



# Guidance

## Traffic Noise Policy Implementation

---

### Procedures for Analysis and Abatement of Roadway Traffic Noise and Construction Noise

This guidance describes the implementation of TxDOT's Traffic Noise Policy and the requirements of the Federal Highway Administration (FHWA) Noise Standard at 23 Code of Federal Regulations (CFR) Part 772.

## Table of Contents

1.0	Introduction .....	7
1.1.	Effective Date .....	7
1.2.	Project Applicability .....	7
1.3.	Roles and Responsibilities .....	7
1.4.	Training .....	9
1.5.	Terminology and Fundamentals of Traffic Sound and Noise .....	9
1.6.	References .....	9
2.0	Traffic Noise Analysis Process .....	10
2.1.	Planning and Scoping .....	10
2.2.	Objectives .....	10
2.3.	Noise Analysis Process Overview .....	10
3.0	Determine the Need for a Traffic Noise Analysis .....	12
3.1.	Type I Projects – Noise Analysis Required .....	12
3.2.	Non-Type I Projects – Noise Analysis Not Required .....	15
3.3.	Type II Projects .....	15
4.0	Collect Data .....	16
4.1.	Traffic Information .....	16
4.1.1.	Requesting Traffic Data .....	16
4.1.2.	Existing and Predicted Traffic .....	17
4.1.3.	K-Factor and Design Hourly Volume (DHV) .....	17
4.1.4.	Vehicle mix .....	17
4.1.5.	Speed Limits .....	18
4.1.6.	Tabular vs Line Diagram Traffic .....	18
4.1.7.	Directional Distribution .....	18
4.2.	Design Information .....	19
4.2.1.	Existing and Proposed Roadways .....	19
4.2.2.	Receptors and Noise Sensitive Land Uses .....	19
4.2.3.	Representative Receptors/Receivers .....	23
4.2.4.	Site Characteristics .....	23
5.0	Measure/Model Noise Levels .....	25
5.1.	Existing Noise Levels .....	26
5.1.1.	Measuring Existing Traffic Noise .....	26
5.1.2.	Modeling Existing Traffic Noise .....	27
5.1.3.	Existing Model Validation .....	28
5.2.	Predicted Noise Levels .....	31

# **TxDOT Traffic Noise Policy Implementation Guidance**

---

5.3. Noise Impact Contours for Undeveloped Areas .....	31
5.4. Construction Noise.....	31
6.0 Determine Impacts.....	32
6.1. Absolute and Relative Impact Criteria .....	33
6.2. Determining Impacts for Noise-Sensitive Land Uses .....	33
6.2.1. Category A .....	33
6.2.2. Category B .....	34
6.2.3. Category C .....	34
6.2.4. Category D .....	34
6.2.5. Category E .....	35
6.3. When Analysis Indicates a Noise Impact.....	35
6.4. No Impacts - Abatement Not Required .....	35
7.0 Consider Abatement Measures .....	36
7.1. Construction of Noise Barriers .....	36
7.1.1. Placement of Noise Barriers .....	36
7.1.2. Noise Barrier Heights .....	37
7.1.3. Neighborhood Concept .....	37
7.1.4. Barrier Optimization.....	38
7.1.5. Consideration of Existing Noise Barriers .....	38
7.2. Other FHWA-approved Abatement Options .....	38
7.2.1. Traffic Management .....	38
7.2.2. Alteration of Alignment .....	39
7.2.3. Acquisition of Buffer Zone .....	39
7.2.4. Insulation of Public Buildings .....	39
7.3. Other Noise Reduction Measures.....	39
7.3.1. Pavement and Vegetation.....	39
7.3.2. Absorptive Treatments .....	40
8.0 Evaluate Abatement Measures .....	41
8.1. Benefited Receptors .....	42
8.2. Feasibility .....	42
8.3. Reasonableness .....	42
8.3.1. Noise Reduction Design Goal.....	43
8.3.2. Cost Reasonableness .....	43
8.3.3. Equivalent Receptors for Cost Reasonableness .....	44
8.3.4. Cost Averaging Among Benefited Receptors .....	45
8.3.5. Third Party Funding.....	46
8.4. Abatement Proposal .....	46

# **TxDOT Traffic Noise Policy Implementation Guidance**

---

9.0	Constructability Assessment for Proposed Abatement .....	48
9.1.	What is a Constructability Assessment?.....	48
9.2.	Preparing a Constructability Assessment .....	48
9.3.	Documentation and Timing .....	50
10.0	Traffic Noise Analysis Documentation .....	51
10.1.	Traffic Noise Analysis Report.....	51
10.2.	Standard Language and Templates .....	52
10.3.	Map Figures .....	52
10.4.	Statement of Likelihood .....	53
10.5.	Project File .....	54
10.5.1.	Required Documentation .....	54
10.5.2.	Optional Documentation.....	54
10.5.3.	Noise Model Files.....	55
10.6.	Environmental Assessment .....	55
10.7.	Traffic Noise Analysis Review.....	56
11.0	Noise Workshops to Solicit Viewpoints on Proposed Noise Abatement .....	56
11.1.	Timing .....	58
11.2.	Who can vote? .....	58
11.3.	Solicitation Materials and Ballots .....	59
11.4.	Solicitation Mail-out(s).....	61
11.5.	Noise Workshop Meeting .....	62
11.6.	Low Response Rate.....	63
11.7.	Counting Votes.....	63
11.8.	Documentation of Noise Workshop .....	65
11.9.	Notification of Workshop Results .....	65
11.10.	Re-voting .....	65
12.0	Additional Topics .....	65
12.1.	Information to Local Officials.....	65
12.2.	Project Reevaluation .....	66
12.3.	Noise Abatement Inventory Reporting .....	66
12.4.	Special Considerations for Phased Projects.....	67
12.5.	Noise Wall Removal Policy .....	67
12.5.1.	Request for Wall Removal .....	67
12.5.2.	Cost and Demolition .....	67
12.5.3.	Future Considerations for Noise Abatement.....	68
13.0	Glossary.....	69
14.0	Abbreviations and Acronyms.....	75

# ***TxDOT Traffic Noise Policy Implementation Guidance***

---

Appendix A – Fundamentals of Sound and Traffic Noise ..... 76  
Appendix B– Revision History ..... 80

**Tables**

Table 1. Noise Abatement Criteria Table ..... 32

Table 2. Interior Building Noise Reduction Factors..... 35

Table 3. Summary of TxDOT Noise Abatement Evaluation Criteria ..... 41

Table 4. Example Noise Workshop Voting Tally ..... 64

Table A-1. Decibel Addition ..... 76

Table A-2. Cause-and-Effect Relationships dB(A)..... 78

Table A-3. Sound Level Change vs. Loudness ..... 78

Table A-4. Common Sound/Noise Levels..... 79

## **1.0 Introduction**

During the rapid expansion of the Interstate Roadway System and other roadways in the 20th century, communities began to recognize that roadway traffic noise and construction noise had become important environmental impacts. In the 1972 Federal-aid Roadway Act, Congress required the Federal Highway Administration (FHWA) to develop a noise standard for new Federal-aid roadway projects. While providing national criteria and requirements for all roadway agencies, the FHWA Noise Standard at 23 Code of Federal Regulations (CFR) Part 772 gives roadway agencies flexibility that reflects state-specific attitudes and objectives in approaching the problem of roadway traffic and construction noise.

This document contains the Texas Department of Transportation's (TxDOT) guidance in support of TxDOT's FHWA-approved Traffic Noise Policy (2019) and describes TxDOT's program to implement the FHWA Noise Standard. It describes the requirements for how roadway traffic noise impacts are defined, how noise abatement is evaluated, how noise abatement decisions are made, and how the analysis is documented.

### ***1.1. Effective Date***

TxDOT's Traffic Noise Policy (2019) is effective as of December 31, 2019. Any traffic noise analysis that is started on or after December 31, 2019, must meet the requirements of the 2019 Traffic Noise Policy and this Implementation Guidance. Any noise workshop or reevaluation for noise for an approved National Environmental Policy Act (NEPA) document started on or after December 31, 2019, must also comply with the 2019 Traffic Noise Policy and this Implementation Guidance.

### ***1.2. Project Applicability***

TxDOT's Traffic Noise Policy and this guidance apply to all Type I (see **Section 3.0**) roadway projects in the State of Texas that require TxDOT environmental review; **regardless of funding or FHWA approval**. This includes Federal projects that are administered by local governments, Toll Road Authorities, as well as TxDOT. This guidance applies uniformly and consistently to all Type I projects throughout the State.

If there are any questions about whether a project is subject to this policy or the FHWA Noise Standard, contact TxDOT's Environmental Affairs Division (ENV).

### ***1.3. Roles and Responsibilities***

For a traffic noise analysis, the project sponsor is the entity responsible for preparing and documenting the analysis. The project sponsor may be a TxDOT district or local government entity.

An ENV noise subject matter expert (SME) must review the traffic noise analysis if the analysis report is prepared for an Environmental Impact Statement (EIS) project or if the traffic noise analysis report indicates predicted traffic noise impacts.

Specific responsibilities of TxDOT ENV, TxDOT districts, and consultants in the traffic noise analysis process are outlined below.

TxDOT ENV:

- Develop TxDOT's Traffic Noise Policy and obtain FHWA approval
- Develop and publish the Traffic Noise Policy Implementation Guidance and example language for documenting traffic noise analyses, as necessary

## ***TxDOT Traffic Noise Policy Implementation Guidance***

---

- Maintain ENV's online Traffic Noise Toolkit, as necessary
- Review, evaluate, and approve traffic noise analyses and any associated noise abatement proposals
- Conduct training in traffic noise analysis and associated computer modeling
- Provide guidance and assistance, as necessary
- Maintain a comprehensive statewide inventory of all constructed noise barriers or other noise abatement measures and provide triennial updates to FHWA, as required
- Reevaluate cost reasonableness criteria for noise abatement measures a minimum of every five years, as required
- Publish and maintain an informative noise barrier brochure
- Develop and publish a comprehensive user's manual for the FHWA-approved traffic noise modeling software

### TxDOT Districts:

- Perform traffic noise analyses according to the latest Traffic Noise Policy and Traffic Noise Policy Implementation Guidance
- Review, evaluate, and approve traffic noise analyses, if the traffic noise analysis report indicates no predicted noise impacts
- Submit traffic noise analyses/noise abatement proposals to ENV for review and approval if an ENV SME's review is required (see above) or if the district, at its discretion, requests review by an ENV SME.
- Review and evaluate all traffic noise analyses performed by consultants before submitting to ENV, if an ENV SME's review is required
- Ensure all personnel responsible for conducting traffic noise analyses receive initial and recurring training in the proper use and application of the Traffic Noise Policy, the Traffic Noise Policy Implementation Guidance, traffic noise modeling software, and sound meters
- Conduct noise workshops to inform the public about a noise abatement proposal and/or to solicit viewpoints about a noise abatement proposal from benefited and bordering property owners and residents, as necessary
- Provide details on constructed noise barriers to ENV, as required
- Provide useful information to local officials on predicted noise levels from roadway projects, to assist them in noise-compatible land use planning and to inform them that new development permitted after the date of public knowledge is not eligible for abatement

### Consultants under contract to perform traffic noise analyses:

- Conduct traffic noise analyses according to the latest Traffic Noise Policy and Traffic Noise Policy Implementation Guidance
- Use the latest FHWA-approved traffic noise modeling software and obtain associated training



## **1.4. Training**

ENV offers two different traffic noise training classes at least once per year. Additional training or assistance is available upon request from ENV.

- Traffic Noise Basics (ENV125): This half-day course provides a general overview of the traffic noise analysis process, including the requirements of TxDOT's Traffic Noise Policy and the Traffic Noise Policy Implementation Guidance. This class is designed for project managers and those with little to no traffic noise experience.
- Highway Traffic Noise Analysis (ENV115): This hands-on, three-day course provides experience in preparing a traffic noise analysis using the FHWA noise software and discusses how to plan, set up, conduct, and document a traffic noise analysis.

## **1.5. Terminology and Fundamentals of Traffic Sound and Noise**

A glossary of important sound and noise policy terms is in **Section 13.0**.

A brief introduction to the basics of traffic sound and noise is in **Appendix A**.

## **1.6. References**

Important reference documents can be found or are linked through ENV's online Traffic Noise Environmental Compliance Toolkit. These documents include:

- TxDOT's FHWA-approved Traffic Noise Policy (2019)
- ENV's Traffic Noise Model User's Guide
- ENV's Templates and Standard Language for Documenting Traffic Noise Analyses
- FHWA's Highway Traffic Noise website
- Title 23, Code of Federal Regulations, Part 772 (23 CFR 772), "Procedures for Abatement of Highway Traffic Noise and Construction Noise", July 2010

## **2.0 Traffic Noise Analysis Process**

### **2.1. Planning and Scoping**

Comprehensive planning and coordination should be accomplished as early as possible in the project development process to ensure that comparative analyses of all transportation alternatives include serious consideration for minimizing or avoiding traffic noise impacts. This could reduce or eliminate the need for costly abatement later in the design process.

Because of the long lead time to complete a traffic noise study, early project scoping to determine the need for a noise study is recommended. ENV strongly recommends that project sponsors obtain appropriate traffic data (see **Section 4.1**) as soon as possible if a noise analysis is required for a project.

Once the determination has been made that a project is a Type I project, a field visit is necessary to ascertain the location of adjacent noise-sensitive land uses. This knowledge will aid in the noise analysis process.

### **2.2. Objectives**

The major objectives of a traffic noise analysis are to:

- Identify noise-sensitive areas where predicted noise impacts may occur for each project alternative
- Consider and evaluate abatement measures to mitigate identified impacts
- Propose implementation of feasible and reasonable abatement measures
- Communicate the results to the public and local officials

### **2.3. Noise Analysis Process Overview**

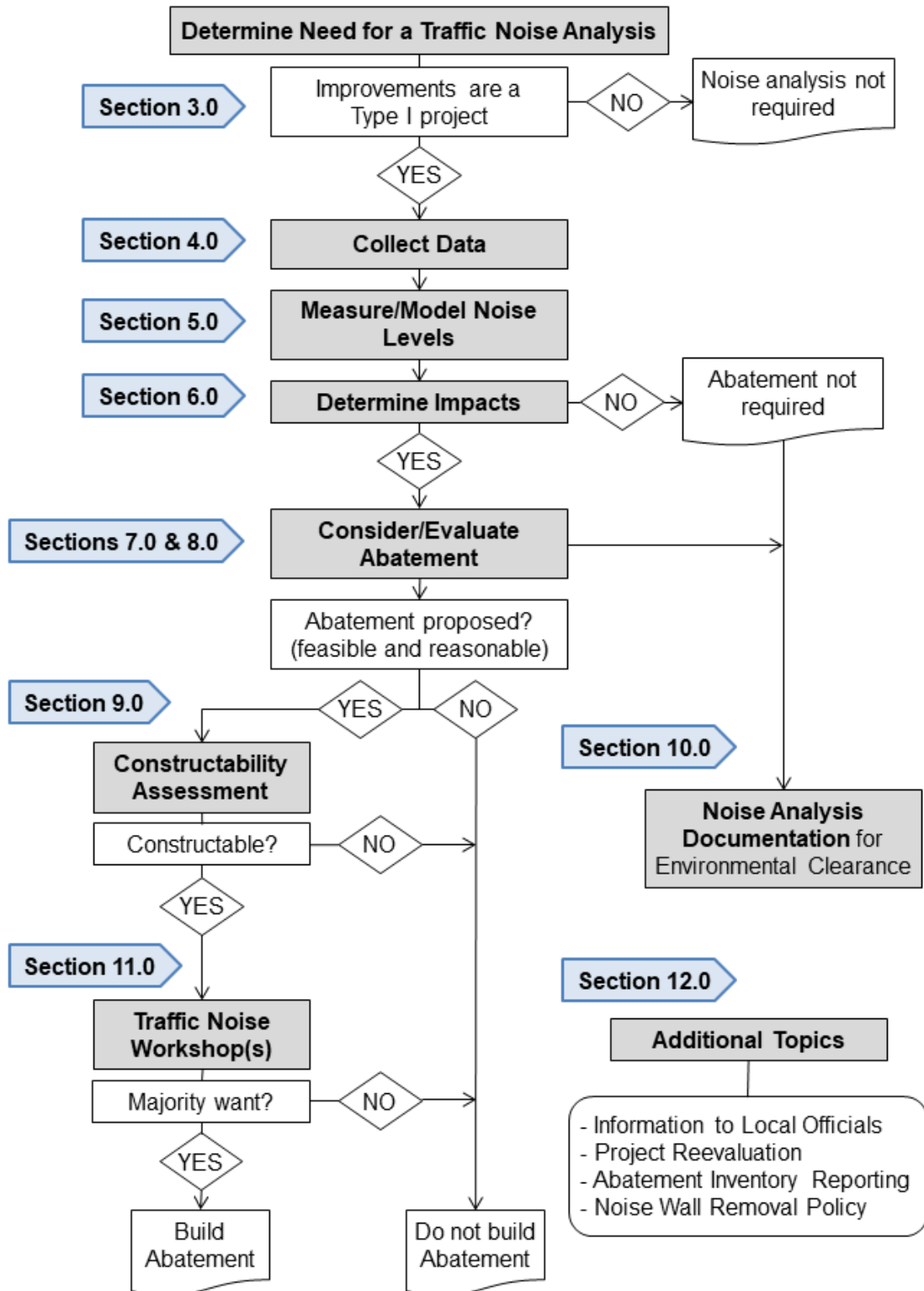
During project scoping, the project sponsor determines the need for a traffic noise analysis based on the types of improvements associated with a proposed project.

When a noise analysis is required, a traffic noise analyst collects data about the existing and proposed roadway, collects sound level measurements, and identifies noise sensitive areas adjacent to the project. Noise modeling software is used to predict traffic noise levels.

Traffic noise level predictions are used to determine impacts. If traffic noise impacts are identified, then noise abatement measures are evaluated according to a set of social, economic, and environmental criteria.

The following flowchart illustrates the traffic noise analysis process. The remaining sections of this guidance follow this process and are indicated on the flowchart.

**Traffic Noise Analysis Process**



## 3.0 Determine the Need for a Traffic Noise Analysis

A traffic noise analysis is required for all Type I highway or roadway projects, regardless of the environmental classification or funding type. If the project is a non-roadway project (i.e. only involves bike lane, sidewalks, hike-and-bike paths, landscaping, or similar pedestrian/non-vehicular facilities), then a traffic noise analysis is not required.

**Per 23 CFR 772.5, a Type I Project is defined as:**

- (1) The construction of a highway [roadway] on new location; or,
- (2) The physical alteration of an existing highway [roadway] where there is either:
  - (i) Substantial Horizontal Alteration – A project that halves the distance between the traffic noise source and the closest receptor between the existing condition to the future build condition; or,
  - (ii) Substantial Vertical Alteration – A project that removes shielding, therefore exposing the line-of-sight between the receptor and the traffic noise source. This is done by either altering the vertical alignment of the highway [roadway] or by altering the topography between the highway [roadway] traffic noise source and the receptor; or,
- (3) The addition of a through-traffic lane(s). This includes the addition of a through-traffic lane that functions as a HOV lane, High-Occupancy Toll (HOT) lane, bus lane, or truck climbing lane; or,
- (4) The addition of an auxiliary lane, except for when the auxiliary lane is a turn lane; or
- (5) The addition or relocation of interchange lanes or ramps added to a quadrant to complete an existing partial interchange; or,
- (6) Restriping existing pavement for the purpose of adding a through-traffic lane or an auxiliary lane; or,
- (7) The addition of a new or substantial alteration of a weigh station, rest stop, ride-share lot, or toll plaza.
- (8) If a project is determined to be a Type I project under this definition then the entire project area as defined in the environmental document is a Type I project.

Contact an ENV SME for assistance if there is any uncertainty about whether proposed improvements meet one of the definitions of a Type I project. Proposed improvements may meet one or more of the Type I definitions.

The following sections provide additional explanation about what is and what is not a Type I project for noise.

### **3.1. Type I Projects – Noise Analysis Required**

The Type I definitions from 23 CFR 772.5 are listed below in “quotation marks,” followed by clarifying explanations and examples. Note that the noise regulation uses the term “highway,” but the TxDOT noise policy uses the more general term “roadway.”

## ***TxDOT Traffic Noise Policy Implementation Guidance***

---

“The construction of a highway [roadway] on new location”

- Explanation: This includes any project that would add or extend a roadway in a location where a roadway does not currently exist.
- Example projects or project elements:
  - Construction of a new two-lane roadway
  - Construction of a new arterial

“The physical alteration of an existing highway [roadway] where there is either:

1. Substantial Horizontal Alteration. A project that halves the distance between the traffic noise source and the closest receptor between the existing condition to the future build condition; or”
  - Explanation: A substantial change in horizontal alignment would cut in half the distance between the outside edge of the outside travel lane and the closest receptor.
  - Example projects or project elements:
    - Realignment of travel lanes
    - Straightening a roadway to remove a curve
  - Exclusions: If there are no adjacent receptors at the location of alteration AND there are no other Type I triggers, then the project is not a Type I project.
2. Substantial Vertical Alteration. A project that removes shielding therefore exposing the line-of-sight between the receptor and the traffic noise source. This is done by either altering the vertical alignment of the highway or by altering the topography between the highway traffic noise source and the receptor”
  - Explanation: Substantial Vertical Alteration includes projects that would change the vertical alignment of the roadway (including adjacent topography) such that receptors would no longer be shielded from traffic noise. For example, the existing roadway is depressed and not visible from an adjacent residential backyard. The project would raise the roadway so that it would be viewable from the backyard. The change in line-of-sight between the roadway and receptor is likely to result in increased traffic noise.
  - Example projects or project elements:
    - Removing or modifying an existing TxDOT-constructed noise barrier
    - Removing a hill or berm
    - Raising a roadway from below grade to at or above grade
  - Exclusions: If there are no adjacent receptors at the location of alteration AND there are no other Type I triggers, then the project is not a Type I project. Depressing lanes to below grade (with no other Type I triggers) are not a substantial vertical alteration if receptors continue to be shielded compared to the existing condition.

