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### 446.01 Introduction

**Note:** The information in this chapter will be updated following the July 13, 2011, implementation date of changes to 23 CFR 772. Traffic noise studies planned for completion following this date should consult WSDOT Air Quality, Noise, and Energy Program for details.

This chapter focuses primarily on environmental noise procedures for roadways. See [Section 446.07](#) for information applicable to procedures for transit and park and ride facilities, in addition to minor guidance for rail, ferries, and aviation. See [Section 446.05\(1\)\(f\)](#) for fish and wildlife.

The level of noise (defined as unwanted sound) near roadways depends on six things:

- Traffic volume.
- Speed of the traffic.
- Percentage of trucks in the flow of traffic.
- Distance to the highway.
- Intervening topography.
- Atmospheric conditions.

Generally, traffic noise is increased by heavier traffic volumes, higher speeds, and a greater percentage of trucks.

WSDOT has several strategies for controlling highway noise:

- Construct noise walls.
- Reduce traffic speeds.
- Coordinate with local agencies to achieve compatible development and prevent “noise sensitive” development near roadways.
- Preserve existing buffer zones. Work with stakeholders to retain lands owned by WSDOT and preserve beneficial topographic features.

- Support local jurisdictions in establishing principal routes for buses and trucks.
- Maintain a prioritized listing of noise barriers proposed for noise sensitive properties that were developed before acquisition of roadway right of way.

For detailed information, see the WSDOT [Noise](#) web page.

Additional research and pilot testing is underway to look at quieter pavement options, but pavements are not approved as noise abatement at this time. For additional information, see the WSDOT [Quieter Pavement Research](#) web page.

### (1) **Summary of Requirements**

A traffic noise analysis is required by law for federally funded projects and required by state policy for other funded projects that: (1) involve construction of a new highway, (2) significantly change the horizontal or vertical alignment of an existing highway, or (3) increase the number of through traffic lanes on an existing highway. [Exhibit 446-1](#) summarizes the noise analysis process.

All completed noise reports shall be distributed to local jurisdictions (planning and executive branches) for identification of impacts and use in local land use decision-making. Detailed requirements for roadway traffic noise are spelled out in the WSDOT's Noise Policy and Procedures.

### (2) **Abbreviations and Acronyms**

BE	Biological Evaluation
dB	decibel
dBA	A-weighted decibels
EDNA	Environmental Designation for Noise Abatement
FRA	Federal Rail Administration
FTA	Federal Transit Administration
Leq	Equivalent sound level
Leq(24)	Equivalent sound level for a 24-hour period
Ldn	Day-night sound level
NAC	Noise Abatement Criteria
TNM	Traffic Noise Model

### (3) **Glossary**

**Abatement** – Reduction in degree or intensity.

**Background Noise** – The total of all noise in a system or situation, independent of state highway traffic noise under study.

**Barrier** – A solid wall or earth berm located between the roadway and receiver location that provides noise reduction.

**Design Year** – The future year used to estimate the probable traffic volume for which a highway is designed, usually 20 years from the beginning of construction for WSDOT projects.

**EDNA** – Environmental designation for noise abatement, being an area or zone (environment) within which maximum permissible noise levels are established.

**Existing Noise Level** – Natural and man made noises considered to be usually present within a particular area’s acoustic environment.

**Highway** – The entire width between the right of way boundary lines of every publicly maintained travel way when any part thereof is open to the public use for purposes of motorized vehicular travel. May also be referred to as a street or road.

**Impacted Community** – Noise sensitive receptor sites (such as schools or neighborhoods) where people would be exposed to substantially increased noise levels or noise levels that approach abatement criteria due to a project.

**Noise Abatement Criteria (NAC)** – Noise levels for various activities or land uses which, when approached or exceeded, are considered to be traffic noise impacts.

**Traffic Noise Impacts** – Impacts which occur when the predicted traffic noise levels approach or exceed the Noise Abatement Criteria or when the predicted traffic noise levels substantially exceed the existing noise levels.

