

Washington State Department of Transportation

**Traffic Noise Analysis and Abatement
Policy and Procedures**

March 17, 2006

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1. Introduction

This chapter provides criteria for conducting traffic sound level analysis, impact and mitigation consistent with federal highway traffic noise standards 23 CFR 772, "Procedures for Abatement of Highway Traffic Noise and Construction Noise". A traffic noise analysis is required by law for federally funded projects and required by state policy and procedures for other funded projects that:

- 1) involve construction of a new highway,
- 2) significantly change the horizontal or vertical alignment, or
- 3) increase the number of through traffic lanes on an existing highway.

Roadway projects that incorporate any of the three elements listed above will be considered "Type I" noise projects for the purposes of discussion in this document. Federal guidance and state policy and procedures also require the review and possible consideration of noise abatement on projects that substantially alter the ground contours surrounding roadways (e.g., removes or alters a natural or previously constructed berms).

The purpose of this document is to provide a means by which the Washington State Department of Transportation (referred to hereafter as the department) and project sponsors associated with the department, in conjunction with other programs, can fairly and uniformly treat citizens seeking relief from the traffic noise of highways. The Federal Highway Administration considers this document an extension and refinement of the requirements set out in 23 CFR 772 for roadway related traffic noise. Fulfillment of the procedures set out in the document assures that the federal noise standard for roadway traffic noise is met.

2. When Noise Abatement is Provided

The department will evaluate placing abatement for traffic noise from highways under two project types, Type I (new construction as described above in Section 1) and Type II (Retrofit).

The development and implementation of Type II projects are not mandatory requirements of U.S.C. 23 109(i) or 23 CFR 772. However, WSDOT maintains a prioritized retrofit list in order to provide greater traffic noise abatement as funding allows. Retrofit projects are prioritized in an order reflecting traffic noise levels, number of benefiting residences or residential equivalents, cost, and the achievable noise reductions. Qualifying neighborhoods must have been constructed prior to May 14, 1976 and meet noise impact criteria to qualify for an evaluation and be considered for placement on the retrofit list. Specific retrofit requirements are outlined in department Directive D22-22.

Sound level abatement for Type II projects are normally constructed in order of their priority but may be constructed out of priority as part of a Type I project, part of some other project, or as a result of legislative direction.

The following Noise Abatement Criteria table identifies noise levels in Leq that are considered an impact on various land use activity categories. If a noise impact is identified as part of a Type I project or project resulting in substantial alteration of ground contours, further analysis of potential noise mitigation shall be studied following the procedures outlined in this document.

Table A: Noise Abatement Criteria (NAC) Table

Activity Category	L _{eq} (h) (dBA)	Description of Activity Category
A	57 (exterior)	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B	67 (exterior)	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals. ⁽¹⁾⁽³⁾
C	72 (exterior)	Developed lands, properties, or activities not included in Categories A or B above.
D	-	Undeveloped lands.
E	52 (interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums.
Source: U.S. Department of Transportation, 1982; endnote source WSDOT, 2005.		

- (1) Bicycle and pedestrian facilities which serve a transportation purpose and qualify as a transportation facility shall not be evaluated for noise impacts or mitigation.
- (2) Interior noise mitigation will only be considered for public institutions such as schools, hospitals and libraries and analysis of exterior sound mitigation is determined to be unreasonable or infeasible.
- (3) Activity category B also includes such uses as campgrounds, RV parks, and cemeteries (ref. p).

3. Analysis Locations

All human use areas including those in areas zoned for commercial use will be included in a traffic noise analysis.

Receptor/Receiver Sites

Normally only outdoor areas of frequent human use are considered for traffic sound level analysis and abatement. Indoor locations may be used where outdoor activities do not exist. Establishment of indoor sound levels will be in accordance with the conditions delineated in the FHWA publication "Measurement of Highway-Related Noise", dated May 1996. Prediction sites should be located at all measurement sites. Not all prediction sites must have field measurements. Additional receiver sites may be added to the model as needed to determine sound levels. For a project with a large number of residences or residential equivalents, it is not necessary to have traffic sound level predictions at every residence or residential equivalent. However, sufficient sound level predictions must be made to accurately represent the sound level

conditions that are most likely to occur. Prediction sites shall extend to within 500 feet of the pavement edge line.

For original noise evaluations, the noise prediction area shall extend to within 500 feet of the pavement edge line for the length of the project, stopping at the end of the project boundary line. For additional roadway lanes and new roadways, evaluation shall be conducted on both sides of the road. For ramps and other irregular features, analysis shall be conducted within a 500-foot line of the pavement edge line for the project.

For Type I project elements or substantial terrain modifications that are added after the initial noise study and environmental document is complete, the noise analyst shall conduct a noise analysis within 500 feet of the pavement edge line of the newly added or revised feature. Again, the analyst must evaluate the opposite side of the roadway when lanes are added to an existing project.

Date of Public Knowledge

The Date of Public Knowledge is the original date of approval of the initial National Environmental Policy Act (NEPA) Record of Decision (ROD), Finding of No Significant Impact (FONSI), or State Environmental Policy Act (SEPA) document for a transportation project. After this date WSDOT or the transportation project sponsor is responsible for analyzing changes in traffic sound levels within the project limits and/or boundary when there is a change in design that could affect the traffic noise environment. However, the project sponsor is no longer responsible for providing sound abatement for new development that occurs adjacent to the proposed highway project that is not already planned, designed, and programmed. Provision of such noise abatement becomes the responsibility of local communities and private developers. For example, if a 100 home development is slated for an area next to a roadway, but only one building permit for a single home has been issued by the time the transportation project environmental documents are completed, only that one home will be considered for noise impacts and potential mitigation in that location. The remaining property will be considered vacant land. For more detail about development dates for when mitigation will be provided, see Section 6, subsection on *Noise Compatible Land Use & Local Ordinances*.

4. Determination of Sound Levels

Measuring Existing Sound Levels

Field measurements are to be conducted along all existing or proposed roadway segments that may be affected by the proposed project where frequent human use is likely to occur. The measurements shall be taken using a time integrating Type 2 (or better) sound level meter on the A-weighted decibel setting. This meter shall be calibrated once per year by a certified laboratory or process per product specifications and ANSI S1.4.1983 Type 1 Sound Level Meter specifications according to the Reference Test Procedure using equipment traceable to the National Institute of Standards and Technology (NIST).

