TRAFFIC NOISE MODELING AND ANALYSIS PRACTITIONERS' HANDBOOK

Florida Department of Transportation
Office of Environmental Management

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ACRONYMS

AADT	Annual Average Daily Traffic
ANSI	American National Standards Institute
ATC	Alternative Technical Concept
CE	Categorical Exclusion
CFR	Code of Federal Regulations
CNE	Common Noise Environment
COA	Class of Action
dB	Decibels
dB(A)	A-weighted decibels
DDHV	Directional Demand Hourly Volumes
DHV	Demand Hourly Volumes
DNSR	Design Noise Study Report
DTM	Digital Terrain Model
DPK	Date of Public Knowledge
EA	Environmental Assessment
EIS	Environmental Impact Statement
ETDM	Efficient Transportation Decision Making
FDM	Florida Department of Transportation Design Manual
FDOT	Florida Department of Transportation
FGDL	Florida Geographic Data Library
FHWA	Federal Highway Administration
FONSI	Finding of No Significant Impact
FRA	Federal Railroad Administration
FTA	Federal Transit Administration
ft.	Feet
GIS	Geographic Information Systems
GPS	Global Positioning System
HOA	Homeowners Association
HT	Heavy Trucks
LDCA	Location and Design Concept Acceptance
Leq(h)	Hourly equivalent noise levels
LIDAR	Light Detection and Ranging
LOS	Level of Service
mph	Miles per hour
MSE	Mechanically Stabilized Earth
MT	Medium Trucks
NAA	Noise Analysis Area
NAC	Noise Abatement Criteria

NEPA	National Environmental Policy Act
NMH	Noise Measurement Handbook (FHWA)
NMSA	Non-Major State Action
NRDG	Noise Reduction Design Goal
NSR	Noise Study Report
OEM	Office of Environmental Management (FDOT)
PD&E	Project Development and Environment
PTAR	Project Traffic Analysis Report
QA	Quality Assurance
QC	Quality Control
RCNM	Roadway Construction Noise Model
ROD	Record of Decision
ROW	Right of Way
SEIR	State Environmental Impact Report
SLM	Sound Level Meter
SLU	Special Land Use
sq. ft.	Square Feet
SWEPT	StateWide Environmental Project Tracker
TNM	Traffic Noise Model
TNST	Traffic Noise Screening Tool
USGS	United States Geological Survey

DEFINITIONS

Approach Criteria – Approaching the criteria means within one (1) A-weighted decibel [dB(A)] of the appropriate Federal Highway Administration (FHWA) Noise Abatement Criteria (NAC).

Common Noise Environment (CNE) – A group of receptors within the same activity category that are exposed to similar noise sources and levels, traffic volumes, traffic mix, speed, and topographic features. A CNE involves a group of receptors that would benefit from the same noise barrier or noise barrier system (i.e., overlapping/continuous noise barriers).

Date of Public Knowledge (DPK) – The approval date of the Categorical Exclusion (CE), the Finding of No Significant Impact (FONSI), the Record of Decision (ROD), State Environmental Impact Report (SEIR) or Non-Major State Action (NMSA). For a Type 1 CE and NMSA, this is the approval date of the *Type 1 Categorical Exclusion Checklist* or *Non-Major State Action Checklist*. Approvals can be found in the StateWide Environmental Project Tracker (SWEPT).

Decibel – A logarithmic expression of a sound level. For traffic noise analysis purposes and as specified by *23 CFR Part 772,* the A-weighted scale, which closely approximates the range of frequencies a human ear can hear, is used. The A-weighted decibel is abbreviated as dB(A).

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

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

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

Insertion Loss – The reduction in traffic noise levels as a direct result of a specific type of abatement measure determined by calculating the difference between future build noise levels with abatement to future build noise levels without abatement.

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.

Multi-family Dwelling – A residential structure containing more than one residence.

Noise Abatement Criterion (NAC) – The noise level, depending upon activity category, at which the Florida Department of Transportation (FDOT) must consider noise abatement for an impacted receptor.

Noise Analysis Area (NAA) – The area within and beyond the project limits that has Type I project characteristics and that requires a noise analysis. The NAA shall completely encompass the area where alterations and construction will occur and shall also include any area beyond the construction limits where design year traffic may contribute to noise impacts from the project. The NAA can be sub-divided based on geographic, traffic, and other similar characteristics for grouping of CNEs.

Noise Barrier – A physical obstruction that is constructed between the highway noise source and the noise sensitive receptor(s) for the purpose of lowering the noise level, including stand-alone barrier structures, berms (earth or other materials), and combination berm/barrier structure systems.

Noise Reduction Design Goal (NRDG) – The optimum desired dB(A) noise reduction (insertion loss) determined by calculating the difference between future build noise levels with abatement to future build noise levels without abatement. The FDOT has selected seven (7) dB(A) as the noise reduction design goal for one (1) or more benefited receptors.

Permitted – Development will be deemed to be permitted if the local agency with jurisdiction has granted a building permit for a specific structure associated with a noise sensitive land use, such as residential, school, place of worship, medical facility, or institutional, prior to the project's DPK.

For mobile/manufactured homes, individual building permits might not be issued. In this case, the noise analyst should look for evidence of an occupancy permit, new mobile home permit, or something similar in lieu of a building permit. These types of permits should be treated in the same manner as a building permit, as stated above. Contact the District Noise Specialist regarding the application of building permit equivalency.

Predicted Existing Traffic Noise Level – The traffic noise level that is determined through the use of the FHWA Traffic Noise Model (TNM) for existing roadway conditions.

Predicted Future Traffic Noise Level – The traffic noise level that is determined through the use of TNM for the future design year traffic and roadway geometry, including build and no-build alternatives.

Property Owner – An individual or group of individuals that hold a title, deed, or other form of legal documentation showing ownership of a commercial or residential property.

Reasonableness – The combination of social, economic, and environmental factors considered in the evaluation of a noise abatement measure. Reasonableness factors include consideration of viewpoints by benefited receptors, cost-effectiveness of abatement measures, and achieving the FDOT NRDG.

Receptor – A discrete or representative location of a noise sensitive area for any NAC land use activity category.

- **Benefited Receptor** – A receptor that receives a noise reduction at or above the minimum threshold of five (5) dB(A) as a result of an abatement measure.

- **Impacted Receptor** – A receptor with a design year build alternative traffic noise level that is predicted to approach, meet, or exceed the NAC for its respective activity category, or will experience an increase in noise levels of 15 dB(A) or more in the design year over the existing noise levels.

- **Isolated Receptor** - A receptor that is located far enough away from other receptors such that a single noise barrier would not be a practical form of abatement for all impacted properties."

- **Modeled Receptor** (TNM receiver) – A georeferenced location within FHWA's TNM that represents a single receptor or a group of receptors with the same characteristics where noise levels are predicted.

Residence – A dwelling unit. Either a single-family residence or each individual dwelling unit in a multi-family dwelling.

Statement of Likelihood – A statement provided in both the Noise Study Report (NSR) and Environmental Document based on the feasibility and reasonableness analysis completed at the time the Environmental Document is being approved.

Substantial Noise Increase – For a Type I project (see definition below), an increase in noise levels of 15 dB(A) or more in the design year over the existing noise level (measured or predicted) as a direct result of the transportation improvement project. A substantial increase will normally occur only on new alignment projects.

Traffic Noise Impacts – Design year build condition noise levels that approach, meet, or exceed the federal 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.

Type I Projects – A highway construction project on new location or a physical alteration of an existing highway which substantially changes the horizontal and vertical alignment, profile, or adds a through lane(s). Specific project definitions according to *Title 23 Code of Federal Regulations (CFR) Part 772 Procedures for Abatement of Highway Traffic Noise and Construction Noise (23 CFR Part 772)* are listed in **Section 1.0, Introduction.**

Type II Projects - A federal or state highway project for noise abatement on an existing highway that is not being modified as part of a Type I project. Type II projects are commonly referred to as retrofit projects and are allowed (but not mandatory) under *23 CFR Part 772*. The development and implementation of Type II projects are not mandatory requirements of *23 U.S.C. § 109(i).* The FDOT does not have a Type II program.

Type III Projects – A project that does not meet the classifications of a Type I or Type II project. Type III projects do not require a noise analysis.

1.0 INTRODUCTION

The official highway traffic noise policy of the Florida Department of Transportation (FDOT) is provided within the *FDOT's Project Development and Environment (PD&E) Manual, Part 2, Chapter 18, Highway Traffic Noise*[1] for the purpose of meeting the requirements set forth in *Title 23 Code of Federal Regulations (CFR) Part 772 Procedures for Abatement of Highway Traffic Noise and Construction Noise (23 CFR Part 772)*[2]. The policy contains detailed descriptions of the types of transportation improvement projects that require a noise impact analysis. These project categories are independent of the Class of Action (COA) determination for the overall project and are defined below:

- Type I Projects – A highway construction project on a new location or a physical alteration of an existing highway which has a substantial horizontal and/or vertical alteration to its alignment, profile, adds a through lane(s), auxiliary lane(s), interchange lane(s)/ramp(s), weigh station(s), rest stop(s), ride-share lot(s) or toll plaza(s). For a complete list of Type I project qualifications, see the *FDOT PD&E Manual, Chapter 18, Section 18.1.3* and *23 CFR Part 772*.
    - Substantial Horizontal Alteration is a horizontal change in the roadway that halves the distance between the traffic noise source (edge of the nearest travel lanes) and the closest receptor between the existing condition to the future build condition.
    - Substantial Vertical Alteration is when a project that removes shielding [not including vegetation removal by FDOT within FDOT Right of Way (ROW)] that exposes the line-of-sight between the receptor and the traffic noise source. This may happen when the vertical alignment of the highway is altered, such as replacing an at-grade rail crossing with a grade separation, or if the topography between the highway traffic noise source and the receptor is altered, such as reducing the back slopes of a cut section so that the line of sight is no longer blocked. For questionable locations, a simple skew exercise be performed, drawing lines for the three emission source heights in Traffic Noise Model (TNM), to document why the line of sight is not changed between the receptor and the noise source.
- Type II Projects - A federal or state highway project for noise abatement on an existing highway that is not being modified as part of a Type I project. Type II projects are commonly referred to as retrofit projects; however, the FDOT does not have a Type II program.
- Type III Projects – A project that does not meet the classifications of a Type I or Type II project. Type III projects do not require a noise analysis.

Refer to *PD&E Chapter 18, Section 18.1.3* for further reference of applicability.

Traffic noise studies are an important aspect of any roadway improvement project, beginning with the analysis performed in the PD&E phase and continuing into the Design phase. The FDOT has prepared this

[1] The FDOT's *Project Development and Environment (PD&E) Manual, Part 2, Chapter 18, Highway Traffic Noise* can be accessed at: *https://www.fdot.gov/environment/pde-manual/pdeman-current*

[2] *Title 23 Code of Federal Regulations Part 772* can be accessed at: *https://www.ecfr.gov/current/title-23/chapter-I/subchapter-H/part-772*

Traffic Noise Modeling and Analysis Practitioners' Handbook to assist analysts in the prediction of existing and future traffic noise levels and the evaluation of the effectiveness of noise barriers while providing consistent, predictable, and repeatable noise studies. The contents of this Handbook provide a compilation of practical approaches and examples that are to be applied in conducting traffic noise impact evaluations on the State Highway System (SHS).

The Federal Highway Administration (FHWA) TNM, Version 2.5 or later, is the required software used to predict traffic noise levels and evaluate the effectiveness of noise barriers.[3] When analysis is required, all traffic noise analyses, traffic noise level assessments, and evaluations of potential mitigation effectiveness shall be performed using the TNM software.

This Handbook is designed for use by FDOT staff and its consultants who perform or review noise studies. It is expected that the users of this document are trained (or working under the guidance of someone who is trained) in the modeling and analysis of traffic noise impacts and abatement using TNM. This Handbook is not to be considered the sole resource for conducting traffic noise studies using the TNM, but rather as a tool for producing consistent, predictable, and repeatable traffic noise studies. In addition to this Handbook, the analyst is also expected to follow the guidance provided in the documents shown in the reference section of this Handbook.

Section 2 of this Handbook provides information and guidance for "pre-modeling" activities including the methodology meeting, data collection, and field work activities such as field reviews and field measurements. **Section 3** provides information and guidance for the computer modeling and analysis of traffic noise including the evaluation of abatement alternatives. **Section 4** provides guidance for the documentation of both modeling input and results. **Section 5** provides guidance for information regarding traffic noise in Environmental Documents.

1.1 Procedure

During the Efficient Transportation Decision-Making (ETDM) screening and prior to the PD&E phase, a preliminary review of potential noise impacts associated with a project is conducted by FDOT. This review should determine if noise sensitive receptors are or may be located within the project area and if there is a possibility that noise sensitive receptors will be impacted due to predicted traffic noise levels with a build alternative approaching or exceeding the Noise Abatement Criteria (NAC) discussed in **Section 1.2, Noise Abatement Criteria Activity Categories,** of this Handbook. The review will include the assessment of land use plans, aerial photographs, field reviews, modeling, and/or similar efforts. This will allow the District Noise Specialist and the Project Manager to determine whether noise impacts are likely to occur based on the types of land uses present and their proximity to the proposed project and assist in the development of the scope of services for the PD&E study. The procedure for performing a highway traffic noise study during PD&E and Design phase Re-evaluation is described in this Handbook. Since the FDOT does not have a Type II program,

[3] The FHWA's Traffic Noise Model webpage can be accessed at: https://www.fhwa.dot.gov/environment/noise/traffic_noise_model/index.cfm

the requirements below apply to Type I projects. Requirements for Type III projects are individually noted where applicable.

For low-volume two lane roadways (that will be two lanes wide after completion of the project), a screening test can be initiated using the FHWA Traffic Noise Screening Tool (TNST), which is based on TNM. A detailed study (using TNM) is required if the project does not pass the screening test, which means that the calculated noise levels are within 5 dB(A) of the NAC. Coordination should take place with the District Noise Specialist to confirm proper use of this screening model. Refer to Part 1, Chapter 102 of the FDOT Design Manual (FDM), Topic No. 625-000-002[4] for the definition of "low volume" roadways and *Table 102.1.1, AADT Thresholds for Low and High Volume Roadways*, for the urban and rural low volume AADTs for two (2) lane roadways.

For all Type I projects (and projects that do not pass the screening test cited above using the TNST), the current approved version of the TNM should be used following the guidelines provided in this Handbook.

1.2 Noise Abatement Criteria Activity Categories

Title 23 CFR Part 772, Table 1 to Part 772 – Noise Abatement Criteria establishes the NAC that are used to determine whether a highway traffic noise impact occurs, listed in **Table 1-1** to this Handbook. The table contains seven Activity Categories used to assess the impact of noise. The following is a description of each Activity Category and the traffic noise impact level at which abatement measures must be considered. The NAC only applies to design year no-build and build conditions.

1.2.1 Activity Category A

Activity Category A focuses on the exterior NAC 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. The FDOT's criterion for approaching the exterior NAC for this activity category is 56 dB(A). An example of this activity category would be the Tomb of the Unknown Soldier. FDOT must approve the land use as Activity Category A prior to the initiation of modeling activities. A request with supporting justification shall be submitted to the FDOT Office of Environmental Management (OEM) for review and approval to apply this activity category to a noise sensitive receptor. OEM uses the guidance from the *FHWA's Noise Policy FAQs – Frequently Asked Questions* to make a determination for Activity Category A.

1.2.2 Activity Category B

Activity Category B includes the exterior NAC for single-family and multi-family dwellings (including mobile home parks, nursing homes, and assisted living facilities). This may include single family and multi-family residences that are multi-story. Unless the area of exterior frequent human use is identified elsewhere,

[4] The FDOT *Design Manual (FDM), Chapter 264 – Noise Barriers and Perimeter Walls* can be accessed at: https://www.fdot.gov/roadway/fdm

residential modeled receptor points should be placed at the edge of the dwelling unit closest to the major traffic noise source or as dictated by professional judgment. If a residential parcel does not have an obvious area of exterior frequent human use (e.g., yard, balcony), the residential parcel is not eligible for evaluation, following guidance provided by FHWA. The FDOT's criterion for approaching the exterior NAC for this activity category is 66 dB(A). There is no interior NAC for Activity Category B.

1.2.3 Activity Category C

Activity Category C includes the exterior NAC for a variety of land use facilities. The FDOT's criteria for approaching the exterior NAC for this activity category is 66 dB(A). Examples of this activity category include 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 nonprofit institutional structures, radio studios, recording studios, recreation areas, golf courses, *Section 4(f)* resources, schools, television studios, trails, and trail crossings. For the purposes of *23 CFR Part 772*, FHWA defines a medical facility as an inpatient medical facility where medical treatment and care occurs (i.e., an overnight stay at the facility is required; e.g., a hospital, rehabilitation facilities). Note that the NAC applies only to the exterior areas of Activity Category C. If exterior areas of frequent human use for this Activity Category are noted during the field review, detailed modeling of the receptor will occur to determine if an exterior noise level impact will occur in the future with the construction of the project.

The FDOT publication *Methodology to Evaluate Highway Traffic Noise at Special Land Uses*[5] shall be used to assess whether noise abatement is feasible and/or reasonable at Activity Category C locations.

1.2.4 Activity Category D

Activity Category D includes the interior NAC for a variety of land use facilities listed in Activity Category C that may have interior uses. The FDOT's criteria for approaching the interior NAC for this activity category is 51 dB(A). Examples of this activity category include auditoriums, day care centers, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios. For the purposes of *23 CFR Part 772*, FHWA defines a medical facility as an inpatient medical facility where medical treatment and care occurs (i.e., an overnight stay at the facility is required; e.g., a hospital, rehabilitation facilities).

The FDOT publication *Methodology to Evaluate Highway Traffic Noise at Special Land Uses* shall be used to assess whether noise abatement is feasible and/or reasonable at Activity Category D locations.

[5] FDOT. *Methodology to Evaluate Highway Traffic Noise at Special Land Uses.* December 2024. *https://fdotwww.blob.core.windows.net/sitefinity/docs/default-source/environment/pubs/noise/slu-guidance-document_december-2024.pdf?sfvrsn=5e5abcb2_3*

1.2.5 Activity Category E

Activity Category E includes the exterior NAC for developed lands that are less sensitive to highway traffic noise. The FDOT's criteria for approaching the exterior NAC for this activity category is 71 dB(A) in exterior areas of frequent human use. Examples of this activity category include hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in Activity Category A-D or F. Note that hotel/motel balconies are not considered areas of external frequent human use, but hotel/motel pools are. Since these land uses are specifically excluded from Activity Category D, no analysis of interior noise levels is required.

The FDOT publication *Methodology to Evaluate Highway Traffic Noise at Special Land Uses* shall be used to assess whether noise abatement is feasible and/or reasonable at Activity Category D locations.

1.2.6 Activity Category F

Activity Category F includes developed lands that are not sensitive to highway traffic 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. There is no NAC for this activity category since these land uses are not sensitive to highway traffic noise, and therefore, no noise analysis is required for these locations.

1.2.7 Activity Category G

Activity Category G includes undeveloped lands that are not permitted. There is no NAC for this activity category. Although consideration of abatement is not required, FDOT must determine and document highway traffic noise levels and provide this information to local governments. Details on what will be required are found in **Section 5.4, Coordination Requirements for Documentation,** of this Handbook.

Table 1-1: Noise Abatement Criteria

NOISE ABATEMENT CRITERIA (NAC) [Hourly A-Weighted Sound Level-decibels (dB(A))]				
Activity Category	Activity Leq(h)[1]		Evaluation location	Description of activity category
	FHWA	FDOT		
A	57	56	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[2]	67	66	Exterior	Residential
C[2]	67	66	Exterior	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 nonprofit institutional structures, radio studios, recording studios, recreational areas, Section 4(f) sites, schools, television studios, trails, and trail crossings.
D	52	51	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[2]	72	71	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.

