



pennsylvania

DEPARTMENT OF TRANSPORTATION

***Pennsylvania Department
Of Transportation***

Project Level Highway Traffic Noise Handbook

Publication No. 24

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Introduction

I.1 Purpose of Handbook

This Handbook supersedes the Pennsylvania Department of Transportation (PennDOT) Publication No. 24, dated December 2013. This Handbook provides procedures and guidance regarding highway traffic noise impact assessment and analysis for project-level Type I (federally and state-funded), Type II (federally and state-funded) and Type III (federally and state-funded) highway traffic noise projects during the Environmental Clearance and Final Design Phases in accordance with the National Environmental Policy Act (NEPA) of 1969.

This handbook has been prepared as a guidance document for use in understanding highway traffic noise impact assessment and analysis, abatement procedures, criteria, coordination requirements, and reporting. The Handbook is based on the Federal Highway Administration's (FHWA) Title 23 Code of Federal Regulations, Part 772 (23 CFR 772). All transportation improvement projects developed in conformance with PennDOT's guidelines shall be in conformance with those mandated by FHWA. The facts of each situation involving traffic noise will vary, and therefore need to be considered on a case-by-case basis by PennDOT and FHWA. This Handbook is for guidance and informational purposes only; it is not regulatory.

I.2 Organization of Handbook

PennDOT's procedure for assessing and analyzing the noise impacts of federally or state funded Type I, Type II and Type III projects is outlined in the 7-Step process listed below.

[Step 1](#) – *Initial Project Level Scoping and Determining the Appropriate Level of Noise Analysis*

[Step 2](#) – *Noise Analysis Procedures*

[Step 3](#) – *Determining Highway Traffic Noise Impacts and Establishing Abatement Requirements*

[Step 4](#) – *Additional Considerations for Final Design Noise Barrier Analysis*

[Step 5](#) – *Construction Noise Consideration*

[Step 6](#) – *Public, Municipality, and Agency Involvement*

[Step 7](#) – *Reporting Results of Highway Traffic Noise Analysis*

These steps are for organizational purposes only and are intended to illustrate the progression that is undertaken when conducting federally or state funded Type I, Type II or Type III projects through the project development stages for transportation improvement projects.

NOTE – *Applicable Environmental Clearance and Final Design Steps:*

[Step 1](#) should occur when the federally or state funded Type I, Type II or Type III project is initially identified. The applicable sections of [Step 2](#) through [Step 7](#) should be addressed during both the Environmental Clearance and the Final Design Phase of a proposed transportation improvement project. Attention should be given to any changes that occurred in the project area between the time the environmental clearance document was approved and the completion of final design activities. When federal funds are associated with the project, coordination with FHWA should occur throughout the project's development.

I.3 Legal Justification

This is a guidance document, not a rule or regulation. The procedures described in this Handbook are in conformance with the following Acts, regulations, policies, guidance, and directives.

I.3.1 Federal and State Acts/Regulation

- Moving Ahead for Progress in the 21st Century Act (MAP-21), of 2012
- FHWA Federal-Aid Policy Guide Title 23 Code of Federal Regulations Part 772
- Pennsylvania Act 120 of 1970, as amended
- National Environmental Policy Act of 1969 (NEPA), as amended

I.3.2 Federal and State Policy, Guidance, and Directives

- FHWA Memorandum FHWA-HEP-12-051, "Consideration of Existing Noise Barriers in a Type I Noise Analysis," January 2015.
- FHWA "Highway Traffic Noise: Analysis and Abatement Guidance" December 2011
- FHWA Report Number FHWA-HEP-05-054, "FHWA Roadway Construction Noise Model (FHWA RCNM) User's Guide," January 2006
- FHWA Report Number FHWA-HP-06-015 "FHWA Highway Construction Noise Handbook," August 2006 FHWA Traffic Noise Model Version 2.5 User's Guide (v. 2.5 Addendum), April 2004

- FHWA Report Number FHWA-EP-00-005 “FHWA Highway Noise Barrier Design Handbook,” February 2000
- FHWA Report Number FHWA-PD-96-010, “FHWA Traffic Noise Model Technical Manual,” February 1998
- FHWA Report Number FHWA-PD-96-00, “FHWA Traffic Noise Model Users Guide,” January 1998
- FHWA Report Number FHWA-DP-96-046, “Measurement of Highway-Related Noise,” May 1996
- FHWA Technical Advisory T 6640.8A, “Guidance For Preparing and Processing Environmental and Section 4(f) Documents,” October 30, 1987
- PennDOT Design Manual, Part 1, Publication 10
- PennDOT Public Involvement Handbook: Publication No. 295
- PennDOT Section 4(f) Handbook: Publication No. 349
- PennDOT Roadway Specifications: Publication No. 408

NOTE – *Additional Federal and State Guidance & Directives:*

Additional federal guidance and directives relating to highway traffic noise abatement can be obtained through the FHWA (<http://www.fhwa.dot.gov/environment/noise/>) or PennDOT home pages (www.penndot.gov).

I.4 Qualifications Necessary to Perform Noise Analysis

Only individuals (PennDOT or consultant staff) qualified in the field of highway traffic noise impact analysis shall be responsible for the highway traffic noise analysis for PennDOT’s transportation improvement projects. In order to be considered qualified, the person performing the analysis must have demonstrated experience in conducting noise analyses for transportation improvement projects and must have exhibited a working knowledge of the procedures and policies outlined in:

- a. The Federal regulation (23 CFR 772) and its accompanying noise guidance material developed by FHWA,
- b. This Handbook (Project Level Noise Handbook - PennDOT Publication No. 24), and

- c. Report Number FHWA-DP-96-046, "Measurements of Highway-Related Noise," May 1996 or current version

The qualified individual must also have successfully completed or been involved in the development and/or instruction of the following:

- Highway traffic noise analysis training provided by FHWA and/or the National Highway Institute (NHI), and
- Training on the most currently approved FHWA noise analysis computer model(s).

Contact Central Office Environmental Staff for FHWA/PennDOT-recognized training courses. Once these training courses are complete, a copy of the certificate of training or evidence of the involvement in course development and/or instruction must be provided to PennDOT Central Office Environmental Staff so that the individual's name may be added to the list of persons qualified to perform highway traffic noise analyses in the Commonwealth. Refresher and additional training may be necessary as a result of advanced highway traffic noise modeling technologies and changes in highway traffic noise policy and/or procedure.

NOTE – PennDOT-Approved Highway Traffic Noise Training/Seminar Courses:

Training courses may be completed through either FHWA- or PennDOT-approved highway traffic noise training. Contact PennDOT Central Office Environmental Staff for a list of accredited training courses/seminars.

I.5 Time-Related Factors and Their Effects on Noise Studies

Several factors may influence the conduct of noise studies, the evaluation of noise impacts, and the selection of warranted, feasible, and reasonable noise abatement features. The factors presented below are generally related to the influences of changes that may occur over time and/or between various phases of a project's development.

I.5.1 Effects of Noise Guidance Revisions

It is the intent of PennDOT to update its noise guidance material on an as-needed basis to respond to policy changes and technical enhancements. For some current projects, previous noise studies have been performed in accordance with noise policies and guidance which have subsequently been modified. For instance, revisions were made to 23 CFR 772 on July 13, 2010. The revisions to the regulations do not automatically trigger the requirement to re-evaluate final NEPA decisions and noise analyses before the final rule's effective date (July 13, 2011). PennDOT is required to consult with FHWA after approval of any Record of Decision, Finding of No Significant Impact

or Categorical Exclusion determination, before they request any subsequent major approvals or grants from FHWA. On or after July 13, 2011, prior to requesting any post-NEPA major approvals from FHWA, PennDOT should consult with FHWA to determine if the amended noise regulation affects the previous NEPA decision, and what, if any, additional analysis may be required. The consultation process will determine if the previous noise study documentation can be efficiently updated to reflect changes in the noise regulation and State noise policy and the applicability of the changes to the undertaking. In some cases, a noise study addendum may be recommended. The results of the consultation should be documented in a memorandum to the file if no additional analysis is required.

NOTE – Grandfathering of Projects before July 13, 2011:

Typically, if a project received environmental clearance before July 13, 2011 and there have been no changes to the project design, concept, scope or location, the project will be grandfathered. This means that any further analysis that is necessary will be done using the regulations under which it was originally evaluated.

For additional information, see [Appendix F](#), 23 CFR 772 *Final Rule and Reevaluation Q & A* from FHWA distributed 12/23/10.

1.5.2 Using Different Traffic Noise Models and Versions

It is the desire and intent of PennDOT to utilize the most up-to-date and efficient modeling techniques in order to provide the most accurate and comprehensive noise analyses for its projects, as long as:

- these modeling techniques do not result in a reduction in the number of areas considered for noise abatement compared to the areas considered in previous noise studies and
- The newer modeling techniques do not result in any reduction of abatement measures determined to be likely based on the noise modeling performed in the previous noise studies.

1.5.2.1 Using Different Noise Models

For some current projects, previous noise analyses may have been performed during earlier project phases using the FHWA noise prediction methodology documented in the FHWA Highway Traffic Noise Prediction Model (FHWA-RD-77-108) and using the STAMINA 2.0/OPTIMA noise prediction software or the FHWA TNM Look-Up Tables or TNMLOOK software. Additional noise analyses for these projects may now be required because of a new project phase, the need to reevaluate the project, or for some other reason. In such instances, it is required that the latest version of FHWA TNM be used for additional noise modeling. Coordination with the

Environmental Policy and Development Section (EPDS) is required if the FHWA TNM modeling indicates that previously modeled areas do not warrant consideration of abatement and/or require less abatement than determined to be likely based on modeling in previous studies,

The above procedure is intended to assure that previously made “commitments” or “perceived commitments” are not compromised solely based on the particular noise model used. This said, the noise analyst must carefully evaluate any changes to assure that they are due solely to the model and not due to other changes such as traffic related factors, alignment modifications, land use changes, etc.

1.5.2.2 Using Different Versions of the FHWA TNM

For some current projects, previous noise analyses may have been performed during earlier project phases using a currently outdated version of the FHWA TNM. Additional noise analyses for these projects may now be required because of a new project phase, the need to reevaluate the project, or for some other reason. In such instances, it is suggested that the most current version of the FHWA TNM be used for additional noise modeling.

If analyses performed using the most current version of the FHWA TNM result in:

- a reduction in the number of areas considered for noise abatement compared to the areas considered in previous noise studies or
- a reduction of abatement measures determined to be likely based on the noise modeling performed in the previous noise studies, then

the affected area(s) and/or abatement measure(s) should be remodeled using a version of the FHWA TNM that is “acoustically consistent” with the version of the FHWA TNM used in the original noise analysis. FHWA TNM Versions 1.0, 1.0a, 1.0b, 1.1, 2.0, and 2.1 are acoustically consistent; i.e., they have similar acoustical algorithms and differ only due to modifications resulting from “fixes” of software “bugs” and graphical users interface (GUI) enhancements. Of these versions, Version 2.1 operates in the most reliable fashion. FHWA TNM Version 2.5 contains different acoustical algorithms than Versions 1.0 through 2.1. PennDOT will publish guidance related to future model versions as they are developed and released.

I.6 Questions Regarding This Handbook

PennDOT Bureau of Project Delivery, EPDS will issue updates and/or make modification to this Handbook as necessary. Please direct questions, comments, or suggestions about this Handbook to the following addresses.

Street Address:

Chief, Environmental Policy and Development Section
Bureau of Project Delivery
Pennsylvania Department of Transportation
Commonwealth Keystone Building
400 North Street, 7th Floor West
Harrisburg, Pennsylvania 17120
(717) 787-1024

Mailing Address:

Post Office Box 3790
Harrisburg, Pennsylvania 17105-3790

1.0 STEP 1 – Initial Project Level Scoping and Determining the Appropriate Level of Noise Analysis

Highway traffic noise impacts are initially discussed during the engineering and environmental scoping field view of the Preliminary Design Phase of the transportation improvement project's development process. This is done to assess the potential for future highway traffic noise impacts of the proposed transportation improvement project on the receptors in the study area. No receptor unit or community shall be denied the consideration of highway traffic noise abatement or denied full and fair participation in the decision-making process on the basis of its national origin, color, race, or income. Such scoping assessments are generally qualitative in nature, performed at the District level (Environmental Manager, Project Manager), and focus on potentially noise-sensitive sites and communities in close proximity to the proposed improvements.

It is PennDOT's policy to assess the highway traffic noise impacts of a transportation improvement project and to give consideration to the appropriate avoidance and/or abatement measures for those projects with noise impacts identified. Projects are classified based on the scope of the improvements, and the appropriate level of noise analysis as outlined below should be performed.

NOTE – Type I projects void of receptors do not require a detailed noise study (see screening analysis), although documentation of noise levels on undeveloped lands is required.

Type I Project – It is PennDOT's policy to assess the highway traffic noise impacts of transportation improvement projects and to give consideration to the incorporation of appropriate avoidance and/or mitigation measures into the design and construction of those federally aided and/or 100% state-funded Type I transportation improvement projects which have potential noise impacts. In order to consider incorporation of noise abatement measures, the appropriate level of highway traffic noise analysis must be completed to adequately answer all portions of the warranted, feasible, and reasonable criteria, which therefore justifies the recommendation to construct the proposed highway traffic noise mitigation measure. Proposed transportation improvement projects which are considered a Type I highway traffic noise project include the following:

- (1) The construction of a highway on new location; or
- (2) The physical alteration of an existing highway 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 or by altering the topography between the highway 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, then the entire project area as defined in the environmental document is a Type I project.

** Per FHWA FAQs issued in January 2015 (refer to [Appendix H](#)), the addition of an auxiliary lane is considered a Type I project if it is in excess of 2500' in length. Appendix H*

Type II Project – Federally-Funded

Type II projects are proposed federal and/or federal-aid transportation improvement projects for highway traffic noise abatement (construction of noise barriers) on an existing highway. PennDOT does not currently participate in a Type II program. If the Department chooses to participate in a Type II program, a priority system, based on a variety of factors, must be developed and approved by the FHWA. The development and implementation of Type II projects are not mandated under CFR 23 U.S.C 109(i) and are, therefore, not required or typically supported with federal aid. If supported, a federally funded Type II transportation improvement project must adhere to the guidelines laid out in 23 CFR 772. The appropriate level highway traffic noise analysis must be completed to adequately answer all portions of the warranted, feasible, and reasonable criteria, which therefore justifies the recommendation to construct the proposed highway traffic noise mitigation measure. Questions regarding Federally Funded Type II Projects should be directed to PennDOT Central Office Environmental Staff.

Type II Project – State-Funded

PennDOT periodically receives requests for highway traffic noise abatement along existing roadways. PennDOT does not actively participate in funding Type II highway transportation noise abatement projects due to resource constraints. In cases where noise abatement is legislatively directed for specific geographic areas, the projects must meet all Department criteria for warrants, feasibility and reasonableness in order for the noise abatement to be constructed.

When a PennDOT Engineering District and/or Central Office receives a request for highway traffic noise abatement along an existing roadway – either by an individual resident(s), federal/state legislator, or other public official – a copy should be forwarded to PennDOT Central Office Environmental Staff where it is added into a statewide inventory database. This database does not rank or organize the request in any order nor does it indicate a project's eligibility for being analyzed for highway traffic noise impacts. This database is for informational purposes only and is intended to only document when, where, and from whom a request is coming.

Type III Project – These projects include those not classified as a Type I or Type II. These can include rehabilitation of an existing highway (non-capacity improvements), online bridge replacements/rehabilitations, non-through lane intersection improvements (i.e., turning lanes), etc. Generally the list of projects described in 23 CFR 771.117(c) and (d) comprise the list of Type III projects (with some exceptions as outlined in FHWA's Highway Traffic Noise: Analysis and Abatement Guidance, page 18). When evaluating a potential Type III project, it is essential that the project elements be thoroughly reviewed to assure that none of the conditions or potential noise effects previously listed in the Type I Project paragraph exist. In certain instances, this review could require some simplified FHWA TNM noise analyses to confirm the non-existence of potential noise impacts.

1.1 Avoidance Techniques

Typical highway traffic noise avoidance techniques should be preliminarily discussed during the scoping portion of all Type I projects, where practical. The avoidance techniques may include placing the design below grade or in cut (i.e., lowering highway profile) and/or moving the proposed roadway away from noise-sensitive receptor(s). Although these are only examples of applicable techniques, it is important that avoidance techniques be considered in order to reduce or eliminate the potential for highway traffic noise impacts wherever practical. It is recognized that highway traffic noise is not the only factor being considered during the Preliminary Engineering Phase. All potential avoidance techniques should be incorporated into the preliminary engineering scope of work for detailed analysis.

1.2 Scoping the Appropriate Level of Noise Analysis

All PennDOT projects require a certain level of noise analysis. The level of analysis will depend on the scope of the project, probable severity of the highway traffic noise impacts, the potential for noise abatement measures, and/or noise-related public controversy. There are three categories for noise verification/studies.

- Type III Classification Verification
- Type I Screening Analysis
- Type I Detailed Analysis

The first category is to verify if the project qualifies as a Type III project, which is therefore exempt from a noise analysis. There are two options to verify this. Projects that qualify under a CE1a or BRPA innately fit the qualifications of Type III. As such, no documentation of noise is required.

For CE1b, CE2, EA or EIS projects, you must perform a qualitative examination documenting and verifying that the project is in fact a Type III project. This examination is documented in the NEPA document.

The second level of analysis is the Screening Analysis. For Type I projects that are unlikely to experience noise impacts and/or where noise abatement measures are clearly not applicable (e.g, driveway access, Main Street scenarios, etc.), a screening analysis should be performed using a simple FHWA TNM model. This procedure is also used for Type I projects void of sensitive receptors to satisfy the undeveloped land impact assessment requirement. See Section 1.2.1.2 below for more information on conducting a Screening Analysis.

The third level of analysis is a Detailed Analysis. A detailed analysis is required when the Type I project has the potential to yield highway traffic noise impacts and/or public controversy is anticipated. The majority of PennDOT Type I projects require detailed analyses. These analyses involve noise monitoring, computer noise modeling using the FHWA TNM, and abatement analyses when impacts have been identified. When determining which level of noise analysis is appropriate, the following issues should be considered:

- Change of traffic volumes
- Change of traffic composition
- Change of traffic speed
- Change of the geometric relationships (either horizontal or vertical) between the facility and the receptors (or lack of receptors where not present)
- Change of the distribution of traffic patterns
- The identification of any existing activities which may be affected by noise from the proposed project. These activities occur on developed lands or on undeveloped lands for which development is permitted prior to the date of public knowledge of the proposed highway project
- Project public controversy based on noise-related issues or perceptions

NOTE – Coordination with EPDS is required before a screening analysis is conducted. Failure to coordinate may result in the need to reanalyze the project using a detailed analysis. Coordination with EPDS is critical during the early stages of project scoping to ensure the proper level of noise analysis, coordination, and documentation is conducted.

1.2.1 Three Levels of Noise Analyses

1.2.1.1 Verification of Type III Classification

Type III projects are exempt from a noise analysis. However, the project team must verify that the project qualifies as Type III. There are two options to verify this. Projects that qualify under a CE1a or BRPA innately fit the qualifications of Type III. As such, no documentation of noise is required. For CE1b, CE2, EA or EIS projects, you must perform a qualitative examination documenting and verifying that the project is in fact a Type III project. This examination is documented in the NEPA document. This is done by examining the criteria provided under 23 CFR 772 and ensuring that the project meets these requirements.

Coordination with EPDS is recommended during the scoping process to ensure the project is considered a Type III project and exempt from a screening or detailed analysis.

1.2.1.2 Screening Analysis

A screening analysis is completed for Type I projects where noise impacts are not anticipated, such as low volume roadways. This procedure can also be used for Type I projects void of sensitive receptors in order satisfy the requirement of analyzing noise impacts for undeveloped lands for use in local noise compatible planning. The screening analysis consists of a simple TNM modeling procedure used to predict traffic noise levels and identify noise impacts. There are limitations to the screening procedures (yields worst-case scenario), and it is not applicable to all projects; consult with Central Office EPDS prior to scoping a screening analysis. If the screening analysis results indicate that noise impacts are likely and the placement of typical abatement devices appears to be feasible (see [Step 3](#)), a detailed analysis is required. If impacts are noted and abatement is clearly NOT feasible (i.e., driveway access), the screening procedures should suffice and a detailed analysis is not required. In these situations, a qualitative discussion of barrier feasibility can be prepared that discusses how the required wall length would not be feasible due to unlimited access points. The wall dimensions can be estimated based on blocking the line of sight (height) to/from the receptor and extending the barrier 4X the distance measured from the roadway to the receptor. These dimensions must be included in the documentation and tailored for each project.

A screening analysis must be performed using a simplified FHWA TNM run to assess a worst-case scenario. The modeling procedure would yield higher noise levels than would be expected in detailed modeling. Model validation and noise monitoring are not required for a screening analysis. TNM Look-up Tables are no longer allowed to be used on any project as of July 13, 2010. Any project requiring further analysis that was previously analyzed using TNM Look-up Tables must be reanalyzed using a simplified TNM run or a detailed analysis as appropriate. See [Section 2.3](#) if undeveloped lands exist in the study area.

The TNM screening model consists of 2D or 3D modeling, depending on the complexity of the project area. The model should be prepared as follows:

- Existing Conditions and Future Design year TNM models should use worst-case peak hour traffic for comparison to the NAC (e.g, increase over existing and absolute NAC)
- The use of TNM terrain lines, tree zones and ground zones should be minimized.
- Roadways shall extend at least 1500 feet beyond the final receiver(s) perpendicular to the roadway on either side of the project.
- Representative receiver locations can be used. They shall, at a minimum, include receiver location(s) closest to the roadway and receivers placed at 50' increments from the roadway to determine the distance from the roadway to which impacts extend.
- Any relevant external noise sources shall be considered (may require measurements).

Documentation of the screening analysis would follow the same requirements of a detailed assessment as described in [Section 7](#).

If any traffic noise impacts are predicted, a detailed model shall be prepared according to the full monitoring, modeling and analysis procedures. The exception would be for projects where noise abatement is clearly not feasible (e.g., driveway access, Main Street, etc.). In these situations, a qualitative discussion of feasibility can be prepared that discusses how the required wall length would not be feasible due to unlimited access points. The wall dimensions can be estimated based on blocking line of sight (height) to/from the receptor and extending the barrier 4X the distance measured from the roadway to the receptor.

For Type I projects void of sensitive receptors, the requirement to assess noise impacts on undeveloped parcels can be met by using a simple 2D TNM straight line model with future design year traffic to predict rudimentary impact contours for use by local planning agencies

1.2.1.3 Detailed Analysis

The detailed analysis is commonly used to assess both minor and major transportation improvement projects throughout the Commonwealth. The majority of the noise assessments conducted by PennDOT Districts are considered detailed analyses. These analyses involve noise monitoring, computer noise modeling using the FHWA TNM, and often abatement analyses when impacts have been identified. The detailed analysis is a three-phased approach aimed at answering and addressing the following questions (refer to pages 30-40 for a detailed description).

1. Do the receptors **warrant** highway traffic noise abatement consideration?
2. Is it **feasible** to provide highway traffic noise abatement from an acoustical, engineering, constructability, and maintainability standpoint?

3. Is it **reasonable** to provide highway traffic noise abatement based upon cost/benefit and acoustical evaluations, evaluations of noise abatement goals and community desires related to potential noise abatement measures?

See [Section 2.3](#) if undeveloped lands exist in the study area.

1.3 Frequently Asked Questions

- What is a substantial horizontal alteration?

Substantial horizontal alteration occurs when a project halves the distance between the traffic noise source and the closest receptor between the existing condition and future build condition.

- What is a substantial vertical alteration?

Substantial vertical alteration occurs when a project 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. In this context, the removal of vegetation does not constitute exposing the line of sight unless the vegetation is of sufficient width to result in substantial noise abatement.

- What is considered an auxiliary lane?

Auxiliary lanes are those lanes adjoined to the traveled way intended for speed change, storage, weaving and other purposes supplementary to through traffic movement.

- Is an auxiliary lane considered a Type I Project?

The addition of an auxiliary lane is a Type I project, unless the auxiliary lane is a turn lane only. The auxiliary lane would need to be longer than 2500' to be considered a Type I project.

- Is a jug handle project considered a Type I Project?

No, unless the jug handle decreases the distance from the road to the nearest sensitive receptor by half. A jug handle is considered a turn lane and would be a Type III project otherwise, and a detailed assessment is not required.

- Is a roundabout project considered a Type I Project?

No, unless the project includes additional thru lanes or decreases the distance from the road to the nearest sensitive receptor by half. A roundabout is considered a turn lane and would be a Type III project otherwise, and a detailed assessment is not required.

- If only a small portion of my project is considered a Type I project, is the entire project area considered a Type I project?

Yes. If a project is determined to be a Type I project per state/federal policy, then the entire project area as defined in the environmental document is a Type I project and must be evaluated as such.

- If, upon initial review, my project is believed to be a potential Type III Project, is it exempt from a noise analysis?

No, not necessarily. When evaluating a potential Type III project, it is essential that the project elements be thoroughly reviewed to assure that none of the conditions or potential noise effects under the Type I definition exist. In certain instances, this review could require some simplified FHWA TNM noise analyses to confirm the non-existence of potential noise impacts. The project should be reclassified as a Type I if design features/changes affect future acoustics.

- Do I need to do a detailed noise analysis for a bridge replacement?

On-line bridge replacements are normally considered Type III projects. A detailed noise analysis would be required only if receptors are present AND the project consists of a significant alteration of the horizontal/vertical alignment, or an increase in through-traffic lanes, or a change in cross section which could result in a loss of shielding. Online bridge replacements and rehabilitations generally only require a qualitative analysis. The detail of any required noise analysis would be dependent upon the complexity of the noise-related issue and would be determined during the project scoping.

- Do I need to conduct a noise analysis on a Type I project if noise abatement is clearly not feasible?

Yes. The noise analysis procedure is a three-step process consisting of warrants, feasibility, and reasonableness. The first step is to determine whether any receptors are impacted by noise (to determine if abatement consideration is warranted). A noise analysis is required to identify impacts to satisfy NEPA and 23 CFR 772 regardless of the potential for mitigation. The screening process can be used in certain situations where barriers clearly are not feasible (e.g., driveways, etc.)

- Do I need to do a noise abatement analysis in Preliminary Design?

