TRAFFIC NOISE ANALYSIS and ABATEMENT POLICY

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This policy document replaces the Montana Department of Transportation (MDT) *Traffic Noise Abatement Policy*, effective date July 1, 2011.

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ACRONYMS USED IN THIS DOCUMENT

ADT: Average Daily Traffic

ANSI: American National Standards Institute

BR: Benefited receptor

CE: Categorical Exclusion (as defined in 23 CFR Part 771, *Environmental Impact and Related Procedures*)

CEI: Cost Effectiveness Index

CFR: Code of Federal Regulations

dB: Decibel

dB(A): Decibel when referring to an A-weighted sound level

DHV: Design Hourly Volume (for traffic)

EA: Environmental Assessment (as defined in 23 CFR 771)

EIS: Environmental Impact Statement (as defined in 23 CFR 771)

FHWA: Federal Highway Administration

FHWA TNM: Federal Highway Administration Traffic Noise Model

FONSI: Finding of No Significant Impact (as defined in 23 CFR 771)

LOS: Level of Service

L_{eq}: Equivalent sound level in dB(A)

L_{eq}(h): One-hour equivalent sound level in dB(A)

MDT: Montana Department of Transportation

MEPA: Montana Environmental Policy Act

NAC: Noise Abatement Criterion

NEPA: National Environmental Policy Act

RCNM: Road Construction Noise Model

ROD: Record of Decision (as defined in 23 CFR 771)

1.0 INTRODUCTION

This document contains the Montana Department of Transportation (MDT) policy on highway traffic noise and construction noise as it affects the human environment. The policy describes MDT's implementation of the requirements of the Federal Highway Administration (FHWA) Noise Standard at Title 23 Code of Federal Regulations (CFR) Part 772. This policy was developed by MDT, reviewed and approved by FHWA, and is considered effective as of the date indicated on the title page. This policy replaces MDT's *Traffic Noise Analysis and Abatement Policy* effective July 1, 2011.

1.1 Background

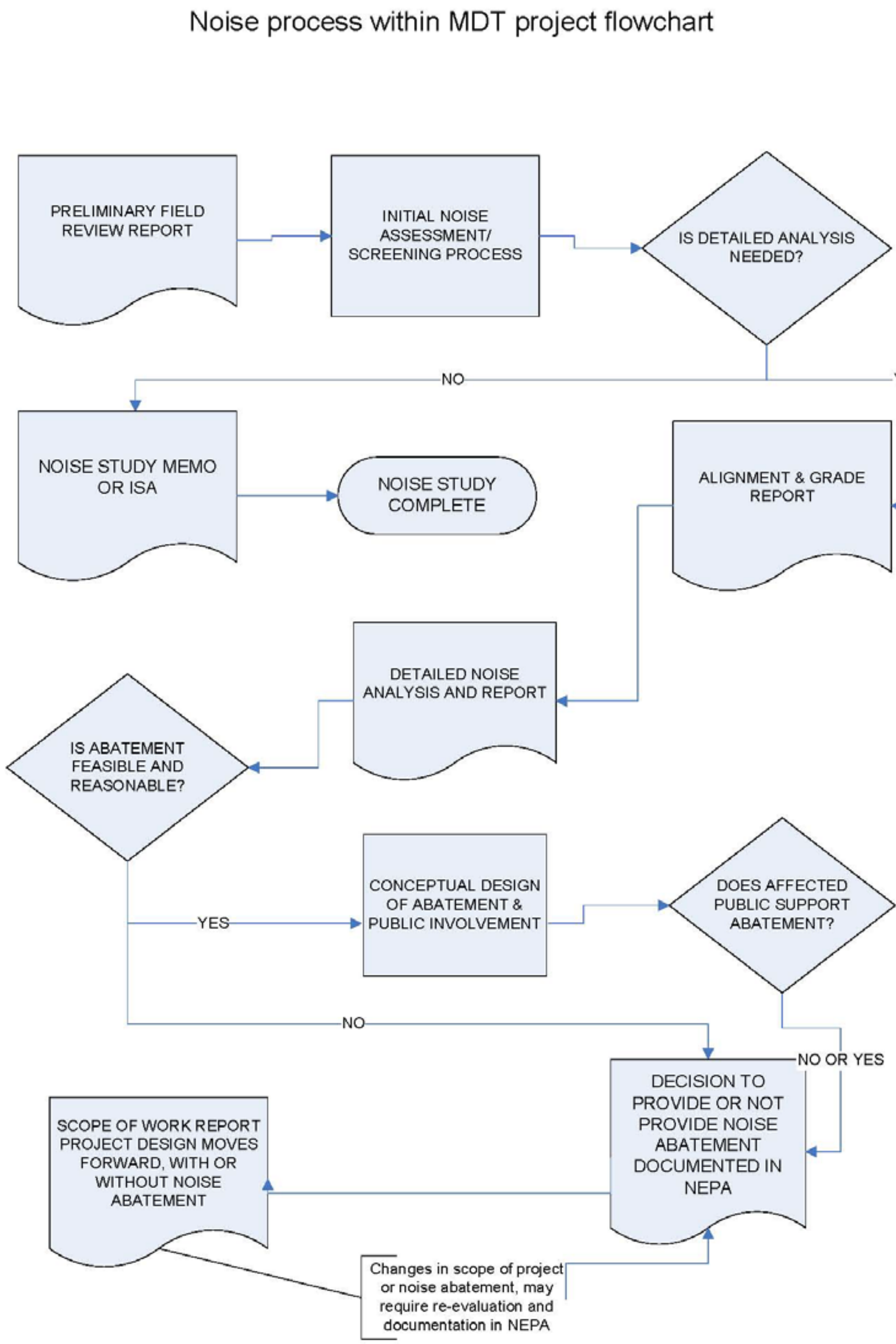
During the rapid expansion of the Interstate Highway System and other roadways in the 20th century, communities began to recognize highway traffic noise and construction noise as important environmental impacts. In the 1972 Federal-aid Highway Act, Congress required FHWA to develop a noise standard for new Federal-aid highway projects. While providing national criteria and requirements for all highway agencies, the FHWA Noise Standard gives highway agencies flexibility that reflects state-specific attitudes and objectives in approaching the problem of highway traffic and construction noise. This document contains the MDT policy on how highway traffic noise impacts are defined, how noise abatement is evaluated, and how noise abatement decisions are made.

As part of the general environmental review process associated with all projects, MDT or its consultants are required to evaluate whether the project needs a noise analysis, and if it does, whether predicted noise levels could result in traffic noise impacts. For Federal-aid projects, if noise impacts are identified then the consideration of reasonable and feasible noise abatement measures is required.

The analyses and abatement strategies used to comply with 23 CFR 772 and this policy will support the analyses and findings related to the National Environmental Policy Act (NEPA).

A process flowchart illustrating how the noise analysis steps are completed within project development is presented in Figure 1.

Figure 1 – Noise Process Flowchart



1.2 Noise Compatible Planning

Noise compatible land use planning has long been recognized as one prong of a three-pronged approach to traffic noise abatement, the other two prongs being source control (noise emission standards for vehicles) and traffic noise mitigation. Because MDT has no authority to regulate land use, MDT developed a guide that may assist local planners and decision-makers in developing pro-active noise-mitigating solutions.[1] It provides local planners and decision-makers with the tools they need to begin considering traffic noise in the planning and zoning process, hopefully reducing future conflicts between noise sensitive land uses and MDT highways. In cases where conflicts cannot be avoided, local governments should encourage developers to consider traffic noise in the layout of the site and the placement of sleeping areas within the building structures to minimize exposure of the noise-sensitive rooms and indoor or outdoor activities to traffic noise. When noise impacts are considered in planning at the local level, millions of dollars in taxpayer money can be saved by avoiding the construction of costly noise barriers.

2.0 PURPOSE

This policy describes the MDT program to implement the FHWA Noise Standards contained in 23 CFR 772. The standards include requirements for noise analysis, impact assessment, abatement evaluation, noise abatement criteria, and requirements for informing local officials. Where FHWA has given state highway agencies flexibility in implementing the standard, this policy describes the MDT implementation approach.

This policy is not to be used for determination of compensation (for damage) on a remainder of a parcel during right-of-way negotiations.

3.0 DEFINITIONS

A-Weighted Sound Level - The sound level in decibels measured with a frequency weighting network corresponding to the A-scale on a standard Type 1 or 2 sound level meter as specified by ANSI S1.4-1983 (R2006)/ANSI S1.4a-1985 (R2006), *American National Standard Specification for Sound Level Meters* (or latest version). The A-scale tends to suppress lower frequencies (below 1,000 hertz) and higher frequencies (above 6,000 hertz) in order to approximate sound as heard by the normal human ear. It is the most widely used weighting system for assessing transportation-related noise.