**Type I Project** – A proposed highway construction at a new location or the physical alteration of an existing highway that significantly changes either the horizontal or vertical alignment or increases the number of traffic through lanes.

**Type II Project (Retrofit)** – A proposed project for noise abatement on an existing highway or highway configuration.

## 446.02 Applicable Statutes and Regulations

This section lists the primary statutes and regulations applicable to noise issues. Required permits and approvals are listed in [Section 446.06](#).

### (1) **National Environmental Policy Act/State Environmental Policy Act**

The National Environmental Policy Act (NEPA), [42 USC 4321](#), requires that all actions sponsored, funded, permitted, or approved by federal agencies undergo planning to ensure that environmental considerations such as noise impacts are given due weight in project decision-making. The State Environmental Policy Act (SEPA) mandates a similar procedure for state and local actions. Federal implementing regulations are at [23 CFR 771](#) (FHWA) and [40 CFR 1500-1508](#) (CEQ). State implementing regulations are in [WAC 197-11](#) and [WAC 468-12](#) (WSDOT). For details, see [Chapters 410](#), [411](#), and [412](#).

### (2) **Federal Noise Control Act and Implementing Regulations**

The Noise Control Act of 1972 ([42 USC 4901 et seq.](#)) authorized the establishment of federal noise emission standards. Companion legislation ([23 USC 109\(i\)](#)) directs the Secretary of Transportation to develop and implement traffic noise standards for highway projects.

Noise impact criteria and abatement implemented by FHWA are in [23 CFR 772](#) (Procedures for Abatement of Highway Traffic Noise and Construction Noise). The current WSDOT Noise Policy and Procedures is based on 23 CFR 772 changes from 1995. New changes to [23 CFR 772](#) take effect on July 13, 2011. This regulation requires preparing a noise study to determine what noise impacts, if any, will result from the proposed highway improvement and what measures will be taken to lessen these impacts. If noise impacts are expected, noise-reduction measures that are determined by the state highway agency and FHWA to be practicable, reasonable, and acceptable to the public must be incorporated into the highway improvement.

### (3) **State Noise Legislation and Implementing Regulations**

The Noise Control Act of 1974 ([RCW 70.107](#)) authorizes an expansion of statewide efforts for abatement and control of noise to protect the health, safety, and welfare of the people; the value of property; and the quality of the environment.

The Washington State Department of Ecology (Ecology) is responsible for implementation under the following regulations:

- [WAC 173-58](#) – Establishes standard procedures for measuring sound levels of sources regulated by Ecology, including, but not limited to, environmental noise, motor racing vehicles, construction, float planes, railroads, and aircraft engine testing.
- [WAC 173-60](#) – Establishes maximum noise levels permissible in identified environments, and EDNA standards measured at the receiver's property line. Highway traffic is exempt from this regulation; however, it does apply to highway construction noise at night between the hours of 10 p.m. to 7 a.m.
- [WAC 173-62](#) – Sets noise emission standards for new motor vehicles for the operation of motor vehicles on public highways. These standards provide several methods of evaluating motor vehicle noise levels, including those from modified exhaust systems on light vehicles.

### (4) **Local Noise Ordinances**

Noise generated by construction or maintenance of state highways or other transportation facilities during nighttime hours (typically 10 p.m. to 7 a.m.) are subject to local ordinances and may require a permit (see [Section 446.06](#)). Local ordinances may address noise from truck compression braking (jake brakes). For more information, see the WSDOT [Traffic Noise](#) web page.

## **446.03 Policy Guidance**

The general policy is to minimize noise impacts from transportation systems and facilities. Many of the Technical Guidance documents in [Section 446.05](#) also function as Policy Guidance.

**(1) Noise Directive 2008 – Improving the Noise Environment When Standard Options Are Not Available**

WSDOT prepared this guidance in response to a budget proviso from the 2007 Legislature. The document provides policy support and describes options that can be considered when traditional noise abatement is not reasonable and feasible. In most situations, application of this directive will occur after completion of the discipline report. Eligible projects must have the following:

1. The public process has identified traffic noise as a major concern.
2. Enhancements are community scale.
3. Enhancements are within project scope.