“The addition of a through-traffic lane(s). This includes the addition of a through-traffic lane that functions as a HOV lane, High-Occupancy Toll (HOT) lane, bus lane, or truck climbing lane”

- Explanation: This includes added capacity and similar projects that add one or more through traffic lanes.

## ***TxDOT Traffic Noise Policy Implementation Guidance***

---

- Example projects or project elements:
  - Widening a two-lane highway to four-lane divided highway
  - Reconstructing and adding one lane in each direction
  - Constructing mainlanes and ramps
  - Widening an interstate from four lanes to six lanes
  - Constructing managed lanes
  - Completing frontage roads and converting to one-way operation
  - Constructing a dedicated bus lane

“The addition of an auxiliary lane, except for when the auxiliary lane is a turn lane”

- Explanation: Auxiliary lanes include acceleration lanes, deceleration lanes, passing lanes, and Super 2 lanes. An auxiliary lane must be 2,500 feet or longer to be considered a Type I project.
- Example projects or project elements:
  - Construction of an auxiliary lane between existing exit ramps
  - Restriping the shoulders of a two-lane roadway to add auxiliary lanes that are approximately 4,500 feet in length
  - Adding Super 2 passing lanes

A note about Super 2 passing lanes: Because Super 2 projects include the addition of auxiliary lanes, they meet the definition of a Type I project; however, a full analysis utilizing computer modeling may not be necessary. Please consult with an ENV noise SME to determine the level of analysis required.

“The addition or relocation of interchange lanes or ramps added to a quadrant to complete an existing partial interchange”

- Explanation: Interchanges usually involve controlled-access facilities and/or a grade separation
- Example projects or project elements:
  - Adding a new lane to an existing ramp
  - Adding direct connectors to an existing interchange
  - Adding a new ramp to an existing incomplete cloverleaf interchange
  - Constructing a grade-separated overpass where new ramps connect to the at-grade roadway

“Restriping existing pavement for the purpose of adding a through-traffic lane or an auxiliary lane”

- Explanation: This is similar to the through-traffic lane and auxiliary lane Type I definitions, except that existing pavement, such as an existing shoulder, is restriped to add the new travel lane.

“The addition of a new or substantial alteration of a weigh station, rest stop, ride-share lot or toll plaza”

- Explanation: Only count alterations that affect roadway traffic patterns.

**IMPORTANT NOTE:** If ANY portion of a project is determined to meet the definition of a Type I noise project, then the entire project, including all build alternatives, analyzed in the environmental documentation is a Type I project.

## **3.2. Non-Type I Projects – Noise Analysis Not Required**

A noise analysis is not required for projects that do not meet at least one of the Type I project definitions. Some example projects or project elements are described below:

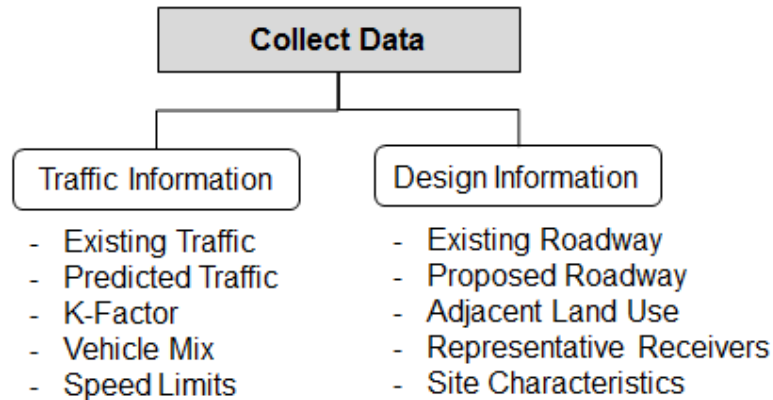
- Projects that include ONLY seal coat/overlay, bridge replacement, and/or safety improvements, such as safety end treatments or bridge rail replacement. These types of projects may include, but are not limited to:
  - Surfacing and roadway rehabilitation
  - Replacing bridge and approaches
  - Extending culverts
  - Improving guardrails, safety devices and equipment
  - Improving intersection signals
  - Installing intelligent transportation system (ITS) signs and devices
- Projects that ONLY widen pavement to provide additional shoulder width, turn lanes, or a continuous center turn lane, but with no additional through-traffic lanes. These types of projects may include, but are not limited to:
  - Widening to add shoulders and bike lanes
  - Widening to add continuous left turn lanes and shoulders
  - Lengthening a left turn lane
  - Upgrading from two-lane rural to three-lane urban to include continuous left-turn lane
  - Adding right turn lane at intersections and signal improvements
  - Reconstructing an existing four-lane undivided highway to four-lane divided highway
  - Adding an acceleration lane
  - Constructing U-turns and acceleration/deceleration lanes
- Non-roadway projects that only involve bike lanes, sidewalks, hike-and-bike paths, landscaping, or similar pedestrian/non-vehicular facilities
  - Constructing hike and bike trails
  - Constructing pedestrian and bike enhancements
- Projects with non-substantial horizontal alteration, such that the alignment shift is less than half the distance to the closest receptor OR there are no adjacent receptors at the project location
- Projects with non-substantial vertical alteration, such that there is a vertical shift but NO adjacent receptors
- Projects that would depress lanes, if receptors would still be shielded compared to the existing condition

## **3.3. Type II Projects**

TxDOT does not have a Type II (retrofit) program. A Type II program would provide an opportunity for noise abatement on an existing roadway when there is not a proposed project with a Type I trigger.

## 4.0 Collect Data

Data collection is critical to the success of a traffic noise analysis. Accurate traffic and appropriate design information are necessary to accurately predict noise levels generated adjacent to a project. A Type I project must be analyzed for noise within the entire project limits under environmental analysis, including transition areas and non-Type I roadway activities.



### 4.1. Traffic Information

Input data for traffic noise modeling such as traffic volumes, traffic speed, and vehicle mix must represent the traffic characteristics that yield the loudest hourly traffic noise levels on a regular basis under normal conditions.

Note that in heavily congested urban corridors, the peak traffic period may not represent the worst noise conditions, since speeds may be lower and heavy truck volumes may drop as truckers try to avoid congestion.

#### 4.1.1. Requesting Traffic Data

As soon as it is determined that a traffic noise analysis will be required for a roadway project, a request for existing and predicted traffic data must be submitted to TxDOT's Transportation Planning and Programming Division (TPP):

- Ensure that the traffic request is made for Noise and Air Analyses
- Ensure that line diagram(s) are consistent with the existing and proposed improvements
- Ensure that appropriate traffic years are requested, as indicated in **Section 4.1.2**

TPP will provide a memo with the existing and predicted traffic information, k-factor, and vehicle mix information that are needed for the noise analysis.

The TPP traffic data memo typically includes both tabular traffic data and traffic line diagrams, as discussed in **Section 4.1.6**.

If this information is obtained from a source other than TPP, such as a Metropolitan Planning Organization or city planning staff, plan for additional time to provide the information to TPP and/or to the district for review and approval.



## 4.1.2. Existing and Predicted Traffic

Traffic information is needed for both the existing and future build conditions and must be approved by TPP and/or the district (if TPP has delegated approval authority for traffic to the district).

- **Existing Traffic** must represent the traffic data for the current (existing) year and the existing roadway configuration.
- **Predicted Traffic** must represent the projected traffic data for the design year and the proposed roadway configuration. The design year is normally 20 years from the current/existing year.

Coordinate with a TxDOT noise SME if you have questions about the appropriateness of traffic data, especially if extrapolation of traffic values to a different year is being considered. Typically, extrapolations within +/- three years can be made in accordance with TPP methods.

## 4.1.3. K-Factor and Design Hourly Volume (DHV)

For computer modeling, use DHV traffic volumes. DHV represents the thirtieth highest hourly traffic count for the design year.

A project's TPP memo provides Average Daily Traffic (ADT) values that must be converted to DHV by using the K-factor.

The K-factor is the design hour factor, applied to the Average Daily Traffic (ADT) to determine the DHV. For rural highways, K-factors generally range from 12 to 18 percent. For urban facilities, K-factors are typically somewhat lower, ranging from 8 to 12 percent.

DHV is determined by the formula: **DHV = K-factor \* ADT**. An example calculation is shown below:

Traffic Data	Calculation	DHV
ADT = 61,650 vehicles per day k-factor = 11.8%	(0.118) * (61,650) k-factor * ADT	7,275 vehicles/hour

**IMPORTANT NOTE:** Remember to use DHV, not ADT, when calculating traffic inputs for the noise model.

## 4.1.4. Vehicle mix

It is important to consider the types and relative numbers of vehicles using the roadway (i.e. the vehicle mix) to accurately predict traffic noise levels. Noise modeling software requires the input of predicted hourly volumes of cars, medium trucks, and heavy trucks for the analysis. These categories correspond to the light duty, medium duty, and heavy duty vehicle classes shown on a project's TPP traffic memo.

Use the "% of DHV" vehicle classification, not "% of ADT" vehicle classification, to calculate traffic noise model inputs.

## ***4.1.5. Speed Limits***

The posted speed limit is typically used to determine noise levels. However, the average operating speed may be used if it is determined to be consistently higher than the posted speed limit

Note that design speeds shown on schematics or plan sheets are NOT the same as posted speed limits. Design speeds are used by engineers to determine the various design features of a roadway. Posted speed limits are set or authorized by TxDOT or local governments and usually correspond to actual traffic speed. Therefore, do not use design speeds for traffic noise modeling without the permission of the district or ENV.

For new location roadways, the future posted speed limit may not be known, pending a traffic engineering study that would be completed after the roadway is constructed. Consult with the district or ENV for recommendations on what speeds to use in the model.

Document any assumptions that were made regarding traffic speeds in the traffic noise analysis report.

## ***4.1.6. Tabular vs Line Diagram Traffic***

The existing year and predicted year ADTs provided in a project's TPP traffic memo table represent the highest cross-sectional volume of traffic for the project roadway within the corridor. As such, ADTs may represent a "worst case" traffic volume for the project roadway. However, because this tabular data is a sum of the traffic on main lanes, frontage roads, and ramps in both directions, it may be of limited use for modeling controlled-access highways.

Therefore, use of data from traffic line diagrams (also called stick diagrams) is preferred for use in the noise model because this data is more representative of actual projected traffic volumes and movements, especially on controlled access facilities.

Line diagrams are also important because they show projected traffic volumes for the individual parts of a roadway, such as frontage roads, main lanes, ramps, and cross streets associated with a project corridor. Note that line diagrams are a simplified representation of the roadway and additional data, such as typical sections and schematic layouts (see **Section 4.2.1**), are needed to further subdivide the traffic data into the individual lane inputs required for modeling.

## ***4.1.7. Directional Distribution***

If traffic line diagrams are available, then the directional distribution percentages shown in the TPP table are usually not used.

However, if line diagrams are not available, then directional distributions must be applied as appropriate to divide the tabular traffic volumes into separate travel directions.

If the directional distribution percentages have a less than 10% difference from an even 50-50 split, it is acceptable to assume a 50-50 directional split for the traffic in the model in most cases. In other words, apply half of the total traffic to each side of the roadway. However, if direction distributions have at least a 10% difference, then run two sets of models, as described in the following example:

An east-west rural roadway with a directional distribution of 60-40.

- The first model run would put 60% of the traffic volume on the eastbound side and 40% of the traffic volume on the westbound side of the roadway

- The second model run would flip the traffic volumes such that 40% of the traffic was on the eastbound side and 60% on the westbound side.
- The noise levels for the higher of the two runs by receiver location would then be included in the traffic noise analysis report.

Sometimes, line diagrams will depict traffic data on undivided roadways with double-headed arrows. In this case, also take into consideration the directional distribution of traffic as described above.

## ***4.2. Design Information***

The environmental process is initiated very early in the planning phase of a roadway project; therefore, only preliminary information may be available. Consequently, it is critical to coordinate closely with the design staff to ensure the latest available information is used in the traffic noise analysis. It may be necessary to update the analysis several times before the final environmental document is completed.

Design information must be obtained for the entire project within the project limits, including transition areas. Refer to ENV's Traffic Noise Model User's Guide for additional considerations regarding modeling limits.

### ***4.2.1. Existing and Proposed Roadways***

The traffic noise model is a three-dimensional representation of the project, using x, y and z coordinates to define modeled objects such as roadways. The following types of design information are recommended or may be useful for developing the traffic noise analysis:

- Pavement striping
- Existing and proposed lane centerlines
- Existing and proposed lane widths (typical sections)
- Existing and proposed right of way (ROW) lines
- Proposed displacements
- Locations and dimensions of bridge sections, retaining walls, traffic barriers, and other fixed objects associated with the roadway
- Survey data for features both in and adjacent to the ROW

Accurate elevations are critical for the items in this list. For noise modeling, it is equally important to accurately locate the centerline of each lane in the roadway.

Average pavement type must be used in the noise model for noise level predictions, as required by FHWA. The only time it is acceptable to model a pavement type other than "Average" is to validate an existing model (see **Section 5.1.3** for more information on existing model validation).

### ***4.2.2. Receptors and Noise Sensitive Land Uses***

Locate all noise sensitive land uses adjacent to the project and within the project limits. A receptor is a noise sensitive location that might be impacted by roadway traffic noise and may benefit from reduced noise levels. A receiver location in the model identifies the specific location of an outdoor area where frequent human activity occurs. If no outdoor location can be identified, an interior location may be used for certain land use types.

## ***TxDOT Traffic Noise Policy Implementation Guidance***

---

Please be aware that receivers that would be displaced by a proposed design do not require analysis; however, ENV recommends identifying displacements on map figures in the documentation.

Modeled receiver points must be accurately located with x, y, and z coordinates.

The types of exterior and interior activity areas that must be considered for a traffic noise analysis are defined and described below, along with recommendations regarding placement of receivers for modeling.

### **Category A (exterior)**

This activity category includes the exterior area of 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 for the area to continue to serve its intended purpose.

- An Activity Category A designation requires approval by TxDOT ENV and FHWA Texas Division.

### **Category B (exterior)**

This activity category includes the exterior activity areas associated with single-family and multifamily residential land uses. Multifamily land uses include apartments, townhomes, condominiums, and duplexes. Multifamily land uses may also include mobile home parks, residential hotels that function as apartment dwellings, campgrounds or RV parks with full-time residents, and senior retirement facilities.

- Default placement of a receiver for single-family residence is within a backyard outdoor activity area. Front yards, side yards, or porches may be considered if these areas are closer to or within line of sight of the roadway AND if there is evidence of frequent outdoor human activity, such as a barbecue grill, picnic table or other seating, a swimming pool, children's play area, etc.
- Each residence in a multifamily dwelling within line-of-sight of the roadway must be considered as an individual receptor when determining impacted and benefited receptors. Units with predicted noise impacts may include those above ground level.
- Receiver placement locations for apartments may include patios and multistory balconies that are built for human usage (i.e. a balcony with an access door). If no such patio or balcony exists, an exterior common gathering area must be used as a receiver location (i.e., pool, gazebo, or playground).
- If a multifamily residential land use does not have either an individual outdoor area within line of sight of the roadway or an exterior common gathering area, then analysis of the land use is not required.

### **Category C (exterior)**

This activity category includes exterior areas for a variety of land use facilities: active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings.

## ***TxDOT Traffic Noise Policy Implementation Guidance***

---

- Receiver placement for these land uses must be at actual locations of frequent outdoor human activity. Examples include picnic tables, a gazebo, a playground, a trailhead, bleachers, or other common gathering areas associated with a specific land use. Note that parking lots and waiting areas are usually not noise-sensitive areas.
- If no defined outdoor gathering areas exist, a receiver may be placed at the center of a reasonable area of the exterior land use.
- For hospitals and medical facilities, consider only those that provide in-patient services, such as hospitals, rehabilitation facilities, or senior care centers. Receiver placement must be at outdoor areas, such as a garden, a pool, or playground.
- For campgrounds and similar facilities, consider the context and actual use. Some campgrounds, such as recreational vehicle (RV) parks, have long-term use and functionally are mobile home parks, which is a residential land use (Category B).
- For cemeteries, place receivers at designated outdoor gathering areas, such as a gazebo, columbarium, or memorial garden. Individual graves are typically not receivers. If there are no designated outdoor gathering areas, placement at the center of a cemetery section is acceptable.
- Section 4(f) properties must be analyzed as Activity Category C even if the land use without Section 4(f) designation would be exempt from analysis. Section 4(f) properties are analyzed at this stricter standard even if the Section 4(f) property is identified within an activity category with a higher NAC. Consult with ENV Cultural Resources staff for additional noise considerations that may be required for Section 4(f) properties.

### **Category D (interior)**

This activity category includes the interior areas of certain land use facilities listed in Category C that may have interior uses: auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios.

- An interior receptor location can only be considered if there are no exterior areas that are likely to be affected by the traffic noise, or where the exterior activity areas are far from or physically shielded from the roadway in a manner that prevents an impact on exterior activities.
- Receiver placement for Category D interior receptors must be at areas of frequent human activity where conversations are held inside the structure. An interior reduction factor will be applied to the predicted noise levels as described in **Section 6.2.4**.

### **Category E (exterior)**

This activity category includes the exterior areas for developed lands that are less sensitive to roadway noise: hotels, motels, offices, restaurants/bars, and other developed lands, properties, or activities not included in A-D or F.

- Receiver locations must be representative of areas of frequent external activity at the receptor.

# TxDOT Traffic Noise Policy Implementation Guidance

---

- For a restaurant, an outdoor dining area is an appropriate exterior activity area. For hotels, outdoor activity areas such as a swimming pool or sport court area are appropriate.
- Temporary waiting areas, such as benches outside an entrance, are typically not appropriate receiver locations. However, a group of picnic tables or a designated smoking area outside an office may be a receiver location to consider, especially if there is direct line of sight to the roadway and it appears to be frequently used. Use best professional judgement.

## Category F (areas that are not sensitive to traffic noise)

This activity category includes developed lands that are not sensitive to roadway traffic noise: agricultural, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing.

- There is no impact criterion for the land use facilities in this activity category and no analysis of noise impacts is required.
- Do not include Category F land uses in the traffic noise analysis.

## Category G (undeveloped)

This activity category includes undeveloped lands that are not permitted for development by the date of public knowledge. The date of public knowledge is the date of the approval of the categorical exclusion (CE), the issuance of the finding of no significant impact (FONSI), or the record of decision (ROD) for a Type I roadway project.

The date of public knowledge is also the date when TxDOT and FHWA are no longer responsible for providing noise abatement for new development that may occur adjacent to a proposed roadway project.

There is no impact criterion for undeveloped properties and TxDOT does not provide abatement for undeveloped properties.

Representative areas of undeveloped lands will be modeled to determine exterior noise impact contours to help local officials plan for future development (see **Section 5.3**).

## Permitted Lands

Land that is permitted for development (that is, a building permit has been issued on or before the date of public knowledge), shall be analyzed under the Activity Category for that type of development.

**IMPORTANT NOTES:** Because the “date of public knowledge” (i.e. date of environmental clearance) is a hard deadline for consideration of noise abatement, it is critical to research local resources to determine if building permits have been issued for undeveloped properties.

If environmental clearance was delayed, if the noise analysis was performed early, and/or if the project is in a rapidly developing area, land uses in the project corridor may need to be reviewed again before environmental clearance to ensure that the traffic noise analysis covers all applicable land uses.

It is also essential to drive the corridor to investigate actual land uses. In some cases, residences have been abandoned or have been converted to business offices.

### **4.2.3. Representative Receptors/Receivers**

TxDOT is required to analyze and determine all predicted traffic noise impacts; however, not all receptors adjacent to a roadway project need to be considered at the beginning of the analysis. While every receptor location could be modeled along a project corridor, use of representative receivers in modeling is encouraged, provided that all impacts are adequately identified.

One receiver point in the model may be used to represent the equivalent or worst case for several separate receptors in the same activity area. This representative receiver point can have similar distance and proximity to the roadway (equivalent case), or be closer to the roadway and more exposed to direct noise (worst case).

If there is no impact at this “representative” receptor, it is unlikely that there will be an impact at any of the remaining receptors. However, if there is an impact at this representative receptor, it will be necessary to later model additional receivers in the vicinity to determine how many receptors are impacted and predicted to benefit from an abatement measure during the barrier analysis process (See **Section 7.0**).

Because the traffic noise analysis is meant to convey the potential noise impacts to the public, it is important to determine the extent of impacts, which may extend beyond the first row of receptors.

Note that traffic noise impacts may occur at receptors located more than 500 feet from major freeways or more than 100 to 200 feet from lightly traveled roads. ENV recommends using these distances as a general guide during the initial selection of representative receptors, with the understanding that additional receivers may need to be selected as part of the analysis.

### **4.2.4. Site Characteristics**

Several factors can affect the levels and propagation of traffic noise. For example, the levels of traffic sound may be reduced by elevated or depressed terrain, surface absorption, dense vegetation, and/or shielding from buildings, fences, or walls. ENV recommends identifying any factors that could affect the transmission of sound from the source to a receptor location (receiver in the model) as early as possible.

Do not rely on the construction plans to provide all the information regarding site details, geometry, etc. for the modeling effort. Locate and identify features that may influence the measured noise levels, including ditches, berms, privacy walls, canals, streets, parking lots, buildings, billboards, etc.

During the field visit, note any of the following site characteristics:

- Location and height of any solid masonry walls associated with Category A through E land uses; these must be included in the models if walls are between the roadway and the modeled receiver:
  - Existing TxDOT-constructed noise barriers
  - Privately constructed neighborhood walls (brick, solid concrete panels, rock wall fences, etc.)
- Wooden fences can be noted, but not modeled, as the noise reduction provided by these fences can vary over time due to the condition of the fence.
- General characteristics of the roadway and areas between the roadway and receptors. Is the roadway curb and gutter or does it have paved shoulders and grassy swales with ditches?