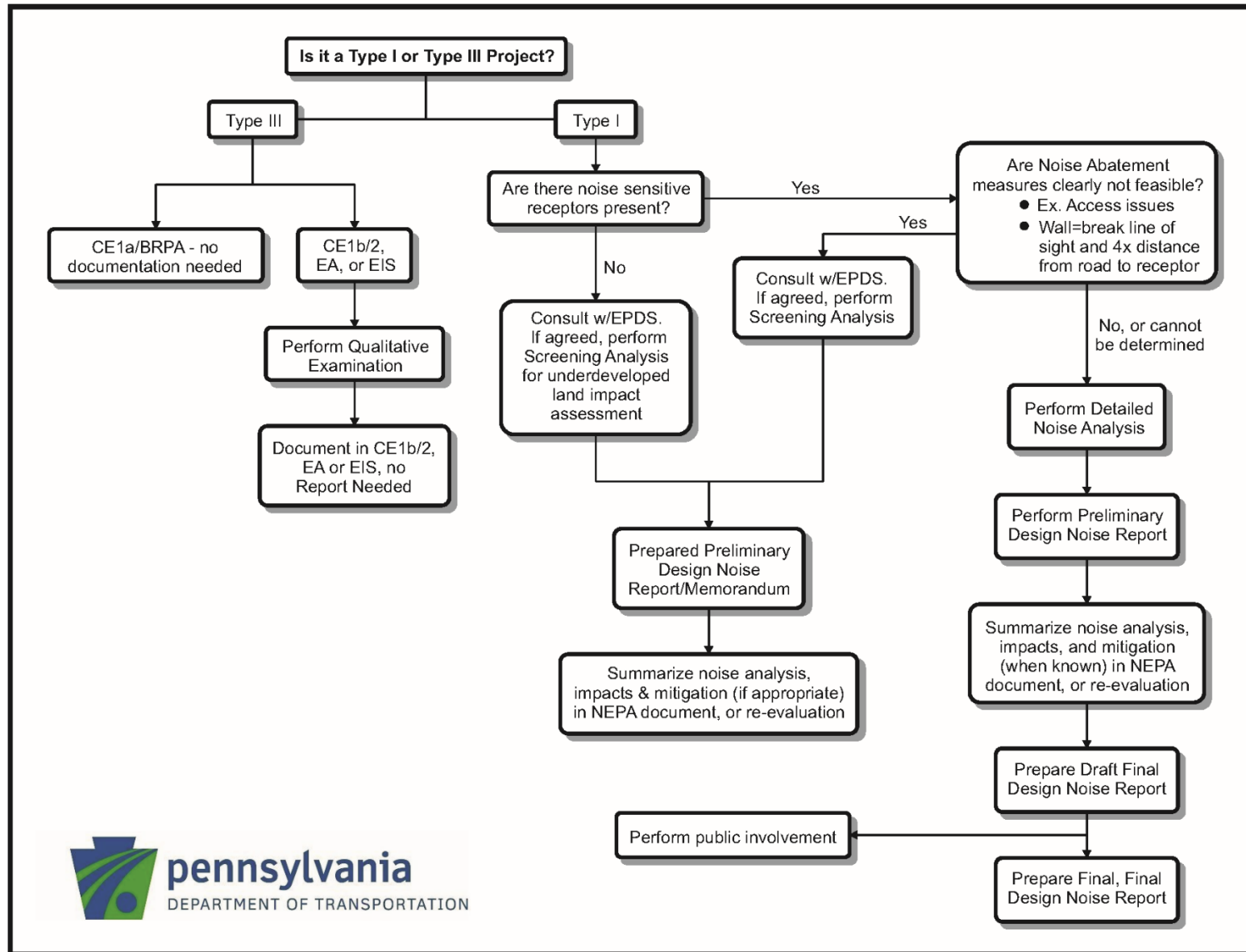
Yes. Highway traffic noise abatement determinations are made at two times during project development. First during the Environmental Clearance/preliminary design phase and next during the Final Design Phase. During the environmental clearance/preliminary design phase, approximate barrier locations and heights need to be determined and a preliminary feasible and reasonable assessment conducted. A statement of the "likelihood" of abatement is made at that time. A commitment to constructing noise abatement is made when the Final Design Highway Noise Analysis is completed and input from the public is solicited.

- Am I required to conduct a noise analysis on undeveloped lands?

Yes. Current policy involves determining impacts for all undeveloped land. When undeveloped lands are “permitted” they qualify for noise abatement consideration. Undeveloped lands are deemed to be permitted if a receptor has received a building permit from the local agency with jurisdiction at the time of the highway traffic noise analysis. Undeveloped land without building plans also need to be addressed for local noise compatible land use planning purposes.

Additional FHWA FAQs related to highway traffic noise can be found in [Appendix H](#).

1.4 SCOPING FLOW CHART



2.0 STEP 2 – Noise Analysis Procedures

2.1 Consideration of Areas Potentially Sensitive to Noise

During the Planning and Programming Phases of a transportation improvement project, consideration should be given to potential highway traffic noise impacts for the entire project limits, as described in the NEPA document. Land uses that are potentially sensitive to transportation noise impacts are identified in [Table 1](#) (Page 30).

2.2 Noise Study Area (NSA) Determination

Field reconnaissance is necessary for identifying and/or verifying the location of receptor sites and highway traffic noise sources. NSAs should be delineated throughout the entire project limits of the proposed transportation improvement project. Common noise environment is defined as a group of receptors within the same Activity Category that are exposed to similar noise sources and levels; traffic volumes, traffic mix, and speed; and topographic features. NSA boundaries typically do not traverse over any major and/or significant highway traffic noise source (i.e., existing or proposed roadways). Grouping common areas into NSAs also assists in evaluating mitigation, organizing reports, and facilitating discussions.

2.3 Undeveloped and Developing Lands

Highway traffic noise analyses will be performed for both developed and undeveloped lands. If undeveloped land is considered “permitted” the appropriate Activity Category will be assigned based on the nature of the proposed development, and it should be treated the same as developed land. Permitted is defined by FHWA as having a definite commitment to develop land with an approved specific design of land use activities as evidenced by the issuance of a building permit. In the case of a subdivision, if at least one building permit within the approved development plan has been received from the local agency with jurisdiction at the commencement of the Environmental Clearance Phase highway traffic noise analysis, then the entire subdivision will be deemed to be permitted.

If undeveloped land is not permitted for development, a noise analysis will still be required to predict future noise levels for use by local planning officials. At a minimum, the distance to the impact threshold for each land use activity will be provided through the screening procedures outlines in Section 1.2.1.2. Noise contours may be used for this purpose. The results should be documented in the project’s environmental clearance and noise analysis documents.

NOTE – Since noise studies can span several years, it may be useful to send a letter to affected municipal officials stating that “PennDOT has/will initiate noise studies for the **Project** on **Date A**. PennDOT will consider noise abatement only for noise-impacted development for which a building permit was issued prior to **Date B (the date of NEPA clearance)**.”

2.4 Determination of Existing Conditions

2.4.1 Selecting Monitored and Modeled Receptor Sites

Areas to be considered for the placement of monitored and/or modeled receptor sites should include individual sites that are in close proximity and could be impacted by the project. The location of monitored and modeled receptor sites should be consistent throughout the entire project limits.

NOTE – *Calibration of Noise Meters:*

All highway traffic noise meters and acoustical field calibrators should be calibrated once a year or in accordance with the manufacturer’s specifications. A copy of the certificate of calibration for each piece of equipment used in the study for the period that highway traffic noise monitoring occurred for the proposed transportation improvement project should be included in the Final Design Reports and/or the project technical files.

A monitored receptor site should be placed at every common highway traffic noise influence area so as to represent the entire community. Receptor sites should be placed between the highway right-of-way line and the outdoor frequent human use area.. Modeled receptor sites should be positioned in all areas necessary to identify impacts, and to evaluate noise barrier locations, lengths, and heights. Modeled receptors should also be placed at locations based on the nature of the transportation improvement project (i.e., topography, locations of special concern). Professional judgment and FHWA guidance should be used to determine where both monitored and modeled receptor sites should be placed.

NOTE – *Exterior Areas of Frequent Human Use:*

In accordance with Title 23 CFR 772.11(b):

- (a) In determining traffic noise impact, a highway agency shall give primary consideration to exterior areas where frequent human use occurs under Activity Categories A, B, C and E.
- (b) Activity Category D includes the interior impact criteria for certain land use facilities listed in Activity Category C that may have interior uses. A highway agency shall conduct an indoor analysis after determination is made that exterior abatement measures will not be feasible and reasonable. An indoor analysis shall be only be done after exhausting all outdoor analysis options.

2.4.2 Worst-Case Highway Traffic Noise Hour

Highway traffic noise analysis should begin by determining the worst-case existing noise hour(s) within the project area. The Engineering District and, when needed, PennDOT Central Office Environmental Staff should discuss the traffic characteristics during the Preliminary Engineering Phase in order to adequately determine the worst-case highway traffic noise hour(s). It is necessary to evaluate hourly traffic volume, speed, and composition to the extent such data are available. There are several techniques to help determine the existing worst-case highway traffic noise hour(s), including the following.

1. *Evaluation of Peak and Off-Peak Traffic Data*

In many cases, experience has shown that the peak traffic hour is the noisiest hour of the day. However, on occasion, conditions such as capacity, effects on vehicle speed, higher-than-normal off-peak truck percentages, or unusual hourly traffic distribution may cause the noisiest hour of the day to be different from the peak traffic hour of the day. Evaluation may be based on the review and/or analysis of historical traffic data, predicted traffic data, supplementary traffic counts, or a combination thereof.

2. *Long-Term Monitoring Sites with Evaluation of Diurnal Traffic Patterns*

If there is some question as to the worst-case highway traffic noise hour, it may be necessary to conduct long-term monitoring to determine the worst-case highway traffic noise hour(s). In this case, long-term monitoring should be done in conjunction with evaluating the existing diurnal traffic patterns to determine the existing worst-case highway traffic noise hour. While long-term monitoring will often correspond to monitoring over a 24-hour period, conditions may exist where the required noise level information can be obtained by monitoring for a lesser period of time, such

as from 6 am to 11 pm. Likewise, long-term monitoring may be appropriate for periods longer than 24 hours if daily variations in noise levels are deemed to be appropriate. The worst-case highway traffic noise hour may not necessarily correspond with the future design year hour since traffic scenarios may vary as a result of the proposed transportation improvement project. Therefore, future peak highway traffic noise hours will have to be confirmed using the existing long-term data, diurnal traffic patterns, and compositions. Major projects and projects with public controversy related to highway traffic noise may necessitate long-term monitoring.

3. *Public Comment*

Public comment may also produce some helpful information on the noisiest day of the week or the noisiest hour of the day. However, keep in mind that public comment has no scientific basis for determining noise levels.

4. *Combination of two or all of the above techniques*

2.4.3 Existing Noise Level Determination

Existing noise is the current noise level, comprised of all natural and artificial noises, considered to be usually present within a particular area's acoustic environment, including existing roadways. Existing noise levels are monitored for one or more of the following reasons:

1. validating the FHWA TNM at locations currently influenced by existing highway traffic noise sources;
2. determining existing noise levels in areas remote from existing noise sources or in other areas where noise model validation cannot be performed;
3. assisting in determining the existing worst-case traffic noise hour (as referenced in [Section 2.4.2](#)); and/or
4. supplementing other noise-related data in defining the existing noise environment.

2.4.4 Monitor Similar and Unique Conditions

When a unique condition is proposed whereby highway traffic noise level predictions (derived by the techniques discussed above) cannot accurately assess the future acoustical environment, it may be necessary to monitor a similar location elsewhere if such a location has similar characteristics. Such a technique may be applicable to projects with parking lots, covered roadways, tunnels, transit facilities, extreme rough surface pavements, open-grated bridge decks, parallel or multiple noise barriers, etc. This technique shall be used in coordination with the Engineering District and PennDOT Central Office Environmental Staff.

2.5 Noise Modeling (Prediction of Existing and Future Conditions)

2.5.1 FHWA Model

Noise modeling of existing and future roadways is an effective tool for predicting noise levels, noise impacts, and the potential benefits of noise abatement. Noise modeling associated with a roadway transportation improvement project is a dynamic process that evolves to address and answer a series of questions related to noise impacts and the potential benefits of noise abatement. The noise-modeling process includes several steps, which are outlined below. Generally, the modeling process includes noise model validation, modeling of worst-case existing conditions, modeling of future no-build conditions, and modeling of future build-conditions associated with a proposed transportation improvement project.

The currently approved FHWA TNM is the applicable tool for the prediction of existing and future noise levels associated with transportation improvement projects. The FHWA TNM should be used only after a thorough understanding of this document and only by qualified individuals that have a thorough understanding of how to use the FHWA TNM, as defined in the Introduction section of this Handbook. See [Section I.5.2.2](#) for information related to use of the appropriate prediction model.

2.5.2 Traffic Speed Determination

Section 772.9(d) of 23 CFR states, “In predicting noise levels and assessing noise impacts, traffic characteristics that would yield the worst traffic noise impact for the design year shall be used.” The posted speed or operating speed may be used to predict highway traffic noise levels (without exceeding the safest speed as determined by the roadway design speed). The operating speed must be used if it has been determined to be consistently faster than the posted speed limit. For proposed roadways, it may be difficult to determine the potential operating speed of the future roadway. In these situations, it is recommended to consider using design speeds or posted speeds plus five miles per hour (5 mph) to ensure worst-case noise level predictions in the design year of the project.

Under no circumstances (except when appropriate for noise model validation only) should any speed below posted be used for noise modeling purposes, even if congestion and slower speeds are anticipated in the peak travel hour(s). In congested corridors, it may be more appropriate to model off-peak travel hours, representing the balance of maximum vehicle volume traveling at maximum speeds. In these situations (i.e., congested corridors), the worst-case noise hour(s) typically occurs in a period approaching or following the typical peak travel hours, when congestion breaks and vehicles again travel at posted speeds or greater. According to FHWA Guidance, “worst hourly traffic noise impacts” usually occur at a time when truck volume and vehicle speeds are the greatest, typically when traffic is free-flowing and at or near Level-of-Service (LOS) C conditions.

2.5.3 Model Validation

2.5.3.1 Purpose

Existing noise levels monitored in the field need to be compared with the FHWA TNM noise level predictions for the traffic conditions observed during the monitoring period, thereby verifying the accuracy of the computer model. Noise model verification procedures are initiated to assure that reported changes in noise levels between existing and future conditions are due solely to changes in traffic conditions and do not erroneously reflect discrepancies due to modeling and monitoring techniques. To ensure model validation is documented accurately, the noise report must contain the monitored and modeled noise level for each noise monitoring location in table format, with reported changes in noise level between the monitored and modeled values.

2.5.3.2 Limitations

These procedures are not applicable in situations where the existing acoustical environment is not dominated by an existing highway traffic noise source. The FHWA TNM is not capable of accurately determining existing noise levels where highway traffic noise is not the dominant contributing acoustical characteristic. Generally, the procedures are intended for sites that are currently influenced by highway traffic noise and will be similarly affected by the proposed transportation improvement project. In areas dominated by background (non-roadway) noise sources, monitored noise levels should be used to determine existing worst-case noise levels in place of modeled noise levels, thereby accurately representing the existing noise environment. Professional judgment should be used when selecting sites to be used for determining worst-case noise levels in such areas.

2.5.3.3 Procedure

In developing a model validation program, the monitoring methodologies listed in the FHWA Guidance Document and in the FHWA Measurements of Highway-Related Noise report should be considered and supplemented with professional judgment and specific conditions related to the transportation project. Where possible, short-term noise monitoring, for modeling validation purposes, should include some measurements taken during the peak noise hour(s) with all noise measurements occurring under generally free-flow traffic conditions.

A noise validation procedure typically includes the following steps.

1. Obtain a series of noise measurements along the project, taking multiple noise measurements at a variety of sites representing all noise study areas (NSAs). Vary times and days, as appropriate, to account for variations in traffic conditions. Observe and record traffic volumes on all influencing roadways (classifying the appropriate vehicular types) and determine the average vehicular speed (can be performed using radar equipment, driving through the project area, distance/time calculations, etc.).

2. Calculate the noise levels using the computer modeling software after having input the traffic characteristics witnessed during noise monitoring (expanded to one hour), site geometry, and any other pertinent existing features.
3. Compare the field-observed values to the predicted values. If the difference between the two values is less than ± 3 dB(A), this is an indication that the model is within the accepted level of accuracy. If observed noise levels differ from modeled noise levels by greater than ± 3 dB(A), a careful examination of the observed data and predicted data should be undertaken to determine the reason(s) for this margin of error. The qualified professional is required to reexamine the input parameters and look for obvious differences such as meteorology, pavement conditions, obstructions, reflections, non-traffic (background) noise sources, etc. In the event a logical explanation for the difference cannot be made, the field measurements at that location(s) should be repeated.
4. If the observed noise levels differ from the modeled noise levels by greater than ± 3 dB(A), and after thorough examination of the observed and predicted data, it may be practical to establish an “adjustment factor” to be applied to modeling results in certain cases. Adjustment factors could also be applied if the difference between observed and modeled noise levels is less than ± 3 dB(A). If adjustment factors are used, they must be discussed and documented. Contact PennDOT Central Office Environmental Staff prior to establishing or implementing adjustment factors.

NOTE – Reporting Decibels as Whole Numbers:

While the FHWA TNM performs and reports official analysis results to the tenth of a dB(A) and most noise monitoring equipment data output is reported to the tenth of a dB(A), all monitored and modeled decibel levels are to be presented to the whole decibel in the main body of reports and at public meetings. Model validation tables can be presented to the tenth of a decibel. Report appendices may also contain values reported to the tenth of a dB(A) when presenting FHWA TNM input and output tables, FHWA TNM parallel barrier analysis input and output tables, noise monitoring field data sheets, noise monitoring output files produced by noise meter software, and noise meter calibration certificates.

NOTE – Decibel Rounding Convention:

In rounding monitored noise level values or noise level values calculated with the FHWA TNM, the recommended convention is illustrated below.

- A value of 60.4 dB(A) shall be reported as 60 dB(A)
- A value of 60.5 dB(A) shall be reported as 61 dB(A)
- A Category B location value of 65.5 dB(A) is reported as 66 dB(A) and is reported as a noise impact (approaching 67 dBA)

In FHWA TNM calculations, noise level values are calculated to the tenth of a dB(A). When calculating barrier insertion losses (I.L.) or comparing existing, no-build, or build alternative noise levels, use the “tenth” values to calculate the I.L. or comparison values and then round the values. Some examples are presented below.

- a. Existing level = 56.9 dB(A), reported as 57 dB(A)
- b. Future No-Build Alternative level = 64.5 dB(A), reported as 65 dB(A)
- c. Future Build Alternative (no barrier) level = 65.5 dB(A) reported as 66 dB(A)
- d. Future Build Alternative (with barrier) = 55.9 dB(A), reported as 56 dB(A)
- e. Build Alternative increase over existing = $c - a = 65.5 \text{ dB(A)} - 56.9 \text{ dB(A)} = 8.6 \text{ dB(A)}$, reported as 9 dB(A)
- f. Build versus No-Build = $c - b = 65.5 \text{ dB(A)} - 64.5 \text{ dB(A)} = 1.0 \text{ dB(A)}$, reported as 1 dB(A)
- g. Barrier Insertion loss (I.L.) = $c - d = 65.5 \text{ dB(A)} - 55.9 \text{ dB(A)} = 9.6 \text{ dB(A)}$, reported as 10 dBA

This process insures that all noise levels, insertion losses, and comparisons are calculated using the actual FHWA and/or monitored values prior to rounding. To explain any “perceived inconsistencies” resulting from the rounding process, include a statement as a note in the appropriate report tables indicating that “noise values, comparisons, and insertion losses are calculated to the tenth of a dB(A) and the rounded for presentation purposes.”

2.5.4 Determining Worst-Case Existing Conditions

Once the validation model is deemed accurate, the noise analyst must develop a worst-case existing FHWA TNM to predict worst-case existing noise levels within the project area. This step is accomplished by replacing the witnessed traffic data (during the monitoring phase) with worst-case existing traffic data derived from traffic engineers and applying these data to the existing roadway geometry.

This step is important because noise monitoring represents a “snap-shot” in time and may not necessarily represent worst-case existing noise levels. The existing worst-case noise levels then serve as a basis for the PennDOT “substantial increase” noise abatement criteria. However, in areas dominated by background noise levels (non-roadway sources), monitored noise levels should be used to represent existing worst-case noise levels, thereby accurately representing the existing noise environment. Please refer to model validation limitations for more information.

2.5.5 Future No-Build Conditions

The noise modeling process continues with the development of the no-build noise model. The no-build noise model is essentially a representation of the existing roadway network that accounts for natural traffic growth through the design year of the project. This step considers future “no-build” traffic projections on the existing roadway network with no project-related improvements in place. This step allows for a comparison of no-build noise levels to existing and build noise levels associated with a highway improvement project in accordance with NEPA requirements.

2.5.6 Future Build Conditions

The final step of the noise impact modeling process (before abatement modeling) is the development of the future design year build conditions noise model. This assessment can include single or multiple build alternatives, depending on the magnitude of the environmental project (i.e., CEE, EA, or EIS). Typically, CEE assessments present one build alternative, EA documents can present one or multiple build alternatives, and EIS documents typically present multiple build alternatives. When multiple build alternatives are presented in an environmental document, noise levels, noise impacts, and potential noise abatement measures for each build alternative must be documented to the same level of detail.

In areas adjacent to proposed project build alternative(s) that contain no receptors, noise modeling should be performed only to the degree necessary to provide noise levels for undeveloped lands to local officials for their land use planning purposes. However, in permitted areas that contain potential noise-sensitive receptors, noise modeling should be detailed enough to thoroughly evaluate noise abatement warrants, feasibility, and reasonableness (see [Section 3.0](#)). Future condition noise modeling is an evolving process, and noise model refinements are typically necessary throughout the process to determine the depth of noise impact, the number of impacted receptors, the effectiveness of noise abatement, and the number of benefited receptors. Additional modeling sites are often added throughout the modeling process to clearly define the depth of noise impact, the number of impacted receptors, and the number of benefited receptors.

The design year noise levels for each alternative can then be compared to the FHWA/PennDOT noise abatement criteria to determine if noise mitigation consideration is warranted, feasible, and reasonable for a given project alternative. The FHWA/PennDOT noise abatement criteria are discussed in detail in the following sections of this document.

3.0 STEP 3 – Determining Highway Traffic Noise Impacts and Establishing Abatement Requirements

3.1 Criteria for Detailed Highway Traffic Noise Abatement Measures

Flexibility is an important element of good highway traffic noise abatement decision-making criteria and procedures. The criteria and procedures should be objective enough to be quantifiable. They should also be flexible enough to allow the decision-makers to make meaningful judgments on a project-by-project basis.

It is PennDOT's policy to implement noise abatement measures on Type I projects when they are determined to be warranted, feasible, and reasonable. The following parameters should be assessed to make the determination for each of the three criteria: warranted, feasible, and reasonable. The decision to recommend or not recommend a highway traffic noise abatement option(s) should be based on the consideration of all of the parameters discussed below and not just any one parameter. This allows for the identification of the overall benefits, including the effect of such abatement on social, economic, and environmental factors.

NOTE - Use Total Noise Level Values when Comparing to NAC Values

When comparing predicted existing, future no-build, and future build noise levels to the Noise Abatement Criteria (NAC) values, it is essential that the prediction of noise levels considers not just the noise level values associated with the proposed transportation improvement(s) but also considers and includes, as appropriate, noise from all normally occurring activities within the area. Noise from other roadways, other transportation facilities (railways, airports, etc.), industrial, commercial, recreational activities, etc. need to be considered and incorporated as appropriate. While the total noise level from the combination of all noise sources in an area may result in the noise level exceeding the NAC (and thus a noise impact existing in the area), the non-project-related noise sources (if substantial noise contributors) could be a factor in determining whether project noise abatement is feasible and/or reasonable.

3.2 Highway Traffic Noise Abatement Measures

The following measures, taken from 23 CFR 772.13(c), should be considered when analyses indicate the need for highway traffic noise abatement.

1. Construction of noise barriers, including acquisition of property rights, either within or outside the highway right of way. Landscaping is not a viable noise abatement feature.
2. Traffic management measures including, but not limited to traffic-control devices and signing for prohibition of certain vehicle types, time-use restrictions for certain vehicle types, modified speed limits, and exclusive lane designations.
3. Alteration of horizontal and vertical alignments
4. Acquisition of real property or interests therein (predominately unimproved property) to serve as a buffer zone to preempt development which would be adversely impacted by traffic noise. This measure may be included in Type I projects only.
5. Noise insulation of Activity Category D land use facilities listed in [Table 1](#). Post installation maintenance and operational costs for noise insulation are not eligible for State or Federal-aid funding.

NOTE –*Acquisition of Property and Category D Receptor Unit Soundproofing:*

Soundproofing or acquisition of buffer property should not be considered without prior coordination with PennDOT Central Office Environmental Staff, the Bureau of Project Delivery, Office of Chief Counsel, and FHWA. This coordination must occur prior to any discussions with the public. Soundproofing for Category D receptor units that would experience exposure to higher absolute highway traffic noise levels as a result of the proposed transportation improvement project will only be considered after all feasible or reasonable measures to abate excessive absolute exterior noise levels have been exhausted. These issues will be dealt with on a site-by-site basis.

3.3 Noise Abatement Determination

Noise Abatement Determination is a Three-Phased Approach.

1. Do any receptors **warrant** highway traffic noise abatement consideration?
2. Is it **feasible** to provide highway traffic noise abatement from an engineering and acoustical standpoint?
3. Is it **reasonable** from a cost/benefit, maintainability, and land use conformity consideration to provide highway traffic noise abatement?

NOTE – Three-Phased Approach of Noise Abatement Determination:

Noise abatement determination is a three-phased approach. Noise abatement design is driven from the results of the noise analysis (i.e., establishment of warrants). All warranted receptors must progress to the “feasible” phase. All feasible noise barriers, regardless of the number of receptor units protected, must then progress to the “reasonable” phase. Following the completion of all three phases, a determination can be made related to the feasibility and reasonableness of noise abatement options.

NOTE – Non-Barrier Abatement Measures:

While noise barriers (walls and/or berms) are by far the most common forms of highway noise abatement, the “non-barrier” abatement measures listed in [Section 3.2](#) should also be evaluated in terms of their feasibility and, if feasible, their reasonableness. In most cases, such evaluations can be documented by a qualitative discussion. If a more detailed evaluation is considered to be necessary, contact PennDOT’s Central Office Environmental staff for guidance.

The three-phased approach for determining the warrants for the consideration of noise abatement and for determining the feasibility and reasonableness of noise barrier is discussed below.

3.3.1 Phase 1 – Warranted Criteria

23 CFR 772.5 describes traffic noise impacts as “Design year build condition noise levels that approach or exceed the noise abatement criteria for the future build condition; or design year build condition noise levels that create a substantial noise increase over existing noise levels.”

This first phase of the process is to determine if highway traffic noise abatement consideration is warranted for the affected communities and/or the affected receptor unit(s).

NOTE – Not Having a Noise Impact:

If noise impacts do not occur at a receptor (i.e., approach, exceed, or substantial increase over existing), consideration of abatement is not required for that receptor. However, that receptor could receive some benefit from noise abatement constructed to protect nearby impacted receptor(s) and, as such, would be modeled and included in any reasonableness calculations ([Section 3.3.3](#)).

It is important to note that the FHWA noise abatement criteria (see [Table 1](#), page 31) refers to absolute noise levels for certain areas' activity categories. In order for a determination to be made, one of the following conditions must be met:

1. Noise impacts are described as impacts which occur when the predicted noise levels (for the design year) approach or exceed the noise abatement criteria in [Table 1](#). "Approach" has been defined by PennDOT as 1 dB(A) below the noise abatement criteria for Activity Categories A, B, C, D and E.
2. Noise impacts are described as impacts which occur when the design year noise levels substantially exceed the existing noise levels ("substantial noise increase"). Since the FHWA guidance on noise abatement does not specifically define "substantial noise increase," PennDOT has developed substantial noise increase criteria for all activity categories (Land Use Activity Categories A, B, C, D and E) where the future noise level increases by 10 dB(A) or more above the existing noise level. A 10 dB(A) increase in noise reflects the generally accepted range of increase which is likely to cause sporadic to widespread complaints. Receptor units that satisfy these criteria warrant further consideration of noise abatement.

Table 1
Hourly Weighted Sound Levels dB(A) For Various Land Use Activity Categories*

Land Use Activity Category	Leq(h) ¹	Description of Land Use Activity Category
A	57 (exterior)	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B2	67 (exterior)	Residential
C2	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.
E2	72 (exterior)	Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in A, B or C.
F	--	Agriculture, 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.

