23 CFR 772 ACCELERATED PROCESS: MEASUREMENT AND MODELING TECHNIQUES

TASK 1:

FHWA NOISE MEASUREMENT HANDBOOK

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Project Overview

- Project issued under FHWA Environmental IDIQ Task Order
- Project objective
  - Update old material (Ex. Measurement of Highway Related Noise – 1996)
  - Need for new guides – Improving the Quality of Environmental Documents

Project Overview

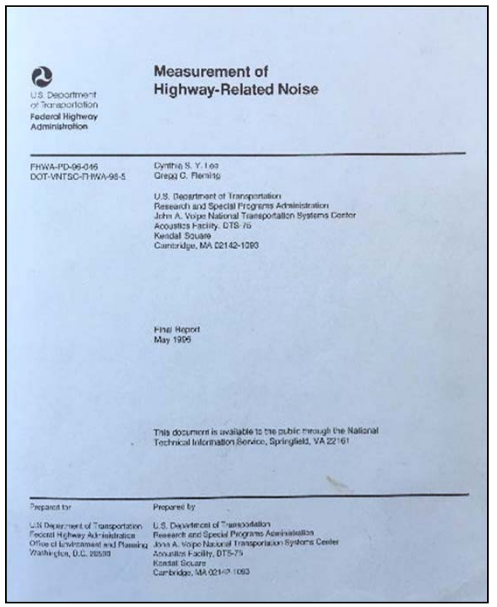
- Project deliverables
  - Develop a noise measurement handbook
  - Develop a noise measurement field guide
  - Techniques for noise study review
  - Techniques for TNM review
- What's next?
  - Construction noise handbook – after completion of NCHRP 25-49
  - Noise Barrier Design Handbook – no firm plans
  - Highway Traffic Noise: Analysis and Abatement Guidance - upcoming

Objectives of Study Tasks 1 and 2

- Task 1: Update and expand *Measurement of Highway-Related Noise* as a new "Noise Measurement Handbook"
- Task 2: Develop a simpler "Noise Measurement Field Guide" aimed at the noise measurement personnel preparing to go into the field and then performing the actual data collection

FHWA Noise Measurement Handbook Introduction

- Transportation agencies measure different aspects of highway noise to …
  - determine or predict community impacts during urban planning
  - conduct research that support their programs
- Noise Measurement Handbook
  - Best-practice guidance
  - Based on 1996 FHWA *Measurement of Highway-Related Noise*
  - Based on current national/international standards and practice



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- Project-Based Application of Measurement Methodologies
- Development of Measurement Plans
- Determination of Existing Noise Levels
- Validation of the FHWA TNM for a Proposed Highway Project on Existing Alignment
- Including Other Noise Sources for Highway Noise Projects
- Building Noise Level Reduction Measurements and Interior Noise Measurements
- Existing Vibration Measurements
- Construction Equipment Noise and Vibration Measurements
- Highway Barrier Insertion Loss Measurements
- Vehicle Noise Emission Level Measurements

Contents (continued)

- Determining the Influence of Pavement on Tire-Pavement Noise
- Determining the Influence of Pavement on Highway Vehicle Noise
- Determining the Influence of Pavement on Highway Traffic Noise
- Determining the Influence of Ground or Pavement Surface on Sound Propagation
- Vehicle Interior Noise Measurements
- Appendices
  - Terminology
  - Instrumentation
  - Report Documentation
  - Minimum Separation-Distance Criteria for Noise Emission Levels
  - Simplified Manual Prediction Method for Rail Noise
  - Noise Metric Conversions

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Project-Based Application of Measurement Methodologies

- By project type, lists applicable measurement methods and associated application
- Example: Type I highway construction, operational noise impacts

Measurement Method	Application to Project
Determination of Existing Noise Levels (Section 3.0)	• Establish existing noise levels to make substantial increase determinations as part of the impact assessment for a proposed highway project (particularly for new alignments).
Validation of the FHWA TNM (Section 4.0)	• Validate FHWA TNM against measurements of traffic noise levels to use model to predict existing and future worst-hour sound levels to make substantial increase determinations as part of the impact assessment for a proposed highway project (particularly for widenings or other reconstruction).
Including Other Noise Sources (Section 5.0)	• Establish noise levels from other transportation sources for purposes of input to or validation of rail or aircraft noise models or for combining with traffic noise.
Building Noise Level Reduction (Section 6.0)	• Determine the Outdoor-Indoor Noise Reduction for buildings for certain types of land uses where interior noise impacts need to be studied as part of a Type I highway project.
Determine Influence of Pavement: • **On tire-pavement noise (Section 11.0)** • **On vehicle noise (Section 12.0)** • **On traffic noise (Section 13.0)** • **On noise propagation (Section 14.0)**	• Help validate FHWA TNM. • Gain understanding of influence of pavement on the project.
Determine Influence of Ground: • **On noise propagation (Section 14.0)**	• Help validate FHWA TNM. • Gain understanding of influence of various ground types on the project.
Existing Vibration (Section 7.0)	• Establish existing vibration for highly vibration-sensitive structures, if project causes train tracks to move within FTA screening distance of these receptors or if highway is close and has irregularities (e.g., bridge joints).

Development of Measurement Plans

- Noise study success predicated on proper planning
- Includes 11 steps in planning a noise study
  - Identify purpose, need, and sound source of interest
  - Identify study area and project limits
  - Obtain highway plans and local mapping
  - Identify potential measurement sites via desk review
  - Confirm sites through field review, identify microphone locations
  - Obtain property and ROW access permissions
  - Assess personnel and equipment needs
  - Develop field schedule
  - Plan for data download, labeling, and storage
  - Arrange travel
  - Final planning

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Including Other Noise Sources for Highway Noise Projects

- Two primary sections:
  - Noise from trains and aircraft

    Guidance replaces prediction methods found in FHWA 1982 document: Advanced Prediction and Abatement of Highway Traffic Noise

  - Methods/applications for including these sources in highway traffic noise analyses

Noise from trains

- Differences from highway
  - Source noise
  - Operations

    Light rail and commuter rail – set schedules for weekdays and weekends

    Freight rail – can vary daily, monthly, annually
- How to determine noise levels, if needed
  - Screening method
  - Measure
  - Predict

    Simplified manual method in Appendix E

    FTA/FRA equations/spreadsheet

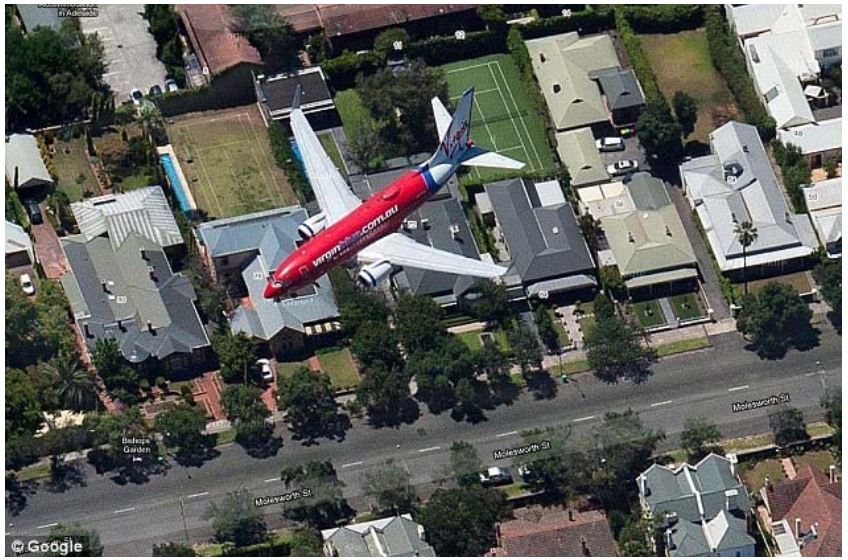
    HUD method

Noise from aircraft

- Differences from highway
  - Source noise
  - Operations

    Aircraft – can vary daily, monthly
- How to determine noise levels, if needed
  - Noise contours (screening method)
  - Measure
  - Predict