The [Noise Directive](#) 2008 is available online.

**(2) State Funds Option for Traffic Noise Analysis**

This policy provides project offices an option for limiting the traffic noise analysis areas on projects that do not require federal approvals. Instead of analyzing all areas adjacent to the roadway between the full project limits, this policy limits analysis to the specific location(s) adjacent to where Type 1 noise activities occur on a project. The State Funds Option also describes a screening process that can be used on some projects. Key points include the following:

- The guidance is optional.
- For projects not subject to NEPA.
- Reduced scope: only evaluate areas adjacent to Type 1 noise activities instead of the entire project area, and only when sensitive receivers are present.
- Reduced effort: allows use of a screening tool, instead of full noise model (in many cases).
- Consultation with WSDOT Air Quality, Noise, and Energy Program required.

The State Funds Option for Traffic Noise Analysis is available through the WSDOT Air Quality, Noise, and Energy Program.

#### **446.04 Interagency Agreements**

No interagency agreements have been identified for highway noise. See [Section 446.07](#) for an Interagency Agreement related to transit projects.

#### **446.05 Technical Guidance**

Guidance for conducting traffic noise studies and preparing documentation is provided in the documents described in this section.

**(1) WSDOT**

- (a) **Traffic Noise Discipline Report** – WSDOT’s Traffic Noise Discipline Report provides the information required environmental documents. A Traffic Noise Discipline Report is needed when a roadway project:

1. Involves construction of a new roadway,
2. Significantly changes the horizontal or vertical alignment of a roadway, or
3. Increases the number of through traffic lanes on an existing highway.

Reports and consideration of abatement may also be required on projects that substantially alter the ground contours surrounding the roadway. The rationale for determining that a Discipline Report is not needed should be documented within the Environmental Review Summary or Environmental Classification Summary.

The [Traffic Noise Discipline Report Checklist](#) serves as a general guide for preparing a noise discipline report, including specific elements to include. Review and approval by the WSDOT Air, Noise, and Energy Program manager or designee is required for all noise reports prior to finalizing the environmental document. Subsequent updates to the noise report must also be approved.

- (b) **Data Requirements** – Before requesting a traffic noise discipline report, the WSDOT project manager needs to compile relevant data that will be needed by the analyst. Such data includes MicroStation (CADD) files, traffic data, and land use and zoning maps. Complete the task request form on the [WSDOT Noise](#) web page.
- (c) **Consultant Scopes of Work** – [Exhibit 446-2](#) is a sample scope of work that can be used as a guide in contracting with consultants for traffic noise studies.
- (d) **WSDOT Traffic Noise Analysis and Abatement Policy and Procedures 2006** – This document provides the required criteria for conducting traffic noise impact and mitigation analyses consistent with federal highway traffic noise standards in [23 CFR 772](#), Procedures for Abatement of Highway Traffic Noise and Construction Noise. It includes information on qualifications for noise analysts, definitions, when noise abatement is required, methodology, public involvement, coordination with local officials, and highway construction noise.
- (e) **WSDOT Noise Evaluation Procedures for Existing State Highways** – The process for conducting noise inventories for retrofits of existing state highways (Type II projects) and establishing priorities for noise abatement projects was previously outlined in WSDOT Directive D 22-22. The process is now described in [Exhibit 446-3](#).

This document also describes the procedure for evaluating non-residential sensitive receivers ([Exhibit 446-3](#), Section E: Example Computations for Noise Barrier Priority Numbers).