## ***TxDOT Traffic Noise Policy Implementation Guidance***

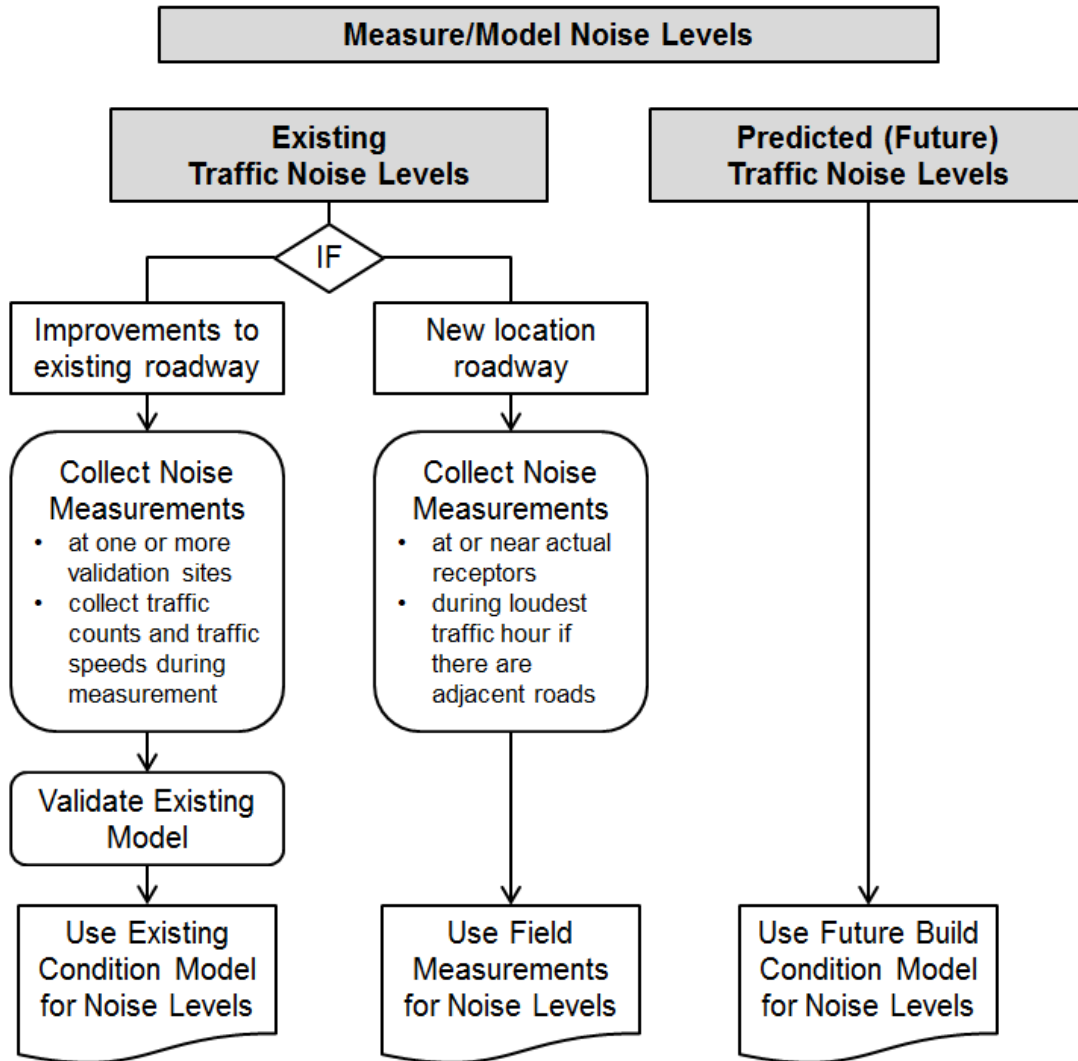
---

- Location and height(s) of traffic safety devices such as concrete traffic barriers along the shoulder or in the median
- Retaining walls or significant breaks in the terrain near potential receptors
- Significant topographic features such as hills, berms, streams, and lakes that are between the roadway and potential receptors
- Existing access points to adjacent properties, such as cross-streets, approved driveways (with curb cuts), gates, and alleys
- Significant utilities
- Other noise sources in the area, such as airports, railyards, or industrial activities. If the sound interferes with the ability to carry on a conversation, then it is worth noting.



## 5.0 Measure/Model Noise Levels

Once traffic data and design information have been collected, this information is used to develop computer models that represent the roadway design and the surrounding noise environment. Field measurements of existing noise levels are needed to validate the existing condition computer model and for projects where there are no existing roadways.



For projects that are improving an existing roadway, TxDOT determines all existing and future traffic noise impacts by modeling. The existing condition model will be validated using field-collected measurements and traffic information (see **Section 5.1.3**).

For projects on new alignment where no roadway currently exists, TxDOT determines all existing year traffic noise levels by field measurements at representative receptor locations and all future year traffic noise impacts by modeling.

Note that it is not necessary to model a no build future scenario under this traffic noise guidance. However, there may be occasions outside of this noise guidance, such as a Section 4(f) evaluation, where this information could be used to compare a build and no build scenario.

Refer to ENV's Traffic Noise Model User's Guide for detailed information on how to prepare the existing and future condition models. Refer to **Section 4.2.4** for site characteristics that may be considered for inclusion in models. Please note that any existing traffic noise barriers must be included in the existing and future models.

Until further notice, FHWA's Traffic Noise Model (TNM) software version 2.5 must be used for modeling on all projects.

## 5.1. Existing Noise Levels

Existing noise levels will be determined through field measurements with a sound level meter or predicted using a noise model, depending on the project design.

### 5.1.1. Measuring Existing Traffic Noise

This section describes general considerations for the collection of noise level measurements intended to represent existing noise levels. TxDOT uses field measurements to determine existing noise levels for new location projects (where a roadway does not currently exist) and for validating existing condition models.

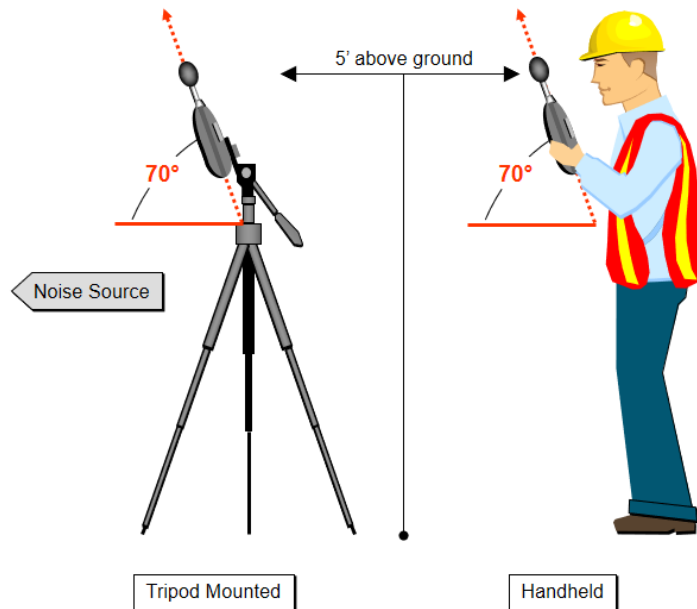
Refer to FHWA's *Noise Measurement Handbook* (FHWA-HEP-18-065, 2018) for detailed instructions and considerations for taking noise field measurements. FHWA's *Noise Measurement Field Guide* (FHWA-HEP-18-066, 2018) includes pre-trip checklists and example data sheets for a variety of situations. These guidance documents are available on the FHWA Noise website under "Measurement."

Field measurements for existing noise levels must be taken:

- During peak hour traffic or when the highest noise levels are expected. The period with the highest levels may not be at the peak traffic hour when vehicles are often traveling at slower speeds, but rather during some other period when traffic volumes may be lower but the overall percentage of trucks or vehicle speeds are higher. Generally, traffic at Level of Service (LOS) C or D volume, with high heavy truck volumes will yield the worst noise hour. However, in heavily congested urban areas, the peak traffic period (often LOS E or F) may NOT represent the worst noise conditions; i.e., speeds may be low and heavy truck volumes may drop as truckers try to avoid severe congestion. Consider the following:
  - Time of day (peak hour vs. any other time of day)
  - Day of the week (weekend vs. work day)
  - Week of the year (tourist season vs. non-tourist season)
- When the roadway pavement is dry
- When the wind speed is less than 15 mph

For statistical accuracy, each measurement must be taken in a **minimum of 15-minute periods**. Measurements along low-volume roadways may require longer measurement periods (30 to 60 minutes) to attain desirable statistical accuracy.

The graphic below illustrates the correct set-up of a sound meter in relation to the noise source or roadway being measured. The sound meter may be tripod mounted or handheld. The sound meter microphone must be positioned at approximately five feet above the typical ground surface (the average ear height) and directed toward the roadway at an approximately 70 degree angle from horizontal. The measurement microphone must also be fitted with a windscreen.



Sound level measurements must be made using A-weighted Leq decibel units (dB(A) Leq). For traffic noise measurements, the “slow” response setting on the sound level meter is typically used.

Measurements must be made with sound level meters of sufficient accuracy to yield valid data for the project. Per 23 CFR 772.13 (d)(2), noise measurements must be taken with an ANSI Type I or Type II integrating sound level meter, which automatically measures and calculates Leq. Sound level meters must be calibrated before and after measurements.

Ideally, field noise measurements for new location projects are made at the frequent human activity areas associated with adjacent noise sensitive land uses (see **Section 4.2.2**). Due to right-of-entry issues, it is often not possible to take measurements in the desired location(s). In these cases, a similar location may be used, if it has similar distance, topography, and line-of-sight to the proposed roadway alignment. Use best professional judgement and document any assumptions or adjustments made during the field measurements.

### 5.1.2. Modeling Existing Traffic Noise

Existing noise levels for projects on existing alignment are usually determined through modeling. Field measurements, however, are required to validate the existing condition model (see **Section 5.1.3**).

Using the FHWA-approved traffic noise modeling software, noise levels will be determined for the existing roadway configuration, within the project limits described in the environmental analysis.

Traffic noise levels must be determined at representative receivers adjacent to the project in the existing year.

If the project is entirely on new location or includes a portion where a roadway does not currently exist (i.e. a bypass project), then field measurements at or near noise sensitive receptors adjacent to the proposed new location alignment must be used to determine the existing noise levels (see **Section 5.1.1**).

Note that there are situations when a combination of measurement and modeling would be appropriate, such as in areas that are already heavily developed or areas where there are other sound sources. Analysts may combine modeling with noise measurements to help determine existing noise levels, using decibel addition (see **Appendix A**).

### ***5.1.3. Existing Model Validation***

Model validation is required to verify the accuracy of noise models used to determine existing noise levels for the project. Validation is also used to confirm that traffic noise is the dominant noise source in a project area.

Validation demonstrates that the existing model is a good representation of existing conditions and that it can predict existing noise levels that are reasonably accurate.

The existing noise model is validated if existing roadway traffic noise levels and predicted roadway traffic noise levels for the existing condition are **within +/-3 dB(A)**. When an existing model is validated, it may be used as the basis for the predicted model.

The model validation process is shown in the flow chart on the next page.

#### **Validation Field Measurements**

Validation of the model requires one or more noise measurements performed in accordance with the considerations described in **Section 5.1.1**. For validation, noise measurements must be taken at one or more validation sites along a project, preferably within major noise-sensitive areas (NSA), common noise environments (CNE), or neighborhoods. If practical and possible, ENV recommends that validation sites coincide with potentially impacted locations. Residential communities are of particular interest, especially communities that have expressed traffic noise concerns.

Validation sites must be selected in an area that is representative of free-flow conditions (i.e., there are no traffic control devices such as traffic signals or stop signs nearby). Validation sites adjacent to major interchanges or near elevated, on-structure roadways are not recommended.

ENV recommends measuring sound levels for a **minimum of 15 minutes** at each selected validation site.

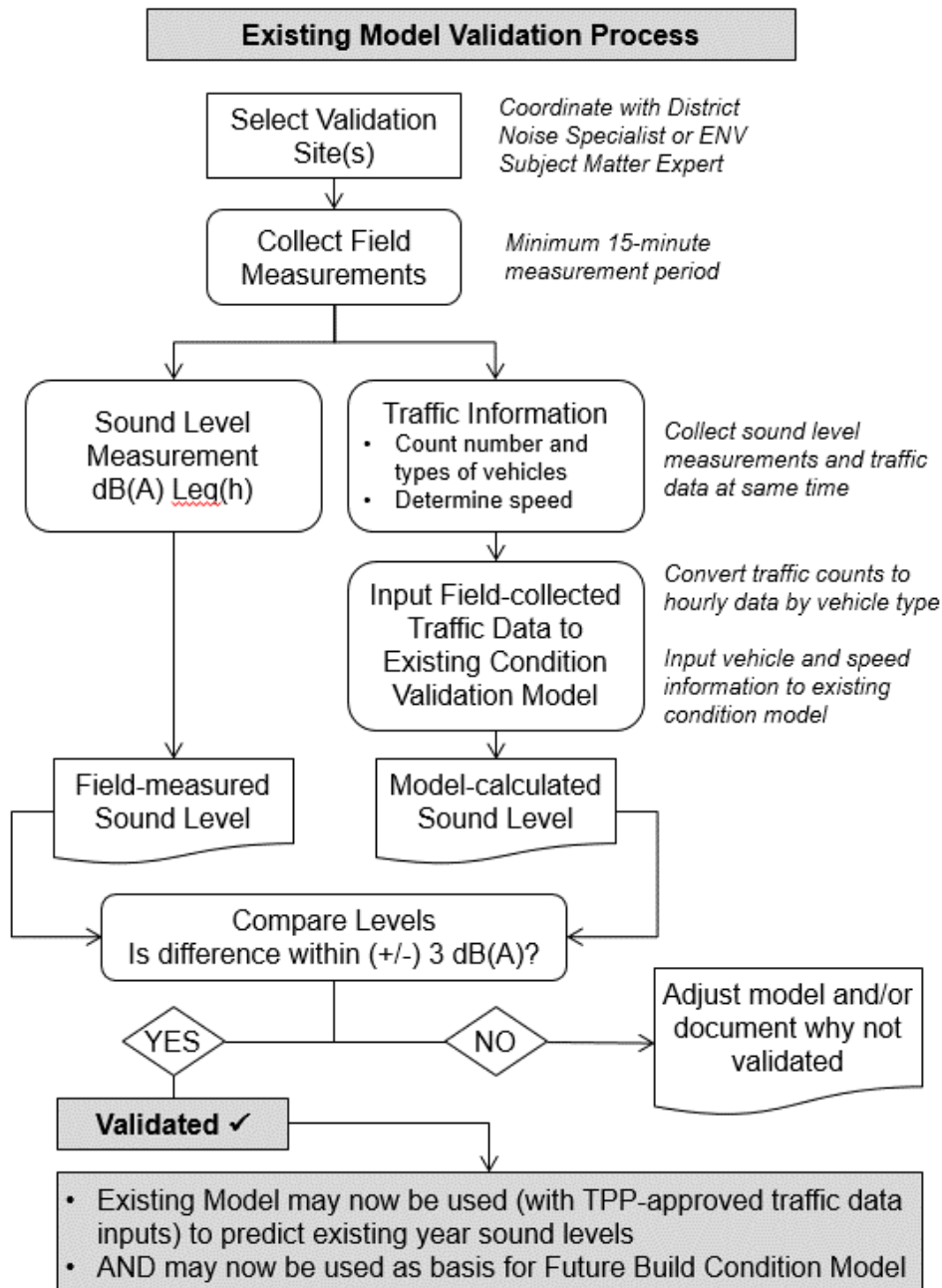
The required number of validation sites is project specific and must be coordinated with the District or ENV Noise Specialist.

Note that the validation measurements do not need to be taken during the worst traffic hour, though congested or stop and go traffic situations are to be avoided. Ideally, take measurements when traffic is traveling at a reasonably constant rate during the measurement period.

Simultaneous traffic counts and determination of average vehicle speeds must occur during each validation noise measurement. Physically count the number and type of vehicles that travel on all lanes adjacent to the sound level meter during the measurement period. Classify vehicles into the

## TxDOT Traffic Noise Policy Implementation Guidance

five types used in the noise modeling software: cars, medium trucks, heavy trucks, buses, and motorcycles.



Vehicle counts and vehicle type classifications must be collected for traffic in both directions, including mainlanes, frontage roads, and ramps within a reasonable distance of the noise meter. On busy roadways, video cameras may be used to record the traffic conditions for determining counts and vehicle mixes upon return to the office.

The location and details of any site characteristics that may affect traffic noise (see **Section 4.2.4**) must be noted on a site sketch or plan set. Taking photographs of the validation site, setup, and roadway is also recommended.

Since the noise modeling software cannot account for noise other than traffic, be certain that traffic noise is the dominant noise source. Activities such as lawn mowing, children playing, air conditioning units, and aircraft flyovers can dominate the background noise levels to an extent that the traffic source is relegated to a lesser impact. If this is the case, the noise level monitoring equipment must be relocated to a more suitable site.

During each measurement period, the sources and duration of the sounds other than those resulting from traffic on a roadway must be noted on field measurement data sheets.

### **Validation Modeling**

Upon return from the field, one or more validation versions of the existing condition noise model are prepared, using field-collected traffic counts and field-observed average traffic speeds as the model inputs. The validation measurement location is added to the model as a receiver.

ENV recommends running separate models for each validation measurement.

Field-collected vehicle counts must be converted to hourly data for use in the validation model. For example, if 20 cars were counted traveling in the eastbound direction during a 15-minute measurement period, then the model input would be  $20 * 4 = 80$  cars/hour.

Run the model to obtain the model-predicted sound level.

### **Validation Comparison**

Validation compares the model-predicted sound level to the field-observed sound level. Per the TxDOT Traffic Noise Policy, if the measured and model-predicted roadway traffic noise levels are within +/- 3 dB(A), then the existing model is considered valid and can be used to predict existing traffic noise levels.

If the results are not within +/- 3 dB(A), then the model is not considered valid until additional measurements are made or until the analyst identifies the reason for the discrepancy and makes a correction within the model.

Problems with validating most models are usually due to errors in input values or due to environmental conditions not accounted for by the model, rather than problems with the noise modeling software.

Verify the accuracy of the model and check for errors in roadway lane coordinates and elevations. Are all major roadway sources included? Check if refinements to the model, such as adding shoulders, concrete traffic barriers, terrain lines, or ground zones, affect the results. Check field notes for unusual environmental conditions that may have occurred during the validation measurement.

Coordinate with the district or ENV Noise Specialist if the existing model does not validate.

### **Pavement**

If the existing pavement condition adjacent to the validation site does not represent an average pavement type, one of the alternative pavement types that more accurately represents the actual pavement condition may be applied to the validation model. Note – Use of an alternative pavement type in the noise modeling software only applies to validation efforts for the prediction of existing

traffic noise levels and must be approved by the ENV noise SME. Alternate pavement types are not to be used for the prediction of future traffic noise levels or impacts.

## **5.2. Predicted Noise Levels**

Predicted noise levels can only be determined by computer modeling.

Using the FHWA-approved traffic noise modeling software, predicted noise levels will be determined for all build alternatives under consideration in the NEPA document (all reasonable alternatives) and the preferred alternative. Alternatives rejected for detailed analysis because they are not reasonable do not require future noise level modeling.

Traffic noise levels must be determined at representative receivers adjacent to the completed roadway project in the design year. For example, if a roadway project will upgrade a roadway from two to four lanes, the predicted levels must be based on data for the four-lane roadway in the design year.

## **5.3. Noise Impact Contours for Undeveloped Areas**

Because predicted noise levels are not determined for undeveloped areas where no development is permitted (Category G), noise impact contours must be calculated using the future conditions model. The predicted noise contours are included in the environmental document to assist local officials with planning for future development that would avoid traffic noise impacts (see **Section 12.1**).

At a minimum, determine the approximate distance to the noise impact contour for all exterior land use categories (Category B, C, and E), i.e. for both the 66 dB(A) and 71 dB(A) sound levels. This distance must be measured either from the typical ROW line or from the edge of nearest travel lane.

Noise impact contours for undeveloped areas must be determined for all projects unless the project corridor is fully developed and therefore has no undeveloped areas. If the adjacent land use has no undeveloped areas, then contour determination and notification of noise information to local officials is not required.

**IMPORTANT NOTE:** Noise contour lines may be used for project alternative screening (see **Section 2.1**) or for land use planning but per the TxDOT Traffic Noise Policy shall not be used for determining roadway traffic noise impacts or the feasibility and reasonableness of noise abatement.

## **5.4. Construction Noise**

Quantitative calculation of construction noise levels is usually not necessary for roadway traffic noise analyses. Potential noise impacts from construction equipment is programmatically addressed in TxDOT's Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges (see Item 7, Section 10 "Abatement and Mitigation of Excessive or Unnecessary Noise").

The following information must be included in the environmental documentation for a traffic noise analysis:

Noise associated with the construction of the project is difficult to predict. Heavy machinery, the major source of noise in construction, is constantly moving in unpredictable patterns. However, construction normally occurs during daylight hours when occasional loud noises are more tolerable. No extended disruption of normal activities is expected. Provisions will be included in the plans and specifications that require the contractor to make every reasonable effort to minimize construction

## ***TxDOT Traffic Noise Policy Implementation Guidance***

noise through abatement measures such as work-hour controls and proper maintenance of muffler systems.

### **6.0 Determine Impacts**

Using the existing and predicted noise levels, TxDOT will determine and analyze expected traffic noise impacts for Type I projects.

In order to determine traffic noise impacts, noise-sensitive land uses must be identified according to the Noise Abatement Criteria (NAC) and as described by activity category in the NAC table (see **Table 1**).