Acoustically Representative - A receptor location that represents the same land use category and magnitude of noise as another location. For good acoustical representation roadway geometry, topography, traffic flow, distance from source to receptor should all be nearly the same.

[1] This document is called *Growing Neighborhoods in Growing Corridors – Land Use Planning for Traffic Noise* and can be found on MDT's website under Brochures, Reports and Studies, Environmental: http://www.mdt.mt.gov/publications/brochures.shtml.

Benefited Receptor – A receptor that receives at least a 5-decibel noise reduction from an abatement measure.

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

Date of Development - The date at which land is permitted for development. See definition “Permitted” below.

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).

Decibel (dB) - A unit of sound pressure level which denotes the ratio between two sound pressures; the number of decibels is 10 times the base 10 logarithm of this ratio. The reference level for noise descriptors in this document is 20 microPascals, or the threshold of human hearing.

Design Hourly Volume (DHV) - The 30^{th} highest hourly volume of the future year traffic assigned for the design, expressed in vehicles per hour.

Design Year - The future year used to estimate the probable traffic volume for which a highway is designed. MDT typically defines design year as 20 years from the completion of construction.

Detailed Noise Analysis - The most comprehensive noise analysis provided under the MDT noise policy for projects where noise impacts may be expected, and where abatement measures may be feasible and reasonable.

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

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

Impacted Receptor - A noise-sensitive location for which a traffic noise impact has been calculated.

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 L_{eq} for one hour.

Multifamily Dwelling - A residential structure containing more than one residence. Each residence with a private exterior space in a multifamily dwelling is counted as one receptor when determining impacted and benefited receptors and determining barrier reasonableness.

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

Noise Contour **-** A line on a map representing points of equal sound level -- similar to ground elevation contour lines on a topographic map.

Noise Level - Unless otherwise indicated, "noise level" as used in this policy refers to the worst hour L_{eq}(h).

Noise Reduction Design Goal - The minimum desired sound level reduction determined by calculating the difference between future build noise levels with and without abatement. For MDT, the noise reduction design goal is 7 dB(A).

Noise Specialist – As referred to in this document, MDT's Noise Specialist is an employee of MDT with experience and training in the area of traffic noise, capable of writing and reviewing technical reports on traffic noise analysis and abatement, collecting ambient noise level measurements in the field, and operating the Traffic Noise Model (TNM).

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. In Montana, in cases where building permits and zoning do not exist, "permitted" is considered as the date at which a developer has shown a definite interest to develop the land within a reasonable period of time and has reached a point where the plans can no longer be practically changed (circumstances such as these will be examined on a case-by-case basis in consultation with FHWA).

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 modeling point in the FHWA Traffic Noise Model (FHWA TNM), at which sound levels are predicted.

Receptor - A discrete or representative location such as a residence or an activity area on a parcel of land being studied for noise impacts. A receptor does not necessarily need to be a modeled receiver in FHWA TNM or a field noise measurement point.

Residence - A dwelling unit such as a single family home or each dwelling unit in a multifamily dwelling.

Screening Noise Analysis - A simplified and streamlined noise analysis used for projects where noise impacts are not expected or where noise impacts may occur but abatement measures would clearly not be feasible. The MDT Noise Specialist must approve selection of this analysis.

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 - One of two types of highway traffic noise impacts. For a Type I project, MDT defines substantial noise increase as an increase in design year noise levels of 13 or more dB(A) over the existing noise level.

Traffic Noise Impacts - Design year build condition noise levels that create a substantial noise increase over existing noise levels; or design year build condition noise levels that approach or exceed the Noise Abatement Criteria (NAC) listed in Table 1 for the future build condition. MDT defines "approach" as one decibel below the NAC.

Type I Project - A proposed Federal or Federal-aid highway project for the construction of a highway on a new location, or the physical alteration of an existing highway which significantly changes either the horizontal or vertical alignment, or increases the number of through-traffic lanes. Specific definitions of Type I projects from 23 CFR 772 are in Section 4, *Applicability*.

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 23 CFR 772.7(e). MDT does not have a Type II program.

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

Worst Noise Hour - A period of 60 minutes within a 24-hour day that reflects the noisiest hour resulting from the maximum amount of traffic traveling at the greatest speed. Sometimes the worst noise hour may be when the vehicle mix is dominated by truck traffic, not necessarily a high volume of automobile traffic.

4.0 APPLICABILITY

The requirements of this policy apply to all projects in the State of Montana that receive Federal-aid funds or are otherwise subject to FHWA approval. They include Federal or Federal-aid projects that are administered by Local Public Agencies as well as MDT.

Noise abatement, such as barriers or berms, will not be considered for non-Federal aid projects due to high costs. MDT does not currently extend the Federal noise regulations to projects that are 100% state funded, nor does MDT have authority over locally-funded projects. Although noise abatement will not be considered for solely state-funded projects, potential traffic noise impacts will still be assessed and disclosed, as appropriate, to support the Montana Environmental Policy Act (MEPA) process.

4.1 Type I Projects

The requirements of this policy apply uniformly and consistently to all Type I projects in the State of Montana. Per 23 CFR 772, Type I projects are defined as:

1. The construction of a highway on new location; or,
2. The physical alteration of an existing highway where there is either:

a. Substantial horizontal alteration. A project that halves the distance between the traffic noise source and the closest receptor between the existing condition to the future build condition; or,
b. Substantial vertical alteration. A project that removes shielding, therefore is exposing the line-of-sight between the receptor and the traffic noise source. This is done by either altering the vertical alignment of the highway or by altering the topography between the highway traffic noise source and the receptor; or,

3. The addition of a through-traffic lane(s). This includes the addition of a through-traffic lane that functions as a high-occupancy vehicle lane, high-occupancy toll - lane, bus lane, or truck climbing lane; or,
4. The addition of an auxiliary lane, except for turn lanes; or,
5. The addition or relocation of interchange lanes or ramps added to a quadrant to complete an existing partial interchange; or,
6. Restriping existing pavement for the purpose of adding a through-traffic lane or an auxiliary lane; or,
7. The addition of a new or substantial alteration of a weigh station, rest stop, ride-share lot or toll plaza.

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.

4.2 Type II Projects

A Type II project is often referred to as a retrofit project. It is a proposed Federal or Federal-aid project for noise abatement on an existing highway where there is no improvement to the highway itself that increases its vehicle-carrying capacity. Type II programs are voluntary and at the discretion of the state highway agency. MDT does not have a Type II program so no noise analyses for Type II projects will be completed. Analyses for Type II projects are not discussed further in this policy.

4.3 Type III Projects

Projects that are not Type I or Type II are classified as Type III. MDT has no Federal requirements to conduct a noise analysis or consider abatement for Type III projects. Noise analyses will not be performed for Type III projects; however, the finding that the project is Type III must be included in the environmental documentation for the project.

5.0 ANALYSIS OF TRAFFIC NOISE IMPACTS

It is important to determine early on in project scoping if a noise study is necessary. An initial determination of a proposed project's need for a noise analysis should be made soon after the project has been programmed and a Preliminary Field Review has been conducted. For instance, a Type III project will not need an analysis, which will affect the scope of environmental analyses required for the project. While very little project information may be available at that time, early review may alert design engineers that traffic noise could be an issue on the project. By considering traffic noise before there are preliminary plans, MDT may be able to shift alignment or look at other actions to avoid and/or minimize traffic noise impacts.

5.1 Minimum Qualifications for Noise Analysts

Only qualified personnel can perform highway traffic noise analysis for MDT. Qualified personnel are those who have successfully completed training in the area of highway noise analysis and the use of the FHWA-approved traffic noise modeling software through a qualified provider, and who are proficient in the use of the latest version of that software.

The persons must have experience in conducting noise analysis studies for highway transportation projects and must have a working knowledge of procedures outlined in this policy and 23 CFR 772, plus the relevant parts of FHWA's *Measurement of Highway-Related Noise* (FHWA Report Number FHWA-PD-96-046, 1996)[2], and FHWA's *Highway Traffic Noise: Analysis and Abatement Guidance* (latest version).[3]

MDT advises consultants conducting noise analyses for the department to work closely with the MDT Noise Specialist.

5.2 Requirements for All Type I Projects

All Type I projects will require a noise analysis; however, not all analyses must be to the same level of detail. Two levels of noise analyses are provided in this policy. A Detailed Noise Analysis is the more involved and comprehensive level and is appropriate for more complex projects where noise impacts are possible and noise abatement actions may be feasible and reasonable. A Screening Noise Analysis is a streamlined process for simpler projects where noise impacts are unlikely, or abatement actions for any potential noise impacts are clearly not feasible and/or reasonable. The level of analysis required for a project will be determined by the MDT Noise Specialist. The two levels are described in more detail below.

