Arizona Department of Transportation

NOISE ABATEMENT REQUIREMENTS

May 2017

Contents

Letter to Users

The Arizona Department of Transportation (ADOT) has developed the Noise Abatement Requirements in coordination with the Federal Highway Administration (FHWA), Arizona Division, in compliance to the Code of Federal Regulations (CFR), noise regulation at 23 CFR 772. The standards include the Noise Abatement Criteria along with all other requirements of 23 CFR 772, such as prediction of noise levels, abatement, information for local officials and construction noise. The entire Part 772 is the Noise Standard. Each state transportation agency is required to have a noise policy that is consistent with the FHWA Noise Standard. In addition to defining traffic noise impacts, the FHWA Noise Standard requires that noise abatement measures be considered when traffic noise impacts are identified for federal projects. Noise abatement measures that are found to be both feasible and reasonable are eligible for federal-aid participation in the same manner as other eligible project costs.

This document contains ADOT's requirements on highway traffic noise and construction noise and describes ADOT's implementation of the requirements of the FHWA Noise Standard at 23 Code of Federal Regulations (CFR) Part 772, replacing all previous policy/guidance on the assessment of traffic noise impacts and abatement measures to be considered for highway projects. It applies to all Type I federal highway projects in the State of Arizona; that is, any projects that receive federal-aid funds or are otherwise subject to FHWA approval. They include federal projects that are administered by Local Public Agencies (LPAs) as well as ADOT. ADOT currently does not have Type II projects.

In addition to federal projects, this document applies to other ADOT-funded projects that involve:

a) construction of a highway on new alignment or
b) a significant change in the horizontal or vertical alignment of an existing highway or
c) adding new through lanes to an existing highway.

As an integral part of continuous improvement, it integrates the most current Recommended Best Practices and Supplemental Guidance for the use of FHWA Traffic Noise Model (TNM) to accurately, consistently and efficiently model relevant noise generation and noise propagation intervening features are right the first time and every time. Subsequently, the processes and additional documents shall be made available online, resulting in reduced number of submissions, and the duration of the noise analysis to the final approval.

Sincerely,

Dallas Hammit
Deputy Director for Transportation
Arizona Department of Transportation

U.S. Department of Transportation
Federal Highway Administration

ARIZONA DIVISION

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May 4, 2017

In Reply Refer To:

ENVI 10
ADOT Noise Abatement Requirements
FHWA Approval

Dallas Hammit
Deputy Director for Transportation
Arizona Department of Transportation
206 S 17th Ave. MD 102A
Phoenix, AZ 85007

Dear Mr. Hammit:

We have received and reviewed the Arizona Department of Transportation (ADOT) Noise Abatement Requirements (NAR). Based on our review, we consider that ADOT NAR meets the requirements of 23 Code of Federal Register 772, and the amount of $49,000 as the maximum reasonable cost of abatement cost-per-benefited-receptor is approved.

Sincerely,

Karla S. Petty
Division Administrator

Ecc:
Paul O'Brien, ADOT Environmental Planning
Beverly Chenausky, ADOT EP Air and Noise Program
Alan Hansen, FHWA
Tremaine Wilson, FHWA

Chapter 1

Definitions

Abatement - A reduction in noise level.

Approach Criteria – one dB(A) below the FHWA Noise Abatement Criteria (NAC) for the land use activity categories A through G. A Receptor is considered impacted if the predicted hourly equivalent traffic $L_{eq(h)}$) noise level meets or exceeds the approach criteria value. The Approach Criteria is one of two criteria that define noise impacts, the other being a Substantial Noise Increase predicted noise levels in Design Year.

Benefited Receptor - The recipient of an abatement measure that receives a noise reduction of at least five dB(A), but not to exceed the ADOT's reasonableness design goal.

Common Noise Environment - A group of Receptors within the same Activity Category in Table 1 that are exposed to similar noise sources and levels; traffic volumes, traffic mix, speed and topographic features. Generally, common noise environments occur between two secondary noise sources, such as interchanges, intersections or cross-roads.

Date of Public Knowledge - The date of approval of the Categorical Exclusion (CE), the Finding of No Significant Impact (FONSI) or the Record of Decision (ROD), as defined in 23 CFR 771. For state-funded projects, the Date of Public Knowledge is the date of approval of the appropriate environmental document.

Decibel (dB) - A unit for measuring sound levels.