- (f) **WSDOT *Biological Assessment Manual*** – Evaluation of noise impacts for fish and wildlife is located in the [Biological Assessment Manual](#), Guidance on Specific Biological Assessment Topics.
  - (g) **WSDOT *Roadside Manual* M 25-30** – WSDOT [Roadside Manual](#) Chapter 460 (Noise Abatement) provides additional information on safety, visual quality, and maintenance that may be useful for designers of noise barriers.
  - (h) ***Development Services Manual M 3007*** – Chapter 3-3 of this manual, Environmental Issues, gives general guidelines that local jurisdictions and private developers should follow when considering development and noise impacts on state roadways.
  - (i) **WSDOT Noise Website** – The WSDOT [Noise](#) web page provides information for noise analysts. It gives links to directional documents and provides WSDOT technical guidance. Data for preparing a noise model is available. The information will be useful in designing noise abatement and analyzing noise. Further guidance on cost effective noise barriers is also available.
- (2) **FHWA**
- (a) **FHWA Technical Advisory** – FHWA [Technical Advisory T 6640.8A](#) (October 1987) gives guidelines for preparing environmental documents. For noise, the draft EIS should include a summary of the noise analysis.
  - (b) **FHWA [Highway Traffic Noise Analysis and Abatement Policy and Guidance](#)** – This document (June 1995) is available at the FHWA [Highway Traffic Noise Regulations and Guidance](#) website.
  - (c) **FHWA [Guidance on Construction Noise](#)** – FHWA guidance on highway construction noise can be found in FHWA [Special Report Highway Construction Noise: Measurement, Prediction, and Mitigation](#) (May 2, 1977).  
  
FHWA Technical Advisory T 6160.2 Analysis of Highway Construction Noise, March 13, 1984, has been canceled.
  - (d) **FHWA [Guidance on Quieter Pavement](#)** – FHWA guidance on when states can consider the use of quieter pavements for noise abatement was published on January 24, 2005.

(3) **Other Technical Resources**

FHWA's [Environmental Guidebook](#) contains links to numerous references on highway construction and traffic noise analysis and abatement.

## 446.06 Permits and Approvals

The only noise permits required are variances from state and local noise laws for construction and maintenance activities during nighttime hours ([WAC 173-60](#)). For details, see the WSDOT [Federal, State, and Local Permits](#) web page, [Section 620.07](#), and [Section 720.04\(10\)](#).

## 446.07 Non-Road Project Requirements

### (1) *Rail, Transit, and Park and Ride Facilities*

For many projects involving rail or transit and park and ride facilities, the Federal Transit Administration (FTA) is responsible for implementation of noise and other environmental protections under [23 CFR 771](#), Environmental Impact and Related Procedures. Noise studies are also required for these facilities.

An Interagency Agreement for coordinated noise analysis and abatement policy and procedures has been developed by FTA, FHWA, WSDOT, and Sound Transit. The current agreement (as of February 2001) documents an agreed-upon noise methodology and criteria for integrated highway and transit projects. The document serves as guidance to those involved in noise discipline studies for environmental documentation on these types of projects.

FTA technical guidance for mass transportation noise analysis is available in [Transit Noise and Vibration Impact Assessment](#), May 2006 (FTA-VA-90-1003-06). Another resource is the FTA General Noise Assessment Spreadsheet designed as an aid in using the FTA General Noise Assessment Procedures. Resource information from FTA is provided at the [website](#).

### (2) *Ferry, Rail, and Air Facilities*

**Railroads** – Measurement of sound levels is regulated under [42 USC 4916](#) and [WAC 173-58](#). Rail projects may require a vibration analysis. Rail projects may also require a horn-noise analysis if a new rail crossing is created or an existing crossing is modified to introduce new horn warning signals. Contact the WSDOT Environmental Services Office Air Quality, Noise, and Energy Air Quality, Noise, and Energy section for additional information.

A process to establish community quiet zones is now available through the Federal Rail Administration (FRA). [FRA horn-noise quiet zone information](#) is available on their website.

**Ferries** – Ferry projects may require a permit pile drive during or after set work hours. Biological Evaluations (BE) should address noise impacts to threatened and endangered species. Vessels, as defined in [RCW 88.12.010\(21\)](#), are regulated for noise under [RCW 88.12](#).