(Based on Table 1 of 23 CFR Part 772)

[1] The Leq(h) Activity Criteria values are for impact determination only and are not design standards for noise abatement measures.

[2] Includes undeveloped lands permitted for this activity category.

Note: FDOT defines that a substantial noise increase occurs when the existing noise level is predicted to be exceeded by 15 decibels or more as a result of the transportation improvement project. When this occurs, the requirement for abatement consideration will be followed.

2.0 PRE-MODELING ACTIVITIES

This section provides information and guidance for activities that take place prior to undertaking computer modeling, including the methodology meeting, data collection, and field work activities.

2.1 Noise Methodology Meeting

Prior to performing the project traffic noise analysis, a methodology meeting should be held with the District Noise Specialist. This meeting establishes an agreed upon methodology and provides for the sharing of necessary information and direction for the noise analysis (i.e., modeling parameters, developed lands, undeveloped lands, special land uses (SLU), available survey data, field measurement locations for model validation, etc.). Any required noise-specific public involvement efforts and expectations should also be discussed. A set of project aerials, photos of project-specific issues such as outdoor advertising, community-specific issues (such as existing development signage), and available typical sections should be available at the meeting. A formal agenda should be prepared outlining the methodology to be followed as well as any project-specific issues that will be addressed during the meeting. The methodology meeting will be documented with meeting minutes that become part of the official project file.

2.2 Data Collection: Traffic Data

The project traffic used for traffic data in the FHWA TNM will be developed in accordance with FDOT *Project Traffic Forecasting Procedure, Topic 525-030-120*[6] and the *Project Traffic Forecasting Handbook*[7] (latest version). All preparers of traffic data used in the TNM shall ensure that the latest FDOT procedures are followed. FDOT's *Traffic Data for Traffic Noise Spreadsheet*[8] should be utilized when converting traffic data to be entered into TNM, and is required to be submitted to FDOT alongside the TNM files. Traffic data used in the TNM should be provided in the Noise Study Report (NSR) or Design Noise Study Report (DNSR).

Traffic forecasts are developed during the PD&E study of a project. The resulting traffic data is typically reported in a Project Traffic Analysis Report (PTAR). Noise traffic data is required for the existing year and the design year, with the design year reflecting both the No-Build Alternative and the Build Alternative. In some cases, traffic data will need to be obtained for both the roadway on which improvements are proposed and other major/minor roadways (cross streets) in the Noise Analysis Area (NAA) that influence traffic noise levels at nearby receptors. For example, if there are noise sensitive receptors for a widening project in close proximity to an interchange for an interstate or other limited access facility, traffic data will have to be prepared for the cross street because vehicular traffic on both roadways may contribute to the total noise level at the receptors, and one or the other roadway could cause abatement measures to be ineffective. Information for any roadways that may influence the results of the TNM should be provided by the traffic

[6] The FDOT *Project Traffic Forecasting Procedure*, Topic 525-030-0120 can be accessed at https://pdl.fdot.gov/Procedures

[7] The FDOT *Project traffic Forecasting Handbook* can be accessed at https://www.fdot.gov/planning/systems/systems-management/systems-management-documents

[8] The FDOT *Traffic Data for Traffic Noise Spreadsheet* can be accessed at https://www.fdot.gov/environment/oem-divisions/eng/highway-traffic-noise

engineer/planner preparing the project traffic forecasts. Required data should be properly vetted during the project's scoping efforts or during contract negotiations to ensure that all sources of potential noise impacts are included within the traffic data development stages for the project. This would include all potential noise sensitive receptors that are in close proximity to the project and shall include arterial roadways, collector-distributor (CD) roads, frontage roads, and other roadways.

Traffic characteristics that would yield the highest traffic noise impact for the design year shall be used. To ensure that "worst case" traffic noise conditions are used in the analysis, the following traffic volume and speed conditions shall be applied:

- For roadways (interstate mainline, CD roads, frontage roads, arterial roads, etc.), the traffic volumes will represent one of the following:
    - The Level-of-Service (LOS) "C" peak hour, peak direction volume as specified by the most recent FDOT *Multimodal Quality/Level of Service Handbook, Generalized Service Volume Tables*[9] when project traffic peak hour directional demand volumes (DDV) are forecasted to exceed the LOS C threshold.
    - The project traffic peak hour directional demand volume if the facility operates at LOS A or B
- The LOS "C" peak direction hourly volume for project-specific conditions shall be determined from the current FDOT *Multimodal Quality/Level of Service Handbook, Generalized Service Volume Tables*. Of note, the same LOS C volume shall be applied to both directions of travel to ensure the highest noise-generating conditions are represented.
- For interchange ramps, peak hour demand volumes for the specific ramp shall be used, even if they are higher than the LOS C peak hour, peak direction volumes.
- The vehicle speed to be used in the TNM is the posted speed for existing/no-build conditions and the proposed posted speed for the future build condition. If the proposed posted speed is unknown, then the design speed is to be used. The vehicle speed used for ramps will be the posted speed, applied along the entire ramp unless modified by the flow condition (e.g., the speed along a loop ramp may vary from the time a vehicle leaves the mainline until it reaches the end of the ramp).

Occasionally, demand traffic data may be provided in the form of an Annual Average Daily Traffic (AADT) volume. In this case, the analyst will proceed with the process described on the following page, beginning with Step 1 where AADT volumes are reduced to demand hourly volumes (DHV) as follows (Skip Step 1 if FDOT Multimodal LOS directional hourly volumes are to be used):

If project traffic peak hour demand volumes are to be used, the analyst should proceed to Step 2 unless

[9] The *FDOT Multimodal Quality/Level of Service Handbook, Generalized Service Volume Tables* can be accessed at: https://www.fdot.gov/planning/systems/systems-management/systems-management-documents

Directional Demand Hourly Volumes (DDHV) are provided in the project traffic report.

If *FDOT Multimodal Quality/Level of Service Handbook* LOS C threshold directional volumes are used in the analysis (i.e., LOS C volumes are lower than project traffic demand volumes), the analyst should proceed to Step 3 to obtain the volumes for each of the five (5) vehicle types to be input into the TNM.

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Step 1. AADT volumes are reduced to DHV by multiplying the AADT volume by the Planning Analysis Hour Factor (K [standard]), as follows:
DHV = AADT volume x K (standard)
- Example: AADT of 50,000 vehicles x K (standard) of 9% (or 0.09) = 50,000 x 0.09 = 4,500.

Step 2. DDHV are calculated using the Directional Distribution Factor (D) to obtain the peak and non-peak directional volumes. As an example, if the D factor is 55% on a bi-directional roadway or one-way pair (a pair of parallel, usually one-way streets that carry opposite directions of the same signed route or major traffic flow), the directional volumes are calculated as follows:
- Example: 4,500 x 55% = 2,475 vehicles for peak direction, which leaves a balance of 2,025 vehicles (or DHV * (1 – D)) for the non-peak direction demand hourly volume.

Step 3. The number of heavy trucks (HT), medium trucks (MT), buses, and motorcycles used in the TNM is obtained by applying the respective percentages for those vehicle types to the calculated directional demand hourly volume (rounding up to the nearest whole number) for the peak hour.

Notably, if a traffic engineer does not provide the percentage of automobiles, it is calculated by subtracting the number of HT, MT, buses, and motorcycles from the total directional volume being used.

- Example: Assuming HT, MT, bus, and motorcycle peak hour factors of 3%, 2%, 1%, and 0.5%, respectively, and a DDHV of 2,475, the number of automobiles, HT, MT, buses and motorcycles in the peak direction of travel would be 2,314, 74, 50, 25 and 12 (rounded to the nearest whole number), respectively.

The flowchart in **Figure 2-1** illustrates the process described above.

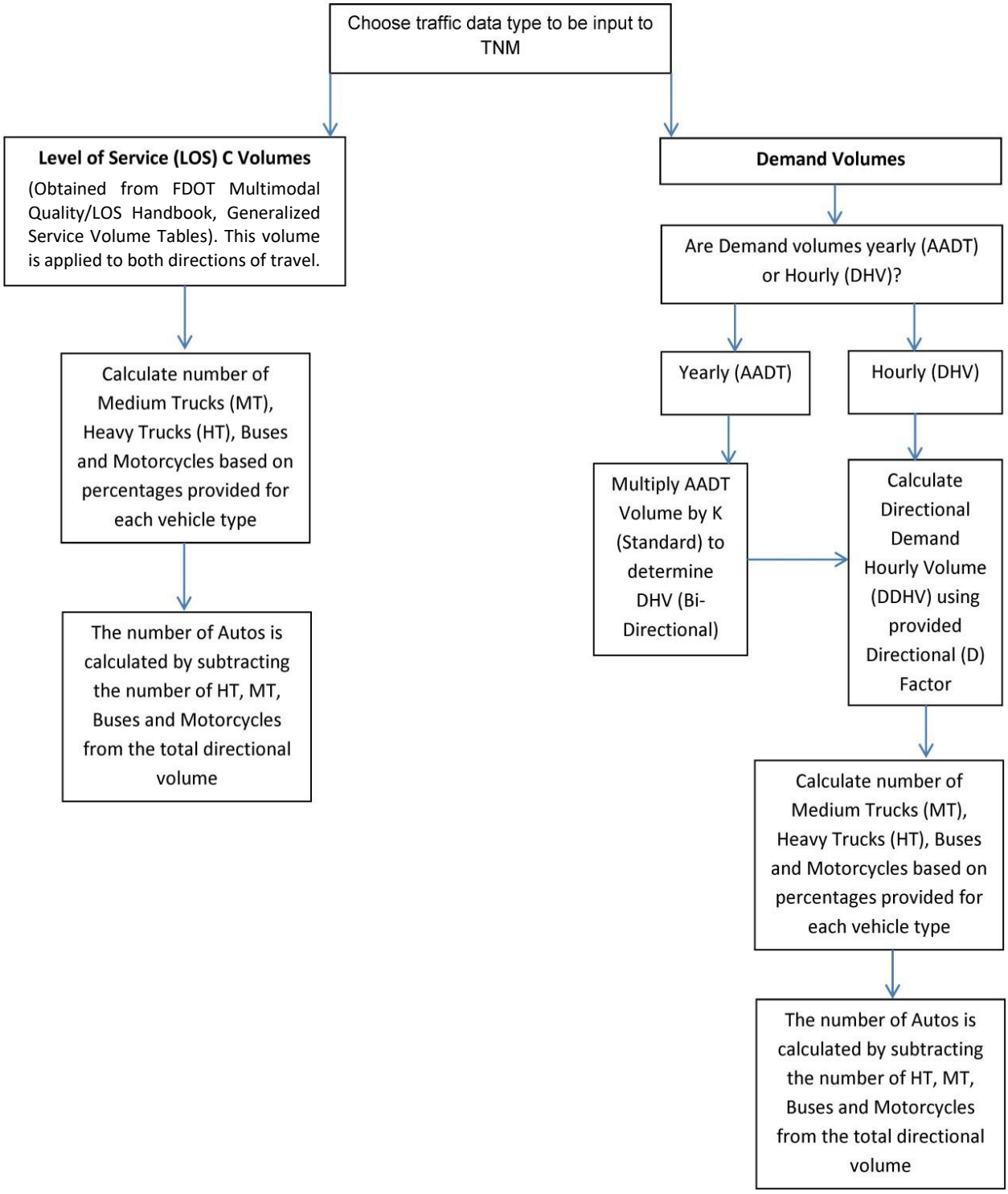

Figure 2-1: Traffic Data Flowchart

2.3 Data Collection: Elevation Data

The "Z" coordinate input to the TNM establishes the elevation of the modeled objects. It is important to use the most accurate elevation data available for all components of the modeling input, especially for roadways, receptors, and barriers (existing and proposed). In order of preference, the following is a list of acceptable sources of elevation data:

1. For receptor points, project-specific survey data (i.e., spot elevations). The number will vary depending on the length/scope of the project;
2. Cross sections from roadway design plans;
3. As built plans for the existing roadway;
4. Digital terrain model (DTM);
5. LIDAR (Light Detection and Ranging), an aerial method of mapping and survey; and
6. United States Geological Survey (USGS) quadrangle maps.

2.3.1 Roadway Data

The FDOT provides the plans necessary to obtain horizontal roadway alignment data for existing roadways, and the proposed improvements for existing roadways or new alignments. This data shall be obtained for all roadways to be included in the analysis. For a PD&E study, an accurate survey may not be available for a proposed roadway alignment/alternative. In such cases, the analyst should consult with the District Noise Specialist or District Project Manager to determine the source of elevation data to be used in the TNM. In most cases, as-built roadway plans (or the best available data) are appropriate for use.

During the Design phase of a project, vertical alignment data for a roadway is obtained from the project's design plans. Vertical alignment data for cross streets may have to be obtained from other sources (such as those listed in **Section 2.3, Data Collection: Elevation Data**) if insufficient coverage is available in a project's plan set.

The source for the horizontal and vertical roadway alignment data that are used in the modeling efforts shall be documented in the NSR or DNSR for the project.

2.3.2 Receptor Data

Elevation data for the receptors is as critical as that for the roadway. However, this data typically cannot be obtained from roadway plans since the receptors in the analysis are outside the ROW.

The United States Geological Survey (USGS) is a common source for elevation data, with the data being available on topographic (topo) maps on the USGS website. The USGS website provides a "*National Map*

Viewer"[10] which is a Geographic Information System (GIS) based interface containing various datasets. One of the available tools of this GIS provides spot elevations for nearly any location within the United States.

LIDAR and DTM are other sources of elevation data. Both may be available in a GIS based format from the *Florida Geographic Data Library* (FGDL)[11].

In the case of planned and permitted developments, it may be possible to obtain elevation data from the site plan. Site plans can be requested from the permitting agency or obtained directly from the site developer.

Regardless of the source of elevation data, it is important to recognize the vertical datum that is being used for the project, to ensure its consistency with the sources of elevation data used for TNM input objects. There are two types of vertical datum commonly used; the National Geodetic Vertical Datum of 1929 (NGVD 29) and the North American Vertical Datum of 1988 (NAVD 88). The vertical datum being used on a project is documented in the roadway plans, or available from the FDOT if plans have not been prepared. The source(s) of elevation data should be referenced in the NSR or DNSR.

2.3.3 Noise Descriptor

The noise level descriptor used by FDOT will be the Leq metric. Leq is 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. Other Input Items

Elevation data are required, including the height and bottom (ground) elevation of existing privacy walls and/or earth berms or are planned to be placed between a roadway and noise sensitive sites, as these features may have an acoustic effect on predicted noise levels. For this reason, all existing neighborhood walls, noise barriers, and earth berms should be surveyed if possible, for use as input into the TNM. It is also important to note the material used to construct existing privacy walls. Open-weave walls, open-board fences, wooden privacy fences, chain link fences, and similar walls are not dense enough to provide meaningful noise level attenuation and are not included in a traffic noise analysis. Data for existing FDOT noise barriers including the height and bottom (ground) elevation, should be obtained from FDOT As-Built plans, if possible.

2.4 Field Work Activities[i]

Noise-related field work includes a field review as well as noise measurements (for validation and/or establishing existing conditions). At minimum, a field review should occur, regardless of the size, scope, or general nature of a project. Noise measurements should be taken if the TNM version being used for the noise evaluation has not been validated for the project. Noise measurements are also needed to establish existing conditions on a new alignment where roadway noise is not the primary source of noise (in this case existing

[10] The National Map Viewer can be accessed at: http://viewer.nationalmap.gov/viewer/
[11] The Florida Geographic Data Library can be accessed at: http://www.fgdl.org

traffic noise levels cannot be modeled using the TNM). A combination of measurements and modeling is performed to validate the TNM for use on a project where an existing roadway is being improved. Regardless of the intent, all measurements shall be conducted in accordance with the requirements detailed in FHWA's publication *Noise Measurement Handbook* (NMH)[12] and the applicable sections of the FDOT Noise Policy (*Part 2, Chapter 18 of the FDOT PD&E Manual*). An example noise level measurement data sheet is provided in Appendix B.

2.4.1 Field Reviews

Regardless of the size, scope, or general nature of a project, land use and field reviews of the project area are an essential part of an analysis. The size and scope of a project determine the number of field reviews to be performed. The primary goal of the field review is to identify existing land uses adjacent to the project corridor for which there are noise abatement criteria. These properties are included in the modeling/analysis.

While technology (Google Earth, etc.) makes it simple to perform a "desktop" review of the project area, there are some land uses that cannot be identified without a field visit. One example would be the number of dwelling units in a multi-family building or a duplex, that from an aerial photograph, appears to be a single-family residence when, in fact, it contains more than one dwelling unit.

When conducting the field review for a project, it is important to note the "exterior area of frequent human use" for multi-family buildings (e.g., apartments and condominiums). When an evaluation includes Activity Category "D" sites (the interiors of schools, libraries, places of worship, etc.), it is also important to note the construction material used for the buildings (wood frame, masonry, etc.).

In the absence of exterior areas of frequent human use, this information will be used to determine the sound level reduction factor that should be applied to the modeling results to predict interior traffic noise levels (for those Activity Categories for which an interior NAC applies). Additional information regarding sound level reduction factors to be used can be found in the FHWA's *Highway Traffic Noise: Analysis and Abatement Guidance*[13] document.

Another goal of the field review is to note any potential conflicts that could arise in areas of potential noise abatement. For engineering issues, conflicts should be further verified/discussed with the engineers developing the conceptual or final design. These include utilities (both overhead and sub-surface), drainage features, access requirements (driveways, cross streets, etc.), outdoor advertising, or any other factors that may impact the placement or routine construction of a noise barrier. The earlier in the process that these types of potential conflicts are identified, the less likely they are to create an issue later in the project. The FDOT will provide detailed utility data to the extent practical and called for in the project scope.

It is also important to note any signs of new development or zoning changes on undeveloped lands. Local

[12] The FHWA *Noise Measurement Handbook* can be accessed at*:* https://www.fhwa.dot.gov/environment/noise/measurement/fhwahep18065.pdf

[13] The FHWA *Highway Traffic Noise: Analysis and Abatement Guidance* can be accessed at: https://www.fhwa.dot.gov/environment/noise/regulations_and_guidance/analysis_and_abatement_guidance/revguidance.pdf

government property records should be reviewed to ensure that new building permits have not been issued for undeveloped lands. A review of property records is needed during the design phase to ensure no new building permits were issued prior to the Date of Public Knowledge (DPK) but after the PD&E noise study was completed.

At least one, if not more, additional land use review(s) should be conducted throughout the life of the project to verify if any land use changes have occurred and also to review potential noise abatement locations for conflicts, as detailed above.

2.4.2 Field Measurements

Field measurements are conducted following the basic FHWA procedures found in the FHWA *Noise Measurement Handbook – Final Report (FHWA-HEP-18-065*). Field measurements of noise are taken for validation and/or for establishing existing conditions (ambient noise measurements).

2.4.2.1 Equipment

A sound level meter (SLM) plays a key part in model validation since the results of the monitoring efforts are used to validate the TNM and/or determine existing noise levels. It is important to use equipment that is accurate and well maintained. At a minimum, the SLM shall be calibrated following the suggested frequency recommended by its' manufacturer. The calibrator emits a pure tone that matches the calibration requirement of the SLM manufacturer. Additional information regarding the noise level measurement equipment is available in the NMH document.

An integrating SLM, American National Standards Institute (ANSI) Type 1 or 2 must be used for all field measurements. The SLM plays a key role since the results of the field efforts are used to validate the TNM and/or determine existing noise levels. It is important to use equipment that is accurate and well-maintained. At a minimum, the SLM shall be calibrated following the suggested frequency recommended by its' manufacturer. The calibrator emits a pure tone that matches the calibration requirement of the SLM manufacturer. Additional information regarding the noise level measurement equipment is available in the FHWA *Noise Measurement Handbook – Final Report* document.

All noise level readings shall be taken using the "A" weighting scale and on the "slow" response setting. The SLM shall be mounted so that the microphone is oriented in the direction of the traffic noise source consistent with the manufacturer's recommendations.