Decibel, A-weighted Scale (dB(A)) - Sound levels are typically measured using a statistically weighted scale. Because the A scale most closely represents the range of human hearing, units of measurement for highway sound levels will use the A-weighted scale and be designated with dB(A).

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

Existing Noise Levels - The hour that currently has the worst noise level resulting from the combination of natural and mechanical sources and human activity present in a particular area.

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

Impacted Receptor - The Receptor that is or is predicted to experience traffic noise levels that ADOT considers approaching or exceeding FHWA Noise Abatement Criteria (NAC) for their appropriate Activity Category or which is predicted to experience a substantial noise increase.

Insertion Loss - A term used in noise analysis to describe the projected noise reduction as a result of a noise barrier being placed between a noise source and a Receptor.

L_{eq} - 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 $L_{eq(h)}$ being the hourly value of L_{eq}.

Level of Service (LOS) - A term that describes the relationship between traffic volume and traffic speed, consisting of six levels (A, B, C, D, E, and F).

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

Noise - Unwanted sound.

Noise Abatement Criteria (NAC) - Criteria established by FHWA based on land use that determine if and where traffic noise impacts occur.

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

Noise Impact Threshold - The decibel level at which predicted noise levels approach the Noise Abatement Criteria (NAC).

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

Predicted Noise Level - The noise level predicted to occur in the Design Year based on the worst expected traffic noise conditions, based upon calculation in validated FHWA TNM run.

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

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

Receiver - A location used in noise modeling to represent the measured or predicted noise level at a particular point.

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

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

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

Substantial Noise Increase - ADOT defines it as an increase in noise levels of 15 dB(A) in the predicted noise level over the existing noise level.

Traffic Noise Impacts - Design Year Build condition noise levels that approach or exceed the NAC listed in Table 1 for the future Build condition or Design Year Build condition noise levels that create a substantial noise increase over existing noise levels.

Type I Project -

a) The construction of a highway on new location or
b) The physical alteration of an existing highway where there is either:

- Substantial Horizontal Alteration. A project that halves the distance between the traffic noise source and the closest Receptor between the existing conditions to the future Build condition. For example, if a house

is located 200' away from a transportation facility, altering the alignment of the roadway such that it is only 100' away from the house would qualify as a substantial alteration or

- Substantial Vertical Alteration. A project that removes shielding therefore exposes the line-of-sight between the Receptor and the traffic noise source. This is done by either altering the vertical alignment of the highway or by altering the topography between the highway traffic noise source and the Receptor or

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

d) The addition of an auxiliary lane (in excess of 2500 ft in length), except for when the auxiliary lane is a turn lane or

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

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

g) The addition of a new or substantial alteration of a weigh station, rest stop, ride-share lot or toll plaza.

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

Type II Project - A federal or federal-aid highway project for noise abatement on an existing highway. For a Type II project to be eligible for Federal-aid funding, the highway agency must develop and implement a Type II program in accordance with section 23 CFR 772.7(e).

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

Traffic Noise Analysis Report - A report on traffic noise levels and eventual impacts in Existing Year and Design Year, No-Build and Build scenarios and alternatives and assessment of mitigation measures' feasibility and reasonableness. This analysis is typically performed during NEPA project development.

Traffic Noise Model (TNM) - FHWA Traffic Noise Model (TNM) is a state-of-the-art computer model for highway traffic noise prediction and analysis. TNM computes highway traffic noise at nearby receivers and aids in the design of highway noise barriers. The most current version of TNM shall be used on all federal and state-funded highway projects for which traffic noise analysis is required.

Chapter 2

Analysis of Traffic Noise

2.1 Project Classification, Inclusiveness and Comprehensiveness

For Type I projects, a traffic noise analysis is required for all Build alternatives under detailed study in the National Environmental Policy Act (NEPA) process. All reasonable alternatives that have been retained for detailed analysis in the Categorical Exclusion documentation, Environmental Assessment or Environmental Impact Statement and not rejected as unreasonable during the alternatives screening process, shall be included in the traffic noise analysis.

Should any segment or component of an alternative meet the definition of a Type I project, the entire alternative shall be considered as Type I and is subject to the noise analysis requirements.

Traffic Noise analysis must include an analysis of traffic noise impacts for each Activity Category, as per 23 CFR 772.11(c)(2), present in the study area.