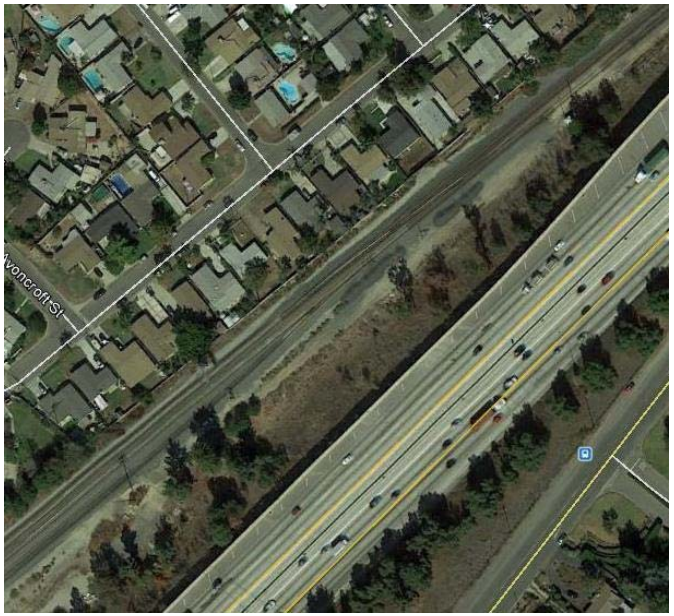
    FAA Aviation Environmental Design Tool (AEDT)



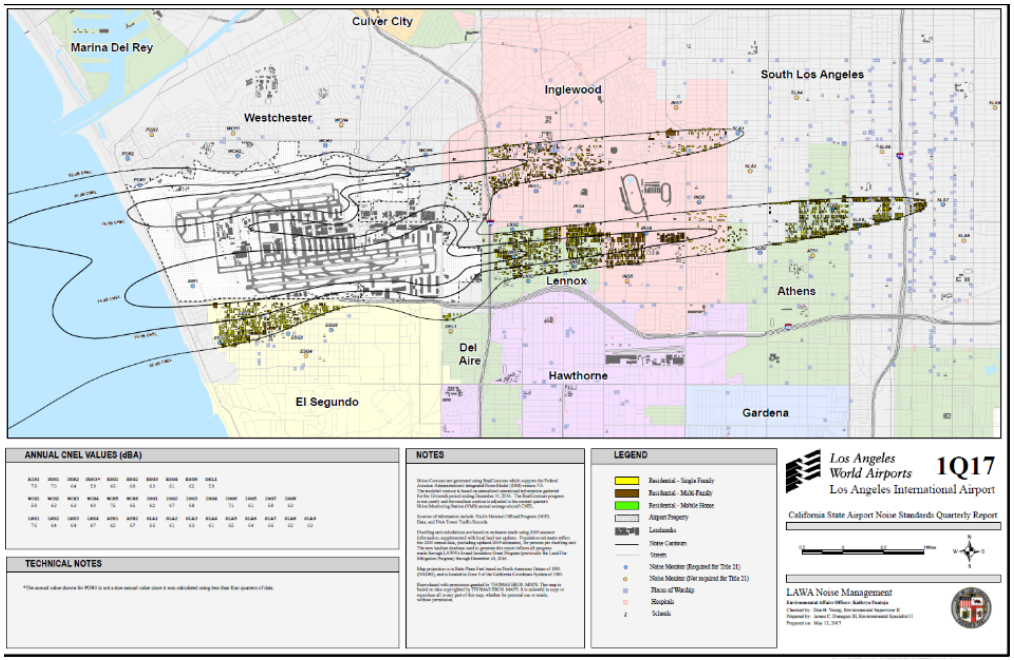
Methods/applications for highway noise projects

- As a first step, screen for possible contributions from train or aircraft noise

Train tracks with FTA screening distances?



Residences within airport noise contours?



Methods/applications for highway noise projects

- Establishing existing noise to determine substantial increase
  - Consider proximity of measurements to other source locations
  - Method for determining combined noise

    $$L_{combined} = 10log_{10}\left(10^{\frac{L_{highway}}{10}} + 10^{\frac{L_{train}}{10}} + 10^{\frac{L_{air}}{10}}\right) \quad (dB)$$

  - May need to convert highway noise to DNL (Appendix F shows method)
- Determining worst noise hour
  - Accomplished via measurements or modeling
  - Guidance on how to include or exclude train and aircraft noise
- Establishing existing noise to validate TNM
  - Eliminate train and aircraft (and other non-highway) noise sources
  - Sample period should be optimized to easily do this

Methods/applications for highway noise projects (continued)

- Impact determination
  - If including other noise sources, then add to highway noise
  - Obtain train and aircraft noise levels
  - May need to convert highway noise to DNL (Appendix F shows method)
- Abatement analysis
  - Consider all sources as part of reasonableness
  - Determine abatement effectiveness for each source
  - Consider that highway noise is mostly continuous, trains and aircraft not

    Focusing abatement on highway noise would reduce noise most of the time
  - Consider that highway noise barriers may reflect other noise sources back toward receptor

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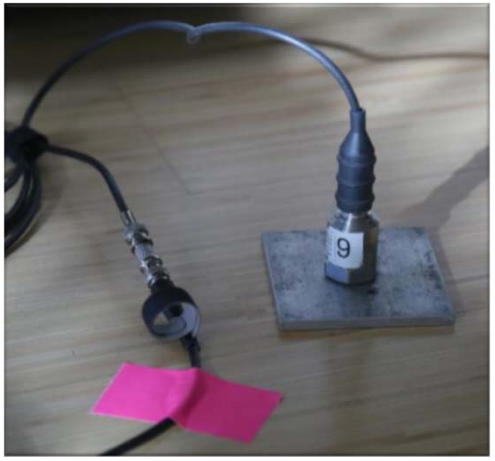
Vibration measurements

- May be important for …
  - projects that push train tracks close to receptors
  - projects with pavement joints close to receptors
  - projects with vibration-sensitive or highly noise-sensitive receptors (residences, labs with special equipment, recording studios, etc.)
  - projects where construction operations could cause damage from vibration
- May need to establish existing vibration levels
  - May need to supplement with noise measurements for potential groundborne noise issues (concert hall, recording studios, etc.)
- May need to measure vibration from construction equipment



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23 CFR 772 ACCELERATED PROCESS: MEASUREMENT AND MODELING TECHNIQUES

TASK 2:

FHWA NOISE MEASUREMENT FIELD GUIDE

Project Manager: Ken Kaliski, RSG
Task Leader: Clay Patton, Bowlby & Associates, Inc.
Assisted by: Judy Rochat, ATS Consulting
Bill Bowlby, Bowlby & Associates, Inc.

Objectives of Study Tasks 1 and 2

- Task 1: Update and expand *Measurement of Highway-Related Noise* as a new "Noise Measurement Handbook"
- Task 2: Develop a simpler "Noise Measurement Field Guide" aimed at the noise measurement personnel preparing to go into the field and then performing the actual data collection

Field Guide Measurement Types

- Determination of Existing Noise Levels
- Validation of the FHWA TNM for a Proposed Highway Project on Existing Alignment
- Including Other Noise Sources for Highway Noise Projects
- Building Noise Level Reduction and Interior Noise
- Existing Vibration
- Construction Equipment Noise and Vibration
- Highway Barrier Insertion Loss
- Vehicle Noise Emission Levels

Other Measurement Types Briefly Discussed

- Determining the Influence of
  - Pavement on Tire-Pavement Noise
  - Pavement on Highway Vehicle Noise
  - Pavement on Highway Traffic Noise
- Determining the Influence of Ground or Pavement Surface on Sound Propagation
- Vehicle Interior Noise Measurements

Measurement “Phases”

- Pre-trip Planning
- Pre-trip Preparation
- On-site

Pre-trip Planning Task Categories

- Personnel
- Site Selection
- Field review
- Noise Descriptors
- Sampling Period
- Timing and Duration of Measurements
- Permissions
- Measurement Plan Approval
- Documentation

Determination of Existing Noise Levels (Pre-trip Planning)

Category	Tasks
Personnel	☐ Identify the personnel that will work on each task: ☐ Measurement Planning_____ ☐ Permissions_____ ☐ Field Work_____ ☐ Data Review_____ ☐ Brief team members.
Site Selection	☐ Determine measurement areas ☐ Determine measurement sites ☐ Select primary noise measurement locations using available online aerial imagery and panoramic views. ***Tip:*** *Avoid choosing locations with permanent, localized noise sources (e.g., pump houses, generators, HVAC or ventilation fans) that do not represent the general noise environment for project area.* ***Tip:*** *Consider difficulty in access to the site while choosing locations.* ☐ Identify secondary or alternative noise measurement locations in the event that local conditions prevent data collection at a primary noise measurement location.