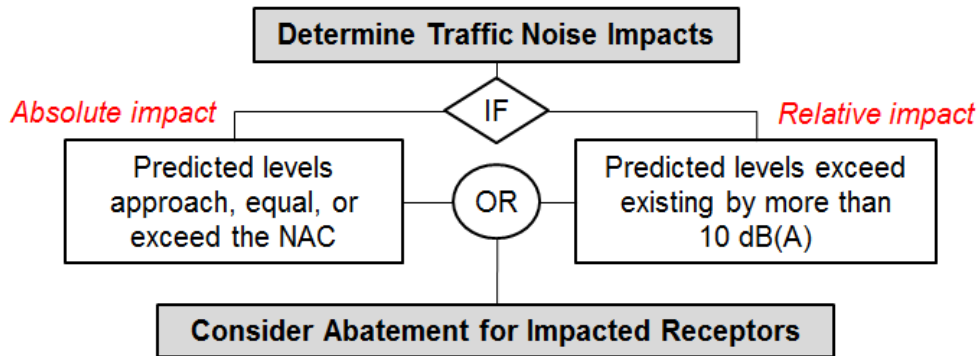
**Table 1. Noise Abatement Criteria Table**

Activity Category	FHWA (dB(A) Leq)	Description of Land Use Activity Areas
A	57 (exterior)	Lands on which serenity and quiet are of extra-ordinary 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)	Residential
C	67 (exterior)	Active sport areas, amphitheatres, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings
D	52 (interior)	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios
E	72 (exterior)	Hotels, motels, offices, restaurants/bars, and other developed lands, properties, or activities not included in A-D or F.
F	--	Agricultural, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing.
G	--	Undeveloped lands that are not permitted.



## 6.1. Absolute and Relative Impact Criteria

A roadway traffic noise impact occurs when the predicted future roadway traffic noise levels approach, equal, or exceed the NAC shown in **Table 1** or when predicted future roadway traffic noise levels substantially exceed the existing roadway traffic noise levels, even though the predicted levels may not exceed the NAC.



Roadway traffic noise impacts can occur under either of two separate conditions:

1. **Absolute Criterion:** Future noise levels approach, equal, or exceed the NAC. TxDOT defines the approach level as one (1) dB(A) below the FHWA Noise Abatement Criteria.
2. **Relative Criterion:** Future noise levels result in a substantial noise increase over the existing noise environment. A substantial noise increase occurs when the predicted noise level exceeds the existing level by more than 10 dB(A). A substantial noise increase is independent of the absolute noise level. A substantial noise increase is a noise impact, even if the future noise level does not approach, equal, or exceed the NAC.

## 6.2. Determining Impacts for Noise-Sensitive Land Uses

### 6.2.1. Category A

FHWA (dB(A) Leq)	Absolute Impact	Relative Impact
57 (exterior)	Predicted noise level <b>56 dB(A) or higher</b>	Difference between proposed and existing noise level is <b>11 dB(A) or higher</b>

The FHWA impact criterion for Category A receptors is 57 dB(A). A traffic noise impact for this activity category is identified if the predicted noise levels are 56 dB(A) or higher (absolute impact), or if the difference between the existing and predicted noise levels is 11 dB(A) or higher (relative impact).

**6.2.2. Category B**

FHWA (dB(A) Leq)	Absolute Impact	Relative Impact
67 (exterior)	Predicted noise level <b>66 dB(A) or higher</b>	Difference between proposed and existing noise level is <b>11 dB(A) or higher</b>

The FHWA impact criterion for Category B receptors is 67 dB(A). A traffic noise impact for exterior residential land uses is identified if the predicted noise levels are 66 dB(A) or higher (absolute impact), or if the difference between the existing and predicted noise levels is 11 dB(A) or higher (relative impact).

**6.2.3. Category C**

FHWA (dB(A) Leq)	Absolute Impact	Relative Impact
67 (exterior)	Predicted noise level <b>66 dB(A) or higher</b>	Difference between proposed and existing noise level is <b>11 dB(A) or higher</b>

The FHWA impact criterion for Category C receptors is 67 dB(A). A traffic noise impact for these exterior land uses occurs when the predicted noise levels are 66 dB(A) or higher (absolute impact), or if the difference between the existing and predicted noise levels is 11 dB(A) or higher (relative impact).

**6.2.4. Category D**

FHWA (dB(A) Leq)	Absolute Impact	Relative Impact
52 (interior)	Predicted noise level <b>51 dB(A) or higher</b>	Difference between proposed and existing noise level is <b>11 dB(A) or higher</b>

The FHWA-impact criterion for Category D receptors is 52 dB(A). A traffic noise impact for these interior land uses occurs when the predicted noise levels are 51 dB(A) or higher (absolute impact), or if the difference between the existing and predicted noise levels is 11 dB(A) or higher (relative impact).

Because the noise modeling software does not adjust for interior noise levels, model results must have an interior noise reduction factor applied for reporting and comparison to the impact criteria.

For receptors that are determined to be NAC category D, refer to **Table 2** to determine interior noise levels for reporting. For example, if the noise model calculated 76 dB(A) at a receiver that was a light framed building with storm windows, the reported noise level would be 51 dB(A). This would then be identified as an absolute impact for the interior location.

**Table 2. Interior Building Noise Reduction Factors**

Building Type	Window Condition*	Noise Reduction Due to Exterior of the Structure
All	Open	10 dB
Light Frame	Ordinary Sash (closed)	20 dB
	Storm Windows	25 dB
Masonry	Single Glazed	25 dB
	Double Glazed	35 dB
*The windows must be considered open unless there is firm knowledge that the windows are in fact kept closed almost every day of the year.		

Source: FHWA publication FHWA-DP-45-1R, Sound Procedures for Measuring Roadway Noise: Final Report

**6.2.5. Category E**

FHWA (dB(A) Leq)	Absolute Impact	Relative Impact
72 (interior)	Predicted noise level <b>71 dB(A) or higher</b>	Difference between proposed and existing noise level is <b>11 dB(A) or higher</b>

The FHWA-impact criterion for Category E receptors is 72 dB(A). A traffic noise impact for these less noise-sensitive exterior land uses occurs when the predicted noise levels are 71 dB(A) or higher (absolute impact), or if the difference between the existing and predicted noise levels is 11 dB(A) or higher (relative impact).

**6.3. When Analysis Indicates a Noise Impact**

When a noise impact occurs, noise abatement measures must be considered as required by the TxDOT Traffic Noise Policy. A noise abatement measure is any positive action taken to reduce the impact of traffic noise on an activity area.

Types of noise abatement measures are discussed in **Section 7.0**.

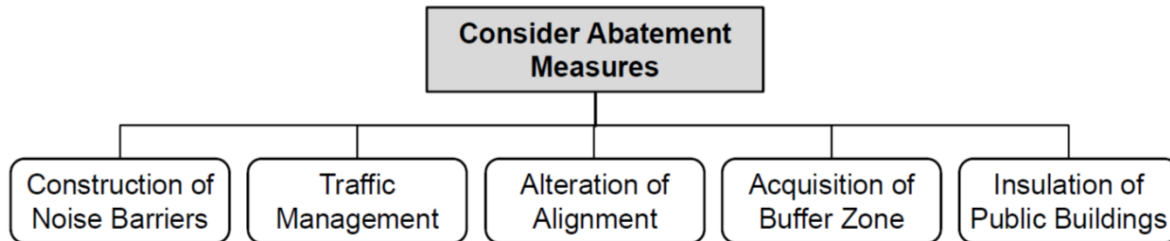
The process for evaluating abatement measures is discussed in **Section 8.0**.

**6.4. No Impacts - Abatement Not Required**

If the analysis indicates that a roadway project would not result in a traffic noise impact, an evaluation of noise abatement measures is not necessary, and no further analysis is required. See **Section 10.0** for documentation requirements.

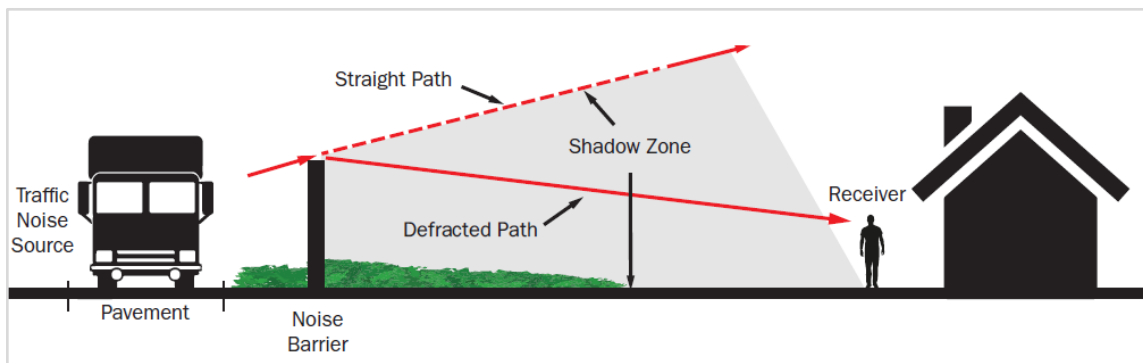
## 7.0 Consider Abatement Measures

When traffic noise impacts are identified, noise abatement shall be considered and evaluated for feasibility and reasonableness per TxDOT and FHWA policy. At a minimum, noise barriers must be analyzed for each impacted receptor location.



### 7.1. Construction of Noise Barriers

Noise barriers are the most commonly used noise abatement measure. A noise barrier is a physical obstruction, constructed between the roadway noise source and noise-sensitive receptor(s). Note that noise barriers do not completely block all noise; they only reduce overall noise levels.



Noise barriers include stand-alone noise walls, noise berms (earth or other material), and combination berm/wall systems.

#### 7.1.1. Placement of Noise Barriers

Due to how sound propagates, noise barriers are most effective when located either close to the source (the roadway) or close to the receptor location.

ENV recommends coordination with the design engineer throughout the noise analysis process to identify issues and solutions related to placement and constructability of noise barriers. Early identification and consideration of site constraints and potential utility conflicts may save time and effort later (see **Section 9.0**).

At a minimum, noise barriers for impacted receptors must be modeled and tested along the ROW.

Considerations for placement of noise barriers include:

- Site characteristics, such as topography; existing utilities; drainage; karst, wetlands, and endangered species habitat; access for vehicles, pedestrians, and maintenance; sight lines; safety features, etc.

- When site constraints (utilities, access, etc.) on controlled-access facilities may make noise barriers along the ROW not feasible, consider placement of barriers between the main lanes and the frontage road. However, note that these in-between barriers would not shield receptors from frontage road traffic noise and therefore may be less effective.
- Wrap-around at the ends, if ROW is available
- Some example design solutions used in Texas include:
  - Staggered, overlapping noise barriers to provide access to a drainage area
  - Barriers with removable panels to provide access to utilities
  - Placing conventional barrier walls between utility poles and adding flexible metal walls to wrap around the poles
  - Using lightweight materials (i.e., acrylic panels) on bridge structures

Refer to FHWA's Noise Barrier Design Handbook (FHWA-EP-00-005, February 2000) for additional discussion of barrier design issues.

### ***7.1.2. Noise Barrier Heights***

Typically, the maximum constructible barrier height for Texas is 20 feet, though individual sections of a wall may be higher if needed. In certain cases, barriers have been constructed up to 24 feet in height.

Concrete noise barriers proposed on structures such as bridges and retaining walls may also be limited to certain heights (typically 8 to 10 feet for bridges) due to structural weight limits. However, lightweight options such as acrylic panels may be considered. Therefore, coordinate with the project design engineer.

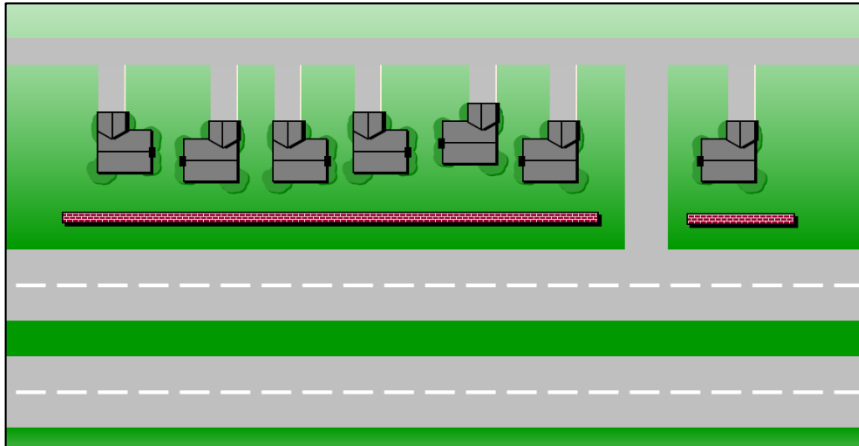
### ***7.1.3. Neighborhood Concept***

It is important to consider the neighborhood context when designing and testing abatement. In many cases, it may be a subjective decision to identify an area as a neighborhood because of historical displacements from previous roadway projects or other factors.

The "Neighborhood Concept" considers the neighborhood as a whole when developing an abatement proposal and ensures that abatement is designed in a manner that does not exclude a few receptors due to their location within the neighborhood. Using this concept, a single barrier proposal consisting of several non-continuous segments designed to allow for roadway access might be proposed instead of separate block-by-block noise barriers analyzed in isolation.

Similarly, application of the neighborhood concept would extend a barrier to include non-impacted or non-benefited receptors in order to provide a uniform barrier for the entire neighborhood.

In the example below, the residence on the right side of the neighborhood would not typically receive the same amount of noise reduction as houses in the middle of the longer wall on the left. However, under the neighborhood concept, the wall would be extended to shield the entire length of the neighborhood.



**Example barrier proposed under the neighborhood concept**

Therefore, when impacts are identified in a group of houses that are part of a residential subdivision, extend the barrier along the entire length of the neighborhood, even if a cross street isolates one or two houses on the end or if some residences are not impacted due to setback distance.

Consideration of this concept must also occur when project limits start or stop in the middle of a neighborhood that has impacts. A noise barrier may need to extend beyond the project limits in order to address impacts within a neighborhood.

#### **7.1.4. Barrier Optimization**

For aesthetic and public perceptions, it is desirable to optimize barriers to a consistent height within a single neighborhood or for adjacent neighborhoods; however, effectiveness must not be sacrificed to achieve this.

#### **7.1.5. Consideration of Existing Noise Barriers**

If the project limits include existing TxDOT-constructed noise barriers, these barriers must be included in the traffic noise models and the associated receptors must be evaluated for noise impacts. If impacts are identified, then the existing noise barrier must be evaluated to determine if it meets the current abatement criteria.

Refer to FHWA's 2012 memorandum called Consideration of Existing Noise Barrier in a Type I Noise Analysis (FHWA-HEP-12-051) for instructions and examples.

### **7.2. Other FHWA-approved Abatement Options**

#### **7.2.1. Traffic Management**

Control devices could be used to reduce the speed of the traffic; however, the minor benefit of one dB(A) per five mph reduction in speed does not outweigh the associated increase in congestion and air pollution. Other measures such as time or use restrictions for certain vehicles are prohibited on state roadways.

## ***7.2.2. Alteration of Alignment***

Any alteration of the existing alignment would displace existing businesses and residences, require additional right of way, and may not be cost reasonable.

## ***7.2.3. Acquisition of Buffer Zone***

The acquisition of undeveloped property to act as a buffer zone is designed to avoid rather than abate traffic noise impacts and, therefore, is not considered feasible.

## ***7.2.4. Insulation of Public Buildings***

Noise insulation may only be considered for public use or nonprofit institutional structures identified as Activity Category D land use facilities listed in **Table 1**. “Public use or nonprofit institutional structures” means the facility is open for public use and owned by the public or that a nonprofit organization owns the facility. Noise analysts must take interior noise measurements for the final noise analysis and abatement design for locations where noise insulation is considered as a potential abatement measure. Post-installation maintenance and operational costs for noise insulation are not eligible for Federal-aid funding.

Insulating buildings can greatly reduce roadway traffic noise. Sometimes this involves installation of sound absorbing material in the walls of a new building during construction. However, insulation can be costly because air conditioning is usually necessary once the windows are sealed.

Noise insulation is normally limited to public use structures such as places of worship, schools and hospitals. A legal agreement is necessary between TxDOT and the owners of a building that will receive noise insulation. The agreement must specify the noise insulation requirements, such as the sound transmission class (STC) of windows and doors used for noise insulation, and ensure that the owners understand that they bear all post installation expenses, such as utilities and maintenance.

## ***7.3. Other Noise Reduction Measures***

### ***7.3.1. Pavement and Vegetation***

When allowed by safety and budget considerations, quiet pavements may be used for a project. However, quiet pavement cannot be considered noise abatement under federal policy because of the changing noise characteristics of different pavements over time.

Quiet pavement is a relative term for any pavement that produces less noise from the action of vehicle tires rolling over it in comparison with other pavements. Quieter pavements are not limited to being asphalt or concrete, but rather incorporate known practices to make the driving surface quieter. Examples of quiet pavement types or treatments include next generation concrete surface (NGCS), permeable friction course (PFC) asphalt, and longitudinal tining.

Based on research in the United States and worldwide, it is possible to select, design, and build pavements that are quieter rather than noisier. The reductions achieved depend on how loud the noisier pavement is relative to the quieter one.

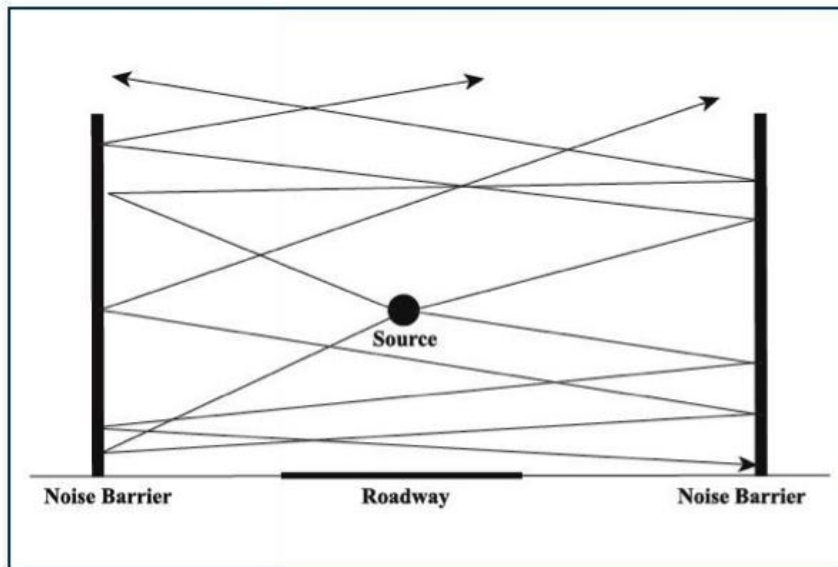
Planting of vegetation or landscaping is aesthetically pleasing, but is not an acceptable noise abatement measure. Studies have shown that vegetation must be sufficiently dense (evergreen) and at least 100 feet deep and 20 feet high to reduce noise levels by a readily perceptible amount (five decibels).

Vegetation may serve as a visual screen for locations where abatement is not feasible or reasonable. FHWA allows states to use federal-aid funds for vegetation near noise barriers or for landscaping near roadsides for aesthetic and visual purposes, but landscaping is not considered noise abatement.

### 7.3.2. Absorptive Treatments

Noise barriers, retaining walls, bridges, and other solid structures made from concrete may reflect traffic noise. This reflection may degrade the noise reduction performance of noise barriers or cause noise increases in areas not protected by barriers, such as when receptors on one side of the highway have a direct line of sight to a new barrier or new retaining wall on the opposite side of the highway.

Studies have suggested 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 needs to be at least 10:1, where the width is the distance between the barriers, and the height is the height of the barriers above the roadway. This means that two parallel barriers 10 feet tall must be at least 100 feet apart.



Per TxDOT's Traffic Noise Policy, when the width between two noise barriers is less than 10 times the height of the noise barriers, the incorporation of sound absorptive treatments shall be considered to reduce acoustic reflections that may degrade barrier performance.

To address this situation: 1) construct noise walls with an acoustically absorptive surface (i.e. a noise reduction coefficient of 0.80 or greater); or 2) modify the design to increase the distance ratio between the barriers to 15:1 ratio.

When evaluating cost reasonableness (see **Section 8.3.2**), the cost of implementing an absorptive surface that is triggered by either of the solutions described above can be evaluated under the alternate barrier cost methodology.



## 8.0 Evaluate Abatement Measures

Abatement measures for impacted receptor locations must be evaluated to determine if they are both feasible AND reasonable. The feasible and reasonable criteria include acoustic reduction thresholds, site constraints, cost, and the viewpoints of property owners and residents. The criteria that must be met in order to propose an abatement measure are summarized in **Table 3**.

**Table 3. Summary of TxDOT Noise Abatement Evaluation Criteria**

Category	Feasible	Reasonable
Acoustic Reduction	Provides at least a 5 dB(A) reduction (“benefit”) for a majority of impacted first-row receptors  AND  Benefits a minimum of two impacted receptors	Provides a substantial noise reduction consisting of a predicted reduction of at least 7 dB(A) for at least one receptor  (Noise Reduction Design Goal)
Cost*	n/a	Does not exceed 1,500 square feet per benefited receptor  (Standard Barrier Cost analysis)
Site Constraints**	Is it possible to build given topography, access requirements, local cross streets, other noise sources, drainage, utilities, and maintenance requirements?	Estimated costs to overcome site constraints are not unreasonably high (Alternate Barrier Cost analysis)
Viewpoints of property owners and residents	n/a	A majority of votes received from benefited and bordering receptors indicates that they want the barrier

\*Though the term “cost” is used, it may be easier to think of the standard barrier cost as an “allowance” that represents the maximum square footage of noise barrier per benefited receptor that is reasonable.