Through the traffic noise analysis and prior to the Date of Public Knowledge, ADOT will identify:

a) noise abatement measures that are feasible and reasonable,

b) noise impacts for which no abatement appears to be feasible and reasonable and

c) need for further noise analysis, in the event that the design and public involvement processes are slated to continue after the approval of the NEPA documentation.

For tiered Environmental Impact Statements or other studies that will examine broad corridors, the appropriate scope and methodology of the noise analysis should be discussed with FHWA and other participating agencies early in the project planning process.

2.2 Commencement of a Traffic Noise Analysis

Commencement of a Traffic Noise Analysis shall not begin without coordination between ADOT Environmental Planning Noise to appropriately identify FHWA TNM inventory features, receiver placement and the methodology required to depict the worst-case traffic generating noise for predictions and modeling.

ADOT Environmental Planning Noise staff shall make every effort in facilitating continuous improvement of the noise analysis process by providing expertise, communication and collaboration, in determining the application of Best Available Practices and Supplemental Guidance pertaining to FHWA TNM modeling.

2.3 Traffic Noise Prediction

Pursuant to 23 CFR 772.9, the Traffic Noise Model (TNM) is the model approved by FHWA for predicting existing and future noise levels on transportation projects.

Existing and future noise levels must be predicted for the No-Build alternative, as well as all reasonable Build alternatives under consideration in the NEPA document and consider Common Noise Environment in comparisons.

The traffic data used to develop the model must be consistent with the traffic used in the planning and NEPA documents.

Predictions are not required for those alternatives that have been determined to be not reasonable and therefore, rejected for detailed analysis.

The FHWA TNM run used to predict existing noise levels must be validated as per 23 CFR 772.11(d)(2).

2.4 Design Concept Report and Traffic Analysis Requirement for Traffic Noise Analysis

2.4.1 Design Concept Report (DCR)

Traffic Noise Analysis shall use the latest approved DCR data thereby, provided for Existing and Design Year, Build and No-Build and every alternative considered.

- Roadway characteristics, coordinates, number of general purpose lanes (GPL) and other lanes, lanes' width, vertical and horizontal alignments, median barriers and other
- Land use, depicting Activity Categories as per Table 1 to Part 772—Noise Abatement Criteria, ensuring with local authorities that any foreseen development is accurately identified and included in the TNM and subsequent analysis.
- Utilities, Railroads, Drainage, Right-of-Way (ROW), Structures, such as bridges, retaining walls, barriers and existing noise walls are to be accurately depicted within TNM

2.4.2 Traffic Analysis

Traffic Noise Analysis shall use the following approved traffic data for the project, for all lanes, general purpose lanes, ramps, HOV lanes, TI, roundabouts, at Level of Service (LOS) C and on other highway influenced infrastructure that may not be considered inconsequential to increasing noise levels within project area.

- Traffic volumes, with lateral distribution (per lane).
- Vehicle type, vehicle distribution of automobiles, medium trucks, heavy trucks, busses and motorcycles with particular attention to percentage of heavy trucks with lateral distribution (per lane).
- Speed of traffic (per lane)

When predicting noise levels for the design year, a 'worst-case' approach should be used, wherein the traffic characteristics that produce the worst traffic noise impact should be used in the analysis. In general this should reflect LOS C traffic conditions during the peak noise hour with traffic moving at five miles per hour above the posted speed limit. If future traffic volumes are less than maximum LOS C volumes, future traffic volumes will be utilized. If no other information is available, the peak hourly volume should be 10% of the predicted Annual average daily traffic (AADT), with factors K, D, and T included in the analysis and with lateral lane across the travel lanes of a multiple-lane highway.

An exception to worst-case approach is pavement type, as all TNM-noise level predictions must utilize "average" pavement type unless, FHWA approval to use a different pavement type has been obtained.

2.5 Design Year and Logical Termini

The Design Year for prediction of future noise levels should correspond to that used in the environmental document. Logical termini of the noise impact study area should correspond to that used in the overall

environmental analysis and include all areas which are potentially to be impacted by highway traffic and construction noise, close to the highway and approximately within 300 ft from ROW, but usually not beyond 650 ft from the edge unless determined otherwise.

2.6 Activity Categories

The activity categories, their NACs, and examples of Receptors that fall into each category are presented in Table 1. Land which is permitted, but which has not yet been developed, including partially developed land with an active permit as defined by the applicable jurisdiction, will be considered under the appropriate category for the permitted development..