Pre-trip Preparation Task Categories

- Instrumentation
- Permissions

Validation of the FHWA TNM for a Proposed Highway Project on Existing Alignment (Pre-trip Preparation)

Category	☐ Tasks
Instrumentation	☐ Assemble instrumentation, accessories and supplies: o Integrating sound level meter(s) o Calibrator o Tripod(s) o Windscreen(s) o Microphone extension cable(s) o Anemometer or handheld wind meter. o Camera o Radios and cell phones o Traffic count boards o Radar gun for speed data collection o Digital watches for all field personnel ☐ Test the instrumentation that will be used for data collection, adjusting settings as needed.
Permissions	☐ Make copies of permission letter from SHA authorizing your work for the project. ☐ Contact local law enforcement the day before the measurements. ***Tip:*** *Describe planned locations, time(s) of day, vehicle make and model*

On-site Task Categories

- Field review (if not conducted during pre-trip planning)
- Site Appropriateness
- Instrumentation Setup
- Documentation
- Data Collection
- Data Storage

Highway Barrier Insertion Loss Measurements (On-site)

Category	Tasks
Field review (if not conducted during pre-trip planning)	☐ Visit each planned measurement site to confirm access and observe local conditions. ☐ Confirm site equivalency for the Indirect Measured method, if necessary. ☐ Visit each traffic count location to confirm there is an unobstructed view of traffic. ☐ Visit each speed data collection location and test radar gun at the location.
Site Appropriateness	☐ Determine if there are any localized, non-representative noise sources that interfere with the data collection. ☐ Move to alternative noise measurement location if needed.
Instrumentation Setup	☐ Attach pre-amp and microphone (with microphone extension, if needed) to sound level meter. ☐ Turn on instrumentation and allow equipment to acclimate to outside conditions for several minutes. ☐ Check and, if needed, set and synchronize the time on all instrumentation (sound level meters, traffic counters, meteorological instrumentation, video cameras, cameras, watches). ☐ Check battery power level. ☐ Check that instrumentation settings are correct. ☐ Calibrate instrument before starting data collection (note initial calibration level and time on Field Data Sheet).

Measurement Summary Data Sheet

Date_____ Page ____ of _____

Site_____

Determination of Existing Noise Levels - Measurement Summary Sheet

Project Name	
Site/Address	
Observer Name	

General Meteorological Conditions

Temperature(s)	
Wind Speed(s)	
Wind Direction(s)	

SLM/Analyzer Information

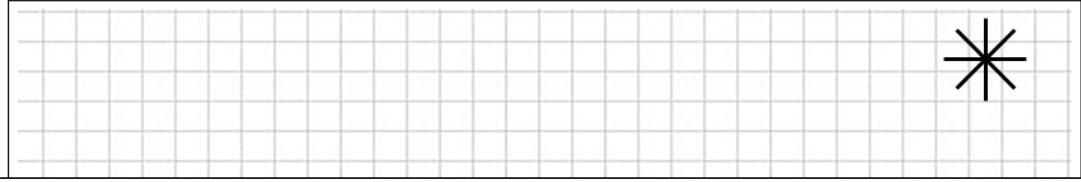
SLM Model		SLM Serial #	
Mic. Height		Mic. Serial #	
Mic. Extension?		Data File Name/Number	

Calibration Information

	Pre-Measurement	Post-Measurement
Calibration Time		
Calibration Level		

Site Sketch

(plan/profile view, distances, roadways, buildings, reflecting surfaces, ground type as appropriate) (Indicate North)



Field Event Log and Traffic Count Data Sheet

Date_____ Page ____ of _____

Site_____

Determination of Existing Noise Levels - Field Log

Period #	Period Start Time	Event Description(s) (include event start and stop)
1		
2		
3		
4		
5		
6		
7		
8		

Validation of Modeled Sound Levels - Traffic Count Data Sheet

Roadway:	Roadway:
Direction:	Direction:

Time Start	Auto	MT	HT	Bus	MC	Auto	MT	HT	Bus	MC

23 CFR 772 ACCELERATED PROCESS: MEASUREMENT AND MODELING TECHNIQUES

TASK 3:

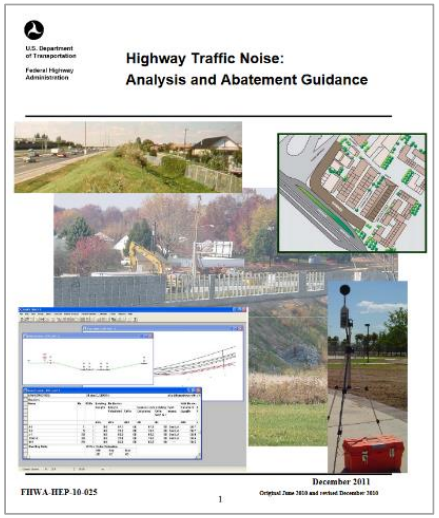
TECHNIQUES FOR REVIEWING NOISE ANALYSES AND ASSOCIATED NOISE REPORTS

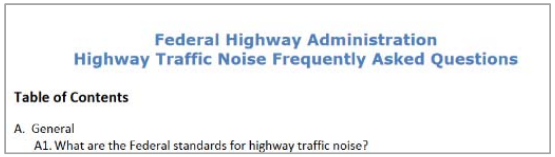
Project Manager: Ken Kaliski, RSG
Task Leader: Darlene Reiter, Bowlby & Associates, Inc.
Assisted by: Geoff Pratt and Rennie Williamson, Bowlby & Associates, Inc.

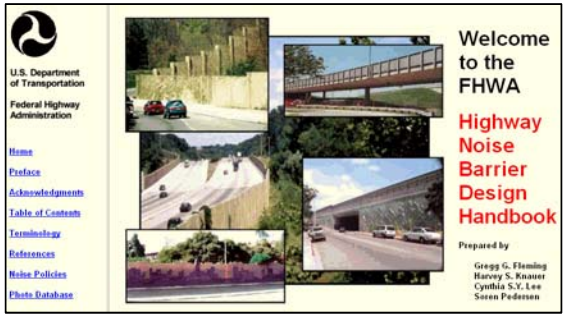
Approach

Standalone “how-to” guide for noise analysis and report review

- Straightforward, accessible, understandable, user-friendly
- Follows the noise study steps
- Includes general review procedures and tools
  - table lookups
  - examples
  - incorporates existing FHWA guidance
- Assist reviewers
  - evaluating accuracy and completeness
  - identifying issues that need to be addressed







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APPENDIX B NEPA Document Noise Section Review Checklist

Noise Report Checklist

Techniques for Reviewing Noise Analyses and Associated Noise Reports
Federal Highway Administration

Noise Study Report Review Checklist

Project	
Jurisdiction	
Project Number	
Report Date	
Reviewer	
Date Review Completed	Click here to enter a date.
Report Filename/Location	

Report Section	Item	N/A	Yes?	Notes
Report Cover	The cover page includes the project information.	☐	☐	
Table of Contents and List of Tables and Figures	The table of contents and lists are complete and correct.	☐	☐	
Summary	The report includes a summary of the results.	☐	☐	
Introductory Material and Project Description	The report references the FHWA noise regulation and SHA noise policy.	☐	☐	
	The report provides the correct project name, limits, description and length.	☐	☐	
	The report identifies the type of project (I, II or III).	☐	☐	
Traffic Noise Fundamentals/ Terminology	The report explains the fundamentals of traffic noise and the terminology used in the noise study report.	☐	☐	

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Noise Study Report Review Checklist

Report Section	Item	N/A	Yes?	Notes
Identification of Noise-Sensitive Land Uses	The report identifies the lands that contain, or will contain, noise-sensitive land uses.	☐	☐	
	The modeling extends an adequate distance to identify all impacts and benefits.	☐	☐	
	Activity Category B (Residential) Land Uses			
	The report identifies all potentially impacted and benefited residential properties.	☐	☐	
	The report identifies and accounts for common areas of residential neighborhoods.	☐	☐	
	The report identifies and accounts for exterior areas (i.e., balconies) of multi-story residential buildings.	☐	☐	
	Category C, D and E Land Uses			
	The report identifies and describes the qualifying exterior areas of Activity Category C land uses.	☐	☐	
	The report identifies and describes the land uses that qualify as Activity Category D.	☐	☐	
	The report identifies the qualifying exterior areas of Activity Category E land uses.	☐	☐	
	Category F Land Uses			
	The report identifies the Activity Category F land uses in the project area.	☐	☐	
	Category G Land Uses			
	The report states whether or not there are Activity Category G undeveloped lands along the project.	☐	☐	
	The text points the reader to the "Information for Local Officials" section.	☐	☐	
	Permitted Land Uses			
	The report identifies permitted noise-sensitive land uses.	☐	☐	