Noise analysis is required for all build alternatives under detailed study in the NEPA process for Type I projects. If any segment or component of an alternative meets the definition of a Type I project, then the entire alternative is considered to be Type I and is subject to the noise analysis requirements. The build alternatives are considered to be all reasonable alternatives that have been retained for detailed analysis in the NEPA documentation and were NOT rejected during the alternatives screening process. For 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.

A Type I traffic noise analysis basically consists of the following steps, which are described in more detail in subsequent sections of this policy:

1. Identify study area and receptors by land use Activity Category (Section 5.3) and distance to the edge of the closest travel lane of the proposed project;

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[2] This report may be found on-line at: http://www.fhwa.dot.gov/environment/noise/measurement/measure.cfm.

[3] This document is available on-line at: http://www.fhwa.dot.gov/environment/noise/regulations_and_guidance/analysis_and_abatement_guidance/guidancedoc.pdf.

2. Determine existing noise levels at a representative subset of receptors;
3. Predict future "build" noise levels at a larger representative subset of receptors. Predict future "no-build" noise levels when needed for the proposed project;
4. Determine traffic noise impacts;
5. Evaluate abatement feasibility and reasonableness if there are traffic noise impacts;
6. Address coordination with local officials, including simple modeling of distance-based future "build" noise level contours for 60 and 64 dB(A) for undeveloped Activity Category G lands. Address construction noise;
7. Prepare the noise study report (Appendix A).

The level of detail and complexity needed for each of these steps will vary according to whether a detailed or screening analysis is being performed. Regardless of the analysis level, noise impact modeling and abatement evaluation/design for MDT projects requires use of the latest approved version of the FHWA Traffic Noise Model (FHWA TNM) or other model found acceptable to FHWA, pursuant to 23 CFR 772.9.

Only those abatement measures that are feasible and reasonable are included in the final noise report and carried forward for public survey. A description of the conceptual design of approved noise abatement will be included in the project's Scope of Work Report, as well as results of public opinion surveys. The NEPA document will include a statement of likelihood for noise abatement and a commitment for additional study if necessary, which would be a design level report completed subsequent to the NEPA process. The coordination of the noise analysis and the NEPA documentation is described in 23 CFR 772.13(g).

Final design of a recommended noise abatement action is reevaluated by an acoustical expert when final plans of the entire project are ready. This reevaluation may require refinement of the modeling in the noise study to ensure the noise abatement placement and barrier heights are correct to meet the commitments in the most current environmental document

5.3 Land Use Activity Categories

To determine under what conditions noise impacts occur, FHWA has designated Land Use Activity Categories A through G and associated Noise Abatement Criteria (NAC) with each as appropriate. The NAC values are hourly equivalent A-weighted sound levels in decibels. The Activity Categories and their respective NAC are described and listed in Table 1. The NAC are for impact determination only; they are not design goals or design standards for noise abatement measures.

The noise analysis must address each Activity Category present in the study area. If undeveloped land has been permitted for development (that is, a building permit has been issued on or before the date of public knowledge), that land should be assigned to the appropriate Activity Category and analyzed in the same manner as developed lands in that category.

Activity Category A (lands on which serenity and quiet are of extraordinary significance and serve an important public need). This category is not common and MDT must submit justifications to FHWA on a case-by-case basis to designate any lands as Category A. Proposals and justifications for designating land as Category A will be submitted through the state's FHWA Division Office and FHWA Headquarters.

Activity Category B (exterior areas of single-family and multifamily residences). The location for modeling or measuring at a Category B receptor is an exterior area of frequent human use. Typically this is an area between the right-of-way line and the building, such as a patio or play area in the backyard of the residence. When an area of frequent use cannot be determined from field review or aerial photography, an area mid-way between the residence and the right-of-way line should be chosen. For residences and structures that face the highway, choose an area of frequent use in the front, such as a front door landing. For apartment buildings, second-floor or higher balconies may be used for the purpose of assessing impacts and abatement benefits in addition to ground floor units

Activity Category C (exterior areas of non-residential lands such as schools, parks, cemeteries, etc., as listed in Table 1). The locations for Category C receptors are in the exterior areas of frequent human use. Category C includes a wide variety of public and private land uses. See Table 1 for examples of Category C land uses. See Section 6.6.1.1 and 6.6.1.2 for a discussion of analyzing Category C receptors.

Activity Category D (interiors of certain Category C facilities). Activity Category D is for those Category C land uses that have facilities with only interior human use. If the Category C land use has both an outdoor use area and an indoor use area, the outdoor use area should be analyzed for impact as Category C, unless the outdoor use area is far from or physically shielded from the roadway in a manner that prevents an impact on the outdoor activities. The indoor use area should be analyzed for impact as Category D. Analysis of interior noise levels should assume an open-window condition unless there is reliable information that the windows are in fact kept closed almost all of the time during which the facility is in use.

Activity Category E (exteriors of developed lands that are less sensitive to highway noise, as listed in Table 1). The location for Category E receptors are in the exterior areas of frequent human use.

Activity Category F (land uses that are not sensitive to highway traffic noise). There is no noise abatement criterion for these land uses, and no highway noise analysis is required under 23 CFR 772. The noise study report should identify any Category F land uses by name, location, and type of land use.

Activity Category G (undeveloped land). Undeveloped land may be either permitted for development or not permitted. For land that has been permitted for development, MDT will assign that land to the appropriate Activity Category A-F and analyze accordingly. For land that has not been permitted for development by the date of public knowledge of the project, MDT will determine future design year noise levels as described in Section 5.4.3, document them in the project environmental documentation and in the noise study report, and provide this information to the appropriate local officials. Federal participation in noise abatement measures will not be considered for Category G lands unless another future Type I project is planned adjacent to such lands.

Table 1 – Land Use Activity Categories and Noise Abatement Criteria

Activity Category	Activity Critieria[1] $L_{eq}(h)$, dB(A)	Evaluation Location	Activity Description
A	57	Exterior	Lands on which serenity and quiet are of extraordinary significance and serve an important public need where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B[2]	67	Exterior	Residential.
C[2]	67	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 stations, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings.
D	52	Interior	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios.
E[2]	72	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] The $L_{eq}(h)$ Activity Criteria values are for impact determination only, and are not design standards for noise abatement.
[2] Includes undeveloped lands that have been permitted for this activity category.

5.4 Detailed Noise Analysis for Type I Projects

A Detailed Noise Analysis is the level of analysis to be performed for MDT Type I projects unless a determination is made for a project to receive a Screening Noise Analysis. MDT's process for determining which projects qualify for a screening level analysis is described in Section 5.5.

5.4.1 Identification of Study Boundaries, Noise Study Areas, and Receptors

Through a combination of a review of project reports, available aerial photography and mapping, and a field review, the project limits and noise study boundaries are determined for confirmation by the MDT Noise Specialist. Noise study boundaries typically extend 500 feet on either side of a proposed project's improvements; however, some geometric conditions and traffic volumes and mixes may cause noise impacts to extend beyond 500 feet. The analyst is responsible for determining project boundaries that encompass all potential impacts. Consideration may also need to be given to the potential for both benefits and impacts outside of the project limits caused by changes in traffic volumes and/or mix on other facilities due to traffic diversion or generation resulting from the proposed project.

All land uses within the noise study boundaries are identified and assigned to the appropriate Activity Categories.

It is usually beneficial on large projects to group land uses together into smaller noise study areas for the purposes of noise modeling and abatement evaluation. A noise study area is generally not longer than a mile. Decision factors for dividing a project into noise study areas include the extents of individual neighborhoods or residential subdivisions, major terrain features (such as hills, mountains, and river crossings), location of large tracts of undeveloped lands, and boundaries defining major changes in land use (e.g., going from a residential area to a commercial or industrial area).

Individual receptor locations within the land uses are also chosen, using the guidance mentioned above under *Land Use Activity Categories*. On undeveloped lands that are permitted for development, use the filed plat to choose receptor locations representing the exterior areas of frequent human use. For residential plats, determine if each lot represents a single-family or multifamily dwelling. Choose representative receptor locations for second row residences as well (these receivers may be grouped two or three at a time).

5.4.2 Determination of Existing Noise Levels and Model Validation

For projects on new alignments, determine the worst-hour existing noise levels (including non-highway traffic noise sources) for developed land uses and activities by field noise measurements. For projects on existing alignments, existing noise levels can be determined by modeling, although field measurements are recommended.