Considerations which apply only to certain categories are:

Activity Category A - All Category A designations must be approved by FHWA on a case-by-case basis. Proposals and justifications for designating land as Category A will be submitted by ADOT to the Arizona FHWA Division Office and FHWA Headquarters.

Activity Category B - There are no special considerations which apply specifically to Category B Receptors.

Activity Category C, Section 4(f) Properties - For properties subject to Section 4(f) protection, impacts must be evaluated by FHWA on a case-by-case basis to determine if there is a "substantial impairment" to the intended use of the property. Section 4(f) protections do not apply to state-funded projects.

Activity Category D - An indoor analysis shall only be done after exhausting all outdoor analysis options. If there are indoor areas of use which are distinct from exterior areas of use considered under Category C, both should be considered as separate Receptors for determination of impact and cost-per-benefited Receptor.

Activity Category E - There are no special considerations which apply specifically to Category E Receptors.

Activity Category F - No highway noise analysis is required for this category.

Activity Category G - Predicted noise levels will be determined for each segment of undeveloped land within the study area of the project, using receivers located at and approximately 300' away from the proposed ROW line.

All noise level measurements and predictions should be rounded to the nearest whole number prior to impact determination or mitigation analysis.

2.7 Areas of Use and Receiver Placement

2.7.1 General Provisions

Location of noise measurement and modeled receivers is to be agreed upon with ADOT Environmental Planning Noise staff prior to the commencing any measurement activities. Primary consideration is given to the outdoor activity areas of frequent human use, represented in noise levels worst-case scenario for the respective Activity Category. All modeled receivers are to be placed at 5 ft height or 17 ft height for representing 2nd level of two story buildings.

2.7.2 Residential Area

Receivers representing individual residences are to be modeled at the corner of the residence closest to the roadway with the highest traffic noise generation and closest to the highway and the ROW.

Every residence in a multi-family/apartment building is to be accounted for as a separate Receptor. Receivers representing multiple residences are to be located in a manner to best account for all noise propagation intervening features between the highway and the Receptors in question. A receiver cannot represent multiple Receptors that have significant vertical alterations, horizontal alterations, and noise propagation intervening features alterations.

2.7.3 Non-Residential Land Use

a) The receivers representing facilities such is a school or a hospital building are to be placed on each of the corners of the building and in the middle of the longer side of the building closest to the highway at 5 ft, and 17 ft for the rooms at 2nd level. Number of represented Receptors is to be equally distributed between the representing receivers. The total number of Receptors assigned to the building is calculated by dividing the total number of occupants by 8.

b) For other non-residential areas such as many of the Category C, D, and E locations listed in where the number of Receptors is not easily defined, the number and placement of receivers should consider the size of the area as well as the amount and intensity of use, as follows:

1) Determine the base number of Receptors in the area: divide the total land area of the receiver by 7,500 sqft, roughly the average size of a residential lot in Arizona.

2) Considering the intensity of use, assign one of the following values to each activity area:

- 0.5 – Low Intensity Area. A part of an area that receives limited use, or which is used primarily during non-peak traffic hours.

Possible Examples: A general use section of a park, an overflow section of a camping ground, etc.

- 1 – Moderate Intensity Area. A part of an area that receives use comparable to a standard residence.

Possible Examples: a small youth activity center, a designated picnic area, etc.

- 2 – High Intensity Area. An area which is used by either a moderate amount of people constantly or by a large number of people at one time.

Possible Examples: a community center or swimming pool, a busy playground, or a courtyard.

Multiply the number of receivers from 1) by the intensity of use determined in 2), and place those receivers where the activity is most likely to occur.

If this can't be determined, then the receivers should be distributed evenly across the area, or in a case of a track every 200 ft.

Example: A city park is located next to the transportation facility, and consists of an area 1000' long by 500' wide. It contains a youth swimming area (30,000 sqft, High Intensity), a picnic area (75,000 sqft, Moderate Intensity) and a Soccer Field (90,000 sqft, Moderate Intensity); the remaining 305,000 sqft of general use area is considered to be Low Intensity. The youth swimming area will be assigned 8 Receptors (4 x 2), the picnic area and soccer field will be assigned 10 and 12 Receptors respectively, and the remaining area will have 21 (41 x 0.5) Receptors spread across it evenly. Similar approach is to be used for land-development areas, where a lot of approx. 7500 sqft is to be considered as a single family residential facility, unless other facility is stated in the land use documents.