The measurement of existing sound levels are needed to help determine close agreement with modeled values, background sound levels, or whether a substantial increase may occur. A substantial increase is based on the increase over existing highway traffic noise levels, which is usually determined by running the model with peak-hour traffic volumes for the future project design year. Although FHWA guidelines indicate that the measurements can be used for existing sound levels, it is more common and appropriate to model the worst-case peak-hour volumes to represent existing conditions in the noise report. Measured values are typically only used for calibration and validation. Initial estimates of the ground types (e.g., pavement, soft ground, field grass) and shielding (e.g., building row density, vegetation and terrain lines)-should be made prior to traffic noise modeling. Modeling of the existing sound levels must be within 2 dBA of the measured sound level after adjustment factors-have been applied and shielding objects included in the model. Traffic counts shall be taken at the same time as the noise measurements, documenting the number of heavy trucks, medium trucks and light duty vehicles.

If a sound level reading should occur that cannot be explained by field notes, appropriate shielding objects, adjustment factor, or background sound levels, the analyst shall take every reasonable measure to explain or correct the reading. If the reading cannot be explained, additional measurements or site review shall be made to either support a different ground type, shielding object, background level, or cause the elimination of the measurement for model validation.

Measurements will be made in accordance with the procedures in FHWA publication "Measurement of Highway-Related Noise". All measurements and reference to sound levels will be in dBA Leq. Any field measurements will be of at least 15 minutes duration except that measurements may be discontinued prior to this if the Leq has not changed in the last 5 minutes of the measurement when the number is rounded to the nearest whole number. The 15-minute Leq is the accepted professional substitute for an hourly Leq. All measurements must have stabilized after 10-minutes to be valid.

To assure more valid and accurate noise models, noise analysts shall take measurements of existing sound levels to compare against their models. These field measurements are made for validation and descriptive purposes. They need not reflect the worst noise hour traffic conditions typically experienced just before or after rush hour. Noise measurements need to be made when traffic is moving in free flow conditions.

Determination of Worst Hourly Noise Levels

There are two methods to determine and model the traffic conditions that yield the worst hourly noise conditions in situations where high traffic volumes cause vehicle speeds to drop far below the posted speed. One way is to gather the appropriate traffic data through the morning and afternoon peak hours. The data must be of a time interval sufficient to include one hour of data prior to the start and one hour following each peak travel period and where traffic is traveling at the operational speed for the roadway under normal conditions.

Use the FHWA acceptable traffic noise model to determine the traffic conditions that yield the worst hourly noise conditions. This procedure will need to be repeated for all areas under analysis.

A preferred alternative method is to use the peak traffic volume and the speed limit in an FHWA accepted traffic noise model. This generally requires less traffic analysis but causes projected traffic sound levels to be higher than would be if measured during the traffic conditions actually yielding the worst hourly noise conditions.

In both cases, the analysis must be sufficient to determine all impacts as well as which and how many receptors would receive benefit. In situations where the peak hour speeds do not fall below 50 mph, the traffic analysis will not need to consider other hours and only the peak conditions will be modeled in the traffic noise analysis. Care should be taken when using either approach as changes in traffic composition (particularly the percentage of heavy trucks) can affect traffic sound levels. When traffic composition changes throughout the day, the combination that yields the highest sound levels on a routine basis must be used.

Projection of Future Sound Levels

The same procedure that is used to determine the existing worst hourly noise levels will be used to determine the future worst hourly noise levels. Traffic growth projections used will be in accordance with the most recent growth data from the responsible Regional Transportation Planning Organization, Metropolitan Planning Organization or other agency as appropriate.

Traffic noise projections will be consistent with the methodology in the Federal Highway Administration Traffic Noise Model Report (reference f) or other methodologies approved by FHWA.

Indoor noise increases may be predicted using approved outdoor sound prediction software, then factored to indoor levels.

Screening procedure

For projects that are unlikely to qualify for mitigation, but which require assessment of noise impacts, the following screening procedures may be used to streamline the process in lieu of detailed modeling.

The analyst may use the FHWA Traffic Noise Model (TNM) look-up tables (provided that the surrounding topography is relatively flat and the project is not built on structure) to identify the anticipated sound levels based on existing year and design year traffic for the project. Note that the use of the look-up tables program will not account for shielding by topography, buildings or vegetation and thus in most circumstances will result in a conservative approach to estimate noise impacts. Analysts using the TNM look-up tables are not required to validate or conduct TNM calibration due to the conservative nature of the look-up table feature. The analyst shall discontinue use of the look-up tables and switch to standard TNM when impacts that may result in mitigation are likely or if there is a need for greater precision on determining noise impacts.

An alternative method would be to use the standard TNM program and develop a simple line model provided the analyst conducts validation and calibration of the model. Similar to the look-up tables program, the simple model would not account for detailed site characteristics and terrain.

5. Identification of Traffic Noise Impacts

A location is determined to have traffic noise impacts if the traffic noise level is predicted to approach or exceed the FHWA noise abatement criteria in the future design year. Impacts also occur where the worst hourly traffic noise is predicted for the design year to increase 10 dBA or more above existing modeled sound levels. These levels are shown in Table 1 of 23 CFR 772.

6. Consideration of Traffic Noise Abatement

Sound abatement will only be considered where noise impacts have been identified. 23 CFR 772 defines noise impacts as "impacts which occur when the predicted traffic noise levels approach or exceed the noise abatement criteria (NAC)(Table A), or when the predicted traffic noise levels (design year) substantially exceed the existing noise levels." The department considers a predicted sound level of 1 decibel below the NAC as sufficient to satisfy the condition of approach. The department considers a 10-decibel increase in noise as substantial. For example, if the NAC is 67 dB for homes, the approach criterion is one decibel below 67 dB at 66 dB.

Locations that are determined to be impacted by traffic noise levels will be considered for traffic noise abatement. Where abatement is warranted, at a minimum, the following types of abatement must be considered:

- Traffic management measures (e.g., traffic control devices and signing for prohibition of certain vehicle types, time-use restrictions for certain vehicle types, and modified speed limits);
- Change of roadway alignment either vertical or horizontal;
- Construction of sound barriers;

- Acquisition of property for noise barrier construction or buffer zones, and,
- Sound insulation of public use or nonprofit institutional structures.