5.4.2.1 Ambient Noise Level Measurements

Ambient noise measurements are done primarily for projects on new alignments, especially those across previously undeveloped ground, to establish existing noise condition for the project area. Ambient noise measurements are also conducted on existing roadways to verify that the modeled noise levels represent field conditions. Field measurements are conducted in accordance with the relevant procedures in FHWA’s *Measurement of Highway-Related Noise* report (FHWA Report Number FHWA-PD-96-046, 1996) or the most recent available protocols. Noise measurement locations are generally a subset of all identified receptors, and should be chosen to be acoustically representative of a grouping of similarly located receptors.

Noise measurements typically consist of a series of 15-minute measurements (minimum of two at roughly the same time of day). Longer measurement times may be necessary to obtain desirable statistical accuracy. If these measurements differ by more than 3 dB(A), a third measurement is needed, unless the variation can be explained by other noise events occurring during the measurement period.

On many rural or smaller widening road projects, there may be a small number of receptors, such that determination of existing levels along the entire project may not be necessary. One approach is to make a longer term measurement (that includes peak traffic periods and daytime off-peak periods) at one measurement location close to the existing road, and use the results to determine the worst noise hour. During this longer term measurement, shorter term measurements may be made at other locations, and these levels can then be adjusted later to represent the worst hour based on the data at the longer-term measurement location. While ambient noise level measurements should be made during the worst case noise hour, it may not always be practical to do so, especially given the rural nature of Montana.

5.4.2.2 Model Validation

When model validation is needed, it is done by comparing measured noise levels with modeled noise levels using same traffic volumes, mix and speeds tallied during the field noise measurements. Model validation does not have to be done for the worst noise hour.

Validation of the model for predicting existing noise levels along an entire project is done often enough to be representative of the affected neighborhoods. Consult with MDT regarding model validation. Validation measurement locations should be representative of first-row receptor locations and should not be blocked by buildings or terrain features[4].

Two to three measurements of at least 15 minutes in length are made at each measurement location. The measurements may be consecutive or done at different times of the day. The measurements do not have to be during the worst noise hour, and should not be made during periods of slow-moving traffic congestion. Validation measurements should be made during daylight hours not close to sunrise or sunset (to avoid temperature inversions) and when winds are generally calm. For measurement locations within 100 feet of the edge of the nearest travel lane, wind speed may be as high as 12 mph, but the speed and direction must be noted. For distances over 100 feet, validation is not recommended because of meteorological effects on sound propagation, but if needed, should be done under lower wind speed conditions. Cloudy or partly cloudy days are preferred over sunny days, especially for distances beyond 200 feet because of meteorological effects not modeled in FHWA TNM.[5]

Directional traffic classification counts of the five FHWA TNM vehicle types are made during each measurement. Average travel speeds are also determined by direction for each vehicle type for each measurement. Pavement type must be noted and used in FHWA TNM for validation purposes.

The FHWA TNM run of the existing conditions for each noise study area should contain each validation location. Separate model runs are made for each measurement at each validation location using the traffic data collected during that measurement (with traffic counts factored up to hourly volumes).

For the FHWA TNM run of a noise study area to be considered valid, two of the three modeled levels at each validation location must be within +/- 3 dB(A) of the corresponding measured levels. When a difference is over 3 dB(A), the model input data is examined for errors and for the need for refinements to the modeling, in particular with regard to pavement widths and terrain.

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[4] The FHWA TNM algorithm for building rows reduces sound uniformly behind a row of buildings; it does not take into account the exact position behind the row, which would affect the measured sound level against which the model would be compared.

[5] Bowlby & Associates, Inc. 2014.

If a measured/modeled difference remains over 3 dB(A) after revision of the model, the discrepancy is noted in the noise study report. Reasons for discrepancies may include contributions from noise sources other than the road during the measurements, atypical vehicle noise emission levels during the measurements, specific pavement conditions not in the model (tining, grooving, excessive roughness or wear, etc.), meteorological effects on the measured levels, or difficult-to-model terrain or ground characteristics.

If the model is consistently over-predicting or under-predicting by an amount greater than 3 dB(A) after attempts to refine the model and if measurement conditions have been ruled out as the likely cause of the discrepancies, calibration of the model (adjustment of modeled levels using the measured/modeled differences) may be considered, but only after consultation with the MDT Noise Specialist. Any calibration of the existing case model must be clearly justified and documented.

5.4.2.3 Determination by Modeling

For projects on existing alignments where there are many receptors and where impacts are expected, the modeling is validated by measurements.

Modeling existing noise levels for use in impact assessment is done for the worst noise hour. The worst noise hour may be determined in three ways:

1. By a longer term field noise measurement, as described above in *Ambient Noise Level Measurements.*
2. By review of detailed traffic data.[6]
3. By simplified modeling of the detailed traffic data using FHWA TNM if it is not clear as to which hour in the worst noise hour. In this and all modeling, vehicle classes must include:
    a. Automobiles – 2-axle, 4-wheel vehicles including pick-up trucks
    b. Medium trucks – 2 axles, 6 wheels, plus automobiles pulling trailers
    c. Heavy trucks – 3 or more axles

Vehicle classes may also include motorcycles and school buses.

5.4.3 Prediction of Future Noise Levels

Future condition noise predictions are made for each alternative under consideration, including the no-build alternative, using the latest version of the FHWA TNM program. Design year traffic conditions representing the worst noise hour (generally, Level of Service (LOS) C or D, with high heavy truck volumes) are used. In urban areas, rush hour may not represent the worst noise conditions; i.e., vehicle speeds may be lower and heavy truck volumes may drop as truck drivers try to avoid congestion. Obtain

[6] Automated traffic data collectors around the state collect traffic volume and mix information and can be obtained through MDT's web site. In addition, MDT provides existing and design year traffic volume information for certain vehicle classes during the preconstruction phase of project development. Other assistance, such as counting and classifying large volumes of traffic, may be obtained through MDT Environmental Services Bureau.

design year ADT and design hourly volume from MDT, including percentages of medium trucks and heavy trucks. If buses and motorcycles are also included in the modeling, obtain volume data for them as well.

Where appropriate, take into account seasonal variations in traffic volumes, such as using data from summer months; consult with the MDT Noise Specialist for guidance.

Use the guidance in Sections 5.3 and 5.4.1 for choosing receptors for modeling as receivers in FHWA TNM.

When predicting future noise levels, the analyst needs to account for any loss of shielding of the roadway due to topography, buildings, or vegetation that may be eliminated when roadway project is built. Alteration of physical shielding, such as a hill, may significantly change noise levels for receivers. Removal of vegetation will generally have little effect on noise levels, but may affect the residents' perception of the noise levels.

5.4.4 Determination of Future Noise Levels on Undeveloped Lands

Design year noise levels based on design hourly volumes need to be predicted for Activity Category G lands (undeveloped lands that have not been "permitted" for development). At a minimum, this analysis should report the distances from the proposed edge of the near travel lane out to where worst-hour L_{eq}(h) levels of 60 and 64 dB(A) are modeled to occur. These results are provided to local public agencies to assist them in their planning in order to prevent traffic noise impacts at future developments along state highways. Creation of noise contours for undeveloped lands will be considered on an individual project basis. Provide the results, along with a letter of explanation, to the local planning office. If the noise analysis is conducted by a firm outside MDT, submit the letter to MDT for review and approval. Noise contours may only be used for project alternative screening or for land use planning purposes, and NOT for determining highway traffic noise impacts.

5.4.5 Determination of Traffic Noise Impacts

For Type I projects, noise impacts must be determined for all Activity Category A-E land uses in the study area. Impacts occur when a proposed highway project results in a substantial noise increase, or when the predicted design year noise levels approach or exceed the NAC.

As defined in Section 3, a "substantial noise increase" occurs when a design year noise level (L_{eq}(h)) is predicted to increase 13 or more dB(A) above the existing noise level. A substantial noise increase is independent of the absolute noise level. A substantial noise increase is a noise impact, even if the future noise level does not approach or exceed the NAC. As defined in Section 3, "approach" means that a design year noise level is predicted to be one decibel below the NAC shown for Activity Categories A-E in Table 1. Noise abatement measures for Type I projects are to be examined and evaluated when either or both of the impact conditions are met.

Discussion of impacts is grouped by noise study area. Impacts are identified by receptor type, name or address, Activity Category, number of dwelling units if residential (or other quantification of the existing activities if non-residential), existing and future noise levels, and type of impact (substantial noise increase and/or approaching or exceeding the NAC).

5.5 Screening Noise Analysis for Type I Projects

For some Type I projects, a screening analysis using FHWA TNM will be appropriate. The screening analysis is a streamlined procedure using simplified TNM modeling to predict traffic noise levels and make a conservative estimation of noise impacts. Such a procedure is encouraged to save resources.