2.8 Measurement of Existing Noise Levels

2.8.1 General Provisions

All measurements of existing noise levels must be done in accordance with "Measurements of Highway Related Noise" (FHWA-PD-96-046 DOT-VNTSC-FHWA-96-5), unless superseded by another FHWA approved methodology. Noise measurements should use three sampling periods that are 10-15 minutes long when determining the $L_{eq(h)}$; in low traffic volume areas, the sampling period should be increased to 30 minutes in length. Noise measurements should also provide GPS coordinates of the site, ground type between dominant noise source and Receptor, noise readings, traffic volumes and mix, atmospheric conditions, and equipment used with valid certificates.

Measurements are to be taken in the areas of planned development, as would be the case for a single family residential facility. Measurements are to be taken under meteorologically acceptable conditions, with winds less than 12 mph and dry pavement. All measurement equipment shall have a valid calibration certificate at the time of measurements, as approved by FHWA.

2.8.2 Measurement for the Purpose of Model Validation

For the purpose of validation of the FHWA TNM, the noise level measurements taken must be representative of free-flow conditions, without traffic controls, away from sound reflective objects (warehouses, parked trucks, privacy walls etc.), without being influenced by other noise sources (aircrafts, lawn mowers, engines running, running water, loud insects, birds, animals), and with a clear view to the roadway.

When and where possible, it is recommended to take two noise measurements simultaneously, with sound level meters placed on the same line perpendicular to the highway, the farther being approximately within 400 ft from the highway, while the other placed half the distance.

Suggested periods for measuring traffic noise levels is 6:00-10:30 AM, and 15:30-18:00, excluding holidays, weekends, preferably on Tuesdays, Wednesdays, or Thursdays.

Any noise source contributing to the noise levels at the location, other than observed traffic noise, must be identified and captured in TNM model for that particular modeled receiver.

2.9 FHWA TNM - Recommendations

Modeling activities should reflect the FHWA Recommended Best Practices for the Use of the FHWA Traffic Noise Model (TNM), Traffic Noise Model: Frequently Asked Questions FAQs and NCHRP Report 791 Supplemental Guidance on the Application of FHWA's Traffic Noise Model (TNM), including other FHWA future provided guidelines.

A good engineering judgment must be applied where meteorological effects (e.g., wind speed and direction, temperature lapse or inversion) play a major role in the received sound levels at far distances, causing the highway noise to exceed the background noise.

2.9.1 Multi-lane Highway Modeling

When Receptors are located below the elevation of the highway, or there are any intervening objects in the sound propagation path that block the line of sight between the roadway and receiver, it is suggested that each travel lane be modeled separately

Grouping two or up to three lanes may be acceptable in circumstances where the information is not available; in such circumstances all heavy trucks flow is to be modeled in the lane(s) closest to the receivers.

2.9.2 Default Ground Type

Based on validation results of FHWA TNM, the default Ground Type selected in FHWA TNM for ADOT projects shall be hard soil, pavement or loose soil. Ground Type shall be the same for all years and scenarios in noise analyses.

2.9.3 Terrain Lines

High-quality topographic data shall be used to ensure the accurate prediction of highway traffic noise levels. Terrain lines should always be placed along elevated roadways that are either on fill or on structure. It is suggested that roadway median and shoulders be modeled.

2.9.4 Existing Barriers

Existing noise barriers and privacy walls are to be included in TNM. It is recommended for the vertical precision of a barrier top to be within ±1 ft.

2.9.5 Tree Zone

The vegetation must be sufficiently dense to completely block the view along the propagation path. Tree zones shall not be used in a TNM input file unless substantial information is available.

2.9.6 Noise Contours

As per 23 CFR 772.9(c), noise contours may only be used for screening alternative layouts and for land-use planning purposes and will not be used for determining noise impacts at specific locations. Noise contours shall not be used for determining whether or not a Receptor is impacted by highway traffic noise.

Chapter 3

Noise Abatement Criteria and Impact Determination

As required by 23 CFR 772.5, ADOT defines a Substantial Increase in noise levels as an increase in noise levels of 15 dB(A) in the predicted noise level over the existing noise level. Any Receptor that meets this criterion is considered impacted. The FHWA traffic noise regulations do not define the point at which a noise level "approaches" the NAC for a specific land use category. As required by 23 CFR 772.11(e), the point at which the noise levels "approach" the NAC is defined by ADOT as one dB(A), for Categories A, B, C, D, and E. There is no noise impact threshold for Category F or Category G locations.

