DEPARTMENT OF TRANSPORTATION

Noise Requirements

for

MnDOT and other Type I Federal-aid Projects

Satisfies FHWA requirements outlined in 23 CFR 772

Effective Date: July 10, 2017

Website address where additional information can be found or inquiries sent:
http://www.dot.state.mn.us/environment/noise/index.html

"To request this document in an alternative format, contact Janet Miller at 651-366-4720 or 1-800-657-3774 (Greater Minnesota); 711 or 1-800-627-3529 (Minnesota Relay). You may also send an e-mail to janet.rae.miller@state.mn.us. (Please request at least one week in advance).

This document contains the Minnesota Department of Transportation Noise Requirements (hereafter referred to as 'REQUIREMENTS') which describes the implementation of the requirements set forth by the Federal Highway Administration Title 23 Code of Federal Regulations Part 772: Procedures for Abatement of Highway Traffic Noise and Construction Noise. These REQUIREMENTS also describe the implementation of the requirements set forth by Minnesota Statute 116.07 Subd.2a: Exemptions from standards, and Minnesota Rule 7030: Noise Pollution Control. These REQUIREMENTS were developed by the Minnesota Department of Transportation and reviewed and approved with by the Federal Highway Administration.

Charles A. Zelle, Commissioner
Minnesota Department of Transportation

6-28-17
Date

Arlene Kocher, Division Administrator
Minnesota Division
Federal Highway Administration

6/29/17
Date

Table of Contents

Tables

1.0 DEFINITIONS

The following definitions are set forth for the MnDOT Highway Noise Requirements.

Term	*Definition*
Benefited Receptor	The receptor of an abatement measure that receives a noise reduction at or above the minimum threshold of 5 dBA.
Cost Effectiveness	Noise abatement must cost less than or equal to $78,500 per benefited receptor (based on noise wall construction cost of $36/ft2) to be cost effective.
Date of Public Knowledge	The date of approval of the Categorical Exclusion (CE), the Finding of No Significant Impact (FONSI), the Record of Decision (ROD), or combined Final Environmental Impact Statement (FEIS)/ROD as defined in 23 CFR 771.
Design Year	The future year used to estimate traffic volumes for which a highway is designed, typically 20 years from date of project opening.
Existing Noise Level	The worst noise hour resulting from the combination of natural and mechanical sources and human activity usually present in a particular area.
Feasibility	The combination of acoustical and engineering factors considered in the evaluation of a noise abatement measure.
FHWA Undertakings	A project, activity, or program funded in whole or in part under the direct or indirect jurisdiction of a Federal agency, including those carried out by or on behalf of a Federal agency; those carried out with Federal financial assistance; and those requiring a Federal permit, license or approval. Therefore, FHWA undertakings include not just projects with FHWA funding, but also projects without FHWA funding but that have an FHWA approval action (e.g. Interstate Access Request).
Future Noise Level	The worst hourly traffic noise level predicted for the design-year using an approved noise prediction model.
Impacted Receptor	Noise sensitive location that experiences a traffic noise impact (see definition for traffic noise impacts).
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 Leq(h) being the hourly value of Leq. In effect, it's analogous to the "average" sound level over a given period of time.
Multifamily Dwelling	A residential structure containing more than one residence. Each residence is counted as a receptor in the noise analysis.
Noise Abatement Criteria (NAC)	The upper limit of FHWA acceptable highway traffic noise levels (23 CFR 772) for different land uses and human activities. Noise abatement must be considered when NAC limits are approached or exceeded.

Term	*Definition*
Noise Barrier	A physical obstruction that is constructed between the highway noise source and the noise sensitive receptor(s) that reduces noise levels, includes standalone noise walls, noise berms (earth or other material, and combination berm/wall systems.
Noise Level (A-weighted)	The most common weighting used in noise measurements. A-weighting cuts off the lower and higher frequencies that the average person cannot hear. The unit of measure is the decibel (dB), commonly referred to as dBA when A-weighting is used.
Noise Reduction Design Goal	The desired dBA noise reduction between future build noise levels with abatement and future build noise levels without abatement. The goal is 7 dBA (must be achieved at a minimum of one receptor for each proposed barrier to achieve reasonableness).
Noise Sensitive Area	A geographic area containing noise sensitive receptors who could be protected behind a single noise barrier. E.g., a continuous neighborhood next to the highway
Owner	Individual or entity named on the deed, or listed as the owner on tax rolls.
Owner/Resident	Owner who resides at the receptor location.
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.
Reasonableness	The combination of social, economic, environmental factors, and points based on benefited receptor votes considered in the evaluation of a noise abatement measure.
Receptor	The specific location of an outdoor area where frequent human use occurs with corresponding Noise Abatement Criteria. Also, a discrete location of a noise sensitive area(s), for land uses listed in Table 1 (Section 4.1).
Residence	Location of a household or dwelling unit; which includes single family homes and individual units in a multifamily dwelling.
Resident	An individual or entity who lives in or utilizes a benefited receptor via contract, includes legal renters of a benefited residence or business or trail authorities without fee title ownership.
Statement of Likelihood	A statement addressing the likelihood of noise abatement provided in the environmental document based on the feasibility and reasonableness analysis completed at the time the environmental document is approved.
Substantial Noise Increase	An increase in noise levels of at least 5 dBA in the design year compared to the existing noise level. This is one of two types of highway traffic noise impacts for Type I projects.
Traffic Noise Impacts	Design year build condition noise levels that approach or exceed the FHWA NAC or create a substantial noise increase.