In instances where severe traffic noise impacts occur, noise abatement measures other than those listed above may be proposed for Type I and II projects. These will be reviewed and approved by the WSDOT (the FHWA in the case of federal-aid highway projects) on a case-by-case basis when the conditions of 23 CFR Part 772.13(a) have been met.

The relevant criteria to consider when identifying and evaluating noise abatement measures to be incorporated in a project are feasibility and reasonableness. Feasibility primarily deals with engineering considerations, for instance can a meaningful reduction in sound level be achieved with proposed mitigation. Or, will abatement measures affect property access. Multiple openings in a barrier may render abatement infeasible.

Reasonableness assesses the practicality of the abatement measure given a number of factors. Such factors will primarily include cost, but also takes into consideration the amount of sound level reduction and future absolute traffic sound levels.

It is the WSDOT's policy to make final decisions on the construction of noise barriers after final horizontal and vertical alignments are determined and a detailed engineering analysis of the feasibility and reasonability of noise abatement can be made. Barriers that meet the WSDOT's criteria as accepted by FHWA will be constructed. The WSDOT Directive D22-22 outlines the criteria for Type II projects.

Consideration of project boundaries

Traffic noise mitigation will only be considered for impacted activity categories (see Noise Abatement Criteria (NAC) within the project limits (boundaries). For contiguous neighborhoods that originate within the project limits for which no logical end point can be identified within the project limits, mitigation may be extended outside the project limits until a logical end point for the mitigation (e.g., sound barrier) is reached, as identified by the acoustical analyst. If the number of sensitive receivers located beyond the project boundary is the reason that mitigation is infeasible or unreasonable, the analyst shall limit the size of proposed mitigation to within the project boundary.

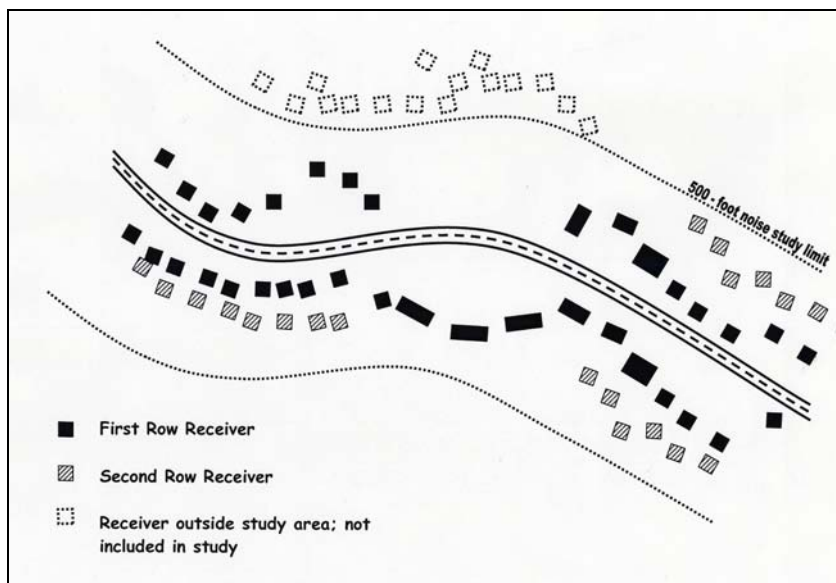
Feasibility

Every reasonable effort should be made to attain a 10 dBA or greater insertion loss (noise reduction) at the first row of receivers. However, for mitigation (e.g., a sound barrier) to be included in a Type I project,

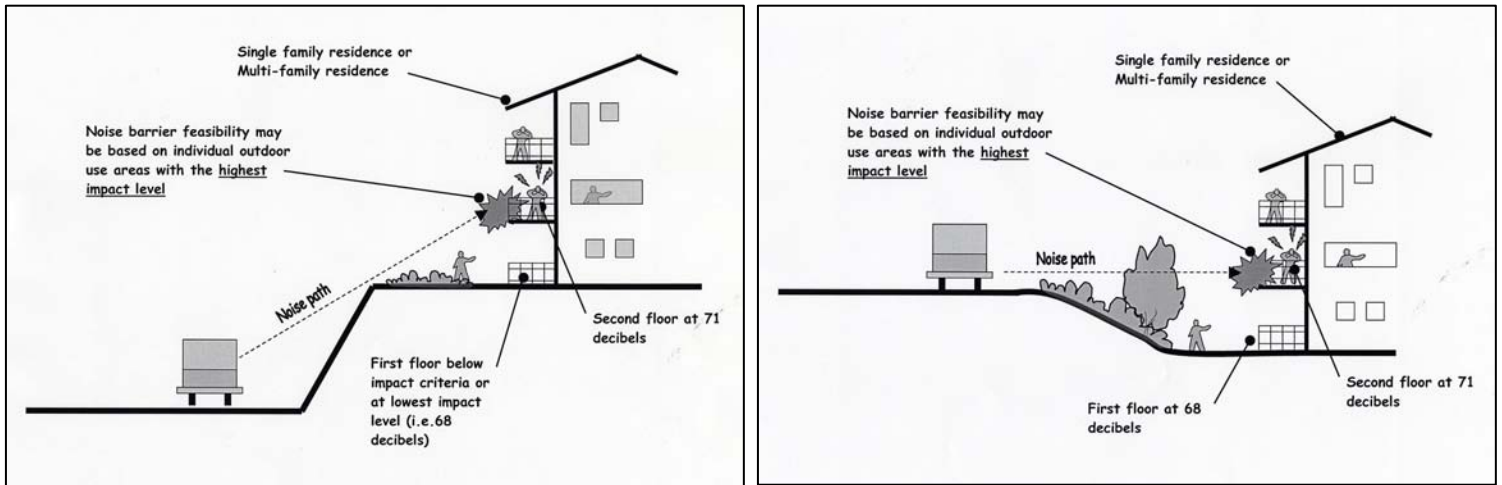
1. mitigation must be physically constructible,
2. a majority of the first row of receivers must obtain a minimum of a 5 dBA noise reduction as a result of mitigation (insertion loss), assuring that every reasonable effort will be made to assess ground floor use areas as appropriate, and
3. at least one receiver must have at least a 7 dBA reduction (the 7 dBA reduction location shall be counted as part of the first row majority).