A Screening Noise Analysis is generally appropriate for two types of projects: when no noise impacts are anticipated; or, when noise impacts may be anticipated but potential noise abatement actions will clearly not be feasible and reasonable. Typically, these will be rural highway projects with uncontrolled access, few receptors, and large distances between receptors. For example, acoustical feasibility (Section 6.5.1) requires that at least three (3) receptors be protected by a continuous proposed noise barrier that guarantees at least a 5dB(A) reduction in noise. If there are less than three receptors (or receptor equivalents) in the area where noise abatement is being vetted, then no further analysis of noise abatement is needed. The decision to use a Screening Noise Analysis for a project will be made through the consultation with the MDT Noise Specialist.

Unless or until there are other FHWA-approved screening methods available, TNM modeling must still be performed, but the models may be simpler than for a Detailed Noise Analysis. TNM template models for Screening Noise Analyses are available from the MDT Noise Specialist, or TNM models can be created independently through coordination with the MDT Noise Specialist.

There are several simplifying measures to be used in the TNM models for a Screening Noise Analysis. The models will use flat ground elevation data with straight-line roads. Model receptors will be offset perpendicularly from the center of the model roads at distances that are representative of the distances from project roads to the nearest noise-sensitive receptors, and/or spaced at 50-foot intervals out to 500 feet to identify distances to NAC approach levels. The TNM roads will extend a minimum of 1,500 feet past the model receptors, i.e., a minimum of 3,000 feet total length. Refer to Section 5.4 for other important technical considerations that must be incorporated into the noise analysis, such as defining the study area, appropriate worst hour traffic volumes, vehicle fleet mix, etc.

The following items must be considered in a Screening Noise Analysis:

- Model validation (Section 5.4.2.2) is not required but the need for onsite noise measurements will be considered case by case;
- Non-traffic noise sources important to the study area must also be considered, such as industry;
- Existing conditions for the study area must be modeled to determine if future noise levels may increase by 13 dB(A) or more;
- All of the future alternatives under consideration for the project must be modeled;
- Future noise levels must be evaluated for noise impacts according to the criteria in Section 3;
- If Design Year noise levels are 64 dB(A) or less; or if noise levels are not predicted to increase more than 10 dB(A) over existing, the Screening Noise Analysis is sufficient;
- Traffic noise abatement actions will not be modeled for Screening Noise Analyses;
- If noise impacts for build alternatives are identified but prospective abatement actions would clearly not be feasible and reasonable (for reasons described in Section 6), the Screening Noise Analysis is sufficient and the findings must be documented;

- If noise impacts are identified and prospective abatement actions may be feasible and reasonable, a Detailed Noise Analysis must be performed;
- Document Screening Analysis in a Noise Technical report (Appendix A).

Careful consideration must be given to the nature of the study area before determining that abatement actions would clearly not be feasible and reasonable. The reason(s) for determining that noise abatement would not be feasible and reasonable under a Screening Noise Analysis must be documented in the noise report.

6.0 ANALYSIS OF NOISE ABATEMENT MEASURES

Depending upon the date of public knowledge of the project and the Activity Category of the receptors, traffic noise abatement measures are to be considered when traffic noise impacts have been identified through the noise analysis process, with the exceptions noted in Section 5.5.

6.1 Date of Public Knowledge

The date of public knowledge of a proposed transportation project is used to determine if noise abatement should be considered as part of the project. This date, which is defined in the Code, is the date that a project's NEPA decision document is approved. MDT will only consider abatement if the receptor was developed or “permitted” for development before the date of public knowledge.

Traffic noise will be re-evaluated prior to construction to assess if the noise environment has changed between the completion of the noise analysis and the Date of Public Knowledge. This includes evaluating changes in design and determining if any additional noise sensitive developments were later platted/permitted and were not part of the original analysis.

6.2 Abatement Considerations

There are two main elements in the consideration of noise abatement: feasibility and reasonableness, both of which are described in detail later in this section. Noise abatement measures must be found to be both feasible and reasonable for inclusion in a proposed project.

When evaluating the feasibility and reasonableness of noise abatement measures, a Noise Abatement Recommendation Worksheet may be completed to assist in the decision-making process. The worksheet is found in the Traffic Noise Chapter of the Environmental Manual.

For Type I Detailed Noise Analysis projects, MDT will examine and evaluate noise abatement when traffic noise impacts are predicted for Activity Categories A-E with some exceptions as noted in Section 5.3. For Category C/D land uses, if either the outdoor use area or the indoor use area is shown to be impacted by the proposed project, then exterior abatement strategies are evaluated first. If no exterior abatement measures are feasible and reasonable, sound insulation of the impacted indoor portions of the facility is evaluated next.

When impacts are identified for Activity Categories A-E, project design modifications will be evaluated first to avoid the impact by using design alternatives that result in lessening the noise effect, such as altering the horizontal and/or vertical alignments. If those options do not provide mitigation, noise barrier walls or berms will be evaluated.

6.3 Possible Noise Abatement Measures

Federal funds may be used for the following noise abatement measures when traffic noise impacts have been identified and abatement measures have been determined to be feasible and reasonable (Sections 6.5 and 6.6). The costs of such measures may be included in Federal-aid participating project costs with the Federal share being the same as that for the system on which the project is located.

If project design modifications are not feasible or cannot provide the necessary noise mitigation, MDT will consider noise abatement in the form of a noise barrier (wall or earth berm) within the highway project's right-of-way or easements. Other possible abatement measures that may be considered include:

1. Acquisition of real property or interests therein (predominantly unimproved property) to serve as a buffer zone to preempt development which would be adversely impacted by traffic noise;
2. Implement traffic management measures including, but not limited to, traffic control devices and signing for prohibition of certain vehicle types, time-use restrictions for certain vehicle types, modified speed limits, and exclusive lane designations. Although these measures have not yet been shown to be reasonable or feasible in Montana, traffic management measures may be considered in the abatement discussion. In rare cases, such as within city limits, it may be possible to restrict trucks on certain routes as a noise abatement action, provided there are similarly acceptable alternate routes for trucks. Speed limits are generally set by the Transportation Commission. Often, when speed limits are reduced, it is to address safety concerns, not noise impacts;
3. Insulate and/or install air conditioning in Activity Category D public use or institutional structures. Post-installation maintenance and operational costs for noise insulation are not eligible for Federal-aid funding;
4. Landscaping generally is not an FHWA-approved noise abatement measure for Federal-aid projects because thick stands of non-deciduous vegetation of over 200 feet in width are required to achieve even small (4-5 dB(A)) noise reductions.

6.4 Alternative Pavements or Textures

Use of alternative pavements or alternative texturing on concrete pavements is not a FHWA-approved noise abatement measure for Federal-aid projects. On projects where noise abatement is not found reasonable and feasible, alternative pavements may provide some noise benefit to nearby homes. The increase in cost for alternative pavements should be weighed with the noise reduction benefit. Consultants should contact MDT for information on alternative pavements, including issues related to rumble strips. To address public interest in or awareness of alternative pavements, the following text (or similar) may be included in the noise technical report:

> Pavement types and surfaces can affect traffic noise. Research efforts to learn more about the long-term noise benefits of different pavement types and surface treatments are ongoing. Quieter pavement types can be preferred for the project when minimum requirements for safety, durability and other materials requirements are also met. However, this cannot be counted as an abatement action under the noise reduction evaluation because it is not a "permanent" solution.

6.5 Feasibility

Feasibility deals primarily with acoustical and engineering considerations of the project such as topography, access, drainage, safety, other noise sources, and whether a substantial noise reduction can be achieved.

6.5.1 Acoustical Feasibility

Acoustical feasibility refers to the minimum number of receptors that must receive a 5 dB(A) for a proposed noise abatement berm or barrier wall to be acoustically feasible. For MDT projects, a noise barrier must be shown to provide this minimum noise reduction for at least three (3) front-row impacted receptors in order to meet the acoustical feasibility requirement. This provides a noticeable noise reduction for a sensible number of receptors. Note: This reduction is not the design goal (7 dB(A) – Section 6.6.2). Instead, this threshold provides the analyst with a screening procedure to advance noise abatement to the next level of analysis.

If significant non-highway noise sources exist in the project area, such as rail lines or airports, noise barrier effectiveness may be compromised. A careful evaluation of such a situation will be completed to determine if a noise barrier is feasible and reasonable for the highway noise sources.

6.5.2 Engineering Feasibility

Several safety and maintenance considerations may dictate whether or not a noise barrier is feasible. Some safety and height limitations that would make a noise barrier infeasible are excessive restriction of driver sight distances, continuous shadowing causing icing of the driving lanes, severe drainage problems associated with the barrier, or installation in flood-prone areas.