Term	*Definition*
Trail	A non-motorized trail, for purposes of applying 23 CFR 772, is generally defined when it possesses three characteristics. 1. Thoroughfare or track across land or snow, used for purposes such as: (A) Pedestrian activities, including wheelchair use (B) Skating or skateboarding (C) Equestrian activities, including carriage driving (D) Non-motorized snow trail activities, including skiing (E) Bicycling or use of other human-powered vehicles (F) Aquatic or water activities 2. Typically owned and/or managed by one of the following: Local governments; Regional transportation authorities; Transit agencies; Natural resource or public land agencies; School districts, local education agencies, or schools; Tribal governments; and any other local or regional governmental entity with responsibility for oversight of transportation or recreational trails. 3. Open to the general public. *Notes:* recreation does not have to be its sole use and trails that allow both motorized and non-motorized use are not exempted from 23 CFR 772.

Type I Projects	A proposed Federal or Federal-aid highway project for the construction of a highway meeting one or more of the following conditions. (1) The construction of a highway on new location; or, (2) The physical alteration of an existing highway where there is either: (i) Substantial Horizontal Alteration. A project that halves the distance between the traffic noise source and the closest receptor between the existing condition to the future build condition; or, (ii) Substantial Vertical Alteration. A project that removes shielding, therefore exposing the line-of-sight between the receptor and the traffic noise source. This is done by either altering the vertical alignment of the highway or by altering the topography (not including the addition or removal of vegetation) between the highway traffic noise source and the receptor; or, (3) Bridge replacement projects that satisfy item (2), above. (4) The addition of a through-traffic lane(s). This includes the addition of a through-traffic lane that functions as a HOV lane, contraflow lane, High-Occupancy Toll (HOT) lane, bus lane, or truck climbing lane; or, (5) The addition of an auxiliary lane, except for when the auxiliary lane is a turn lane. (6) The addition or relocation of interchange lanes or ramps added to a quadrant to complete an existing partial interchange; or, (7) Restriping existing pavement for the purpose of adding a through-traffic lane or an auxiliary lane; or, (8) The addition of a new or substantial alteration of a weigh station, rest stop, ride-share lot or toll plaza. (9) If a project is determined to be a Type I project as defined above, 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; often referred to as retrofit projects. Eligibility requires the development of a priority ranking system to allow consistent and uniform application of a Type II Program State-wide (see Appendix G).
Type III Project	A Federal or Federal-aid highway project that does not meet classification of a Type I or Type II project. Type III projects do not require a noise analysis.

2.0 INTRODUCTION

This document contains the Minnesota Department of Transportation (MnDOT) noise requirements (hereafter referred to as 'REQUIREMENTS') for highway traffic and construction. These REQUIREMENTS describe MnDOT's implementation of the Federal Highway Administration (FHWA) Noise Standard in 23 Code of Federal Regulations (CFR) Part 772[1] and the modeling requirements covered by 23 CFR 774.15. These REQUIREMENTS were developed by MnDOT and Local Public Agencies (LPAs) and reviewed and approved by FHWA. Additional guidance and clarification are found in MnDOT Highway Project Development Process manual (HPDP)[2] and on the MnDOT noise website[3].

Following the rapid expansion of the Interstate Highway System and other roadways in the 1950s, communities began to express concerns about noise from highway traffic and construction. In the 1970 Federal-aid Highway Act, Congress required FHWA to develop a noise standard for new Federal-aid highway projects. The FHWA Noise Standard outlines national criteria and requirements for all highway agencies while allowing some flexibility for implementation at the state level. State-specific attitudes and objectives in approaching the problem of highway traffic and construction noise. This document contains the MnDOT's REQUIREMENTS on how highway traffic noise impacts are defined, how noise abatement is evaluated, and how noise abatement decisions are made.

In addition to defining road traffic noise impacts, the FHWA Noise Standard requires consideration of traffic noise abatement where traffic noise impacts are identified for Type I Federal projects. Where noise abatement is found to be feasible and reasonable, highway agencies must then construct noise abatement. Noise abatement measures are eligible for Federal-aid participation at the same pro rata share as other eligible project costs.

In 2016, the Commissioners of the MPCA and MnDOT agreed that the traffic noise regulations and mitigation requirements from the FHWA are sufficient to determine reasonable mitigation measures for highway noise. By this agreement[4], existing and newly constructed segments of highway projects under MnDOT's jurisdiction are statutorily exempt from Minnesota State Noise Standard[5] (MN Rule 7030) if the project applies the FHWA traffic noise requirements. As a result, any required noise analysis will follow FHWA criteria and regulations only. Project will no longer directly address Minnesota Rule 7030.

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[1] The Federal Regulations on the Procedures for Abatement of Highway Traffic Noise and Construction Noise were effective July 13, 2011. https://www.gpo.gov/fdsys/pkg/CFR-2016-title23-vol1/pdf/CFR-2016-title23-vol1-part772.pdf

[2] http://www.dot.state.mn.us/planning/hpdp/index.html

[3] http://www.dot.state.mn.us/environment/noise/index.html

[4] See Appendix H for agreement based on MN Rule 7030

[5] https://www.revisor.mn.gov/rules/?id=7030

2.1 Purpose

This document outlines the MnDOT requirements for implementing 23 CFR 772 in Minnesota. These REQUIREMENTS also fulfill the reasonability requirements for the State noise statutory exemption.