¹ Impact thresholds should not be used as design standards for noise abatement purposes.
² Includes undeveloped lands permitted for this activity category
* PennDOT has chosen to use Leq(h) [not L10(h)] on all of its transportation improvement projects.

3.3.1.1 Land Use Activity Category A

Activity Category A include lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose. Some examples of lands that have been analyzed as Activity Category A receivers include the Tomb of the Unknown Soldier, a monastery, an outdoor prayer area of a facility for nuns, and an amphitheater. Highway traffic noise abatement shall be considered whenever the design year total predicted noise levels approach or exceed 57 dB(A) (Leq). PennDOT Central Office and FHWA must approve a land use as Activity Category A.

3.3.1.2 Land Use Activity Category B

Activity Category B includes the exterior for residential land use. This Category also includes mobile home parks and multi-family residences. When analyzing areas with multi-family dwelling units, the analyst must identify all dwelling units predicted to experience highway traffic noise impacts. This may include units above the ground level (e.g., balcony on 3rd floor of apartment complex). Highway traffic noise abatement shall be considered for residential areas whenever the design year total predicted exterior noise levels approach or exceed 67 dB(A) (Leq). See [Table E1](#) in [Appendix E](#) for example applications of the determination of Equivalent Residential Units for Land Use Activity Area B sites.

NOTE – Equivalent Residential Unit (ERU)

The most common type of receptor analyzed in a noise study is a single-family residence, an Activity Category B land use. Such a site is typically represented by one receptor having a value of one residential unit in the feasibility and reasonableness determination process. Uses may also exist within all activity categories that may need to be represented by a single receptor which represents multiple units. Some examples include multi-unit dwellings such as apartments (Activity Category B), schools (Activity Category C), and motels (Activity Category E). To address such cases, PennDOT's methodology is to represent such uses with one receptor having an Equivalent Residential Unit (ERU) value which represents the degree of use which occurs at a site. The ERU value is a function of the "person-hours per year" of use of the site, expressed as a ratio to the "person-hours per year" of use by an average single-family dwelling in Pennsylvania. While the ERU value for a single-family residence is always one, ERU values for other sites will vary based on a variety of factors.

While application of ERU value methodology is required, the noise analyst may use any reasonably supported approach to arrive at a "person-hours per year" use value. [Appendix E](#) includes tables which provide examples of how such ERU values may be calculated for various types of activities. These tables are provided for guidance purposes only and their use is not mandatory. These tables may be modified to more appropriately represent available input data used in the development of a "person-hours per year" value and the associated ERU value. Optional spreadsheets are also provided to aide in the calculation of ERU values.

There may also be situations where activities occur over an area of land. Examples include uses associated with parks, cemeteries, athletic fields, etc. Such uses may best be represented by a grid of receptor points spaced within the property, with each grid point having an ERU value of one. [Appendix E](#) includes PennDOT's methodology for development and application of this approach. Also included within [Appendix E](#) is a process for the adjustment of specific grid point ERU values, if required.

While the above methodologies related to ERU values and grid-based analyses are to be applied uniformly for all projects, it is recognized that data availability varies and assumptions (using professional judgment) will need to be made in the application of these methodologies. Such assumptions should be documented in the appropriate noise analysis report.

3.3.1.3 Land Use Activity Category C

Activity Category C includes the exterior areas of a variety of nonresidential land uses not specifically covered in Category A or B. This category includes public and private facilities. Highway traffic noise abatement shall be considered when design year total predicted exterior noise levels approach or exceed 67 dB(A) (Leq). [Appendix E](#) describes the methodology that should be used to address Category C areas that can be represented by a series of grid points. [Table E2](#) in [Appendix E](#) presents examples of methodologies used to adjust the Equivalent Residential Unit values of specific points within the grid. [Table E3](#) in [Appendix E](#) provides example applications of the determination of Equivalent Residential Units for Land Use Activity Area C sites which are more appropriately represented by single receptor points.

3.3.1.4 Land Use Activity Category D

Activity Category D includes the interior of a variety of nonresidential public and private facilities that may be sensitive to increased noise levels such as 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. Highway traffic noise abatement shall be considered when design year total predicted interior noise levels approach or exceed 52 dB(A) (Leq). Refer to [Table E4](#) in [Appendix E](#) for examples of the methodology used to calculate the Equivalent Residential Use values for Activity Category D sites. Information is also available in FHWA guidance documents related to indoor noise prediction.

3.3.1.5 Land Use Activity Category E

Activity Category E is the exterior criteria for motels, hotels, offices and other developed lands not included in A-D or F. Highway traffic noise abatement shall be considered when design year total predicted exterior noise levels approach or exceed 72 dB(A) (Leq). Examples of the application of the methodology to determine Equivalent Residential Units for Activity Category E sites is included in [Table E5](#) in [Appendix E](#).

3.3.1.6 Land Use Activity Category F

Activity Category F includes a number of land uses that are not sensitive to noise such as agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing. No noise analysis is generally required for these locations.

3.3.1.7 Land Use Activity Category G

Activity Category G includes undeveloped lands that are not “permitted” for development. Although consideration of mitigation is not required, PennDOT must determine and document highway traffic noise levels and provide this information to local officials. The minimum information to provide is the distance to the impact threshold of each land use category. By providing local government with the best estimate of future noise levels, the highway agency may place responsibility for noise abatement on local government and/or property owner.

3.3.2 Phase 2 – Feasibility Criteria for Noise Barriers

For Screening Analyses: If impacts are noted and abatement is clearly NOT feasible (i.e., driveway access), the screening procedures should suffice and a detailed analysis is not required. In these situations, a qualitative discussion of barrier feasibility can be prepared that discusses how the required wall length would not be feasible due to unlimited access points. The wall dimensions can be estimated based on blocking the line of sight (height) to/from the receptor and extending the barrier 4X the distance measured from the roadway to the receptor. These dimensions must be included in the documentation and tailored for each project. Additional information on the screening analysis process can be found in Section 1.2.1.2.

For Detailed Analyses: To determine feasibility for a highway traffic noise barrier, the following seven acoustical and engineering parameters need to be considered. Each of the seven parameters is in the form of a question requiring a “yes” or “no” answer. For a proposed noise barrier to be considered “feasible,” there needs to be a “yes” answer to all seven questions. The answers to these questions will be documented in the Warranted, Feasible, and Reasonable Worksheet in order to determine the proposed noise barrier’s feasibility.

1. Can a noise reduction of at least 5 dB(A) be achieved at the majority of the impacted receptor units (i.e., 50% or greater)?
2. Can the noise barrier be designed and physically constructed at the proposed location?
3. Can the noise barrier be constructed without causing a safety problem?
4. Can the noise barrier be constructed without restricting access to vehicular or pedestrian travel?
5. Can the noise barrier be constructed in a manner that allows for access for required maintenance and inspection operations?

6. Can the noise barrier be constructed in a manner that allows utilities to adequately function?
7. Can the noise barrier be constructed in a manner that allows drainage features to adequately function?

NOTE – 5 dB(A) or Greater Highway Traffic Noise Reduction:

A noise reduction of at least 5 dB(A) for the majority of impacted receptors is required for a noise barrier to be determined to be feasible. Once the proposed noise barrier is determined to be warranted, feasible, and reasonable, it should be optimized to provide a balance between the most obtainable insertion losses per additional cost.

3.3.3 Phase 3 – Reasonableness Criteria for Noise Abatement Devices

A determination of noise barrier reasonableness will include the consideration of the parameters from the following subsections. 23 CFR 772 requires that the reasonableness factors listed in paragraphs 3.3.3.1, 3.3.3.2, and 3.3.3.3 must collectively be achieved in order for a noise abatement measure to be deemed reasonable. PennDOT will reevaluate the criteria used to determine allowable cost for abatement every 5 years. When making a determination of noise barrier reasonableness, the parameters used during the Environmental Clearance Phase (NEPA process) are also utilized during the Final Design Phase. In addition to these basic reasonableness parameters, there are additional parameters that pertain to and are only considered during the final design reasonableness determination. When performing a reasonableness analysis for the environmental clearance document, some parameters are not quantifiable at this stage of the analysis (e.g., desires of the impacted community). In the following descriptions of reasonableness parameters, a clear indication will be made when they specifically relate to final design. Questions relating to these parameters will be asked in the Warranted, Feasible, and Reasonable Worksheets in order to determine the proposed noise barrier's reasonableness.

The following options related to noise barriers should be evaluated for reasonableness:

1. Noise barrier height and length consistent with NEPA document recommendations (if recommendations were made)
2. Line-of-Site (LOS) option
3. Optimized noise barrier option
4. Where noise barriers are proposed on bridge parapets, provide an option which models the standard ten-foot high parapet mounted wall (ten feet, measured from the top of the parapet)
5. Any other options deemed necessary

3.3.3.1 Noise Barrier Cost Reasonableness Value

a. Noise Barriers

PennDOT's noise barrier cost reasonableness value is based upon a Maximum Square Footage of Abatement Per Benefited Receptor (MaxSF/BR) value of 2,000. This MaxSF/BR criterion shall be applied statewide as part of the noise barrier reasonableness determination process for all types of projects. It replaces the previously used "Cost per Benefited Receptor" criteria.

In determining the "Square Footage Per Benefited Receptor (SF/BR)" value during the reasonableness evaluation of any analyzed barrier, the square footage (SF) of a barrier shall be based upon its length and its height from the finished ground elevation at the base of the barrier to its top elevation (acoustical profile line). It is important to use sound judgment in order to establish an accurate SF value. For example, if the noise barrier will sit on top of a retaining wall, bridge parapet, Jersey barrier, or similar feature and this feature is modeled as a noise barrier in the analysis of the "No Barrier" case, then the base elevation of the noise barrier should be considered the top elevation of the supporting (retaining wall, bridge parapet, Jersey barrier, etc.) structure.

In determining "Benefited Receptor (BR)" values, count any receptor receiving 5 dB(A) or greater insertion loss (I.L.) as being benefited.

NOTE – Analyzing Apartment, Condominium, and Single/Multi-Family Units:

Since apartment and condominium buildings often share common outdoor use activities, it may be difficult to determine and analyze impacts and benefits. In these instances, utilize the methodologies described in [Appendix E](#). Professional judgment should be used and the PennDOT Central Office consulted when difficulties arise related to these multiple uses situations.

NOTE – Abatement for Non-First/Ground Floors:

Highway traffic noise barriers are often unsuccessful in providing highway traffic noise reductions for any floor other than the first/ground floor of receptor units. This is due to the inability to construct a noise barrier to the height necessary to provide effective noise mitigation while still being reasonably cost-effective for those non-first/ground floors (i.e., not feasible or reasonable).

b. Noise Berms

A guideline for assessing the reasonableness of a noise berm barrier is to estimate the volume of material which would be required to provide a berm barrier of the same length and height as a barrier wall. Using the data for the same barriers evaluated in determining the MaxSF/BR value of 2,000, the volume of material for the average height of all barriers (approximately 13.8 feet) was used to compute an average square foot area of a berm with 2:1 slopes and a 5 foot level top. This value (450 SF) was multiplied by the total length of barriers evaluated to produce a volume in cubic yards (CY). This volume was divided by the total number of benefited receptors associated with the barriers evaluated to produce a CY/BR value of 1,146. Based on these calculations, a "Maximum Cubic Yards Per Benefited Receptor (MaxCY/BR)" value of 1,200 was selected.

In addition to determining a CY/BR value for a berm barrier and comparing it with the MaxCY/BR value, it may also be possible to estimate the cost of a berm if information is obtainable related to the project's material (earth, stone, rock, etc.) availability, the cost of bringing in excess material (borrow), and the acquisition of additional right-of-way, if needed. On a "waste" job, the cost of constructing a berm barrier may somewhat offset costs of hauling excess material off-site (if the berm was not constructed). Use professional judgment when estimating the cost of an earthen berm. A reasonable berm barrier shall not exceed the MaxCY/BR value of 1,200 and its estimated net cost shall not exceed \$50,000 per benefited receptor.

3.3.3.2 Noise Reduction Design Criteria and Goals

23 CFR 772 requires an establishment of a noise reduction design goal for highway traffic noise abatement measures. Establishment of such a goal helps to assure the development of an optimized noise barrier design in order to achieve the most effective noise barrier in terms of both noise reduction (insertion losses) and cost.

Although at least a 5 dB(A) reduction of noise levels for the majority of impacted receptors is required to meet the feasibility criteria, the following tiered noise barrier abatement goals should be addressed when evaluating the reasonableness of any abatement device for Activity Category A, B, C, and E land use facilities:

1. It is required that exterior noise levels be reduced by at least 7 dB(A) for at least one benefited receptor.
2. While conforming to the MaxSF/BR criteria, it is desirable to obtain the 7 dB(A) minimum exterior insertion loss for additional impacted receptor sites if justified by a "point of diminishing returns" evaluation.
3. While conforming to the MaxSF/BR criteria, it is desirable to provide additional exterior insertion loss above the 7 dB(A) minimum if justified by a "point of diminishing returns" evaluation.

4. If possible, it is desirable to reduce future exterior noise levels to the low-60-decibel range (60-63) for Category B and C receptors and the upper-60 dB(A) range (65-68) for Category E receptors.
5. If possible, it is desirable to reduce future exterior noise levels back to existing exterior noise levels.

In accordance with 23 CFR 772.11(c)(2)(iv), interior noise analyses for Activity Category D land use facilities shall only be conducted after exhausting all outdoor analysis options and only after outdoor abatement options have been determined to be not feasible or not reasonable. If conditions warrant the evaluation of interior noise levels at an Activity Category D land use facility, the facility shall be represented by an analysis point having an equivalent residential unit value as determined by the procedures described in [Appendix E](#). The following tiered noise barrier abatement goals should be addressed:

1. It is required that interior noise levels be reduced by at least 7 dB(A) at the facility's analysis point.
2. While conforming to the MaxSF/BR criteria, it is desirable to provide an interior insertion loss above the 7 dB(A) minimum if justified by a "point of diminishing returns" evaluation.

When optimizing the proposed noise barrier, the tiered sets of required and desirable abatement goals listed above should be evaluated in terms of establishing noise reductions for impacted receptors only (not for non-impacted receptors). In the design of noise abatement features, the following barrier optimization techniques should be employed:

- a. **Point of Diminishing Returns Approach** - The relationship between noise barrier square footage and noise barrier performance is non-linear. This means that noise benefits typically increase with increased barrier height and/or length; however, at some point, further increases in barrier height and/or length result in smaller and smaller increases in benefit until a point of diminishing returns is reached. A point can be identified where a potential noise barrier provides the best balance between square footage and benefit. Final design highway traffic noise barriers should seek to maximize benefits while minimizing cost, given the need to achieve predetermined design goals and maintain noise barrier feasibility and reasonableness.
- b. **Barrier Optimization** - The 7 dB(A) noise reduction criteria values discussed in [Section 3.3.3.1](#) shall NOT be considered "upper limit" values in the design of noise abatement features. In other words, don't just design a noise barrier for a 7 dB(A) insertion loss unless this level represents the point of diminishing returns or unless further increasing the barrier square footage (thereby increasing the insertion loss) causes the MaxSF/BR value of 2,000 to be exceeded.
- c. **Noise Barrier Heights on Structures** - When optimizing noise barriers on bridge parapets, designs must be in compliance with bridge design and

bridge construction standards and shall be dealt with on a project-by-project basis. Coordinate with PennDOT Engineering District Bridge Unit and the Central Office, Bureau of Project Delivery, Bridge Quality Assurance Division when establishing noise barrier heights on bridge structures. This coordination should occur as early as possible in the project development process and, at the latest, prior to submitting the Final Design Highway Traffic Noise Report to PennDOT Central Office for review.

3.3.3.3 Consideration of Viewpoints

As related to the viewpoints of property owners and residences, the viewpoints of all benefited receptors shall be solicited in order to obtain enough responses to document a decision on either desiring or not desiring a noise abatement measure. Although the public may express opinions regarding the desire for or against particular noise abatement measures at any point in the development of a project, the solicitation of viewpoints does not formally occur until information contained within the draft version of the Final Design Noise Analysis Report has been approved for circulation to the public by PennDOT and FHWA. This process assures the public has access to the results of noise analyses prior to making any decision related to the desire for or available choices associated with noise abatement measures. More information is provided in [Step 6](#).

3.3.3.4 Activity Category C Land Uses

Within Activity Category C, there are several activities that can be difficult to quantify the number of receptor units. Category C criteria are applied to **exterior** activities related to active sports areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or non-profit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings. Methodologies and formula for calculating the cost/effectiveness of abatement of Activity Category C receptors is presented in [Appendix E](#).

NOTE – Public Parks:

A highway traffic noise impact on a public park, picnic area, recreation area, or playground may result in a constructive use of a Section 4(f) property determination. Refer to [Step 6 – Public, Municipality, and Agency Involvement](#) and [Step 7 – Reporting Results of Highway Traffic Noise Analysis](#) for further details on how to obtain public input and documentation requirements of public parks, picnic areas, recreation areas, and playgrounds.

3.3.3.5 Existing Noise Barriers within a Type I Project

As PennDOT continues to expand existing highway systems, it is likely Districts will encounter Type 1 projects that involve noise barriers already in place. FHWA has provided guidance in these

situations in the memorandum “Consideration of Existing Noise Barriers in a Type I Noise Analysis” FHWA-HEP-12-051 located in [Appendix D](#).

3.4 Completing the Warranted, Feasible, and Reasonable Worksheets

After the warranted, feasible, and reasonable analysis is completed, the rationale for the areas where noise abatement is warranted must be documented in a Warranted, Feasible, and Reasonable Worksheet for that NSA/partial NSA. It may be appropriate and necessary to prepare a separate worksheet for each noise abatement measure system, particularly if more than one noise abatement measure exists in a NSA or if an abatement measure transcends through several NSAs. It is PennDOT's policy that the final decision on the implementation of highway traffic noise abatement measures will be made only after careful and thorough consideration of the warrants, feasibility, and reasonableness of proposed highway traffic noise abatement measures.

A Warranted, Feasible, and Reasonable Worksheet must be completed for each noise-impacted area that warrants highway traffic noise abatement consideration in accordance with PennDOT and FHWA guidelines. Begin obtaining information for the worksheets during the Environmental Clearance Phase of the preliminary design process. The worksheet must be finalized prior to completion of the Final Design Highway Traffic Noise Report so that final approval can be given by FHWA during its review. Copies of worksheets for wall and berm type barriers are included in [Appendix A](#). Excel files of the worksheets have also been embedded into [Appendix A](#). Worksheets will become part of the permanent project file and must be considered as important decision-making documents which must be preserved.

NOTE – Documentation of the Warranted, Feasible, and Reasonable Worksheets:

The worksheet(s) associated with each NSA's proposed noise barrier(s) or noise barrier system(s) must be incorporated into the final design document. The final submissions of the final design documents must have the worksheets signed by the Engineering District's Environmental Manager and the qualified professional(s) who performed the highway traffic noise analysis. The worksheets do not have to be signed on draft final design document submissions. These worksheets will document, within the administrative record, the warrants, feasibility, and reasonableness of providing highway traffic noise abatement measures for the proposed transportation improvement project.

3.5 Highway Traffic Noise Barrier Design Commitments

Highway traffic noise abatement commitments are made at two times during a project's development: in the Environmental Clearance Phase and the Final Design Phase.

1. Preliminary Design/Environmental Clearance

Before adoption of the final environmental clearance document, the Engineering District Office shall identify highway traffic noise abatement measures for each impacted location which are warranted, feasible, and reasonable. At the time that the environmental clearance document is being finalized, noise studies will have progressed to the stage where noise-impacted areas have been identified. At this stage, it is unlikely that exact barrier location abatement types, right-of-way requirements, etc. can be determined. However, approximate barrier location and height information should be known at this time.

For the areas where abatement considerations are being recommended, the final environmental clearance document must contain language similar to the following: "The Pennsylvania Department of Transportation is committed to the construction of warranted, feasible, and reasonable highway traffic noise abatement measures at the noise-impacted locations identified in (table, figure, chart, etc.) contingent upon the following conditions:

- detailed noise analyses during the Final Design Phase;
- analysis and determination of the feasibility and reasonableness of highway traffic noise abatement measures methodology and criteria;
- community input regarding desires, types, heights, and locations as well as aesthetic considerations;
- safety and engineering aspects as related to the roadway user and the adjacent property owner.

Feasible and reasonable noise abatement measures will be constructed contingent upon the above factors and conditions. Final recommendations on the construction of any noise abatement measure(s) will be determined during the completion of the project's final design and public involvement processes." The above documentation should be contained in a Preliminary Engineering Highway Traffic Noise Report. This report should be reviewed by the District and Central Office, with concurrence provided by FHWA. The format and content of this report should generally follow that described for the Final Design Highway Traffic Noise Report, as outlined in Section 7.0.

2. Final Design

During the Final Design Phase, the exact location, abatement types, aesthetic treatments, right-of-way requirements, etc. should be determined and be a part of the final recommendation for highway traffic noise abatement. A detailed discussion for each recommended noise barrier should be presented in the Final Design Highway Traffic Noise Report.

3.6 Abatement Measure Reporting

23 CFR 772 requires that each highway agency shall maintain an inventory of all constructed noise abatement measures and requires that the inventory shall include the specific items listed in Section 772.13(f) of 23 CFR 772. [Appendix G](#) contains examples and spreadsheet tables for recording this information for wall and berm type abatement devices. To the extent available, information required on these forms should begin to be added when the Final Design Highway Noise Analysis is nearing completion, with the form(s) following the Warranted, Feasible, and Reasonable Worksheets in the Final Design Noise Analysis Report. The table(s) should be totally completed within three (3) months after the award of the project and provided to the District Environmental Manager.

NOTE – With the exception of the project-related bid costs, all of the information required to be entered on the [Appendix G](#) table(s) should be available from the analyses and evaluations performed at the completion of the Final Design Highway Noise Analysis process. This information is required to be included in the Final Design Noise Report. Project bid costs can be found in ECMS; reference [Appendix G](#).

4.0 STEP 4 – Additional Considerations for Final Design Highway Traffic Noise Barrier Analysis

4.1 Final Design Considerations and Measures

The need for a project to move into a final design noise study is dependent upon the extent of noise impacts, likelihood for providing abatement, and potential for design changes that may affect the acoustics and findings of the NEPA study. Type I projects typically proceed into a final design noise study which reconsiders highway traffic noise abatement in light of more exact designs and project alignment refinements. In addition, land use changes (e.g., conversion from residential to commercial) may preclude a barrier's construction or potentially create the need for a barrier that was not evaluated in the NEPA phase. The level of effort required for the final design noise study should be commensurate with potential for design change, land use modifications, and abatement potential as outlined in the environmental clearance documents. For projects that identify noise-impacted sites that clearly will not be eligible for mitigation (i.e., roadway widening where driveway access precludes barrier construction), the final design analysis can consist of a memorandum referencing the preliminary design noise study and conclude that its results remain valid. The majority of final design noise assessments will involve a detailed reanalysis of the project using additional noise measurements, modeling using refined engineering, and concluding with public involvement and concurrence from FHWA.

During the Final Design Phase, highway traffic noise abatement shall be reconsidered in light of more exact designs and project alignment refinements. Abatement shall then be considered based on reanalysis of the roadway/noise receptor relationships and expanded community input.

A highway traffic noise analysis conducted during the Final Design Phase shall primarily be concerned with abatement of noise impacts identified during the Preliminary Design Phase. The goals of a final design noise analysis are to:

- determine if any warranted highway traffic noise abatement measures are feasible and reasonable;
- determine the desires of the impacted and benefited receptor unit(s); and
- incorporate appropriate aesthetic treatments.

The highway traffic noise analysis data file shall be reviewed as the first step in the refinement process for final design abatement. Close attention should be paid to the public coordination and comments conducted during the Preliminary Design Phase (particularly in areas where abatement is warranted). When final alignment boundaries are set, the final design study should commence according to the procedures set forth in this Handbook. The draft version of the Final Design Highway Traffic Noise Report should be compiled and submitted to EPDS and subsequently to FHWA (when federal funds are used) for concurrence prior to conducting final public meetings where barrier options and recommendations are presented.

Preliminary coordination with the public should be conducted at a public meeting after concurrence with the draft version of the Final Design Highway Traffic Noise Report. If the community chooses to accept the highway traffic noise abatement being recommended, the process proceeds to the conceptual design stage where the type, size, and location of highway traffic noise abatement will be determined through an iterative process involving the community and PennDOT. After the community accepts the final highway traffic noise abatement design, based on understandings and factors discussed in [Section 4.3](#), noise abatement proceeds to the PS&E and construction phases.

If, as a result of refined engineering, the project limits become extended, the receptors within the extended areas need to be assessed for highway traffic noise impacts. The justification for extending the project limits must be discussed in the Final Design Highway Traffic Noise Report. The project limits are not to be extended solely for providing additional noise abatement to receptors not affected by the project.

4.2 Date of Public Knowledge

To be eligible for abatement consideration during the Final Design Phase, developed and undeveloped lands are required to have been “permitted” by the “date of public knowledge.” The “date of public knowledge” shall be the date that a project’s environmental analysis and documentation is approved (i.e., the date of approval of a CEE, date of the issuance of the Finding of No Significant Impact, or the date of the Record of Decision). The evaluation, design, and/or construction of any noise abatement after this date becomes the responsibility of local communities and private developers.

The “date of public knowledge” and a thorough discussion of undeveloped lands that are and are not considered to be “permitted” must be documented within the text of the Final Design Highway Traffic Noise Report. This is in addition to the documentation required on the Warranted, Feasible, and Reasonable Worksheets.

If significant changes are made to the selected alignment (e.g., horizontal/vertical) during the Final Design Phase that result in significant changes to the noise environment, PennDOT is responsible for assessing impacts only where the significant noise change(s) occurs. This must be done for developed lands as well as undeveloped lands which are considered “permitted” at the time the change is assessed in the Final Design Phase noise analysis.

4.3 Desires of Those Individuals Impacted by Highway Traffic Noise

During the Final Design Phase, it is extremely important to determine if the majority of the owners and residents of affected receptor units really want the noise barrier. This may require a voting survey. Any receptor unit owner or resident opposing the proposed noise barrier must submit a voting survey form which indicates the owners/residents’ opposition to the proposed noise barrier.

This indicates that the owner/resident thoroughly understands the potential future noise impacts as well as the fact that, if a noise barrier is declined by the community at this time, a noise barrier will not be built in the future for the area under question. This letter/survey must be documented in the Final Design Highway Traffic Noise Report. Refer to [Step 6](#) – Public, Municipality, and Agency Involvement in this Handbook and PennDOT Public Involvement Handbook: Publication No. 295 for assistance on the public involvement process.

4.4 Applications for Absorptive Noise Barriers

Depending on the specifics of the transportation improvement project, an absorptive noise barrier surface may be recommended to optimize the benefits of the proposed highway traffic noise abatement. Cases where it may be appropriate to consider noise barrier panels with absorptive surface(s) include:

- a parallel noise barrier system;
- when there is an extremely sensitive receptor(s) on the other side of the highway from the proposed noise barrier;
- when there is a retaining wall with a reflective surface on the other side of the highway from the proposed reflective-surfaced noise barrier;
- when there are impacted receptors on the other side of the highway for whom a noise barrier on their side was determined not to be feasible or reasonable; and
- a bifurcated highway system.

Determination for the use of an absorptive treatment will be made in accordance with the guidance set forth below and in consultation with the District, Bureau of Project Delivery's Environmental Policy and Development Section (EPDS), and FHWA personnel upon review of the noise data. Under no circumstances should the use of absorptive treatment be presented to the public until approval from EPDS and FHWA has been obtained.