Several aspects of the overall height of a prospective noise barrier should be considered. An abatement barrier must be able to meet the two noise reduction levels (Sections 6.5.1 and 6.6.2) without being excessively tall. MDT has determined that common terrain and weather conditions in Montana, including common high wind events, means that barriers greater than 20 feet in height may not be allowable without compromising the structural integrity under typical construction design specifications Coordination with the project design team is needed to support the final barrier height.

Careful evaluation is needed regarding barrier placement, taking into consideration acoustics and maintenance of the barrier. Acoustically, the best locations for barriers are usually either close to the receiver or close to the noise source, depending on the terrain. Maintenance access is needed to both sides of the barrier, unless agreements are made with landowners otherwise. It is undesirable for a barrier to be placed in an area where it would create a dark tunnel effect; for example, a narrow space between land owner fences and the barrier. Maintenance areas must be large enough for maintenance vehicles to traverse.

From a highway safety standpoint, the noise barriers should be placed as close as practical to the right-of-way line, and preferably not placed off of the public road right-of-way. MDT's preference is to place the barriers outside of the highway clear zone; however, there are cases, i.e., fill situations, where this is not feasible. If the barrier is constructed in the clear zone, the barrier can be built on top of a jersey type barrier. Other methods of crash protection may also be viable. If the barrier is located on the shoulder, the barrier (including any protective device) should be at least two feet from the edge of shoulder or 10 feet from the shoulder stripe, whichever is greater. The slope between the edge of pavement and the barrier must be 10:1 or flatter.

When barriers are constructed at or near the shoulder line, safety, drainage, and ice and snow removal must be considered. The barrier may not be located within an intersection sight distance triangle for any approaches.

Other factors to consider are topography, utilities, maintenance access to adjacent properties, and access to adjacent properties on arterial widening projects. Consultants should seek guidance on engineering feasibility considerations from the MDT Highways Bureau and Bridge Design Bureau.

6.6 Reasonableness

The reasonableness evaluation involves an examination of costs, public support, potential for associated adverse impacts and whether a certain amount of noise reduction can be achieved. These three factors must all be met, at a minimum, for a noise abatement measure to be considered reasonable.

Two other subjective factors may come into consideration as well, as described in the section of Optional Reasonableness Factors.

6.6.1 Cost Effectiveness

The cost effectiveness of noise abatement can be considered by calculating a Cost Effectiveness Index (CEI), which takes into consideration the noise reduction the barrier will provide and the number of benefited receptors. The CEI is used to determine cost reasonableness only, it is not meant to estimate that actual material and construction costs associated with the approved noise abatement. The CEI should be calculated separately for each prospective barrier:

$CEI = \frac{Total\ barrier\ cost}{ANR \times BR}$, where: $Total\ barrier\ cost = Total\ barrier\ area\ (above\ ground) \times a\ planning\ unit\ cost\ for\ materials\ and\ foundations$ (see Table 2 below)

$ANR = Average\ noise\ reduction\ of\ benefited\ receptors, in\ dB(A)$
$BR = Number\ of\ benefited\ receptors$

For example, the following illustrates the CEI calculation for 56 benefited receptors protected by a 3500 foot long wall, 10 feet high, with a planning cost of $35/ft^2. The number of receptors with their corresponding noise reduction for this example is:

28	@	10 dB(A)
6	@	8 dB(A)
8	@	9 dB(A)
14	@	7 dB(A)

$$Average\ noise\ reduction\ (ANR) = \frac{sum\ product\ of\ receptors \times average\ noise\ reduction}{\#\ benefited\ receptors}$$

$$= \frac{\big((28 \times 10) + (6 \times 8) + (8 \times 9) + (14 \times 7)\big)}{56} = 8.9 \text{ dB(A)}$$

$$Total\ wall\ cost = 3500\ ft \times 10\ ft \times \$40/ft2 = \$1{,}400{,}000$$

$$CEI = \frac{\$1{,}400{,}000}{(56 \times 8.9 \text{ dB(A)})} = \$2{,}907$$

Depending on the planning unit cost used, a barrier that has a CEI greater than the corresponding value in Table 2 is not considered reasonable to build.

As of the date of this policy, a planning cost of $\$40/ft^2$ is used for noise barriers (generally concrete panel or block), which includes wall and foundation construction. MDT may choose to reassess the CEI and barrier planning for each proposed noise barrier project. Table 2 illustrates how CEI adjusts with changes in planning costs.

Table 2 – Planning Cost vs CEI

Planning cost ($/sq. ft.)	CEI ($/dB(A)*BR)
35	4900
40	5600
45	6300

6.6.1.1 Determination of Benefited Receptors for Non-Residential Land Uses

Benefited receptor equivalents for non-residential land uses are determined with the understanding that the residential land use represents an average lot size and exterior areas of frequent human use during daylight hours, on a year-round basis. To calculate the benefited receptor equivalents for non-residential land uses that have both indoor and outdoor uses, simply divide the square footage of the impacted area of the land use by the average lot size of nearby residential lots. If average lot size is unknown or indeterminable, use a default value of 5000 square feet per receptor.

Example 1: A 25,000 square foot indoor auditorium, all within the impacted area:

$$\frac{25{,}000\ sq\ ft}{5{,}000\ sq\ ft} = 5\ benefited\ receptor\ equivalents.$$

Example 2: A 3,000 square foot daycare center where average lot sizes are 5,000 square feet = 1 benefited receptor equivalent (site is smaller than minimum lot size but still equivalent to 1 receptor).

The benefited receptor equivalents will be evenly placed in areas approximating the human use areas.

6.6.1.2 Non-Residential Land Uses with Outdoor-Only Seasonal Usage

Since many land uses in Table 1 Category C are outdoor only uses, the benefited receptor equivalents are determined by dividing the square footage of the impacted area by the average lot size of nearby residential neighborhoods and multiplying that result by a seasonal multiplier. The analyst determines the months of the year the land is used and calculates a seasonal multiplier for the months of use. This method assumes that the majority of outdoor usage is during daylight hours. If the analyst determines that a particular outdoor-only land use experiences significant usage after dark, then the analyst should use the actual hours of usage, not daylight-only hours.

Average hours of sunlight for each month for many Montana communities are listed in Table 3. Seasonal usage and seasonal multipliers (determined by dividing the sum of monthly hours of use by the year-round hours of daylight) are listed in Table 4. Seasonal multipliers should be determined for each land use in question based on the months of the year activity occurs.

Table 3 – Average Hours of Sunlight

Month	Average Hours Of Sunlight	Month	Average Hours of Sunlight
January	9.00	July	15.50
February	10.33	August	14.25
March	12.00	September	12.50
April	13.67	October	10.83
May	15.25	November	9.25
June	16.00	December	8.50

Table 4 – Seasonal Multiplier

Season	Hours	Seasonal Multiplier
Year-round	147.08	None
Jun-Jul-Aug	45.75	0.31
Sept-June	101.33	0.69
Apr-Oct	98.00	0.67

NOTE: For Category C land uses that include areas where people sleep, such as campgrounds and RV parks, each camping site or RV unit is counted as one benefited receptor and then the total number of those in an impacted area is multiplied by the seasonal factor.

The following examples all assume an average residential lot size of 5,000 square feet.

Example 3: Outdoor Sports area with three tennis courts totaling approximately 12,000 square feet impacted area and open in only the non-winter months, the equivalent number of benefited receptors would be $\frac{12{,}000\ sq\ ft}{5{,}000\ sq\ ft} \times 0.67$ *(seasonal weight)* = *1.6 benefited receptor equivalents.*

Example 4: Summer-use only campground with 12 of 18 campsites impacted:
$12 \times 0.31\ (seasonal\ weight)\ =\ 3.7\ benefited\ receptor\ equivalents.$

Example 5: An RV park with 25 impacted units, in use all year except for winter months: $25\ \times\ 0.67\ (seasonal\ weight)\ =\ 16.7$ *benefited receptor equivalents.*

Example 6: A 1 1/2-acre school playground impacted: $\frac{65{,}340\ sq\ ft}{5{,}000 sq\ ft} \times 0.69\ (seasonal\ weight) =$
$9\ benefited\ receptor\ equivalents.$

6.6.2 Noise Reduction Design Goal

Noise barriers must achieve a minimum noise reduction design goal of 7 dB(A) to be considered reasonable. This is different from Acoustical Feasibility (Section 6.5.1) which requires a 5 dB(A) noise reduction be achieved at a minimum of three (3) homes for noise berms or barrier walls to be considered further. If noise abatement can be constructed to meet that minimum 5 dB(A) at three receptors criteria, then design is carried forward and the abatement must meet the Noise Reduction Design Goal of 7 dB(A) minimum for at least 60 percent of first row receptors. If this design goal is not attainable or does not meet the CEI, then the noise abatement cannot be carried forward. This requirement ensures that the majority of impacted and benefited receptors behind a noise barrier will experience a noticeable reduction in noise.