In order for this policy to adequately cover complex ground terrain, elevated roadways, roadways through cut-slope, and other configurations, the first row decibel reduction calculation (feasibility) will use first row receivers defined in the following way, using best professional judgment.

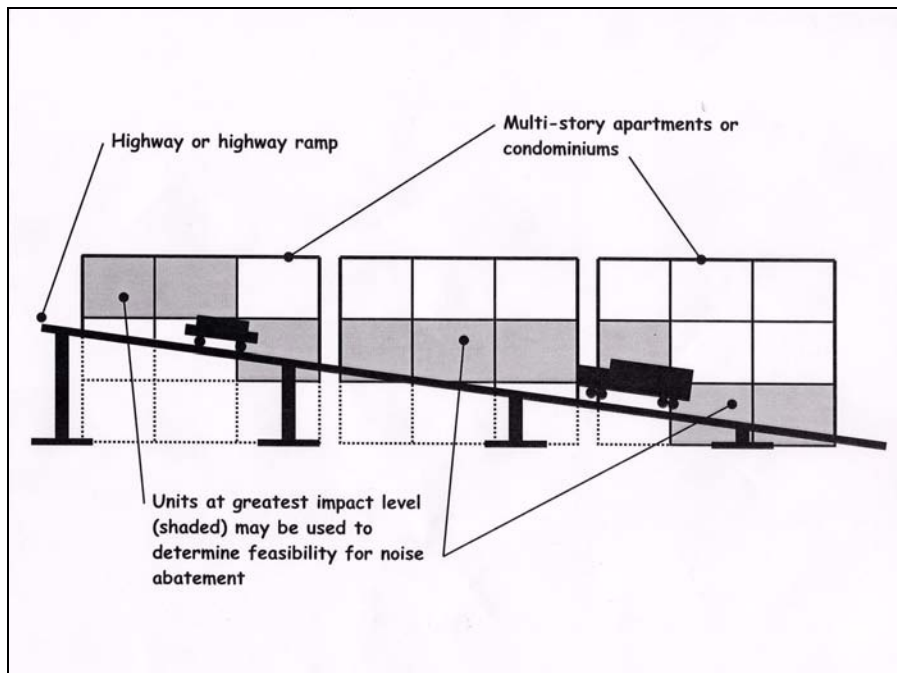
Step A: Identify the first row of receivers from an aerial point of view. The black squares and rectangles in this illustration show the first row.



Step B: Identify the first row of receivers from the front and appropriate sides of the buildings. Note that the first row may be positioned at locations higher than the ground floor.



Step C: Identify the appropriate line-of-sight for impacted receivers (please only count one receiver per story within the vertical column of the building).



If including receptor locations above the ground floor, the analyst shall only account for viable outdoor use areas. Outdoor use areas must include enough space to reasonably place a chair, barbecue or table.

Costs for sound mitigation on elevated structures may be much higher than on the ground. The actual cost of the elevated mitigation, in addition to any modifications of the structure to support

a barrier that is due solely for noise mitigation, shall be used against the allowance in Table B to evaluate reasonableness.

At times traffic noise from elevated roadways on fill or naturally elevated topography does not impact receivers within the descending noise shadow, but instead impact second or third row receivers emerging within the direct line-of-sight with the roadway. For these situations, the first row of receivers within 500 feet of the roadway with a direct line-of-site of the roadway shall be counted as the “first row” under the feasibility criteria (bullet 2 above).

Safety factors that should be considered in the feasibility assessment of the noise abatement include: maintaining a clear recovery zone, redirection of errant vehicles, adequate sight distance, and fire/emergency vehicle access. The consideration of the abatement should also include potential environmental impacts to wetlands, historic properties, parklands, property access, utility placement, and other design considerations.

Multiple reflections of noise between two parallel plane surfaces, such as noise barriers or retaining walls on both sides of a highway, can theoretically reduce the effectiveness of individual barriers and contribute to overall noise levels. Studies suggest that to avoid a reduction in the performance of parallel reflective noise barriers, the width-to-height ratio of the roadway section to the barriers should be at least 10 to 1. The width is the distance between the barriers, and the height is the average height of the barriers above the roadway. This means that two parallel barriers 10 feet (3 meters) tall should be at least 100 feet (30 meters) apart. Where this ratio cannot be achieved, consider using an absorptive material on at least one face.

Though some sound may be reflected from a barrier placed on one side of the roadway to the unprotected side, little benefit is derived from making the wall absorptive. Studies have shown that any measured increases in sound levels have been less than can be perceived by normal human hearing. As a general design consideration, sound barriers should have sufficient height to block the view of truck exhaust stacks. For design purposes, a truck exhaust stack height of 13 feet (4 meters) should be used. This is not meant to be a minimum barrier height requirement.

Reasonableness

Once the construction of sound mitigation has been determined feasible, then the department will determine whether its construction is reasonable by thoroughly considering a wide range of criteria as stated below. Sound barriers or other types of noise mitigation will only be constructed by the department if they have been determined reasonable. Reasonableness will be determined based on the factors that are discussed below.

1. The noise mitigation cost per residence (or residential equivalent) is at or less than indicated in Table B below. This is determined by counting all residences and calculated residential equivalencies benefited by the sound abatement (barrier) in any subdivision and/or given development, and dividing that number into the total cost of the sound abatement measure. Each impacted or benefited unit in a multi-family building will be counted as a separate residence. The table below shows that as the

predicted future noise level increases, it is reasonable to implement more costly measures, if necessary, to mitigate traffic noise.

2. Consideration of aesthetic barrier treatments, artwork, revegetation, and any increased cost of alternative barrier construction materials with transmission losses lower than 20 dB per frequency range shall not be included in the sound mitigation reasonableness cost calculations for long-term noise mitigation. Decisions on aesthetic treatments, revegetation and barrier material choice is based on applicable department practices and funding availability.