The following guidelines should be followed on all projects where absorptive-faced noise barriers are being considered.

- Criteria for Consideration
 - Absorptive-faced noise barriers will be analyzed for a single barrier configuration (a barrier located on only one side of the highway) on a case-by-case basis only. Coordination with EPDS is required for these situations.
 - Absorptive-faced noise barriers will be analyzed for parallel barrier configurations (a barrier located on both sides of the

highway) where the ratio of the distance between the barriers to barrier-height is less than 10:1 (e.g., a configuration such that a 100-foot cross section is flanked on both sides by sound barriers at least 10 feet high). Such a configuration has the potential to degrade barrier performance by 3 dBA or more. Professional judgment should be used in terms of evaluating parallel barriers with a ratio between 10:1 to 20:1. While these configurations do not typically cause barrier performance degradation of more than 3 dBA, certain relationships between receptor locations (distance and height) and highway geometry may cause exceptions to this rule-of-thumb. In addition, in certain instances, a degradation of several decibels may have a marked effect on the determination of feasibility and/or reasonableness of a barrier.

- Evaluation Tools and Techniques
 - The most recent version (or approved version for the project) of the FHWA TNM will be used to model the degradation to predicted insertion loss due to reflected sound for parallel barrier situations. This will be done with the “Parallel Barrier Analysis Module” contained within the software.
 - It is recommended that a minimum of 3 cross section analyses be used in the area of the parallel barrier configuration, including a cross section analysis within 500 feet of the terminus of the parallel barriers. Ideally, a cross section analysis at every 500 to 1,000 feet along the parallel barrier corridor is recommended. The location of impacted receptors (and the similarity in geometric relationship between source and receptor) should dictate the selection and quantity of the FHWA TNM cross section study areas. In complex situations, it may be necessary to develop one or more cross section(s) for each NSA or group of receivers that would experience varying degrees of reflective noise.
 - Cross section analyses should include a reflective barrier to determine the potential increase to the FHWA TNM post-barrier noise levels and also include an absorptive surface analysis using a Noise Reduction Coefficient (NRC) of 0.70. Additional NRC values may also be evaluated, dependent upon the availability and rating of PennDOT-approved absorptive barrier systems at the time of analysis.
 - It should be noted that the “Parallel Barrier Analysis Tool” does not link its results to the main FHWA TNM analytical computation and, as such, the results will need to be applied as an adjustment factor at the appropriate impacted NSAs.

The “adjustment factor” may vary from location to location due to variations in the geometric relationship and topography between receivers, roadways, and barriers. Similarly, some cases may exist where the same “adjustment factor” should be applied throughout an entire area (or project) due to similar geometric relationships and topography within a given area. During final design, changes to a specific noise barrier could change the adjustment factor which would be applied, thereby changing reported noise levels.

- FHWA TNM results for parallel barrier configurations should be presented using the adjustment factors developed in the Parallel barrier module for both reflective and absorptive walls.
- Absorptive Surface Determination
 - If the analysis determines that the adjusted levels for reflective walls yields the noise reduction goal at impacted receptors, no absorptive treatment is needed.
 - It is the Department’s policy to permit the use of absorptive walls in parallel barrier configurations when:
 - the degradation results in noise levels and/or insertion loss values that cause the barrier not to be feasible and/or reasonable;
 - one or all of the required noise abatement goals are not met because of the parallel barrier degradation; or
 - a reasonable increase of the barrier height does not counter the negative effect of parallel barrier reflective noise.
 - Keep in mind that final noise levels and decisions related to noise mitigation options are not determined until the project progresses well into final design.
 - The final determination for the use of an absorptive treatment will be made in consultation with the District, EPDS, and FHWA personnel based upon review of the noise data.
 - Under no circumstances should the use of absorptive treatment be presented to the public until approval from EPDS and FHWA has been obtained.

- Documentation
 - Documentation of the parallel barrier analysis should include a discussion of methodology and results, including a table showing the sound level increase associated with the parallel reflective barriers at receptors studied in the cross section analysis. This table should include the prediction of results for a reflective and an absorptive wall according to the evaluation tools and techniques presented above. The recommended general statement for all environmental clearance documents in Publication 24, Section II-27, should be expanded to state that the final determination on absorptive treatment will be made during final design.

4.5 Value Engineering and Contractor-Suggested Changes

Highway traffic noise abatement measures shall be evaluated with respect to current PennDOT value engineering policies during the Final Design Phase and prior to construction and/or changes proposed by the contractor. This shall be done in order to determine if the application of value engineering concepts is warranted. The currently approved noise model program is an excellent tool to optimize the noise abatement being proposed. Specific information regarding highway traffic noise abatement value engineering will be distributed to PennDOT Central Office Bureaus and to the Engineering Districts, as appropriate.

NOTE – Value Engineering Effects on Acoustical Profiles and Aesthetic Commitments:

Value engineering should not jeopardize the proposed noise barrier in terms of its acoustical profile or its aesthetics. Typically, commitments to acoustical profiles and aesthetics (i.e., surface textures, slopped top panels, full panels, post type, landscaping, etc.) occur during the public involvement process and therefore cannot be removed from the project as the result of value engineering or as the result of the contractor requesting alternatives. The Engineering District should coordinate with the professional(s) designing the noise barrier to determine, through the use of the currently approved computer-modeling program, if value engineering changes are compatible with the abatement commitments made during the public involvement process.

NOTE – Noise Barrier Reserves:

In areas where there is little distance between the shoulder of the highway and the noise barrier, it may be beneficial (and more cost-effective) to consider purchasing extra “replacement” panels. Replacement noise barrier panels purchased ahead of time can save excessive amounts of time and money should a panel become damaged. Consult FHWA when a project contains federal funds.

4.6 Context-Sensitive Solutions

In order to achieve a successful noise barrier design, a noise barrier must be acoustically effective, structurally sound, safe for the motorist, durable, and visually attractive. A noise barrier should complement the community for which it is abating noise. The relationship of the proposed noise barrier to the environment is a primary factor in the aesthetics that cannot be ignored. Location, color, texture, material, shape, placement, and detail all influence the effect of the barrier on the environment. The landscape, which dictates the highway’s character, will impact the style of the barrier. All of these factors and their incorporation in the noise barrier design will determine the aesthetics and, ultimately, the public acceptability of the noise barrier. Below are only a few considerations that each Engineering District may consider on a project-by-project basis. Reference the FHWA Highway Noise Barrier Design Handbook, February 2000 for a more comprehensive discussion of a wide variety of considerations.

- Tree/vegetation plantings and landscaping may be considered when plantable space is available while also considering maintainability issues. The appropriate Engineering District should determine the type, amount, and placement of plantings on the highway side of the noise barrier. Although not necessary, community and municipality input can be considered.
- Consider providing a barrier kick plate for protection from landscaping equipment and snow removal machinery.
- Consider providing a cap on the top of the noise barrier or integrally cast into the barrier panels. When a noise barrier varies in height, angled or sloped barrier panel tops may be considered as a way to smooth out and “blend” the noise barrier into the surrounding environment.

4.7 Design-Build Projects

For design–build projects, 23 CFR 772 requires that the Preliminary Engineering Noise Report shall document all considered and proposed noise abatement measures for inclusion in the NEPA document. It also requires that final design of design-build noise abatement measures shall be

based on the preliminary noise abatement designs developed in the technical noise analysis and that noise abatement measures shall be considered, developed, and constructed in accordance with 23 CFR 772 and in conformance with the provisions of 40 CFR 1506.5(c) and 23 CFR 636.109. These latter two provisions contain direction related to the requirements of design-build projects.

Following the approval of the Preliminary Engineering Noise Analysis Report by PennDOT and FHWA, the District's Environmental Manager shall transmit to the District's Portfolio (or Project) Manager:

- a. A copy of the Preliminary Engineering Noise Analysis Report or information contained in the noise technical data file pertaining to noise abatement features
- b. A copy of any sections of the project's environmental clearance document related to noise abatement determinations
- c. Any other noise-related information pertinent to the project
- d. A narrative which addresses the necessary and appropriate acoustical and aesthetic requirements related to noise abatement features determined to be feasible and reasonable. The content and specificity of this narrative will vary depending upon the detail of barrier design available at the time that the project proceeds into the design-build phase. The intent of the narrative is to provide acoustical and aesthetic requirement information to the developer of a design-build performance specification. The developer of the specification can then meld these requirements with the structural and engineering requirements.

The District shall provide a mechanism for the District Environmental Manager (or designee) to monitor, track, and report on the development and implementation of project noise abatement measures through the design-build process. Please refer to PennDOT Publication 448 for additional Design-Build guidance.

5.0 STEP 5 – Construction Noise Consideration

Construction noise should be addressed as part of the development of any transportation facility. Roadway construction is often conducted in proximity to residences and businesses and should be controlled and, if necessary, monitored in order to avoid excessive impacts. The reaction by a community to construction-generated noise can threaten construction schedules. In general, a project's schedule can be maintained by balancing the type, time of day, and duration of construction activities; considering the intent of local noise control requirements; and being proactive to community concerns.

For PennDOT projects, potential construction-related noise impacts from transportation improvement projects should be evaluated on a project-by-project basis, considering land uses/identified, construction measures being used, and public concern. The level of analysis can range from qualitative to quantitative analyses, depending on the anticipated level of impact. The impact of construction noise does not appear to be serious in most instances. Calculation of construction noise levels is usually not necessary. The decision to develop a detail construction noise analysis usually results from combination of factors including the scale and scope of the project along with public concern about construction noise. In some cases, the decision to complete a construction noise analysis may occur after construction begins resulting from public complaints. It is best to anticipate public concerns so the project plans, specification and estimates include consideration for construction noise abatement where necessary.

5.1 Tools for Evaluating Highway Construction Noise

5.1.1 FHWA Highway Construction Noise Handbook

To aid in the analysis of construction-related noise impacts, the FHWA has developed the FHWA Highway Construction Noise Handbook. This document outlines the measurement, prediction, mitigation and public involvement components of a construction noise analysis. The Highway Construction Noise Handbook and the Roadway Construction Noise Model (RCNM) are available online through the FHWA's Web site.

5.1.2 FHWA Roadway Construction Noise Model (RCNM)

To aid in the analysis of construction-related noise impacts, the FHWA has developed the Roadway Construction Noise Model (RCNM) for the prediction of construction-related noise. This model is not required for use on federal-aid projects; however, it can be used for the prediction of construction noise during the Project Development and Construction Phases. The RCNM allows users to quickly create a variety of construction work scenarios and determine the impact of changing construction equipment and adding/removing the effects of shielding due to noise mitigation devices such as barriers.

5.2 Source Control

In devising construction noise-control strategies, an important option is to control the noise at the source. By specifying and/or using less noisy equipment, the noise impacts produced by construction of a highway facility can be greatly reduced or even eliminated. Source control requirements may have the added benefit of promoting technological advances in the development of quieter equipment. Additional options to reduce anticipated construction-related noise impacts should focus on limiting the time of day or allowable duration for specific activities in noise-sensitive areas or planning construction staging-areas in a practical way, away from noise-sensitive areas and activities. A more thorough discussion of source controls is contained in the “FHWA Highway Construction Noise Handbook.”

NOTE – *Construction Noise-Related Coordination with Locals:*

When construction noise is an issue, the Engineering District should coordinate with the communities and local municipalities to establish periods of time when construction activities that cause high noise levels should not occur. Any time construction noise specifications are required to be included in PS&E packages, detailed coordination is suggested with PennDOT and the local municipality.

5.3 Construction Noise Documentation

Based on the degree of information available at this phase, the effects of construction noise should be documented in the Environmental Clearance document and Final Design Highway Traffic Noise Report. In doing so, the temporary nature of the impacts should be noted. An indication of the types of construction activities that can be anticipated and the noise levels typically associated with these activities can be obtained from the FHWA Highway Construction Noise Handbook or from the FHWA RCNM. Utilizing a common-sense approach, traffic noise analyses should identify measures to mitigate potential highway construction noise impacts. Low-cost, easy to implement measures should be incorporated into project plans and specifications (e.g., work-hour limits, equipment muffler requirements, location of haul roads, elimination of “tail gate banging,” reduction of backing up for equipment with alarms, community rapport, complaint mechanisms). For example, the following language may be incorporated.

“The contractor shall use only equipment adapted to operate with the least possible noise and shall conduct their work so that annoyance to occupants of nearby property and the general public will be reduced to a minimum.”

or

“The contractor shall construct noise abatement measures at the initial stages of construction when feasible to protect against construction noise.”

or

“The Pennsylvania Department of Transportation is committed to abatement of construction noise at the locations identified in (Table, Figure, Chart, etc.) contingent on the following considerations:

1. detailed construction noise analysis and/or design considerations during the Final Design Phase;
2. community input regarding sequence of operations and time and activity constraints;
3. site and source control of construction; and/or
4. safety and engineering aspects.

It is likely that the noise abatement measures for the identified construction noise-impacted areas will be carried out if found to be feasible and reasonable based on the contingencies listed above.”

6.0 STEP 6 – Public, Municipality, and Agency Involvement

6.1 Degree and Type of Involvement

The degree and type of public/municipality/agency involvement will vary from project to project. For projects requiring the consideration of highway traffic noise, public involvement activities should allow for presentations and subsequent discussions of both highway traffic noise and construction noise levels and impacts related to the Type I and Type II (federally and state-funded) projects. Opportunities for such involvement should be provided as appropriate during both the environmental document preparation phase and the Final Design Phase. Discussion should relate to issues such as:

- highway traffic noise levels;
- highway traffic noise-related impacts;
- highway traffic noise abatement options, including partial highway traffic noise abatement options; and
- areas where highway traffic noise abatement is not feasible and reasonable.

NOTE – Final Design Noise Abatement Public Meeting(s):

Final design noise abatement public meetings should not be conducted until the draft version of the Final Design Highway Traffic Noise Report is approved by EPDS and FHWA. Highway traffic noise abatement commitments will be finalized at the final design noise abatement public meeting(s). The results of the final design noise abatement public meeting(s) will be included in the final version of the Final Design Highway Traffic Noise Report.

6.2 Local Officials

An effort should be made to inform local officials within whose jurisdiction the highway project is located of ways to prevent future highway traffic noise impacts on currently undeveloped lands. The following [from 23 CFR 772.17] are several ways this can be achieved.

- The best estimation of future noise levels (for various distances from the edge of the nearest travel lane) for both developed and undeveloped lands or properties in the immediate vicinity of the project.

- Information that may be useful to local communities to protect future land development from becoming incompatible with anticipated highway noise levels.
- PennDOT's current Type II Policy (PennDOT does not currently have a Type II retrofit policy).

6.3 Affected Receptors

When construction of a noise barrier is being considered in the Final Design Phase, such measures will not be approved without documentation that the affected community has had the opportunity to provide input into the development process. A good community relation effort can often prove to be the most effective highway traffic noise mitigation component. PennDOT Publication No. 295 "Public Involvement Handbook" should be referenced for all projects involving highway traffic noise issues.

Coordination with all receptor unit owners and residents directly affected by highway traffic noise is a very important part of the Final Design Phase. At any time during this process, the impacted community or individual receptor unit owner(s) may express viewpoints related to noise abatement. However, the official viewpoint regarding the desires for or against a noise abatement device will not be accepted by PennDOT until the community has had the opportunity to gain knowledge of the implications of a barrier/no barrier decision based on the information developed at the conclusion of the Final Design noise analysis process.

This allows the community the opportunity to provide input based on the proposed location, type, height, and length of the noise abatement feature. The abatement design is further refined to include the community's comments and to optimize the abatement feature. Subsequent community meetings allow for a refinement of the abatement design, keeping in mind the acoustic, engineering, and safety considerations until agreement is reached.

NOTE – Public Involvement for Land Use Activity Categories C, D and E:

An active public involvement approach with all the owners and users of these non-residential land uses, should be incorporated to determine the types, duration, frequency, and areas of activity usage as well as community importance and significance of the outdoor activities. Public involvement activities should recognize that these land uses may cover an area greater than the defined study area for the project, and appropriate steps should be made to accommodate these special circumstances (i.e., township meetings). Although some users may be further removed (in terms of location) from these activity areas than others, efforts need to be taken to obtain their input throughout the highway traffic noise analysis process. Therefore, all the communities that use these activity areas, as well as their local officials, should be invited to participate in the public involvement process.

6.4 Voting Procedures

As long as it is documented in the Final Design Highway Traffic Noise Report how benefited receptor unit owners/residents voted (desire for a barrier, location, and color/), the method of obtaining votes (i.e., flyers, door-to-door, public meeting, etc.) shall be determined by the Engineering Districts on project-by-project bases.

6.4.1 Voting on the Construction of the Noise Barrier

The viewpoints of residents and property owners will be solicited as part of the public involvement process. Both property owners and renters of the receptor units that are benefited by highway traffic noise may vote on whether they are in favor of the proposed noise wall. The owner of each benefited receptor unit shall receive one vote of equal value for each benefited receptor unit owned. The renter shall receive one vote for the unit in which they reside. In the case of conflicting desires, it is recommended that the project team tally the votes and summarize the results on project mapping. Final interpretation of the voting results will be made by PennDOT and its consultants, considering all feedback gained during the public involvement process.

Of all the votes tallied, 50% or greater must be in favor of the proposed noise barrier in order for the noise barrier to be considered reasonable. When assessing those votes that are not in favor of the proposed noise wall, the Engineering District needs to assess the number and location of these opposing votes on a noise barrier by noise barrier basis. This may result in partial highway traffic noise abatement or the inability of satisfying the request of the opposing votes.

NOTE – Partial Highway Traffic Noise Abatement:

PennDOT is dedicated to providing feasible and reasonable noise abatement. If the opposing votes are located in areas where partial highway traffic noise abatement is feasible and reasonable without compromising or jeopardizing the noise barrier's abatement ability for the remaining benefited receptors, every reasonable effort must be made to accommodate the needs and wants of every benefited receptor, despite their approval of or opposition to the proposed noise barrier.

Every reasonable effort should be made to contact the owner/renter of the benefited site(s) for voting purposes. Multiple attempts should be made to obtain a vote, including mail, certified letter, and door to door surveys.

6.4.2 Voting on the Color & Texture of the Noise Barrier

The owner of each receptor unit that is benefited by a barrier shall receive one vote of equal value. For example, if the owner has a 30 unit apartment building, they get 30 votes, one for each unit. The renter shall receive one vote for the unit in which they reside. In the case of conflicting desires, those receptor units that abut the noise barrier, abut the right-of-way line, or have an unobstructed

view of the noise barrier will receive greater consideration than those receivers that have an obstructed view of the barrier. In the case of conflicting desires, it is recommended that the project team tally the votes and summarize the results on project mapping. Final interpretation of the voting results will be made by PennDOT and its consultants, considering all feedback gained during the public involvement process.

PennDOT will decide the color and texture on the highway side of the proposed noise barrier unless there is third-party funding involved. Since the design of the project and the configuration of the receptor units vary from project to project, this voting procedure may not be straightforward. Professional judgment will be required in making this determination.

6.5 Third-Party Funding Options

Third-party funding is limited to aesthetic and functional enhancements above and beyond that for which PennDOT is responsible. Third-party funding will be limited to functional enhancements such as access doors, absorptive treatment, etc. and aesthetic enhancements such as wall graphics, plantings, etc. and cannot be used to contribute funds when the reasonableness criteria is not met. Any additional costs associated with the desires of a municipality/community to have special graphical designs (i.e., standard color/texture vs. imprinted or painted graphical designs) on either the residential side or the highway side of the proposed noise barrier must be paid for by the municipality/community.

Regardless of contribution sharing, no barrier should be funded by PennDOT which does not meet the warrants, feasibility, and reasonableness requirements. The Engineering District must work with those providing the funding to work out the details of the agreement. Once the noise barrier components (posts, panels, caps, etc.) are ordered, the third party is committed to the funds associated with the agreement, and no changes will be made to the order unless the third party is willing to absorb the additional cost associated with the order change. All third-party funding agreements must be addressed in a non-discriminatory way and documented in the Final Design Highway Traffic Noise Report.

6.6 Responding to Type II Abatement Requests

Since PennDOT does not have a Type II noise program, Federal Funding of noise abatement is limited to constructing feasible and reasonable abatement for Type I projects. PennDOT periodically receives requests to provide noise abatement along existing highways. The following standardized letter should be used when responding to inquiries concerning abatement on existing highways.

Standard PennDOT Type II Response Letter

Dear Resident:

Thank you for your correspondence dated _____ which expresses interest in constructing noise barriers on existing Route _____.

The Pennsylvania Department of Transportation (PennDOT) noise abatement policy is currently limited to the construction of warranted noise barriers as part of a highway project on new alignment or for a major reconstruction project with additional travel lanes. PennDOT does not have a funding mechanism for noise barrier retrofit projects on existing highways at this time due to constrained federal and state highway dollars. PennDOT continues to use its available funding to address our most critical bridge and highway needs and to maintain our existing infrastructure.

Additional information on the Department's noise abatement program can be found in our Publication #24, Project Level Highway Traffic Noise Handbook. This publication is available on the PennDOT website at <http://www.penndot.gov> or by calling our Materials and Services Management Division at 717-787-6746.

Thank you for your continuing interest in Pennsylvania's Transportation Program. If you have any further questions regarding this issue, please contact _____.

7.0 STEP 7 – Reporting Results of Highway Traffic Noise Analyses

7.1 Environmental Clearance Reporting

It is the responsibility of the Engineering District and the qualified professionals performing the highway traffic noise analyses to ensure that the results of the highway traffic noise analyses are accurately documented in all sections (i.e., cultural resources) of all the environmental clearance documents [Section 106, Section 4(f), Evaluation Report, and EIS/EA/CEE] for that transportation improvement project. For projects requiring a highway traffic noise assessment as part of a CEE, EA, or EIS, a determination will need to be made on whether to report results using a narrative or to report the results of a simple or detailed analysis. The scope and magnitude of a noise analysis is determined by the extent of anticipated noise effects, not on the NEPA classification. A project may be classified as an EIS due to significant wetland impacts but have no noise-impacted receptors in the project area. In this case, no noise analysis would be required. Conversely, a CEE project for a roadway widening within the existing right-of-way in an already noisy area may require a detailed noise analysis. [Step 1](#) provides further direction on scoping the appropriate level of analyses.

7.1.1 Categorical Exclusion Evaluation, Environmental Assessments and Environmental Impact Statements

The need for and/or type of noise consideration, analysis and abatement is a function of the potential for noise impact and not the class of environmental action. For projects requiring a detailed noise analysis as part of a CEE, EA or EIS, the highway traffic noise analysis shall address the number of highway traffic noise monitoring sites as they relate to impacted communities, proposed highway traffic noise impact prediction techniques, and software requirements as well as any unusual circumstances. It should also include the avoidance techniques offered to reduce or eliminate the potential highway traffic noise impacts. PennDOT Publication 10, Design Manual, Part 1 should be referenced for all transportation improvement projects involving highway traffic noise issues.

The data presented in an EIS should be similar to that presented for an EA. However, the Draft EIS has several additional sections. The “Affected Environment” section shall briefly discuss the existing highway traffic noise environment if such data were analyzed. This section shall include a statement indicating that noise impacts are discussed in the “Environmental Consequences” section. If the EIS is the revised NCHRP format, these sections will be combined into one general discussion of “Environmental Resources, Impacts, and Mitigation”.

The environmental document shall identify/summarize locations where noise impacts are predicted to occur, where noise abatement is feasible and reasonable, and locations with impacts that have no feasible or reasonable noise abatement alternative. For environmental clearance, this analysis shall be completed to the extent that design information on the alternative(s) under study in the environmental document is available at the time the environmental clearance document is

completed. Details of the analysis should be provided in the Preliminary Engineering Highway Traffic Noise Report, with a summary in the environmental document. A statement of likelihood shall be included in the Preliminary Engineering Highway Traffic Noise Report and/or environmental document since 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 shall also indicate that final recommendations on the construction of an abatement measure(s) is determined during the completion of the project's final design and the public involvement processes.

NOTE – General Statement for All Environmental Clearance Documents:

All environmental clearance documents must have this general statement relating to proposed noise abatement: “Both recommended and non-recommended noise barriers may change between the environmental document and final design as a result of changes in the transportation improvement project design.” As appropriate, add “Final determinations on any absorptive barrier surface treatments will be made during the Final Design Phase.”

7.1.2 NEPA Reevaluations

1. A NEPA reevaluation is performed when the following conditions apply:
 - Three years have passed since the circulation of the DEIS and an acceptable FEIS in not yet submitted;
 - After approval of the EIS, FONSI, or CEE and before requesting FHWA's approval of major steps to advance the action (final design, right-of-way acquisition, PS&E); or
 - Three years have passed since the approval of the FEIS and major steps to advance the action (final design, right-of-way acquisition, PS&E approval) have not yet occurred.

A NEPA reevaluation is intended to assist in determining if a Supplemental EIS is required, or to verify whether or not the approved environmental document (FONSI/CE designation) remains valid. Environmental and community impacts are compiled based on the current roadway footprint and compared to the ROD/FEIS/FONSI/CE impact data. This procedure is well-suited for environmental resources that remain relatively static (e.g., wetlands, floodplains, etc.), though the reevaluation of traffic noise for an entire project can be a large undertaking. If a Final Design noise analysis has not or will not be conducted, the NEPA reevaluation should consist of a revised noise study to document consistency with the FEIS/FONSI/CE determination. For projects that will have a Final Design noise analysis

component of the contract, the NEPA reevaluation noise section should be brief and conclude that “impacts/mitigation will be revisited during final design.”

7.1.3 Preliminary Engineering Noise Report

A Preliminary Engineering Noise Report shall be prepared for use as a guide in the analysis of highway traffic noise impacts during the Preliminary Engineering Phase of the transportation improvement project. The document shall contain a discussion of the methodology and computer program(s) utilized and all relevant data used to arrive at the recommendations in the environmental document.

The preliminary engineering report shall contain all data collected and analyzed to perform the highway traffic noise analysis such as:

- highway traffic noise monitoring field data sheets;
- mapping used to define highway traffic noise monitoring sites;
- all input for highway traffic noise computer analyses;
- all final output of computer analysis including noise barrier optimization analyses;
- maps used to lay out the highway traffic noise analysis input parameters, including receptors and highway segments plotted along with their coordinates;
- proposed noise barrier type, size, and location data; and
- public comments, coordination, and responses related to noise issues.

The Preliminary Engineering Noise Report shall be compiled prior to the completion of the Environmental Clearance Phase and one copy shall be sent to the project manager for inclusion in the Engineering District’s project file. Since several of the above items could possibly generate large documents, electronic storage (i.e., CD ROM) is recommended.

7.1.4 Section 106 Evaluations

Highway traffic noise analysis for a Section 106 evaluation shall be identified as a part of the overall transportation improvement project. The highway traffic noise analysis will focus on the question of whether there is a noise impact on a Section 106 property. If there is a noise impact on a Section 106 property, the Pennsylvania Historical and Museum Commission (PHMC) will consult on the effects using the information gained from the highway traffic noise analysis. FHWA will make the final determination on whether the noise impact would result in an Adverse Effect. Contact the District Cultural Resource Professionals and/or PennDOT Central Office Cultural Resource Staff for proper Section 106 procedures.

7.1.5 Section 4(f) Evaluations

The Section 4(f) document and mitigation commitments must be referenced in the Final Design Highway Traffic Noise Report. PennDOT Publication No. 349, Section 4(f) Handbook, should be referenced.