\*\*A Constructability Assessment (see **Section 9.0**) by the project design engineer must conclude that a barrier can be constructed and that associated costs are not unreasonably high.

All abatement analyzed within a project area must have an equal and consistent level of analysis. For example, if a hard look at subsurface utilities is performed in the analysis of one barrier, the same level of analysis must occur for all other barrier analyses within the project area.

The barrier analysis function in the noise modeling software is used to evaluate noise reduction levels provided by abatement measures for impacted receptor locations, using the future condition model.

Noise abatement measures that meet feasible AND reasonable criteria for acoustic reduction, cost, and known site constraints must be proposed for incorporation into the project and described in the environmental documentation. The requirements for evaluating abatement measures are described in more detail below.

## 8.1. Benefited Receptors

The recipient of an abatement measure that receives a noise reduction at or above the minimum threshold of 5 dB(A), regardless of whether the receptor was “impacted,” is termed a benefited receptor. Benefited receptors are used, as described in the following sections, as a measure to evaluate feasibility and reasonableness.

IMPORTANT NOTE: During the impact analysis phase of the noise analysis, it was acceptable to model representative receivers. However, for the barrier analysis phase, it is very important to model, at a minimum, all first-row receptors associated with an impacted representative receiver in order to determine benefited receptors. Also consider including second-row receivers in the barrier analysis, if they would be benefited.

## 8.2. Feasibility

Feasibility is the determination of whether an abatement measure provides a minimum reduction in noise levels and whether it is possible to build an abatement measure given site constraints.

According to the TxDOT Traffic Noise Policy, to be feasible an abatement measure must provide sufficient noise reduction such that:

- It achieves a noise reduction of at least 5 dB(A) at greater than 50% of first-row impacted receptors, and
- Benefits a minimum of two impacted receptors. Noise abatement measures that benefit only a single, isolated receptor are NOT FEASIBLE, and do not require further assessment beyond identification of the receiver as impacted. Impacted frequent human activity areas for Category C land uses, however, will require assessment if the impacted area is equivalent to at least two receptors (see **Section 8.3.3**).

Additionally, engineering considerations must be analyzed to determine whether a barrier is constructible (see **Section 9.0**).

Depending on the level of design available when a barrier analysis is prepared, many constructability constraints may not be known. Therefore, unless constructability has been thoroughly analyzed, the primary consideration for feasibility in the environmental phase of the project is typically the predicted acoustic reduction that would be provided by the abatement measure.

IMPORTANT NOTE: For a barrier to be not feasible due to site constraints, these factors must make an abatement measure not constructable. All projects with preliminary barrier proposals based only on acoustic feasibility must have a constructability assessment (see **Section 9.0**) before holding noise workshops and finalizing barriers in the construction plans (PS&E) before project letting.

## 8.3. Reasonableness

Reasonableness is the combination of social, economic, and environmental factors considered in the evaluation of noise abatement measure. The following three reasonableness factors or “tests” must be met for a noise abatement measure to be considered reasonable.

- Noise reduction design goal of 7 dB(A) (see **Section 8.3.1**)
- Cost reasonableness (see **Section 8.3.2**)
- Solicitation of viewpoints from affected receptors (see **Section 11.0**)

The noise reduction design goal and cost reasonableness tests are part of the evaluation of an abatement measure that must take place before the abatement proposal is prepared.

Solicitation of viewpoints from affected receptors is usually performed after the CE determination or after the public hearing for an EA or EIS project (see **Section 11.1**). Viewpoints are obtained as part of a noise workshop. Voting requirements and noise workshop procedures are discussed in **Section 11.0**.

### **8.3.1. Noise Reduction Design Goal**

TxDOT has defined the noise reduction design goal as achieving a reduction in noise that is at least 7 dB(A) (a substantial noise reduction). At least one benefited receptor must achieve the noise reduction design goal.

### **8.3.2. Cost Reasonableness**

There are two types of cost reasonableness measures that may be used in a traffic noise barrier analysis. These are the standard barrier cost and the alternate barrier cost. The standard barrier cost must be calculated for all abatement analyses, if it is determined that an abatement measure would meet both acoustic reduction criteria.

It is also important to note that third party funding cannot be used in the cost barrier reasonableness analyses (see **Section 8.3.5**)

#### **Standard Barrier Cost**

Under the standard barrier cost, a proposed noise barrier (or berm) is cost reasonable if the cost to construct the surface area of the barrier wall does not exceed 1,500 square feet per benefited receptor, based on an indexed-wall-only cost criterion<sup>1</sup> approved by FHWA.

Though the term “cost” is used, think of the standard barrier cost as an “allowance” representing the maximum square footage per benefited receptor. The “cost” value used in the standard barrier cost analysis is independent of the actual estimated dollar cost per square foot necessary to construct a noise barrier.

The standard barrier cost does not include the costs of any additional ROW, utility adjustments directly associated with construction of a noise barrier, or costs for additional design elements necessary to accommodate unusual topographic or drainage features directly associated with construction of a noise barrier.

For berms, use a centerline length and height to determine if the equivalent square footage is cost reasonable.

---

<sup>1</sup> FHWA Cost Memo approved in accordance with 23 CFR 772.13(d)(2)(ii). See ENV's online Traffic Noise Toolkit for the latest copy of the memo.

## **Alternate Barrier Cost**

If the construction costs associated with a proposed barrier are believed to be unreasonably high based on site-specific conditions, an alternate barrier cost analysis must be performed. This analysis includes the costs of any additional ROW, of utility adjustments directly associated with construction of a noise barrier, and for additional design elements necessary to accommodate unusual topographic or drainage features directly associated with construction of a noise barrier.

The alternate barrier cost analysis is optional, and it is only calculated after a standard barrier cost analysis has been performed. A barrier may no longer be considered cost reasonable if the alternate barrier cost is greater than two times the FHWA-approved wall-only cost (i.e., the standard barrier cost).

An alternate barrier cost assessment must use ENV's Alternate Barrier Cost Assessment Worksheet, available in the online Traffic Noise Toolkit. On this worksheet, include dollar amount estimates of all costs associated with the barrier construction. This information is usually obtained from project engineering or design staff and may be performed as part of a Constructability Assessment (**Section 9.0**).

### ***8.3.3. Equivalent Receptors for Cost Reasonableness***

In some cases, the number of benefited receptors to use for cost reasonableness calculations may not be readily apparent. For land uses that consist of large areas (like parks, cemeteries, or schools) represented by a common gathering area (like a picnic area, garden, or playground), the equivalent number of benefited receptors must be determined as part of the barrier analysis.

#### **Equivalent Receptors for Category B Land Uses**

In general, one single-family home with an outdoor activity area is equivalent to one receptor, regardless of how many or how few people live in the residence.

Similarly, one unit of an apartment complex with an individual outdoor activity area within line of sight of the roadway is also equivalent to one receptor.

For apartments or other multifamily residences that do not have individual exterior activity areas within line of sight of the roadway, the impact analysis and acoustic reduction portion of the barrier analysis must be based on the predicted noise levels at an exterior common gathering area, such as a pool, gazebo, or playground. For cost reasonableness, the number of benefited receptors represented by the common area is equivalent to the number of dwelling units that are potentially affected by roadway noise (i.e., facing the roadway and within the 66 dB(A) noise impact contour) and that would be reasonably shielded by the barrier (i.e., first and second story units).

#### **Equivalent Receptors for Category C Land Uses**

To determine the number of equivalent receptors for Cost Reasonableness for Category C land uses, first determine the average representative lot size of residential development within the project area and the approximate impacted area within the Category C land use. To calculate the equivalent number of impacted receptors, divide the impacted land area of the Category C receptor by the area of the representative lot size. An example of the barrier analysis for Category C land uses is described below.

Note that the actual areas of frequent human outdoor activity (receiver locations in the model) must first be used to determine if a barrier would meet the acoustic reduction requirements. Once those

criteria have been met, then check if the barrier would be cost reasonable, using the calculated equivalent receptors.

Example: a municipal park is located adjacent to the project area. Several areas of frequent outdoor human activity within the park were predicted to have traffic noise impacts, including a trailhead, playground, and picnic area.

- Identify the representative lot size of residential development. The average residential lot size in the community adjacent to the park is 60 feet x 120 feet or 7,200 square feet (sq. ft.).
- Next, determine the land area of the impacted portion of the park. Noise modeling predicts noise impacts from the project to a distance of 350 feet from the ROW. The park has 1,000 feet of frontage. The total impacted area of the park is 350,000 sq. ft. If there is unusable land area, such as wooded area that is not accessible to park users within the impacted portion of the park, consider subtracting that area.
- Finally, divide the 350,000 sq. ft. of impacted land area by the typical lot size of 7,200 sq. ft. for an equivalent number of receivers equal to 48.6. Rounding up, the park is representative of 49 equivalent benefited receptors for the reasonableness determination.

### **Equivalent Receptors for Category D Land Uses**

For Category D receptors, each interior establishment in a Category D land use is equivalent to one receptor per the TxDOT Traffic Noise Policy.

### **Equivalent Receptors for Category E Land Uses**

When determining cost reasonableness for restaurants and offices, each establishment is equivalent to one receptor. Cost reasonableness for hotels with a common gathering area such as a pool or sport court must be determined in a manner similar to multifamily residences (Category B) with common area.

### **8.3.4. Cost Averaging Among Benefited Receptors**

Cost averaging is a method to leverage more abatement throughout a corridor by using barriers that have high cost-reasonableness to cover barriers that are not otherwise cost reasonable.

For example, a traffic noise analysis indicates that several reasonable and feasible noise barriers proposed for dense multifamily residential areas have estimated standard barrier cost values that are much lower than the 1,500 square feet per benefited receptor allowance (i.e., very cost reasonable). The “extra” square footage could theoretically be used to provide abatement to less dense areas of impacted single family residences where acoustic criteria are met, but the cost reasonableness criteria are exceeded.

Cost averaging is usually considered on corridor projects where

- there are large numbers of impacted receptors;
- there are several noise barriers proposed with many benefited receptors; but,
- there are also areas where barriers that meet acoustic reduction requirements are not cost reasonable.

For these types of projects, TxDOT has the option to cost average noise abatement among benefited receptors within common noise environments (CNE) as long as no single CNE exceeds two times the

Standard Barrier Cost criterion and collectively all CNEs being averaged do not exceed the Standard Barrier Cost criterion. This means that cost averaging is allowed for potential barriers with a standard barrier cost value less than 3,000 square feet per benefited receptor, as long as the cumulative cost across all barriers in the corridor is less than 1,500 square feet per benefited receptor.

Contact an ENV noise SME to discuss this option and to request a copy of ENV's Cost Averaging for Common Noise Environments methodology.

### ***8.3.5. Third Party Funding***

Third Party Funding is not allowed on federal or federal aid Type I projects if the noise abatement measure would require the additional funding from the third party to be considered feasible and/or reasonable. Third party funding is acceptable on federal or federal aid Type I projects to make functional enhancements such as landscaping, absorptive treatment, and access doors or aesthetic enhancement to a noise abatement measure already determined reasonable and feasible.

### ***8.4. Abatement Proposal***

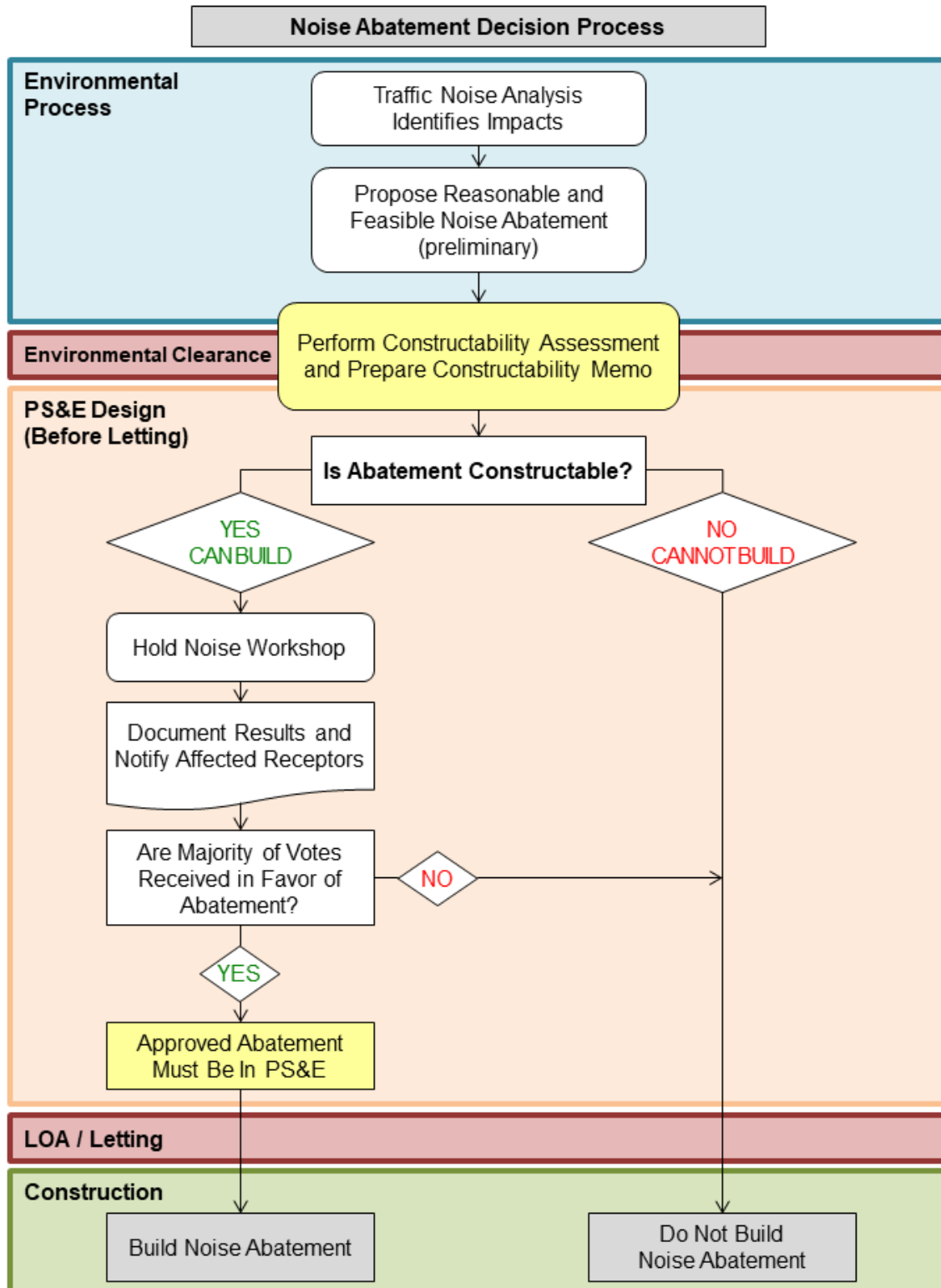
Using the feasible and reasonable criteria described above and the considerations described in **Section 7.1**, the analyzed barrier(s) must be optimized to provide a balance of cost reasonableness and noise reduction.

Once noise abatement has been determined acoustically reasonable and feasible and cost reasonable, it is necessary to document the results of the analysis and describe the abatement proposal (see **Section 10.0**). Typically, only one abatement option for each impacted area is identified and proposed.

For noise impacts for which abatement measures are not feasible and reasonable, the documentation (see **Section 10.0**) must describe the results of the analysis and why abatement was not proposed.

# TxDOT Traffic Noise Policy Implementation Guidance

The flow chart below illustrates the noise abatement decision process.



## 9.0 Constructability Assessment for Proposed Abatement

This section describes decisions and analysis that must occur after the initial (preliminary) proposal of a noise abatement measure. See flow chart above for context.

### 9.1. *What is a Constructability Assessment?*

A Constructability Assessment, which may include an optional alternate barrier cost assessment, for a proposed abatement **MUST** be performed to confirm the location and placement of a proposed abatement measure. This assessment must occur before holding a noise workshop (see **Section 11.0**).

At the time of a noise analysis (based on schematic design) and/or at environmental clearance, a proposed abatement measure is typically considered “preliminary.” This means that based on the design at the time of the environmental studies, the location and height of the abatement measure meets the feasible and reasonable abatement criteria for acoustic reductions and cost requirements (see **Section 8.0**). However, a complete investigation of site conditions, final project design, and the desires of affected property owners and residents has not yet been completed.

This is why the noise analysis report and the environmental document that includes proposed noise abatement must include the Statement of Likelihood (see **Section 10.4**) and proposed noise barriers are described as “preliminary.”

### 9.2. *Preparing a Constructability Assessment*

A Constructability Assessment must be performed by the design engineer and may result in changes to a proposed barrier location or the determination that a barrier is not feasible or reasonable due to site conditions (see **Section 8.2**) or the direct costs associated with building a noise barrier (see **Section 8.3.2**).

The following are example considerations for noise barrier constructability:

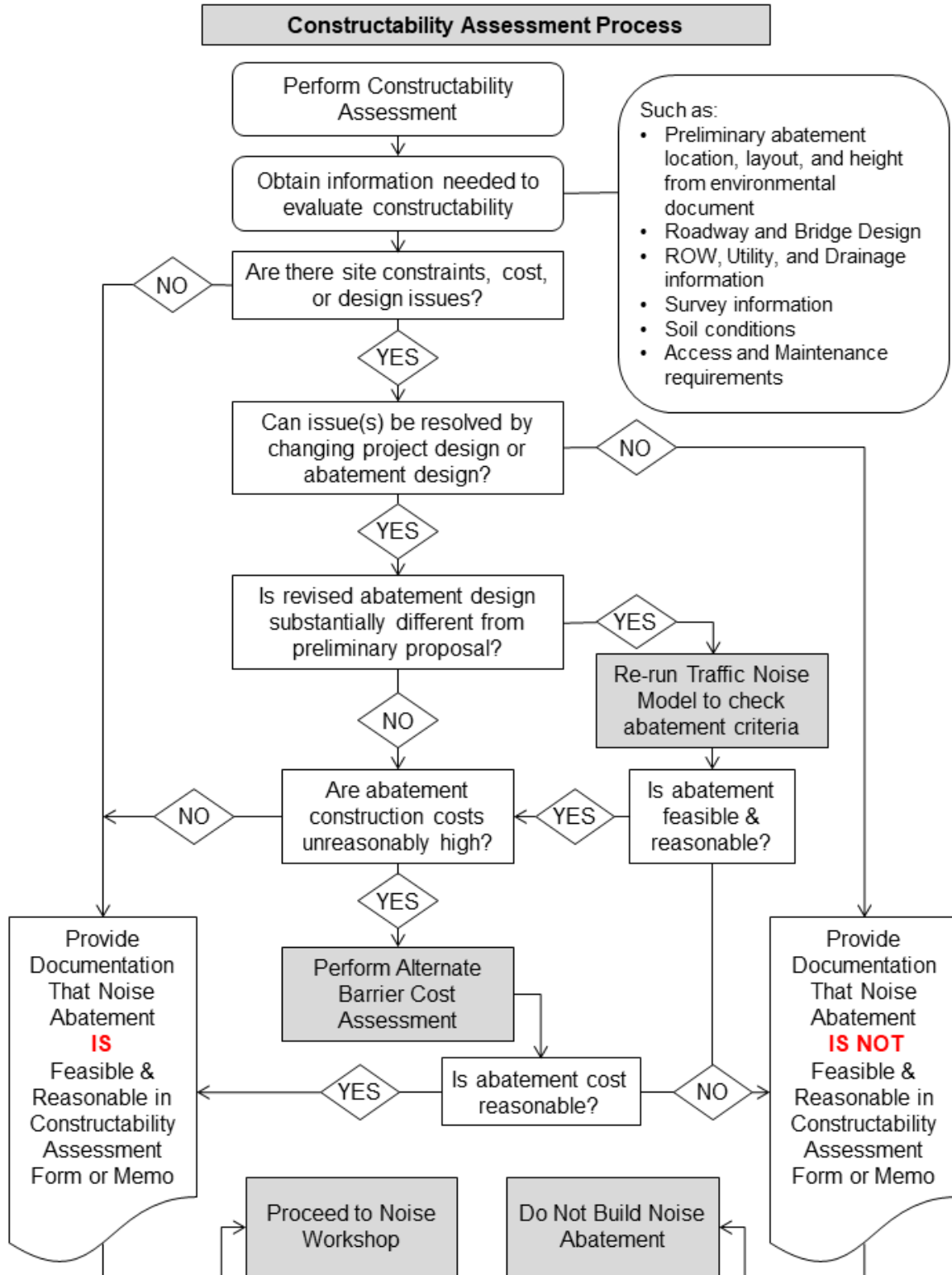
- Can a substantial reduction in noise levels be achieved given access, drainage, utilities, safety, or maintenance requirements?
- Would topographic constraints prevent the construction of a noise barrier of sufficient size to achieve a substantial reduction in noise levels?
- Are there any environmental constraints (such as karst, endangered species habitat, wetlands, or cultural resources) that could affect placement or construction of a noise barrier?
- Are direct construction costs for a noise barrier unreasonably high? (utility adjustments, purchase of additional ROW, additional design elements, etc)
- Are other (non-traffic related; e.g. aircraft, rail, commercial, or industrial) noise sources present in the area that would negate the ability of a traffic noise abatement measure to achieve a substantial reduction in noise levels?
- Are barrier heights possible given site constraints? Generally, noise barriers greater than 20 feet tall are not feasible to construct. Heights on bridge or retaining wall structure may also be constrained due to weight and wind loading.

Note that the example considerations listed above do not represent all possible factors associated with design and construction of noise abatement. Site and design considerations may be project specific.



# TxDOT Traffic Noise Policy Implementation Guidance

The chart below shows considerations and decision outcomes for a Constructability Assessment.



The determination that it is possible or not possible to design and construct proposed noise abatement must be made using standard engineering methodology and sound engineering judgement.