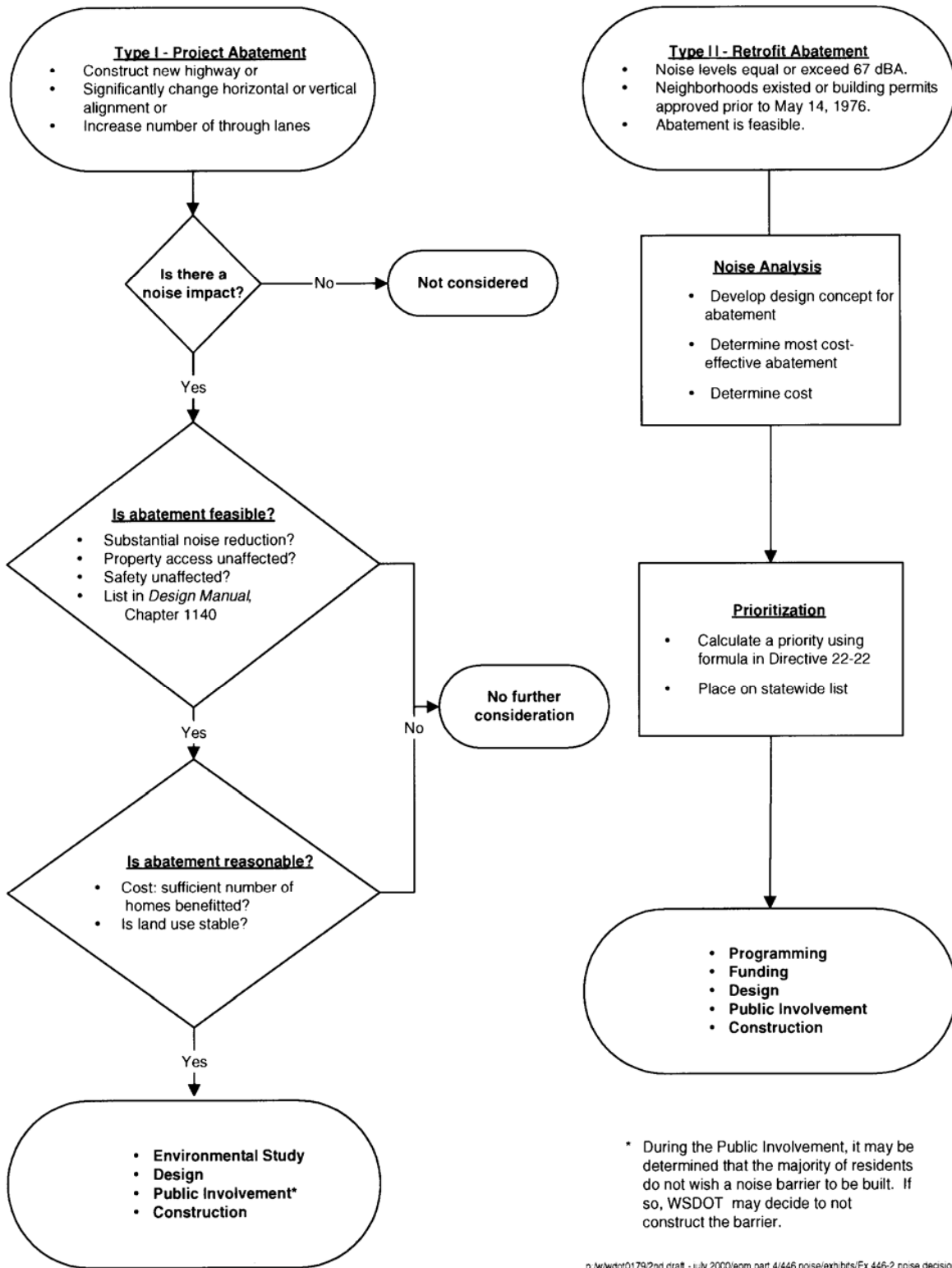
**Airports** – WSDOT airports have noise abatement guidelines.

## 446.08 Exhibits

[Exhibit 446-1 Traffic Noise Abatement Decision Process](#)

[Exhibit 446-2 Sample Scope of Work for Highway Noise Analyses](#)

[Exhibit 446-3 Noise Evaluation Procedures for Existing State Highways](#)



\* During the Public Involvement, it may be determined that the majority of residents do not wish a noise barrier to be built. If so, WSDOT may decide to not construct the barrier.