NOTE – *Cultural and Section 4(f) Resource Coordination:*

Consultation and coordination with those responsible for the resource must be carried out and documented in the Environmental Clearance and Final Design Highway Traffic Noise Reports.

7.1.6 Title VI and Environmental Justice

When assessing highway traffic noise, Title VI and Environmental Justice must be adhered to. No one, on the basis of national origin, color, race (and, for Environmental Justice, minority and low income), should be denied the benefits of highway traffic noise abatement, and fair participation will be provided (during the public involvement process) in the decision-making process. Further information can be obtained regarding Title VI and Environmental Justice from the following FHWA website: http://www.fhwa.dot.gov/environment/environmental_justice/facts/. For further assistance on this issue, contact PennDOT Central Office Environmental Section.

7.2 Final Design Highway Traffic Noise Report: Format, Content, and Processing

7.2.1 Final Design Highway Traffic Noise Report Format and Content

The Final Design Highway Traffic Noise Report should include, at least, the information presented in the following outline. Although the intent is to provide statewide uniformity for all Final Design Highway Traffic Noise Reports, there is the understanding that, in many cases, additional information and variations to the following outline may be necessary due to project specifics.

Section 1: Executive Summary

- A synopsis of the project and proposed noise abatement commitments

Section 2: Introduction

- Project history, background, design year, and specific details of the project, including the preferred alternative and side road improvements, purpose and need, characteristics of noise

- Regional location map
- Project location map
- NEPA documentation and consistency (in some cases, it may be necessary to attach the noise section of the NEPA document as an appendix)

Section 3: Methodology

- FHWA and State noise policies
- Analysis procedure/model/version
- Monitoring and modeling methodology used
- Years considered

Section 4: Existing Highway Traffic Noise Environment (Monitored and Modeled Data)

- Existing Land uses, traffic conditions and roadway information
- Identification and description of each NSA, receptors and NAC activity categories
- Monitored highway traffic noise results (short- and long-term)
- Noise meter calibration
- Existing traffic volume, speed, and composition data (recorded and historic data)
- Receptors monitored
- Receptor monitoring data (i.e., time of day monitored, noise level, traffic counts, and composition)
- Basis for determination of existing and background noise levels
- Basis for determination of worst-case existing noise hour and associated noise levels
- Noise model validation information

Section 5: Future Highway Traffic Noise Environment (Modeled Data)

- Modeled highway traffic noise input and results

- Future highway traffic noise consequences as a result of no-build and proposed transportation improvement project

Section 6: Highway Traffic Noise Consideration and Abatement Alternatives

- Comparison of existing and future total noise levels for all identified receptors
- Determination of noise impacts
- Abatement considerations and options for each impacted community/group (options should always include an LOS option).
- Highway traffic noise abatement commitments and recommendations (attach the Warranted, Feasible, and Reasonable Worksheets as an appendix)
- Noise barrier matrix indicating the height of the noise barriers at each location where the height changes (i.e., barrier profile) and whether the barrier is ground-mounted or on structure.

Section 7: Construction Noise Consideration and Abatement Opportunities

- Identification and discussion of construction noise impacts and possible abatement opportunities and recommendations

Section 8: Public Involvement Process

- Discussion of public involvement efforts (including community meetings, individual meetings, and special coordination)
- Voting results related to desire for a barrier
- Voting results for the barrier's location/color and texture
- Abatement commitments: acoustic profiles and aesthetics
- Coordination with local officials

Appendices:

- List of preparers and reviewers
- Site sketches of monitored locations, noise meter printouts, noise meter and calibrator calibration reports that cover the monitoring period, FHWA TNM input and output information, traffic data used in the analysis, pertinent correspondence

- Copy of the highway traffic noise portion of the NEPA clearance document (when determined to be necessary)
- Warranted, Feasible, and Reasonable Worksheets for both the draft and final version of the Final Design Highway Traffic Noise Report (for the final version, the worksheets need to be signed by the appropriate people)
- Noise Abatement Report Form(s) in the Final Design Highway Traffic Noise Report. See [Section 3.6](#) and [Appendix G](#).

NOTE – Report Graphics:

Detailed graphics should be incorporated throughout the entire Final Design Highway Traffic Noise Report, especially to illustrate NSA boundaries, monitored/modeled highway traffic noise locations, levels, and proposed noise barrier locations. Each graphic needs to adequately identify and label names of highways/roadways, location of structures (bridges, culverts, etc.), communities' names, special interest areas, residential/commercial/industrial sites, municipal/state boundaries, monitored/model sites, right-of-way acquisitions, and areas where vehicle access to an existing roadway is being removed as well as anything else that was discussed in the text that can be graphically shown. Additional labeling may be necessary depending on the specifics of the transportation improvement project. Graphics are only as good as the text associated with them; therefore, an adequate description of the project area and explanation of the activities being proposed is also necessary.

NOTE – Printouts of Model Runs:

The electronic files of the noise model used for the noise impact assessment analysis as well as electronic copies of the model runs shall be attached as an appendix to the Final Design Noise Report. A text file (.TXT) describing the model runs should be also attached.

7.2.2 Final Design Highway Traffic Noise Report Processing

Upon completion of a draft Final Design Highway Traffic Noise Report and prior to any public meeting(s), the appropriate Engineering District, under its letterhead and signature, shall forward three copies to the EPDS. PennDOT Central Office Staff shall review the draft Final Design Highway Traffic Noise Report. After this review, if comments are provided, the draft report will be returned to the Engineering District for revisions before PennDOT Central Office approval.

Once revised and approved, one draft report (in electronic format) will be forwarded to FHWA by the EPDS for its review and concurrence. It is PennDOT's practice to provide error-free documents (including grammatical and typographical errors) to FHWA. FHWA shall review the draft Final Design Highway Traffic Noise Report and submit comments to the EPDS. The EPDS shall forward the comments to the Engineering District Office for resolution. In the letter transmitting the comments to the Engineering District Office, the EPDS Delivery and/or FHWA shall determine the appropriate processing for the revised document and indicate when it should be released for public review and comment.

NOTE – FHWA Review Requirements:

Projects utilizing federal funds must be reviewed by FHWA.

Once it has been determined that the draft Final Design Highway Traffic Noise Report is in an acceptable form, the Engineering District Office may make it available for public and agency review and conduct the necessary public meeting(s). After receipt of the public and agency review comments on the draft Final Design Highway Traffic Noise Report, the Engineering District Office shall analyze the comments and determine if:

- Additional noise impact assessment is required to address comments; and
- Noise abatement measure commitments have changed.

Once these have been considered, the final version of the Final Design Highway Traffic Noise Report shall be submitted to the EPDS. The final version of the Final Design Highway Traffic Noise Report must have the Warranted, Feasible, and Reasonable Worksheets signed by the Engineering District's Environmental Manager and the qualified professional performing the highway traffic noise analysis as well as the results of the final design noise mitigation public meeting(s). The final version of the Final Design Highway Traffic Noise Report shall be processed in the same manner as the draft version of the document, with final approval being provided by FHWA.

Appendix A - Warranted, Feasible and Reasonable Worksheet Templates for Noise Wall and Noise Berm on Type I Project

Highway Traffic Noise Abatement Warranted, Feasible, and Reasonable Worksheet – Noise Wall

Date _____
Project Name _____
County _____
SR, Section _____
Community Name and/or NSA # _____
Noise Wall Identification (i.e., Wall 1) _____

General

1. Type of project (new location, reconstruction, etc.): _____
2. Total number of impacted receptor units in community
Category A units impacted _____
Category B units impacted _____
Category C units impacted _____
Category D units impacted (if interior analysis required) _____
Category E units impacted _____

Warranted

1. Community Documentation
 - a. Date community was permitted (for new developments or developments planned for or under construction) _____
 - b. Date of approval for the Categorical Exclusion (CE), Record of Decision (ROD), or Finding of No Significant Impact (FONSI): _____
 - c. Does the date in 1.a precede the date in 1.b? If yes, proceed to Warranted Item 2. If no, consideration of noise abatement is not warranted. Proceed to “Decision” block and answer “no” to warranted question. As the reason for this decision, state that “Community was permitted after the date of approval of CE, ROD, or FONSI, as appropriate.”
 Yes No
2. Criteria requiring consideration of noise abatement (note N/A if category is not impacted or present or analysis not required). A “yes” answer to any of the following three questions requires the consideration of noise abatement.
 - a. With the proposed project, are design year noise levels predicted to approach or exceed the NAC level(s) in [Table 1](#)? Yes No
 - b. With the proposed project, is there predicted to be a substantial design year noise level increase of 10 dB(A) or more at Activity Category A, B, C, D, or E receptor(s)? Yes No

- c. With the proposed project, are design year noise levels predicted to be less than existing noise levels, but still approach or exceed the NAC levels in [Table 1](#) for the relevant Activity Category?

Yes No

Feasibility – Questions 1c through 7 must all be answered “yes” for a noise barrier to be determined to be feasible.

1. Impacted receptor units
 - a. Total number of impacted receptor units: _____
 - b. Percentage of impacted receptor units receiving 5 dB(A) or more insertion loss: _____
 - c. Is the percentage 50 or greater? Yes No
2. Can the noise wall be designed and physically constructed at the proposed location? Yes No
3. Can the noise wall be constructed without causing a safety problem? Yes No
4. Can the noise wall be constructed without restricting access to vehicular or pedestrian travel? Yes No
5. Can the noise wall be constructed in a manner that allows for access for required maintenance and inspection operations? Yes No
6. Can the noise wall be constructed in a manner that permits utilities to function in a normal manner? Yes No
7. Can the noise wall be constructed in a manner that permits drainage features to function in a normal manner? Yes No

Reasonableness

1. Community Desires Related to the Barrier
 - a. Do at least 50 percent of the responding benefited receptor unit owner(s) and renters desire the noise wall? If yes, continue with Reasonableness questions. If no, the noise wall can be considered not to be reasonable. Proceed to “Decision” block and answer “no” to reasonableness question. As the reason for this decision, state that “The majority of the benefited receptor unit owners do not desire the noise wall.” Yes No
2. Square Footage Per Benefited Receptor (SF/BR) Evaluation
 - a. Area (SF) of the proposed noise wall _____
 - b. Number of benefited receptor units (any unit receiving 5 dB(A) or more insertion loss) _____
 - c. $SF/BR = 2a/2b$ _____
 - d. Is 2c less than or equal to the MaxSF/BR value of 2000? Yes No

3. Noise Reduction Design Goals (Activity Categories A, B, C, and E) A “yes” answer is required to Question 3a for the noise wall to be determined to be reasonable. Questions 3b through 3e represent desirable goals that need not be met for a noise wall to be determined reasonable. However, they must be addressed and should be considered in the determination of the recommended noise wall.
- a. Does the noise wall reduce design year exterior noise levels by at least 7 dB(A) for at least one benefited receptor? Yes No
 - b. Does the noise wall provide an insertion loss of at least 7 dB(A) for more receptors than required under 3a.while still conforming to the MaxSF/BR value of 2,000 and a “point of diminishing returns” evaluation? Yes No
 - c. Does the noise wall provide insertion losses of greater than 7 dB(A) while still conforming to the MaxSF/BR value of 2,000 and a “point of diminishing returns” evaluation? Yes No
 - d. Does the noise wall reduce future exterior levels to the low-60-decibel range (60-63) for Category B and C receptors and the upper-60 dB(A) range (65-68) for Category E receptors? Yes No
 - e. Does the noise wall reduce design year noise levels back to existing levels? Yes No
4. Noise Reduction Design Goals (Activity Category D) A “yes” answer is required to Question 4a for the barrier to be determined to be reasonable. Question 4b represents a desirable goal that need not be met for a noise wall to be determined reasonable. However, this goal must be addressed and should be considered in the determination of the recommended noise wall.
- a. Does noise wall reduce design year interior noise levels by at least 7 dB(A) for the facility’s analysis point? Yes No
 - b. While conforming to the MaxSF/BR criteria and justified by a “point of diminishing returns’ evaluation, does the noise wall provide an interior insertion loss above the 7 dB(A) minimum Yes No

Decision

Is the Noise Wall WARRANTED? Yes No

Is the Noise Wall FEASIBLE? Yes No

Is the Noise Wall REASONABLE? Yes No

Additional Reasons for Decision:

Responsible/Qualified Individuals Making the Above Decisions

_____ Date: _____
PennDOT, Engineering District Environmental Manager

_____ Date: _____
Qualified Professional Performing the Analysis
(name, title, and company name)

Highway Traffic Noise Abatement Warranted, Feasible, and Reasonable Worksheet – Noise Berm

Date _____
Project Name _____
County _____
SR, Section _____
Community Name and/or NSA # _____
Noise Wall Identification (i.e., Wall 1) _____

General

1. Type of project (new location, reconstruction, etc.): _____
2. Total number of impacted receptor units in community/
Category A units impacted _____
Category B units impacted _____
Category C units impacted _____
Category D units impacted (if interior analysis required) _____
Category E units impacted _____

Warranted

1. Community Documentation
 - a. Date community was permitted (for new developments or developments planned for or under construction) _____
 - b. Date of approval for the Categorical Exclusion (CE), Record of Decision (ROD), or Finding of No Significant Impact (FONSI): _____
 - c. Does the date in 1.a precede the date in 1.b? If yes, proceed to Warranted Item 2. If no, consideration of noise abatement is not warranted. Proceed to “Decision” block and answer “no” to warranted question. As the reason for this decision, state that “Community was permitted after the date of approval of CE, ROD, or FONSI, as appropriate.” Yes No
2. Criteria requiring consideration of noise abatement (note N/A if category is not impacted or present or analysis not required). A “yes” answer to any of the following three questions requires the consideration of noise abatement.
 - a. With the proposed project, are design year noise levels predicted to approach or exceed the NAC level(s) in [Table 1](#)? Yes No
 - b. With the proposed project, is there predicted to be a substantial design year noise level increase of 10 dB(A) or more at Activity Category A, B, C, D, or E receptor(s)? Yes No
 - c. With the proposed project, are design year noise levels predicted to be less than existing noise levels, but predicted design year noise levels still predicted to approach or exceed the NAC levels in [Table 1](#) for the relevant Activity Category? Yes No

Feasibility – Questions 1c through 7 must all be answered “yes” for a noise berm to be determined to be feasible.

1. Impacted receptor units
 - a. Total number of impacted receptor units: _____
 - b. Percentage of impacted receptor units receiving 5 dB(A) or more insertion loss: _____
 - c. Is the percentage 50 or greater? Yes No
2. Can the noise berm be designed and physically constructed at the proposed location? Yes No
3. Can the noise berm be constructed without causing a safety problem? Yes No
4. Can the noise berm be constructed without restricting access to vehicular or pedestrian travel? Yes No
5. Can the noise berm be constructed in a manner that allows for access for required maintenance and inspection operations? Yes No
6. Can the noise berm be constructed in a manner that permits utilities to function in a normal manner? Yes No
7. Can the noise berm be constructed in a manner that permits drainage features to function in a normal manner? Yes No

Reasonableness

1. Community Desires Related to the Barrier
 - a. Do at least 50 percent of the benefited receptor unit owner(s) and renters desire the noise berm? If yes, continue with Reasonableness questions. If no, the berm can be considered not to be reasonable. Proceed to “Decision” block and answer “no” to reasonableness question. As the reason for this decision, state that “The majority of the benefited receptor unit owners and renters do not desire the berm.” Yes No
2. Cubic Yards Per Benefited Receptor (CY/BR) Evaluation
 - a. Volume (CY) of the proposed noise barrier _____
 - b. Number of benefited receptor units (any unit receiving 5 dB(A) or more insertion loss) _____
 - c. $CY/BR = 2a/2b$ _____
 - d. Is 2c less than or equal to the MaxCY/BR value of 1200? Yes No
3. Noise Reduction Design Goals (Activity Categories A, B, C, and E) A “yes” answer is required to both Questions 3a and 3b for the barrier to be determined to be reasonable. Questions 3c and 3d represent desirable goals that need not be met for a noise berm to be determined reasonable. However, they must be addressed and should be considered in the determination of the recommended noise berm.
 - a. Does the berm reduce future noise levels by at least 7 dB(A) for 50% or more of the benefited receptors? Yes No
 - b. Is the estimated net cost of the noise berm less than \$50,000 per benefited receptor unit? Yes No
 - c. Does the berm provide insertion loss above 7 dB(A) while still conforming to the MaxCY/BR value of 1200? Yes No

- d. Does the berm reduce future exterior levels to the low-60-decibel range (60-63) for Category B and C receptors and the upper-60 dB(A) range (65-68) for Category E receptors? Yes No
4. Noise Reduction Design Goals (Activity Category D) A “yes” answer is required to both Questions 4a and 4b for the berm to be determined to be reasonable. Question 4c represents a desirable goal that need not be met for a noise berm to be determined reasonable. However, this goal must be addressed and should be considered in the determination of the recommended noise berm.
- a. Does noise berm reduce design year interior noise levels by at least 7 dB(A) for the facility’s analysis point? Yes No
- b. Is the estimated net cost of the noise berm less than \$50,000 per benefited receptor unit? Yes No
- c. While conforming to the MaxCY/BR criteria and justified by a “point of diminishing returns’ evaluation, does the noise berm provide an interior insertion loss above the 7 dB(A) minimum Yes No

Decision		
Is the Noise Berm WARRANTED?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Is the Noise Berm FEASIBLE?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Is the Noise Berm REASONABLE?	<input type="checkbox"/> Yes	<input type="checkbox"/> No
Additional Reasons for Decision:		

Responsible/Qualified Individuals Making the Above Decisions

_____ Date: _____
PennDOT, Engineering District Environmental Manager

_____ Date: _____
Qualified Professional Performing the Analysis
(name, title, and company name)

Appendix B - Definitions and Guidance on Terms

Absorptive Noise Panels – Noise barrier panels that absorb a significant portion of incident sound rather than reflecting all incident sound.

Approach – Defined by PennDOT as one dB(A) below the set noise abatement criteria [e.g., highway traffic noise abatement consideration is warranted at 66 dB(A) for Land Use Activity Category B receptors]. See [Table 1](#) (page 31) for NAC levels. Note that values of 65.5 to 65.9 are rounded to 66 dB(A).

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

Auxiliary Lanes – The portion of the roadway adjoining the traveled way for parking, speed change, turning, storage for turning, weaving, truck climbing, and other purposes supplementary to through-traffic movement. The width of an auxiliary lane typically is equal to that of a through traffic lane.

Avoidance – An act or practice of avoiding or withdrawing from something.

Benefited Receptor – Any receptor unit that obtains a net insertion loss (including background noise levels) of at least 5 dBA. Such receptor may be either impacted or non-impacted.

Buses/Recreational Vehicles – Includes single-unit buses, articulated buses, school buses, motor homes, and passenger cars or motor homes pulling trailers or boats.

Common Noise Environment - A group of receptors within the same Activity Category in [Table 1](#) 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, cross-roads.

Construction Noise Level Descriptor – The noise level descriptor to be used for construction noise shall be the hourly equivalent sound level, Leq(h) or Lmax depending on the situation. The specific construction noise descriptor shall be determined by coordinating with PennDOT Central Office Environmental Staff.

Constructive Use – Constructive use occurs when the transportation improvement project does not incorporate land from a Section 4(f) resource but the project's proximity impacts are so severe that the protected activities, features, or attributes that qualify a resource for protection under Section 4(f) are substantially impaired. Substantial impairment occurs only when the protected activities, features, or attributes of the resource are substantially diminished. FHWA is not required to determine that there is no constructive use. However, such a determination could be made at the discretion of FHWA.

Date of Public Knowledge - The date of approval of the Categorical Exclusion (CE), the Finding of No Significant Impact (FONSI), or the Record of Decision (ROD), as defined in 23 CFR 771.

dB(A) – The sound pressure levels in decibels measured with a frequency-weighting network corresponding to the A-scale on a standard sound level meter as specified by ANSI S1.4-1983 (1997). The A-scale tends to suppress lower frequencies (e.g., below 1,000 Hz) and best approximates the sound as heard by the normal human ear.

Design Speed – The maximum safe speed that can be maintained over a specified section of highway when conditions are so favorable that the design features of the highway govern.

Design Year – The future year used to estimate the probable traffic volume for which a highway is designed. Generally, a time period of 10 to 20 years from the start of construction is used.

Environmental Documents – Documents required by NEPA, PA Act 120, and related legislation [CEE, EA, EER, EIS, technical files, Section 4(f) Report, and Section 106 Report] that detail specific impacts and the severity of those impacts on the environment.

Existing Noise Level – The current noise level, comprised of all natural and artificial noises, considered to be usually present within a particular area's acoustic environment, including existing roadways.

Feasibility - The combination of acoustical and engineering factors considered in the evaluation of a noise abatement measure.

Noise Level Descriptor –The noise level descriptor to be used for highway traffic noise measurement and analysis is the hourly equivalent sound level, $Leq(h)$. $Leq(h)$ is the steady-state, A-weighted sound level which contains the same amount of acoustic energy as the actual time-varying, A-weighted sound level over a one-hour period.

Non-Impacted Receptor – Any receptor not meeting the definition of an Impacted Receptor.

Heavy Truck – Any vehicle having three or more axles and designed for the transportation of cargo (typically single-unit trucks, truck tractor-semi trailer combinations, and trucks or truck tractors with semi trailers in combination with full trailers). Generally, the gross weight of a heavy truck is greater than 12,000 kilograms (26,000 pounds).

Impacted Receptor – An individual receptor unit that has a future design year noise level that approaches or exceeds the NAC and/or that experiences a substantial noise level increase of 10 dB(A) or more above existing noise levels.

Insertion Loss (IL) – The actual acoustical benefit derived from the presence of a noise barrier.

Leq – The equivalent steady-state sound level which, in a stated period of time, contains the same acoustic energy as the time-varying sound level during the same period.

Line-of-Site (LOS) – A straight line between the observer location and a specific noise source.

L_{max} – The highest sound pressure level, in dB(A), for a specific time period.

Medium Truck – All vehicles having two axles and six wheels designed for the transportation of cargo. Generally, the gross vehicle weight of a medium truck is greater than 4,500 kilograms (10,000 pounds) but less than 12,000 kilograms (26,000 pounds).

Multifamily Dwelling - A residential structure containing more than one residence. Each residence in a multifamily dwelling shall be counted as one receptor when determining impacted and benefited receptors.

National Environmental Policy Act (NEPA) – Federal legislation that establishes environmental policy for the nation. It provides an interdisciplinary framework to ensure that decision-makers adequately take environmental factors into account. NEPA mandates that the level of documentation for federally aided projects be determined by the potential impact the project may have on the surrounding natural, cultural, and social environment.

Noise Abatement Criteria (NAC) – Noise levels for various activities or land uses that represent a compromise between noise levels that are desirable and those that are achievable. The NAC are absolute values which, when approached or exceeded, identify highway traffic noise impacts and require the consideration of highway traffic noise abatement measures.

Noise Barrier – A solid wall or berm located between the roadway and receptor location that reduces overall net noise levels.

Noise Reduction Coefficient (NRC) – A single number rating of the sound-absorptive properties of a material. The Department has a NRC criteria of 0.70 or greater when an absorptive treatment is required.

Noise Reduction Design Goal - The optimum desired dB(A) noise reduction determined from calculating the difference between future build noise levels with abatement, to future build noise levels without abatement. While the Department has established its noise reduction design goal as 7 dB(A), it encourages designs of noise abatement devices that provide higher levels of abatement as long as those devices meet all feasibility and reasonableness criteria.

Noise Study Area (NSA) – A group or grouping of receptors into common areas of similar noise influences throughout the entire project limits.

Operating Speed – The highest overall travel speed at which a driver can travel on a given highway under favorable weather conditions and under prevailing traffic conditions without at any time exceeding the safe speed as determined by the design speed on a section-by-section basis.

Pennsylvania Act 120 – Mandates environmental regulatory procedures for 100% of state-funded projects.

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.

Posted Speed – The maximum allowable speed limit for a specified section of highway that is posted and enforced by the appropriate law enforcement agency.

Project Limits – The physical end points of a proposed project which includes all areas where construction activities are proposed for the transportation improvement project. Highway traffic noise assessment is required for all receptors within the project limits.

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.

Reasonableness - The combination of social, economic, and environmental factors considered in the evaluation of a noise abatement measure.

Receptor -A discrete or representative location in a noise study area(s), for any of the land uses listed in [Table 1](#).

Residence -A dwelling unit. Either a single family residence or each dwelling unit in a multifamily dwelling.

Receptor Unit – When looking at residences, each residential dwelling unit should be considered as one (1) unit (i.e., single-family detached homes, apartment, etc.). Special activity areas will be dealt with on a comparative and/or project-by-project basis.

Reflective Noise Panels – A noise barrier panel that reflects incident sound rather than absorbing a significant portion of the incident sound.

Significant Changes In Horizontal and Vertical Alignment – The identification of the physical alteration of an existing highway which significantly changes either the horizontal or vertical alignment, requiring the use of judgment. A small change in alignment in a densely developed urban area may be deemed to be significant whereas a much greater change in alignment in a suburban or rural area may not be deemed significant.

Sound Transmission Class (STC) – A single number rating used to compare sound insulation properties of barriers. The Department has a STC criteria of 25 or greater based upon ASTM E90 and ASTM E413.

Statement of Likelihood - A statement provided in the environmental clearance document based on the feasibility and reasonableness analysis completed at the time the environmental document is being approved.

Substantial Construction - The granting of a building permit, prior to right-of-way acquisition or construction approval for the highway.

Substantial Noise Increase - An increase of 10 dB(A) above existing levels resulting from the Build Alternative in the design year. A 10 dB(A) increase reflects the generally accepted noise level increase which is likely to cause sporadic to widespread complaints. Such an increase requires the consideration of noise abatement.

Traffic Noise Impacts – Impacts which occur when the design year build predicted total noise levels approach or exceed the NAC or when the predicted noise levels substantially exceed the existing noise levels.

Through-Traffic Lanes – A continuous main lane, including high-occupancy vehicle (HOV) lane or frontage road. Through-traffic lanes exclude lanes for parking, speed change, turning, storage for turning, weaving, and other purposes supplementary to through-traffic movement.

Type I Project –

- (1) The construction of a highway on new location; or
- (2) The physical alteration of an existing highway 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 or by altering the topography between the highway 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 per § 772.5 then the entire project area as defined in the environmental document is a Type I project.

Type II Project - A Federal or Federal-aid highway project for noise abatement on an existing highway. For a Type II project to be eligible for Federal-aid funding, the highway agency must develop and implement a Type II program in accordance with Section 772.7(e).

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

Worst-Case Noise Hour – A period of 60 minutes throughout a 24-hour hour day that reflects the peak noise hour. This period is often, but not always, associated with the peak traffic hour.

Appendix C - Title 23 Code of Federal Regulations, Part 772

OPI: HEP-41

SUBCHAPTER H - RIGHT-OF-WAY AND ENVIRONMENT

PART 772 - PROCEDURES FOR ABATEMENT OF HIGHWAY TRAFFIC NOISE AND CONSTRUCTION NOISE

Sec. 772.1 Purpose.

To provide procedures for noise studies and noise abatement measures to help protect the public health welfare and livability, to supply noise abatement criteria, and to establish requirements for information to be given to local officials for use in the planning and design of highways approved pursuant to Title 23, United States Code (U.S.C.).

Sec. 772.3 Noise standards.

The highway traffic noise prediction requirements, noise analyses, noise abatement criteria, and requirements for informing local officials in this directive constitute the noise standards mandated by 23 U.S.C. 109(i). All highway projects which are developed in conformance with this directive shall be deemed to be in conformance with the Federal Highway Administration (FHWA) noise standards.