There may be creative engineering solutions available to work around constructability issues. Use FHWA's Highway Noise Barrier Design Handbook (FHWA-EP-00-005, February 2000), available on the FHWA noise website, as a resource.

### ***9.3. Documentation and Timing***

The design engineer completes ENV's Constructability Assessment for Proposed Noise Barrier Form, which is available in the online Traffic Noise Toolkit.

An ENV Noise SME will review constructability assessments for completeness and consistency with the feasible and reasonable abatement criteria (see **Section 8.0**).

A constructability assessment may occur at any point before a noise workshop, including before the environmental decision.

- If an assessment is performed before the completion of the traffic noise analysis report, the results of the constructability assessment will be incorporated into the traffic noise analysis report, with documentation attached to the report.
- If an assessment occurs after completion of the traffic noise analysis report, the assessment must be documented using the Form indicated above and must be completed prior to distributing the solicitation packet for a noise workshop.

If adjustments to the preliminary abatement location are recommended by the design engineer, re-modeling by the noise analyst may be necessary to confirm that the revised abatement measure still provides feasible and reasonable acoustic reductions. Revised models must be submitted with the constructability assessment documentation for the project file.

If a Constructability Assessment demonstrates that a barrier is not feasible or reasonable, then do not hold a noise workshop for that barrier.

**IMPORTANT NOTE:** Per 23 CFR 772.13(h), noise abatement measures that are found to be reasonable and feasible must be incorporated into the plans and specifications **BEFORE** approval of the plans and specifications.

This means that constructability assessments and noise workshops must be completed **BEFORE** project letting, so that approved noise abatement is included in the plans and specifications.

## **10.0 Traffic Noise Analysis Documentation**

Documentation for a traffic noise analysis is designed to provide comprehensive information to the public, local government officials, and other decision-makers.

For non-Type I projects, the environmental document or project file (ECOS) shall include a determination that a traffic noise analysis was not required.

For Type I projects, prior to CE approval or issuance of the FONSI or ROD and per TxDOT noise policy, the environmental documentation shall:

- Identify locations where traffic noise impacts are predicted to occur.
- Identify the preliminary locations where noise abatement measures are feasible and reasonable, and are likely to be incorporated into the project. When abatement is proposed, the document will also include a statement that the final recommendation on the construction of abatement measures will be made after the final design and public involvement processes are complete.
- Identify noise impacts for which noise abatement measures are not feasible and reasonable

Documentation may also include analysis and decisions regarding any proposed abatement that occurs after the environmental decision, such as constructability assessments, noise workshop documentation and reevaluations.

Therefore, documentation may consist of one or more of the following:

- A determination that a traffic noise analysis was or was not required
- Traffic noise analysis report and noise model files
- Constructability assessment and/or alternate barrier cost assessment worksheet
- Local official letter (sent after the environmental decision)
- Noise workshop summary report and/or other noise workshop documentation
- Documentation of the final decision to build or not build a proposed abatement measure.
- Documentation of reevaluations for noise, as applicable

### ***10.1. Traffic Noise Analysis Report***

The traffic noise analysis report is intended to be technical documentation of the noise analysis. The report is designed to provide comprehensive information to the public, local government officials and other decision makers.

For the public, the traffic noise analysis report must clearly, concisely, and accurately provide individuals affected by a roadway project with a basic understanding of traffic noise fundamentals, regulatory requirements, the traffic noise analysis process, and any associated impacts and abatement.

For local government officials and other decision makers, the report provides an important element of the overall environmental data needed for an informed selection of a project alternative and for the development of noise-compatible land use plans.

Based on information provided in the traffic noise analysis report, the reader will be able to easily understand how the noise analysis was conducted and the results of the analysis.

The traffic noise analysis report must cover the following required information, as applicable to the project:

- Statement that analysis complies with TxDOT's FHWA-approved policy
- Brief overview of noise fundamentals
- FHWA NAC Table
- Noise impact criteria definition
- Noise level table and identification of noise impacts
- Evaluation of noise abatement measures for impacted receivers
- Noise abatement proposal, if applicable
- Statement of Likelihood, if applicable
- Local official statement
- Construction noise statement
- Date of Public Knowledge statement
- Map Figures showing location of receivers and proposed barriers

### ***10.2. Standard Language and Templates***

The ENV's Standard Language for Documenting Traffic Noise Analyses and associated Templates in the online Traffic Noise Toolkit contains example language covering the above requirements for many typical noise analysis situations.

ENV recommends that additional information that is not outlined in the templates may be added if it would improve the reader's understanding of the traffic noise analysis. Such information could include additional data collected as part of the study, assumptions or modifications made due to an atypical situation, reasoning for why predicted traffic noise levels may be decreasing, or reasoning for not proposing a noise barrier due to constructability issues such as utility conflicts.

Additions or changes to the recommended template language need to be reasonable and directly applicable to the project. For example: While the analysis may show that multiple barrier variations (i.e. barriers of different heights or barrier on edge of ROW vs edge of pavement) for a given impact could meet the abatement criteria, the report must focus the discussion on the most reasonable and feasible barrier proposal. Optionally, additional analysis such as spreadsheets of barrier variation results may be submitted as backup documentation for inclusion in the project file.

### ***10.3. Map Figures***

The traffic noise analysis report must include map figures showing the modeled representative receiver locations, where noise impacts are predicted to occur, and locations of any proposed barriers in relation to the proposed improvements.

Noise receiver map figures must:

- Use the following map symbology for noise-related features:
  - Non-impacted receivers = black dots and labels

- Impacted receivers = red dots and labels
  - Benefited receivers = green dots and labels
  - Proposed barriers = green lines
  - Displaced receivers, if not otherwise shown by location of proposed improvements or proposed ROW = yellow "X" or crosshatched polygons
- Use white halo around labels and receiver points so they are visible against aerial backgrounds
  - Use recent aerial imagery
  - Scale map so that reader can easily visualize each receiver location (i.e., if receiver dot is obscuring the entire house, you might want to change the scale and/or adjust the size of your symbol). For most projects, ENV recommends a scale of 1 inch to 400 feet. Inset maps can be effective for areas with dense receivers.
  - Show receivers on maps in a logical and sequential order so that representative receiver locations are easy to find
  - Show project start and end points
  - Show existing and proposed ROW lines
  - (Optional, but recommended) Show line work of proposed improvements (not a detailed schematic, but enough information to show the reader that traffic lanes will be added or adjusted in certain locations)
  - (Optional but recommended) Identify (label by name) adjacent land uses and neighborhoods, especially in areas where abatement is proposed.

### ***10.4. Statement of Likelihood***

When noise abatement measures are proposed, a statement of likelihood must be included in the traffic noise analysis report, as well as in the noise section of the EA or EIS, if one is being prepared for the project. The statement of likelihood is required because feasibility and reasonableness determinations may change due to changes in project design after approval of the environmental document.

The statement of likelihood shall include the preliminary location and physical description of noise abatement measures determined feasible and reasonable in the preliminary analysis. The statement of likelihood also shall indicate that final recommendations on the construction of abatement measure(s) will be determined during the completion of the project's final design and the traffic noise workshop.

Note that the Statement of Likelihood is included in the template language in the online Traffic Noise Toolkit.

TxDOT's statement of likelihood is made up of the following required elements:

- A preliminary noise abatement proposal table or narrative description that describes each proposed noise abatement measure (usually a noise barrier), with the following information:
  - Number of benefited receptors
  - Length, height, and square footage
  - Estimated square footage per benefited receptor

- The statement that: “Any subsequent project design changes may require a reevaluation of this preliminary noise barrier proposal. The final decision to construct the proposed noise barrier will not be made until completion of the project design, utility evaluation, and polling of all benefited and bordering property owners and residents.”

### ***10.5. Project File***

The project file (ECOS) is the written record documenting the basis for one of the following noise determinations: the proposed project impacts no receivers, the proposed project impacts receivers but no feasible and reasonable abatement measures are available, or that the proposed project impacts receivers and includes feasible and reasonable abatement measures.

The following information must be submitted for the project file (i.e. ECOS) when a traffic noise analysis is required.

#### ***10.5.1. Required Documentation***

The minimum submittal of a traffic noise analysis will consist of the following:

- Traffic Noise Analysis Report
- A zip file (TNM.zip) containing the noise model files (objects.dat and objects.idx files in separate named folders for each model), as described in **Section 10.5.3**.
- Copy of approved traffic data (TPP memo) used for analysis. Include full traffic data memo as an attachment to the traffic noise analysis report; additional traffic documentation, such as model input calculations may be included with the TNM.zip.

If noise abatement measures are proposed in the traffic noise analysis report, documentation of the completed traffic noise workshops shall include the materials presented, comments from the public and associated responses, and the results of the voting for each proposed barrier. See **Section 11.8** for more information on noise workshop documentation requirements.

If noise abatement measures are proposed, but later dismissed after environmental clearance due to design changes or a constructability assessment, documentation must be included in the project file. See **Section 9.0** for more information on constructability assessment requirements.

#### ***10.5.2. Optional Documentation***

Additional documentation supporting the traffic noise analysis (optional or as needed) may consist of the following:

- Existing and proposed schematics for the project
- Existing and proposed typical sections for the project
- Spreadsheet(s) showing traffic calculations for model inputs
- .dxf files to display ROW or proposed improvements in model
- Index document with descriptions of the models (for complex projects with many models)
- Spreadsheet(s) identifying the reported receivers vs all modeled receivers
- Spreadsheet(s) showing barrier analysis results

- Results of research on adjacent development and building permits
- Constructability assessment documentation for barriers that are not feasible due to site constraints, if constructability assessment was completed before environmental clearance. Attach ENV's Constructability Assessment for Proposed Noise Barrier Form to the report.

### 10.5.3. Noise Model Files

Copies of all noise model files must be submitted in a .zip file. A ZIP file is a collection of one or more files and/or folders that is compressed into a single file for easy transfer and storage. Because FHWA's noise modeling software (TNM 2.5) uses a folder and two data files to define a model, it is standard practice to create a ZIP file to keep this structure intact. The preferred zip file contents are depicted and described below.



**TNM.zip** = A .zip file containing folders with model files.

- Each folder within the zip file contains the TNM-generated model data files (objects.dat and objects.idx). Do not rename the objects files. Individual model folders do not need to be zipped.
- Make folder names short but descriptive enough to identify the model(s). If the project area was split into many models, consider including an index document with additional identifying information.
- Optional backup documentation (see **Section 10.5.2**) may also be included in the .zip file



**Existing condition model(s)**



**Future condition model(s)**



**Contour model(s)**

- Contour points may be included in the future condition model on smaller projects



**Validation model(s)**



**Barrier analysis model(s)**

- Instead of separate model(s), tested barriers may be included in the future condition model. However, because ENV recommends that the barrier analysis models be more detailed and include all potentially benefited receptors; it may be easier to perform the barrier analysis in one or more separate model runs.
- Include "remembered" results for the barrier analysis. Clearly identify any proposed barriers.
- Suggest naming model based on impacted receiver name or R#

### 10.6. Environmental Assessment

Refer to ENV's Environmental Assessment (EA) Handbook in the online NEPA and Project Development Toolkit for instructions on how to document the results of the traffic noise analysis in an EA. In addition,

ENV's Standard Language for Documenting Traffic Noise Analyses, Example D, provides standardized language for use in the EA.

### ***10.7. Traffic Noise Analysis Review***

The project sponsor must submit the traffic noise analysis report, noise model files, and supporting documentation to the district environmental staff for review and approval.

District environmental staff will assign reviews to an ENV Noise SME if a traffic noise analysis report is prepared for an EIS project or if the traffic noise analysis indicates predicted traffic noise impacts. Even if the noise analysis does not identify predicted noise impacts, district environmental staff may, at their discretion, request ENV SME review of the noise analysis documentation.

## **11.0 Noise Workshops to Solicit Viewpoints on Proposed Noise Abatement**

A traffic noise workshop is held to solicit viewpoints of the property owners and residents associated with a proposed noise abatement measure. The term "noise workshop" can refer to both the process and an actual meeting.

The flowchart on the next page illustrates the noise workshop process, including required activities and decision points.

If noise abatement is determined to meet the acoustic criteria, is cost reasonable, and is constructible (see **Section 8.0**), TxDOT will solicit the viewpoints of all benefited receptors for a proposed abatement, as well as non-benefited receptors that border or are directly adjacent to a proposed abatement.

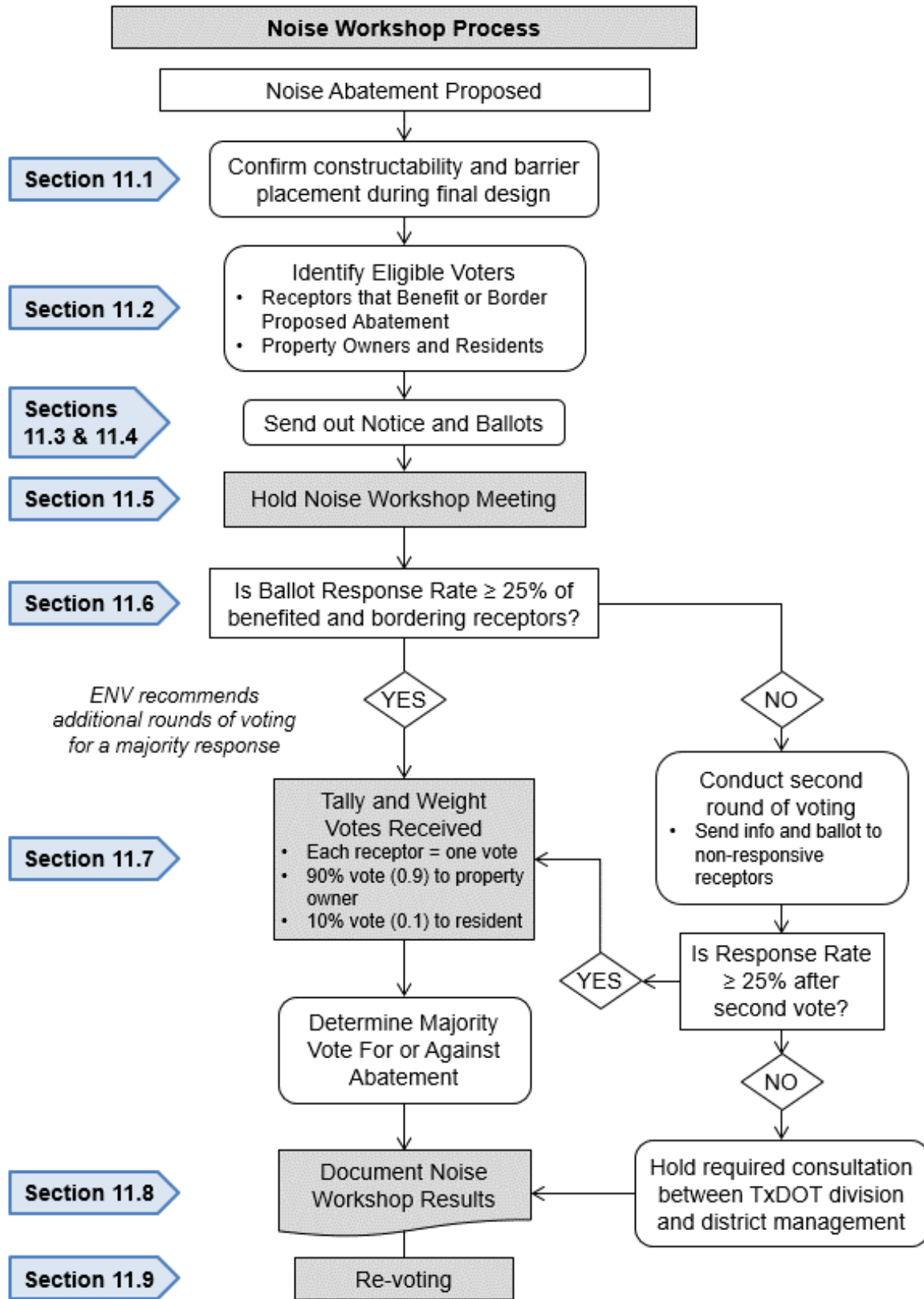
In order for an abatement measure to be incorporated into the construction plans, enough responses (votes) must be obtained to document a decision that benefited receptors and non-benefiting bordering receptors desire the proposed noise abatement measure. The decision, as described below, is based on a **majority of the total votes received**.

As part of the voting process and to ensure that adjacent receptors can make an informed decision, TxDOT will also conduct at least one noise workshop or meeting in which noise impacts and noise abatement are discussed.

Generally, residential receptors prefer traffic noise barriers, while non-residential receptors prefer to maintain visibility for their properties from adjacent roadways. However, TxDOT must not pre-determine whether a receptor wants or does not want a barrier without soliciting viewpoints of the affected receptors.



# TxDOT Traffic Noise Policy Implementation Guidance



## 11.1. Timing

ENV recommends that the noise workshop be held after the CE determination or after the public hearing for an EA or EIS project. However, informal coordination with property owners and residents may occur earlier.

For projects that might have a long timeline or multiple construction phases, waiting until closer to the construction let date before obtaining viewpoints would help avoid issues with changes in ownership of adjacent properties and issues with design refinements or design changes after the initial environmental decision.

A constructability assessment (see **Section 9.0**) must be completed by the design engineer to confirm the location and placement of the proposed abatement before proposed abatement measures are presented to benefited and bordering receptors at a noise workshop. This step ensures that what is presented to the eligible voters is representative of what will be constructed if the barrier is approved by the vote. It also ensures that barriers that are not feasible and reasonable to construct are not presented as part of a noise workshop.

Under no circumstances should a project be let for construction without completion of a constructability assessment, and if noise barrier(s) were determined constructable, without subsequent completion of a noise workshop.

## 11.2. Who can vote?

Votes are solicited from property owners and non-owner residents near the proposed noise abatement measure. Each affected property (receptor location) has one total vote.

Eligible voters must be associated with receptor locations that are either benefited receptors or receptors that border or are directly adjacent to a proposed abatement measure:

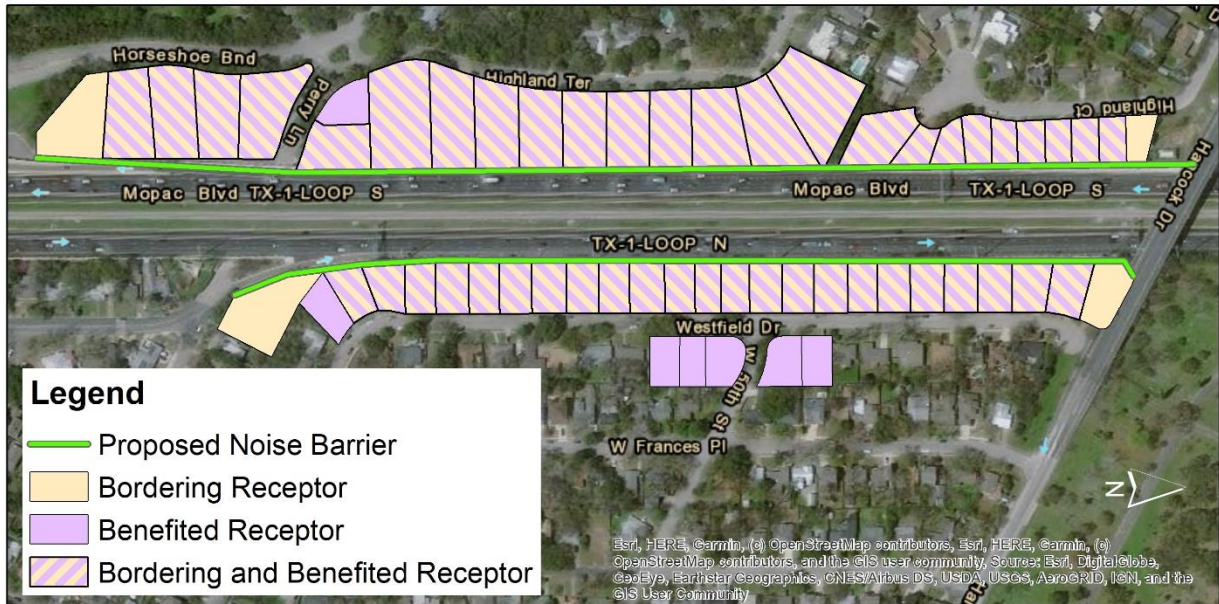
- Benefited receptors are identified through the barrier analysis process. Benefited receptors typically are the properties that are closest to the roadway (first-row properties). However, benefiteres may include second-row properties if the abatement measure would provide at least a 5 dB(A) predicted noise reduction for that location.
- Receptors that border or are directly adjacent to an abatement measure (where the property line touches TxDOT ROW adjacent to the noise abatement) also have a vote because they would be directly affected in a permanent way by the placement of a noise barrier adjacent to their property. Often, receptors located on the ends of barriers will not fully benefit from the proposed noise abatement.

For single-family residential land uses, eligible voters would include the property owner of the receptor location and any non-owner residents, such as renters. Ballots shall include a checkbox or other method for an eligible voter to indicate if they are the owner or a non-owner resident/renter. The weighting system for votes received from owners and residents/renters is explained in **Section 11.7**.

For multifamily residential land uses, such as apartments, eligible voters would include both the property owner and the benefited or bordering residents at the time of the noise workshop. Ballots shall include a checkbox or other method for an eligible voter to indicate if they are the owner or a non-owner resident/renter. The weighting system for votes received from owners and residents/renters is explained in **Section 11.7**.

# TxDOT Traffic Noise Policy Implementation Guidance

The figure below shows an example of eligible voters associated with a proposed noise barrier.



In some cases, the strip of land immediately adjacent to the TxDOT ROW near benefited receptors may be owned by a home owner’s association (HOA), utility company, or other entity. Though coordination during design and construction may need to occur with this property owner to maintain access, the decision to construct a barrier within TxDOT ROW would be based on the votes of the benefited receptors and non-benefited receptors that border a proposed abatement. Landscaped vacant land or utility corridors do not qualify as noise-sensitive land uses.