The CONSULTANT shall prepare a technical memorandum documenting the methodology and assumptions used to guide the noise analysis.

The CONSULTANT shall conduct a reconnaissance of the project study area to identify all of the land uses and locate noise sensitive properties within 500 feet of the project as described in [23 CFR 772](#). The CONSULTANT shall note physical and terrain features that affect noise propagation and features that may be altered during construction.

The CONSULTANT shall then conduct a noise study for the project area based on the guidelines presented in the current Federal Aid Policy Guide, Sub-chapter H, Part 772 Procedures for Abatement of Highway Traffic Noise and Construction Noise, and the WSDOT Traffic Noise Abatement Policy and Procedures. Noise measurements will be conducted at sites as needed to calibrate the traffic noise model and to ensure complete description of existing noise levels that are representative of the land uses along the proposed alignments.

All measurements will be conducted for 15 minute sampling periods during daytime off-peak hours

(10 AM to 4 PM) when traffic is moving freely. At each measurement site, traffic counts will be conducted concurrently with the noise measurements. All noise sources will be noted and those that may interfere with future mitigation determination will be identified. Traffic volumes that are counted during the noise measurement survey will be modeled and the resulting sound levels will be compared with the measured sound levels to reach close agreement. The use of shielding and alpha factors may be needed to adjust modeled receptor noise levels and will be used in consultation with the WSDOT Acoustic Program Manager or designee. Once the model has been calibrated, existing peak hour traffic will be used with speed limit speeds to calculate existing peak hour noise levels. In locations where there are no existing roadways, the loudest noise hour from a 24 hour noise measurements will be used to represent the existing noise level.

The CONSULTANT shall model the future year traffic noise level with and without the proposed project using the FHWA Traffic Noise Model (TNM) or other appropriate model agreed upon by FHWA and WSDOT Acoustics section. Peak hour noise in the design year for each alternative will be modeled at selected noise sensitive receptors based on forecast traffic volumes. Modeling must be adequate to accurately predict the noise levels at each of the receptors, assess the number of properties within 500 feet of the project that are impacted or will be impacted and determine the increase in traffic noise and amount of reduction to each outdoor area as a result of mitigation.

In accordance with FHWA and WSDOT requirements, noise abatement measures will be considered at locations along the alignments where traffic noise impacts are predicted. Mitigation measures considered must include walls or berms, as well as the five other FHWA methods specifically mentioned in [23 CFR 772](#). The CONSULTANT shall provide location, length, height, profile, estimated cost and number of benefiting noise sensitive properties for each proposed barrier. The analysis will contain a complete discussion of impacted areas that do not meet WSDOT's criteria for abatement and specifically note reasons for not including mitigation.

Construction activities that may cause annoyance at nearby noise sensitive land uses will be qualitatively assessed by the CONSULTANT in accordance with WSDOT's procedures. The CONSULTANT will discuss local laws applying to construction noise.

Deliverables:

1. Noise Model Data files (electronic version)
2. Record of field measurements and traffic counts
3. Noise Analysis Technical Memorandum containing:
  - 3.1 Tables of contents, figures and charts
  - 3.2 A summary including the impacts of each alternative and mitigation recommended
  - 3.3 A project description including relevant aspects of each alternative and a vicinity map
  - 3.4 A characteristic of noise discussion of noise
    - 3.4.1 The definition and characteristics of noise
    - 3.4.2 Nature of the logarithmic scale
    - 3.4.3 Noise descriptors used in the report
    - 3.4.4 Typical sound source noise levels
  - 3.5 Discussion of methodology used including abatement criteria, noise model and traffic data with speeds, vehicle type percentages and peak hour volumes for existing and design year for each alternative.
  - 3.6 Discussion of existing land use including areas of zoning and major terrain features.
  - 3.7 Discussion of existing and future noise levels.