Table 1 to Part 772—Noise Abatement Criteria

[Hourly A-Weighted Sound Level decibels (dB(A))[1]]

Activity category	Activity L_{eq}(h)	Criteria[2] L_{10}(h)	Evaluation location	Activity description
A	57	60	Exterior	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B[3]	67	70	Exterior	Residential.
C[3]	67	70	Exterior	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings.
D	52	55	Interior	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios.
E[3]	72	75	Exterior	Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in A-D or F.
F				Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing.
G				Undeveloped lands that are not permitted.

[1] Either Leq(h) or L10(h) (but not both) may be used on a project.
[2] The Leq(h) and L10(h) Activity Criteria values are for impact determination only, and are not design standards for noise abatement measures.
[3] Includes undeveloped lands permitted for this Activity Category.

Chapter 4

Analysis of Noise Abatement Measures

When traffic noise impacts are identified, noise abatement shall be considered and evaluated for feasibility and reasonableness, thus identifying noise abatement measures.

4.1 Noise Abatement Measures

1. Each analysis should consider the following noise abatement measures.

- Acquisition of ROW to provide a Buffer Zone
- Change to Horizontal or Vertical Alignment
- Insulation of Category D land use facilities
  It is only considered if exterior noise abatement is not feasible and reasonable.
- Traffic Management Measures
  - Control Devices
  - Traffic/Vehicle Restrictions
- Noise Barriers
  - Noise Walls
  - Noise Berms
  - Combination Wall/Berm
- Line-of-Sight
  When feasible/reasonable to do so, abatement measures should be designed to at least break the line-of-sight between traffic and receivers so as to achieve the maximum noise abatement.

2. Sound Absorptive Material

a) If a highway agency chooses to use absorptive treatments as a functional enhancement, the highway agency shall adopt a standard practice for using absorptive treatment that is consistent and uniformly applied statewide, as per 23 CFR 772.13(c)(2).

b) Sound absorbing wall, or material, considered must have been included in ADOT's Approved Products List, or as a minimum had been placed on the approved list by another state's Department of Transportation, and approved by ADOT to be considered as a noise abatement option for a noise barrier.

3. Other Measures – Vegetation and Quiet Pavement

As it requires 100' of dense evergreen vegetation to provide a noticeable reduction in noise levels, these may not be considered for abatement of highway noise.

Quiet pavements may not be used as an abatement measure on federally funded or approved projects unless otherwise directed by FHWA.

Chapter 5

Feasibility

Pursuant to the 23 CFR 772.13(d)(1), the initial consideration for each potential abatement measure should be both the engineering and acoustic factors that determine whether it is possible to design and construct the measure.

5.1 Engineering Feasibility Factors

- Safety: abatement measures will not be constructed in such a way as to create a potential safety hazard or to inhibit response to a safety emergency.
- Barrier height: Due to safety, structural and wind load considerations, ADOT will not normally construct noise barriers higher than 20 ft, as a stand-alone structure. However, a wall segment height may be up to 24 ft.
- Barrier curvature: When feasible, barrier should not be having an outline or surface that curves inward, like the interior of a circle or sphere, thus focusing the reflected noise to a single point, if there are noise sensitive Receptors in the area of the focus.
- Breaks in Barrier: When feasible, noise barriers should be designed and located in such a manner that does not require any breaks or openings in the barrier. In some cases, breaks in barriers can be accommodated with offset, overlapping barriers.
- Topography: the topography of the local area may potentially preclude the use or reduce the effectiveness of certain noise abatement measures such as barriers and berms.
- Drainage: any noise abatement measure constructed must provide for adequate drainage, both as a safety concern and to prolong the lifespan of the roadway.
- Utilities: in the event of a conflict between existing or planned utilities and potential noise abatement measures, any extra cost involved with utility relocation or modification may be included in the wall cost when comparing against the cost-per-benefited-Receptor.
- Maintenance requirements: abatement measures must be designed and constructed in such a way as to allow access to perform maintenance activities both for the barrier and for adjacent properties.
- Access to adjacent properties: abatement measures must not be designed or constructed in a manner that denies access to any property adjacent to the barrier.
- Overall project purpose: the use of abatement measures must be consistent with the overall purpose of the project.