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NEPA Noise Section Checklist

Techniques for Reviewing Noise Analyses and Associated Noise Reports
Federal Highway Administration

NEPA Document Noise Section Review Checklist

Project	
Jurisdiction	
Project Number	
Report Date	
Reviewer	
Date Review Completed	Click here to enter a date.
Report Filename/Location	

NEPA Document Section	Item	N/A	Yes?	Notes
Categorical Exclusion (CE)				
Noise	The CE references the FHWA noise regulation and SHA noise policy.	☐	☐	
	The CE references the noise study report in an appendix/attachment.	☐	☐	
	The CE identifies the type of project (Type I, Type II or Type III).	☐	☐	
	The CE identifies all impacted noise-sensitive land uses.	☐	☐	
	The CE identifies impacts as NAC or "substantial increase."	☐	☐	
	The CE summarizes the conclusions of the noise abatement evaluation.	☐	☐	
	The CE identifies impacted land uses for which abatement is not feasible or reasonable.	☐	☐	
	The CE includes a statement of likelihood.	☐	☐	

Page 1

Techniques for Reviewing Noise Analyses and Associated Noise Reports
Federal Highway Administration

NEPA Document Noise Section Review Checklist

NEPA Document Section	Item	N/A	Yes?	Notes
	The CE includes a discussion of information for local officials or a reference to the applicable section of the noise study report.	☐	☐	
Environmental Assessment (EA) and Environmental Impact Statement (EIS)				
Introductory Material and Project Description	The EA or EIS references the FHWA noise regulation and SHA noise policy.	☐	☐	
	The EA or EIS references the noise study report in an appendix/attachment.	☐	☐	
	The EA or EIS identifies the project as Type I.	☐	☐	
Traffic Noise Fundamentals/ Terminology	The EA or EIS explains the fundamentals of traffic noise and terminology.	☐	☐	
Identification of Noise-Sensitive Land Uses	The EA or EIS describes the noise-sensitive land uses in the project area.	☐	☐	
Determination of Existing Noise Levels	The EA or EIS describes the existing noise environment.	☐	☐	
Determination of Future Noise Levels	The EA or EIS describes the future noise levels with the project.	☐	☐	
Determination of Traffic Noise Impacts	The EA or EIS discusses the impact criteria in the SHA noise policy.	☐	☐	
	The EA or EIS identifies all impacted land uses and their associated activity categories for each Build Alternative.	☐	☐	
Construction Noise	The EA or EIS includes a discussion of construction noise.	☐	☐	

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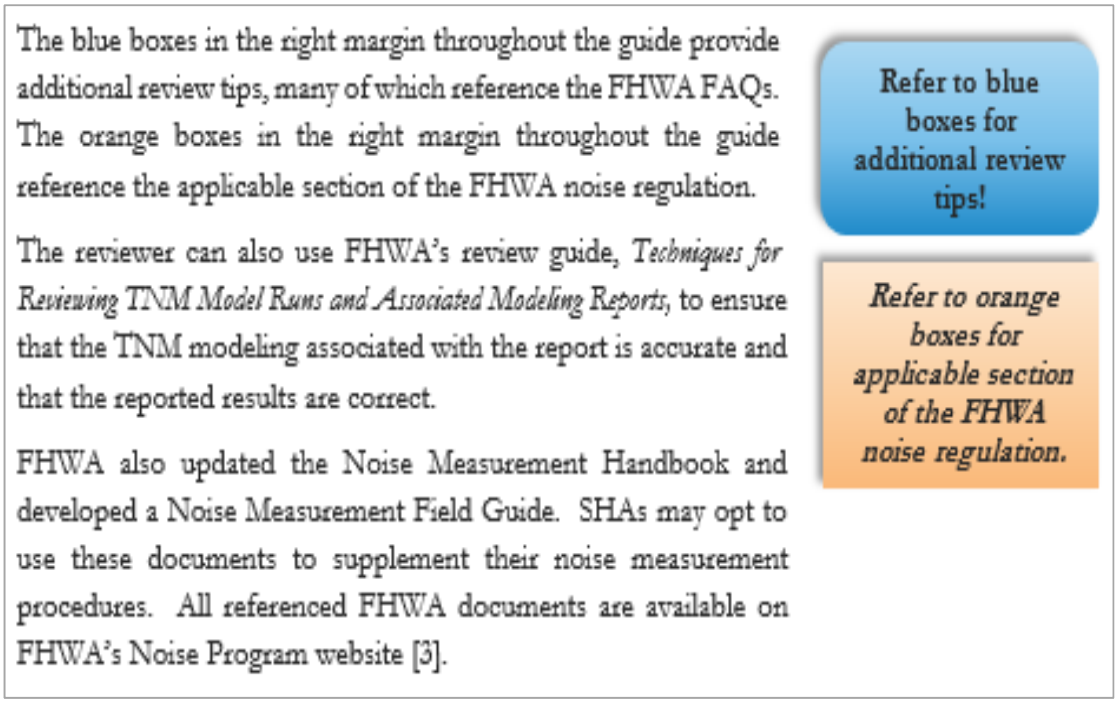
How to Use the Guide

Dual column format

- Left column
  - main body
- Right column
  - reviewer tips
    - FHWA guidance
    - FAQs
  - regulation section



The blue boxes in the right margin throughout the guide provide additional review tips, many of which reference the FHWA FAQs. The orange boxes in the right margin throughout the guide reference the applicable section of the FHWA noise regulation.

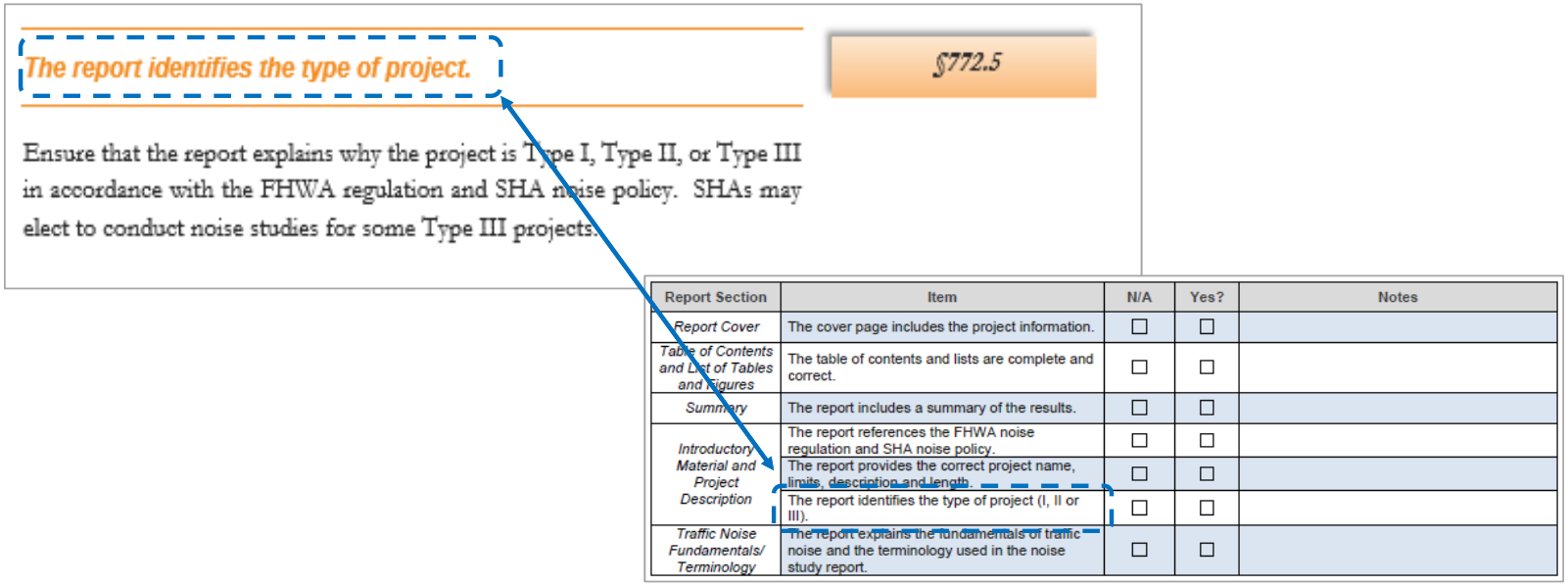
The reviewer can also use FHWA's review guide, *Techniques for Reviewing TNM Model Runs and Associated Modeling Reports*, to ensure that the TNM modeling associated with the report is accurate and that the reported results are correct.