- 3.8 An impact analysis that includes a table comparing the noise levels at each receiver for existing conditions and the design year for each alternative as well as the number of sensitive residences or other sites represented by each receiver.
- 3.9 A mitigation analysis that includes a discussion for each impacted receiver of the reasonableness and feasibility of each of the six methods of mitigation listed in [23 CFR 772](#) as well as a map showing the location of each receiver and proposed mitigation.
- 3.10 A construction noise section that includes:
  - 3.10.1 Typical construction equipment noise levels.
  - 3.10.2 Nature and duration of construction noise.
  - 3.10.3 Typical means of reducing construction noise.
  - 3.10.4 Local ordinances relating to construction noise.
  - 3.10.5 Land uses or activities that may be affected by construction noise.
- 3.11 Bibliography

Based on information formerly contained in:  
WSDOT Directive D 22-22  
Effective Date: November 2, 1987

## **I. Introduction**

### **A. Purpose**

Exhibit 446-4 sets forth guidelines to conduct a noise inventory for existing state highways and prioritize noise retrofit sites.

### **B. Supersession**

D 22-22, "Noise Evaluation Procedures for Existing State Highways,"  
November 2, 1987.

D 22-22, "Noise Evaluation Procedures for Existing State Highways,"  
January 17, 1975.

### **C. References**

1. FHWA Federal-Aid Highway Program Manual, Vol. 7, Chapter 7, Section 3  
"Procedures for Abatement of Highway Traffic Noise and Construction  
Noise," August 9, 1982.
2. IDC, August 26, 1983, Position Paper "Criteria for Programming of Noise  
Attenuation Work" from Tom McLain to District Administrators.

## **II. Rules**

- A. Part 8 of FAHPM 7-7-3 promulgates rules for noise abatement on Type II  
projects (existing highways) with federal aid participation.
- B. The priority listing is developed based on an inventory of noise sensitive  
developments which existed, or for which a building permit had been approved,  
prior to May 14, 1976.
- C. Department program, budget, and fiscal procedures apply to any noise  
abatement project that may be constructed from the noise inventory and  
priority listing.
- D. The steps in Section III, PROCEDURES are used to determine the noise  
sensitive developments that have the highest priority.
- E. The Department's priority listing is current as of December 31, 2005.  
When new sites must be investigated, because of citizen complaints or public  
official's concerns, the procedures in this Directive will be used to prioritize  
those new sites.

### III. Procedures

- A. Because the priorities are part of the public record, an accurate administrative record is kept identifying the steps taken to establish the final priority number of each site.

Special care must be taken to identify those elements not included in the priority listing, and why they were not, for administrative review and use in support of the Department's actions.

- B. Noise Inventory, Prioritization Procedures, and Site Identification
1. Conduct initial traffic noise evaluation to eliminate highway sections where traffic is insufficient to create a one hour time-weighted average sound level (Leq) of 67 dBA at the assumed right of way or actual right of way. This can be done in the office.
    - a. Use "Annual Traffic Report" data or available special traffic studies.
    - b. Predict noise levels based on the most current FHWA Traffic Noise Model.
    - c. Use posted traffic speed.
    - d. Minimize on-site investigations at this stage.
  2. Coordinate highway sections potentially having excessive noise with adjacent residential property or special sites.
    - a. Eliminate all highway sections without adjacent residential or special sites or without physically practical solutions.
    - b. Eliminate areas where roadside development, including access driveways, precludes noise abatement measures.
  3. Continue inventory procedure with expanded emphasis upon developed areas with potentially excessive noise.
    - a. Using the FHWA Traffic Noise Model, plot contours of where Leq = 67 dBA on statewide arterial route maps or other suitable maps where applicable development exists.
    - b. Segregate impacted residential areas into workable units for subsequent analysis.
  4. Conduct on-site inspection as preparation for the second phase of prediction.
    - a. Eliminate sites where terrain will minimize a noise impact to less than a Leq = 67 dBA or prohibits feasible abatement measures such as a housing development on a steep slope above the highway.