Table B – Reasonableness Allowances

Column A	Column B	Column C	Column D
Design Year Traffic Sound Decibel Level (dBA)	Noise level increase as a result of the project (dBA) ⁽²⁾	Allowed Wall Surface Area Per Qualified Residence or Residential Equivalent	Allowed Cost Per Qualified Residence or Residential Equivalent ⁽¹⁾
66		700 Sq Feet (65.0 Sq. Meters)	\$37,380
67		768 Sq Feet (71.3 Sq. Meters)	\$41,110
68		836 Sq Feet (77.7 Sq. Meters)	\$44,640
69		904 Sq Feet (84.0 Sq. Meters)	\$48,270
70		972 Sq Feet (90.3 Sq. Meters)	\$51,900
71	10 (substantial, tier 1) ⁽⁴⁾	1,040 Sq Feet (96.6 Sq. Meters)	\$55,530
72	11 (substantial, tier 1)	1,108 Sq Feet (102.9 Sq. Meters)	\$59,160
73	12 (substantial, tier 1)	1,176 Sq Feet (109.3 Sq. Meters)	\$62,790
74	13 (substantial, tier 1)	1,244 Sq Feet (115.6 Sq. Meters)	\$66,420
75	14 (substantial, tier 1)	1,312 Sq Feet (121.9 Sq. Meters)	\$70,060
76 ⁽³⁾	15 (substantial, tier 2) ⁽⁵⁾	1,380 Sq Feet (128.2 Sq. Meters)	\$73,690

(1) Cost reevaluated as needed. Based on \$53.40 per square foot constructed cost.

(2) If the noise level increase as the result of the project is 10 dBA or more, follow the allowed wall surface and cost for the level of increase in Column B in lieu of the total design year sound decibel level in Column A. For total highway related sound levels at 76 or more dBA or the project results in an increase of 15 or more decibels, continue increasing the allowance at the rate provided in the table unless circumstances determined on a case-by-case basis require an alternative methodology for determining allowance.

(3) If the traffic related noise level is 80 dBA or more or there is an increase of traffic related noise of 30 dBA or more over existing traffic noise levels as a result of a proposed transportation project, then the impacts are considered severe. Additional consideration for mitigation may be considered under these circumstances.

(4) Tier 1 is when the noise levels are 10 to 14 dBA over existing traffic noise as a result of the transportation project.

(5) Tier 2 is when the noise levels are 15 or more dBA over existing traffic noise as a result of the transportation project (or total highway related noise levels are between 76 and 79 decibels). Additional consideration for mitigation may be considered under these circumstances.

The use of the property should be included when considering the reasonableness of abatement. For example, churches and parks may be in use only during specific hours or days of the week.

These same facilities generally have a greater number of receivers than if simply counted as a residence. In these cases, residential equivalents (usage factor multiplied by the number of users [D22-22, page 4]) shall be used. The residential equivalents described in the environmental procedures manual (D22-22) shall be used when including general use facilities in an analysis whether for a Type I or Type II project.

Projects with Tier 2 substantial and severe noise impacts or exceedances may provide additional consideration under the reasonableness cost formula set out in Table B.

Community Input

The relationship of the location of a sound barrier to the residences or residential equivalents to be protected will be considered in making a reasonableness determination. Very tall barriers located very close to the residents can have a negative visual impact.

Residents living adjacent to a highway may have scenic or desirable views that they wish to maintain. If noise mitigation is warranted, when possible noise mitigation measures may be designed which effectively reduce traffic noise while maintaining the view. Consideration of desirable views should be included when assessing mitigation measures. Should it not be possible to both effectively mitigate traffic noise and maintain the view, the opinion of the majority of the affected property owners shall determine if sound abatement is desired. In the case of rental property, the property owner's opinion shall take precedence over the renter's opinion on whether sound mitigation is desired. A community may offer an alternative method of decision-making on whether or not to accept a sound barrier provided that there is cohesive community support for the sound barrier and the decision is clear and binding (e.g., based on approved covenants, restrictions or bylaws of a community organization).

The majority opinions of the affected property owners will be considered in the design of the noise abatement. Where a location meets the eligibility requirements for noise abatement, the opinion of the affected property owners and particularly those of adjacent property owners, will be used in determining whether a barrier or other practicable mitigation is implemented; the location, height, length of barrier; and where practicable, the composition and finish of a barrier. Property owners' opinions will also be considered in the reevaluation of the assumptions used in applying reasonableness criteria.

Land Use

During our analyses, we may encounter communities that are in transition from residential (sensitive land use, Class B) to commercial or industrial use. For these areas, we will only consider noise abatement if the local jurisdiction meets either of two requirements: 1) The local jurisdiction has an ordinance in place barring any new residential developments (or other noise sensitive uses) adjacent to state highways, and 2) The local jurisdiction agrees in writing to halt any further commercial development in said area.

Other Considerations

Ground floor verses Upper Story Considerations for Noise Barriers

As indicated previously in the “Feasibility” subsection of Section 6, every reasonable effort will be made to evaluate ground floor outdoor activity areas. Design of noise mitigation measures for other than ground floor receivers can result in a barrier which must be very high and would likely not meet the criteria (i.e., costs, visual impacts, etc.). At times, barriers that are constructed tall enough to break the line of sight in these cases may not be acceptable to ground floor residents. On the other hand, a building with more than one floor may be so located that it is possible to mitigate traffic noise levels to an upper floor by constructing a sound barrier of reasonable height. Care should be taken to discuss any visual concerns with property owners behind such barriers.

Mitigation should not be excluded for ground floor impacts merely on the basis that mitigation cannot be provided for upper floor impacts.

Vegetation Preservation

All reasonable efforts should be made to preserve the natural vegetation whether or not sound abatement is proposed.

Barrier Systems

At times the placement of barriers side-by-side at one location may provide co-benefits. Such barrier placement can create a situation where one barrier provides additional benefit behind the second barrier or vice versa. It may also be that the two barriers are feasible together but not independently. An arrangement of barriers in this manner is referred to as a barrier system. Such improvements through the placement of a system of complementing barriers may be considered on a case-by-case basis, within the project limits, when audible benefits are achieved as a result of the system.

Impacts Behind Existing Noise Barriers

Impacts identified behind an existing sound barrier (where noise impacts were mitigated due to a past project) will be considered similarly to those areas without barriers. If impacts are identified, an analysis shall be conducted to determine what mitigation may be reasonable and feasible, including changes to the existing barrier or construction of a new barrier to replace the old one. The traffic noise reduction benefits of noise mitigation for Type I and Type II projects shall be maintained in perpetuity.