5.2 Acoustic Feasibility Factor

Further to the 23 CFR 772.13(d)(1)(i), for a noise abatement measure to be acoustically feasible ADOT requires achievement of at least a five dB(A) highway traffic noise reduction at 50 % of impacted Receptors. In some instances, the noise level at a particular location may be affected by an alternate noise source such as other roadways/streets, railroads, industrial facilities, and airplane flight paths. In such locations, noise abatement for the proposed transportation project may not be acoustically feasible, since a substantial overall noise reduction cannot be achieved due to other noise sources. In such cases, the noise analysis for the location must consider the impact of the alternate noise source when determining acoustic feasibility. Regardless of the presence of alternate noise sources, barriers which are otherwise reasonable and feasible will be constructed.

Chapter 6

Reasonableness

There are three reasonableness factors or "tests" that must collectively be achieved in order for a noise abatement measure to be deemed reasonable. These are:

1. Viewpoints or Preferences of Property Owners and Residents
2. Noise Reduction Design Goal, and
3. Cost-effectiveness

6.1 Viewpoints or Preferences of Property Owners and Residents

The preferences of the property owners and residents of the benefited Receptors of a noise barrier will be taken into account when determining whether the barrier is considered reasonable. Noise barriers that are otherwise feasible and reasonable will automatically be considered to be desired unless the public involvement aspect of the NEPA process indicates that a substantial portion of benefited Receptors are opposed to the barriers. In that case, ADOT will make a good faith effort to determine the preferences of the property owners and/or legal occupants of each benefited Receptor location through a survey process. If less than a 50% response rate of property owner and residents is achieved and a substantial portion of the received responses are opposed to the recommended abatement measures, then further outreach will be attempted through the use of public meetings until either a 50% response rate is achieved or it becomes apparent that such a level of response is not possible due to situational concerns. ADOT will make a decision as to the reasonableness of the recommended mitigation based on the results of this process.

6.2 Noise Reduction Design Goal

Noise barriers should be designed to reduce projected unmitigated noise levels by at least seven dB(A) for benefited Receptors closest to the transportation facility. To be considered reasonable, at least half of the benefited Receptors in the first row shall achieve this level of noise reduction. Any Receptor that meets or exceeds the design goal counts toward satisfying the noise reduction design goal of the reasonableness criterion. Benefited Receptor does not have to be necessarily impacted.

6.3 Cost Effectiveness

The maximum reasonable cost of abatement is $49,000 per benefited Receptor (cost-per-benefited- Receptor) with barrier costs calculated at $35 per square foot, $85 per square foot if constructed on a structure. Any cost of removal of previously built walls, drainage, and other similar construction work shall be included in the cost assessment above.

The cost of an abatement measure is the total cost of that measure divided by all the benefited Receptors protected by that abatement. The cost-per-benefited Receptor and barrier-cost-per-square-foot require FHWA approval, and will be re-calculated on a regular interval, not to exceed five years, in the following manner:

1. The cost-per-benefited Receptor is determined by taking the square-foot cost of barriers determined below and multiplying by 1400 sqft.

2. The square-foot cost of barriers is determined by taking the greater of the current square-foot cost value or the average cost of construction of actual barriers for the preceding five years + 20%.

The current values were approved by FHWA on May 4, 2017.

6.1.1 Third Party Funding

Third party funding cannot be used to make up the difference in cost between the reasonable cost-per-benefited-Receptor and the actual cost of the barrier. Third party funding can only be used to pay for additional features such as landscaping, aesthetic treatments, alternative barrier materials including sound absorptive materials, for noise barriers that are feasible and already meet cost-effectiveness criteria.

Chapter 7

Inventory and Reporting of Abatement Measures

ADOT shall maintain an inventory of all constructed noise abatement measures. Inventory shall include the following parameters:

a) Type of abatement;

b) Cost (overall cost, unit cost per/sq. ft.);

c) Average height;

d) Length;

e) Area;

f) Location (state, county, city, route);

g) Year of construction;

h) Average insertion loss/noise reduction as reported by the model in the final noise analysis or most recent addendum;

i) NAC category(s) protected;

j) Material(s) used in construction (i.e., precast concrete, berm, block, cast in place concrete, brick, metal, wood, fiberglass, combination, plastic [transparent, opaque, other];

k) Features (i.e., absorptive, reflective, surface texture);

l) Foundation (ground mounted, on structure); and

m) Project type (Type I, Type II, and optional project types such as state funded, county funded, tollway/turnpike funded, other, unknown).