FHWA also updated the Noise Measurement Handbook and developed a Noise Measurement Field Guide. SHAs may opt to use these documents to supplement their noise measurement procedures. All referenced FHWA documents are available on FHWA's Noise Program website [3].

How to Use the Guide

Statement and response format

- Response provides additional information for the reviewer on that topic
- Link to checklist



How to Use the Guide

Review process

- Move through a noise report using Section 2 and the associated checklist
  - Evaluate each item
  - Add notes on items that are missing, incorrect, or need attention
- Similar process for NEPA noise section
- Checklist could be completed by report preparer

Section 2 Snapshots – Identification of Noise-Sensitive Land Uses

2.6 Identification of Noise-Sensitive Land Uses

§772.11(c)(2)

The report identifies the lands that contain, or will contain, noise-sensitive land uses.

FHWA test for Category A designation.

Activity Category A land uses are extremely rare. FHWA developed a *"Test for Meeting Activity Category A Designation"* determine if a land use qualifies as Activity Category A (FAQ D2). If a land use meets FHWA's criteria, the SHA should prepare a *"Proposal for Justification for Designating Land Use as Activity Category A"* and submit it to their FHWA Division Office.

The Tomb of the Unknown Soldier at Arlington National Cemetery is an example of an Activity Category A land use.

2.6.1 Activity Category B (Residential) Land Uses

The report identifies all potentially impacted and benefited residential properties.

§772.11(c)(2)(ii)

Check that the study includes all potentially impacted and benefited residential properties including single and multi-family residences (duplexes, apartments, condominiums), mobile home communities and facilities that provide long-term residential stays. If there are no exterior areas of frequent human use at a residential property (e.g., at some apartments or nursing homes), then the property is not considered noise-sensitive and is not evaluated for impacts. Outdoor land uses can be individual areas, such as yards, patios or balconies.

Residential hotels and motels that function as apartment dwellings are Activity Category B. (FAQ D6)

Section 2 Snapshots – Identification of Noise-Sensitive Land Uses

2.6.2 Activity Category C, D and E Land Uses

The report identifies and describes the qualifying exterior areas of Activity Category C land uses.

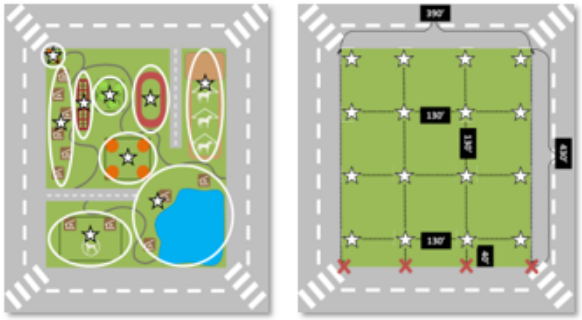
§772.11(c)(2)(iii)

FHWA Fact Sheets

FHWA developed six fact sheets for "Calculating and Placing Non-Residential Receptors (NRRs) including:

- Activity Categories A - E (FHWA-HEP-17-057)
- Methodology: Single Point (FHWA-HEP-17-058)
- Methodology: Frontage (FHWA-HEP-17-054)
- Methodology: Lot Size (FHWA-HEP-17-056)
- Methodology: Grid (FHWA-HEP-17-055)
- Methodology: Usage (FHWA-HEP-17-059)

Examples of the grid and single point methodologies are shown below.



The report identifies and describes the land uses that qualify as Activity Category D.

§772.11(c)(2)(iv)

Confirm that the analysis evaluates Activity Category C land uses that do not have an exterior area of frequent human use as Activity Category D land uses, which are evaluated for interior impacts. As an example, if a place of worship has a playground, it would be an Activity Category C land use. If the exterior area is far from or physically shielded from the roadway in a manner that prevents an impact on the exterior area, the land use is Activity Category D (photo at left). Additionally, if there are no exterior areas of frequent human use, then the facility is an Activity Category D land use.

For the purposes of 23 CFR 772, the FHWA defines a "medical facility" as an inpatient medical facility where medical treatment and care occurs. (FAQ D4)

Section 2 Snapshots – Determination of Existing Noise Levels

2.7.1 Measurement of Existing Noise Levels

§772.11(a)(1)

The report identifies the applicable noise measurement procedure (i.e., FHWA Noise Measurement Handbook or SHA noise policy).

Check that the noise study documents and discusses the noise measurement procedure in adequate detail to meet any SHA requirements. This could include detailed information about the measurement equipment.

SHA's may use FHWA's updated Noise Measurement Handbook and associated Noise Measurement Field Guide to supplement their noise measurement procedures.

Measurement sites should be clear of obstructions and the microphone should be located at least 10 feet from any reflective surfaces.

2.7.2 Prediction of Existing Noise Levels for Projects on Existing Alignments

§772.11(a)(2)

The analysis used an approved version of the FHWA TNM.

§772.9(a)

The report shows the predicted existing interior noise levels for Activity Category D land uses.

Verify that the report shows predicted existing interior noise levels for any Activity Category D land use. FHWA Guidance includes a procedure for determining the interior noise levels for Activity Category D land uses by evaluating the type of building construction. Table 2 provides the appropriate noise level reduction for combinations of building types and window conditions. The predicted exterior noise level is reduced by the appropriate amount to arrive at the predicted interior noise level, which is compared to the NAC for Activity Category D land uses.

Table 2: Building Noise Reduction Factors

Building Type	Window Condition	Reduction
All	Open	10 dB
Light Frame	Ordinary Sash (closed)	20 dB
	Storm Windows	25 dB
Masonry	Single Glazed	25 dB
	Double Glazed	35 dB

* Consider the windows open unless there is firm knowledge that the windows are in fact kept closed almost every day of the year.

Source: FHWA *"Highway Traffic Noise Analysis and Abatement: Policy and Guidance."*

Section 2 Snapshots – Determination of Future Noise Levels

2.9 Determination of Future Noise Levels

§772.9(d)

The report identifies the design year and discusses the future traffic volumes, truck percentages, and speeds used to predict future noise levels and documents the source(s) of that data.

Check that the report discusses the future volumes and speeds used to predict noise levels and documents the source of that data. The report should also discuss the percentage(s) of trucks on the study roadways since truck volumes

The reported noise level changes are consistent with what would be expected.

Compare the predicted design year noise levels for the Build Alternative(s) to the existing worst hour noise levels to assess whether the changes are reasonable based on: the type of project (widening or new alignment), the projected increase in traffic, the path between the source and the receiver, and the characteristics of the intervening terrain.

Table 3: Highway Project Examples

Widening Projects			
Facility Type	**Existing Lanes**	**Future Lanes**	**Speed (mph)**
Arterial	2	5	45
	5	7	45
Freeway	4	6	65
	4	8	65
New Alignment Projects			
Facility Type	**Existing Noise Level (dBA)**	**Future Lanes**	**Speed (mph)**
Arterial	40	2	45
	50	2	45
Freeway	40	4	65
	50	4	65