The microphone shall be located five feet above ground level or five feet above the base level of the noise sensitive receptor of interest. A windscreen designed for use on the SLM shall be used at all times during the field measurement period.

2.4.2.1.1 Calibration Requirements

Prior to the field measurement period, the SLM shall be calibrated and the results noted on the field data

sheet. The SLM shall also be calibrated at the end of the field measurement period. If the difference between the two calibrations is greater than one (1) dB, the measurement period shall be repeated.

2.4.2.2 TNM Validation

This section describes the process that shall be used to validate noise levels obtained in the field. The primary purpose of the field measurements are to determine if traffic is the primary noise source in the area and to ensure that the model reasonably predicts [i.e., within +/- 3.0 dB(A), per FHWA criteria] the existing traffic noise based on the current conditions. As required by the FHWA (*23 CFR § 772.11(d)(2))* and the FDOT (*PD&E Manual, Part 2, Chapter 18, Highway Traffic Noise*), field measured traffic noise levels must be compared to the predicted results under the same conditions. To do this with a consistent degree of accuracy, the information gathered in the field during the time of the sound level measurements is key.

A combination of measurements and modeling is performed to validate the TNM model. Note that for new alignments, validation measurements should be performed at the existing roadway to which the proposed new alignment will connect.

2.4.2.2.1 Validation Site Selection

The required number of validation sites is project-specific and shall be coordinated with the District Noise Specialist. If practical and possible, validation sites should coincide with potentially impacted locations. Residential communities are of particular interest, especially communities that have expressed traffic noise concerns. Additionally, validation sites shall be selected in an area that is representative of free-flow conditions (i.e., there are no traffic control devices such as traffic signals or stop signs nearby).

Since the TNM cannot account for noise other than traffic, analysts must be certain that traffic noise is the dominant noise source. Activities such as lawn mowing, children playing, air conditioning units, and aircraft flyovers can dominate the background noise levels to an extent that the traffic source is relegated to a lesser impact. If this is the case, the noise level monitoring equipment should be relocated to a more suitable site. During each measurement period, the sources of the sounds other than those resulting from traffic on a roadway are noted on field measurement data sheets.

2.4.2.2.2 Field Data Collection for Validation

Validation sessions require the collection of accurate field data for the locations where field measurements are obtained. One way to obtain the location of the SLM is to use a global positioning system (GPS) unit that has an accuracy of 0.5 meters or better. If using a GPS unit isn't practical, aerial photography or a set of plans for the project can be used to establish the location of the validation site. A measuring wheel or measuring tape can be used to obtain the distance from the edge of pavement of the roadway and at least two other points (an intersecting street, drainage feature, power pole, building corner, etc.).

Analysts also locate and identify features that may influence the measured noise levels, including ditches, berms, privacy walls, canals, streets, parking lots, buildings, billboards, etc. The location and any details of

these features are to be noted on the site sketch or plan set. Taking photographs of the site is recommended. While in the field, the following input parameters necessary to run the computer model should be obtained:

1: Distance from the edge of the nearest travel lane of each roadway to the noise monitoring location;
2: Width of roadway lanes and paved shoulders;
Note: If the roadway is an urban curb and gutter configuration or if it has paved shoulders and grass swales. The dimensions of all of these features, including traffic safety devices such as "Jersey" barriers at the shoulder or in the median, and the height above the roadway shall also be obtained. Analysts should not rely on the construction plans to provide all of the information regarding site details, geometry, etc. for the modeling effort.
3: Height of the SLM;
4: Barrier/buffer information including trees, berms, and structures;
5: Type of propagation path (hard versus soft);
6: Variations in terrain between the SLM and the source;
7: Grade, if any; and
8: The existing pavement type and condition; and
Note: If the pavement condition does not reflect an average pavement type, one of the alternative pavement types that more accurately reflects the actual pavement condition may be applied. Use of this alternative pavement type in the TNM is only applicable to validation efforts and the prediction of existing traffic noise levels It is not to be used for the prediction of future traffic noise impacts and must be approved by the District Noise Specialist before any use.
9: Traffic Counts and Vehicle Classification.

(i) Taking Measurements

At each measurement location, a minimum of 30 minutes of readings (three [3] repetitions of ten [10] minutes each) shall be taken. Since the TNM cannot account for noise other than traffic, analysts must be certain that traffic noise is the dominant noise source. Activities such as lawn mowing, children playing, air conditioning units, and aircraft flyovers can dominate the background noise levels to an extent that the traffic source is relegated to a lesser impact. If this is the case, the noise level monitoring equipment should be relocated to a more suitable site. During each measurement period, the sources of the sounds other than those resulting from traffic on a roadway are noted on field measurement data sheets.

If the field data was gathered without background noise that would influence the overall reading (e.g., a dog that barks continuously throughout the measurement period), the field measurements will be considered complete. If not, and a logical explanation for any unusual readings cannot be made, the field measurements at that location(s) should be repeated in accordance with the FHWA's current measurement procedures. Field measurements may also require repetition if the application of the TNM modeling process is not validated as required by *23 CFR § 772.11(d)(2)*.

Coordination with the District Noise Specialist should occur to determine if validation measurements should be re-performed if land use changes have occurred post-measurement and are large enough to influence

noise levels. Additionally, if an update to the noise model has occurred post-measurement, validation measurements must be re-performed if the new noise model will be utilized to determine impacts and assess abatement.

Traffic noise measurements, for validation purposes, are conducted in accordance with the FHWA's measurement procedures found in the FHWA *Noise Measurement Handbook – Final Report (FHWA-HEP-18-065)* and supplemented with accepted professional judgment. An example noise level measurement data sheet is provided in **Appendix B**.

(ii) Traffic Counts and Classification

Obtaining traffic data in the field is the key to successful model validation. At a minimum, analysts must separate traffic counts by direction and vehicle type consistent with the FHWA/TNM vehicle classification system for use in traffic noise studies (shown in **Table 2-1**).

Table 2-1: Vehicle Classification for Traffic Noise Studies

	Autos	Medium Trucks (MT)	Heavy Trucks (HT)	Buses	Motorcycles
Description	2 axles and 4 tires, primarily designed for transportation of 9 or fewer passengers or for transportation of cargo.	2 axles and 6 tires, and designed to haul cargo	Cargo vehicles with 3 or more axles	All vehicles designed to carry more than 9 passengers	All vehicles having 2 or 3 tires with an open-air driver and/or passenger compartment
Examples	Passenger cars, pick-up trucks	Large pickup with dual rear tires, delivery vans, local moving vans, dump trucks, service trucks, motor-homes	Tractor-trailer units, including dual rear tire pickups pulling a trailer, large motor-homes with 3 axles, large dump trucks	Local and long distance buses, hotel/airport vans, school buses	Harley Davidson, Honda Gold Wing, Yamaha and other makes of motorcycles

Source: *FHWA Noise Measurement Handbook (FHWA-HEP-18-065), June 1, 2018*

(iii) Traffic Speeds

Since traffic noise levels are, in part, speed dependent, every effort should be made to accurately depict the traffic speed for each vehicle type during the measurement period. Traffic speeds are best obtained through the use of a hand-held radar gun or similar device. Some roadways may have higher or lower volumes of one vehicle class versus another, and it is very important to obtain the speed of each vehicle class, especially the low volume variety, which are most often buses and motorcycles. Capturing speeds for as many vehicles in each vehicle class is recommended. The overall goal of measuring traffic speeds is not to get the fastest

speeds, but rather an accurate representation of the speeds for all vehicle types observed during each measurement period.

(iv) Meteorology Data

While the meteorological data (other than the default values for relative humidity, temperature, and wind) are not used in TNM, it is important to note the actual field conditions prior to and during the field measurements. This will document the appropriateness of the weather conditions for taking field measurements. Temperature and humidity can affect the sensitivity of SLMs and may result in the SLM not recording the noise accurately or, in some cases, not at all. To ensure that this does not happen, it is important to know and adhere to the manufacturer's operating conditions for the SLM and calibrator in use. The temperature and humidity can easily be determined by the use of a hand-held or mounted thermometer and hygrometer. The wind speed and direction can also be determined through the use of a hand held or mounted anemometer and compass. If the observed wind speed exceeds the recommended limits in the NMH document, measurements shall be suspended until conditions improve or postponed until a later date. Rain and/or wet roads could result in higher noise and shall be avoided during monitoring.

2.4.2.2.3 TNM Modeling for Validation

The noise environment documented in the field should be replicated in the TNM model. Existing roadways should be entered into the model. For the purpose of model validation, the actual pavement type may be used in the TNM as long as the pavement type is verified by FDOT.

Traffic data observed in the field should be entered into the model. Since the TNM predicts traffic noise levels that represent steady-state noise for a period of one (1) hour, field samples are typically collected for periods of less than one (1) hour and therefore must be converted so they reflect an hourly condition. For example, if the monitoring is conducted for ten (10) minutes and during those ten (10) minutes 100 autos, four (4) medium trucks, ten (10) heavy trucks, zero buses and one (1) motorcycle were counted, each value shall be multiplied by six to obtain hourly values (if the measurement period was 15 minutes, the volumes shall be multiplied by four). The measured speeds would be applied to all vehicle types based on the average readings taken for each vehicle type. If no speed was recorded for a particular vehicle type, the analyst should use the average speed of all other vehicle types during that measurement period.

Next, input any barriers, building rows, terrain lines, or ground zones that existed at the measurement site. Privacy walls are to be included in the modeling if the density of the construction material is enough (a minimum density of four (4) pounds per square foot) to provide reasonable noise attenuation. See FHWA's *Noise Barrier Design Handbook*[14] for further discussion on noise transmission loss. Open-weave walls, open-board fences, wooden fences, chain link fences, and similar privacy structures shall not be included in the modeling effort since they may have little or no noise reduction impact on the measured noise levels. The

[14] The FHWA *Noise Barrier Design Handbook* can be accessed at: https://www.fhwa.dot.gov/Environment/noise/noise_barriers/design_construction/design/index.cfm

District Noise Specialist shall be consulted for any questions regarding features to be included in the TNM.

2.4.2.2.4 Validating TNM

The results of the Existing TNM Model compiled for the project shall be reviewed for consistency with the field measured data, using the traffic data collected in the field for input into the Existing TNM Model. If the results are within the accepted FHWA and FDOT limit of +/- 3 dB(A), the validation effort will be considered complete. If this is not the case, then the Existing TNM Model must be reviewed in detail to determine if site feature(s) (i.e., terrain, ground zones, building barriers, etc.) were not correctly accounted for within the Existing TNM Model input, or if sources of sound other than motor vehicle traffic during the field measurement period had too great an influence. If the difference between the measured and modeled noise cannot be reconciled, the measurement period (or site if all measurement periods fail) cannot be used for the purpose of validating the model. If validation measurements were not obtained at any other site, the field measurements must be repeated until at least one measurement period is validated. If the results indicate that the measured noise levels are higher than those predicted by the TNM, an explanation should be provided as to why the measured levels were higher (i.e., other sound sources were present during the monitoring that cannot be accounted for using the TNM).

The results of the model validation effort shall be documented in the appropriate NSR or DNSR. Documentation shall include a table within the report that shows the field measured value, the modeled value, and the difference between the two. Copies of the field measurement data sheets must be provided in the appendix of an NSR. The location of each validation site shall also be illustrated on the same plan sheets/aerials as the modeled receptors.

2.4.2.3 Determining Ambient Noise Conditions

Field measurements are required along a new alignment to determine the existing noise levels where traffic noise does not exist or is only a minor element in the overall noise.

Measurements should be taken five (5) feet above ground level and at locations representative of noise-sensitive receptors adjacent to the proposed roadway alignment. If possible, a location along the alignment should be chosen that represents a noise environment similar to most areas along this section of the alignment. At each measurement location, a minimum of 30 minutes of readings (three [3] repetitions of ten [10] minutes each) shall be taken, and pertinent field conditions noted. At least two sets of readings (if practical) should be taken at each location.

While it may not always be practical, it is recommended that one set of readings be taken during the morning hours and a second set be taken during the afternoon hours. If doing so would provide more reliable measurements, it is further recommended that these readings be taken over a period of two or more days. The resultant noise level for each reading shall be noted and an arithmetic average ambient reading for each site shall be determined.

The entire project corridor should be reviewed under these conditions to determine if any unusual noise

sources (e.g., aircraft, industrial, electrical generators, insects or other animals) exist that may influence the ambient readings. If any unusual noise sources are noted during the study, they must be identified in the field documentation.

Coordination with the District Noise Specialist should occur to determine if ambient measurements should be re-taken if land use changes have occurred post-measurement that are large enough to influence noise levels. Specific questions regarding ambient noise field measurements should be directed to the District Noise Specialist.

3.0 TRAFFIC NOISE MODEL GUIDELINES

This section provides guidance for the TNM input that is typically used in the analysis of FDOT projects. Specific questions or concerns not addressed here should be directed to the appropriate District Noise Specialist. Quality assurance (QA) and quality control (QC) are essential to ensure a high-quality report with consistent, predictable, and repeatable results. A checklist provides assurance that the QA/QC review efforts have occurred. An example modeling QC checklist is provided in Appendix C.

3.1 File Naming Conventions and File Information

This section describes the process for setting up a TNM file using a logical naming convention and the type of information to be included in the model run, roadway, and receptor and barrier identification. The FHWA *Traffic Noise Model User's Guide*[15] recognizes that use of the term "File" is a misnomer. The term "File" is used for consistency with most window-based programs. A TNM run is saved in a subdirectory (i.e. folder) and the logical naming convention is applied to the folders. Sharing a TNM run with someone else requires that you transfer the entire folder.

The names of input files should be simple, short, and descriptive (significant extensions may cause the TNM file to be deemed inaccessible). Due to limitations on the total number of characters in a file name, input files should also not be saved inside a long string of folders. The file name should be descriptive enough to clearly let the user know what project and scenario is being evaluated. Standardizing the naming of input files will make it easier for an analyst (and others who might need to use a TNM file) to locate and open each file as needed. The following provides example input file names for a project on US 27 for which the existing, future no-build, future build, and abatement scenarios are being evaluated:

- US27EX (i.e., existing)
- US27NB (i.e., no-build)
- US27B (i.e., build)

[15] FHWA Traffic Noise Model, User's Guide webpage: https://www.fhwa.dot.gov/environment/noise/traffic_noise_model/tnm_v25/users_manual/index.cfm

- US 27BAR1 (i.e., barrier 1)

3.1.1 Run Identification Input

Analysts shall use the TNM's run identification input to document additional information about the project and scenario being evaluated. Run titles should essentially mirror the input file name. For example, if the input file name is "US27EX", the run title would be "US 27 – Existing". If a project is divided into segments, the project segment being evaluated shall also be identified (e.g., US 27 – Existing - Elden to Pace). If a project is segmented for other reasons, such as the typical section, the segment identification can also be included in the title (e.g., US 27 – Existing - Segment 1). Where segment numbers are used, the limits of each segment shall be defined in the NSR. If stationing is available, analysts could also use the beginning and end stations for each segment.

When identifying the organization in the run identification input, analysts shall identify either the FDOT District or company that is preparing the analysis (e.g., District One, Central Office, XYZ Consulting Company). Under the Project/Contract heading, provide the FDOT Financial Project Identification Number (FPID) or, if unavailable, the contract number. Finally, the individual performing the analysis shall be identified by their initials. This will allow any future modeling questions to be directed to the appropriate person within the FDOT or the consulting firm responsible for the modeling input.

Figure 3-1 illustrates how this information would appear for an example project, assuming the analyst's name is Michelle Miller and she is an employee of the FDOT District One.

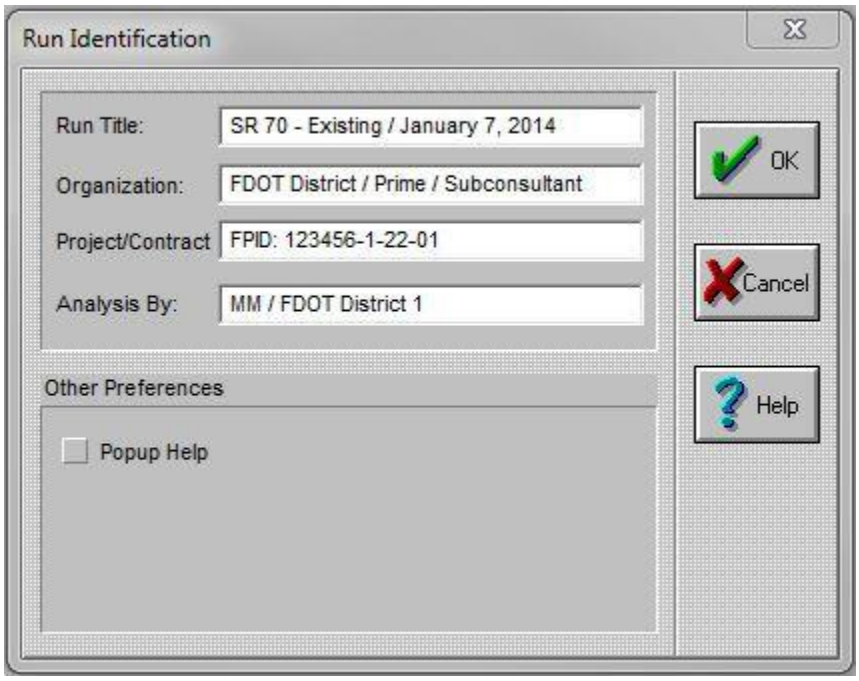

Figure 3-1: Run Identification

3.2 TNM Input

3.2.1 State Plane Coordinate System

The state plane coordinate system shall be used to define the X and Y coordinates of all roadways, receptors, barriers, and other features input to the TNM. The use of the state plane system allows for consistent replication of project information (unlike the use of an aerial or roadway plan sheet with a user-drawn coordinate system).

3.2.2 Roadway Input

3.2.2.1 Roadway Names

The first input you will provide related to roadways (including ramps and roadways on structure) is the name of the roadway. Roadways should be identified consistently throughout the modeling process. Naming roadways is best done by identifying both the roadway and the direction. For example, I-95 NB could be used to identify northbound I-95. The use of stationing is recommended for segment or point identification as well.

3.2.2.2 Roadway Travel Lanes and Shoulders

Consistent with the FHWA *Traffic Noise Model User's Guide*, individual roadway lanes should be modeled and the lanes shall overlap. The input for paved shoulders shall be such that the shoulder overlaps the travel lane adjacent to the shoulder. Both can be accomplished by inputting the X, Y, and Z coordinates of the centerline of each lane or shoulder and adding 0.2 feet to the width of the travel lane or shoulder (e.g., a travel lane with a width of 12 feet shall be input as 12.2 feet). The pavement width used shall represent either the existing or planned roadway width, depending on the scenario being evaluated.

The use of lane-by-lane modeling will greatly increase the model calculation or "run" time. For this reason, analysts shall use the lane-by-lane modeling for the roadway being evaluated but not necessarily for all roadways included in the TNM input file. For example, on an interstate widening project, analysts shall model all travel lanes on the interstate individually, and group travel lanes together for other roadways such as arterials, interchange ramps, and Collector-Distributor (CD) roads.

As with all TNM input items, the naming convention used is important. When using lane-by-lane modeling, analysts shall identify each lane being modeled (e.g., inside, center, outside, etc.). The locations of shoulders shall also be identified (e.g., inside and outside).

Modeled roadways shall extend at least eight times the distance between the roadway and the most distant receptor, with the receptor centered along the roadway. For instance, a modeled roadway segment should extend at least 4,000 feet in either direction beyond a receptor that is located 500 feet from the center of

the road.

3.2.2.3 Intersecting Roadways

Model any intersecting roadway that carries a substantial volume of traffic, if this information is available, and the traffic noise from the intersecting roadway would likely influence the predicted traffic noise level at nearby noise sensitive receptors. Minor cross streets or other local roadways in the vicinity of a project usually do not require modeling.