- b. Secure criteria of design concepts for abatement (barrier wall, earth berm, etc.).
  - c. Measure noise to confirm original predictions.
5. Prepare fully-documented analysis of impacted work units.
    - a. Apply second analysis of work unit areas (to secure documented Leq dBA level for “Before Impact Factor”). See Section IV.
    - b. Include abatement design concepts in analysis for “After Impact Factor.”
    - c. Develop cost estimates for abatement treatment.
    - d. Plot noise contours based upon the most cost-effective attenuation method and inventory residences within work units.
    - e. Complete the Benefit Cost Computations of Section IV and arrange the work units in resultant numerical priority sequence.

#### IV. Computation Procedures of Noise Priority Numbers

##### A. Noise Impact

The noise impact for a given group exposed to the same noise level Leq is

$$\text{Group Impact} = N \times \text{U.F.} \times 2 \left( \frac{\text{Leq} - \text{Lref}}{10} \right), \text{ where } \left( \frac{\text{Leq} - \text{Lref}}{10} \right) \text{ is a power of 2}$$

where N is the number of people in a given group exposed to a noise level of Leq, U.F. is the usage factor for the site, and Lref is the appropriate “NOISE ABATEMENT CRITERIA” for the land use of the site as provided in TABLE 1 FAHPM 7-7-3.

Group impact is computed for each group and added together for each site to give the site impact. This is done for the site both before and after abatement assumptions. This difference is called benefit.

##### B. Priority Number

1. Obtain the benefit for each site.
2. Estimate the cost of noise barriers for each site. Benefit divided by cost in \$1,000s is used to determine the priority number.

##### C. User Numbers

1. Residential – Based on statistics of Washington State obtained by the Office of Fiscal Management in 1980, the average number of occupants in a single family home is three per house and two per apartment or mobile home.
2. Special Sites – The user number for schools, parks, churches, hospitals, etc., is the estimate of the number of users.

## D. Usage Factors

Established usage factors are shown below.

Site	Hours/ Day	Days/ Week	Months/ Year	Usage Factor
Homes	24	7	12	1
Apartments and mobile homes	24	7	12	1
Hospitals	24	7	12	1
Churches	6	3	12	.11
Schools	10	5	9	.22
Parks	10	7	5	.17

Factors for other special sites shall be submitted for approval.

## E. Example Computations For Noise Barrier Priority Numbers:

## 1. Residential neighborhood.

Assume that before abatement treatment there are four homes exposed to a Leq noise level of 65 dBA, ten homes at 67 dBA, and three homes at 69 dBA. Since the usage factor is one, the average number of people per home is three, and the noise abatement criteria for residential land use is 67 dBA, the computation is as follows:

$$12 \times 2 \left( \frac{65 - 67}{10} \right) + 30 \times 2 \left( \frac{67 - 67}{10} \right) + 9 \times 2 \left( \frac{69 - 67}{10} \right) = 12 \times .870 + 30 \times 1 + 9 \times 1.149 = 50.78$$

This is the “Before” impact. Assume that after construction of a noise barrier there are eight homes at 63 dBA, six homes at 60 dBA, and three homes at 67 dBA. The after impact is as follows:

$$24 \times 2 \left( \frac{63 - 67}{10} \right) + 18 \times 2 \left( \frac{60 - 67}{10} \right) + 9 \times 2 \left( \frac{67 - 67}{10} \right) = 24 \times .758 + 18 \times .615 + 9 \times 1 = 38.26$$

This is the “After” impact. With an estimated noise barrier cost of \$102,000, the priority number of this site is:

$$\frac{50.78 - 38.26}{102} = \frac{12.51}{102} = .123$$

## 2. Church

Assume a church has 100 members exposed to 68 dBA before noise walls are constructed. Since the usage factor is 0.11 for a church and the noise abatement criteria is 67 dBA, the computation is as follows:

$$100 \times .11 \times 2 \left( \frac{68 - 67}{10} \right) = 11 \times 1.072 = 11.8$$

This is the “Before” impact. Assume that the noise barrier reduced the exposure to 57 dBA. The “After” impact is as follows:

$$100 \times .11 \times 2 \left( \frac{57 - 67}{10} \right) = 11 \times .5$$

With an estimated noise barrier cost of \$20,000, the priority number is:

$$\left( \frac{11.8 - 5.50}{20} \right) = .315$$