Section 2 Snapshots – Determination of Future Noise Levels

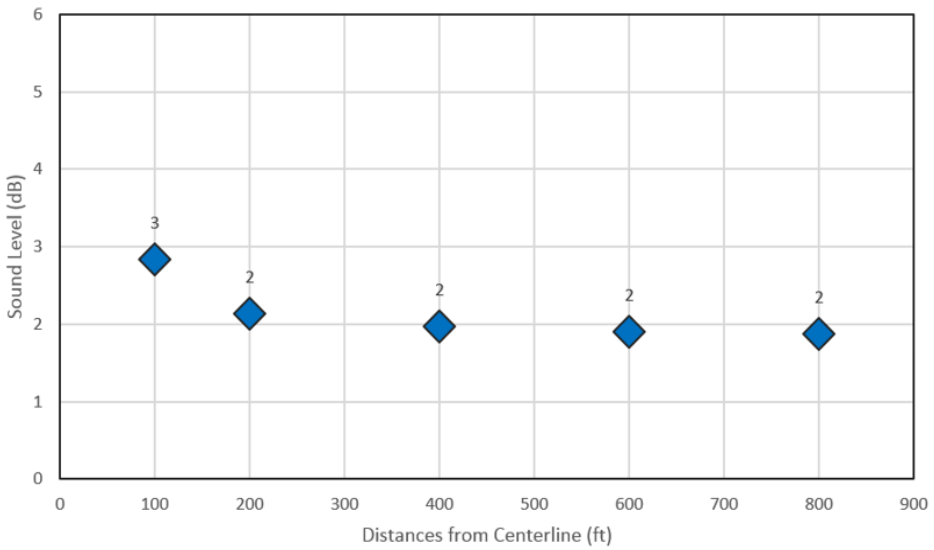


Figure 4: Noise Increases for Freeway Widening (4 to 6 Lanes)

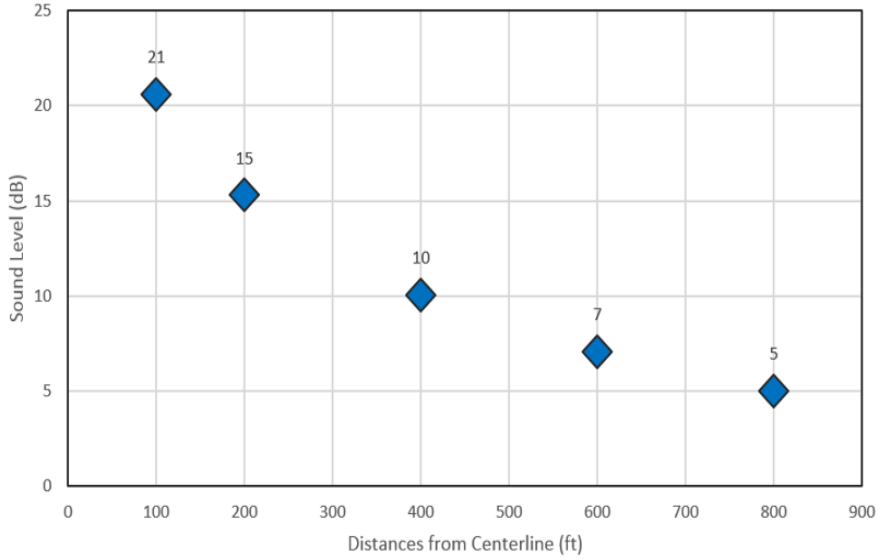


Figure 6: Noise Increases for New 2-Lane Arterial with Background Noise Level of 40 dBA

Section 2 Snapshots – Determination of Noise Impacts

2.10 Noise Impact Evaluation — *§772.11*

The report explains the regulatory definition of a noise impact.

Confirm that the report clearly discusses the two types of impacts that can occur. Per the FHWA regulation, impacts occur if predicted future noise levels approach or exceed the NAC or if the project causes a substantial increase in existing noise levels.

The analysis accounts for impacts to upper floor units in multi-family buildings.

Verify that the analysis includes upper floor units of multi-family buildings such as apartments and condominiums. The reported impacts should include these locations.

If the SHA allows multiple land uses to be represented by a single receiver in the TNM modeling, then a check of that grouping may be needed to ensure that all impacts are identified.

Section 2 Snapshots – Noise Abatement Evaluation

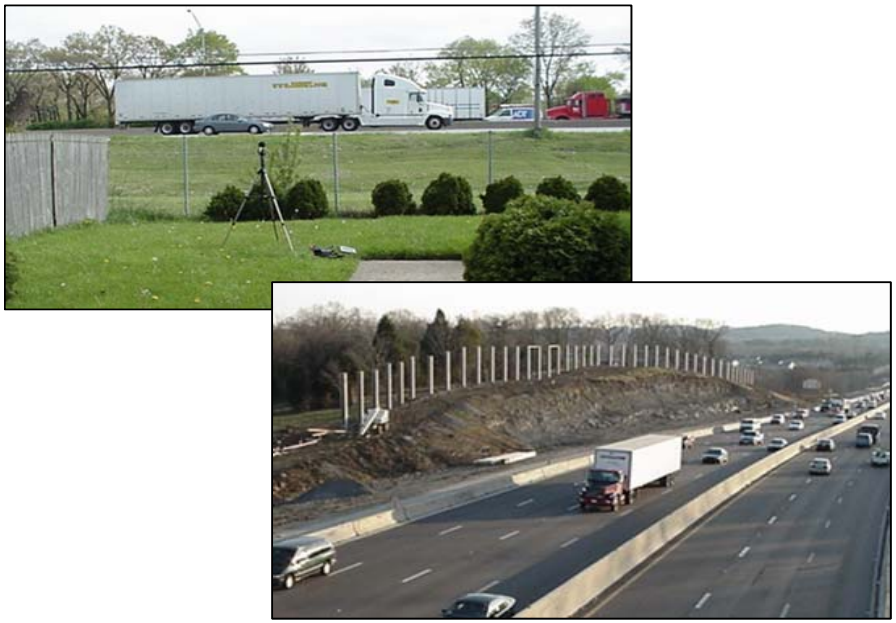
The report identifies the most acoustically effective barrier locations.

Verify that the report identifies the most acoustically effective location for each noise barrier. Noise barriers are generally most effective when they are close to the road (i.e., at the highway shoulder) or close to the receptor (i.e., at/near the right-of-way). Siting a proposed barrier at the most acoustically effective location for the affected receptors is critical to accurately assess whether a

Table 4: Noise Barrier Design and Insertion Loss

Insertion Loss	Degree of Difficulty	Reduction in Sound Energy	Relative Reduction in Loudness
5 dB	Simple	68%	Readily perceptible
10 dB	Attainable	90%	Half as loud
15 dB	Very difficult	97%	One-third as loud
20 dB	Nearly impossible	99%	One-fourth as loud

Source: FHWA *"Noise Barrier Design Handbook."*



Section 2 Snapshots – Noise Abatement Evaluation

2.11.5 Absorptive Noise Barrier Treatments

§772.13(c)(2)

The analysis evaluated the need for absorptive treatments in accordance with the SHA noise policy.

2.13 Information for Local Officials

§772.17

The noise study report includes information for local officials.

Confirm that the report includes the following information:

1. Information on noise compatible planning concepts,
2. The best estimation of the design year noise levels on the undeveloped lands along the project at various distances from the edge of the nearest travel lane of the highway improvement (typically in the form of noise contour information – see image on right), and
3. Information on Type II project eligibility.

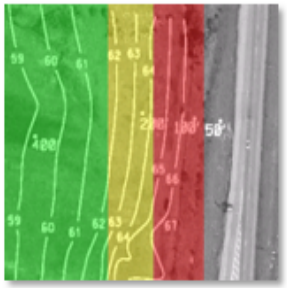


Table 6: Noise Barrier Design and Insertion Loss

Width to Height Ratio	Maximum Change in IL	Recommendation
Less than 10:1	3 or greater	Action required to minimize degradation.
10:1 to 20:1	0 to 3	At most, degradation barely perceptible; no action required
Greater than 20:1	No measurable degradation	No action required.

Source: FHWA *"Noise Barrier Design Handbook."*

Section 3 Snapshots

3.0 Reviewing the Noise Section of the NEPA Document

The noise section of the environmental document must summarize the noise study results and conclusions as listed in the FHWA Nosie regulation.

3.1 Categorical Exclusion (CE)

The CE references the FHWA noise regulation and SHA noise policy.

Confirm that the section references the current FHWA noise regulation and SHA noise policy as well as any applicable SHA procedures.

The CE references the noise study report in an appendix/attachment.

Verify that the section references the noise study report.

3.2 Environmental Assessment (EA) and Environmental Impact Statement (EIS)

EAs and EISs expand upon the information provided in CEs. The *Improving the Quality of Environmental Documents* report recommends a new EIS blueprint as indicated in Table 7.