Sec. 772.5 Definitions.

Benefited Receptor. The recipient of an abatement measure that receives a noise reduction at or above the minimum threshold of 5 dB(A), but not to exceed the highway agency's reasonableness design goal.

Common Noise Environment. A group of receptors within the same Activity Category in [Table 1](#) 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, cross-roads.

Date of Public Knowledge. The date of approval of the Categorical Exclusion (CE), the Finding of No Significant Impact (FONSI), or the Record of Decision (ROD), as defined in 23 CFR 771.

Design Year. The future year used to estimate the probable traffic volume for which a highway is designed.

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.

Feasibility. The combination of acoustical and engineering factors considered in the evaluation of a noise abatement measure.

Impacted Receptor. The recipient that has a traffic noise impact.

L10. The sound level that is exceeded 10 percent of the time (the 90th percentile) for the period under consideration, with L10(h) being the hourly value of L10.

Leq. The equivalent steady-state sound level which in a stated period of time contains the same acoustic energy as the time-varying sound level during the same time period, with Leq(h) being the hourly value of Leq.

Multifamily Dwelling. A residential structure containing more than one residence. Each residence in a multifamily dwelling shall be counted as one receptor when determining impacted and benefited receptors.

Noise Barrier. A physical obstruction that is constructed between the highway noise source and the noise sensitive receptor(s) that lowers the noise level, including stand-alone noise walls, noise berms (earth or other material), and combination berm/wall systems.

Noise Reduction Design Goal. The optimum desired dB(A) noise reduction determined from calculating the difference between future build noise levels with abatement, to future build noise levels without abatement. The noise reduction design goal shall be at least 7 dB(A), but not more than 10 dB(A).

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.

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.

Reasonableness. The combination of social, economic, and environmental factors considered in the evaluation of a noise abatement measure.

Receptor. A discrete or representative location in a noise study area(s), for any of the land uses listed in [Table 1](#).

Residence. A dwelling unit. Either a single family residence or each dwelling unit in a multifamily dwelling.

Statement of Likelihood. A statement provided in the environmental clearance document based on the feasibility and reasonableness analysis completed at the time the environmental document is being approved.

Substantial Construction. The granting of a building permit, prior to right-of-way acquisition or construction approval for the highway.

Substantial noise increase. One of two types of highway traffic noise impacts. For a Type I project, an increase in total noise levels of 5 to 15 dB(A) in the design year over the existing noise level.

Traffic Noise Impacts. Design year build condition noise levels that approach or exceed the NAC listed in [Table 1](#) for the future build condition; or design year build condition noise levels that create a substantial noise increase over existing noise levels.

Type I Project.

- (1) The construction of a highway on new location; or
- (2) The physical alteration of an existing highway 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 or by altering the topography between the highway 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 per § 772.5 then the entire project area as defined in the environmental document is a Type I project.

Type II Project. A Federal or Federal-aid highway project for noise abatement on an existing highway. For a Type II project to be eligible for Federal-aid funding, the highway agency must develop and implement a Type II program in accordance with Section 772.7(e).

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

Sec. 772.7 Applicability.

- (a) This regulation applies to all Federal or Federal-aid Highway Projects authorized under title 23, United States Code. Therefore, this regulation applies to any highway project or multimodal project that:
 - (1) Requires FHWA approval regardless of funding sources, or
 - (2) Is funded with Federal-aid highway funds.
- (b) In order to obtain FHWA approval, the highway agency shall develop noise policies in conformance with this regulation and shall apply these policies uniformly and consistently statewide.
- (c) This regulation applies to all Type I projects unless the regulation specifically indicates that a section only applies to Type II or Type III projects.
- (d) The development and implementation of Type II projects are not mandatory requirements of Section 109(i) of Title 23, United States Code.
- (e) If a highway agency chooses to participate in a Type II program, the highway agency shall develop a priority system, based on a variety of factors, to rank the projects in the program. This priority system shall be submitted to and approved by FHWA before the highway agency is allowed to use Federal-aid funds for a project in the program. The highway agency shall re-analyze the priority system on a regular interval, not to exceed 5 years.
- (f) For a Type III project, a highway agency is not required to complete a noise analysis or consider abatement measures.

Sec. 772.9 Traffic Noise Prediction

- (a) Any analysis required by this subpart must use the FHWA Traffic Noise Model (TNM), which is described in “FHWA Traffic Noise Model” Report No. FHWA-PD-96-010, including Revision No. 1, dated April 14, 2004, or any other model determined by the FHWA to be consistent with the methodology of the FHWA TNM. These publications are incorporated by reference in accordance with Section 552(a) of Title 5, U.S.C. and Part 51 of Title 1, CFR, and are on file at the National Archives and Record Administration (NARA). For information on the availability of this material at NARA, call (202) 741-6030 or go to <http://www.archives.gov/federal-register/index.html>. These documents are available for copying and inspection at the Federal Highway Administration, 1200 New Jersey Avenue, SE, Washington, DC 20590, as provided in Part 7 of Title 49, CFR. These documents are also available on the FHWA’s Traffic Noise Model Web site at the following URL: <http://www.fhwa.dot.gov/environment/noise/>.

- (b) Average pavement type shall be used in the FHWA TNM for future noise level prediction unless a highway agency substantiates the use of a different pavement type for approval by the FHWA.
- (c) Noise contour lines may be used for project alternative screening or for land use planning to comply with § 772.17, but shall not be used for determining highway traffic noise impacts.
- (d) In predicting noise levels and assessing noise impacts, traffic characteristics that would yield the worst traffic noise impact for the design year shall be used.

Sec. 772.11 Analysis of Traffic Noise Impacts

- (a) The highway agency shall determine and analyze expected traffic noise impacts.
 - (1) For projects on new alignments, determine traffic noise impacts by field measurements.
 - (2) For projects on existing alignments, predict existing and design year traffic noise impacts.
- (b) In determining traffic noise impacts, a highway agency shall give primary consideration to exterior areas where frequent human use occurs.
- (c) A traffic noise analysis shall be completed for:
 - (1) Each alternative under detailed study;
 - (2) Each Activity Category of the NAC listed in [Table 1](#) that is present in the study area;
 - (i) Activity Category A. This activity category includes the exterior impact criteria for 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. Highway agencies shall submit justifications to the FHWA on a case-by-case basis for approval of an Activity Category A designation.
 - (ii) Activity Category B. This activity category includes the exterior impact criteria for single-family and multifamily residences.
 - (iii) Activity Category C. This activity category includes the exterior impact criteria for a variety of land use facilities. Each highway agency shall adopt a standard practice for analyzing these land use facilities that is consistent and uniformly applied statewide.

- (iv) Activity Category D. This activity category includes the interior impact criteria for certain land use facilities listed in Activity Category C that may have interior uses. A highway agency shall conduct an indoor analysis after a determination is made that exterior abatement measures will not be feasible and reasonable. An indoor analysis shall only be done after exhausting all outdoor analysis options. In situations where no exterior activities are to be affected by the traffic noise, or where the exterior activities are far from or physically shielded from the roadway in a manner that prevents an impact on exterior activities, the highway agency shall use Activity Category D as the basis of determining noise impacts. Each highway agency shall adopt a standard practice for analyzing these land use facilities that is consistent and uniformly applied statewide.
- (v) Activity Category E. This activity category includes the exterior impact criteria for developed lands that are less sensitive to highway noise. Each highway agency shall adopt a standard practice for analyzing these land use facilities that is consistent and uniformly applied statewide.
- (vi) Activity Category F. This activity category includes developed lands that are not sensitive to highway traffic noise. There is no impact criteria for the land use facilities in this activity category and no analysis of noise impacts is required.
- (vii) Activity Category G. This activity includes undeveloped lands
 - (A) A highway agency shall determine if undeveloped land is permitted for development. The milestone and its associated date for acknowledging when undeveloped land is considered permitted shall be the date of issuance of a building permit by the local jurisdiction or by the appropriate governing entity.
 - (B) If undeveloped land is determined to be permitted, then the highway agency shall assign the land to the appropriate Activity Category and analyze it in the same manner as developed lands in that Activity Category.
 - (C) If undeveloped land is not permitted for development by the date of public knowledge, the highway agency shall determine noise levels in accordance with 772.17(a) and document the results in the project's environmental clearance documents and noise analysis documents. Federal participation in noise abatement measures will not be considered for lands that are not permitted by the date of public knowledge.

- (d) The analysis of traffic noise impacts shall include:
 - (1) Identification of existing activities, developed lands, and undeveloped lands, which may be affected by noise from the highway;
 - (2) For projects on new or existing alignments, validate predicted noise level through comparison between measured and predicted levels;
 - (3) Measurement of noise levels. Use an ANSI Type I or Type II integrating sound level meter;
 - (4) Identification of project limits to determine all traffic noise impacts for the design year for the build alternative. For Type II projects, traffic noise impacts shall be determined from current year conditions;
- (e) Highway agencies shall establish an approach level to be used when determining a traffic noise impact. The approach level shall be at least 1 dB(A) less than the Noise Abatement Criteria for Activity Categories A to E listed in [Table 1](#);
- (f) Highway agencies shall define substantial noise increase between 5 dB(A) to 15 dB(A) over existing noise levels. The substantial noise increase criterion is independent of the absolute noise level.
- (g) A highway agency proposing to use Federal-aid highway funds for a Type II project shall perform a noise analysis in accordance with §772.11 of this part in order to provide information needed to make the determination required by §772.13(a) of this part.

Sec. 772.13 Analysis of Noise Abatement

- (a) When traffic noise impacts are identified, noise abatement shall be considered and evaluated for feasibility and reasonableness. The highway agency shall determine and analyze alternative noise abatement measures to abate identified impacts by giving weight to the benefits and costs of abatement and the overall social, economic, and environmental effects by using feasible and reasonable noise abatement measures for decision-making.
- (b) In abating traffic noise impacts, a highway agency shall give primary consideration to exterior areas where frequent human use occurs.
- (c) If a noise impact is identified, a highway agency shall consider abatement measures. The abatement measures listed in §772.15(c) of this chapter are eligible for Federal funding.
 - (1) At a minimum, the highway agency shall consider noise abatement in the form of a noise barrier.
 - (2) If a highway agency chooses to use absorptive treatments as a functional enhancement, the highway agency shall adopt a standard practice for using absorptive treatment that is consistent and uniformly applied statewide.

- (d) Examination and evaluation of feasible and reasonable noise abatement measures for reducing the traffic noise impacts. Each highway agency, with FHWA approval, shall develop feasibility and reasonableness factors.
- (1) Feasibility:
- (i) Achievement of at least a 5 dB(A) highway traffic noise reduction at impacted receptors. The highway agency shall define, and receive FHWA approval for, the number of receptors that must achieve this reduction for the noise abatement measure to be acoustically feasible and explain the basis for this determination; and
 - (ii) Determination that it is possible to design and construct the noise abatement measure. Factors to consider are safety, barrier height, topography, drainage, utilities, and maintenance of the abatement measure, maintenance access to adjacent properties, and access to adjacent properties (i.e., arterial widening projects).
- (2) Reasonableness:
- (i) Consideration of the viewpoints of the property owners and residents of the benefited receptors. The highway agency shall solicit the viewpoints of all of the benefited receptors and obtain enough responses to document a decision on either desiring or not desiring the noise abatement measure. The highway agency shall define, and receive FHWA approval for, the number of receptors that are needed to constitute a decision and explain the basis for this determination.
 - (ii) Cost effectiveness of the highway traffic noise abatement measures. Each highway agency shall determine, and receive FHWA approval for, the allowable cost of abatement by determining a baseline cost reasonableness value. This determination may include the actual construction cost of noise abatement, cost per square foot of abatement, the maximum square footage of abatement/benefited receptor and either the cost/benefited receptor or cost/benefited receptor/dB(A) reduction. The highway agency shall re-analyze the allowable cost for abatement on a regular interval, not to exceed 5 years. A highway agency has the option of justifying, for FHWA approval, different cost allowances for a particular geographic area(s) within the State, however, the highway agency must use the same cost reasonableness/construction cost ratio statewide.
 - (iii) Noise reduction design goals for highway traffic noise abatement measures. When noise abatement measure(s) are being considered, a highway agency shall achieve a noise reduction design goal. The highway agency shall define, and receive FHWA approval for, the design goal of at least 7 dB(A) but not more than 10 dB(A), and shall

- define the number of benefited receptors that must achieve this design goal and explain the basis for this determination.
- (iv) The reasonableness factors listed in §772.13(d)(5)(i), (ii) and (iii), must collectively be achieved in order for a noise abatement measure to be deemed reasonable. Failure to achieve §772.13(d)(5)(i), (ii) or (iii), will result in the noise abatement measure being deemed not reasonable.
 - (v) In addition to the required reasonableness factors listed in §772.13(d)(5)(i), (ii) and (iii), a highway agency has the option to also include the following reasonableness factors: date of development, length of time receivers have been exposed to highway traffic noise impacts, exposure to higher absolute highway traffic noise levels, changes between existing and future build conditions, percentage of mixed zoning development, and use of noise compatible planning concepts by the local government. No single optional reasonableness factor can be used to determine reasonableness.
- (e) **Assessment of Benefited Receptors.** Each highway agency shall define the threshold for the noise reduction which determines a benefited receptor as at or above the 5 dB(A), but not to exceed the highway agency's reasonableness design goal.
 - (f) **Abatement Measure Reporting:** Each highway agency 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, in accordance with OMB's Information Collection requirements.
 - (g) Before adoption of a CE, FONSI, or ROD, the highway agency shall identify:
 - (1) Noise abatement measures which are feasible and reasonable, and which are likely to be incorporated in the project; and
 - (2) Noise impacts for which no noise abatement measures are feasible and reasonable.
 - (3) Documentation of highway traffic noise abatement: The environmental document shall identify locations where noise impacts are predicted to occur, where noise abatement is feasible and reasonable, and locations with impacts that have no feasible or reasonable noise abatement alternative. For

environmental clearance, this analysis shall be completed to the extent that design information on the alternative(s) under study in the environmental document is available at the time the environmental clearance document is completed. A statement of likelihood shall be included in the environmental document since 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 shall also indicate that final recommendations on the construction of an abatement measure(s) is determined during the completion of the project's final design and the public involvement processes.

- (h) The FHWA will not approve project plans and specifications unless feasible and reasonable noise abatement measures are incorporated into the plans and specifications to reduce the noise impact on existing activities, developed lands, or undeveloped lands for which development is permitted.
- (i) For design-build projects, the preliminary technical noise study shall document all considered and proposed noise abatement measures for inclusion in the NEPA document. Final design of design-build noise abatement measures shall be based on the preliminary noise abatement design developed in the technical noise analysis. Noise abatement measures shall be considered, developed, and constructed in accordance with this standard and in conformance with the provisions of 40 CFR 1506.5(c) and 23 CFR 636.109.
- (j) Third party funding is not allowed on a Federal or Federal-aid Type I or Type II project 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 a Federal or Federal-aid highway Type I or Type II project to make functional enhancements, such as absorptive treatment and access doors or aesthetic enhancements, to a noise abatement measure already determined feasible and reasonable.
- (k) On a Type I or Type II projects, a highway agency has the option to cost average noise abatement among benefited receptors within common noise environments if no single common noise environment exceeds two times the highway agency's cost reasonableness criteria and collectively all common noise environments being averaged do not exceed the highway agency's cost reasonableness criteria.

Sec. 772.15 Federal Participation

- (a) Type I and Type II projects. Federal funds may be used for noise abatement measures when:
 - (1) Traffic noise impacts have been identified; and
 - (2) Abatement measures have been determined to be feasible and reasonable pursuant to §772.13(d) of this chapter.

- (b) For Type II projects.
 - (1) No funds made available out of the Highway Trust Fund may be used to construct Type II noise barriers, as defined by this regulation, if such noise barriers were not part of a project approved by the FHWA before the November 28, 1995.
 - (2) Federal funds are available for Type II noise barriers along lands that were developed or were under substantial construction before approval of the acquisition of the rights-of-ways for, or construction of, the existing highway.
 - (3) FHWA will not approve noise abatement measures for locations where such measures were previously determined not to be feasible and reasonable for a Type I project.
- (c) Noise Abatement Measures. The following noise abatement measures may be considered for incorporation into a Type I or Type II project to reduce traffic noise impacts. The costs of such measures may be included in Federal-aid participating project costs with the Federal share being the same as that for the system on which the project is located.
 - (1) Construction of noise barriers, including acquisition of property rights, either within or outside the highway right-of-way. Landscaping is not a viable noise abatement measure.
 - (2) Traffic management measures including, but not limited to, traffic control devices and signing for prohibition of certain vehicle types, time-use restrictions for certain vehicle types, modified speed limits, and exclusive lane designations.
 - (3) Alteration of horizontal and vertical alignments.
 - (4) Acquisition of real property or interests therein (predominantly unimproved property) to serve as a buffer zone to preempt development which would be adversely impacted by traffic noise. This measure may be included in Type I projects only.
 - (5) Noise insulation of Activity Category D land use facilities listed in [Table 1](#). Post-installation maintenance and operational costs for noise insulation are not eligible for Federal-aid funding.

Sec. 772.17 Information for local officials.

- (a) To minimize future traffic noise impacts on currently undeveloped lands of Type I projects, a highway agency shall inform local officials within whose jurisdiction the highway 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 highway improvement where the future noise levels meet the highway agency's definition of "approach" for undeveloped lands or properties within the project limits. At a minimum, identify the distance to the exterior noise abatement criteria in [Table 1](#);
 - (3) Non-eligibility for Federal-aid participation for a Type II project as described in §772.15(b).
- (b) If a highway agency chooses to participate in a Type II noise program or to use the date of development as one of the factors in determining the reasonableness of a Type I noise abatement measure, the highway agency shall have a statewide outreach program to inform local officials and the public of the items in §772.17(a)(1)- (3).

Sec. 772.19 Construction noise.

For all Type I and II projects, a highway agency shall:

- (a) Identify land uses or activities which may be affected by noise from construction of the project. The identification is to be performed during the project development studies.
- (b) Determine the measures which are needed in the plans and specifications to minimize or eliminate adverse construction noise impacts to the community. This determination shall include a weighing of the benefits achieved and the overall adverse social, economic and environmental effects and the costs of the abatement measures.
- (c) Incorporate the needed abatement measures in the plans and specifications.

23 CFR 772, including Table 1 and Appendix A, may be found on <http://edocket.access.gov//.pdf>

Appendix D - Referenced Federal Highway Administration Guidance

Helpful FHWA Links:

<http://www.fhwa.dot.gov/environment/noise/>

http://www.fhwa.dot.gov/environment/noise/regulations_and_guidance/analysis_and_abatement_guidance/guidancedoc.pdf

<http://edocket.access.gpo.gov/2010/pdf/2010-15848.pdf>

Appendix E - Methodologies for Determining Equivalent Residential Unit Values and Assessing Noise Barrier Reasonableness in Activity Category B, C, D, and E Areas

Federal Highway Administration (FHWA) noise abatement criteria (NAC) identify a variety of uses within Activity Categories B through E. Unlike single family residential sites within Category B which are represented by one receptor point, other receptors may represent uses by more than one person or family. In addition, in some instances, activities may occur over areas of land, as opposed to occurring at a single location associated with the activity. Therefore, PennDOT has adopted requirements that are based on determining numbers of equivalent residential units. The information within this Appendix discusses examples of methodologies available to determine Equivalent Residential Unit (ERU) values and guidance on the application of such methodologies.

METHODOLOGY FOR EVALUATING ACTIVITIES OCCURRING OVER AN AREA OF LAND

Upon review of 81 barriers determined to be feasible and reasonable on 28 projects in Pennsylvania, the following information was obtained:

Total barrier length = 239,836 feet
Total barrier area = 3,618,417 square feet (sf)
Average Barrier Height = 15.1 feet

At an average height of 15.1 feet, a one-mile length of barrier would contain:

$5,280 \text{ feet/mile} \times 15.1 \text{ feet} = 79,728 \text{ square feet/mile}$

For a barrier to be determined to be cost-effective (one of the reasonableness criteria), PennDOT requires that the square foot of barrier /benefited residence (residences receiving 5 dB(A) or more barrier insertion loss) value does not exceed 2,000. For a one-mile long average height barrier protecting a single row of residences, this limiting value would be obtained with residential dwellings spaced at approximately 130 feet as calculated below:

$79,728 \text{ square feet per mile} / 2,000 \text{ square feet per residence} = 39.86 \text{ residences/mile}$
 $5,280 \text{ feet per mile} / 39.86 \text{ residences per mile} = 132 \text{ feet per residence SAY } 130 \text{ feet}$

Apply the above calculated 130 foot value to activity uses occurring over areas of land in the following manner:

1. Locate closest point within the use area at each border of the use area closest to the proposed project; mark these points.
2. Draw a line connecting the above points and continue line to the boundaries of the use.
3. Treat this line as the first row of receptors and space points at every 130 feet along this line beginning at the left side boundary of the use area.

4. Using the above lines and points as a base, establish a perpendicular grid with points spaced at 130 feet intervals in both directions. Mark as receptors only those points within areas which are used (either actively or passively), but excluding points within the designated boundaries that are not used (these could include inaccessible portions of the property, drainage ponds, areas used only for parking, etc.).
5. Model all receptors and determine which ones are impacted. Focus noise barrier design only on these impacted receptors, but count any receptor receiving 5 dB(A) or greater insertion loss as a benefited receptor. Treat each receptor equally, except for specific locations within the area of use that may have greater usage (See [Table E2](#) for examples and methodologies to address these situations.)
6. Determine characteristics (height, length, benefited receptors, etc.) of the barrier system required to protect the area of use. If part of the barrier system also protects adjacent residential areas, treat entire barrier system by adding benefited homes with qualifying grid point receptors.
7. Calculate “square footage of barrier per benefited receptor” values.
8. Determine barrier recommendations by addressing the required and desirable reduction design criteria and goals discussed in 3.3.3.2.

**METHODOLOGY FOR DETERMINING EQUIVALENT RESIDENTIAL UNITS (ERU) AND
EVALUATING REASONABLENESS FOR SINGLE RECEPTORS REPRESENTING ACTIVITIES OF
MULTIPLE USERS**

In addition to the methodology discussed above for application to areas of land,, PennDOT has also developed methodologies for the determination of the number of residential units to be used to represent multi-dwelling structures and activity sites used by more than one family or person. These methodologies focus on the development of Equivalent Residential Unit (ERU) values based on the relationship of a “person hours used per year” value for a specific activity use to the average “person hours used per year” value associated with an average single family dwelling in Pennsylvania.

This methodology normalizes all ERU values to an ERU base value of 13,578, representative of the usage (person hours per year) of occupants of a single family residential dwelling unit in Pennsylvania. This base value was calculated in consideration of the following factors:

Persons per household = 2.48 (Source: Pennsylvania Quick Facts from the US Census Bureau for Year 2000)

Hours per day used by average household occupant = 8.67 (sleeping) + 1.80 (household activity) + 0.54 (caring) + 0.16 (homework) + 2.82 (TV) + 0.20 (telephone) + 0.6 (eating) = 14.79 - SAY 15 (Source: Bureau of Labor Statistics 2009 data)

$$\text{Person hours per day} = 2.48 \times 15 = 37.2$$

$$\text{Person hours per year} = 37.2 \times 365 = 13,578$$

While application of ERU value methodology is required, the noise analyst may use any reasonably supported approach to arrive at a “person-hours per year” use value. This Appendix includes the following tables which provide examples of how such ERU values may be calculated for various types of activities. These tables are provided for guidance purposes only and their use is not mandatory. These tables may be modified to more appropriately represent available input data used in the development of a “person-hours per year” value and the associated ERU value.

TABLE E1: Activity Category B (Exterior Receptors)

- Duplex Dwelling
- Apartment Complex with Common Outdoor Uses
- Apartment Building with Balconies
- Apartment Pool

TABLE E2: Activity Category C (Exterior Receptors -Adjustments to grid points within 130' grid area)

- Playground
- Trail
- Picnic Area
- Cemetery (2 cases)

TABLE E3: Activity Category C (Exterior Receptors not evaluated based on 130' grid point methodology)

- Playground
- Amphitheatre
- Picnic Area
- Swim Club
- Athletic Facility

TABLE E4: Activity Category D (Interior Receptor)

- Day Care Center
- Auditorium
- Medical Facility
- Radio Studio
- Place of Worship

TABLE E5: Activity Category E (Exterior Sites)

- Motel
- Office
- Restaurant

[Tables E1](#) through [E5](#) are provided for guidance purposes only and their use is not mandatory. These tables may be modified to more appropriately represent available input data used in the development of a “person-hours per year” value and the associated ERU value.

While the above methodologies related to ERU values and grid-based analyses are to be applied uniformly for all projects, it is recognized that data availability varies and, for any specific situation, data may be limited and assumptions (based on professional judgment) may need to be made. Such assumptions should be documented in the appropriate noise analysis report. In addition, depending upon the availability and type of information, there may be a variety of ways to establish ERU values, as illustrated in [Table E2](#) for the two cemetery cases.

Apply the ERU values determined from the above methodologies in the following manner:

1. Model all receptors and determine which ones are impacted. Focus noise barrier design only on these impacted receptors, but count any receptor receiving 5 dB(A) or greater insertion loss as a benefited receptor. Treat each receptor equally, except for specific locations within the area of use that may have greater usage (See [Table E2](#) for examples and methodologies to address these situations.)
2. Determine characteristics (height, length, benefited receptors, etc.) of the barrier system required to protect the area of use. If the barrier system protects multiple activity uses combine the benefited receptors from all activity categories and uses.
3. Calculate “square footage of barrier per benefited receptor” values.
4. Determine barrier recommendations by addressing the required and desirable reduction design criteria and goals discussed in 3.3.3.2.