3.2.2.4 Pavement Type

The pavement type default is "average" and must be used in the prediction of future traffic noise levels. For existing noise level prediction or model validation studies, the actual pavement type may be used at the discretion of the District Noise Specialist.

3.2.2.5 Elevated Roadways

The "Z" coordinate of roadway segments is an important TNM input. If a roadway is elevated and on fill by a mechanically stabilized earth (MSE) wall or embankment section, the roadway itself becomes a barrier if it lies between a receptor and some or all of the roadway lanes being evaluated (or other roadways). This is not the case for roadway segments on structure (bridge) when sound can pass under the structure.

It is important to locate and identify all roadway segments on structure. Doing so ensures (1) intersecting roadways will not cause a TNM-generated error message and (2) that sound from other roadways is allowed to pass through/underneath the structure (i.e., the elevated roadway does not act like a barrier, as discussed above). Please refer to the FHWA *Traffic Noise Model User's Guide* for additional information regarding the modeling of roadways on structure.

3.2.2.6 Roadway Length

Since roadways rarely run in a straight line and on a flat plane, most roadways have to be segmented to allow the accurate depiction of real-world conditions. To accomplish this, segments of varying lengths must be used to reflect changes in gradient or curvature. The more curvature you have, the greater the number of tangent segments you will be required to input.

3.2.2.7 Roadway Medians

Paved roadway medians shall be modeled either as a zero-traffic roadway or as a "pavement" ground zone. Regardless of the method used, the analyst shall ensure that the width is enough so that the TNM doesn't "assume" the default ground type on either side of the median. If using a zero-traffic roadway, 0.2 feet can be added to the width of the median roadway input to ensure sufficient overlap (as with ensuring overlap of individually modeled roadway travel lanes and shoulders). If the roadway median ground type is something other than TNM's default ground type (i.e., lawn), then a ground zone of the appropriate type shall be

modeled.

3.2.3 Traffic Data

3.2.3.1 Traffic Volumes

As stated in **Section 2.2, Data Collection: Traffic Data**, when peak hour demand volumes are used in an analysis, traffic volumes are calculated for the peak and off-peak directions of roadway travel. When receptors are located on both sides of the roadway of interest, the analyst should create two TNM files to represent worst-case conditions. Concurrence on the application of directional traffic splits should be obtained from the District Noise Specialist.

One TNM input file would have the peak traffic on the northbound travel lanes (off-peak traffic on the southbound travel lanes) and receptors on the east side of the roadway. The second TNM input file would have the peak traffic on the southbound travel lanes, off peak traffic on the northbound lanes, and receptors on the west side of the roadway. Using this method ensures that the "worst-case" conditions are evaluated for all receptors, regardless of which side of the roadway they are located on.

The distribution of directional traffic volumes amongst individual travel lanes depends on the circumstances surrounding the roadway. If there are no known restrictions (high occupancy vehicle (HOV) lanes, truck lanes, etc.) then the peak directional traffic is distributed evenly by the number of travel lanes being modeled. The individual lane volumes are estimated to the nearest whole number. (e.g., a calculated lane volume of 947.6 autos per lane is rounded up to 948 autos per lane).

When a roadway project involves HOV lanes or designated lanes for certain vehicle types, the analyst assigns the appropriate type and volume of vehicle to the appropriate travel lane based on the predictions provided.

3.2.3.2 Speed

The vehicle speed to be used in the TNM is the posted speed for existing/no-build conditions and the proposed posted speed for the future build condition. If the proposed posted speed is unknown, then the design speed is to be used. The vehicle speed used for ramps will be the posted speed, applied along the entire ramp unless modified by the flow condition (e.g., the speed along a loop ramp may vary from the time a vehicle leaves the mainline until it reaches the end of the ramp).

3.2.3.3 Flow Control

Flow control allows analysts to address the impact of vehicle acceleration away from selected traffic control devices such as stop signs, toll booths, traffic signals, and on-ramp start points. The speed constraint used should be obtained from the TNM Manual. In general, 100 percent of vehicles are affected by all traffic control devices except traffic signals, which typically catch only a portion of vehicles on their red phase. The percentage of the vehicles affected to be applied is 100 percent unless a traffic study indicates otherwise.

3.2.4 Receptors

3.2.4.1 Receptor Location/Placement

In determining traffic noise impacts for properties with Activity Category A, B, C or E, areas of frequent exterior human use should be identified. The maximum horizontal distance from the edge of pavement that a receptor site will be modeled will vary based on topography and traffic conditions and will be determined on a case-by-case basis. At a minimum, the horizontal distance should be sufficient to identify all potential impacts consistent with the requirements of *23 CFR Part 772*. If there is any question concerning the modeling of a receptor location, contact the District Noise Specialist for guidance.

To distinguish receptors located on the first and second floors, additional letters shall be assigned to the receptor ID. In the example above, the ID's for receptors on the first and second floor would be "3-W- 23A" and "3-W-23B", respectively. Regardless of the specific labeling convention that is used, the NSR or NSR Addendum should describe the convention used.

Receptor placement is important as it can determine if a property is impacted and affect the results of noise barrier analyses and barrier optimization. Analysts may have to develop two sets of receptors for the same property depending on the purpose of the modeling effort. If the purpose is to determine whether a property is impacted, the placement of the receptor should be the area of frequent human exterior use. Unless the area of frequent human use is identified elsewhere, residential receptor sites should be placed at the edge of the dwelling unit closest to the major traffic noise source or as dictated by professional judgment.

If the purpose is to determine whether a noise abatement measure, especially a noise barrier, would benefit a property, additional receptors may be required. **Figure 3-2** illustrates a situation where additional receptors, for the same property, should be considered in a noise barrier evaluation. As shown, only considering abatement for the first scenario would be inappropriate since more of the property is impacted and requires abatement consideration. The second scenario depicts the correct receptor placement for the purpose of determining noise barrier effectiveness.

When more than one noise sensitive site is clustered together within a NAA, a single receptor can be modeled as representative of a group of noise sensitive sites with uniform characteristics (distance from roadway, land use, topography, etc.) It is acceptable to combine receptor points that may be located more toward the center of the frontage of the community.

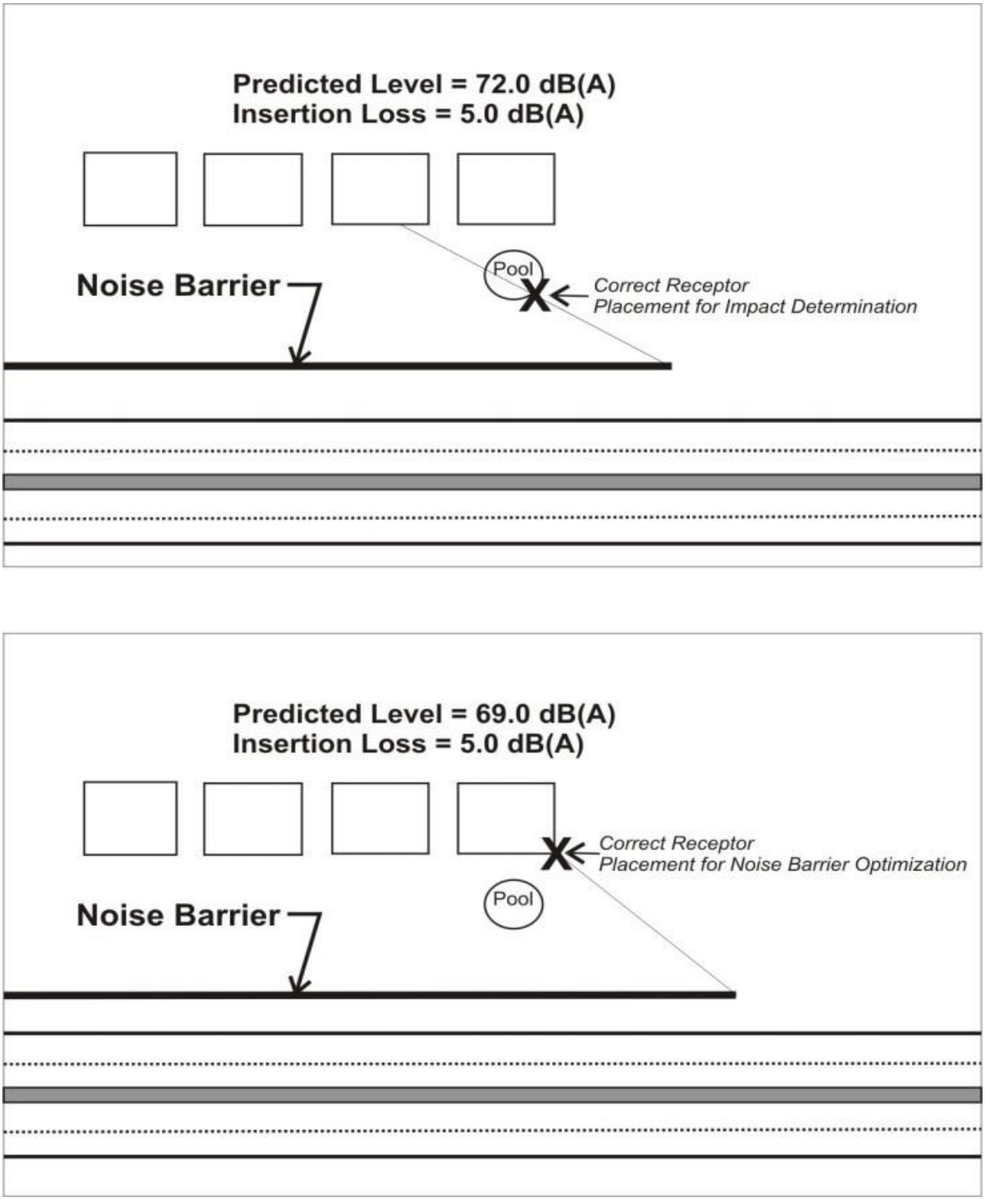

Figure 3-2: Receptor Placement

For an arterial roadway in an urban area that has a uniform distance from the roadway to numerous noise sensitive sites, a single receptor may be used to represent the sites for the purpose of the noise impact assessment as long as the roadway and traffic characteristics are consistent within the area of concern. For roadways that vary in alignment and elevation (i.e., an urban highway that has frequent overpasses, underpasses, interchanges and ramps), numerous receptors will need to be modeled as these design features can significantly affect motor vehicle acoustics.

Modeling of SLU locations (i.e., non-residential noise sensitive land uses such as parks, playgrounds, trails, schools and places of worship) will require extra attention to receptor placement and shall be done by applying the principles illustrated in the FDOT's *Methodology to Evaluate Highway Traffic Noise at Special Land Uses*.

Due to the various types of SLU locations, any questions regarding the application of this methodology to project specific conditions should be directed to the District Noise Specialist. Documentation of decisions and rationale is of extreme importance.

3.2.4.2 Receptor Locations for Non-Residential Receptors

The following is guidance for consideration of special situations that are not residential land uses.

For Activity Category A sites (lands on which serenity and quiet are of extraordinary significance), the receptor point(s) are to be located at a point(s) representing an area of frequent human use and at a point(s) closest to the roadway that is anticipated to generate the greatest noise impact. The FDOT Office of Environmental Management (OEM) must approve of the use of Activity Category A receptors.

Sites at Recreational Vehicle (RV) parks are to be treated as Activity Category B of the NAC. Each location within an RV park that has a "hookup" (i.e., connection for electrical, water, sewer, etc.) is treated as one (1) residential receptor.

For Activity Category C sites, (i.e., active sport areas, amphitheaters, cemeteries, hospitals, etc.) the placement of the receptor point(s) will depend on the type of site. Locations of receptors need to be consistent with the guidance provided in FDOT's *Methodology to Evaluate Highway Traffic Noise at Special Land Uses*.

1. For active sport areas, an array/grid of receptors is placed in areas of use and where impacts are expected to be predicted. If an impact is identified, the same receptor array/grid is used to determine the feasibility and cost reasonableness of abatement.

2. For amphitheaters, the outdoor seating areas and/or the performance stage are typically the primary areas of concern. An array/grid of receptors is placed in areas of use and where impacts are expected to be predicted. If an impact is identified, the same receptor array/grid is used to determine the feasibility and cost reasonableness of abatement.

3. For auditoriums, appropriate exterior receptor locations are placed at features that attract frequent human use (e.g., gazebos). If no exterior use areas exist, then the receptor is considered Activity Category D and is located at an interior point that would be a site of frequent human use, such as a stage, seating area, etc. As stated in the FDOT *PD&E Manual, Part 2, Chapter 18, Highway Traffic Noise)*, the prediction of interior traffic noise levels will be coordinated with the District Noise Specialist. If interior levels are to be predicted, refer to **Section 3.3.1.1, Activity Category D – Interior Noise Analysis,** for the appropriate reduction factor to be applied to the predicted exterior noise.

4. Campgrounds have receptors placed at points where camping facilities (e.g., grills, patios) are designated (regardless of whether there is an active occupant).

5. At cemeteries, receptors are placed in an array/grid and follow the same analysis procedure noted above for active sport areas.

There are several types of Activity Category E sites for which the following guidance is provided.

1. Hotels and motels that have an outdoor pool or other gathering areas (e.g., shuffleboard courts, grill, etc.) are considered noise sensitive and frequent exterior use areas. These locations are modeled to identify potential impacts. Offices that have outdoor features that are a gathering area (e.g., table(s), awning(s), etc.) used by employees and others. These areas shall be considered areas of frequent human use.

2. Restaurants/bars that have outdoor seating areas at which customers are served are considered noise sensitive. Receptor point(s) are placed at the point of frequent human use within these areas that are closest to the traffic noise source.

3. If the outdoor frequent use area is separated from the roadway by a building, the building itself is modeled as a barrier to reflect the nature of the site accurately.

Since there are no Noise Abatement Criteria established for such properties, it is not necessary to model Activity Category F and G properties.

As previously noted, the placement of receptors for the establishment of traffic noise impacts may not be consistent with the placement of receptors for the purpose of determining the effectiveness of noise abatement efforts, especially for larger use areas like campgrounds, parks, trails, school grounds, and similar uses. In these cases, the placement of additional receptors is established following the guidance found in the "Special Use" methodology.

3.2.4.3 Receptor Labeling

Like roadways, receptor points should be labeled in a manner that is logical and consistent. Typically, alpha/numeric systems are used, starting on one side of the roadway and working south to north or west to

east, consistent with the baseline of survey stations. This process is then repeated on the opposite side of the roadway as well. If a project has been segmented or there are distinct NAAs, an analyst may want to use a receptor identification system that includes NAA identification (e.g., letters or numbers). For example, the 23rd receptor on the west side of I-95 within the third NAA could be identified as "3-W-23". *(Caution – IDs can clutter the aerial display, so they should be as simple and brief as possible with the requirement that aerials be completely legible).*

To distinguish receptors located on the first and second floors, additional letters shall be assigned to the receptor labels. In the example above, the labels for receptors on the first and second floor would be "3-W-23A" and "3-W-23B", respectively. Regardless of the specific labeling convention that is used, the NSR or DNSR should describe the convention used.

3.2.4.4 Receptor Heights

TNM's default receptor height should be set to five (5) feet above ground. When selecting receptor sites, receptors shall be included such that all potentially impacted sites are either specifically modeled or represented. The number of receptors modeled will vary depending on the location of the receptors in proximity to one another and their distance from the roadway(s) in the TNM input.

Modeled receptor heights for first (ground) floor receptors are always assumed to be five (5) feet above ground elevation. Analysts shall increase the height above ground by ten (10) feet for each additional floor above ground level (i.e., 15 feet for a second-floor receptor, 25 feet for a third-floor receptor, etc.).

3.2.4.5 Adjustment Factors

The Receiver "Adjustment Factors" tab provides the analyst the ability to manually adjust the predicted noise level from a roadway segment to a receiver to account for things that cannot be modeled by the TNM (such as background noise, other transportation noise sources, etc.). Analysts shall not use this function unless the expected change to the predicted traffic noise level is three or more dB(A) consistent with FHWA guidance found in *Appendix A* of the FHWA *Traffic Noise Model User's Guide, version 1.0*[16]. If an analyst does use an adjustment factor, the feature that causes the need for an adjustment and the reasons for applying the adjustment must be fully quantified and documented prior to finalizing the TNM results.

3.2.5 Existing Noise Barriers

Existing barriers (berms, noise barriers, privacy walls) shall be included in a TNM input file as a fixed barrier if the material and thickness of the barrier would provide a sound level reduction. This may include a median or shoulder barrier (e.g. a solid traffic "Jersey" barrier). Privacy walls with slatted openings or similar patterns, regardless of their composition, do not provide significant noise reduction to be considered in the modeling effort. If there is any question regarding the appropriateness of modeling an existing wall, consult with the

[16] FHWA. *Traffic Noise Model User's Guide, Version 1.0*. January 1998. https://www.fhwa.dot.gov/environment/noise/traffic_noise_model/old_versions/tnm_version_10/users_guide/tnm10usersguide.pdf

District Noise Specialist to determine the appropriate input.

Projects which have existing noise barriers present should follow guidance in the FDOT's Methodology to Evaluate Existing Noise Barriers[17].

3.2.6 Building Rows

If a large building or series of buildings exist between a roadway and modeled noise sensitive sites, analysts shall include the building(s) as building rows in the TNM input file. The average height of the building row and the percentage of the row that provides noise reduction to receptors behind the row is a necessary part of the input. The maximum percentage of coverage allowed by TNM for a building row is 80%. *If a row of buildings occupies more than 80% of the entire length of the row, then model the building row as a barrier.*

In some cases, such as where a building is a large apartment or office building, it is best to model those structures as barriers. The name of the building row should reflect the nature of the row and its relative location if warranted. If data regarding the height of a structure is not readily available, assume ten (10) feet for each story of a building or mobile home, twelve (12) feet for a single-story home, and 22 feet for a two-story building. For each additional floor of a building or residence, add ten (10) feet. The Z-coordinate of a building row shall always be the ground elevation at the face of the building.

3.2.7 Terrain Lines

A terrain line should be used in areas where topographic features alter the propagation path for traffic noise. For example, terrain lines shall be used to define the bottom of the slope for roadways on fill/embankment, and also for roadways constructed on MSE or retaining walls. If a particular roadway segment is on fill/embankment or MSE wall, and a terrain line is not used to represent the bottom of the slope or the bottom of the MSE wall, TNM will assume the ground line extends from the roadway edge out to the next closest object, which may be a receptor, which would be an inaccurate representation of the conditions. The use and modeling of terrain lines should follow the guidance provided in the TNM/FAQ. *Remember to use care in the placement and application of terrain lines since they may have a significant impact on the predicted noise and model run times.*

3.2.8 Ground Zones

Ground zones are used when there is a large area of ground that is different than the default ground type used in the project setup information. With the exception of dry ponds that are designed to hold runoff and will not contain water all the time, all water features shall be included in the TNM input file if they are located between the roadway and modeled receptors.

[17] FDOT. *Methodology to Evaluate Existing Noise Barriers*. February 2025. https://fdotwww.blob.core.windows.net/sitefinity/docs/default-source/environment/existing-noise-barrier-guidance-document_02-20-25420a274a-f186-4ab0-bc27-a3cf93db1166.pdf?sfvrsn=7ed34bf2_1

3.2.9 Tree Zones

For tree zones to be included in the TNM, the vegetation must be sufficiently dense to block the view along the propagation path completely. Since this condition is rarely possible, *tree zones shall not be used in a TNM input file unless otherwise directed by the District Noise Specialist*.

3.2.10 Noise Contours

Although noise contours (i.e., areas of traffic noise impacts) are allowed for project alternative screening or for land use planning, noise contours shall not be used for determining highway traffic noise impacts or the determination of the feasibility and reasonableness of providing noise abatement per *23 CFR § 772.17*, as they generalize. Noise contours are used as a tool to assess the potential impacts of a variety of corridors or alignment alternatives. They are also used as a land use planning tool when they are provided to local government consistent with *23 CFR § 772.17*. In this case, the contours aid in future noise impact reduction as part of a local government's planning and zoning efforts.