2.2 Noise Standards

These REQUIREMENTS outline the MnDOT program to implement the following standards:

- FHWA Noise Standards 23 CFR 772 and 23 CFR 774: includes requirements for traffic noise modeling, noise analysis, noise abatement criteria, and informing local officials.
- Minnesota Pollution Control Agency administrative rule 7030.0010-7030.1060: governs standards, classification, methodology, and noise limits.
- Minnesota Statute 116.07[6] Subd. 2a: lists the following exemptions from the state noise standards:

  "No standards adopted by any state agency for limiting levels of noise in terms of sound pressure level which may occur in the outdoor environment shall apply to (1) segments of trunk highways constructed with federal interstate substitution money, provided that all reasonably available noise mitigation measures are employed to abate noise, (2) an existing or newly constructed segment of a highway, provided that all reasonably available noise mitigation measures, as approved by the commissioners of the department of transportation and pollution control agency, are employed to abate noise..and (3) except for the cities of Minneapolis and St. Paul, an existing or newly constructed segment of a road, street, or highway under the jurisdiction of a road authority of a town, statutory or home rule charter city, or county, except for roadways for which full control of access has been acquired."

FHWA requires that states give numerical meaning to the phrase "approach the criterion." MnDOT defines "approach" as being 1 dBA, or less, below the applicable Federal NAC (e.g., 66 dBA for Category B residential land uses).

2.3 Applicability

2.3.1 General Projects (Non-Transit Only Projects)

These REQUIREMENTS apply uniformly and consistently to the following project types administered by either MnDOT or LPAs:

- Type I FHWA Undertakings in the State of Minnesota

[6] https://www.revisor.mn.gov/statutes/?id=116.07

- Projects that exceed mandatory Environmental Quality Board (EQB) thresholds
- Projects for which an EAW is voluntarily completed

For multi-state or border projects, the lead state is responsible for analysis of noise impacts for the entire project. Noise requirements in each state will apply to all portions of the project within that state. For example, if the project is split between Minnesota and South Dakota then Minnesota requirements apply to the Minnesota portion of the project and the South Dakota requirements apply to the portion there.

State noise standards apply to non-FHWA undertakings or other projects not subject to federal noise requirements, unless the project falls under one of the exemption categories described in Section 2.2 above (Minn. Stat. 116.07, Subd. 2a.).

Per the 2016 agreement between the Commissioners of the MPCA and MnDOT, the FHWA-approved requirements are sufficient to satisfy the "reasonably available noise mitigation measures" in the state noise exemption.

If there are any questions about whether a project is subject to these REQUIREMENTS or the FHWA Noise Standard, contact MnDOT noise staff (LPAs should contact the State Aid Federal Aid Project Development Engineer).

2.3.2 Type II Noise Projects

MnDOT does not have a Type II program but has developed and implemented a Highway Noise Abatement Program for the Metro District and a Greater Minnesota Stand-Alone Noise Barrier Program for all other Districts. The programs construct noise abatement where no MnDOT highway projects are planned. They are entirely state funded and are not federal highway undertakings, so no FHWA review/approval is required.

2.3.3 Transit Only Projects

The determination of whether to use FHWA or FTA's noise analysis and procedures depends upon the specific circumstances of a project. The FHWA noise regulations under 23 CFR 772 applies to multimodal projects even though the term "multimodal" is not defined in the regulation. A proposed transit project that would share an existing highway right-of-way (ROW) is not necessarily a multimodal project under 23 CFR 772.7(a). A transit-only project that meets all three of the following criteria is not considered a multimodal project for purposes of 23 CFR 772:

1) Lead Agency: The Federal Transit Administration (FTA) is the lead agency in the National Environmental Policy Act (NEPA) process and FHWA is not a co-lead. The FHWA's limited participation is as a cooperating agency.

2) Project Purpose: The main transportation purpose of the project, as stated in the purpose and need statement of the NEPA document, is transit-related and not highway-related.

3) Funding: No Federal-aid highway funds are being used to fund the project

Transit-only projects that meet all three criteria should use the FTA's Transit Noise and Vibration Impact Assessment Guidance Manual[7] procedures to evaluate noise impacts for the transit and highway elements of transit projects.

2.4 Federal Participation

Federal funds may be used for noise abatement on Type I projects when traffic noise impacts have been identified and abatement is feasible and reasonable. The federal cost share for eligible noise abatement measures (see Chapter 5) is the same for the roadway where the project is located. Noise abatement measures that are eligible for federal aid are described in Chapter 5.

[7] https://www.transit.dot.gov/sites/fta.dot.gov/files/docs/FTA_Noise_and_Vibration_Manual.pdf

3.0 TRAFFIC NOISE PREDICTION

Future noise levels must be predicted for all build alternatives. Noise levels for the existing condition must also be determined through modeling or noise measurement.

3.1 Approved Traffic Noise Prediction Tools

The most current approved FHWA Traffic Noise Model (TNM)[8] must be used for traffic noise analysis. Use of any FHWA approved noise model other than TNM requires prior MnDOT approval.