For non-residential noise sensitive land uses (NAC Categories C, D, and E), a vote is obtained from a person or entity with the legal authority to make decisions for the benefited or bordering property. The users of a non-residential property, like a park or cemetery, do not vote, though they can provide input if the property owner desires.

Comments, including viewpoints, may be submitted by non-eligible voters, but would not be weighted as part of the voting process.

### 11.3.Solicitation Materials and Ballots

Example templates to use to prepare a noise workshop invitation and ballot are available in ENV’s online Traffic Noise Toolkit.

As part of the solicitation, property owners and residents will receive information that:

- invites them to a noise workshop or meeting,
- describes the abatement (typically a noise barrier) under consideration and the anticipated traffic noise effects with and without the barrier,
- describes the process that TxDOT will follow to make a decision on whether to build the barrier, and
- includes a ballot to submit back to TxDOT

## ***TxDOT Traffic Noise Policy Implementation Guidance***

---

Because an eligible voter may not be able to attend the scheduled noise workshop meeting, the solicitation materials must provide enough information for the recipient to make an informed decision to vote for or against a proposed barrier (a “workshop in an envelope”). The notice and ballot must clearly indicate the due date for submittal of the ballot.

ENV’s Building Barriers to Traffic Noise Brochure is available in English and Spanish in ENV’s online Traffic Noise Toolkit. Printed copies may also be obtained upon request from ENV.

The typical solicitation packet consists of a notice (or letter), a ballot, a map of the proposed barrier location, a copy of the noise barrier brochure, and a pre-stamped/pre-addressed return envelope for the recipient to mail in the ballot.

Follow standard public involvement practices for the noise workshop, as appropriate. For example, provide the notice and ballot in both English and Spanish if other public involvement materials for the project were also translated into Spanish.

The notice or cover letter must include the following information:

- Project name
- Explanation of the purpose of the meeting
- Date, time, and location of the noise workshop meeting
- Background on the noise analysis process
- Specific information about the proposed abatement, including the height and placement of the barrier
- Process that TxDOT will use to make a decision to build or not build the barrier
- Explanation of the materials included with the notice or cover letter (ballot, brochure)
- Due date for submission of the ballot
- Contact person and deadline for requesting translation services or other special accommodations at the noise workshop meeting
- Contact person for any questions
- If noise workshop materials will be available online, such as on a project website after the meeting, mention the website in the notice.

Ballots may be a generic form for all properties bordering the proposed barrier or individually tailored to eligible properties.

A ballot must have the following:

- Project name
- Short instructions/explanation of the requested vote
- Approximate location and height of the proposed barrier
- Checkboxes to indicate vote for or against the proposed barrier
- Name and mailing address of the voter
- Address of the affected property

- Checkboxes to indicate if the voter is the property owner or a non-owner resident/renter
- Instructions for non-resident owners to please share the ballot and information with their residents or renters
- A comment box
- A signature line, with date
- A due date
- Name and point of contact at TxDOT
- Submittal address for the ballot

For non-residential or entity-owned properties, the ballot might also include a checkbox to indicate if the signature person has the legal authority to make decisions for the affected property.

Due dates for ballot submittal must be at least 10 days after the date of the noise workshop meeting. Indicate whether the due date deadline is a received by or a postmark date. Allow for mail processing times before starting to tally votes.

The ballot can also be used to solicit opinions on the aesthetic properties of a proposed barrier. If this is an option for the proposed barrier, include on the ballot checkboxes with example textures or treatments from which the voter can choose.

### ***11.4.Solicitation Mail-out(s)***

The most common method to provide the solicitation materials and ballot is by mail; however, door-hangers, scheduled individual meetings, or e-mail may also be effective in some cases.

For single-family homes and multifamily residences with discrete property owners and addresses (such as some townhomes and condominiums) send information and ballots to the property owner mailing address as identified in the tax records and if different, to the physical address of the property.

For multifamily residential properties, such as apartment complexes, send information and ballots to the property owner(s) as identified in the tax records. In the cover letter or on the ballot, request that the property owner share this information with affected tenants.

Ballots shall include a checkbox or other method for an eligible voter to clearly indicate if they are the owner or a resident. Because TxDOT cannot know with certainty whether a benefited or bordering residential property is owner-occupied or rented, we must rely on the property owner (as identified in the tax records) to help by sharing the noise workshop information to their residents/renters. The notice, cover letter, or ballot shall include instructions requesting that the property owner share the information and ballot with their residents. A property owner's failure to share the information and ballot with their residents does not invalidate the vote.

For non-residential properties, information and ballots must be sent to the property owner as identified in the tax records and worded to request that the information and ballot be provided to whoever has the legal authority to make decisions for the property. For publicly-owned properties, such as parks, libraries, or other recreation areas, this may be the mayor or city manager. For privately-owned properties, such as day care centers, medical facilities, or cemeteries, this may be a single owner, board of directors, or property management company.

If solicitation materials will be mailed, send at least two weeks in advance of the meeting. If a longer lead time is planned, reminder postcards or emails (if available) could be sent one week before the meeting.

In order to show due diligence, ENV recommends using a trackable method of mailing at one or more points during the noise workshop process if it appears that voter participation is low. Certified mail through the U.S. Postal Service is a good method, because it includes tracking and a signature. However, be aware that if a recipient is not home at the time of delivery, they usually must go to the post office to sign for the packet, which could be inconvenient and lead to non-responsiveness.

When possible, use prior public engagement experiences on the project to guide the planning for the noise workshop and the mail-out process.

If the district desires, copies of solicitation materials may also be sent to applicable local public officials. The materials must include a cover letter explaining the noise barrier proposal and noise workshop process. If a copy of the ballot is included, the ballot must be watermarked or clearly labeled as "Example," because local officials are not eligible to vote on the abatement proposal.

### ***11.5.Noise Workshop Meeting***

A noise workshop meeting must be held at a location close to the project area, preferably near the proposed abatement measure, in a location that is easy for people to find and access. If multiple abatement measures are proposed along a corridor, a single noise workshop meeting may be held for multiple barriers at a central location.

For single-owner, non-residential receptors, individual noise workshop meetings with the owner or owner's representative may be scheduled at their convenience and/or desire.

ENV recommends that the noise workshop be run similarly to a typical TxDOT project public meeting. Noise workshops tend to be smaller, more intimate meetings, with groups of people who are neighbors and presumably know one another. ENV recommends the following:

- Be friendly and polite
- Have signs directing people to the workshop location and the sign-in table
- Have displays and a presentation
- Have extra copies of the ballot and a ballot box for voters to submit their ballots
- Be prepared to answer questions about both the proposed abatement and the project
- Provide translation services if requested, or have bilingual staff available

The noise workshop meeting must describe the abatement measure (typically a noise barrier) under consideration, the predicted traffic noise effects with and without the barrier, and describe the process that TxDOT will follow to make a decision on whether to build the barrier.

Displays or exhibits could include:

- Copy of the project schematic showing the proposed noise barrier location in relation to the project improvements
- Detail design information for the barrier, such as a typical section or schematic drawing of the wall
- A graphic rendering showing the proposed noise barrier in place. Be sure to indicate what both sides of the noise barrier would look like.

- Proposed aesthetic treatment or treatment options, if the attendees can vote on a preference
- A display showing the real-life proposed height of the wall. This could be a rod or tape measure placed vertically, a piece of tape at the appropriate height on a nearby wall, or a roll plot showing the height.

### ***11.6. Low Response Rate***

If property owners or residents from fewer than 25% of eligible receptors submit a ballot by the requested deadline, then a second round of voting is required. However, ENV strongly recommends additional rounds of voting to achieve a response from a majority of the receptors.

A second round of voting must, at a minimum, consist of an additional mail-out with a letter and ballot to the eligible voters who did not submit a ballot by the requested deadline. A second noise workshop meeting is not required.

For the second round of voting, consider additional outreach, such as door hangers or knocking on doors, in addition to the mail-out to non-responsive eligible voters.

For example, one district sent postcards to the receptors who had already voted. The postcard thanked them for their vote, provided an update on the project, and requested that they encourage their neighbors to submit their ballots.

If certified mail was used on the first mailout, consider using regular first class mail for the second, or vice-versa.

Eligible voters who submitted a ballot during the first round of voting do not need to vote again to have their votes counted.

### ***11.7. Counting Votes***

TxDOT will distribute polling ballots to all benefited receptors and non-benefited receptors that border or are directly adjacent to a proposed abatement. TxDOT will make a decision on whether to build the barrier based on the ballots returned by the property owners and non-owner residents associated with these receptors. Only ballots received by the specified due date are counted.

Each discrete receptor property receives one vote.

For residential properties, one vote is allocated per residential receptor; however, a weighting system is applied:

- For owner-occupied dwelling units, the property owner's response counts as the one vote. If multiple ballots are received from multiple owners of the same unit (e.g. a husband and wife each submit a ballot), they are collectively counted as one vote.
- For non-owner-occupied dwelling units, a response from the resident/renter counts as 10% of the vote (weighted as 0.1 vote) and a response from the owner counts as 90% of the unit's vote (weighted as 0.9 vote).

<p><b>IMPORTANT NOTE:</b> Ballots for nonresponsive eligible voters are never counted as a vote either for or against a proposed abatement measure.</p>
---

## TxDOT Traffic Noise Policy Implementation Guidance

**Table 4** shows an example of how votes would be weighted and tallied for a barrier proposed for seven eligible residential properties. Note that the response rate percentage is based on the individual receptors that respond, regardless of whether ballots come from an owner, a resident, or a resident-owner. The weighting and vote tally is calculated after the response rate requirement is met.

**Table 4. Example Noise Workshop Voting Tally**

Location of Benefited or Adjacent Receptor	Ballots Received?	Total Ballot Weight	Ballot Weighted Yes		Ballot Weighted No	
			Owner (90%)	Resident (10%)	Owner (90%)	Resident (10%)
1010 Sunny Ln	Yes – resident owner	1.0	0.9	-	-	0.1
1012 Sunny Ln	No response	-	-	-	-	-
1014 Sunny Ln	Yes – owner only	0.9	0.9	-	-	-
1016 Sunny Ln	Yes – resident owner	1.0	1.0		-	-
1018 Sunny Ln	Yes – resident only	0.1	-	-	-	0.1
1020 Sunny Ln	Yes – owner only	0.9	-	-	0.9	-
1022 Sunny Ln	Yes – resident owner	1.0	1.0		-	-
6 properties responded out of 7 possible 86% response rate			3.8 weighted vote YES		1.1 weighted vote NO	
			$3.8/4.9 = 78\%$ YES		$1.1/4.9 = 22\%$ NO	
Received ballot weighted total = 4.9 votes			<b>Based on ballots received, barrier would be constructed</b>			

TxDOT will consider a noise barrier within TxDOT ROW reasonable for incorporation into construction plans if **a majority of the total votes received** from benefited or bordering receptors indicate that they want the barrier constructed, unless votes are received from less than 25% of the eligible receptors.

If less than 25% of the benefited and bordering receptors cast a ballot after two rounds of voting, TxDOT may decide whether or not to construct noise abatement after a required consultation between TxDOT division and TxDOT district director level management. The consultation will consider whether there are language barriers, high levels of tenants, or seasonal variability that might be affecting ballot response. TxDOT will document the reason for the decision.

If substantive comments or questions are included on a submitted ballot, a reasonable attempt must be made to contact that person and address their concern(s). Be sure to include the comments and responses to comments in the documentation of the noise workshop.



## **11.8. Documentation of Noise Workshop**

After completion of the noise workshop(s) and voting, the project sponsor prepares documentation of the noise workshop according to ENV's Template: Documentation of Noise Workshop Cover Page, available in the online Traffic Noise Toolkit. The Documentation of Noise Workshop summarizes the voting results and compiles the supporting noise workshop materials into a package for submittal to district environmental staff.

Multiple noise workshop meetings held for a project may be consolidated in a single documentation package or documented in individual summary documents.

## **11.9. Notification of Workshop Results**

After completion of the noise workshop voting and submittal of noise workshop documentation, district environmental staff must notify eligible voters by letter of the workshop results.

All reasonable and feasible noise abatement measures approved through the noise workshop voting process MUST be added to the construction plans (PS&E) before project letting.

## **11.10. Re-voting**

After a decision has been made to build or not build an abatement measure, TxDOT will only consider re-voting under the following conditions:

- An error was found in the original noise workshop voting process that materially draws into question the overall result,
- There are substantial constructability or substantial design changes to a noise abatement proposal since the original noise workshop, or
- An approved barrier has not been constructed within five years of a noise workshop, due to project delays.

Any decision to re-vote would require consultation between TxDOT division subject matter experts and TxDOT division and district director level management.

## **12.0 Additional Topics**

### **12.1. Information to Local Officials**

To minimize future traffic noise impacts on currently undeveloped lands adjacent to Type I projects and per TxDOT's Traffic Noise Policy, TxDOT must inform local officials within whose jurisdiction the roadway project is located of:

- (1) Noise compatible planning concepts.
- (2) The best estimation of the future design year noise levels at various distances from the edge of the nearest travel lane of the roadway improvement where the future noise levels "approach" the NAC (66 and 71 dB(A)) for undeveloped lands or properties within the project limits. The traffic noise analysis provides decision-makers with an important element of the overall environmental data needed for an informed selection of a project alternative and for the development of compatible land use plans.

(3) Notification that TxDOT does not have a Type II (retrofit) program.

(4) Date of Public Knowledge - The date of the environmental decision establishes the "date of public knowledge" and determines the date when TxDOT is no longer responsible for providing roadway traffic noise abatement for new development which occurs adjacent to the proposed roadway project.

Note that this is not required if the project corridor is fully developed and noise impact contours were not determined.

At a minimum, a notification of the availability of this information is typically sent to the mayor's office in incorporated areas and to the county judge's office in unincorporated areas. However, there is nothing that precludes additional notification to other local officials or agencies.

For all projects, send a letter to local officials after environmental clearance. A letter template is included in the online Traffic Noise Toolkit (Template: Letter related to noise contours for land use planning). ENV recommends including a copy of the noise contour results or a link to the document online, if available.

Letters must not be sent out until after the environmental decision for the project, as the "date of public knowledge" cannot precede the date of approval of the CE, FONSI, or ROD.

Letters must be sent no later than 30 days after the date of the environmental decision for the project.

## ***12.2. Project Reevaluation***

A reevaluation of a project does not trigger a new or revised noise analysis unless there is a change to the design that is considered a Type I project (i.e. a new lane would be striped or the alignment would be shifted substantially closer to receptors when compared to the design described in the previously approved environmental documentation). It is only necessary to analyze the areas when Type I changes have been made in a reevaluation. Existing model validation for reevaluations is not required.

In areas where Type I changes have been made, prepare a new traffic noise analysis, following the normal process as explained in this guidance. Prepare a new traffic noise analysis report for the reevaluation that includes a short explanation of the design changes and their effect on noise impact determinations and potential noise abatement.

If any new development (e.g. new residential development) has occurred within the area where Type I changes have occurred, then new receivers must be analyzed.

Note that a new noise analysis is not required for new development that occurred after the original environmental decision unless the development is adjacent to that part of the project for which a Type I change has been made. In other words, new development alone is not a Type I reevaluation trigger.

## ***12.3. Noise Abatement Inventory Reporting***

TxDOT is required to compile and submit to FHWA an inventory of constructed abatement measures every three years, as described in 23 CFR 772.13(f) and per TxDOT's Traffic Noise Policy.

TxDOT shall maintain an inventory of all constructed noise abatement measures. The inventory shall include the following parameters: type of abatement; cost (overall cost, unit cost per/sq. ft.); average height; length; area; location (State, county, city, route); year of construction; average insertion loss/noise reduction as reported by the model in the noise analysis; NAC category(s) protected; material(s) used (precast concrete, berm, block, cast in place concrete, brick, metal, wood, fiberglass, combination, plastic (transparent, opaque, other)); features (absorptive, reflective, surface texture); foundation (ground mounted, on structure); project type (Type I, Type II, and optional project types such as State funded,

county funded, tollway/turnpike funded, other, unknown). The FHWA will collect this information on a triennial basis.

### ***12.4. Special Considerations for Phased Projects***

Some transportation improvement projects may be implemented over time in phases and/or in segments along a larger corridor. Phased projects often have a schematic identifying an interim phase leading to a larger, ultimate project. An example is a new location, controlled-access facility, in which the outer frontage roads will be constructed in the near term, while the main lanes would be built at some point in the future. Segmented projects may have start and end points defined on the schematic, but timing and design transitions between the project segments may not be known at the time of environmental clearance. Often, the environmental decision will be made for the ultimate condition, using the best available information. However, the decision to perform a noise analysis for an interim phase requires careful consideration of anticipated project timing, as well as additional planning factors (such as funding availability, effects on noise-sensitive communities, and effects of adjacent projects). Consult with ENV to discuss methods and considerations for projects that may involve phasing.

### ***12.5. Noise Wall Removal Policy***

As a general rule, TxDOT does not remove noise walls unless required due to a conflict with TxDOT projects. This noise wall removal policy applies to noise walls, either constructed or under construction using state or federal funds. This policy was approved by FHWA on September 13, 2021.

#### ***12.5.1. Request for Wall Removal***

In the event that a noise wall is no longer wanted (for any reason), local governments, organizations, or individuals may request TxDOT's approval to completely or partially remove a noise wall. The request must be in writing and must be submitted to the TxDOT District Engineer. The request must be supported with documentation demonstrating 100% of the current property owners have agreed to the removal. Responses must be obtained from all the properties that border or benefit from the noise wall, as determined in the original Type I noise analysis. TxDOT will not assist with or bear any costs associated with obtaining this documentation. The request must also include an offer to reimburse TxDOT for TxDOT's costs in originally constructing the noise wall (adjusted for inflation). TxDOT may agree to waive all or part of such reimbursement.

Upon receipt of a written request meeting the above-stated requirements, TxDOT, in its sole discretion, will approve or refuse the request. If TxDOT approves the request, the local government, organization, or individual will be responsible for removal of the noise wall and restoration of the area previously occupied by the noise wall to a condition that is acceptable to TxDOT.

#### ***12.5.2. Cost and Demolition***

Reimbursement to TxDOT for costs to construct the noise wall (adjusted for inflation) is required, unless TxDOT agrees to waive all or part of those costs. If federal aid dollars were used for the noise wall's original construction, TxDOT is obligated to reuse the reimbursement elsewhere on federal aid projects.

TxDOT will not bear any costs or other liability associated with complete or partial removal of a noise wall or restoration of the area previously occupied by the noise wall.

Prior to beginning any demolition or other activities on TxDOT property, the local government, organization, or individual must obtain TxDOT's written approval of its plans for partial or complete removal of the noise wall and restoration of the area previously occupied by the noise wall.

To reduce liability and at TxDOT's discretion, TxDOT may instead collect removal and restoration costs from the local government, organization, or individual for TxDOT to perform the removal.

### ***12.5.3. Future Considerations for Noise Abatement***

If a noise wall is removed, in part or entirely, TxDOT will not reconstruct the noise wall unless a new Type I project proposes a new wall that meets all of the requirements in TxDOT's Traffic Noise Policy and Implementation Guidance.

## 13.0 Glossary

*Note: Terms in SMALL CAPS are defined elsewhere in the glossary.*

**23 CFR 772** – Title 23, Code of Federal Regulations, Part 772 “Procedures for Abatement of Roadway Traffic Noise and Construction Noise”: FHWA regulations for roadway traffic noise analysis and ABATEMENT during the planning and design of federally aided roadway projects

**Abatement** – Any positive action taken to reduce ROADWAY traffic noise levels for impacted RECEPTORS.

**Abatement Measure** – Typically a NOISE BARRIER in the form of a noise wall. Other noise abatement measures that can be considered are:

- Traffic management
- Alteration of horizontal and vertical alignment
- Acquisition of real property to serve as a buffer zone
- Insulation of NAC Category D structures
- Berms

**Absolute Criterion** – One of two criteria (see RELATIVE CRITERION) used to determine when a noise impact occurs. Under this criterion, a noise impact occurs when the PREDICTED NOISE LEVEL APPROACHES, equals, or exceeds the FHWA NOISE ABATEMENT CRITERIA.

**Activity Category** – Categories of land use adjacent to a ROADWAY project. See NOISE ABATEMENT CRITERIA table.

**Approach** – The approach level to determine a traffic noise impact is one (1) dB(A) below the FHWA NOISE ABATEMENT CRITERIA for Activity Categories A to E (see ABSOLUTE CRITERION).

**Attenuation** – Reduction or lowering the level or sound of noise.

**Alternate Barrier Cost** – An alternative method to determine cost reasonableness that includes the costs of any additional ROW, of utility adjustments directly associated with construction of a NOISE BARRIER, and for additional design elements necessary to accommodate unusual topographic or drainage features directly associated with construction of a NOISE BARRIER (see STANDARD BARRIER COST).

**Automobiles** – Vehicles with two axles and four wheels designed primarily for transporting passengers and or cargo (includes light trucks). Generally, the gross weight is less than 10,000 pounds.

**Average Daily Traffic (ADT)** – The average 24-hour traffic count (vehicles per day). Typically, the total amount of traffic during a stated period (normally one year) divided by the number of days in that period. The ADT is only used as the basis for determining the DESIGN HOURLY VOLUME (DHV). The DHV is used to model a “worst case” scenario in DESIGN YEAR traffic noise levels.

**A-Weighting dB(A)** – An adjustment in SOUND meters and traffic noise modeling software to ensure SOUND levels are measured/calculated in a manner that approximates the SOUNDS that can be heard by the human ear. This is accomplished by suppressing the low and very high frequencies that cannot be heard by the human ear.

**Benefit or Benefited Receiver/Receptor** – The recipient of an ABATEMENT MEASURE that receives a noise reduction at or above the minimum threshold of 5 dB(A), regardless of whether the RECEPTOR was IMPACTED.