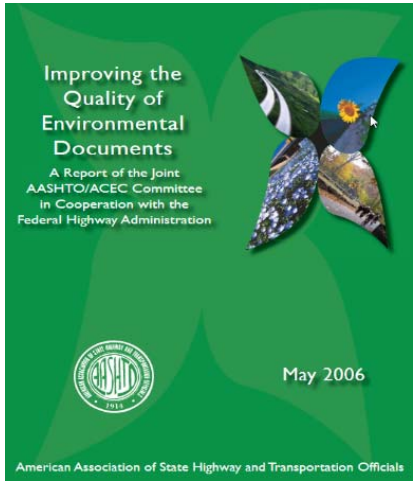


Table 8: Noise Study Report and EA/EIS Sections

Noise Study Report Section	EIS Chapter/Section		EA Chapter/Section
	Traditional Approach	New FHWA Blueprint	
Introductory Material and Project Description	Affected Environment	Environmental Resources	Various: • Affected Environment and Environmental Consequences • Affected Environment and Environmental Impacts • Environmental Consequences
Traffic Noise Fundamentals/Terminology			
Identification of Noise-Sensitive Land Uses			
Determination of Existing Noise Levels			
Determination of Future Noise Levels	Environmental Consequences		
Determination of Traffic Noise Impacts		Impacts	
Construction Noise			
Noise Abatement Evaluation		Mitigation	
Information for Local Officials			

Section 4 Snapshots

4.0 Reviewing Other Noise Reports

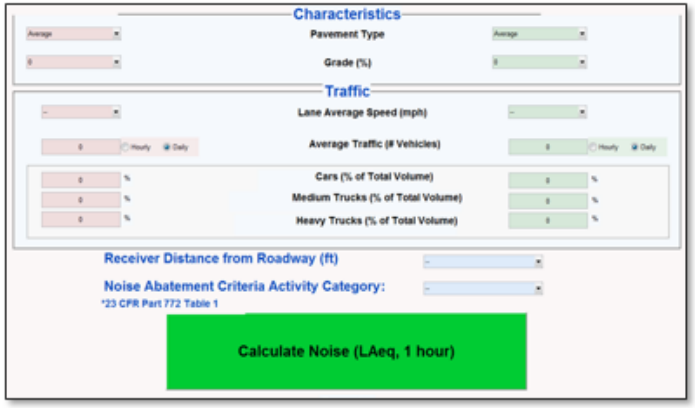
Other types of noise reports and materials that may require review include noise screening reports, public involvement materials, noise reevaluations, and noise barrier design documents. This section provides some general information and guidance for the review of these materials but is not intended to replace any SHA review processes or procedures.

4.1 Noise Screening Reports

Some SHAs include a noise screening process in their noise policies. The SHA does not need to conduct a detailed noise study if the screening analysis concludes that the project will not create impacts because 1) the traffic projections are very low, or 2) the potentially affected land uses are well beyond the limit for noise impacts.

FHWA developed a Low Volume Road Noise Calculation Tool to assist in screening projects for impacts for low volume road projects.

Review of a noise screening analysis might involve ensuring that the modeled traffic volumes and speeds are correct. A review of the project area and plans should confirm that there are no potentially impacted noise-sensitive land uses.



23 CFR 772 ACCELERATED PROCESS: MEASUREMENT AND MODELING TECHNIQUES

TASK 4:

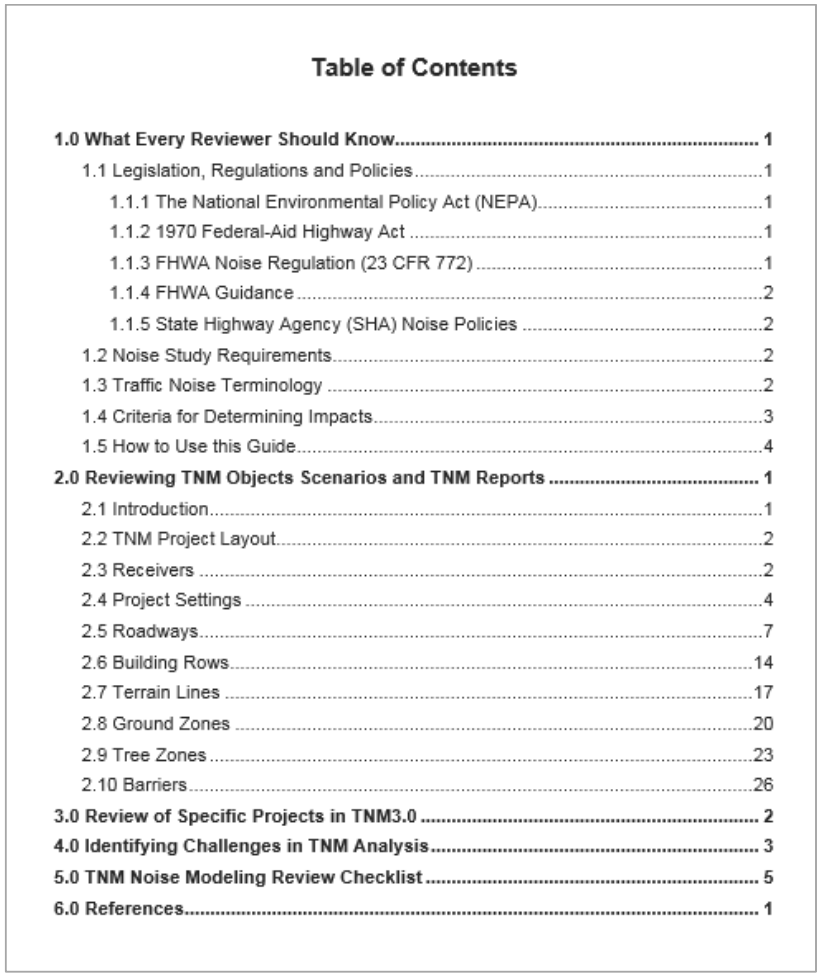
TECHNIQUES FOR REVIEWING TNM MODEL RUNS AND ASSOCIATED MODELING REPORTS

Project Manager: Ken Kaliski, RSG
Task Leader: Ahmed El-Assar, Environmental Acoustics *(A Division of Gannett Fleming)*
Assisted by: Darlene Reiter, Geoff Pratt, and Rennie Williamson, Bowlby & Associates, Inc.

Approach and Guide Sections

Standalone “how-to” guide for model review

- Straightforward, accessible, understandable, user-friendly
- Includes general review procedures and tools
  - examples
  - guidance
- Assist reviewers
  - evaluating accuracy and completeness
  - identifying issues that need to be addressed



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TNM Model Review Checklist

Techniques for Reviewing Noise Analyses and Associated Noise Reports
Federal Highway Administration

TNM 3.0 Noise Modeling Review Checklist

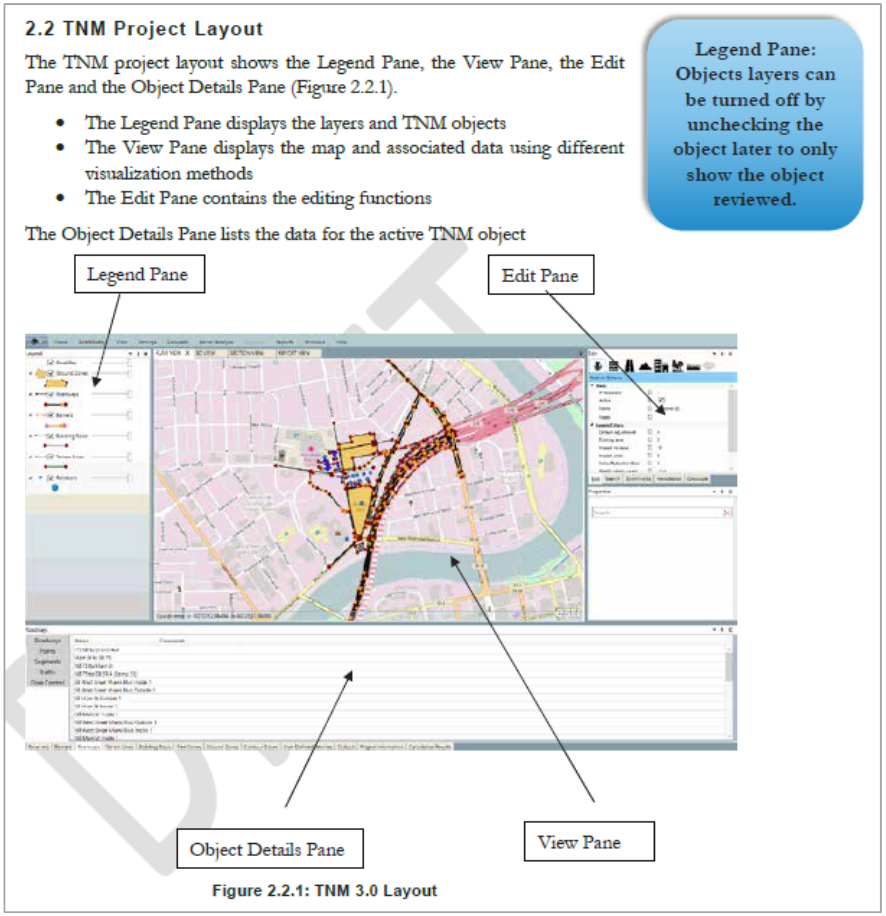
Project Information	
Project	
Jurisdiction	
Project Number	
Project Plans and Date	
Traffic Data Source and Date	
TNM Model Information	
TNM Project Name	
Year	
Alternative	
Filename/Location	
Review Information	
Reviewer	
Date Review Completed	Click here to enter a date.