3.1.1 Previous Noise Analysis done under Different Noise Modeling Software

For projects undertaken prior to July 10, 2017, the noise analyses will have used MNNOISE, a STAMINA 2.0/OPTIMA-based noise prediction software[9]. If additional noise analyses is required for a new project phase or NEPA re-evaluation, modeling must be updated with the latest approved version of FHWA TNM.

Coordinate with MnDOT noise staff if updated FHWA TNM modeling, compared to (MNNOISE) indicates that previously modeled areas no longer warrant abatement or require less abatement than recommended in previous modeling. Previous "commitments" for noise abatement shall not be compromised solely because of the noise model. MnDOT noise staff will work with the noise analyst to evaluate project changes to assure that they are due solely to the model change and not from changes to traffic, alignment, land use, etc.

3.2 Noise Prediction of Alternatives

Noise levels must be modeled for all reasonable build alternatives in the environmental document (does not include alternatives rejected for detailed analysis because they are not reasonable or do not meet the project's purpose and need). However, evaluation of noise abatement and solicitation of viewpoints from benefited receptors is only needed for the preferred alternative. Consult MnDOT noise staff prior to any design changes being considered after the date of public knowledge that could change the project from Type I to Type III or change alignments, profile, or the number of lanes.

3.3 Use of Pavement Type

Use "average" pavement type in TNM[10] for all noise analysis.

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[8] TNM 2.5 is currently the only FHWA-approved noise model. TNM 3.0 is expected to be released in 2018.

[9] FHWA Highway Traffic Noise Prediction Model (FHWA-RD-77-108)

[10] The reference energy mean emission levels used in the prediction model represents an average of concrete and asphalt pavements.

3.4 Use of Noise Contours

Noise contour lines produced by TNM or other graphics program can be used for alternatives screening or land use planning but not to determine highway traffic noise impacts.

3.5 Worst Traffic Noise Impact

All traffic noise modeling must be based on the worst noise hour for the design year. Take care not to model traffic volumes that would result in traffic congestion affecting the worst hour noise levels (see Appendix C).

Seasonal traffic variations can be considered for modeling noise levels in areas with substantially different seasonal traffic (e.g., busy summer resort communities). Seasonal traffic considerations are only considered when data is available to demonstrate elevated volumes for an entire season (e.g., summer), rather than a few peak weekends (e.g., 4th of July weekend) or unique events.

3.6 Modeling Conventions and Preferences

Residences

In low population areas where residences are far enough apart to experience different traffic noise levels, individual receptors should be modeled. In more developed residential areas where some residences have a similar noise environment, multiple residences can be modeled as a single representative modeling location.

Traffic lanes

FHWA recommends modeling individual traffic lanes. However, if data limitations make this impractical, multiple lanes with similar speeds, volumes, and vehicle class mixes can be grouped into one single lane Managed facilities like MnPASS, priced dynamic shoulder lane (PDSL), dynamic shoulder lanes (DSL), and bus shoulders must be modeled individually because of their unique characteristics (e.g. markedly different speed and volume profiles) relative to general purpose lanes.

Flat earth models

Realistic and reasonable roadway and receptor elevation data must be incorporated into noise models so no "flat earth" models are accepted by MnDOT.

3.7 Determining Noise Analysis Limits Beyond Project Termini

The noise analysis must include all areas that are affected by the project, including impacts from the project that occur beyond the official project limits/termini.

1. The analyst should verify their approach to noise modeling with MnDOT and/or FHWA Environmental Staff prior to starting the noise analysis.

2. The first step in determining the affected area is the analyst should extend the modeling limits at a minimum 500' or to a "logical" termini point greater than 500' from the end of

physical construction. This "logical" termini point for the noise analysis might be a roadway crossing or change in land use that is beyond 500 feet from the end of physical construction. At this point, the analyst should determine if the project's impacts extend beyond this point. If these impacts do exist, the analyst should extend the modeling further away from the project terminus (to 1000'), to a point where the future build condition noise levels do not create a substantial noise increase (5 dBA) over future no-build levels or cause receptors to approach or exceed the applicable Federal NAC **as a result of the project (future no-build vs. future build)**. If noise modeling indicates impacts beyond 1000' from the project terminus, contact MnDOT noise staff for further guidance.

3. The mapped receptors and associated narrative must clearly indicate that the analysis has gone far enough to demonstrate that receptors are neither experiencing a 5 dBA (or greater) increase nor are they approaching/exceeding applicable NAC for the future build vs. future no-build year conditions as a result of the project.

4. Once the limits of the noise analysis have been determined, continue the analysis to determine impacts (existing condition vs. future build) and mitigation using MnDOT's REQUIREMENTS.