The TNM contouring program shall not be used to develop noise contours. Instead, contours shall be developed by using a receptor grid, the roadway's proposed typical section and approved traffic data. The resultant impact zone is determined by using the proposed edge of pavement of the roadway as the reference point.

3.3 Noise Impact Analysis Guidelines

Title 23 CFR Part 772, Table 1 to Part 772 – Noise Abatement Criteria establishes the NAC that are used to determine whether a highway traffic noise impact occurs. Refer to **Section 1.2, Noise Abatement Criteria Activity Categories,** and **Table 1-1** for more detail.

During a project's PD&E phase, a traffic noise analysis shall be completed for the alternative(s) under detailed study and for each Activity Category of the NAC that is present in the study area. Noise level predictions will be required for the following project alternatives and study years:

ALTERNATIVE	YEAR
No-build	Existing and Design year
Build	Design year only

During a project's Design phase, noise level predictions are required for the build alternative and Design year only, unless a substantial increase has been identified during the project's PD&E phase. If a substantial increase of 15 dB(A) or greater is identified during the PD&E phase, existing noise levels must be re-evaluated during subsequent evaluations.

3.3.1 Traffic Noise Prediction

Title 23 CFR § 772.11(b) states that in determining traffic noise impacts, primary consideration should be

given to exterior areas where frequent human use occurs. A traffic noise impact occurs when the modeled future highway traffic noise levels for the worst-case noise condition approach or exceed the NAC. A traffic noise impact also occurs when modeled future highway traffic noise levels substantially exceed the existing highway traffic noise level, even though the modeled levels may not exceed the NAC. For projects with new alignments, the average ambient field measurements should be compared to the predicted future project traffic noise level for each measurement site to determine the increase in noise levels as a result of the proposed project.

FDOT has determined that the NAC is approached when it is within one (1) dB(A) of the appropriate federal NAC and that a substantial increase occurs when the increase over existing conditions (measured or predicted) is 15 dB(A) or greater. To assess the highway traffic noise impact of a project, both criteria (approach of the NAC and substantial increase) must be evaluated.

Design year traffic noise impacts are based on the modeled build noise levels or the difference between the build and existing measured or modeled traffic noise levels. If one or more noise sensitive receptors are impacted by project related traffic noise levels that approach or exceed the NAC or substantially increase when compared to existing (measured or predicted) noise levels, then abatement measures must be considered. If the abatement criteria are not approached or exceeded and if projected traffic noise levels do not substantially increase existing noise levels, abatement measures will not be considered.

For example, with an Activity Category B receptor, if the difference between the existing and build condition predictions is an increase of five (5) dB(A), say from 63 dB(A) to 68 dB(A), then the receptor can be stated to have no substantial increase on highway traffic noise. However, since the predicted future build level approaches or exceeds the FHWA NAC for Activity Category B, noise abatement must be considered. If the predicted increase went from 42 dB(A) (existing) to 63 dB(A) (build) (a 21 dB(A) increase), the receptor (and therefore the project) would be considered to have a substantial increase and would require abatement consideration.

As previously mentioned, FDOT has determined that the NAC is approached when it is within 1 dB(A) of the appropriate federal NAC. For example, with an Activity Category B receptor with a predicted future noise level of 66 dB(A), the approach criterion would be met, and abatement must be considered. However, a level of 65.9 dB(A) would not be considered to have approached or exceeded the abatement criterion, and abatement consideration would not be required.

3.3.1.1 Activity Category D - Interior Noise Analysis

According to *23 CFR Part 772*, an indoor analysis shall be performed after a determination is made that exterior areas are impacted by traffic noise, but 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, Activity

Category D shall be used as the basis of determining noise impacts. Note that the NAC applies only to the interior areas of this activity category. This will involve:

1. The identification of interior areas of frequent human use. Coordination with the District Noise Specialist to ensure proper application.

2. The identification of the building envelope for expected noise reduction based on the information found in *Table 6 – Building Noise Reduction Factors* of the FHWA report, *Highway Traffic Noise: Analysis and Abatement Guidance (FHWA-HEP-10-025), December 2011* and shown in **Table 3-1**;

3. Determination of the open window/closed window condition (see **Table 3-1**). For interior noise analysis, the FDOT considers all windows closed; and

4. If the expected reduction cannot be determined as identified in #2 above, or if #3 above cannot be determined, physical measurements of the amount of noise reduction provided by the building envelope will be conducted consistent with the methodology found in the FHWA, *Noise Measurement Handbook (FHWA-HEP-18-065), June 2018* and the associated document *Noise Measurement Field Guide - Final Report* (*FHWA-HEP-18-066)*, June *2018*.

The FDOT publication *Methodology to Evaluate Highway Traffic Noise at Special Land Uses* shall be used to assess whether noise abatement is feasible and/or reasonable at Activity Category D locations.

Table 3-1: Building Noise Reduction Factors

Building Type	Window Condition*	Noise Reduction Due to Exterior of the Structure
All	Open	10 dB
Light Frame	Ordinary Sash (closed)	20 dB
	Storm Windows	25 dB
Masonry	Single Glazed	25 dB
	Double Glazed	35 dB

*For interior noise analysis, the FDOT considers all windows closed.
Source: FHWA Highway Traffic Noise: Analysis and Abatement Guidance, Table 6 - Building Noise Reduction Factors.

3.3.1.2 Non-Highway Transportation Noise Sources

When non-highway transportation noise sources such as airport operations, transit lines, and light commuter rail contribute to the noise level in the project area, the effects of these secondary sources on the total noise level at sensitive receptors must be assessed as part of the highway traffic noise assessment process. For these types of projects, coordination with the District Noise Specialist on methodology must occur prior to implementing any noise analysis. Existing studies performed for airport and transit facilities may be consulted and used as available and appropriate in this assessment. However, if no such studies have been performed or available studies are considered out of date (at the discretion of the District Noise Specialist), then noise

levels from these secondary sources must be assessed separately and mathematically combined with highway traffic noise levels to determine total impacts and the feasibility and reasonableness of noise abatement for the highway improvement. For guidance on mathematically combining decibels, see FHWA's *Highway Traffic Noise: Analysis and Abatement Guidance* (FHWA-HEP-10-025).

For transit and freight rail facilities proximate to highway projects, noise levels at noise sensitive receptors should be assessed using either the Federal Transit Administration's (FTA's) *Transit Noise and Vibration Impact Assessment Manual,* or the Federal Railroad Administration's (FRA's) online *Guidance on Assessing Noise and Vibration Impacts,* as appropriate. This includes rail facilities that either cross the highway project area, parallel to the highway project area, or are beyond the terminus of the project but still are close enough to affect noise-sensitive receptors near the project terminus.

Noise levels using metrics provided from the modeling of the railroad facility [e.g., day-night average sound level (Ldn)] should be converted to Leq, and the cumulative noise level from both the highway and non-highway sources should be determined mathematically. The feasibility and reasonableness of potential noise abatement associated with the highway facility should be determined relative to the cumulative noise from all sources and the anticipated insertion loss. Assessment of the magnitude of noise impacts from rail and transit facilities must comply with *Railroad Noise Emissions Compliance Regulations, 49 CFR Part 210* and *FTA Transit Noise and Vibration Impact Assessment Manual*.

Existing aviation noise studies, provided they have been performed consistent with the requirements of *Airport Noise Compatibility Planning, 14 CFR Part 150*, can be used in assessing the contribution to overall noise levels from nearby airports.

3.4 Noise Abatement Analysis Guidelines

3.4.1 Criteria and Requirements

Traffic noise abatement is considered only if the predicted future build traffic noise levels approach or exceed abatement levels in the NAC, or if build traffic noise levels substantially increase from existing noise levels (either field-measured or predicted). Alternative noise abatement measures will be evaluated 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. In abating traffic noise impacts, FDOT shall give primary consideration to exterior areas where frequent human use occurs.

Noise abatement will be analyzed a minimum of two (2) times during the development of a project. The first time will be during the PD&E phase when the Environmental Document is prepared. By the time the Environmental Document is prepared, the noise studies will have progressed to the stage where noise-impacted areas have been identified. Although at this stage, it is unlikely that exact locations, abatement types, ROW requirements, or design and construction feasibility factors can be determined, the approximate noise barrier location and height information should be determined. The second time noise abatement will

be analyzed will be during the Design phase prior to Plans, Specifications, and Estimates (PS&E) approval. Any noise sensitive receptor that is permitted between the completion of the NSR and the DPK will be analyzed for traffic noise impacts, and if impacts are predicted, abatement will be considered during the Design phase of the project.

Traffic management, alteration of horizontal and vertical alignments, acquisition of real property to create a buffer zone, noise insulation of Activity Category D land use, and noise barriers are acceptable noise abatement measures. Landscaping is not a viable noise abatement measure.

As noted in *23 CFR § 772.13(c)(1)*, at a minimum, the FDOT shall consider noise abatement in the form of a noise barrier. Therefore, all impacted receptors will require analysis for traffic noise reduction using a noise barrier. The exception to this is for "isolated residential impacts," where there is only one impacted residence that could benefit from a noise barrier and, as such, would not meet minimum feasibility requirements. In these cases, a generalized statement of this nature can be made in the *NSR,* stating that noise barriers will not be evaluated for isolated impacted receptors.

When considering noise barriers for noise abatement, the feasibility and reasonableness factors described in the following sections must be evaluated for each viable alternative under detailed analysis.

3.4.1.1 Feasibility Factors

Feasibility factors for noise abatement measures involve both acoustic (noise reduction) and engineering considerations when considering a potential abatement measure.

3.4.1.1.1 Noise Reduction Factor

The feasibility of providing noise abatement is focused on the ability of the noise barrier to provide a reduction of at least five (5) dB(A) to impacted receptors (note that the number of land uses or residences represented should be considered). The more reduction that can be achieved, the better the barrier, as long as the cost, visual impact, and other factors of the barrier are not unreasonable. Coordination with the District Noise Specialist must occur to determine unreasonable factors. If a minimum of five (5) dB(A) reduction cannot be achieved at a particular receptor, that receptor is not considered benefited. The number of impacted receptors required to achieve a five (5) dB(A) reduction or greater in order for a noise barrier to be considered feasible will be equal to two (2) residences or greater.

3.4.1.1.2 Design and Construction Factors

Consideration should be given to whether a noise barrier can be constructed using standard construction methods and techniques. Factors to be considered include terrain changes, utilities, safety (e.g., lane closures, sight distance), bridges, overpasses, and similar difficulties. The proposed plan should be reviewed by appropriate personnel to determine if alternative construction methods and techniques will increase the construction costs or time, impact roadway safety, or result in other impacts. Additional costs incurred solely

to accommodate the construction of a noise barrier should be included in the cost reasonableness evaluation of the noise barrier.

If a noise barrier must be placed on a structure, such as a bridge or an MSE wall, the ability of this structure to support the additional wind and dead loads safely must be established before a final commitment to build the noise barrier is made. According to the Part 2, Section 264 of the FDM, Topic No. 625-000-002, proposed noise barriers on structure (e.g., on a bridge or MSE wall) will not exceed a maximum height of eight (8) feet. If a new bridge is being designed and a noise barrier is contemplated for placement on the bridge, the ability of the bridge to support the load of the noise barrier and the crashworthiness of the proposed barrier within the clear zone will be considered as early as practicable. Placement of noise barriers on structure will require approval by the State Structures Design Engineer.

3.4.1.1.3 Safety Factors

Safety is a critical factor in determining whether a particular abatement measure is feasible. Noise barriers should be designed in accordance with Part 2, Section 264 of the FDM, Topic No. 625-000-002. If a conflict between a noise barrier and safety exists, primary consideration should be given to safety. An example of such a conflict would be the loss of a safe sight distance (line of sight) at an intersection or driveway as a result of the placement of a noise barrier. Conflicts are considered during the feasibility assessment of the noise barrier and may result in a determination that a noise barrier is not feasible. Noise barriers cannot exceed the following heights:

1. For ground-mounted noise barriers, the maximum height is 22 ft. above ground level.

2. For noise barriers on bridges and retaining wall structures, the maximum height is eight (8) ft. unless a taller noise barrier is specifically approved in writing by the State Structures Design Engineer.

3. For ground-mounted Traffic Railing/Noise Barrier combinations, the maximum height will be 14 ft. above ground level.

Non-crash-tested noise barriers within the clear zone require shielding.

3.4.1.1.4 Access Factors

Accessibility to adjacent properties on non-limited access roadways must be considered since the placement of a noise barrier may block ingress and egress to these properties. Other access issues to be considered include access to a local sidewalk or normal routes of travel.

3.4.1.1.5 Right of Way Factors

ROW needs, including access rights, easements for construction and/or maintenance, and additional land must be considered as part of the feasibility of noise barrier construction. If necessary, the FDOT can consider the purchase of additional ROW or make a request for the donation of ROW from the adjacent property owners(s) for the purpose of noise barrier construction and/or maintenance. The additional cost to purchase

ROW shall be included in the overall cost reasonableness calculations. In the case where the purchase of ROW is not possible or if the adjacent property owner(s) do not wish to donate the necessary ROW, the noise barrier or noise barrier system shall be determined not feasible. ROW needs will be determined as early in the process as possible.

3.4.1.1.6 Maintenance Factors

Maintenance of a noise barrier must be considered to ensure that the barrier can be maintained using standard practices. Maintenance crews must have reasonable access on both sides of the barrier for both personnel and equipment. Since graffiti can be a serious problem, consideration should be given as to how it can be reduced.

3.4.1.1.7 Drainage Factors

Drainage is an important element that must be considered in the location and design of a noise barrier. Directing stormwater along, under, or away from a noise barrier can cause construction and maintenance problems and therefore, must be given adequate consideration.

3.4.1.1.8 Utility Factors

Utility issues, including the impact of noise barriers on utilities and the reverse must be assessed early in the process. Both overhead and underground utilities can have a significant impact on design and construction options.

3.4.1.2 Reasonableness Factors

Once a noise abatement measure is determined to be feasible, the reasonableness of noise abatement will then be determined. The following reasonableness factors must collectively be achieved in order for the noise abatement measure to be deemed reasonable:

1. Achievement of the FDOT Noise Reduction Design Goal (NRDG).
2. Cost-effectiveness of the highway traffic noise abatement measure; and
3. Consideration of the viewpoints of the benefited property owners and residents (during the Design phase).

Two of the factors of reasonableness are considered during the PD&E phase: cost-effectiveness and achievement of the FDOT NRDG. The consideration of the viewpoints of benefited receptors (property owners and residents) is done during the Design phase.

3.4.1.2.1 Noise Reduction Design Goal

As stated in *23 CFR § 772.13(d)(2)(iv)* for an abatement measure to be considered reasonable, it must attain the FDOT NRDG. To ensure the provision of reasonable traffic noise abatement consideration at the greatest number of impacted locations, FDOT has selected a seven (7) dB(A) noise level reduction for one (1) or more

benefited receptors as the NRDG. Failure to achieve the NRDG will result in the noise abatement measure being deemed not reasonable. The NRDG should be applied to residential as well as non-residential land uses (i.e., NAC Activity Category C, D, and E).

3.4.1.2.2 Cost-Effectiveness

FDOT has established cost-effectiveness criteria that have been in place for many years. Using the current statewide average unit cost of $40.00 per square foot, a reasonable cost of $64,000 per benefited receptor is looked upon as the upper limit, which was last updated in 2024. Only benefited receptors will be included in the calculation used to determine if a proposed noise abatement measure has a reasonable cost. Note that this cost does not include the cost of an optional additional taper of vertical height for shoulder-mounted noise barriers, as this is a safety feature.

The standard cost of any specialized foundation due to site conditions required for the potential noise barrier are to be included in the calculations of cost-effectiveness. However, if the foundation and earthwork are part of the road construction, they should not be included in the noise barrier cost calculations. The cost of designing the noise barrier, inclusion of tapers, relocation of utilities (above or below ground) that are permitted within FDOT ROW, clearing and grubbing, mobilization, maintenance of traffic, construction engineering and inspection, and related activities that are considered as part of the total construction project, are not included in the cost-effectiveness calculation. To be considered as a noise abatement cost, the costs must be incurred solely because of the installation of the noise barrier. An example would be when there is a need to extend a culvert that would not be necessary for roadway construction but is required to construct the noise barrier.

The cost-effectiveness of an abatement measure must be determined during the PD&E Study to enable FDOT to make a Statement of Likelihood in the Environmental Document to pursue this abatement effort in the Design phase. The PD&E Noise Study should also note that the reasonableness of providing noise abatement in the form of a noise barrier is subject to a detailed review in Design and subsequent Re-evaluations.

The primary method of determining the cost for noise abatement by FDOT involves a review of the cost per benefited receptor for the construction of a noise barrier benefiting a single location (such as a subdivision or contiguous impacted areas) with each area being considered a Common Noise Environment (CNE) area. A CNE implies that a group of receptors of the same NAC activity category are exposed to similar noise sources and levels, traffic volumes, traffic mix, speed, and topographic features and are benefited by the same noise barrier or noise barrier system.

Noise barriers may be provided for CNEs that contain different Activity Categories of the NAC, provided that the combined person-hour usage (outlined in *FDOT's* Methodology to Evaluate Highway Traffic Noise at Special Land Uses) results in a cost reasonable noise barrier. Contact the District Noise Specialist for questions related to the application of the CNE criteria.

In the case of RV parks that also serve as a mobile home site, noise abatement will be considered when at least 51 percent of the noise impacted spaces are occupied 51 percent of the year or more by "permanent" residents. A permanent resident would be one who occupies the dwelling unit at least 51 percent of the calendar year. For these locations, where usage is often seasonal and of short duration, the property owner will determine the occupancy rate of that portion of the facility that is impacted by traffic noise. If less than 51 percent of the impacted spaces are occupied less than 51 percent of the year, abatement measures will not be considered. The same occupancy requirements will apply for other forms of temporary housing not identified here and will be considered on a case-by-case basis in consultation with OEM. The noise abatement measure must be feasible and reasonable before it will be considered further.

Third-party funding is not allowed to subsidize the cost of a noise barrier for the purpose of making the noise barrier feasible or reasonable. Third-party funding, as noted in *23 CFR § 772.13(j),* is acceptable on a federal or federal-aid highway Type I project to make functional enhancements as long as the noise abatement measure already has been determined to be feasible and reasonable.

3.4.1.2.3 Viewpoint of the Benefited Receptors

During the PD&E phase, input from the public regarding the project, including traffic noise and abatement, is gathered during workshops, public hearings, and other public involvement opportunities, such as the project website, email, written comments and phone calls.

A more detailed process to solicit the viewpoint of the benefited receptors is invoked during the Design phase of the project. Each benefited receptor (owner or resident) will be given the opportunity to provide input to FDOT regarding their desire to have the proposed noise abatement measure constructed. They may also be given the opportunity (at the discretion of the District) to provide input regarding their aesthetic preferences from a list of pre-selected options.

During the Design phase of the project, FDOT will use either a noise abatement workshop and/or a public survey to determine the wishes of the benefited receptors. Each benefited receptor (owner or resident) will be given the opportunity to provide input to FDOT regarding their desire to have the proposed noise abatement measure constructed. They may also be given the opportunity (at the discretion of the District) to provide input regarding their aesthetic preferences from a list of pre-selected options.

It is the desire of FDOT to obtain a response for or against the noise barrier from a numerical majority (greater than 50%) of the benefited receptors (owners and residents) that provide a response to the survey. Multiple techniques to solicit input may be used, including multiple mailings, door-to-door follow-up, and even telephone solicitation (as needed) to provide adequate information to allow FDOT to make an informed decision on whether abatement is desired or not. If, after three attempts to gather the input from the benefited receptors, a minimum response rate of 50% is not achieved, the FDOT may determine the abatement measure to be not reasonable. If a numerical majority of the benefited residents and property owners that provide a response to the survey do not favor the construction of a noise barrier, FDOT will not provide the noise barrier. It is important to note that the viewpoints of the property owner will be considered

as having the greatest weight in the decision as to whether FDOT will provide noise abatement. While the viewpoint of the non-owner resident will be considered, their viewpoint will carry less weight, consistent with the formula shown in **Table 3-2**.

