each.

The first example is a blasting project. If blasting occurs along a small portion of the project corridor where work would occur, it would be most effective to develop a composite noise assessment with one element that evaluated noise generated by blasting activities and a second element that evaluated noise generated by other construction activities. This would require the biologist to complete at least two noise assessments to effectively characterize these different elements. The area influenced by blasting noise would be substantially larger than the area

affected by routine construction activities and equipment. Therefore, a larger radius would define the extent of noise surrounding the blasting activities than the radius defining the extent of noise from other activities. As a result, the noise component of the action area defined for the project would display a larger circle of anticipated noise effects around blasting activities than is exhibited around the remaining corridor.

A second example of a project requiring a more detailed noise assessment is a project corridor that is surrounded by both hard and soft site conditions. For those areas surrounding the road that possess soft site characteristics, the biologist would calculate the extent of noise that is generated by proposed construction activities and equipment using an attenuation rate for soft site conditions. For those areas surrounding the road that possess hard site characteristics, the biologist would calculate the extent of noise that is generated by proposed construction activities and equipment using an attenuation rate for hard site conditions. The extent of anticipated noise impacts in soft site areas would be smaller in area than the extent that is exhibited in hard site areas. As a result, the noise component of the action area defined for the project would display a larger radius of anticipated noise effects in hard site areas than is exhibited around the remaining soft site segments of the project corridor.

There may be some specific projects that warrant a more rigorous noise assessment than is described in the procedure or outlined in the examples provided above. For example, the blasting activities described above could take place in a canyon, where surrounding topography would inhibit the transmission of noise to surrounding areas or confine noise impacts to a smaller area. For these projects, the WSDOT project manager may request that a project biologist work with WSDOT noise specialists to develop a more sophisticated analysis. Figure 7-1 below illustrates the variation in the extent of noise impacts stemming from different project activities (paving vs. blasting) as well as variation in surrounding topography.

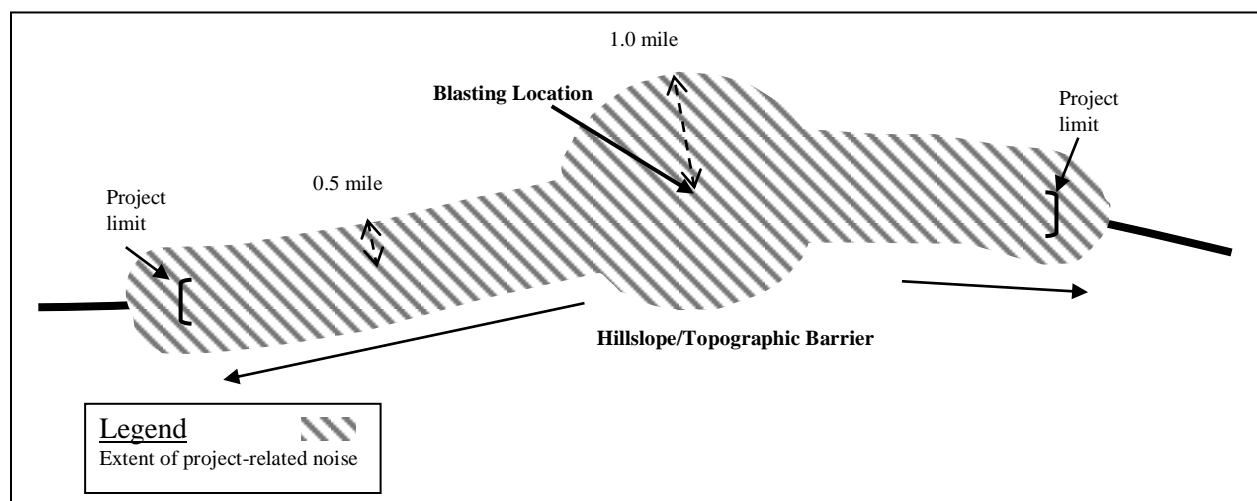


Figure 7-1. Extent of noise based on project activities and topography.