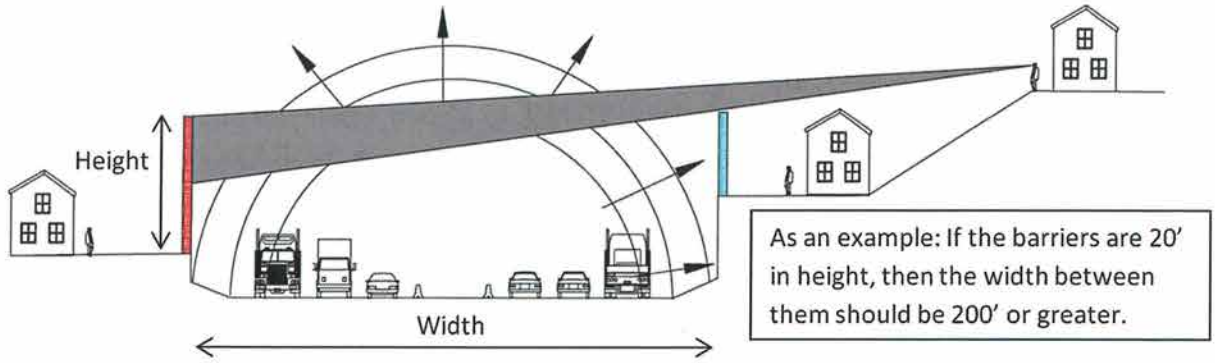
3.8 Procedure to Address Reflected Noise from Non-acoustical Absorptive Parallel Barriers

In certain situations, sound can reflect off of noise barriers or other structures on one side of the road and reduce the noise barriers' effectiveness or cause noise increases in areas opposite the barriers/structures. If modeling shows that noise levels could increase by 3 dBA (Leq) from this type of reflection, MnDOT will add acoustic absorption[11] under either of the following conditions described in Figure 1:

- The ratio of the width (W) between facing parallel barriers or retaining walls to the average height (H) of the barriers or walls is equal to or less than 10.
- Receptors have a direct line of sight from a noise sensitive area of frequent human use to a barrier or retaining wall on the opposite side of the highway.

[11] Absorption materials must have a minimum noise reduction coefficient (NRC) of 0.80.

Figure 1: Noise reflection example



Incremental costs for acoustic absorption are not included in the reasonableness determination.

Noise modeling guidance for reflections

To model noise reflections, use an "image roadway" or the TNM Parallel barrier tool.

1. Create an "image roadway" to mirror the new barrier using the same traffic volumes/classes and speeds as the actual roadway.
2. Remove the barrier that the image roadway was mirroring.
3. If increases from reflections are at least 3 dBA, install acoustic absorption.
4. To model performance of the treatment, reduce the image source roadway traffic volumes equally across the vehicle mix categories by the noise reduction coefficient (NRC) value of the product (e.g., reduce image source traffic volumes by 85% for 0.85 NRC).

4.0 ANALYSIS OF TRAFFIC NOISE IMPACTS

A noise impact analysis is required for all Type I projects.

For a Tier 1 Environmental Impact Statement (EIS), or other study that examines broad corridors, discuss the scope and methodology of the noise analysis with FHWA and other participating agencies early in the project planning process.

4.1 Noise Impact Criteria and Assessment

Determining Noise Analysis Area

Any Type I activity for any alternative makes the entire project a Type I project.

Existing Noise Levels

Existing noise levels must be determined to assess whether a substantial noise increase (5 dBA or greater) is predicted. These can be determined any of the following ways:

1) Validated noise modeling for receptors near existing highway alignments (see Section 3)
2) Collect noise measurements for receptors near new alignments (see Appendix B)

3) A combination of modeling and measurements, as appropriate for the specific project.

Determining Impacts

The following are considered noise impacts:

1) Predicted worst noise hour levels (L_{eq}) for future build alternatives that approach or exceed the FHWA NAC (Table 1)
2) Predicted worst noise hour levels (L_{eq}) for future build alternatives that exceed existing noise levels by 5 dBA or more

The noise analysis must do the following for all build alternatives:

1) Model noise levels for all noise sensitive land uses within the project area that may be affected by traffic noise from the project, including developed and undeveloped lands.
2) Focus on outdoor areas of frequent human use[12].

The noise analysis is also used to evaluate noise-related impacts to Section 4(f) resources where quiet is important. Where this applies, consult with MnDOT noise staff on the analysis scope[13].

Documenting Impacts

Noise studies must identify all potentially impacted receptor locations in a table and include a figure(s) that identifies the locations of each receptor with a unique ID designation. The table must include the following for each receptor:

- A unique ID (e.g., NW-1)
- FHWA land use activity category (Table 1) and associated NAC
- Number of units represented
- Noise level for existing conditions and each build alternative
- Note which receptor(s) have a traffic noise impact

See link below for traffic noise flowcharts for environmental documents.
http://www.dot.state.mn.us/environment/noise/policy/

[12] The exception is Category D land uses when there is no outdoor use areas or outdoor use areas are shielded from traffic noise.
[13] Section 4(f) is addressed in 23 CFR 774.15(e) and 23 CFR 771.15(f). For more detail, see *Noise Impact Analysis for Section 4(f) Properties Guidance Where Quiet is Important* at http://www.dot.state.mn.us/environment/noise/policy/

Table 1 FHWA Noise Abatement Criteria

Activity Category	*Activity Criteria[1,2] $L_{eq}(h)$ dBA*	*Evaluation Location*	*Activity Description*
A	57	Exterior	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B[3]	67	Exterior	Residential
C[3]	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 studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings
D	52	Interior	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios
E[3]	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

Notes
(1) Leq(h) shall be used for impact assessment
(2) Leq(h) Activity Criteria values are for impact determination only, and are not design standards for noise abatement
(3) Includes undeveloped lands permitted for this activity category

Activity Categories

The noise analysis must include analysis for each Activity Category present in the study area. The following information further explains the FHWA NAC land use activity categories that apply to the noise abatement criteria given in Table 1.