For example, if a renter of a single-family home wishes to have noise abatement but the owner does not, the opinion of the homeowner would prevail. If the owner of the home did not respond for or against the noise abatement measure, then the renter's opinion would be used to be equivalent to 10% of the homeowner's. This means that ten (10) renters in favor of the noise abatement would equal the vote of one (1) owner-occupied home.

The input of Homeowners Associations (HOA) should be considered during the survey process, especially if the HOA owns common land adjacent to FDOT ROW where the noise barrier would be located. However, no formal vote shall be made by the HOA, and the desires of the HOA cannot preclude those of the benefited receptors behind the noise barrier.

Table 3-2: Viewpoint Weighting Factors

Property Type	Owner Occupies Property	Owner Does not Occupy Property	
		Owner	Renter
Single-Family	100%	90%	10%
Multifamily (duplex, apartments, condominiums)*	100%	90%	10%
Mobile Home Park*	100%	80%	20%
Offices, Businesses	100%	80%	20%
* The weighting factor is for each unit (mobile home, apartments, condominiums), not for the entire mobile home park, apartment complex, or condominium building.			

3.4.1.2.4 Outdoor Advertising Sign Impacts

Although it is not to be considered as either a feasibility or reasonableness option, Florida Law requires consideration of the potential to construct a noise barrier that might block the motorist's view of an existing, conforming and legally permitted outdoor advertising sign. As early in the PD&E Study as possible, the District Outdoor Advertising section of the Office of Right of Way must be notified (consistent with the FDOT *Right of Way Procedures Manual*[18]*, Topic No. 575-000-000*) in order to identify outdoor advertising signs affected by any proposed noise barrier. At a minimum, the section number and milepost for each noise barrier, along with an estimated construction date, will be given to the Outdoor Advertising Section so notice of the possible screening of a sign can be provided to the affected sign permit holder(s) Note: If the latitude and longitude

[18] The FDOT Right of way Procedures Manual can be accessed at: *https://www.fdot.gov/rightofway/ProceduresManual.shtm*

of the sign can be provided, this will assist the FDOT ROW representative coordinating the *Section 12.1 - Outdoor Advertising Signs* of the *Right of Way Procedures Manual* in locating the needed information.

Outdoor advertising signs that are legally permitted, conforming and erected may increase the height of the sign if visibility is blocked due to the construction of "noise attenuation" barriers consistent with *Section 479.25, F.S.* This statute requires FDOT to notify a local government or local jurisdiction before erecting a noise barrier that will block a lawfully permitted sign. The local government or local jurisdiction is then required to notify FDOT if increasing the height of an outdoor advertising sign will violate any local ordinance or land development regulation of the local government. When the notice has been received from the local government or local jurisdiction, and prior to the erection of the noise barrier, FDOT shall inform all property owners identified as impacted by highway noise, and who may benefit from the proposed noise attenuation barrier, as part of a written survey, that:

1. Erection of a specific noise barrier may block the visibility of an existing outdoor advertising sign;
2. The local government or local jurisdiction may restrict or prohibit increasing the height of the existing outdoor advertising sign to make it visible over the noise barrier; and
3. If a majority of the impacted property owners vote for the construction of the noise barrier, the local government or local jurisdiction will be required to:
    a. Allow an increase in the height of the sign in violation of a local ordinance or land development regulation;
    b. Allow the sign to be relocated or reconstructed at another location if the sign owner agrees; or
    c. Pay the fair market value of the sign and its associated interest in the real property.

The statute also requires FDOT to hold a public hearing within the boundaries of the affected local government or local jurisdiction to receive input on proposed noise barriers that may conflict with the local ordinances or land development regulations, and to suggest or consider alternatives or modifications to the proposed noise barrier to alleviate or minimize the conflict with the local ordinances or land development regulations, or minimize any costs associated with relocation, reconstructing, or paying for the affected outdoor advertising sign. Alternatives or modifications to proposed noise barriers that would not provide the minimum 5 dB(A) reduction will not be considered.

The written survey materials shall inform the affected property owners of the location, date, and time of the public hearing. The public hearing may be held concurrently with other public hearings scheduled for the project. A general notice of the public hearing shall also be published in a newspaper in accordance with the notice provision of *Section 335.02(1), F.S.*[19], and contain the same information provided in the written survey

[19] *Section 335.02(1), F.S.* can be accessed at:
http://www.leg.state.fl.us/statutes/index.cfm?App_mode=Display_Statute&URL=0300-0399/0335/Sections/0335.02.html

materials. The notice shall not be placed in that portion of a newspaper in which legal notices or classified advertisements appear. Please refer to *PD&E Manual, Part 1, Chapter 11, Public Involvement*[20], for additional details about meeting notification requirements.

FDOT shall not construct a noise barrier that screens or blocks the visibility of a lawfully permitted outdoor advertising sign until after the public hearing is held and the numerical majority of the impacted property owners have approved the construction of the noise barrier. If the construction of the noise barrier is approved, FDOT shall notify the local governments or local jurisdictions. The local governments or local jurisdictions shall then exercise one of the options listed above.

The construction of business names/logos or building addresses on noise barriers is in violation of *23 CFR § 750.709*[21]. For noise barriers in urban and suburban areas, imprinting of subdivision names or logos on the noise barrier may be considered only at the portion of the noise barrier at the legal entrance to the subdivision. FDOT allows consideration of noise barrier aesthetic enhancement that meets FHWA regulations related to this process. Each request for such an application will be handled on a case-by-case basis.

3.4.2 Noise Barrier Modeling

To achieve consistency in the modeling and analysis of noise barriers, it is recommended that the following step-by-step noise barrier evaluation process be followed. The evaluation process focuses on selecting an optimized noise barrier configuration with consideration given to barrier aesthetics. The optimization process considers the amount of noise reduction provided by a barrier, the number of impacted and benefitted receptors, and the cost reasonableness of constructing a barrier.

Each residence that is represented by a receptor should be counted individually when determining the cost-effectiveness of a noise abatement measure. For example, if one (1) receptor represents five (5) benefited residences, the cost per benefited receptor should account for the five (5) benefitted residences when determining the cost effectiveness of a noise abatement measure.

Currently, it is the FDOT's preference to place noise barriers at or near the ROW.

Within the FDOT ROW, consideration should be given to "wrapping" barrier ends at roadway intersections. Doing so may improve barrier performance by reducing the amount of sound flanking around the ends of the barrier. If placement of a noise barrier at or the ROW (or other location outside the clear recovery zone) is not possible due to engineering constraints or other limitations, post and panel noise barriers can also be placed within the clear recovery zone but will require shielding by a crash-tested device.

It may be necessary to consider a noise barrier on the roadway shoulder, embankment, or structure (bridge or MSE wall) if a ROW barrier is determined to not meet acoustic or cost-effectiveness criteria. The maximum allowed height for noise barriers on roadway shoulder or embankment is 14 feet, while the maximum allowed

[20] The FDOT *PD&E Manual, Part 1, Chapter 11, Public Involvement* can be accessed at: https://www.fdot.gov/environment/pde-manual/pdeman-current

[21] *23 CFR § 750.709* can be accessed at: https://www.ecfr.gov/current/title-23/chapter-I/subchapter-H/part-750

height on structure or MSE wall is eight (8) feet. To determine the current FDOT height restrictions for noise barriers on structure and if there are any safety offsets required for barriers at or near the roadway shoulder consult the FDOT *Design Manual (FDM), Chapter 264 - Noise Barriers and Perimeter Walls* and the *PD&E Manual, Chapter 18, Highway Traffic Noise*. The noise analyst shall consult with the District Noise Specialist concerning the preferred placement of noise barriers.

The "Z" coordinate at the bottom of the barrier is the actual ground level and can be expected to vary along the length of the wall, sometimes dramatically. Analysts should ensure that any variation is accounted for in the TNM input file. Sources of this information are discussed in **Section 2.3, Data Collection: Elevation Data,** of this Handbook. A field review can help the analyst decide what level of accuracy is needed for PD&E efforts, but when noise barriers are being considered for a project's Design phase, project cross sections should be used for establishing ground levels for noise barriers.

3.4.2.1 Initial Noise Barrier Length and Height

A noise barrier is to be input into the TNM at a length that is considerably greater than what one might anticipate would be needed to maximize noise reduction so that traffic noise flanking the ends of the noise barrier is considered in the analysis. In this Handbook, this is referred to as the "unadjusted noise barrier length". A good starting point is to have the barrier extend beyond the end/last receptor at least approximately four times the perpendicular distance between the receptor and the noise barrier. The unadjusted barrier length can also be influenced by other features, such as intersecting cross streets and driveways. In these cases, land use or geographic features may dictate the unadjusted barrier length.

When modeling noise barriers as abatement features, the unadjusted barrier length is subdivided, typically into 20-foot to 100-foot increments (with the 20-foot segments at the ends and the 100-foot segments in the middle of a barrier), so that small portions of the noise barrier at either end can be raised or lowered as needed during the optimization process.

During PD&E and unless there are significant increases/decreases in ground elevation, noise barriers are typically modeled at constant heights from eight (8) feet in two-foot increments to the maximum height of 22 feet. If, at these heights, the cost of a noise barrier is close to, but exceeds the cost-effectiveness criteria, the incremental height of the barrier is reduced by one (1) foot.

3.4.2.2 Noise Barrier Optimization

The noise barrier optimization should maximize the noise level reduction while maintaining a cost per benefited receptor at or below the reasonable limit. It is important to note that analysts should not "stop" optimizing a barrier once the NRDG is achieved or a benefit is provided to impacted receptors (i.e., do not just design the barrier to meet the minimum noise reduction criteria).

Noise reduction results for the unadjusted barrier length at a particular height are reviewed to determine which impacted receptors would benefit from a noise barrier at that particular height. Impacted receptors that cannot be provided at least a five (5) dB(A) reduction at a particular height for the unadjusted barrier

length are dropped from consideration when evaluating that particular height. The height for the 20-foot to 100-foot segments at either end of the noise barrier should be lowered to zero feet while evaluating the amount of noise reduction achieved to maintain the same number of impacted and benefited receptors as the unadjusted barrier length for that particular height, while also achieving the NRDG. In other words, at each evaluated barrier height, the length of the barrier should be optimized such that only those impacted receptors benefiting from the barrier are considered. The objective of this process is to achieve noise reduction requirements while also minimizing excess barrier length and thus reducing the overall cost (and the cost per benefited receptor) of the noise barrier. Although benefiting the maximum amount of impacted receptors is preferable, receptors that require excessive amounts of barrier length to be benefited may be dropped from consideration if a shorter barrier is cost-effective for other impacted receptors that are benefited.

When optimizing a noise barrier, consideration should be given to minimizing the number of "steps" along the top of the noise barrier due to fluctuations in the ground elevation at the base of the noise barrier. If "steps" along the top profile of the noise barrier are necessary due to changing ground elevations, every attempt should be made to minimize the size of the steps no more than six (6) inches to 1.5 ft. between adjacent panels. It is also important to report the noise barrier height as the "height above finished grade" so that a portion of the bottom panels of the noise barrier are not buried, which may result in a lower overall noise barrier height than what was recommended.

3.4.3 Noise Barrier Results and Recommendations

A final recommendation for a noise barrier should be for a barrier that benefits the most impacted receptors (i.e., at least a five [5] dB(A) reduction) while achieving the NRDG of seven (7) dB(A) for at least one impacted receptor) and the cost of the barrier is at or below the reasonable limit of $64,000 per benefited receptor. The optimal results for all noise barrier heights for residential impacts are tabulated and reported in a table similar to the example shown in **Table 3-3**. This provides sufficient information to estimate approximate noise barrier costs for a project (part of programming a project for the design phase) and assists the Department in their evaluation of a recommended noise barrier configuration in the Final Design phase. Final recommendations regarding noise barrier height and length should be based on the number of impacted and benefited receptors, the cost per benefited receptor, the number of impacted receptors within a noise reduction range, and the average noise reduction provided (i.e., a combination of these factors). Recommendations should be made for the highest noise barrier that is feasible and reasonable, where appropriate.

As shown in the example **Table 3-3**, a noise barrier would need to be a minimum of ten (10) feet in height to benefit at least one (1) of the impacted receptors (i.e., reduce traffic noise levels by at least five (5) dB(A)), and also achieve the NRDG of at least seven (7) dB(A). Three (3) of the 23 impacted receptors could not be provided at least a five (5) dB(A) reduction at any barrier height or length. The maximum number of impacted receptors that could be provided a reduction of five (5) dB(A), with at least a seven (7) dB(A) reduction at one receptor, is 20. However, none of the configurations above a height of 18 feet are cost reasonable (the cost per benefited receptor is above the FDOT $64,000 cost-effectiveness requirement.). The maximum number

of impacted receptors that could be provided a reduction of five (5) dB(A), with at least a seven (7) dB(A) reduction at one receptor, while remaining cost reasonable is 20, with two non-impacted receptors also benefited. Therefore, an 18-foot high and 1,805-foot long noise barrier is the most cost-effective recommendation.

Table 3-3: Noise Barrier Analysis Results (example)

Barrier Height (feet) [1]	Barrier Length (feet)	No. of Residential Impacts [2]	Noise Reduction at Impacted Residences			Number of Benefited Residences [4]				Impacted Residences Not Benefited [6]	Total Estimated Cost [7]	Cost per Benefited Receptor [8]
			5-5.9 dB(A)	6-6.9 dB(A)	≥ 7.0 dB(A) [3]	Impacted	Not Impacted [5]	Total	Avg. Reduction dB(A)			
8	N/A[3]	23	2	0	0	N/A[3]	N/A[3]	N/A[3]	N/A[3]	N/A[3]	N/A[3]	N/A[3]
10	1,605		6	2	2	10	1	11	6.5	13	$642,000	$58,364
12	1,705		4	4	4	12	1	13	6.8	11	$818,400	$62,954
14	1,705		5	5	6	16	2	18	7.0	7	$954,800	$53,044
16	1,805		4	7	8	19	2	21	7.8	4	$1,155,200	$55,010
18	1,805		2	8	10	20	2	22	8.0	3	$1,299,600	$59,073
20	1,905		0	6	14	20	3	23	8.5	3	$1,524,000	$66,261
22	1,905		0	5	15	20	3	23	9.0	3	$1,676,400	$72,887

[1] Full height is for indicated length.

[2] Receptors with a predicted noise level of 66 dB(A) or greater.

[3] FDOT Noise Reduction Design Goal is 7 dB(A) at a minimum of 1 benefited receptor. Analysis ends if NRDG is not achieved.

[4] Residences that receive a minimum 5 dB(A) reduction from analyzed noise barrier.

[5] Benefited residences with predicted noise levels that do not approach the NAC.

[6] Impacted residences that do not received a minimum 5 dB(A) reduction from analyzed noise barrier.

[7] Unit cost of $40/ft^2 and does not include the cost of tapers, if needed.

[8] FDOT Reasonable Cost Guideline is $64,000 per benefited residence.

Once an optimal barrier height and length have been chosen (during the Design phase), a thorough engineering feasibility review of the barrier should be conducted by the FDOT consistent with Chapter 32 of the FDOT PPM to ensure the recommended barrier can be constructed as planned, or if further refinements are necessary before proceeding with the noise barrier specific public involvement.

3.4.4 Parallel Noise Barriers

A parallel barrier situation rarely occurs. Should this be the case, the determination of how to model this condition will be determined by the width-to-height ratio, which is the ratio of the separation between two parallel barriers (W), their average height (H_{AVG}), and the amount of insertion loss degradation. As a rule, if the W / H_{AVG} ratio is 10:1 or more, the insertion loss degradation is negligible, and the modeling of the parallel barrier condition is not required. If the ratio is less than 10:1, contact the District Noise Specialist for guidance on how to model this condition. Further information on modeling parallel noise barriers is provided in the *FHWA Traffic Noise Model User's Guide*.

3.4.5 Design Phase Considerations

Abatement measures proposed in the PD&E phase are reconsidered and analyzed during the Design phase in light of more exact design, project alignment refinements, and detailed project data. Notably, if there is a gap of time between approval of the NSR and the Environmental Document (constitutes the project's DPK), a review of any new potential NAAs must be considered during the Design phase and documented in the DNSR. In addition, land use changes that have occurred before the DPK may preclude the construction of abatement measures or potentially create the need for abatement that was not considered during the PD&E phase.

The final noise abatement locations, barrier types, lengths and heights, and aesthetic treatment recommendations are determined during the project's Design phase and through the public involvement process. The goals of the highway traffic noise analysis performed during the Design phase are to:

1. Determine if the abatement measures recommended during PD&E are still reasonable and feasible;
2. Determine if new abatement measures are required;
3. Determine the desires of the benefited receptors; and
4. Incorporate aesthetic treatments.

The final noise abatement commitments must be documented in the Re-evaluation and the DNSR (as required by *Part 2 Section 264.2.1, of the FDM, Topic No. 625-000-002*) prior to construction advertisement, regardless of project funding sources.

Title 23 CFR § 772.13(h) states that 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 traffic noise impact on existing activities, developed lands, or undeveloped lands for which development is permitted.

For non-conventional (i.e., not the traditional design-bid-build) projects, the *Request for Proposal (RFP)* package will include the noise abatement requirements. Prior to the approval of an Alternative Technical Concept (ATC), a DNSR should be prepared. If an ATC proposes changes to the horizontal or vertical alignments depicted in the Concept Plans, any associated required changes to the noise abatement locations must be addressed. Any modifications or additions to noise abatement locations and dimensions depicted in the *RFP* must be approved by FDOT based on the information from a DNSR prepared by the Design-Build Firm. The Design-Build Firm must coordinate with the District Noise Specialist to ensure proper public involvement occurs during Final Design.

4.0 NOISE STUDY DOCUMENTATION

The NSR/DNSR should have a logical sequence that adequately describes the procedures used in developing the report, performing the required analyses, and arriving at the appropriate conclusions. Data in the NSR should be well presented by utilizing graphics and references so the report is readily understandable by both technical and non-technical audiences. Noise levels (field-measured or TNM predicted) should be reported to the nearest 1/10th of a decibel. The report should focus on relevant information. TNM modeling files should be provided in Statewide Environmental Project Tracker (SWEPT).

The NSR/DNSR should also include the following:

1. The existing (measured or predicted) as well as the predicted future build and no-build noise levels for each receptor;

2. Required field measurement data and any necessary explanation of the results of this data;

3. A complete set of aerials showing the Noise Analysis Area, the full project limits, and the location of receptor points used in the noise analysis; and

4. The date of the last land use review for the Noise Analysis Area. The NSR/DNSR must use the FDOT, *Technical Report Cover Page, Form No. 650-050-38*[22] as the cover sheet of the report. Additionally, a sample NSR title page is provided in **Appendix E**. The title page of the NSR/DNSR includes the following statement (non-obligatory for non-federal projects):

> *The environmental review, consultation, and other actions required by applicable federal environmental laws for this project are being, or have been, carried out by the Florida Department of Transportation (FDOT) pursuant to 23 U.S.C. § 327 and a Memorandum of Understanding dated May 26, 2022 and executed by the Federal Highway Administration and FDOT.*

The following sections discuss the requirements for documenting the analyses conducted for a project including the validation of the TNM, the assessment of impacts, barrier analysis, and any noise contour analysis. Example NSR outlines for both PD&E studies and design-phase reevaluations are provided in **Appendix D**.

4.1 Methodology and Assumptions

Include the following information related to methodology and assumptions in the NSR:

1. Noise model(s) and methodology used;

[22] The FDOT *Technical Report Cover Page, Form No. 650-050-38* can be accessed at: https://pdl.fdot.gov/Forms

2. Alternatives and years considered;
3. Existing and design year vehicle volumes, speeds, and composition data;
4. Receptor locations and descriptions, including land use activity category;
5. Basis for determination of existing and future traffic noise levels; and
6. Noise descriptor used.