Extenuating Circumstances

Any special circumstances will be evaluated to determine if it is in the best interest to provide sound abatement. This could include the historical significance of an area or the presence of any long-term efforts to maintain the character or cultural value of a sensitive area. More consideration is given to areas with larger increases over existing sound levels. This gives greater consideration to projects for highways in new locations and major reconstruction than it does to projects of smaller magnitude.

Properties on or eligible as historic properties, will be considered for noise mitigation when sound levels are determined to affect criteria for which the property is eligible. These properties will be considered for noise mitigation under our standard policy and procedures based on existing use.

Severe noise increases or impacts (either a predicted design year increase of 30 or more dBA over existing sound levels, or an absolute traffic sound level of 80 dBA or more) will receive additional consideration and may exceed the above-mentioned cost per residence or residential equivalent outlined in Table B.

7. Exemptions

Changes in operational speed of the highway and installations of turn pockets that are independent of and cannot be directly linked to Type I highway improvements are exempt from noise study under this policy. Also exempt from traffic noise analysis and mitigation include transportation related improvements for activity types that would not influence the sound environment. Examples include non-motorized bicycle and pedestrian pathways and low speed maintenance roads or tracks that are not typically open for public travel, provided that placement of such non-motorized paths and maintenance roads would not change topography in such a way as to trigger a traffic noise impact from an adjacent highway.

8. Decision to Recommend Noise Abatement

The decision to recommend or not recommend that sound mitigation be implemented will normally be the responsibility of the Acoustics Program Manager (or Regional Traffic Noise Abatement Manager if a program is established in a region) with concurrence from design personnel.

9. Contents of the Study

The traffic noise study should describe the procedures used in developing and performing the analysis and considerations made in arriving at the appropriate conclusions. The report should be easily understood by both the technical reviewer and the layperson and be presented in a reader friendly format. All reported sound levels shall be to the nearest whole decibel. Specifically, the traffic noise study and report should include the following information:

- Project description;
- Model(s) and methodology used;
- Alternatives and years considered;
- Existing and design year volumes, speeds, and composition;
- Receptor/receiver locations (including activity category A, B,C, and E locations) extending 500 feet from the edge line (fog line);
- Activity (land use) categories encountered (reference noise abatement criteria table) extending 500 feet from the pavement edge line (fog line);
- Existing and projected sound levels in the design year for all alternatives at receptor/receiver locations extending 500 feet from the edge line (fog line);
- Identify impacts;
- Comparison of site to reasonableness and feasibility criteria;
- Method of determining property owners' opinions and the results of such if mitigation is recommended and there is potential community concern about noise barrier placement;
- Complete basis for recommendation regarding abatement (include a discussion of the feasibility of all above listed forms of abatement at a minimum);
- Construction noise; and
- An appendix containing printouts of TNM modeling data tables and receiver location graphics for all evaluation years and project scenarios.

Traffic noise analysis for Type II projects will be of sufficient scope to provide the information needed to make the determination required by paragraph CFR 772.13a and WSDOT Directive D22-22.

10. Acoustical Analyst Qualifications

Any lead acoustical analyst or staff member responsible for the assessment of traffic noise impacts, traffic noise abatement, or review and approval of final noise reports shall at a minimum have completed the FHWA course on "The Fundamentals and Abatement of Highway Traffic Noise" or the more current, NHI Course: "142051 Highway Traffic Noise".

11. Public Involvement

The regional design office and the regional noise analysis manager (or acoustics program manager) will decide on the appropriate level of public involvement for each project. The

purpose of the public involvement will be to make sure that the wishes of the affected communities are known to the department and that every effort to provide noise abatement to an impacted community is taken. Public involvement is also necessary to keep the adjacent communities informed of the actions of the department and what to expect in the future. Depending on the size, controversy and impact of the project, actions to involve the public may include:

- Open houses,
- Environmental document hearings,
- Mailers,
- Workshops,
- Surveys, and/or
- Joint WSDOT/Citizen committees.

Where a community or homeowner's association exists, all correspondence to members will occur through the community or homeowner's association lead to the greatest extent possible. Polls, petitions or surveys of the community's desires will only be considered valid if the following occurs in conjunction with other criteria of this chapter:

- Performed or requested by the department;
- Performed by the association under the rules and bylaws of the association; or
- Contain the address, signature and printed name of property owner and/or residents along with their expressed wish concerning abatement. Noise abatement will not be planned if, after local government agency and affected property owner involvement, it is documented that the majority of the affected property owners are in opposition to or have no desire for noise mitigation. The design office or project sponsor will be responsible to ensure that the desires of each community are known to the department and that correspondence and written documentation is complete. This means that the same people surveyed will be apprised of the department's decision regarding abatement. Where barriers are proposed this will include the approximate height, length and alignment of barriers.

12. Coordination with Local Officials

Noise compatible land use and zoning surrounding high traffic corridors and highways is one of the most effective means of preventing impacts to property owners and residents. The department will assist local governments by providing them with copies of the highway traffic noise analysis and report for projects within their boundaries (Ref. 23CFR772.1). Provision of the noise report is intended to inform local jurisdictions about anticipated future noise levels so that local decision-makers can plan appropriately.

WSDOT will apprise local governments and officials as well as political representatives through the department's public involvement process as outlined in the WSDOT Design Manual chapters 210 and 220 and may take additional measures as determined on a case-by-case basis. Local

governments and officials shall be invited to all community meetings or sound related meetings and public open houses.

13. Construction Off Right of Way

Normally, sound abatement built pursuant to this policy shall be evaluated and constructed within the department rights of way. There may be cases in which department right of way is not the most prudent location for abatement, but abatement may be reasonable if constructed on adjacent property. In these cases:

- The department's mitigation cost reasonableness allowance is limited to normal cost for abatement on department right of way;
- The adjacent property owners allow access and easements as necessary to construct and maintain the abatement; and
- Any additional cost to acquire access, acquire property, provide alternative access, or provide additional infrastructure to accommodate access must be added to the barrier cost calculation and compared to the normal reasonableness cost allowance of the abatement to determine whether the proposed abatement is reasonable.