- **Activity Category A** (lands on which serenity and quiet are of extraordinary significance and serve an important public need). Activity Category A land uses are analyzed at this stricter standard even if the land use is identified within an activity category with a higher FHWA NAC. Proposals and justifications for designating land as Category A are

submitted through the FHWA Minnesota Division Office and FHWA Headquarters for approval.

- **Activity Category B (exterior areas of single-family and multi-family homes).** This category includes all types of permanent residential dwelling units, including detached homes, multi-unit residential structures, apartments, condominiums, townhomes, mobile homes, but no transient lodgings, such as hotels and motels. When analyzing areas with multi-family dwelling units, identify all dwelling units predicted to experience highway traffic noise impacts. This may include units above the ground level.

  Multi-family dwelling units often have associated common areas for recreational or other use. The number of receptors used to represent these locations should consider the potential use and capacity limits of the activity area. These common areas are typically available for use by residents of the entire multi-family facility rather than limited to those units near the highway. The number of receptors for common areas should include all users or potential users of the impacted common area(s).

- **Activity Category C (exterior areas of non-residential lands such as schools, parks, cemeteries, etc.).** Exterior impact criteria for this category generally applies to identified exterior areas of frequent human use where noise abatement would provide a significant benefit. The equivalent number of residences is based on the context and intensity of each non-residential land use within the project area (see Appendix A for examples). Consultation with MnDOT noise staff may be required.

- **Activity Category D (interiors of select Category C facilities; see Table 1).** Only consider interior levels after analysis of outdoor activity areas or determining that exterior abatement measures are not feasible or reasonable. Activity Category D designations are rare and placement of receptors is done on a case by case basis in consultation with MnDOT noise staff, (see Appendix A and *Interior Noise Analysis Flowchart for Category D Facilities*[14]).

- **Activity Category E (exteriors of developed lands that are less sensitive to highway noise).** Determine that properties identified as "hotels" do not actually function as apartment buildings since permanent residential units (B) and hotels and motels (E) fall under different categories with different impact levels. The number of receptors are determined the same as for Activity Category B. Due to the unique variations of scenarios for Activity Category E, placement of receptors will be done on a case by case basis in consultation with MnDOT noise staff, (see Appendix A).

- **Activity Category F (land uses that are not sensitive to highway traffic noise).** No highway noise analysis is required under FHWA NAC Table 1 for land uses in this activity category.

[14] http://www.dot.state.mn.us/environment/noise/policy/

- **Activity Category G (undeveloped land).** Land is considered permitted for development if a building permit has been issued on or before the date of public knowledge and analyzed under the Activity Category for the permitted type of development. For land that is not permitted for development by the date of public knowledge, the noise analysis shall still document future noise levels and the results shall be documented in the project environmental documentation and in the noise analysis report. At a minimum, the analysis should report the distance from the proposed edge of the traveled way to the FHWA NAC for all exterior land use categories. Noise abatement for undeveloped Category G lands is not eligible for federal-aid.

4.2 Required Noise Measurements

Collecting Noise Measurements

Noise measurements must be collected at representative noise sensitive locations along the full project limits for all Type I projects. Field measurements can only be conducted under "appropriate environmental" conditions, which must be part of measurement documentation:

- Temperature between 32 and 110 degrees F
- Relative humidity between 5 and 90%
- Winds less than 12 mph
- No recent or ongoing precipitation that causes visible water/snow on road surface

Noise measurements must be collected using ANSI Type I or Type II[15] sound level meters and procedures should be consistent with FHWA *Measurement of Highway Related Noise*.

Traffic counts must be collected at the same time as the noise measurements that include the number of heavy trucks, medium trucks, buses, light duty vehicles, and vehicle speeds. For additional guidance see Appendix B.

Model Validation

- Existing roadways: compare measured noise levels to the modeled existing levels
- New roadways: use measurements to describe existing noise levels for areas where no road currently exists

Measured and modeled existing noise levels must be within 3.0 dBA for the model to be considered validated. If the model fails to validate, reassess the model for accuracy. Repeat field measurements may be necessary. See Appendix B and C for more details.

[15] ANSI S1.4-1983

5.0 ANALYSIS OF NOISE ABATEMENT MEASURES

5.1 Consideration of Noise Abatement Measures

If traffic noise impacts are identified, noise abatement must be evaluated. Noise walls are the most common form of traffic noise abatement but various measures are evaluated. However, where noise abatement is feasible and reasonable, the type of abatement will be determined based a combination of factors include social, economic, and environmental considerations.

The following noise abatement measures shall be considered:

1) Construction of noise barriers, including acquisition of property rights, either within or outside the highway right-of-way. Neither landscaping nor privacy fencing are viable noise abatement measures.
2) Traffic management measures including, but not limited to, traffic control devices and signing for prohibition of certain vehicle types, time-use restrictions for certain vehicle types, modified speed limits, and exclusive lane designations.
3) Alteration of horizontal and vertical alignments.
4) Acquisition of real property or interests therein (predominantly unimproved property) to serve as a buffer zone to preempt development which would be adversely impacted by traffic noise. This measure may be included in Type I projects only.
5) Noise insulation of Activity Category D land use facilities listed in Table 1. Post-installation maintenance and operational costs for noise insulation are not eligible for Federal-aid funding.