The NSR should also include a comparison of the total traffic noise levels for the no-build alternative and the preferred build alternative along with the appropriate NAC and existing (measured or predicted) noise levels. Include all abatement considerations and a Statement of Likelihood (See **Section 4.5, Statement of Likelihood**).

Include an illustration similar to **Table 4-1** in the NSR to assist the public in understanding how traffic noise levels relate to other sound sources.

Table 4-1: Typical Noise Levels

COMMON OUTDOOR ACTIVITIES	NOISE LEVEL dB(A)	COMMON INDOOR ACTIVITIES
	---110---	Rock Band
Jet Fly-over at 1000 ft		
	---100---	
Gas Lawn Mower at 3 ft		
	---90---	
Diesel Truck at 50 ft, at 50 mph		Food Blender at 1 m (3 ft)
	---80---	Garbage Disposal at 1 m (3 ft)
Noise Urban Area (Daytime)		
Gas Lawn Mower at 100 ft	---70---	Vacuum Cleaner at 10 ft
Commercial Area		Normal Speech at 3 ft
Heavy Traffic at 300 ft	---60---	
		Large Business Office
Quiet Urban Daytime	---50---	Dishwasher Next Room
Quiet Urban Nighttime	---40---	Theater, Large Conference Room (Background)
Quiet Suburban Nighttime		Library
	---30---	Bedroom at Night, Concert Hall (Background)
Quiet Rural Nighttime		
	---20---	
	---10---	
		Lowest Threshold of Human Hearing
	---0---	
Lowest Threshold of Human Hearing		
Source: California Dept. of Transportation Technical Noise Supplement, Sept. 2013, Pg. 2-20.		

4.2 Validation Analyses

The efforts used to validate the TNM are documented in the project files in both hard copy and electronic format. For the efforts related to model validation, analysts include the following information in the files and within the appendices of the appropriate report (NSR or DNSR):

1. A listing of all measurement equipment used and the results of the field calibrations;
2. A listing of all traffic data (volume, speed, and classification) obtained and a source of the data;
3. A table summarizing the measured and predicted sound level differences for each validation site; and
4. The TNM files used in the validation effort with the appropriate Read Me file uploaded to SWEPT along with the NSR/DNSR.

4.3 Impact Assessment

The following items are included in the NSR or DNSR to support the analyses that were conducted to ascertain the impact of traffic noise within the project corridor:

- A table or appendix documenting traffic volumes, classification, and speeds used in the analyses for existing, future no-build, and future build conditions that were modeled;
- For a PD&E study, a table showing the predicted modeling results for existing, future no-build, and future build conditions. This table may be included in the body of the text (as a summary table if desired) or as an appendix to the report, depending upon the number of receptors that were modeled. For a project's Design phase, tables should be provided for the future design year build condition only unless otherwise directed by the District Noise Specialist;
- Typical sections of both existing and future roadways that were modeled; and
- A plan view or aerial overlay that shows the validation measurement sites, the modeled receptors, potentially feasible/cost-effective noise barriers (in the PD&E phase), recommended noise barriers (in the Design phase), and any related information. Cross streets, neighborhoods of interest and key cultural features (e.g., schools, places of worship) as referenced in the text shall also be identified.

If there are no impacted receptors within the project, the following statement (or variation thereof) should be used in the NSR conclusion section:

> *Based on the noise analyses performed to date, there appear to be no impacted areas within the project that require abatement consideration.*

4.4 Noise Barrier Analyses

To document efforts related to the noise barrier evaluation, the following are included in the NSR or DNSR as appropriate:

- A table showing the overall benefits and related costs of various barrier options considered following the guidelines and examples in **Section 3.4.3., Design Phase Considerations** ;
- Figures or aerials that illustrate the location of all modeled noise sensitive receptors, field measurement locations (if applicable), and noise barriers considered as being potentially feasible and cost reasonable if the study is prepared during PD&E, or the final recommended barriers if the study is prepared in a project's Design phase; and
- All TNM input files with the appropriate Read Me file that describe what area of a project is evaluated in each input file and the naming convention that was used must be uploaded to SWEPT along with the NSR/DNSR.

For those locations where noise barriers were determined not to be potentially feasible and reasonable, it is also important to explain why this is the case (i.e. too many cross streets or driveway openings, residences are located too far from the roadway to be benefited, etc.).

4.5 Statement of Likelihood

During a PD&E study, or concurrent PD&E/Design study, the FDOT commits to construct noise barriers contingent upon their being determined feasible, cost reasonable, and supported by the adjacent community/communities during a project's Design phase when detailed engineering data is available. Consistent with the requirements of *23 CFR Part 772*, NSRs produced during the PD&E study must contain a "Statement of Likelihood".

When feasible and reasonable noise abatement measures are identified, in accordance with *23 CFR Part 772*, the NSR should include a Statement of Likelihood similar to the following:

> *The Florida Department of Transportation is committed to the construction of feasible and reasonable noise abatement measures at the noise-impacted locations identified in [insert a table or figure which shows the proposed location and physical description of noise abatement measures determined feasible and reasonable] contingent upon the following conditions:*
>
> 1. *Final recommendations on the construction of abatement measures are determined during the project's Final Design and through the public involvement process;*
> 2. *Detailed noise analyses during the Final Design process support the need, feasibility and reasonableness of providing abatement;*

3. *Cost analysis indicates that the cost of the noise barrier(s) will not exceed the cost reasonable criterion;*

4. *Community input supporting types, heights, and locations of the noise barrier(s) is provided to the District Office; and*

5. *Safety and engineering aspects as related to the roadway user and the adjacent property owner have been reviewed and any conflicts or issues resolved.*

Appropriate project-specific contingencies may be added to the statement of likelihood.

If no feasible or reasonable abatement is identified, the following statement (or variation thereof) shall be used:

> *Based on the noise analyses performed to date, there are no feasible and reasonable solutions available to mitigate the noise impacts at the locations identified in [insert a table or figure which shows the proposed location and physical description of noise abatement measures determined not feasible or reasonable].*

4.6 Noise Contour Analyses for Local Officials

Noise contours shall be documented in the NSR in the form of a table and/or figure that represents the best estimate of the contours from the proposed edge of pavement at which traffic noise levels would approach or exceed the NAC for Activity Categories A, B, C and E for each project segment should be developed. Example contour illustrations are provided in **Table 4-2** and **Figure 4-1**. On completion of a PD&E Study, the District office shall transmit the NSR with the contour information to the appropriate local officials for use in future land use planning. A statement is included in the NSR documenting this transmittal. A statement should also be made that a copy of the final NSR will be circulated to the appropriate local planning/zoning officials for their use upon approval of the Environmental Document.

Table 4-2: Example Noise Contour Table

Land Use Activity Category [*1]	Corresponding FDOT NAC	NAC Impact Distance (Approx. Feet) [*2]					
		SR 13 to W. of Buckman Bridge		W. of Buckman Bridge to US 17		US 17 to Ortega River	
		N. of I-295	S. of I-295	N. of I-295	S. of I-295	N. of I-295	S. of I-295
Category A	56 dB(A)	>500	>500	>500	>500	>500	>500
Category B and C	66 dB(A)	480	480	160	144	358	358
Category E	71 dB(A)	140	140	Within ROW	Within ROW	170	170

[*1] Activity Categories as defined in 23 CFR 772.

[*2] Distance refers to the project's nearest edge of pavement.

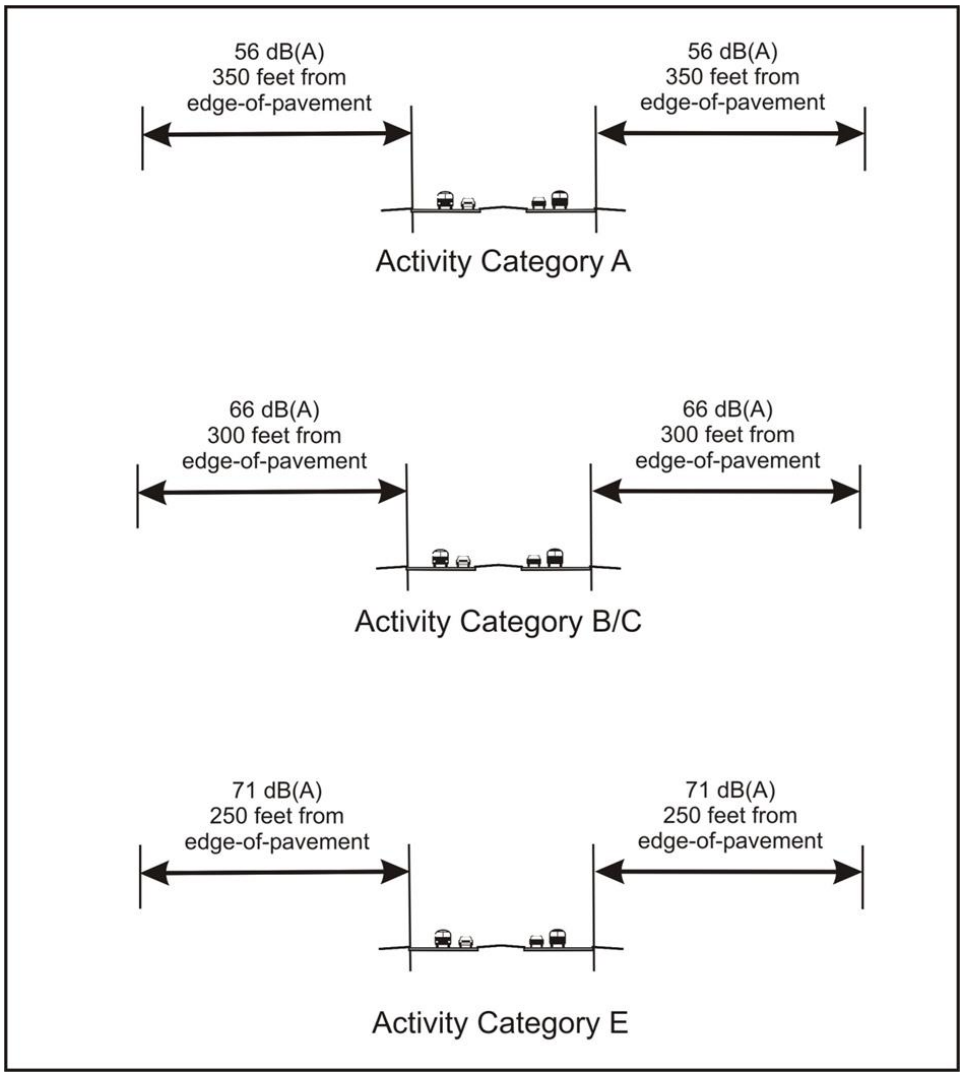

Figure 4-1: Example Noise Contour Illustration

4.7 Construction Noise and Vibration

The early identification of potential construction noise and/or vibration impacts that may result from the construction of the project is important. The level of consideration for construction noise and vibration is discussed in FHWAs, *Highway Traffic Noise: Analysis and Abatement Guidance*[23]. Any potential construction noise or vibration impacts that are identified in the PD&E phase shall be documented in the NSR and in the Environmental Document, along with any identified abatement measures that are potentially feasible and reasonable. A list of example construction noise and vibration-sensitive receptors has been developed and can be found in **Table 4-3**. This will allow avoidance and/or mitigation options to be developed during the Final Design phase. These options can then be placed in the construction plans and applied during the construction of the project by the Contractor.

Table 4-3 Construction Noise and Vibration Sensitive Sites

Noise	Vibration
Eye Centers/Clinics Medical Centers Hospitals Geriatric Centers Sound Recording Studios TV/Radio Stations Residences Technical Laboratories Hearing Testing Centers Theaters Schools Motels/Hotels Funeral Homes Libraries Meditation Centers Churches/Shrines Parks Day Care Centers Outdoor Theaters	Eye Centers/Clinics Medical Centers Hospitals Geriatric Centers Sound Recording Studios TV/Radio Stations Residences Technical Laboratories Antiques Shops Museums Historic Buildings
Note: This list is not meant to be all-inclusive or exclusive but rather an indication of the type of sites likely to be sensitive to construction noise and/or vibration.	
Source: FDOT Noise and Vibration Task Team; August 17, 1999.	

A discussion of construction noise and vibration impacts must be included in the Environmental Document, whether the NAC are exceeded or not. It is generally based on site-specific conditions and should, at a minimum, include a general reference to the FDOT's *Standard Specifications for Road and Bridge*

[23] The FHWA's *Highway Traffic Noise: Analysis and Abatement Guidance* can be accessed at https://www.fhwa.dot.gov/environment/noise/regulations_and_guidance/analysis_and_abatement_guidance/revguidance.pdf

Construction[24] to control noise and/or vibration impacts.

Examples of standard specifications that may be applied to a project include:

1. Section 6-3.1 related to the storage of materials to minimize noise impacts on sensitive receptors;

2. Section 100-2.1 related to equipment approval requiring the use of factory-recommended exhaust mufflers and to remove or repair any equipment that is disapproved by the Engineer;

3. Section 100-2.2 requires adequate equipment maintenance to minimize noise pollution caused by construction equipment;

4. Section 100-2.3 suggests that all stationary equipment be screened from noise sensitive receptors beyond normal working hours and, if feasible, screen this equipment during normal working hours to reduce noise impacts;

5. Section 120-6.4 addresses the concept of establishing haul routes that will direct construction vehicles away from developed areas when feasible and keep noise from hauling operations to a minimum; and

6. Section 455-1.1 requires that the Contractor take reasonable precautions to prevent structural damage to existing structures by monitoring settlement and vibrations in accordance with the requirements of the specifications.

FHWA's *Construction Noise Handbook*[25] provides guidance for the prediction and mitigation of construction noise. The *Roadway Construction Noise Model* (RCNM; found within TNM 3.2), which is the FHWA's national model for the prediction of construction noise, may be used as needed. RCNM provides a construction noise screening tool to predict construction noise levels and determine compliance with noise limits for a variety of construction noise projects. The use of the RCNM should be coordinated with OEM prior to application.

Any recommended special construction noise and/or vibration mitigation measures identified during the review of potential construction and/or vibration impacts will be described in the NSR and in the Environmental Document, as appropriate. In considering construction noise and/or vibration mitigation, it should be noted that special provisions may be added as appropriate to the project's construction specifications. Any unique noise and/or vibration control efforts to be considered during construction shall be coordinated with the District Noise Specialist and Project Manager prior to inclusion in the NSR.

The following is a sample construction noise and vibration statement for inclusion in the appropriate

[24] The FDOT Standard Specifications for Road and Bridge Constriction can be accessed at *https://www.fdot.gov/programmanagement/implemented/specbooks/default.shtm*
[25] The FHWA's Construction Noise Handbook can be accessed at *https://www.fhwa.dot.gov/environment/noise/construction_noise/handbook/*

NSR/DNSR and Environmental Document:

> *Based on the existing land use within the limits of this project, construction of the proposed roadway improvements will (will not) have any noise or vibration impact. If noise sensitive land uses develop adjacent to the roadway prior to construction, additional impacts could result. It is anticipated that the application of the FDOT Standard Specifications for Road and Bridge Construction will minimize or eliminate most of the potential construction noise and vibration impacts. However, should unanticipated noise or vibration issues arise during the construction process, the Project Manager, in concert with the District Noise Specialist and the Contractor, will investigate additional methods of controlling these impacts.*

4.8 Noise Specific Public Involvement

Public involvement is an important aspect of any transportation improvement project. Any public involvement activities that take place as part of the project should be documented in the NSR or DNSR. At a minimum, the NSR shall describe the nature of the events that took place (workshop or hearing, date, location, time, etc.) and note whether any traffic noise related issues were raised by the public that were related to the project in question. If written comments are received regarding noise or vibration issues, they should be included as an appendix to the NSR or DNSR.

The NSR should also summarize any coordination or communications that may have taken place with other agencies. Include comments and any responses to any comments.

As discussed in the following section, the details of noise barrier specific public involvement with individual communities should be documented, including an appendix containing copies of materials sent to property owners when gathering a community consensus regarding potential noise abatement options.

4.8.1 PD&E Study Public Involvement

Public involvement during a PD&E study typically contains two major events: a public workshop (sometimes referred to as an “alternatives public workshop”), and a public hearing for the project. At the public workshop, the noise analyst should discuss noise sensitive sites within the project corridor. The discussion should include a description of the analysis procedures and the potential for traffic noise impacts utilizing generalized noise contours following the guidelines in **Section 4.6, Noise Contour Analyses for Local Officials**.

At the public hearing for the project, the noise analyst should be prepared to discuss site-specific results of the noise study, including the location of impacted receptors and the potential for further noise abatement consideration during the Design phase, if applicable. A draft NSR should be available at the public hearing.

4.8.2 Noise Barrier Specific Public Involvement in the Design Phase

Prior to initiating noise barrier related public involvement during the Design phase, the optimal barrier length and height should be established, and any engineering/constructability issues should be identified and

resolved.

Noise barrier specific public involvement includes informational meetings and written surveys to affected property owners and tenants. Additionally, door-to-door and telephone solicitations are necessary if insufficient responses are received from a written survey. As stipulated in the *PD&E Manual, Part 2, Chapter 18, Highway Traffic Noise*, it is the FDOT's desire to obtain a response for or against a noise barrier from the majority of the benefited property owners and tenants that respond to the survey.

The following provides examples of the type of written correspondence prepared by the FDOT and provided to property owners and tenants in connection with a noise barrier survey:

- Notification Letter: The notification letter alerts the property owner(s)/tenants of the FDOT's intent and also informs them that further information is forthcoming. This letter is mailed using regular (non-certified) mail services. The letters are mailed to the address of the property of interest and to the property owner's address, if different than the property of interest. Property ownership information can be obtained from the property appraiser's office/website for the county in which the project is located. If a noise barrier specific informational meeting is being held, date, time, and location details are also provided in this letter.

- Noise Barrier Survey Package: This package should include a certified letter from the FDOT describing the roadway improvement project and the noise barrier(s) of interest, an exhibit illustrating the proposed location of a barrier(s), information regarding the advantages and disadvantages of noise barriers, color and texture options (if applicable), and a noise barrier survey form. The address of the property being surveyed and the registered property owner's name(s) should be shown on this form. It is recommended that each survey be individually numbered for easier tracking once they are returned.

Copies of all Design-phase traffic noise related public involvement materials should be provided as an Appendix in the DNSR to properly document survey efforts.

4.9 Projects with Concurrent PD&E and Design Phases

Noise studies for projects with concurrent PD&E and Design phases are still required to follow the requirements of *23 CFR Part 772* and this Handbook. When Design activities overlap PD&E activities, only the PD&E phase NSR may be prepared because the roadway plans may have enough detail (Phase II Design plans) to allow noise abatement commitments to be made at that time. It is important that subsequent plan sets be reviewed for changes in roadway geometry that could necessitate a change to the noise analysis. These projects will still utilize a DPK based on the date of the approval of the Environmental Document for the project.

Once the Final Design of the project is completed, the review of the design plans must verify that no changes have occurred relative to what was previously evaluated and documented in the NSR. If significant changes

have occurred that may alter the results of the original noise study and any noise abatement commitments (if applicable), a Re-evaluation is warranted and documented in a new DNSR before the project is advertised for construction. Changes to the horizontal and vertical roadway alignment should follow the guidance provided in the Type I Projects Matrix provided in *PD&E Manual, Part 2, Chapter 18, Figure 18-2*.

The Design Project Manager must work with the environmental staff to ensure that the final noise abatement commitments are reflected in the Re-evaluation of the Environmental Document before the project moves to the Construction phase.

If the abatement measures recommended during the PD&E phase are no longer considered feasible or reasonable during Design for a given location(s), such determination(s) will be made in the Re-evaluation process prior to requesting approval for construction advertisement (*PD&E Manual Part 1, Chapter 13, Re-evaluations*[26]). Commitments regarding the exact abatement measure locations, heights, and type (or approved alternatives) will be made during the Design phase and recorded on the *Project Commitments Record (PCR)* as required by *Procedure No. 650-000-003, Project Commitment Tracking*[27]. See *PD&E Manual Part 2, Chapter 22, Commitments*[28] for more information on commitments.