14. Individual and Local Agency Participation

WSDOT and other jurisdictions following this policy must comply with environmental justice and non-discrimination requirements, and the equal protection clauses of state and federal constitutions. To do so, where abatement costs would exceed the allowable limits as set in the department procedures, the department may not accept additional funding from individuals, local improvement districts or other governmental agencies to make the mitigation reasonable if it would not be considered reasonable without the additional funding. Local agencies or improvement districts may contribute to the mitigation to make the barrier taller, longer or more appealing, but only if the abatement was already found to be reasonable. In cases where abatement is unreasonable per this policy, local agencies or improvement districts may also elect to step in and pay the total amount for the noise abatement provided that the local agency or improvement district maintain all aspects of the mitigation (e.g., graffiti control, repairs) per local agreement and there is no cost to WSDOT.

15. Highway Construction Noise

Construction noise is temporary but may affect nearby property owners or residents. During project development, the designer should consider ways to reduce or mitigate the impacts of construction activities. All reasonable methods shall be incorporated in the plans and specifications of the contract.

In most cases, daytime noise from construction activities are exempt from state and local laws. For all other cases, coordination with or permits from local agencies may be needed. Each local

agency will need to be contacted to determine the local regulation and if a permit is required and if there are any concerns or restrictions. Some acoustical information and analysis may be needed before the local agency will grant a permit. This is done on a case-by-case basis.

These same regulations apply to maintenance activities in all but emergency situations. In the latter case, the police department and the local permitting agency should be contacted and apprised of the situation at the earliest possible opportunity.

16. Other Clarifications

Design-build and design-bid-build projects will require the same noise analysis outlined in this policy. Further refinements to cover inconsistencies with design-build projects will be developed in a technical memorandum.

Additional refinements and technical memoranda about various noise related procedures will be available on the department web page for clarification of issues as they arise.

17. Supercedence

These procedures as modified are effective immediately and replaces all previous policies and guidance on the assessment of highway related traffic sound level analysis, impacts and mitigation measures to be considered on roadway projects.

18. Definitions

ABATEMENT: A reduction in degree or intensity.

APPROACH: This term has been defined as 1 dBA below the set FHWA Noise Abatement Criteria (NAC). (See Table 1 of 23 CFR 772 in Appendix B for NAC levels).

AUTOMOBILES: All vehicles with two axles and four wheels designed primarily for transportation of fifteen or fewer passengers (automobiles and vans), or transportation of cargo (light trucks). Generally, the gross vehicle weight is less than 10,000 pounds (4,500 kilograms).

A-WEIGHTED SOUND LEVEL (dBA): The sound pressure levels in decibels measured with a frequency weighting network corresponding to the A-scale on a standard sound level meter as specified by ANSI S1.4-1971. The A-scale tends to suppress lower frequencies, (e.g., below 1,000 Hz) and best approximates the sound as heard by the normal human ear.

AFFECTED PROPERTY OWNERS (RESIDENCES or RECEIVERS): Within 500 feet of pavement edge line (commonly known as fog line, ref. o), all property owners who are found to benefit from a 3dBA or greater noise reduction as a result of the proposed mitigation; or,

receivers directly behind the barrier who will have visual blockage as a result of proposed mitigation but who may not benefit from mitigation.

BACKGROUND SOUND: The total of all sound in a system or situation, independent of highway traffic noise under study.

BARRIER: A solid wall or earth berm located between the roadway and receiver location that provides noise reduction.

BENEFITED: Property owners (receivers) within 500 feet of the highway edge line (fog line) found to receive a 3 dBA or greater traffic sound level reduction as a result of the proposed mitigation.

CFR: The Code of Federal Regulations.

DATE OF PUBLIC KNOWLEDGE: The original date of approval of the initial National Environmental Policy Act (NEPA) Record of Decision (ROD), Finding of No Significant Impact (FONSI), or State Environmental Policy Act (SEPA) document. If there are two conflicting dates for state and federal environmental documents, the NEPA document date shall take precedence.

DEPARTMENT: Washington State Department of Transportation, also known as WSDOT.

DESIGN YEAR: The future year used to estimate the probable traffic volume for which a highway is designed. A time, usually 20 years from the year construction is scheduled to begin, is generally used.

EXISTING SOUND LEVEL: The current sound level, made up of all natural and human-made sounds, considered to be usually present within a particular area's acoustic environment.

HEAVY TRUCK: Any vehicle having three or more axles and designed for the transportation of cargo. Generally, the gross weight is greater than 26,000 pounds (12,000 kilograms).

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 (reference k). May also be referred to as a street or road.

IMPACTED COMMUNITY: A grouping of acoustically sensitive receptor sites that reflect the group of citizens exposed to traffic sound levels at least approaching the noise abatement criteria or increasing to substantially exceed existing sound levels due to a project.

INSERTION LOSS: The actual acoustical benefit derived from a sound barrier.

LEQ: The equivalent steady-state sound level that, in a stated period of time, contains the same acoustic energy as the time-varying sound level during the same period.

MAJORITY: Defined as 60% of the first row residents or residential equivalents and 55% of all other residents or residential equivalents behind the proposed barrier where property lines are within 500 feet of the pavement edge line (fog line).

MEDIUM TRUCKS: All vehicles having two axles and six wheels designed for the transportation of cargo. Generally, the gross vehicle weight is greater than 10,000 pounds (4,500 kilograms) but less than 26,000 pounds (12,000 kilograms).

NOISE ABATEMENT CRITERIA (NAC): Sound levels for various activities or land uses that represent traffic sound levels that identify highway traffic noise impacts. One way traffic noise impacts are identified are when traffic noise levels in the design year of a project approach or exceed the NAC for residences or residential equivalents within 500 feet of the pavement edge line (fog line). See NAC table above in Section 2.

PLANNED, DESIGNED, AND PROGRAMMED (or DATE OF DEVELOPMENT): A new development is so designated when a definite commitment and local approval has been made to develop the property in question, and there is also official local knowledge and approvals that such development has been "planned, designed, and programmed." A definite commitment means that a developer has shown a definite interest to develop the land within a reasonable amount of time and has reached a point where he/she can no longer practically change his/her plans. For noise analysis purposes under this policy, the commitment is identified as the date of issuance of the building permit.