Post-installation maintenance and operational costs for noise insulation are not eligible for Federal-aid funding or non-Federal-aid funding.

The use of quieter pavements and the planting of vegetation or landscaping are not eligible for federal aid and not acceptable as noise abatement.

5.2 Feasibility

Feasibility is defined by the constructability and the ability to sufficiently reduce noise.

5.2.1 Acoustic Feasibility (Noise Reduction)

1) Each noise abatement measure must achieve a noise reduction of at least **5 dBA** at impacted receptors in order for them to be considered benefited.
2) It is not required that every impacted receptor receive the minimum benefit in order for the noise abatement to be considered acoustically feasible, but at least one impacted receptor per proposed barrier must receive the minimum reduction of 5 dBA to achieve acoustic feasibility.

5.2.2 Engineering Feasibility (Constructability)

1) It must be possible to construct or install the proposed abatement for it be considered feasible. Constructability reviews include the following:

    a. **Safety:** cannot create a crash hazard, restrict critical sight lines at intersections or access ramps, or provide unacceptable barrier to emergency access.

    b. **Barrier Height:** local design requirements, such as height limits on fencing and walls do not apply to noise abatement but engineering limitations such as static loading and wind loads must be considered. MnDOT has established a maximum noise barrier heights to 20 feet above the finished ground line at the barrier.

    c. **Topography**: confirm that available location(s) for a barrier do not cause it to be acoustically ineffective (e.g., fails to block the line of site between the road and receptor) or require substantial engineering to construct.

    d. **Drainage**: cannot restrict adequate drainage or run-off that causes flooding of travel lanes, ROW, or adjacent property, or where the cost to circumvent these conditions would be excessive.

    e. **Utilities**: barriers should not cause a condition that could interrupt the operation, use or maintenance of critical overhead or underground utilities or signage, or where the cost to circumvent these conditions would be excessive.

    f. **Maintenance**: noise barriers cannot prohibit required maintenance of the roadway (e.g., snow removal), the adjacent ROW (eliminating required access for landscaping), or the barrier itself (collision damage, repainting, etc.). This assumes that all measures (e.g. different wall design, maintenance easements, etc) have first been explored and found to not be possible.

2) The noise analysis may reference the MnDOT Road Design Manual, the MnDOT Standard Plans, or the FHWA Noise Barrier Design Handbook for site design requirements and other engineering feasibility issues. (See Appendix G.)

5.3 Reasonableness

There are three reasonableness factors or "tests" that must be met for a noise abatement measure to be considered reasonable.

1) Noise Reduction Design Goal
2) Cost Effectiveness
3) Viewpoint of Benefited Residents and Owners

5.3.1 Noise Reduction Design Goals

While a receptor is considered "benefited" if it receives a minimum noise reduction of 5 dBA (see 5.2.1 Acoustic Feasibility), "reasonableness" criteria requires a noise reduction design goal of at least 7 dBA for at least one benefited receptor at each proposed noise wall. For federal-aid

highway undertakings, noise abatement should attempt to achieve 7 dBA of reduction for as many benefited receptors as possible without exceeding cost effectiveness threshold. The maximum height considered for a noise barrier is 20 feet.

For projects on the trunk highway system, the analyst shall maximize noise reduction for as many benefited receptors as possible while remaining within the limits placed on barrier height (20 ft.) and cost effectiveness ($78,500 per benefited receptor). Therefore, a 20-foot high barrier is analyzed first and will be used when it is cost-effective. Shorter barriers are only considered if a 20-foot barrier is not cost-effectives.

5.3.2 Cost Effectiveness

1) The cost effectiveness threshold of $78,500 per benefited receptor is based on an estimated noise wall construction cost of $36 per square foot ($ft^2$)[16]. The current price is based on limited historical data from MnDOT projects and national data for acoustically absorbent concrete post/concrete panel type wall[17]. The cost effectiveness threshold will be updated at least every five years, with the next update no later than 2022.

2) In multifamily dwelling, habitable ground floor units facing the project roadway can be considered impacted/benefitted, regardless of whether they have exterior use areas. To be considered benefited receptors for cost reasonableness, they must receive at least 5 dBA noise reduction (see Section 5.2.1). Units with ground floor or upper floor patios or balconies are modeled like other residential facilities.

3) The additional costs of items, such as guard rail, rub rail, utility relocation, construction on structure, and special anchoring or support systems, are only included in baseline unit cost estimates if they would not exist 'but for' the noise barrier.

4) Purchasing Right-of-way which is absolutely necessary for the construction of a noise barrier shall be counted toward the cost effectiveness threshold after clearly exhausting all options for constructing a reasonable and feasible noise barrier within existing right-of-way. Only the fair market value of the portion of a parcel absolutely necessary to construct a noise barrier may count against the barrier's cost effectiveness threshold unless the parcel becomes an uneconomic remnant (as defined in 23 CFR 710)after removal of the portion absolutely necessary to construct the barrier.

5) FHWA continues to support noise compatible land use planning. This planning approach may include types of land use and defining sufficiently wide roadway corridors to minimize the likelihood of needing additional right-of-way to construct noise abatement.