6.6.3 Public Support from Benefited Receptors

The viewpoints of benefited residents and property owners are considered in the decision to provide noise abatement, especially considering a visual obstruction such as a barrier or berm. For example, a barrier height that will cause excessive shadowing of private property may make the barrier undesirable to the residents; this should be discussed with affected property owners and residents during public outreach for noise abatement. Each dwelling unit receives one weighted vote, regardless of how many people reside in the unit, or how many owners the property has. For a residence that is owned but rented by someone else, a total of two weighted votes would be received, one from the renter(s) and one from the owner(s).

A benefited receptor is one that receives a noise reduction from the abatement measure of at least 5 dB(A), whether or not that receptor has been found to be impacted. To simplify the discussion, viewpoints are counted as votes, with more weight given to property owners and renters of first-row receptors, as illustrated below.

- First row renter – 1.5 votes
- First row property owner (non-residing) – 2 votes
- First row owner-occupied – 3 votes
- Non-first row renter – 1 vote
- Non-first row owner-occupied – 1 vote
- Non-first row property owner (non-residing) – 1 vote

If one property has multiple dwelling units, the owner(s) of the multi-unit dwelling provide input for the property as a whole, not for each individual dwelling unit.

Noise abatement will be carried forward if there is a 51% majority of weighted votes received in support of the barrier. Support of noise abatement will be based on the responses received. A second outreach will be attempted if the response rate is less than 40% of all possible respondents (not the weighted values). The decision to provide noise abatement will rest on the responses received, regardless of the final response rate. MDT will make every effort to solicit responses from affected residents, through neighborhood meetings, mailings and individual outreach if necessary. Balloting procedures will be explained during public outreach.

If support for the barrier is lacking, the abatement proposal will be dropped from consideration, and the area will not be eligible for future Type II noise abatement (23 CFR 772.15(b)(3)), if MDT subsequently develops a Type II program.

MDT will attempt to seek comment from affected residents on the aesthetics of proposed noise barriers. The exception to this is if there is already an existing aesthetic theme in the project corridor, then the noise barriers will be designed to match the existing aesthetics of the corridor. To be carried forward, the added expense of noise barrier aesthetics must still meet the reasonableness criteria for cost effectiveness.

6.7 Third Party Funding

For Type I Federal-aid projects, third party funding cannot be used to reduce the cost in the numerator of the CEI formula to lower the calculated CEI for a prospective abatement action. Third party funding can only be used to pay for additional features such as landscaping, aesthetic treatments, and functional enhancements, such as sound-absorbing treatment and access doors, for noise barriers already determined to be feasible and reasonable.

6.8 Sound-Absorbing Noise Barrier Treatments

The addition of sound-absorbing treatment to noise barriers or the use of integrated sound-absorbing barrier systems is sometimes necessary to reduce potential sound level increases due to reflections from a single noise barrier wall or behind parallel noise barrier walls on either side of a road or ramp. Analysis of the need for and effectiveness of sound absorption in such cases should generally be done using the FHWA TNM program.

MDT's standard practice is to analyze the need for sound absorption when parallel barriers are proposed and the width (distance between barriers) to barrier height ratio is less than 20:1. Use of sound absorption will be considered when there are modeled increases in the levels of more than 2 dB(A) behind one or both of the walls due to reflections at one or more of the receptors, and when the sound absorption will reduce the increases to less than one decibel.

For single barriers, sound absorbing materials may be analyzed in these cases:

1. A bike/pedestrian path is proposed for the highway side of a barrier;
2. Activity Category A, B or C receptors are across the roadway from the wall;
3. A frontage road is between the noise barrier and the receptors.

Use of sound absorption will be considered when there are modeled increases in the levels of more than 2 dB(A) due to reflections, resulting in a "with reflections" level of at least 64 dB(A), and when the sound absorption will reduce the increases to less than 1 dB(A).

6.9 Use of Clear Panels in Noise Barriers

When noise barriers greater than nine feet in height will substitute for, replace, or are immediately behind a backyard fence or lot line, and where the distance between the barrier and the exterior area of frequent active human use is less than approximately 25 feet, MDT will consider the installation of clear panels at the top of the barrier in the affected areas, and if the improvement can be made while still meeting the CEI.

6.10 Information Required for a NEPA Decision

Accurate and complete documentation of the noise impacts analysis and any decisions to provide noise abatement is imperative. The noise analysis reports for Type I projects are stand-alone documents. Germaine information is taken from the noise analysis report to support the NEPA analysis and decision. The specific information required is outlined in 23 CFR 772.13. Appendix A gives details on reporting for Type I projects.

Decisions to provide or not provide noise abatement must be well-explained and defensible. Prior to the NEPA decision, MDT must identify and document:

1. Where noise impacts occur;
2. The prospective noise abatement measures that are feasible and reasonable, and are likely to be incorporated into the project;
3. Noise impact locations for which no abatement appears to be feasible and reasonable.

For noise abatement measures that have been found to be feasible and reasonable, a statement of likelihood, similar to the following, should be included in the narrative environmental document in the interest of public disclosure:

> "Based on the studies thus far accomplished, the State intends to install highway traffic noise abatement measures in the form of a barrier at __(location)__. The preliminary indications of likely abatement measures are based on a preliminary design cost for a barrier of $__(total barrier cost)__ that will reduce noise levels by ___ to ___ dB(A) for (#)__ dwelling units (residences or other sensitive receptors). If it subsequently develops during final design that these conditions have substantially changed, the abatement measures might not be provided, or may be modified. A final decision of the installation of the abatement measure(s) will be made upon completion of the project's public involvement process for noise abatement."

The noise analysis report should include: a description of each abatement measure considered; a discussion of the anticipated costs, problems and disadvantages associated with that measure; and, a discussion of the anticipated benefits. In many cases it is impractical to consider any noise abatement measures other than the construction of noise barriers. This discussion encompasses the reasonableness and feasibility of noise abatement. Careful explanation and consideration of all the applicable criteria that provide the best, most defensible decision is needed in the report and environmental document. Feasible and reasonable abatement measures are incorporated into the project to minimize noise impacts and enhance the community to the extent practicable.

The FHWA will not approve Type I project plans and specifications unless feasible and reasonable noise abatement measures are incorporated into the plans and specifications to reduce the noise impact on existing activities, developed lands, or undeveloped lands for which development is permitted.

6.11 Design-Build Projects

Design-build projects are unusual in that they progress on an accelerated schedule whereby the Design Build firm is responsible for both designing and building the project. The Design Build firm may or may not be responsible for conducting the NEPA analysis in accordance with the provisions of 23 CFR 636.109, including the noise assessment. However, MDT will ultimately be responsible for the NEPA decisions. In design-build projects, just as with any MDT project, noise abatement measures must be considered, developed, and constructed in accordance with the provisions of 23 CFR 772, 23 CFR 636.109, and this policy.

6.12 Inventory and Reporting of Abatement Measures

All state highway agencies are required by FHWA to maintain an inventory of all constructed noise abatement measures and provide that information to FHWA on a periodic basis. The inventory parameters are listed in 23 CFR 772.13(f). MDT will compile the data in a spreadsheet on an ongoing basis as abatement measures are implemented. Noise barrier Inventory data from all states is managed by FHWA.

7.0 INFORMATION FOR LOCAL OFFICIALS

Highway traffic noise must be reduced through a program of shared responsibility. Local governments can use their authority to regulate land development in such a way that noise-sensitive land uses are either prohibited from being located adjacent to a highway, or that developments are planned, designed, and constructed in such a way that noise impacts are minimized, such as in noise mitigated developments.

It is MDT's policy to furnish the results of Type I highway traffic noise analyses to local government officials. With regards to undeveloped lands that have not been permitted for development, the results will include at a minimum the distances from the proposed edge of the traveled way to where the design year L_{eq}(h) of 60 and 64 dB(A) are predicted to occur.