This information shall be reported to FHWA as requested by either the FHWA Division office or FHWA Resource Center.

Chapter 8

Interaction with Local Jurisdictions

8.1 Consultation with Local Jurisdictions

ADOT will consult with all local jurisdictions as part of the noise analysis process, and will consider the wishes of the local jurisdiction when considering noise abatement measures, as per Title 23 CFR 772.17.

8.2 Use of Local Jurisdiction Noise Abatement Policies on FHWA Projects

Any FHWA-funded or approved project which is administered by a Local Public Agency and which meets the requirements for a Type I project will utilize the ADOT Noise Abatement Requirements for determination of traffic noise impacts and feasibility/reasonableness of potential noise abatement.

8.3 Noise Compatible Land Use Planning

For any project where there are Category G lands, as per 23 CFR 772.17(a)(2), future noise levels at and approximately 300' away from the ROW line will be predicted for each segment of undeveloped lands.

Following FHWA approval of the Noise Analysis Report, this information will be made available to the local officials with the responsibility for making zoning/permitting decisions for that location. This information will be accompanied by the statement: "This information is presented purely to assist with noise-compatible land use planning decision making. Abatement for lands permitted after the Date of Public Knowledge for this project is not eligible for federal aid."

Environmental documents will contain information identifying areas that may be impacted by traffic noise, noise level contour information, the best estimation of future noise levels in the vicinity of the project, and other appropriate highway project design information.

ADOT may provide assistance to local jurisdictions in the development of noise controls.

Chapter 9

Federal Participation

For Type I projects, federal funds may be used for noise abatement measures when traffic noise impacts have been identified and abatement measures have been determined to be feasible and reasonable. These abatement measures which may be considered include noise barriers, traffic management measures, horizontal or vertical alignment alterations, acquisition of property to serve as a buffer zone, or noise insulation of Activity Category D land use facilities. Post-installation maintenance and operational costs for noise insulation are not eligible for federal-aid funding.

For a Type II project to be eligible for federal-aid funding, the highway agency must develop and implement a Type II program in accordance with section 23 CFR 772.7(e). Title 23 CFR 772.17 requires states to provide this information to local governments. The regulation also requires that the state make local officials aware of the eligibility requirements for federal-aid participation in Type II projects. As per 23 CFR 772.7(d), the development and implementation of Type II projects are not mandatory requirements.

Chapter 10

Construction Noise

10.1 General Requirements

To fulfill the requirement of 23 CFR 772.19, the evaluation of construction noise impacts and assessment of construction noise mitigation shall be performed on a project-by-project basis.

The process to minimize impacts of highway construction noise, shall:

1. Identify land uses or activities which may be affected by noise from construction of the project within the traffic noise technical report.
2. Determine the measures that are needed in the plans and specifications to minimize or eliminate adverse construction noise impacts to the community.
3. Consider construction techniques and scheduling to reduce construction noise impacts to nearby Receptors and incorporate the needed abatement measures in the project plans.

10.2 ADOT Requirements

ADOT's Standard Specifications for Highway and Bridge Construction stipulate that all exhaust systems on equipment should be in a good working order and properly designed engine enclosures and intake silencers should be used where appropriate. The Standard Specifications also stipulate that ADOT employees and contractors will follow all local rules and ordinances, including any local ordinances related to construction site and equipment. For all Type I Projects, ADOT will consider the effects of noise from project construction activities and will determine any additional measures that are needed in the plans or specifications to minimize or eliminate adverse impacts from construction noise. To minimize noise impacts during construction, each noise analysis should recommend that stationary or idling equipment be located as far away from Receptors as possible.

Any abatement measures dealing with construction noise determined to be necessary, reasonable, and feasible will be included in the project plans and specifications.

10.3 Wildlife and construction noise

Should situation in the project require evaluation of wild life noise sensitive activities such as bird nesting, the process shall:

- Identify individual construction equipment and activities schedule with duration.
- Use FHWA Roadway Construction Noise Model (RCNM) to predict construction noise levels for the specific location in question.
- If at some point before or during the construction works, nesting activities occur within 1000 ft, at minimum landscape buffer is required or rescheduling of the construction activities.

ADOT Environmental Planning Noise staff shall provide further guidance if required.