SEVERE TRAFFIC SOUND LEVEL IMPACTS: Traffic sound levels of 80 dBA Leq and higher for outdoor activity areas. Measurements must be in accordance with reference c.

SEVERELY EXCEED: A 30-dBA increase over existing sound levels.

SHIELDING OBJECTS: natural or artificial barriers (blockage) (e.g., natural topography, house rows, vegetation) that intervene between a noise source and receiver.

SIGNIFICANT CHANGE IN HORIZONTAL OR VERTICAL ALIGNMENT: A relocation of the highway that would result in an increase in the noise environment for affected residences (receivers) or residential equivalent locations by three or more decibels.

SOUND LEVEL MEASUREMENTS: Measurements taken by the acoustics analyst or qualified staff person to calibrate and validate the traffic noise model for the existing year and design year.

SOUND LEVEL METER CALIBRATION: A step to assure accuracy of a sound level measurement instrument (meter). Occurs in two circumstances:

- (1) as independent annual test of the sound level meter to assure that it is within a certain accuracy range per National Institute of Standards and Technology (NIST) standards, and
- (2) for field use of the microphone calibrator both before and after a sound level measurement is taken to assure sound level meter accuracy at the time of the measurement.

SUBSTANTIALLY EXCEED, TIER 1: A 10-dBA increase over existing sound levels.

SUBSTANTIALLY EXCEED, TIER 2: A 15-dBA increase over existing sound levels.

TRAFFIC NOISE MODEL CALIBRATION (not to be confused with validation): A step to assure accuracy of sound level predictions. The calibration step includes:

- (1) measurement of traffic sound levels within 100 feet from the center of the roadway (or 25 feet from the edge line (fog line) if the centerline is greater than 100 feet from the edge of the roadway);
- (2) measurement in an area with flat terrain and no obstructions; accurate measurement of traffic speeds (radar gun preferred);
- (3) accurate traffic counts.

The calibration site is modeled using the above parameters to obtain a predicted sound level. The difference between the measured and modeled sound levels is called the adjustment factor. The adjustment factor is applied to the validation model and all subsequent models. (See Reference l and m.)

TRAFFIC THROUGH-LANES: A portion of the paved roadway surface (highway) on which motor vehicles are allowed to travel and extends between two access points (public intersections and interchanges). Access points do not include driveways. Interchange ramp lanes are considered as traffic through lanes except when expanded to add vehicle storage.

TRAFFIC NOISE IMPACTS: Impacts which occur when the predicted traffic sound levels approach or exceed the Noise Abatement Criteria or when the predicted traffic sound levels substantially exceed the existing sound levels.

TYPE I PROJECTS: Applicable to new construction or re-construction. A proposed highway project for the construction of a highway 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 OR RETROFIT PROJECTS: A proposed project for traffic noise abatement on an existing highway or highway configuration. These are stand-alone projects and construction of these sound level abatement measures are not necessarily associated with projects that provide traffic capacity improvements. However, properties and communities must meet the conditions of the retrofit program (formerly Directive D22-22), 23 CFR 772 and section 339 (b)(2) of the "National Highway System Designation Act of 1995".

VALIDATION: Comparison of measured traffic sound levels with current modeled traffic sound levels in the same location to ensure the traffic noise model is developed and constructed properly. The difference between measured and modeled sound levels must be within 2 decibels (dBA).

WORST CASE NOISE HOUR: A period of (60) minutes throughout a (24) hour day in the existing year and future design year that reflects the peak traffic noise hour, usually associated with the peak traffic hour but not in every instance (e.g., where high traffic volumes cause vehicle speeds to drop far below the posted speed). Identification of this hour is not applicable for field sound level measurements used to calibrate and validate the model.

WSDOT: Washington State Department of Transportation. Also known as the department.

19. References

- a. Washington State Department of Transportation (WSDOT) Directive D22-22.
- b. United States Code of Federal Regulations (CFR) Part 772 (23 CFR Part 772), May 2, 2002.
- c. Federal Highway Administration Report "Measurement of Highway-Related Noise." May 1996.
- d. Federal Highway Administration Special Report, "Highway Construction Noise: Measurement, Prediction and Mitigation." May 2, 1977.
- e. Federal Highway Administration Technical Advisory T6160.2, "Analysis of Highway Construction Noise." March 13, 1984.
- f. Federal Highway Administration Traffic Noise Model Report, "FHWA-PD-96-010", February 1998 and Revision No. 1 April 1, 2004.
- g. Federal Highway Administration Report Number FHWA-EP-00-005, DOT-VNTSC-FHWA-00-01, "FHWA Highway Noise Barrier Design Handbook", Final Report, February 2000.
- h. National Highway System Designation Act of 1995.
- i. "Fundamentals and Abatement of Highway Traffic Noise", September 1980.
- j. FHWA directive "Highway Traffic Noise Analysis and Abatement: Policy and Guidance", June 1995.
- k. Uniform Vehicle Code and Model Traffic Ordinance 1992, SS 1-27.
- l. Rochat, Judith L. and Gregg G. Fleming. 2004a. Validation of FHWA's Traffic Noise Model (TNM): Phase 1. FHWA-EP-02-031, DOT-VNTSC-FHWA-02-01.
- m. Rochat, Judith L. and Gregg G. Fleming. 2004b. Addendum to Validation of FHWA's Traffic Noise Model (TNM): Phase 1. FHWA-EP-02-031 Addendum, DOT-VNTSC-FHWA-02-01 Addendum.
- n. Federal Transit Administration "Transit Noise and Vibration Impact Assessment", April 1995 (or newer version when available).
- o. US Department of Transportation/Federal Highway Administration, "Manual for Uniform Traffic Control Devices", part 3, sections 3.B.01, 04 and 06, Millennium Edition, December 2000.
- p. Federal Highway Administration memo, HEP-41, from Bob Armstrong, "Highway Traffic Noise Analysis for Cemeteries, Trails and Trail Crossings", June 16, 1995.

? Questions ?

Please contact the Washington State Department of Transportation Environmental Services Office Acoustics Unit at (206) 440-4541 or see our web page using the following web link.

<http://www.wsdot.wa.gov/regions/Northwest/rp&s/environmental/aae/default.htm>