Information on planning neighborhoods that are more compatible with the highway environment can be found in these references:

1. *Growing Neighborhoods in Growing Corridors: Land Use Planning for Traffic Noise* (MDT, 2008): http://www.mdt.mt.gov/other/research/external/docs/research_proj/noise_plan/final_report.pdf
2. *Noise Compatible Planning* (USDOT FHWA): http://www.fhwa.dot.gov/environment/noise/noise_compatible_planning/
3. *Highway Traffic Noise: Analysis and Abatement Guidance* (USDOT FHWA), the latest version: http://www.fhwa.dot.gov/environment/noise/regulations_and_guidance/analysis_and_abatement_guidance/
4. *Entering the Quiet Zone: Noise Compatible Land Use Planning*, (USDOT FHWA, 2002): http://www.fhwa.dot.gov/environment/noise/noise_compatible_planning/federal_approach/land_use/index.cfm
5. *The Audible Landscape* (USDOT FHWA, 2001): http://www.fhwa.dot.gov/environment/noise/noise_compatible_planning/federal_approach/audible_landscape/index.cfm

8.0 CONSTRUCTION NOISE

Construction of a highway project may cause localized, short-duration noise impacts. Construction noise can adversely affect people living in the area. Analysis and mitigation of construction noise impacts will be addressed when noise and vibration issues arise during project development or if complaints are received by the affected public. At a minimum, for all Type I projects, the noise study:

1. Identifies land uses or activities that may be affected by noise from construction of the project. The identification is to be performed during the project development studies;
2. Determines the measures that may be needed in the plans and specifications to minimize or eliminate adverse construction noise impacts to the community. This determination includes a weighing of the benefits achieved and the overall adverse social, economic, and environmental effects and costs of the abatement measures;
3. Incorporates the needed construction noise abatement measures into the plans and specifications.

Construction noise impacts can be minimized by using standard MDT specifications for the control of noise sources during construction (refer to current MDT "Standard Specifications for Road and Bridge Construction," Section 107). Local noise ordinances may prohibit construction activity between certain times of the day, or there may be other restrictions imposed on the contractor. Contractors are required to comply with all applicable regulations governing equipment source levels and noise resulting from construction site activities during improvement projects. Alternately, the Contractor may seek a variance to operate outside the local noise ordinance.

As examples, the following techniques can be used to reduce construction noise impacts:

1. Place stationary noise sources as far from sensitive receptors as reasonably feasible;
2. Use portable noise barriers or take advantage of natural terrain features between the noise source and sensitive receptors to provide shielding;
3. Turn idling equipment off;
4. Drive equipment forward instead of backward whenever possible; lift instead of drag materials; and avoid scraping or banging activities by substituting quieter hand methods, if possible.
5. Confine work that does not have to be done at night to daylight hours. When work must be done at night, complete the noisiest work as early as possible.

Construction noise can be further reduced through the use of properly sized and maintained mufflers, engine intake silencers, less obtrusive backup alarms, engine enclosures, noise blankets, and rubber linings. Additional information can be found in 23 CFR 772.19 and the *FHWA Highway Construction Noise Handbook*, Final Report No. FHWA-HEP-06-015 and DOT-VNTSC-FHWA-06-02, August 2006, on the FHWA web site at: http://www.fhwa.dot.gov/environment/noise/construction_noise/handbook/.

While construction noise modeling is rarely done for Type I noise studies, there is available a program for predicting noise levels from various types of equipment and construction activities, the FHWA Roadway Construction Noise Model (FHWA RCNM), on the FHWA web site at: http://www.fhwa.dot.gov/environment/noise/construction_noise/rcnm/.

Construction equipment noise levels are usually measured at 50 feet from the source. Typical levels are shown in Table 5. Construction equipment noise levels typically decrease 6-8 dB(A) per doubling of distance if there is a clear view of the equipment, and more if there is shielding that interrupts that view. For example, a bulldozer creating 80 dB(A) of noise at 50 feet will have an observed value of approximately 72-74 dB(A) at 100 feet and approximately 64-68 dB(A) at 200 feet.

Consultants should seek approval from the MDT Noise Specialist before doing construction noise modeling for a noise study.

Table 5 – Typical Construction Equipment Maximum Sound Levels

Equipment Description	Acoustical Use Factor, %[1]	Maximum Sound Level at 50 feet, dB(A)[2]
Auger Drill Rig	20	84
Backhoe	40	78
Boring Jack Power Unit	50	83
Chain Saw	20	84
Clam Shovel (dropping)	20	87
Compactor (ground)	20	83
Compressor (air)	40	78
Concrete Mixer Truck	40	79
Concrete Pump Truck	20	81
Concrete Saw	20	90
Crane	16	81
Dozer	40	82
Drill Rig Truck	20	79
Drum Mixer	50	80
Dump Truck	40	76
Excavator	40	81
Flat Bed Truck	40	74
Front End Loader	40	79
Generator	50	81
Generator (<25KVA, VMS signs)	50	73
Gradall	40	83
Grapple (on backhoe)	40	87
Horizontal Boring Hydraulic Jack	25	82
Impact Pile Driver	20	101
Jackhammer	20	89
Man Lift	20	75
Mounted Impact hammer (hoe ram)	20	90
Pavement Scarifier	20	90
Paver	50	77
Pickup Truck	40	75

Table 5 – Typical Construction Equipment Maximum Sound Levels

Pneumatic Tools	50	85
Pumps	50	81
Refrigerator Unit	100	73
Rivet Buster/chipping gun	20	79
Rock Drill	20	81
Roller	20	80
Sand Blasting (Single Nozzle)	20	96
Scraper	40	84
Shears (on backhoe)	40	96
Slurry Plant	100	78
Slurry Trenching Machine	50	80
Vacuum Excavator (Vac-truck)	40	85
Vacuum Street Sweeper	10	82
Ventilation Fan	100	79
Vibrating Hopper	50	87
Vibratory Concrete Mixer	20	80
Vibratory Pile Driver	20	101
Warning Horn	5	83
Welder/Torch	40	74

[1] The percentage of the time period under consideration when the equipment is at its maximum level, used to convert maximum sound levels to Leq, where Leq = Maximum Sound Level + 10 log (Acoustical Use Factor/100).

[2] Measured on "slow" response, as defined in ANSI S1.4-1983 (R2006)/ANSI S1.4a-1985 (R2006).

Source: *FHWA Roadway Construction Noise Model User Guide*.

9.0 UPDATES TO POLICY/MANUAL

Changes to the policy will be made as needed, or every 5 years, per FHWA recommendations. The updated policy will be posted to the MDT Website. Additional copies of the policy can be obtained by calling or writing to:

Noise Specialist
Montana Department of Transportation, Environmental Services Bureau
PO Box 201001
Helena, MT 59620-1001
406-444-7659

MDT attempts to provide reasonable accommodations for any known disability that may interfere with a person participating in any service, program or activity of the department. Alternative accessible formats of this document are available upon request. For further information call (406) 444-7659 (voice) or (406) 444-7696 (TTY).

APPENDIX A – NOISE STUDY DOCUMENTATION

The noise analysis report should be a stand-alone document and a summary section will be included in the body of the EA or EIS. All supporting documentation (TNM run files, spreadsheets of formatted input and data and results, CEI calculations (in Excel or equivalent), noise abatement worksheets (if applicable), measurement results, site sketches and photographs) are included with the report in electronic format. A generalized report format is provided below.

I. Report Format for Type I Projects

To maintain consistency and to better incorporate the noise report into the Environmental Document, the following report format is used:

1. Introduction – Description of project, need for noise analysis;
2. Determination of activity categories and applicable noise abatement criteria for adjacent land uses;
3. Methodology /Assumptions – Includes ambient noise measurements, verification and calibration (if necessary) of the noise model;
4. Affected Environment – Determination of existing noise levels and description of other noise sources;
5. Environmental Consequences – Prediction of future noise levels for all study alternatives, including construction noise, and identification of traffic noise impacts;
6. Mitigation Considerations – Identification and consideration of highway traffic noise abatement, including feasibility and reasonableness of abatement. The discussion of mitigation should include all mitigation considered even if rejected, such as shifting of vertical/horizontal alignment;
7. Coordination with Local Officials – Includes a section on noise compatible planning, noise mitigated development, explanation of noise contours or set-back distances to ensure no future noise impacts with sensitive land uses. If noise contours are provided, they should include the 60 and 64 dB(A) L_{eq}(h) contours;
8. Other considerations;
9. TNM data files and the CEI calculations must be in Excel (or equivalent) spreadsheets. All report data, spreadsheets and text need to be provided in electronic format.

II. Documentation for Type III Projects

It is recommended that an affirmative statement saying a noise analysis is not required be included with the environmental documentation for Type III projects. Suggested language that could be included in a file memorandum is:

> The proposed project meets the criteria for a Type III project established in 23 CFR 772. Therefore, the proposed project requires no traffic noise analysis or abatement evaluation. Type III projects do not involve added capacity, construction of new through lanes, changes in the horizontal or vertical alignment of the roadway, or exposure of noise sensitive land uses to a new or existing highway noise source. MDT acknowledges that a noise analysis would be required if changes to the proposed project result in reclassification to a Type I project.

I. Distribution of Reports

Draft report:

- MDT Environmental Services Bureau
- Lead Design Office

Final report distribution:

- Environmental Services Bureau
- Lead Design office (further distribution may include Right-of-Way, District -Preconstruction)
- Local Planning Agency
- Check with Environmental Services Bureau for other specific distribution instructions