Table E1

APPLICABLE CRITERIA ASSOCIATED WITH ACTIVITY CATEGORY B		Category B Exterior Uses				
		Single Family Residence	Duplex Dwelling	Apartments or Condominium Complex		
				Apartment Complex with Common Outdoor Uses Available To and Shared by All Residents	Apartment Building with Balconies but Without Common Outdoor Uses	Apartment Pool
A	Number of units in building ²	1	2	50		
B	Number of units exposed to project-related noise				25	
C	Capacity of Specific Use					150
D	Average Use Factor					0.30
E	Hours Available Per Day	15*				10
F	Average Time Used by Each Person Per Day (hours)	2.48*				
G	Person-Hours Per Day	37.2*				450
H	Days Per Year Used	365*				110
I	Person-Hours Used Per Year = G x H	13578*				49500
J	Equivalent Residential Units (ERU) = Row I Value divided by 13578	1	2	50	25	4
Description of Example Activity and Use		Residence occupied 15 hours per day by PA average 2.48 persons per household	A structure with two residential units	A 50 unit apartment complex has an exterior open-space area which is available for use year-round by all residents for activities such as exercising, playing, sledding, dog-walking, etc.	A 50 unit apartment complex has 25 units which contain balconies which are exposed to the proposed project. These balconies are large enough to accommodate a chair for sitting.	A large apartment complex has an outdoor swimming pool and pool deck area which is exposed to the proposed project. The facility has a capacity of 150 people and is available for use on 110 days per year for 10 hours per day. It is estimated that, on average, the facility is 30 percent full.
Modeling Guidance				The number of equivalent residential units shall never exceed the number of units within the apartment or condominium complex, even if analyzing multiple locations within the complex		
			Use professional judgment in selecting locations for analysis. Location should be representative of an exterior area of frequent human use by the inhabitants of the dwelling. In the absence of a defined exterior point of use such as a deck, patio, pool, balcony, etc., select a ground level location 10 feet from the building that has the most exposure to the proposed project.			
Application of Equivalent Residential Unit (ERU) Value			Apply the ERU value to a receptor point that represents the point of exterior use most exposed to the proposed project	Apply the ERU value to a receptor point that represents the point of exterior use most exposed to the proposed project	Model each of the exposed balconies as one receptor with an ERU value of 1	Apply the ERU value to a receptor point that represents the point of exterior use most exposed to the proposed project
NOTES:						
*	= Base Values representative of a typical resident in Pennsylvania					
	= Input Value					
	= Calculated Value					
	= Calculated ERU Value					

Table E2

APPLICABLE CRITERIA ASSOCIATED WITH ACTIVITY CATEGORY C		BASE	Adjustments to Grid Point Values Within Category C Exterior Use Area Represented by Grid Points (130' Grid)				
Exterior design year L_{eq} noise level equal to or exceeding 66 dBA with the Build condition or design year exterior Build condition L_{eq} 10 dBA or greater than existing exterior L_{eq} noise level.		Residence	Playground	Trail	Picnic Area	Cemetery (Case 1)	Cemetery (Case 2)
A	Average Event Attendance of Outside Use Area		5				2
B	Average Time Used by Each Person Per Event (hours)			0.05			1
C	Average Number of Events per Event Day						
D	Capacity of Site				20	2000	2000
E	Average Use Factor				0.40		
F	Hours Available Per Day		8		12		
G	Average Time Used by Each Person Per Day (hours)	15*			1	1	
H	Persons Using Per Day	2.48*		3000		200	
I	Person-Hours Per Day	37.2*	40	150	96	200	
J	Days Per Year Used	365*	240	365	250	365	1
K	Person-Hours Used Per Year = I x J	13578*	9600	54750	24000	73000	4000
L	Equivalent Residential Units (ERU) = Row K Value divided by 13578	1	0.7	4	2	5	0.295
M	Grid Points Within Overall Land Use Activity Area		80	120	8	80	80
N	Apply specific site's ERU Value to this number of points within 130' grid		1	3	2		
O	Retain ERU Value of 1 for the following number of points within 130' grid		79	117	6		
P	Apply this value equally to each grid point in 130' grid					0.0672	0.0037
Description of Example Specific Activity and Use		Residence occupied 15 hours per day by PA average 2.48 persons per household	A small playground is located within large park area that has been categorized 80 grid points using the 130' grid method. On average, the playground is used by 5 people per hour over the 8 hours per day of it available use. The playground's use is limited to 8 months per year.	400' of a hiking/jogging trail traverses a large park area that has been categorized by 120 grid point using the 130' grid method. On average, 3000 people per day use the trail. The average time per person on this section of trail is 3 minutes.	A picnic area is located within a small park which has been categorized by 8 grid points using the 130' grid method. The picnic area has 5 tables with an average capacity of 4 people per table. The picnic area is available for use on 250 days per year, 12 hours per day. On average the area is 40 percent occupied.	A cemetery with a capacity of 2000 grave sites has been categorized by 80 grid points using the 130' grid method. On an average day, the cemetery is visited by 200 people for an average length of time of 1 hour.	A cemetery with a capacity of 2000 grave sites has been categorized by 80 grid points using the 130' grid method. On average, each grave site is visited once per year by two people for a period of 1 hour/visit.

APPLICABLE CRITERIA ASSOCIATED WITH ACTIVITY CATEGORY C	BASE	Adjustments to Grid Point Values Within Category C Exterior Use Area Represented by Grid Points (130' Grid)				
Exterior design year L_{eq} noise level equal to or exceeding 66 dBA with the Build condition or design year exterior Build condition L_{eq} 10 dBA or greater than existing exterior L_{eq} noise level.	Residence	Playground	Trail	Picnic Area	Cemetery (Case 1)	Cemetery (Case 2)
Modeling Guidance	Use the 130' grid point closest to the location of the playground to represent the playground.	Place one point at 130' intervals along the trail (use 3 points to represent the 400' of trail).	Use the 130' grid point closest to the location of the picnic area to represent the picnic area			
Application of Adjustment to Equivalent Residential Unit (ERU) Value	Since the ERU value in this example is less than 1, retain the 130' grid point ERU value of 1 for this point and the remaining 79 grid points.	Since the ERU value in this example is 4, apply the ERU value of 4 to the three points on the trail and eliminate the 3 grid points in the 130' grid closest to the trail. Retain the ERU value of 1 for the remaining 117 grid points.	Since the ERU value in this example is 2, apply the ERU value of 2 to the one grid point representing the picnic area. Retain the ERU value of 1 for all the remaining 6 grid points.	Distribute the ERU Value of 5 equally amongst all 80 grid points by applying the value of $5/80 = 0.625$ to each grid point.	Distribute the ERU Value of 0.147 equally amongst all 80 grid points by applying the value of $0.147/80 = 0.0018$ to each grid point.	

NOTES:

*	= Base Values representative of a typical resident in Pennsylvania
[Yellow Box]	= Input Value
[Green Box]	= Calculated Value
[Orange Box]	= Calculated ERU Value

Table E3

APPLICABLE CRITERIA ASSOCIATED WITH ACTIVITY CATEGORY C		BASE	Category C Exterior Uses Represented by a Single Location on the Property				
Exterior design year L_{eq} noise level equal to or exceeding 66 dBA with the Build condition or design year exterior Build condition L_{eq} 10 dBA or greater than existing exterior L_{eq} noise level.		Residence	Playground	Amphitheatre	Picnic Area	Swim Club	Athletic Facility
A	Average Event Attendance of Outside Use Area			1000			75
B	Average Time Used by Each Person Per Event (hours)			3			4
C	Average Number of Events per Event Day			1.5			2
D	Capacity of Site				20	250	
E	Average Use Factor				0.40	0.60	
F	Hours Available Per Day				12	10	
G	Average Time Used by Each Person Per Day (hours)	15*	1				
H	Persons Using Per Day	2.48*	150				
I	Person-Hours Per Day	37.2*	150	4500	96	1500	600
J	Days Per Year Used	365*	300	25	250	90	365
K	Person-Hours Used Per Year = I x J	13578*	45000	112500	24000	135000	219000
L	Equivalent Residential Units (ERU) = Row K Value divided by 13578	1	3	8	2	10	16
Description of Example Activity and Use		Residence occupied 15 hours per day by PA average 2.48 persons per household	A school playground is used 300 days per year by 150 children per day. Each child uses the playground for an average period of 1 hour.	For a average concert, an amphitheater has 1000 people in its outside area that is exposed to the proposed project. There are a total of 25 days when concerts are held with an average of 1.5 concerts per event day. The average concert length is 3 hours	A picnic area has 5 tables with an average capacity of 4 people per table. The picnic area is available for use on 250 days per year, 12 hours per day. On average the area is 40 percent occupied.	A community swim club has an outdoor swimming pool and surrounding use area that are exposed to the proposed project. The facility has a capacity of 250 people and is available for use on 90 days per year for 10 hours per day. It is estimated that, on average, the facility is 60 percent occupied.	A community has a general purpose athletic facility which is used for baseball, football, and soccer year round. On average, there are 2 athletic events per day. Participants and viewers total 75 for the average event. The average event is 4 hours in duration.
Modeling Guidance			Use professional judgment in selecting locations for analysis. Consider using a point representative of the most exposure to the proposed project.				
Application of Adjustment to Equivalent Residential Unit (ERU) Value			Apply the ERU value to a receptor point that represents the point of exterior use most exposed to the proposed project	Apply the ERU value to a receptor point that represents the point of exterior use most exposed to the proposed project	Apply the ERU value to a receptor point that represents the point of exterior use most exposed to the proposed project	Apply the ERU value to a receptor point that represents the point of exterior use most exposed to the proposed project	Apply the ERU value to a receptor point that represents the point of exterior use most exposed to the proposed project
NOTES:							
*	= Base Values representative of a typical resident in Pennsylvania						
	= Input Value						
	= Calculated Value						
	= Calculated ERU Value						

Table E4

APPLICABLE CRITERIA ASSOCIATED WITH ACTIVITY CATEGORY D		BASE	Category D Interior Uses Represented by One Receptor				
Interior design year L_{eq} noise level equal to or exceeding 51 dBA with the Build condition or design year Build condition L_{eq} 10 dBA or greater than existing interior L_{eq} noise level.		Residence	Day Care Center	Auditorium	Medical Facility	Radio Studio	Place of Worship
A	Average Event Attendance of Interior Use Area				25		
B	Average Time Used by Each Person Per Event (hours)			3			
C	Average Number of Events per Event Day						
D	Capacity of Site			2000			
E	Average Use Factor			0.75			
F	Hours Available Per Day				8	24	
G	Average Time Used by Each Person Per Day (hours)	15*	8				
H	Persons Using Per Day	2.48*	50			9	
I	Person-Hours Per Day	37.2*	400	4500	200	216	
J	Days Per Year Used	365*	230	110	312	365	
K	Person-Hours Used Per Year = I x J	13578*	92000	495000	62400	78840	100100
L	Equivalent Residential Units (ERU) = Row K Value divided by 13578	1	7	36	5	6	7
Description of Example Activity and Use		Residence occupied 15 hours per day by PA average 2.48 persons per household	A day care center is used 230 days per year by 50 children per day for an average of 8 hours per day.	An auditorium has capacity of 2000 people. For an average event, the auditorium is 75 percent of capacity. There are a total of 110 days per year when an event is held in the auditorium, with the average length of an event being 3 hours.	A medical clinic has offices and a waiting room. On an average day, there are 25 people in the facility during each of its 8 hours of operation. The facility is open on Mondays through Saturdays.	A radio studio is operational on a 24/7 basis. At any time there 9 people staffing the facility.	A church conducts one service on Saturday night (50 people) and 3 services (100 people each) and a Sunday school (70 people) on Sunday morning. All activities are one hour in duration. During the week, the facility is used 5 days a week for a 4-hour daycare (60 people) and 6 nights a week by social groups (25 people each night, 2 hours each night). <i>In a situation like this, it may be best to calculate the person hours per year value for the multiple uses independent of the spreadsheet as follows:</i> [Saturday and Sunday Usage = 50+300+70 = 420 person hours/week; Other Usage =(60 x 4 x 5) + (6 x 25 x 2) = 1205+300= 1505 person hours/week; Total Use = (420+1505)x52= 100,100 person hours/year]
Modeling Guidance			Use either open window or closed window conditions as appropriate. If necessary and possible, perform interior and exterior measurements. Use professional judgment in locating analysis and/or measurement sites. Consider locating analysis/measurement sites 10 feet inside window on exposed side of building. Refer to FHWA documents for guidance.				
Application of Equivalent Residential Unit (ERU) Value			Category D interior criteria are only applied if no exterior activities are associated with the listed Activity Category C land uses. If exterior activities do exist, these activities are evaluated using Activity Category C criteria.				

NOTES:

- * = Base Values representative of a typical resident in Pennsylvania
- Yellow = Input Value
- Green = Calculated Value
- Orange = Calculated ERU Value

Table E5

APPLICABLE CRITERIA ASSOCIATED WITH ACTIVITY CATEGORY E		BASE	Category E Exterior Uses Represented by a Single Location on the Property		
Exterior design year L_{eq} noise level equal to or exceeding 71 dBA with the Build condition or design year exterior Build condition L_{eq} 10 dBA or greater than existing exterior L_{eq} noise level.		Residence	Motel	Office	Restaurant
A	Average Event Attendance of Outside Use Area				
B	Average Time Used by Each Person Per Event (hours)				
C	Average Number of Events per Event Day				
D	Capacity of Site				200
E	Average Use Factor				0.60
F	Hours Available Per Day				8
G	Average Time Used by Each Person Per Day (hours)	15*	2	1.5	
H	Persons Using Per Day	2.48*	195	25	
I	Person-Hours Per Day	37.2*	390	37.5	960
J	Days Per Year Used	365*	210	160	210
K	Person-Hours Used Per Year = I x J	13578*	81900	6000	201600
L	Equivalent Residential Units (ERU) = Row K Value divided by 13578	1	6	0.4	15
Description of Example Activity and Use		Residence occupied 15 hours per day by PA average 2.48 persons per household	A 200 unit motel has an average occupancy rate of 65 percent, with an average of 1.5 people per room (daily person use = $200 \times 0.65 \times 1.5 = 195$). It has a popular exterior patio area that is available for multiple uses by all occupants during 7 months of the year ($7 \times 30 = 210$ days/year). On average, the normal guest uses this area for a 2 hour period.	A small business office has an outside lunch and break area that is used 5 days per week, 8 months per year by an average of 25 employees per day. Over the course of the day, each of these employees uses the area for a total of 1.5 hours.	A restaurant has an outside dining area which seats 200 customers. This area is exposed to the proposed project. The average occupancy rate is 60 percent for each of the 8 hours per day that this area is open. The outside dining area is used 7 months per year, 7 days per week.
Modeling Guidance				Since the Equivalent Residential Use value is less than 0.5 (<1.0 rounded), this can be considered a location without frequent human us and need not be modeled.	
Application of Equivalent Residential Unit (ERU) Value			Apply the ERU value to a receptor point that represents the point of exterior use most exposed to the proposed project	Apply the ERU value to a receptor point that represents the point of exterior use most exposed to the proposed project	Apply the ERU value to a receptor point that represents the point of exterior use most exposed to the proposed project

NOTES:

- * = Base Values representative of a typical resident in Pennsylvania
- Yellow = Input Value
- Green = Calculated Value
- Orange = Calculated ERU Value

Appendix F - 23 CFR 772 Final Rule and Reevaluation Q & A

Question: The FHWA/FTA National Environmental Policy Act (NEPA) regulations at 23 CFR 771.129 requires highway agencies to consult with FHWA to determine if NEPA documents and decisions remain valid, in a process known as “re-evaluation.” Does the final noise rule (23 CFR 772) automatically require re-evaluations of NEPA decisions and associated noise analyses approved before July 13, 2011?

Answer: No. The final noise rule does not automatically trigger the requirement to re-evaluate final NEPA decisions and noise analyses before the final rule’s effective date (July 13, 2011).

However, 23 CFR 771.129 requires the highway agency to consult with FHWA after approval of any Record of Decision, Finding of No Significant Impact or Categorical Exclusion determination, before the highway agency requests any subsequent major approvals or grants from FHWA. Examples of such approvals include, but are not limited to: approval to acquire right-of-way; final design and construction funding. During this consultation, the FHWA in consultation with the highway agency will determine if the previous NEPA decision and documentation remain valid OR that additional analysis is required. (For a more detailed overview of the FHWA re-evaluation process, please see the two-part article in the FHWA Environmental Quarterly Spring and Summer 2009 issues, Volume 5, Issues 2 and 3. The articles can be viewed and downloaded free of charge at the FHWA Resource Center website at <http://www.fhwa.dot.gov/resourcecenter/teams/environment/publications.cfm>)

During the consultation, the highway agency and FHWA will discuss changes to laws and regulations that have gone into effect after the NEPA decision, along with any changes in the project design, scope, location and the affected environment.

On or after July 13, 2011, prior to requesting any post-NEPA major approvals from FHWA, the highway agency should consult with the FHWA to determine if the amended noise regulation affects the previous NEPA decision, and what, if any, additional analysis may be required. The results of the consultation should be documented in a memorandum to the file if no additional analysis is required.

Question: Can you provide an example of a re-evaluation of the NEPA decision that would not require a revised or new noise analysis on or after July 13, 2011?

Answer: Yes. Most projects that were not subject to the requirements of the previous FHWA Noise Standard will not be subject to the amended rule unless changes to the project location, design concept or scope have occurred. Example: In August 2011, a highway agency requests FHWA approval of the Plans, Specifications and Estimates (PS&E) for a project that did not require a noise analysis under the previous noise regulation; that is, the project was not a Type I or Type II project under the previous noise rule. During consultation, the FHWA and SHA will review the applicability section of the final rule (23 CFR 772.7). If they agree that the project currently described in the PS&E package is not a Type I or Type II project under the amended rule, then the amended rule will not apply. If there are no other changes that require additional analysis, the re-evaluation process will conclude with a memorandum to the project file

summarizing the consultation. It will state that requirements of the amended FHWA Noise Standard at 23 CFR 772 do not apply to the project because it is not a Type I or Type II project (that is, under the amended final rule, it is a Type III project). No further noise analysis is required prior to the request for PS&E approval.

Question: A Type I project received its final NEPA approval in 2008. What are the re-evaluation requirements for FHWA approvals requested on or after July 13, 2011? Will a new noise study need to be prepared?

Answer: The highway agency should consult with FHWA to determine what additional analysis and documentation is needed. During the consultation, the FHWA in consultation with the highway agency will determine if the previous noise study documentation can be efficiently updated to reflect changes in the noise regulation and State noise policy and the applicability of the changes to the undertaking. In some cases, a noise study addendum may be recommended. Any new or updated noise study documentation will verify whether the project is subject to the amended FHWA Noise Standard, examine the project design, location and scope, the surrounding land uses, and existing and future (design year) noise levels. Using the revised Noise Abatement Criteria (Table 1 of 23 CFR 772) and the revised highway agency Noise Policy, any traffic noise impacts will be identified or confirmed. If new or changes in impacts will occur, the highway agency may need to update the noise abatement analysis, using its revised State Noise Policy. In consultation with highway agencies, the FHWA may determine that additional public involvement, including solicitation of the views of affected residents and property owners, may be needed. In re-visiting noise abatement decisions, highway agencies and Division Offices should take a flexible but quantifiable and well-documented approach, especially during the transition to full implementation of the final rule. (See page 38 of the FHWA Highway Traffic Noise Analysis and Abatement Guidance, issued with the final rule.)

Question: Our Division Office expects that the highway agency will have several high priority projects ready for construction bids in the summer of 2011. Will technical assistance be available to address noise during NEPA re-evaluations?

Answer: Yes. To assist with the implementation of the final noise rule, FHWA Headquarters and Resource Center specialists have been assigned to each Division Office. These specialists, along with Headquarters Project Development Specialists from the Office of Project Development and Environmental Review, will be available to provide both general and project-specific noise and NEPA technical assistance.

DRAFT 11/18/2010

Appendix G - Noise Abatement Measures Reporting for Noise Walls and Berms

**TABLE G1
EXAMPLE: RECORDING BASIC INFORMATION FOR A NOISE WALL**

GEOGRAPHIC INFORMATION					
DISTRICT	COUNTY	MUNICIPALITY	ROUTE		SECTION
6-0	Delaware	Nether Providence Township	I-476		200
STATUS OF INFORMATION (Place "X" in appropriate location)					
COMPLETED ACTIVITY: PRELIMINARY ENGINEERING (); FINAL DESIGN (X); CONSTRUCTION ()			DATE OF COMPLETED ACTIVITY		9/9/2010
NOISE BARRIER WALL INFORMATION					
ID/NUMBER	LOCATION	BEGIN STATION	END STATION	HIGHWAY SIDE	COMMUNITY SIDE
BARI	East Side	100+00	500+00	Absorptive	Reflective
TYPE AND MOUNTING	MATERIAL	SURFACE ACOUSTIC TREATMENT		AESTHETICS	
		HIGHWAY SIDE	COMMUNITY SIDE	HIGHWAY SIDE	COMMUNITY SIDE
Ground-Mounted Noise Wall	Precast Concrete	Absorptive NRC=0.85	Reflective	Vertical Flute Formliner	Exposed Aggregate
LENGTH (ft)	HEIGHT RANGE (ft)	AVERAGE HEIGHT (ft)	AREA (sf)	SF/BR VALUE	FHWA TNM DATA FILE
406	10 to 18	16.7	6765	1353	Bar1 Final 9.11.11
TOTAL NUMBER OF BENEFITED RECEPTORS (those with LL > 5 dBA) >>>		5	BARRIER COST & COST/SF (BID YEAR 20XX)		
Activity Category A >>>		0	LOW BIDDER	SECOND BIDDER	
Activity Category B >>>		3	\$193,720	\$199,650	
Activity Category C >>>		2	\$28.64	\$29.51	
Activity Category D >>>		0	THIRD BIDDER	AVERAGE	
Activity Category E >>>		0	\$178,398	\$196,685	
AVERAGE INSERTION LOSS FOR BENEFITED RECEPTORS >>>		8 dB(A)	\$26.37	\$29.07	

TABLE G2
EXAMPLE: RECORDING BASIC INFORMATION FOR NOISE BERM

GEOGRAPHIC INFORMATION					
DISTRICT	COUNTY	MUNICIPALITY	ROUTE		SECTION
6-0	Delaware	Nether Providence Township	I-476		200
STATUS OF INFORMATION (Place "X" in appropriate location)					
COMPLETED ACTIVITY: PRELIMINARY ENGINEERING (); FINAL DESIGN (X); CONSTRUCTION ()				DATE OF COMPLETED ACTIVITY	9/9/2010
NOISE BERM INFORMATION					
ID/NUMBER	LOCATION	BEGIN STATION	END STATION	HIGHWAY SLOPE	COMMUNITY SLOPE
BERM1	East Side	100+00	500+00	2:01	3:01
TOP WIDTH (ft)	MATERIAL	SOURCE OF MATERIAL		LANDSCAPING	
5	Soil	FROM JOB	BORROW	HIGHWAY SIDE	COMMUNITY SIDE
		Class 1 Excavation	From Offsite Borrow Pit	Crown Vetch	Grass
LENGTH (ft)	HEIGHT RANGE (ft)	AVERAGE HEIGHT (ft)	Volume (CY)	CY/BR VALUE	FHWA TNM DATA FILE
406	10 to 15	12	6316	1263	Berm 1 Final 9.11.11
TOTAL NUMBER OF BENEFITED RECEPTORS (those with LL _c > 5 dBA) >>>		5	BARRIER COST & COST/CY(BID YEAR 20XX)		
	Activity Category A >>>	0	LOW BIDDER	SECOND BIDDER	
	Activity Category B >>>	3	\$85,000	\$90,000	
	Activity Category C >>>	2	\$13.45	\$14.25	
	Activity Category D >>>	0	THIRD BIDDER	AVERAGE	
	Activity Category E >>>	0	\$80,000	\$95,000	
AVERAGE INSERTION LOSS FOR BENEFITED RECEPTORS >>>		8 dB(A)	\$12.67	\$15.04	

NOTE – Access to Project Bid Information

Project-related bid information can be obtained online through PennDOT’s Engineering and Construction Management System (ECMS). The ECMS home page can be accessed at: <http://www.dot14.state.pa.us/ECMS/> in the following manner:

Upon entering the home page, logon as a guest by clicking “[here](#)” in the box on the right, then click “OK” in the pop-up box – The Bid Results Portal page will appear. From this page, bid information related to a project can be obtained once the project number is entered.

If you don’t know the project number, click on “Advanced Search,” then select District, then County, then enter a State Route number. On the top banner click “Search.” The Bid Results page will show ranked results of total project bids for contractors who bid on the listed projects. You may want to record the project number for future reference.

Opposite your project number (in the third column) is a radio button that can be clicked to show the bid tabs for the low bidder, the second bidder, and the third bidder. From this list, you can see how a barrier was bid (lump sum, individual items) and obtain the unit costs, quantities, and costs on an item by item basis.

This ECMS information should enable the completion of the forms in Appendix G.

NOTE – Access to Project Bid Plans and Specifications

Bid Specification information can also be obtained through ECMS in the following manner:

From the ECMS home page, click on the “Solicitation” banner on the top, then select “Contractors,” then select “Bid Packages.” Enter “Project Number” in box at top right, and click “GO.” Click appropriate “Plans” or “Special Provisions” or other available radio buttons for desired information in pdf format.

Appendix H - Federal Highway Administration Highway Traffic Noise Frequently Asked Questions

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A. General

A1. What are the Federal standards for highway traffic noise?

The Federal noise regulation at 23 CFR 772 constitutes the official Federal noise standards. The standards include the Noise Abatement Criteria along with all other requirements of 23 CFR 772, such as prediction of noise levels, abatement, information for local officials and construction noise. The entire Part 772 is the Noise Standard.

A2. What are the responsibilities of the FHWA and state departments of transportation regarding implementation of 23 CFR 772?

The Federal Highway Administration (FHWA) is the designated government agency for administering the Federal-aid highway program. This program makes funds available to the States to assist in their highway construction and improvement programs. The States select the projects they will undertake by priority and develop these projects according to Federal requirements while considering project alternatives and potential impacts. The States are also responsible for the planning, design, and construction of highways within their jurisdictions. FHWA reviews each State's noise policy to make sure it satisfactorily meets Federal requirements. Additionally, FHWA provides technical advice and approvals at key stages of project development.

Each State transportation agency (including the District of Columbia and Commonwealth of Puerto Rico) is required to have a noise policy that is consistent with the FHWA noise standard. The State noise policies have all been reviewed and approved by FHWA for consistency with the FHWA noise standard.

A3. I have concerns about traffic noise levels in my community. What agency should I contact?

Since each State has specific knowledge of the highway projects in their State, you should contact the State Department of Transportation (SDOT). The FHWA Division Office in your State can provide the contact information for the SDOT noise analysis section. The SDOT noise contact will be able to address public concerns regarding a specific project, noise complaint, or request for a noise barrier.

A4. When does 23 CFR 772 apply to a project?

The regulation applies in the cases described in 23 CFR 772.7(a):

“(a) This regulation applies to all Federal or Federal-aid Highway Projects authorized under title 23, United States Code. Therefore, this regulation applies to any highway project or multimodal project that:

- (1) Requires FHWA approval regardless of funding sources, or
- (2) Is funded with Federal-aid highway funds.”

A5. What are the differences between NEPA and 23 CFR 772 in considering traffic noise impacts?

There is a major difference between NEPA and 23 CFR 772 requirements for determining traffic noise impacts. NEPA requires comparison of a proposed alternative with a baseline (the no-build alternative or no action alternative, in the design year) to determine whether traffic noise impacts will occur. The proposed project itself must create the traffic noise impact. However, 23 CFR 772 utilizes the opportunity provided by a proposed project to consider mitigating current as well as future noise problems. Therefore, under 23 CFR 772, if the predicted noise level approaches or exceeds the Noise Abatement Criteria, there is a traffic noise impact regardless of whether or not the proposed project is the cause. Even if existing noise levels decrease in the future, e.g. from 72 dB(A) to 69 dB(A), at a Category B site, there is still a traffic noise impact, and noise abatement must be considered.

A6. Does the noise analysis performed to satisfy 23 U.S.C. 109(i) and 23 CFR 772 satisfy all noise analysis requirements for highway projects under NEPA?

It is FHWA's view that the noise analysis performed to satisfy the requirements of 23 CFR 772 generally satisfies the requirements under NEPA. However, some Type III projects may require additional analysis of traffic noise impacts on wildlife or historic properties, or for unusual circumstances where the project will increase noise levels, but does not include activities classified as a Type I project.

NEPA also requires analysis of the no build or no action alternative, which is not a requirement of 23 CFR 772. Some state DOT noise policies require analysis of the future no build case to satisfy the NEPA requirement. States may also find analysis of the future no build useful to compare future no build and future build noise levels because there are circumstances where project construction reduces future noise levels. For example, if a project's purpose is to straighten out a curve, in which the alignment moves away from sensitive receptors, comparing the future build to future no-build could potentially show reductions in noise levels due to the project.

A7. Are payments allowed for noise damages?

States cannot use Federal-aid funds to compensate property owners for noise damages, but can use Federal-aid funds for noise abatement. Eligible noise abatement measures are listed at 23 CFR 772.15(c) and include noise barriers, traffic management measures, alteration of horizontal and vertical alignments, acquisition of land as buffer areas in predominantly undeveloped areas, and noise insulation of Activity Category D land use facilities. Normally, State DOT's provide noise abatement by contracting construction of highway traffic noise abatement measures to a third-party.