Input	Question	N/A	Yes?	Notes
Project Settings	Is the basic setup information complete?	☐	☐	
Receivers	Are receivers named using the street address or project stationing?	☐	☐	
	Are the number of receptors set correctly for each receiver?	☐	☐	
	Are the receivers in the order of traffic flow?	☐	☐	
	Do the receiver elevations and heights appear to be correct?	☐	☐	
	Is the height above ground accurate for modeled upper-floor receivers?	☐	☐	
	Are enough receivers modeled to account for impacts and benefits?	☐	☐	
	Are the NAC correct for the modeled receivers?	☐	☐	
	Is the Noise Reduction Design Goal set per the noise policy?	☐	☐	
	Is the threshold for Substantial Increase set per the noise policy?	☐	☐	
Barriers	Are barrier names assigned?	☐	☐	
	Fixed Height Barriers (Buildings, Parapet Walls, Median Barriers)			
	Are large buildings modeled?	☐	☐	
	Are parapet walls, median barriers, etc. modeled per the noise policy?	☐	☐	
	Do the barrier elevations appear to be correct?	☐	☐	
	Do the barrier heights appear to be correct?	☐	☐	
	Are barrier reflection surfaces assigned as appropriate?	☐	☐	
	Are barriers on structure modeled accurately and are the shielded lists correct?	☐	☐	
	Proposed Barriers			
	Are the proposed barriers modeled at the most acoustically effective location?	☐	☐	
	Are the barrier point names tied to stationing?	☐	☐	
	Do the barrier elevations appear to be correct?	☐	☐	
	Are the barrier heights, perturbation increment, and number of perturbations assigned in accordance with the noise policy?	☐	☐	
	Are barrier reflection surfaces assigned as appropriate?	☐	☐	
	Are barriers on structure modeled accurately and are the shielded lists correct?	☐	☐	

How to Use the Guide

Similar to Task 3 format

- Dual column
- Statement and response



2.2 TNM Project Layout

The TNM project layout shows the Legend Pane, the View Pane, the Edit Pane and the Object Details Pane (Figure 2.2.1).

- The Legend Pane displays the layers and TNM objects
- The View Pane displays the map and associated data using different visualization methods
- The Edit Pane contains the editing functions

The Object Details Pane lists the data for the active TNM object

Legend Pane: Objects layers can be turned off by unchecking the object later to only show the object reviewed.

Figure 2.2.1: TNM 3.0 Layout

Snapshots – Receivers

2.3 Receivers

The model should include receivers at area(s) of frequent human use. The reviewer can enable the receiver layer (Figure 2.3.1), review the plan view, and check receiver data in the Object Details Pane or receivers report (Figure 2.3.2). The reviewer can save and export the report to Excel, Word and PDF.

Are the number of receptors set correctly for each receiver?

In some cases, one TNM receiver can represent multiple receptors. However, the receptors should have similar sound levels for both existing and future conditions and would be expected to experience comparable noise reductions if a barrier was constructed.

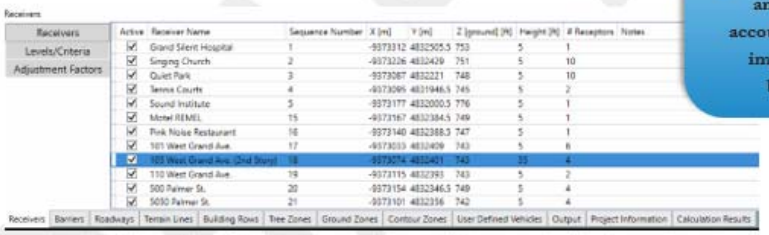


Figure 2.4.3: Receivers Input Data

If the SHA allows multiple land uses to be represented by a single receiver in the, then a check of that grouping may be needed to ensure an accurate accounting of all impacts and benefits.

Are enough receivers modeled to account for impacts and benefits?

The analysis will only identify all impacts if the modeling extends an adequate distance from the road. The distance needed to identify all impacts will vary from project to project. The impact distance for arterial widening projects may only be a couple of hundred feet while the impact distance for a new alignment project may be well beyond 500 feet. Similarly, the modeling should extend an adequate distance to ensure all benefits are identified if a barrier is evaluated. This distance will vary from area to area and will also depend on the SHA's noise barrier design process.

The reviewer can use the measurement tool to determine distances.

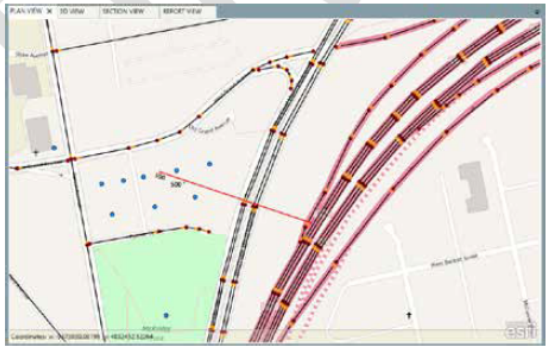


Figure 2.4.5: Measurement Tool (feet or meters)

A preliminary TNM analysis can identify a conservative distance within which impacts would be expected for a project. The analysis then includes all uses within that distance to ensure identification of all impacts.

Snapshots – Roadways

Are traffic volumes and speeds assigned to all applicable roadway segments?

The reviewer can check the roadways Object Details Pane (Figure 2.5.7) or roadways report (Figure 2.5.8) to ensure traffic and speeds are assigned correctly. Traffic volumes and speeds should be input for each vehicle category and vehicle speed is assigned for each category.

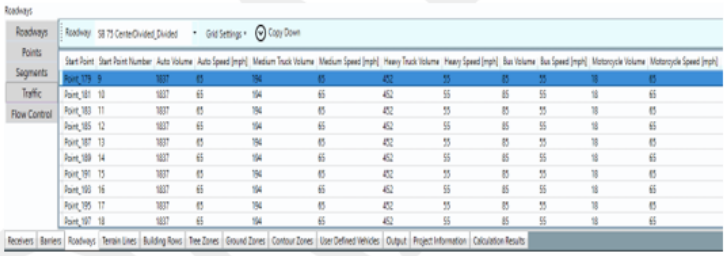


Figure 2.5.7: Roadway Traffic Volume and Speed

HOV and Truck restricted lanes should be reviewed to ensure trucks are assigned to these lanes.

Are traffic control devices modeled accurately?

The reviewer can check roadways Object Details Pane or roadways report to determine if roadway traffic flow control devices (i.e. stop sign, traffic signal, Toll Barrier and On Ramp) are entered correctly. In addition, traffic flow control devices input should be checked for percent of vehicle affected and constrained speed. TNM3.0 allows the analyst to add a traffic control at any point on the road and there is no need to break the road into two roadways and place the traffic control device at the beginning of the second roadway as was previously done with TNM2.5.

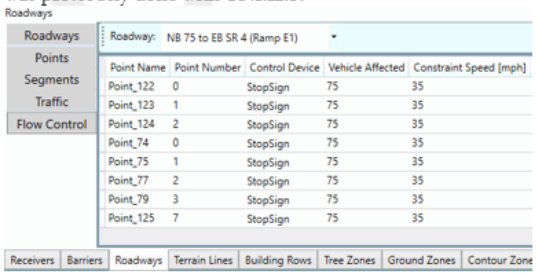


Figure 2.5.9: Roadway Traffic Control Devices

Traffic control devices are not shown in the plan or 3D views.