4.10 Design-Build Projects

When a Design-Build firm proposes an alternative technical concept to the concept included in the *RFP* for the Design-Build project, the District must re-evaluate the noise study in conformance with the provisions of *23 CFR § 636.109*. The Design-Build noise study Re-evaluation must follow the analysis procedures outlined in this Handbook.

Changes to the horizontal and vertical roadway alignment should follow the guidance provided in the Type I Projects Matrix provided in the PD&E Manual, Part 2, Chapter 18, Figure 18-2. If changes in the roadway design occur during the Design-Build process, the following guidance shall be considered:

1. If the Re-evaluation results in the identification of additional impacted receptors, a change in the location of impacted receptors, or an increase in the proposed noise abatement dimensions (height and/or length), the FDOT will construct the proposed abatement as long as it's feasible, reasonable, and desired by the public.

2. If the Re-evaluation results in reduced traffic noise impacts due to changes in the project design or previously predicted noise impacts no longer warrant abatement consideration, the FDOT will consider abatement based on the commitments, public sentiment, and consultation with OEM,

[26] The *FDOT's Project Development and Environment (PD&E) Manual, Part 1, Chapter 13, Re-evaluations* can be accessed at: https://www.fdot.gov/environment/pde-manual/pdeman-current

[27] The FDOT's *Procedure No. 650-000-003, Project Commitment Tracking* can be accessed at https://pdl.fdot.gov/

[28] The *FDOT's Project Development and Environment (PD&E) Manual, Part 2, Chapter 22, Commitments* can be accessed at: https://www.fdot.gov/environment/pde-manual/pdeman-current

provided that abatement construction is feasible.

3. The public shall be engaged when modifications to noise abatement commitments and the intent to alter abatement measures are being considered.

4.11 State Environmental Impact Report

The Highway Traffic Noise section of a State Environmental Impact Report (SEIR) should summarize the anticipated traffic noise impacts identified in the NSR and appropriately reference the basis for decision the same as for a federal project as described in this Handbook. The applicable standard statements and Statement of Likelihood in **Section 4.5** should be included.

4.12 Re-evaluations

The Re-evaluation of any Environmental Document that included an NSR shall also include an update of the traffic noise analysis. Assumptions made and data used during the original noise analysis and documented in the NSR shall be reviewed and updated to ensure the assumptions and any preliminary commitments are still valid. This may include, but not necessarily be limited to, current and future traffic data (volumes, speeds, composition), roadway alignment (horizontal and vertical), land use, propagation path, barriers/buffers (including trees, berms, structures), variation in terrain between a noise source and receptors, and changes in TNM versions. If the latest noise evaluation utilized a previous version of TNM (prior to TNM version 2.5), an update of the traffic noise analysis is required. Changes to the horizontal and vertical roadway alignment should follow the guidance provided in the Type I Projects Matrix provided in the PD&E Manual, Part 2 Chapter 18, Figure 18-2. Coordination with the District Noise Specialist should occur to determine if validation measurements should be re-performed if land use changes have occurred post measurement and are large enough to influence noise levels. Additionally, if an update to the noise model has occurred post measurement, validation measurements must be re-performed if the new noise model will be utilized to determine impacts and assess abatement.

The Re-evaluation may result in no change to the NSR or in a completely new DNSR being required. At a minimum, it must be documented that the original noise report and analysis were reviewed and that the assumptions, project conditions, and results are still valid. Computer modeling efforts will be conducted using the latest approved version for any required subsequent noise Re-evaluation as a result of a major design change.

Coordination with OEM during the Re-evaluation process on federal projects is required (see PD&E Manual, Part 1, Chapter 13, Re-evaluations).

The final noise abatement commitments must be documented in the Re-evaluation and the DNSR prior to construction advertisement, regardless of project funding sources. If the DNSR is substantially modified from the version previously distributed to the affected local governments, a revised version should be sent out to them.

5.0 NOISE DISCUSSION IN ENVIRONMENTAL DOCUMENTS

The results of the noise analyses shall be reported in an NSR and summarized in the appropriate section of the project's Environmental Document. The expected level of noise impacts discussion for each type of Environmental Document is provided in the sections below. 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.

The final NSR is uploaded into the SWEPT project file and a summary should be included in the Environmental Document. The Highway Traffic Noise section of the Environmental Document should contain enough detail to convey the degree of noise impact attributed to the proposed project, along with certain required statements. The Environmental Document must reference the NSR for additional details using a statement similar to the following:

> *The Noise Study Report for this project is available from the District Office, located at _____.*

The Environmental Document will also include information regarding the consideration of noise abatement measures that have or have not been determined to be feasible and reasonable based on the information available at the time the NSR was completed.

After OEM grants Location and Design Concept Acceptance (LDCA) for a federal project, or a SEIR has been approved, a copy of the NSR is sent to the appropriate local government officials who have jurisdiction over where the highway project is located. Other information that will aid these officials in their planning and land use decisions to minimize highway noise impacts in the future may be sent along with the NSR. See **Appendix F** for a sample NSR transmittal cover letter to a local planning agency.

Type III projects do not require a noise analysis. For these projects, the Highway Traffic Noise section within the Environmental Document should include a statement similar to the following:

> This project has been determined to be a Type III project as defined in *23 CFR § 772.5* and does not require a noise analysis.

5.1 Type 2 Categorical Exclusion

On the *Type 2 Categorical Exclusion Determination Form* in SWEPT, identify if it is a Type I or Type III project pursuant to *23 CFR Part 772* and *Section 335.17, F.S.* Summarize the results of noise impacts documented in the NSR. The summary should include locations with the predicted noise impacts that have feasible and reasonable abatement barriers, and locations with impacts that have no feasible or reasonable noise abatement alternative. Include the NSR as Technical Material and add a map for noise as an attachment, if applicable.

5.2 Environmental Assessment with Finding of No Significant Impact

The Highway Traffic Noise section of the Environmental Assessment (EA) must reference and summarize the NSR. Specific references to the items discussed in **Section 3.3, Noise Impact Analysis Guidelines** and **Section 3.4, Noise Abatement Analysis Guidelines,** are included as appropriate. Coordination that occurred during the noise study must be documented. The Comments and Coordination section shall include letters from agencies expressing comments on the NSR. Resolution of comments shall also be documented in this section. In the Finding of No Significant Impact (FONSI), provide a summary of all noise impacts resulting from the project. If abatement measures are being recommended for further consideration, identify the sites for which the abatement is proposed. For those locations with impacts where abatement is not feasible and/or reasonable, provide those locations and an explanation as to why the abatement measure(s) considered was determined not to be feasible and/or reasonable.

5.3 Environmental Impact Statement

The Highway Traffic Noise section of an Environmental Impact Statement (EIS) should summarize the NSR and include the following information:

1. A brief description of NAAs and their location, including information on the numbers and types of activities that may be impacted. The availability of the NSR at the District Office will be noted.

2. The extent of the impact (in decibels). This will include a brief description of the methodology used and identification of the computer model used, along with a comparison of the future predicted noise levels with both FDOT NAC and the existing predicted noise levels.

3. Noise abatement measures that have been considered and those measures that would likely be incorporated into the proposed project.

4. Noise impacts for which no feasible and reasonable abatement is available and the reasons why.

5.4 Coordination Requirements and Documentation

When the Environmental Document is approved, send copies of the NSR to the appropriate local government officials within whose jurisdiction the highway project is located. See **Appendix F** for a sample NSR transmittal letter. The following information should be transmitted along with the NSR consistent with *23 CFR § 772.17(a)*:

1. Noise compatible planning concepts;

2. A representation of the estimated distances from the proposed edge of pavement at which traffic noise levels would approach or exceed the NAC for Activity Categories A through E for each segment of the project; and

3. After the DPK, FDOT is no longer responsible for providing noise abatement to new development that occurs adjacent to the proposed highway project.

The above items are intended solely to assist local officials and private developers in promoting compatibility between land development and highways. Upon request, FDOT may provide additional available material and technical guidance that may assist local officials and private developers in this respect. The NSR transmittal letter should be included in the SWEPT project file.

6.0 CONCLUSIONS

From the beginning of the noise study, close coordination between the analyst, the District Noise Specialist and both the consultant and FDOT project managers is of paramount importance. All decisions made regarding the methodology used in the analysis should be discussed and clarified with the District Noise Specialist prior to implementation and properly documented in the project file.

Data collection and the generation of TNM input will have a direct influence on the results and recommendations produced at the conclusion of the study. Field reviews during the course of the study can provide assurance that project conditions are being accurately represented in the TNM. Noise barriers being considered for inclusion in the roadway construction plans should be thoroughly reviewed for any engineering or geographic constraints that may preclude their construction.

The methodology, results and recommendations of the noise study should be clearly documented in the NSR or DNSR for the project. Doing so ensures the reader (whether technical or layperson) will have a clear understanding of the approach and outcome of the noise study.

Public involvement is vital to any transportation improvement project. Traffic noise concerns raised by the public should be documented in the NSR or DNSR as appropriate. Noise barrier specific public involvement is important because it can determine whether or not a noise barrier will be constructed as part of the project. Clearly conveying the results of the noise study and the advantages and disadvantages of noise barriers can aid in the public's decision-making process.

Following the requirements stated in *23 CFR Part 772*, the FDOT *PD&E Manual, Part 2, Chapter 18 - Highway Traffic Noise*, and the contents of this Handbook will result in consistent, predictable, and repeatable traffic noise studies statewide.

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APPENDIX A - Noise Study Traffic Data Form

These columns (A-U) below should be provided in the Noise Study Report as an Appendix.
If additional rowas are needed for additional traffic segments, **Traffic Segment Numbers** (Column A) should be provided for each roadway segment.

Highway Traffic Noise: Traffic Data

Project/Data Information	
Project Name	
Project Number	
Condition	
Year	
Source	
Preparer [Traffic Engineer]	
Prepared Date	
Notes	

	Roadway Details					Traffic Details										Raw Traffic Data Selection & Off-Peak Calculation		
Traffic Segment Number	Roadway Name	From	To	Roadway Type	Number of Lanes *In 1direction	LOS C Peak Hour Peak Direction (PHPD)	Demand Hourly Volumes (DHV) Peak Hour Peak Direction (PHPD)	% Autos	% Medium Trucks	% Heavy Trucks	% Buses	% Motorcycles	Standard K-factor	D-factor	Posted Speed (mph)	LOS C vs. DHV Comparison	Peak Direction Volume* *Used on both sides for LOS C	Off-Peak Direction Volume* *DHV only
1																LOS C	0	N/A
2																LOS C	0	N/A
3																LOS C	0	N/A
4																LOS C	0	N/A
5																LOS C	0	N/A
6																LOS C	0	N/A
7																LOS C	0	N/A
8																LOS C	0	N/A
9																LOS C	0	N/A
10																LOS C	0	N/A
11																LOS C	0	N/A
12																LOS C	0	N/A
13																LOS C	0	N/A
14																LOS C	0	N/A
15																LOS C	0	N/A
16																LOS C	0	N/A
17																LOS C	0	N/A
18																LOS C	0	N/A
19																LOS C	0	N/A
20																LOS C	0	N/A
21																LOS C	0	N/A
22																LOS C	0	N/A
23																LOS C	0	N/A
24																LOS C	0	N/A
25																LOS C	0	N/A
26																LOS C	0	N/A
27																LOS C	0	N/A
28																LOS C	0	N/A
29																LOS C	0	N/A
30																LOS C	0	N/A
31																LOS C	0	N/A
32																LOS C	0	N/A
33																LOS C	0	N/A
34																LOS C	0	N/A
35																LOS C	0	N/A
36																LOS C	0	N/A
37																LOS C	0	N/A
38																LOS C	0	N/A
39																LOS C	0	N/A
40																LOS C	0	N/A
41																LOS C	0	N/A
42																LOS C	0	N/A
43																LOS C	0	N/A
44																LOS C	0	N/A
45																LOS C	0	N/A
46																LOS C	0	N/A
47																LOS C	0	N/A
48																LOS C	0	N/A
49																LOS C	0	N/A
50																LOS C	0	N/A
51																LOS C	0	N/A
52																LOS C	0	N/A
53																LOS C	0	N/A
54																LOS C	0	N/A
55																LOS C	0	N/A
56																LOS C	0	N/A
57																LOS C	0	N/A
58																LOS C	0	N/A
59																LOS C	0	N/A
60																LOS C	0	N/A
61																LOS C	0	N/A
62																LOS C	0	N/A
63																LOS C	0	N/A
64																LOS C	0	N/A
65																LOS C	0	N/A
66																LOS C	0	N/A

APPENDIX B - Example Noise Measurement Data Sheet

Site/Run #:

Noise Measurement Data Sheet

Date: _____ **Measurement Taken By:** _____

Project: _____

Site ID: _____

Weather Conditions: Clear: Partly Cloudy: Cloudy: Other:

Temperature: Start: End: (°F)

Wind Direction: Start: End:

Wind Speed (Start): Min: Max: Average: (mph)

Wind Speed (End): Min: Max: Average: (mph)

Humidity: Start: End: (%)

Equipment Data

Sound Level Meter: Serial Number:

Date of Last Traceable Calibration:

Calibration: Start: End: Difference:

Battery: Start: End:

Weighting Scale: Response:

Calibrator: Serial Number:

Results: Leq:
in dB(A)

Major Noise Sources:

Background Noise Sources:

Other Notes/Observations:

Observed Traffic Data Site Sketch on Reverse Side

Observed Traffic Data Site #: Run #:

Vehicle Types						
	Volume	Speed	Volume	Speed	Volume	Speed
Auto						
Medium Truck						
Heavy Truck						
Bus						
Motorcycle						

Site Sketch

APPENDIX C - Example TNM Input File QA/QC Checklist

TRAFFIC NOISE MODEL (TNM) INPUT FILE CHECK LIST

Project Name and Limits:
County:
FPID Number:
FDOT District:
Analyst/Organization:

PROJECT ALTERNATIVE

- □ Existing Conditions (Year ____)
- □ No Build Conditions (Design Year ____)
- □ Build Alternative (Design Year ____) Location: _____

TNM INPUT

File Name: _____

- □ Run Identification Correct
- □ Units in file - English or Metric
- □ Pavement type – Average & Default Ground Type – Lawn
- □ Traffic volumes & posted speeds match Noise Study Report & Approved Traffic Volumes
- □ Roadway and Ground Zones named correctly
- □ Receiver heights (5 ft.), Criteria (66 dBA), and Substantial Increase (15 dBA)
- □ All Noise Analysis Areas/sites represented
- □ Tree Zone heights and locations correct
- □ Building Row heights and locations correct
- □ Terrain Line heights and limits correct
- □ Ground Zone designations and limits correct
- □ Roadway width, elevations, and directions correct
- □ Ground elevations at proposed barrier locations and receivers correct
- □ Input file includes all appropriate Roadways, Ground Zones, Existing barriers/berms, Tree Zones, Bridges, and Building Rows
- □ Cross section data along roadway verified using skew view in TNM
- □ TNM print outs checked for missing data and data consistent within each category

Name of Reviewer:_____

Date of Review: _____

APPENDIX D - Example Noise Study Report Outlines

EXAMPLE PD&E NOISE STUDY REPORT (NSR) OUTLINE

EXECUTIVE SUMMARY
TABLE OF CONTENTS
- List of Tables
- List of Figures

ACRONYMS
SECTION 1 - Introduction
- 1.1 Project Description (includes Project Location Map)
- 1.2 Purpose and Need
- 1.3 Existing Facility
- 1.4 Proposed Improvements (includes conceptual typical section(s))

SECTION 2 – Methodology (opening paragraph references regulation and policy)
- 2.1 Noise Metrics
- 2.2 Traffic Data
- 2.3 Noise Abatement Criteria
- 2.4 Noise Abatement Measures
  - 2.4.1 Traffic Management
  - 2.4.2 Alignment Modifications
  - 2.4.3 Buffer Zones
  - 2.4.4 Noise Barriers
- 2.5 Noise Model
  - 2.5.1 Model Validation
- 2.6 Noise Sensitive Sites
  - 2.6.1 Common Noise Environments and Noise Sensitive Areas
- 2.7 Special Land Uses
- 2.8 Existing Noise Levels: Ambient Measurements (documents noise monitoring to establish existing noise levels; usually only included for new alignment projects); OR Modeled Existing Noise Levels (documents TNM-modeled existing conditions; usually only included for existing alignment projects)
- 2.9 Existing Noise Barriers

SECTION 3 - Traffic Noise Analysis Results
- 3.1 Substantial Increase in Noise
- 3.2 Noise Abatement Criteria Evaluation
  - 3.2.1 NAA #1
  - 3.2.1 NAA #2
  - 3.2.3 NAA #3
  - 3.2.4 …etc.

SECTION 4 - Conclusions
- 4.1 Impacted Noise Sensitive Sites
- 4.2 Recommended Noise Barriers
- 4.3 Statement of Likelihood

SECTION 5 - Construction Noise and Vibration
SECTION 6 - Community Coordination
REFERENCES
APPENDICES
- APPENDIX A Traffic Data
- APPENDIX B Project Aerials
- APPENDIX C Predicted Noise Levels
- APPENDIX D Model Validation Field Sheets
- APPENDIX E SLU Equivalent Residence Calculation Worksheets

EXAMPLE DESIGN NOISE STUDY REPORT (DNSR) TABLE OF CONTENTS

APPENDIX E SLU Equivalent Residence Calculation Worksheets
APPENDIX F Engineering Review Results
APPENDIX G Noise Barrier Survey Package(s)

APPENDIX E – Example Report Title Page

Noise Study Report

Florida Department of Transportation

District X

Project Title

Limits of Project

County, Florida

Financial Management Number: XXXXX-X

ETDM Number: XXXXXX

Date

The environmental review, consultation, and other actions required by applicable federal environmental laws for this project are being, or have been, carried out by the Florida Department of Transportation (FDOT) pursuant to 23 U.S.C. § 327 and a Memorandum of Understanding dated May 26, 2022, and executed by the Federal Highway Administration and FDOT.

(Signature Block as Needed)

APPENDIX F - Sample Noise Study Report Tranmittal Cover Letter

Date

Addressee
Appropriate Growth Management Office
Local Government
City, Florida Zip Code

The Florida Department of Transportation (FDOT) has received approval of (**INSERT LDCA or SEIR APPROVAL HERE**) for the Project Development and Environment (PD&E) Study for **(INSERT PROJECT NAME HERE**). As part of the PD&E Study, a traffic noise study was performed. Consistent with applicable federal regulations and state policies, attached is a copy of the Final Noise Study Report/Design Noise Study Report (Choose one as appropriate). (**INSERT APPROPRIATE SECTION/TABLE/FIGURE HERE**) contains information related to the estimated distance from the edge of the nearest travel lane for the improved roadway where traffic noise impacts are predicted to occur in the future design year for the project for the different land use categories contained in the Federal Highway Administration (FHWA) and FDOT Noise Abatement Criteria (NAC).

This information is being provided to assist the local planning agency and developers in the prevention of future traffic noise impacts on lands which are currently undeveloped. The Date of Public Knowledge for the project is the date of approval of the Environmental Document for the project. The FDOT is not responsible for providing noise abatement for noise sensitive land uses that are permitted for construction after that date. Upon request, the FDOT may provide additional available materials and technical guidance related to noise compatible land use planning to assist the local agencies and developers in this regard.

Sincerely,

(INSERT DISTRICT NOISE SPECIALIST/FDOT PM NAME HERE)

The environmental review, consultation, and other actions required by applicable federal environmental laws for this project are being, or have been, carried out by the Florida Department of Transportation (FDOT) pursuant to 23 U.S.C. § 327 and a Memorandum of Understanding dated May 26, 2022 and executed by the Federal Highway Administration and FDOT.