# ***TxDOT Traffic Noise Policy Implementation Guidance***

---

The total number of benefited receptors is used to evaluate the cost reasonableness of an ABATEMENT MEASURE (see REASONABLE).

**Categorical Exclusion (CE)** – Documentation prepared for a project that involves actions that would result in no SIGNIFICANT environmental impacts. Specifically, these actions would not induce significant impacts to planned growth or land use for the area; would not require the relocation of significant numbers of people; would not have a significant impact on any natural, cultural, recreational, or historic resource; would not involve significant air, **noise** or water quality impacts; would not have significant impacts on traffic patterns; or would not otherwise, either individually or cumulatively, have any significant environmental impact.

**Common Noise Environment** – A group of RECEPTORS within the same FHWA NOISE ABATEMENT CRITERIA (NAC) activity that are exposed to similar noise sources and levels; traffic volumes, traffic mix, and speed; and topographic features. Generally, common noise environments occur between two secondary noise sources, such as interchanges, intersections, and cross-roads.

**Contour (noise)** – The location of a specific noise level relative to the source.

**Date of Public Knowledge** – The date of approval of the CATEGORICAL EXCLUSION (CE), the issuance of the FINDING OF NO SIGNIFICANT IMPACT (FONSI), or the RECORD OF DECISION (ROD) for a Type I roadway project - when FHWA and TxDOT are no longer responsible for providing noise ABATEMENT for new development adjacent to a proposed ROADWAY project.

**Decibel (dB)** – The basic unit for measuring SOUND pressure levels

**Design Hourly Volume (DHV)** – The traffic count (vehicles per hour) determined by applying the K-FACTOR to the AVERAGE DAILY TRAFFIC. The DHV is used to model a “worst case” scenario in DESIGN YEAR noise levels. DHV is the 30th highest hourly volume for the DESIGN YEAR.

**Design Year** – The future year used to estimate the probable traffic volume for which a roadway is designed. Normally 20 years from the current (existing) year, but may also be the design year of the regional transportation plan used.

**Diffraction** – The bending of sound waves around an obstacle (over or around a noise barrier), which results in a corresponding “attenuation” of the sound level.

**Environmental Assessment (EA)** – A document prepared for a project when the significance of environmental impacts is not clearly exhibited. The assessment may result in a FINDING OF NO SIGNIFICANT IMPACT or may be elevated to an ENVIRONMENTAL IMPACT STATEMENT.

**Environmental Impact Statement (EIS)** – A document prepared for a project when SIGNIFICANT impacts are evident or identified in an Environmental Assessment.

**Existing Noise Levels** – The worst noise hour resulting from the combination of natural and mechanical sources and human activity usually present in a particular area.

**Feasible** – The combination of acoustical and engineering factors considered in the evaluation of a noise ABATEMENT MEASURE. See **Section 8.2** of this Guidance and 23 CFR 772.13(d)(1).

**Finding of No Significant Impact (FONSI)** – Finding of No Significant Impact is one potential outcome from performing an Environmental Assessment. The other outcome is to perform an EIS.

**First-row Receiver** – A modeled representative location of a noise-sensitive land use that is directly adjacent to or closest to a roadway and that is not separated from the roadway by other land uses.

# ***TxDOT Traffic Noise Policy Implementation Guidance***

---

**Heavy Trucks** – Vehicles with three or more axles. Generally, the gross weight is greater than 26,520 pounds.

**Impact** – The DESIGN YEAR condition noise levels that APPROACH, equal, or exceed the NAC listed in 23 CFR 772 Table 1 for the future build condition or DESIGN YEAR build condition noise levels that create a SUBSTANTIAL NOISE INCREASE OVER EXISTING NOISE LEVELS.

**Insertion Loss** – The actual benefit (noise level reduction) derived from the construction of a NOISE BARRIER.

**K-factor** – A number applied to the AVERAGE DAILY TRAFFIC to determine the DESIGN HOURLY VOLUME. The K-factor is normally 0.10 (plus or minus one percent).

**Leq (Equivalent Noise Level)** – The equivalent steady-state SOUND level that, in a given time period, contains the same acoustic energy as a time-varying SOUND level during the same period. Leq is used for all traffic noise analyses for TxDOT ROADWAY projects.

**Loudness** – The subjective/perceived assessment of the intensity of sound.

**Mitigation** – The alternative to the preferred term ABATEMENT.

**Multifamily residential** – A type of residential structure containing more than one RESIDENCE, such as apartments, duplexes, townhomes, or condominiums. Each RESIDENCE in a multifamily dwelling shall be counted as an individual RECEIVER when determining IMPACTED and BENEFITED RECEIVERS.

**Noise Abatement Criteria (NAC)** – These are absolute SOUND levels, provided by FHWA (see **Table 1: Noise Abatement Criteria**), and used to determine when a noise IMPACT occurs (see ABSOLUTE CRITERION). The NAC categories are not used as a design goal for a noise ABATEMENT MEASURE.

**Noise Barrier** – A physical obstruction, constructed between the roadway noise source and noise-sensitive RECEPTOR(s) that lowers the noise level. Noise barriers include stand-alone noise walls, noise berms (earth or other material), and combination berm/wall systems. The construction of a noise barrier is one of the ABATEMENT MEASURES that must be considered when a traffic noise analysis indicates that a ROADWAY project would result in a noise IMPACT.

**Noise Reduction Design Goal** – The desired noise reduction determined by calculating the difference between future build noise levels at a RECEIVER with ABATEMENT, compared to future noise levels at that same RECEIVER without noise ABATEMENT. The TxDOT noise reduction design goal is 7 dB(A) and is used to evaluate REASONABLENESS of an ABATEMENT MEASURE.

**Noise Sensitive Area (NSA)** – One or more receptors that have frequent human activity and might be impacted by roadway traffic noise. NSAs are listed in FHWA's Noise Abatement Criteria table.

**Noise Workshop** – A formal or informal meeting for PROPERTY OWNERS and residents who are adjacent to or would BENEFIT from a proposed noise ABATEMENT MEASURE. The purpose of a workshop is to provide information and to solicit viewpoints regarding the proposed ABATEMENT MEASURE. Typically, the proposed ABATEMENT MEASURE is a NOISE BARRIER.

**Permitted** – A definite commitment to develop land with an approved specific design of land use activities, as evidenced by the issuance of a building permit.

**Predicted Noise Level** – The level of traffic noise modeled at a RECEIVER in the DESIGN YEAR of a proposed ROADWAY project.

**Property Owner** – An individual or group of individuals that holds a title, deed, or other legal documentation of ownership of a property or a RESIDENCE.

# ***TxDOT Traffic Noise Policy Implementation Guidance***

---

**Reasonable** – The combination of social, economic, and environmental factors considered in the evaluation of a noise ABATEMENT MEASURE. See **Section 8.3** of this Guidance and 23 CFR 772.13(d)(2).

**Receiver**– A modeled representative location of one or more noise-sensitive area(s) for any of the land uses as described in FHWA’s NOISE ABATEMENT CRITERIA (NAC). A receiver may represent multiple receptors. See also FIRST-ROW RECEIVER.

**Receptor** - A discrete or representative location of a noise-sensitive area listed in FHWA’s NOISE ABATEMENT CRITERIA (NAC).

**Record of Decision** – A record of decision (ROD) issued by TxDOT or FHWA signals formal approval of an ENVIRONMENTAL IMPACT STATEMENT (EIS) concerning a proposed roadway project. The ROD identifies the selected alternative.

**Relative Criterion** – One of two criteria (see ABSOLUTE CRITERION) used to determine when a noise IMPACT occurs. Under this criterion, a noise IMPACT occurs when the PREDICTED NOISE LEVEL “substantially exceeds” (more than 10 dB(A)) the existing level even if it does not APPROACH, equal, or exceed the FHWA NOISE ABATEMENT CRITERIA.

**Residence** – A dwelling unit; either a single-family residence or each dwelling unit in a MULTIFAMILY RESIDENTIAL dwelling.

**Roadway** – A general term denoting a public way for purposes of vehicular travel, including the entire area within the right of way.

**Significant** – Do not use this term in a traffic noise analysis in order to avoid any conflict or confusion with a FINDING OF NO SIGNIFICANT IMPACT for ENVIRONMENTAL ASSESSMENTS.

**Sound** – Mechanical energy produced by the movement of waves of compressed air radiating spherically from a source that can be sensed by the human ear.

**Sound Absorptive Treatment** – Material or treatment applied to a reflective NOISE BARRIER to reduce acoustic reflections.

**Sound Meter** – A device used to measure existing (actual) sound levels. Also referred to as a sound level dosimeter or analyzer. Sound meters used for TxDOT traffic noise measurements must be ANSI Type II or better.

**Soundwall or Sound Wall**– Alternative to the preferred term “noise barrier.”

**Standard Barrier Cost** – A method to determine cost reasonableness using the indexed wall-only cost criterion approved by FHWA. The standard barrier cost does not include the costs of any additional ROW or utility adjustments directly associated with construction of a noise barrier or costs for additional design elements necessary to accommodate unusual topographic or drainage features directly associated with construction of a noise barrier (see ALTERNATE BARRIER COST)

**Statement of Likelihood** – Statement provided in the environmental decision document based on the feasibility and reasonableness analysis completed at the time the environmental document is being approved. The statement of likelihood shall include the preliminary location and physical description of noise ABATEMENT MEASURES determined FEASIBLE and REASONABLE in the preliminary analysis. The statement of likelihood shall also indicate that final recommendations on the construction of ABATEMENT MEASURE(S) would be determined during the completion of the project’s final design and the public involvement processes.

**Substantial Horizontal Alteration** – see TYPE I definition.



# ***TxDOT Traffic Noise Policy Implementation Guidance***

---

**Substantial Noise Increase** – When the PREDICTED NOISE LEVEL exceeds the existing level by more than 10 dB(A) (see RELATIVE CRITERION).

**Substantial Noise Reduction** – A reduction in noise levels of at least 7 dB(A) at impacted RECEIVERS. This reduction is independent of the NAC impact threshold. The goal is to achieve a substantial noise reduction at all first row RECEIVERS. At least one first row RECEIVER must achieve a substantial noise reduction to be REASONABLE. Also known as the Noise Reduction Design Goal

**Substantial Vertical Alteration** – see TYPE I definition.

**Third Party Funding** – Funding by non-TxDOT or private entities is not allowed on federal or federal aid Type I projects if the noise ABATEMENT MEASURE would require the additional funding from the third party to be considered FEASIBLE and/or REASONABLE. Third party funding is acceptable on federal or federal aid Type I projects to make functional enhancements, such as SOUND ABSORPTIVE TREATMENT and access doors, or aesthetic enhancements to a noise ABATEMENT MEASURE already determined REASONABLE and FEASIBLE.

**Through-Traffic Lane(s)** – Includes the addition of a general-purpose lane, toll lane, managed lane, High Occupancy Vehicle (HOV) lane, High Occupancy Toll (HOT) lane, bus lane, or truck climbing lane; or the addition of an auxiliary lane except for when the auxiliary lane is a turn lane, addition or relocation of interchange lanes or ramps added to a quadrant to complete an existing partial interchange. Restriping existing pavement for the purpose of adding a through-traffic lane or an auxiliary lane and the addition of a new or substantial alteration of a weigh station, rest stop, ride-share lot, or toll plaza, also constitute a through-traffic lane.

**Traffic Noise Model (TNM)** – FHWA's required traffic noise modeling software.

**Type I Project** – a proposed ROADWAY project for:

1. The construction of a roadway on a new location
2. The physical alteration of an existing roadway where there is either:
  - Substantial Horizontal Alteration – a project that halves the distance between the traffic noise source and the closest RECEPTOR between the existing condition to the future build condition; or,
  - Substantial Vertical Alteration – a project that removes shielding therefore, exposing the line-of-sight between the RECEIVER and the traffic noise source. This is done by either altering the vertical alignment of the roadway or by altering the topography between the roadway traffic noise source and the RECEPTOR; or,
3. The addition of a THROUGH-TRAFFIC LANE(s). This includes the addition of a THROUGH-TRAFFIC LANE that functions as a HOV lane, HOT lane, bus lane, or truck climbing lane, or;
4. The addition of an auxiliary lane, except for when the auxiliary lane is a turn lane, or;
5. The addition or relocation of interchange lanes or ramps added to a quadrant to complete an existing partial interchange, or;
6. Restriping existing pavement for the purpose of adding a THROUGH-TRAFFIC LANE or an auxiliary lane, or;
7. The addition of a new or substantial alteration of a weigh station, rest stop, ride-share lot or toll plaza; or,

If a project is determined to be a Type I project under this definition then the entire project area as defined in the environmental document is a Type I project.

## ***TxDOT Traffic Noise Policy Implementation Guidance***

---

**Type II Project** – A Federal or Federal-aid roadway project for noise abatement on an existing roadway. For a Type II project to be eligible for Federal-aid funding, TxDOT must develop and implement a Type II program in accordance with section 772.7(e). The development and implementation of Type II projects are not mandatory requirements of Federal law or regulation. TxDOT does not participate in a Type II (retrofit) program.

**Type III Project** – A Federal or Federal-aid roadway project that does not meet the classifications of a Type I or Type II project. Type III projects do not require a noise analysis.

## **14.0 Abbreviations and Acronyms**

ADT	Average Daily Traffic
CE	Categorical Exclusion
CFR	Code of Federal Regulations
dB	Decibel
dB(A)	Decibel (A-weighted)
DHV	Design Hourly Volume
EA	Environmental Assessment
EIS	Environmental Impact Statement
ENV	Environmental Affairs Division of TxDOT
FHWA	Federal Highway Administration
FONSI	Finding of No Significant Impact
HOT	High Occupancy Toll
HOV	High Occupancy Vehicle
Leq	Equivalent Noise Level
NAC	Noise Abatement Criteria
NEPA	National Environmental Policy Act
ROD	Record of Decision
ROW	Right of Way
TNM	Traffic Noise Model
TPP	Transportation Planning and Programming Division of TxDOT
TxDOT	Texas Department of Transportation
USC	United States Code

## Appendix A – Fundamentals of Sound and Traffic Noise

### Sound

Sound can be defined as mechanical energy produced by the movement of waves of compressed air radiating spherically from a source that can be sensed by the human ear. Or, simply stated, sound is what we hear. Although sounds are perceived differently from one person to another, they can be precisely measured.

#### **Decibel**

Sound spans a large dynamic range, and any associated calculations in units of pressure involve cumbersome astronomical numbers. Therefore, in order to simplify the process, the strength of sound is commonly measured on a relative scale of sound pressure levels expressed in decibels or “dB.”

Because the decibel is a simple representation of a much larger value, it is considered as a logarithmic (based on powers of 10) rather than a linear function. Consequently, sound levels cannot be added by ordinary arithmetic means. Representative examples of decibel addition are shown in **Table A-1**.

According to this table, doubling a noise source (i.e., doubling traffic) produces only a 3 dB increase in the overall sound pressure level.

**Table A-1. Decibel Addition**

Difference Between Two Sources	For Example	Add to the Higher Level	Resultant Sound Level*
0 dB	60 and 60 dB	3 dB	63 dB
1 dB	60 and 61 dB		64 dB
2 dB	60 and 62 dB	2 dB	64 dB
3 dB	60 and 63 dB		65 dB
4-9 dB	60 and 65 dB	1 dB	66 dB
10 dB or more	60 and 70 dB	0 dB	70 dB

Note: This table only represents approximations of the logarithmic function of decibel addition.  
 \* Accurate within 1 dB

#### **A-weighted Levels**

Sound is composed of a wide range of frequencies measured in Hertz (Hz). Adult humans respond to sounds ranging from 20-20,000 Hz or, roughly, from the lowest note of a pipe organ to the highest note of a violin.

Traffic sounds normally range from 100-4,000 Hz. Because the human ear does not hear all frequencies, an adjustment is made to the high and low frequency to approximate the average human

response to traffic sounds. These adjusted sound levels are referred to as “A-weighted levels” and expressed as “dB(A).”

### ***Equivalent Sound Level (Leq)***

Roadway traffic sounds are never constant. Sound levels vary in frequency and their intensity fluctuates over time. Therefore, an equivalent sound level, expressed as “Leq”, is used to represent a single number to describe varying traffic sound levels averaged over time.

More specifically, Leq is the equivalent steady-state sound level that, in a given time period, contains the same acoustic energy as a time-varying sound level during the same period. Leq is used for all traffic noise analyses of TxDOT roadway projects.

### ***Sources***

The primary sources of roadway traffic sounds are the tires, engine and exhaust of the various types of vehicles present.

The level of traffic sounds generally depends on the overall number, type and speed of the vehicles (especially trucks), pavement type, and the distance between the source (traffic) and the receptor (human). Any condition (such as a steep incline) that causes heavy laboring of a vehicle’s engine would also affect the overall level of traffic sounds.

There are additional, more complicated factors that affect the level of traffic sounds, including elevated or depressed roadways/terrain and surface absorption.

Some of the more common factors that influence the level of traffic sounds at a receptor are outlined in **Table A-2**. These cause-and-effect relationships can be used throughout the traffic noise analysis to double-check preliminary and final calculations; however, they are not to be used in the place of actual sound level measurements and/or modeling.

# TxDOT Traffic Noise Policy Implementation Guidance

**Table A-2. Cause-and-Effect Relationships dB(A)**

Change*	Increase**	Decrease**
Traffic count doubled	3	
Speed limit lowered by 5 mph		1
Depressed roadway		3-5
Elevated roadway		3-5***
Distance doubled over pavement		3
Distance doubled over grass		4
<b>Effects are Cumulative</b>		
For example: Speed limit lowered by 5 mph + Distance doubled over grass = decrease 5 dB(A)		
<p>* Assume that all other factors remain constant.</p> <p>** These values are approximations and are not to be used to calculate sound.</p> <p>*** For nearby receptors, levels may actually increase slightly at more distant receptors because of possible reductions in shielding and/or surface absorption.</p>		

## **Loudness**

The term “loudness” is used to describe the manner in which people perceive the intensity of sound.

The loudness level is based on a subjective comparison of different sounds under controlled laboratory conditions.

The human ear is a far better detector of relative (comparative) differences in sound levels than absolute levels. **Table A - 3** depicts the relationship between changes in sound levels and the perceived change in loudness.

**Table A-3. Sound Level Change vs. Loudness**

Sound Level Change	Relative Loudness
1 dB(A)	No perceptible change
3 dB(A)	Barely perceptible change
5 dB(A)	Readily perceptible change
10 dB(A) increase	Perceived as twice as loud

# TxDOT Traffic Noise Policy Implementation Guidance

## Noise

Noise is commonly defined as unwanted sound. However, as indicated in the above discussion on loudness, the determination of “unwanted” is very subjective and can vary substantially from one person to another.

### Sound/Noise Levels

Representative sound pressure levels (decibels) for a variety of common outdoor and indoor areas/activities are depicted in **Table A-4**.

**Table A-4. Common Sound/Noise Levels**

Outdoor	dB(A)	Indoor
Air horn	110	Rock/Blues Band
Jet Flyover at 1000 feet		Baby Crying
Leaf Blower	100	Subway
Gas Weed Eater		Fire Alarms
Riding Lawn Mower	90	Blender
Gas Edger		Crowded Restaurant
Police Whistle	80	Disposal at 3 feet
Air Conditioner Compressor		Shouting at 3 feet
	70	
		Normal Conversation at 3 feet
Normal Conversation at 3 feet	60	Clothes Dryer at 3 feet
Babbling Brook		Large Business Office
Quiet Urban (daytime)	50	Refrigerator
Quiet Urban (nighttime)	40	Quiet Office/Library
Wilderness	30	
	20	Recording Studio
	10	Threshold of Hearing

# TxDOT Traffic Noise Policy Implementation Guidance

## Appendix B– Revision History

The following table shows the revision history for this guidance document.

<b>Revision History</b>	
<b>Effective Date Month, Year</b>	<b>Reason for and Description of Change</b>
September 2024	<p>Version 2</p> <ul style="list-style-type: none"> <li>Revised Traffic Noise Analysis Process graphic (p.11)</li> <li>Minor clarifications to traffic discussion (Section 4.1)</li> <li>Added guidance on cemeteries (p.21) and waiting areas (p.22)</li> <li>Added clarification that TNM 2.5 must be used for modeling (Section 5.0, p.26)</li> <li>Moved Construction Noise to Section 5.4 (no guidance changes)</li> <li>Revisions to Placement of Noise Barriers (Section 7.1.1)</li> <li>Added Constructability Assessment footnote to Table 3 (p.41)</li> <li>Revisions to Feasibility (Section 8.2) and Alternate Barrier Cost (p.44)</li> <li>New Constructability Assessment section (Section 9.0)</li> <li>New Abatement Decision Process flow chart (p.47) and Constructability Assessment process chart (p.49)</li> <li>Minor clarifications to Map Figures (Section 10.3), Required Documentation (Section 10.5.1) and Noise Model Files (Section 10.5.3)</li> <li>Revised Workshop Timing (Section 11.1)</li> <li>New graphic showing benefiting and bordering eligible voters (p.59)</li> <li>Added reference to workshop templates to Section 11.3</li> <li>Minor revisions to Low Response Rate (Section 11.6) and Counting Votes (Section 11.7)</li> <li>Added Notification of Workshop Results (Section 11.9)</li> <li>Additional Topics moved to Section 12.0 and re-ordered</li> <li>Added Special Considerations for Phased Projects (Section 12.4)</li> <li>Added Noise Wall Removal Policy (Section 12.5)</li> <li>Added First-row Receiver definition (p.70)</li> </ul>
December 2019	<p>Version 1</p> <p>New guidance document for traffic noise analyses prepared in accordance with the 2019 Traffic Noise Policy.</p> <p>This document replaces the 2011 Guidelines for Analysis and Abatement of Roadway Traffic Noise and the 2018 Environmental Handbook for Traffic Noise.</p>