A8. What is Noise Compatible Planning (NCP)?

Reducing highway traffic noise is a shared responsibility between Federal, State and Local governments. The FHWA encourages State and Local governments to practice compatible land use planning and control near highways. The FHWA also encourages local governments to use their authority to regulate land development to either prohibit development of noise sensitive land uses adjacent to highways or establish requirements for developers to plan, design, and construct noise sensitive development using methods that minimize noise impacts.

The prevention of future impacts is one of the most important parts of noise control. New development and highways can be compatible. But, local government officials need to know what noise levels to expect from a highway and what techniques they can use to prevent future impacts. The regulation requires that States at a minimum must provide the distance to the approach criteria for each land use category on undeveloped lands (23 CFR 772-17(a)(2)). States may accomplish this by including a table of future noise levels at specific locations or a figure of distances to typical noise levels along the roadway. Title 23 CFR 772.17 requires states to provide this information to local governments. Making this information available for real estate transactions informs developers about the potential for future noise impacts. The regulation also requires that the state make local officials aware of the eligibility requirements for Federal-aid participation in Type II projects. Implementation of NCP will help eliminate situations where the State DOT is unable by law to provide noise mitigation. Please visit our NCP webpage for additional information.

A9. What is the focus of the FHWA Noise Abatement Criteria (NAC)?

The FHWA NAC focuses on levels where highway traffic noise could potentially interfere with speech communication in exterior areas. 23 CFR 772's primary focus is on determining traffic noise impacts and considering noise abatement for exterior areas of frequent human use.

B. Noise Analysis

B1. What triggers the requirement to complete a noise analysis?

State highway agencies must complete a noise analysis for any project where 23 CFR 772.7(a) applies and the project includes any activity included in the list of Type I or Type II projects shown below.

B2. What is the maximum effective distance for noise barriers as an abatement measure?

The maximum effective distance of a noise barrier depends on a variety of factors including the site geometry, the height of the barrier, the presence of noise sources other than the project, and meteorological effects, among others. For additional information on the limitations for using TNM to design noise barriers, see the TNM FAQ #26 under "Barriers", at: http://www.fhwa.dot.gov/environment/noise/traffic_noise_model/tnm_faqs/faq07.cfm#mbarriers1

C. Project Definitions

C1. What is a Type I project?

Type I project is defined in 23 CFR 772.5:

1. The construction of a highway on a new location; or,
2. The physical alteration of an existing highway 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;
 - 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 or by altering the topography between the highway 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.

C2. How does the FHWA define auxiliary lanes when determining a Type I project?

The FHWA noise guidance recommends that State highway agencies take a broad approach to defining auxiliary lanes with respect to Type I projects as defined in paragraph (4) of the definition of Type 1 project in 23 CFR 772.5. Although the function of an auxiliary lane differs depending on the type of facility, an auxiliary lane should classify the project as Type I if the auxiliary lane is 2,500 feet or longer (see the AASHTO Policy on Highway Design or Green Book and Institute of Transportation Engineers (ITE) Manual "Freeway and Interchange Geometric Design Handbook" for more information).

C3. Is the removal of an existing noise barrier a Type I project?

The removal from an existing noise barrier would most likely be a Type I project if the removal of the noise barrier meets the Type I definition of "substantial vertical alteration" under 23 CFR 772.5. The removal of an existing noise barrier may remove shielding by altering the topography, thereby exposing the line-of-sight between the highway traffic source and the sensitive noise receptors.

C4. What is a Type II project?

Also called a retrofit project for noise abatement, a Type II project as defined in 23 CFR 772.5, provides noise abatement on an existing highway per 23 CFR 772(7)(d), participation in a Type II program. The regulation limits Federal participation in the funding of such projects to noise abatement measures (barriers) along lands developed prior to construction of the original highway. FHWA participation in Type II projects also requires that the State develop a system to prioritize projects using a variety of factors in accordance with 23 CFR 772.7(e). Typically, these factors include the density of development, traffic volumes and the age of the community among others.

C5. What is a Type III project?

Type III projects include all projects subject to 23 CFR 772.7(a) that do not meet the classifications of a Type I or Type II project. Type III projects do not require a noise analysis.

D. Land Use Considerations

D1. What are the FHWA Noise Abatement Criteria (NAC)?

The FHWA NAC are objective absolute noise levels for varying land use categories that are used to determine if and where traffic noise impacts occur, as defined in 23 CFR 772.5. States must consider noise abatement measures where impacts occur and must include abatement in the project plans, specifications and estimates if abatement is found to be feasible and reasonable.¹

Table 5 : 23 CFR Part 772, Table 1 Noise Abatement Criteria (NAC) Hourly A Weighted Sound Level in Decibels (dBA)

Activity Category	$L_{eq}(h)$	$L_{10}(h)^2$	Analysis Location	Description of Activity Category
A	57	60	Exterior	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B ³	67	70	Exterior	Residential.
C ³	67	70	Exterior	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.
D	52	55	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	75	Exterior	Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in A–D or F.
F				Agriculture, 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.

¹Either $L_{eq}(h)$ or $L_{10}(h)$ (but not both) may be used on a project.

²Either $L_{eq}(h)$ and $L_{10}(h)$ Activity Criteria values are for impact determination only, and are not design standards for noise abatement measures.

³Includes undeveloped lands permitted for this activity category.

D2. Activity Category A Land Use

a. What is an Activity Category A land use?

Activity Category A includes lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose. The regulation further requires all highway agencies to submit a justification to FHWA on a case-by-case basis for approval of Activity Category A designation for locations identified as potential Activity Category A land uses. The following FAQs clarify FHWA’s approach to Activity Category A land use determinations and provides a test for Activity Category A designations.

Activity Category A land uses have a lower noise impact level at approach or exceed 57 Leq, per 23 CFR772, Table 1. However, it is important to note that if an Activity Category A land use is determined to be impacted, the consideration of feasible and reasonable noise abatement is the same as any other impacted land use.

b. Must a site already be serene and quiet to receive an Activity Category A determination?

Yes. Please see the evaluation criteria in the Test for Meeting Activity Category A Designation below.

c. Are there any examples of Activity Category A classifications that help with making future determinations?

In making the determination, FHWA looks to examples of existing Activity Category A designations such as the Tomb of the Unknown Soldier at Arlington National Cemetery and the Wolf Trap Amphitheater. New Activity Category A determinations should be locations of similar character and significance.

d. Does the Activity Category A determination apply to an entire property, or can it apply to a specific site within a larger area?

When the considered use occurs in a particular area of a property the consideration for an Activity Category A determination occurs on a "site" basis rather than considering the entire property. For example, The Tomb of the Unknowns is an Activity Category A designated land use within the Arlington National Cemetery, which is not an Activity Category A land use.

e. Will FHWA classify undeveloped lands as an Activity Category A land use?

Undeveloped lands fall under Activity Category G in Table 1 to Part 772: Noise Abatement Criteria. If undeveloped land is permitted for development as a Activity Category A land use then the requirements of 23 CFR 772.11(c)(2)(vii)(B) apply.

f. Does a project sponsor have an obligation to make a site serene and quiet to receive an Activity Category A designation?

No, as with all Activity Categories listed in Table 1, the NAC value is only for the purpose of determining impacts. If impacts are determined, the Activity Category A land use is applied against the same feasible and reasonable criteria as any other Activity Category land use in Table 1. Therefore, the regulation does not require that noise levels be lowered to the NAC value. The definition of an Activity Category A land use includes serene and quiet, but for the reasons stated above, the regulation does not require that noise levels be lowered to achieve a serene and quiet setting.

g. Does the frequent human use requirement (23 CFR 772.11(b) and Table 1) apply to Activity Category A land uses?

Title 23 CFR 772 considers noise impacts on the human environment, thus a site must have frequent human use to receive classification as an Activity Category A land use. Serenity and quiet may be desirable at a wildlife preserve, but it would not be considered for Activity Category A classification if no human use occurs at the site.

h. What process does FHWA use to make Activity Category A designations?

The FHWA uses the following process to make Activity Category A designations:

Test for Meeting Activity Category A Designation

In order to meet the requirements for Activity Category A designation, evaluate the site and related activity in accordance with, and in compliance with, the above questions and answers and answer all of the following questions in the affirmative:

Serenity and Quiet Question: Is the site currently serene and quiet?

- Yes, if the current L_{eq} noise level does not approach or exceed the Activity Category A Noise Abatement Criterion (NAC) during any period when serving its intended purpose.
- No, if the current L_{eq} approaches or exceeds the Category A NAC during any period when serving its intended purpose.

Public Need Question: Does the site currently serve an important public need?

- Yes, if there is an important benefit of the public visiting or using the site due to its historical, religious, cultural, or natural significance.
- No, if there is no benefit.

Intended Purpose Question: Is the preservation of serenity and quiet essential to serve the site's intended purpose?

- Yes, if the intended use of the site in the future (design year) will continue to have historical, religious, cultural, or natural significance.
- No, if the current intended purpose of the site will change in the future in a manner that will not require serenity and quiet.

Frequent Human Use Question: Is the site frequently used (or frequently available for use) by the public?

- Yes, if the public can access the site during all times when it is available and able to serve its intended purpose. NOTE: The owner of a site may limit the number of visitors at a given time in order to conserve the site's serenity and quiet.
- No, if, with the exception of limits of usage established to maintain a site's serenity and quiet, the public is restricted from using the site during certain periods when the site is still available to serve its intended purpose.

Determination: If the answers to ALL of the above questions are yes, the SDOT should send supportive documentation to the appropriate FHWA Division Office and participate in any necessary additional coordination with FHWA staff to finalize the eligibility determination. If the answer(s) to any of the above questions is no, SDOTs must include this information in the project's noise documentation in accordance with the SDOT's noise policy and send the documentation to the FHWA Division Office as required by the FHWA noise regulation and/or the SDOT's noise policy.

D3. What is an Activity Category B land use activity?

Activity Category B includes single and multi-family residences. Residential hotels and motels that function as apartment dwellings should also be treated as Category B.

D4. Activity Category C Land Use Activity

a. What is an Activity Category C land use activity?

Activity Category C includes 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. Each State DOT must adopt standard practices for analyzing these land uses that is consistent and uniformly applied statewide.

b. How does FHWA define a medical facility as used in 23 CFR 772?

For the purposes of 23 CFR 772, the FHWA defines a medical facility as an inpatient medical facility where medical treatment and care occurs.

c. How is noise considered in evaluating use of Section 4(f) lands?

The requirements of Section 4(f) are separate from 23 CFR 772, but may also call for consideration of noise impacts to lands subject to Section 4(f). A noise impact does not necessarily constitute a Section 4(f) use. However, even when noise increases do not constitute a Section 4(f) use, noise impacts may still require consideration for abatement under 23 CFR 772. Abatement measures may result in

additional impacts that require consideration under Section 4(f), NEPA, Section 106, or as visual impacts.

Section 23 CFR 774.15 of FHWA's regulations governing implementation of Section 4(f) include specific discussion to aid in assessing whether noise impacts would constitute a constructive use and require a Section 4(f) evaluation. In general, a constructive use occurs when "The projected noise level increase attributable to the project substantially interferes with the use and enjoyment of a noise-sensitive facility of a property protected by Section 4(f)". Examples include, hearing performances at an outdoor amphitheater, sleeping in a campground, visiting a historic site where a quiet setting is related to the site's significance, enjoying an urban park where serenity and quiet are significant attributes, or viewing wildlife in an area of a refuge intended for such viewing.

Conversely, 23 CFR 774.15(f) states that a constructive use does not occur when the impact of projected traffic noise levels of the proposed highway project on a noise-sensitive activity do not exceed the FHWA noise abatement criteria or the increase in the projected noise levels of the proposed project is barely perceptible (3 dBA or less).

d. How are noise impact addressed in regard to historic properties in the context of Section 106 of the National Historic Preservation Act?

As with Section 4(f), the consideration of historic properties under Section 106 is a separate requirement, but may be related to the assessment of noise impacts under 23 CFR 772. There is no metric for analyzing when a change in noise constitutes an effect under the regulations implementing Section 106 (36 CFR Part 800), since that will be dependent on the contributing characteristics and use of the historic resource. Some properties, such as designed or cultural landscapes where the landscape itself is the significant feature or where the setting is especially important, may be extremely sensitive to any change that can be perceived by the human ear. In such cases FHWA considers anything above 3 db(A) to be a change that should be considered an effect. These cases should be assessed to determine whether it could adversely affect the contributing characteristics of the property. Other historic properties, such as historic transportation facilities, could be relatively unaffected by noise. It depends on the resource as to when noise impacts may diminish the integrity of a property's significant historic features, including a change in character of the property's setting or use [see 36 CFR 800.5(a)(1) and (2)]. Mitigation to address impacts of noise to a historic property is a separate matter from any abatement determined justified under 23 CFR 772, and as with Section 4(f) properties, the abatement measures may present additional impacts to be considered.

e. How are trails and trail crossings defined in the context of 23 CFR 772?

Trails and trail crossing are Activity Category C land use activities under 23 CFR 772.

Trails are defined in 23 USC 206(a)(2)(A-F) of the recreational trails program and require a noise analysis under 23 CFR 772. Motorized activities as described in 23 USC 206(a)(2)(G) are noise generators (Activity Category F) and consideration for noise impacts is not required.

Trail crossings describe locations where trails cross surface transportation facilities.

D5. What is an Activity Category D activity?

Activity Category D includes 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. Highway agencies consider abatement of interior locations at Category D land uses where exterior abatement is not feasible or reasonable.

D6. What is an Activity Category E activity?

Activity Category E includes a variety of commercial activities such as hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in A–D or F. As stated in question D11, residential hotels and motels that function as apartment dwellings should be treated as Activity Category B.

D7. What is an Activity Category F activity?

Activity Category F includes a variety of land uses that are not considered sensitive to noise such as agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing. Retail facilities under Category F include development such as malls, stores and shops.

D8. What is an Activity Category G activity?

Activity Category G includes undeveloped lands without a permit for future development. Treat undeveloped lands with a permit by the date of public knowledge as the developed use for the purposes of the noise analysis and consideration for abatement of project related noise impacts.

a. How does FHWA define “permit” under 23 CFR 772?

FHWA defines “permit” as used in category G as a definite commitment to develop land with an approved specific design of land use activities as evidenced by the issuance of a building permit. As of the effective date (July 13, 2011) of the current 23 CFR 772, FHWA eliminated “planned, designed and programmed” land use and requires issuance of a building permit as the trigger to indicate a definite

commitment to develop the property in question has occurred. Some areas do not issue building permits. In these cases, the highway agency may use other triggers such as the presence of foundations to indicate a commitment to develop.

D9. What is the applicable Activity Category for undeveloped portions of a natural area or preserve with no exterior areas of frequent human use?

The appropriate activity category of natural areas, preserves, or similar locations with no exterior areas of frequent human use is Activity Category G, defined in 23 CFR 772 as undeveloped lands with no permitted use. In these cases, the SDOT must provide information on noise compatible planning concepts and the best estimation of the future design year noise levels to the appropriate local officials (see 23 CFR 772.17). In this case, FHWA also recommends providing that information to the landowner or landowner's representative of the undeveloped land.

D10. What is the applicable Activity Category for a natural area or preserve with exterior areas of frequent human use?

Portions of natural areas, preserves, or similar locations with exterior areas of frequent human use normally receive an Activity Category C classification. This category includes cemeteries, schools, places of worship and other uses where serenity and quiet are desirable, but that do not meet the Activity Category A designation requirements.

D11. What is the applicable Activity Category for a rest stop or rest area?

The addition of a new or substantial alteration of an existing rest stop or rest area is a Type I project, per paragraph (7) of the Type I definition in 23 CFR 772.5, since either activity results in expansion of the highway facility. When assessing a rest stop or rest area for noise impacts, the Activity Category to be used will depend on the use of the rest stop. If the rest stop is designed and used to park vehicles, in particular heavy vehicles, then the rest stop is functioning more as a noise generating land use and should be categorized as Activity Category F. If the rest stop is designed and used in a park-like setting, such as those along scenic routes, then the rest stop should be treated as a noise sensitive land used under Activity Category C. As with any land use that is not listed on Table 1 of 23 CFR 772, the best approach is to investigate the site to determine how users interact with the site and classify the site accordingly.

E. Determination of Noise Levels

E1. How are existing noise levels determined?

Existing noise levels are determined by using one of the following methods:

1. Perform sound level measurements at representative receptors taken during the worst noise hour;
2. Predict noise levels using the FHWA Traffic Noise Model; or,

3. Use a combination of sound level measurements and prediction with a validated Traffic Noise Model. Measurements should occur during free flow traffic conditions and do not need to occur during the worst noise hour.

E2. How are future noise levels determined?

Future noise levels are determined by using the FHWA Traffic Noise Model® (FHWA TNM®) or any other model deemed by the FHWA as being consistent with the methodology of TNM per 23 CFR 772.9(a). For additional information on TNM, see the TNM FAQs at: http://www.fhwa.dot.gov/environment/noise/traffic_noise_model/tnm_fags/

E3. What is the method for analyzing abatement for multi-story land uses, such as multi-family apartments or condominiums?

Generally, it is not feasible and/or reasonable to build a noise barrier tall enough to mitigate noise for floors above the ground floor level. For instances where the highway is elevated it is possible that upper floors of adjacent buildings approach the same elevation as the highway and abatement for impacts to exterior areas at upper floors may be feasible and reasonable. Therefore, the analysis may result in abatement for the ground floor or upper floors in some cases. There may be situations, specific to local terrain or other shielding objects, where a noise barrier is warranted, reasonable and feasible for higher floors.

E4. What is the methodology for analyzing Activity Category C, D and E land uses?

Activity Category C, D and E land uses are generally any location that is not a residence, but may be sensitive to noise impacts. This would include any of the land uses listed in Categories C, D and E above.

Each highway agency has methodologies in the noise policy that provides approaches to determining the number of receptors represented by a land use.

E5. How do we determine and abate noise levels for Category D (interior) activities?

If no exterior areas of frequent human use are present, then consider the NAC Category D activity. The method for measuring an interior noise level is to measure the exterior noise level and use Table 7 from the [Highway Traffic Noise Analysis and Abatement policy \(PDF 325KB\)](#) to subtract from the exterior value and determine the interior noise level. The regulation does not allow noise insulation for residences.

F. Identifying Noise Impacts

F1. How do we determine noise impacts?

A traffic noise impact occurs when the existing noise levels for a Type II project or future (design year) noise levels for a Type I project approach or exceed the noise abatement criteria (NAC) or when predicted future traffic noise levels substantially exceed the existing noise level even though the predicted levels may not exceed the NAC. This definition reflects the FHWA position that traffic noise impacts can occur under either of two separate conditions:

- When noise levels are unacceptably high (absolute level); or
- When a proposed highway project will substantially increase the existing noise environment (substantial increase)

Adequate assessment of the noise impact of a proposed project requires analysis of both criteria. The FHWA noise regulation requires State DOTs to establish a definition of "approach" that is at least 1 dB(A) less than the NAC for use in identifying traffic noise impacts in traffic noise analyses.

F2. What is a substantial increase in noise level?

For Type I projects, States are required to define a substantial increase in noise levels within a range of a 5 to 15 dBA increase over existing noise levels and then apply the substantial noise increase uniformly and consistently. Any predicted increase at or above the substantial increase limit selected by the state in their policy results in a noise impact. A substantial increase impact is not limited by the absolute noise level.

F3. Can noise analysts use the TNM contours function to determine impacts or analyze abatement considerations?

Contours may not be used to determine impacts or for abatement consideration. As defined in 772.9(c), noise contour lines may be used for project alternative screening or for land use planning to comply with §772.17 of this part, but shall not be used for determining highway traffic noise impacts.

F4. What noise barrier standards are required?

There are no Federal requirements or FHWA regulations related to the selection of material types used in the construction of highway traffic noise barriers. Individual state highway agencies select the material types they allow contractors to use when building these barriers, as well as the testing procedures required to evaluate barriers and construction materials. The state DOTs normally make this selection based on a number of factors such as aesthetics, durability and maintenance, cost, public comments, seismic or wind considerations, etc. Discussion of the process for evaluating noise barrier products designed and manufactured privately before installation, including testing such as susceptibility to shatter, flame spread, material strength, etc., can be found in Chapter 10 of the Noise Barrier Design Handbook.

G. Noise Abatement

G1. Are states required to provide abatement when the analysis identifies noise impacts resulting from the project?

The state must consider abatement measures when the analysis identifies highway noise impacts resulting from the project and must implement noise abatement determined feasible and reasonable.

G2. What is "feasible" highway traffic noise abatement?

Feasibility deals primarily with objective engineering considerations (e.g., can a barrier be built given the topography of the location; can a substantial noise reduction be achieved given certain access, drainage, safety, or maintenance requirements; are other noise sources present in the area, etc.). The preliminary and final project design should address safety, maintenance, and drainage concerns for all noise abatement measures. These issues should be part of the feasibility determination and can usually be resolved using good design practices. Also, noise barriers must be acoustically feasible. The minimal substantial reduction allowed is 5 dB. States define the number of impacted receptors that must achieve a 5 dB(A) reduction. A State must then apply these standards uniformly and consistently statewide.

G3. What is "reasonable" highway traffic noise abatement?

Reasonableness considers three required criteria:

- Cost per benefited receptor
- Meeting the noise reduction design goal
- The outcome of a solicitation of viewpoints of benefited owners and residents

States may also use optional criteria as part of the assessment of reasonableness as shown in 23CFR772.13(d)(2)(v). The criteria used for determining reasonableness indicate a broad consideration of conditions that apply in a given location.

Highway Agencies consider the cost of abatement per benefited receptor using cost estimates based on historical construction costs for abatement. States that do not have a recent history of abatement construction may use regional or national trends as shown in the FHWA noise barrier inventory data available at http://www.fhwa.dot.gov/environment/noise/noise_barriers/inventory/ instead of historical costs. Some States allow for a quantity of noise barrier per benefited receptor rather than using a cost per benefited receptor.

Reasonable abatement must also achieve a noise reduction design goal for benefited receptors as defined in the state noise policy. The highway agency chooses the design goal in a range of 7-10 dB(A) and a number of benefited receptors that must receive a reduction equal to or greater than the agency design goal to meet this reasonableness criterion. Any receptor that meets or

exceeds the design goal counts toward satisfying the noise reduction design goal of the reasonableness criterion.

Highway agencies must determine the desires of the benefiting residents and property owners. The FHWA-approved noise policy for each State outlines the procedure used to make this determination, but this process generally involves surveying the affected residents.

G4. What types of abatement measures are eligible for Federal-aid funding?

There are several alternative abatement measures allowed for use of Federal-aid funds. The noise analysis must at a minimum consider abatement in the form of a noise barrier and consider other measures where they are applicable. These alternative abatement measures are:

1. Traffic management measures (e.g., traffic control devices and signing for prohibition of certain vehicle types, time use restrictions for certain vehicle types, modified speed limits, and exclusive lane designations).
2. Alteration of horizontal and vertical alignments.
3. Construction of noise barriers, including acquisition of property rights, either within or outside the highway right of way. Landscaping is not a viable noise abatement measure.
4. Acquisition of real property or interests therein (predominately unimproved property) to serve as a buffer zone to preempt development which would be adversely impacted by traffic noise. This measure may be included in Type I projects only.
5. Noise insulation of Category D land uses. Post-installation maintenance and operational costs for noise insulation are not eligible for Federal-aid funding.

G5. Can states use quieter pavement as abatement?

States cannot use quieter pavement for noise abatement. This does not preclude a State DOT from using quieter pavement as abatement on non-Federal-aid projects. States may also use quieter pavement on Federal-aid projects without classifying the pavement as a noise abatement measure.

G6. Does vegetation reduce noise levels?

States may not use vegetation for noise abatement, for projects subject to the provisions of 23 CFR 772. The FHWA takes this approach because studies have shown that vegetation must be a minimum of 100 feet thick, a minimum of 20 feet high and sufficiently dense (100% opacity) to provide a 5-dBA noise reduction. However, vegetation may serve as a good visual screen for locations where abatement is not feasible or reasonable. States may use Federal-aid funds for vegetation near barriers or for landscaping near roadsides for aesthetic and visual purposes, but landscaping is not noise abatement.

G7. Who does the state DOT survey to obtain viewpoints?

772.13(d)(2)(i) requires solicitation of the viewpoints of the residents (including renters) and owners of benefited receptors.

G8. When should the solicitation of viewpoints occur to satisfy the requirement in 23 CFR 772.13(d)(2)(i)?

The solicitation of viewpoints should occur following approval of the final noise abatement design. The statement of likelihood should include a disclosure that the solicitation of viewpoints will occur during the completion of the project's final design and the public involvement processes, as stated in 23 CFR 772.13(g)(3).

G9. What is the process for analyzing multi-family dwellings for impacts and consideration of abatement?

The analysis must include all noise sensitive receptors, including multi-family dwellings for determination of noise impacts and consideration of abatement where impacts occur. The regulation requires consideration of each residence in a multi-family dwelling unit. The measurement location should be at areas of frequent human outdoor use. At times, it is difficult to determine areas of frequent human use, which may require a site visit. There may be locations where residents use balconies and patios making those locations the area of frequent human use. Other times there will be a communal outdoor area of frequent human use, such as a grill area, picnic tables, or playground. These are also good locations to take noise measurements as part of the noise study.

G10. When only one side of the highway has a noise barrier, does the noise level increase for the opposite side of the highway where there is no noise barrier?

Construction of a noise barrier on the opposite side of the highway from a receptor without a barrier should not result in a substantial increase in highway noise levels. If both the direct noise levels and the reflected noise levels are not abated by natural or artificial terrain features, the noise increase is theoretically limited to 3 dB(A) due to a doubling of energy from the noise source. In practice, however, not all of the acoustical energy reflects back to the receiver. The barrier diffracts some of the energy over the barrier, some energy is reflected to points other than the receiver, some is scattered by ground coverings (e.g., grass and shrubs), and some is blocked by the vehicles on the highway. Additionally, some of the reflected energy to the receiver is lost due to the longer path that it must travel. Attempts to measure this reflective increase rarely show an increase of greater than 1-2 dB(A).

G11. Why are some communities eligible for noise abatement while others are not?

The regulation requires consideration for feasible and reasonable noise abatement, typically a barrier, at locations where the noise analysis identifies impacts resulting from a Type I project. Feasibility determinations deal with engineering considerations such as whether it is possible to build the barrier given the site constraints and whether the barrier achieves a 5 dB(A) or greater reduction in predicted noise levels for impacted receptors.

Reasonableness determinations consider the social, economic, and environmental factors of abatement. States consider, at a minimum, the cost of abatement, the ability of the abatement measure to meet or exceed the state's noise reduction design goal, and the views of the owners and residents of receptors predicted to benefit from an abatement measure. States may also consider alternative reasonableness factors, such as the predicted increase in noise level, the predicted absolute noise level, and the length of exposure to high noise levels among others. States have flexibility in the decision-making process and in defining their reasonableness factors. If a barrier is determined not to be feasible, it is usually due to either engineering or acoustic feasibility considerations. When abatement is determined not reasonable, it is because the cost exceeds cost reasonableness allowance, the residents did not desire abatement, or it was not possible to achieve a design that met the noise reduction design goal. Other reasonableness factors could have contributed to a determination that a barrier is not reasonable. The value of the properties considered for noise abatement is not an acceptable reasonableness criterion. The FHWA will not participate in funding of noise abatement determined not to be feasible or reasonable.