[16] Cost includes the following "typical" construction items needed only to construct a noise barrier: mobilization, clearing, grubbing, removal of chain link fence, granular or concrete backfill, concrete/metal posts, concrete panels, traffic control (including portable concrete barrier), temporary fence, silt fence and turf reestablishment (seed/sod, fertilizer, erosion control).
[17] MnDOT standard wall design

6) The project proposer is responsible for all noise abatement costs for a federal-aid project. Funding to construct feasible/reasonable noise abatement must not be required from a local unit of government or otherwise transferred to residents.

7) A barrier will be proposed if it is reasonable and feasible.

8) If additional design elements or enhancement features, such as aesthetic treatments or alternative barrier alignments and landscaping, are requested by someone other than the project proposer (e.g., a local unit of government or property owner) then funding for these costs may become the requestor's responsibility.

    a. Requests must be submitted in writing and agreed upon by the project proposer
    b. Costs are not counted towards the cost effectiveness threshold
    c. If requested by a property owner, a local unit of government may receive funds for additional design elements or enhancement features through a voluntary special assessment of the property owner.
    d. Requests will not be considered when federal laws (e.g., Sec 106/4f vs 23 CFR 772) have to be balanced for a barrier solely to avoid or minimize a Section 106 adverse effect or section 4f impact.

5.3.3 Viewpoints of Benefited Residents and Owners

Eligibility

The solicitation of viewpoints (aka voting) from the benefited receptors is only conducted for the preferred alternative when the barrier is feasible, meets noise design reduction goals, and is cost effective. Only property owners and residents of benefited receptors are allowed to vote. See Appendix E for more details on outreach tools for voting/soliciting viewpoints.

Outreach Strategy and Timing

The outreach strategy for voting is determined by the sponsoring agency with MnDOT and/or FHWA approval, depending on funding source. MnDOT requires a minimum of one direct mailing and one public meeting for all Type I projects. For and EA/EIS, the public meeting is typically held after the NEPA document is released for public comment. CE outreach normally occurs after selection of the preferred alternative that has low risk of further changes (e.g. alignment, profile, scope of work) beyond the question of noise abatement measures. Other requirements include the following:

- Minimum 30 calendar day response time is required for each mailing
- Minimum 15 calendar days between mailing ballots and holding a public meeting
- Minimum 15 calendar days between the public meeting and the date the ballots are due
- The second mailing, if required, will not take place prior to the completion of the 30 calendar-day requirement for the first mailing.

For further details, see traffic noise flowcharts for environmental documents located at http://www.dot.state.mn.us/environment/noise/policy/. See Appendix E for Guidance on Public Involvement Related to Noise Studies.

Required Outreach Information

The solicitation must include information about the project and the proposed noise abatement. The vote must be documented and include the benefited receptor's street address on the ballot.

Weighing Votes

Abutting properties are adjacent to proposed highway right-of-way. Properties separated from the project roadway by a transportation facility carrying vehicular traffic (not including private roads, allies, or trails) or active rail lines are considered non-abutting. See MnDOT's noise webpage for more guidance on abutting properties:
http://www.dot.state.mn.us/environment/noise/policy/

Votes are weighted as follows:

1) Benefited properties abutting the highway right-of-way
    a. Property owner gets 4 points for each benefited receptor unit (occupied and unoccupied)
    b. Resident gets 2 points for each benefited receptor unit
    c. An owner/resident gets a total of 6 points
2) Benefited properties not abutting the highway right-of-way
    a. Property owner gets 2 points for each benefited receptor unit (occupied and unoccupied)
    b. Resident gets 1 point for each benefited receptor unit
    c. An owner/resident gets a total of 3 points
3) Due to the myriad of Association structures and the unique characteristics each one possesses, benefited receptors that are part of an Association with a common land ownership and property units served by an Association with a common land ownership will be weighted on a case-by-case basis in consultation with MnDOT noise staff and FHWA. See Appendix F for an example of how votes are counted for an Association that has common land ownership.
4) Manufactured home parks are weighted the same as the property owner and residents in #1 and #2 above.

5) For multi-family dwelling, only units with exterior areas of frequent human use can be benefited receptors. These residences are weighted the same as the property owner and residents in #1 and #2 above.

   Multi-family dwelling with no exterior areas of frequent human use receive only "owner" points for every first floor apartment that faces the highway and no "resident" points are assigned for renters.

6) For multi-family dwelling with common activity areas (e.g., playgrounds, swimming pools, tennis courts), only the building owner receives points. Residences do not receive points for benefited common activity area.

7) Due to the unique variations of scenarios, the number and placement of non-residential receptor units for designated Activity Categories C and E are reviewed by MnDOT noise staff on a case-by-case basis to determine the number and placement of receptors. See Appendix A for more details.

8) Commercial properties receive only "owner" points unless there is an exterior area of frequent human use (e.g., restaurant patio) that would be considered a "resident" and assigned "resident" points for that renter[18].

9) Single benefited receptors (e.g., house, apartment or condo; not individual people) can only vote "yes" or "no;" no split votes are allowed. Votes must individually be either all yes or all no points. Votes may not be split (i.e., an owner receives 4 points, he may not vote 3 "no" and 1 "yes"; all 4 points must be either "yes" or "no".

10) Non-benefiting receptors do not receive points.

Calculating Votes

First Solicitation - If at least 50.0%[19] of all possible voting points are received by mail or ballot at public meeting, a simple majority of voting points cast will determine whether the proposed barrier will be constructed. If responses representing less than 50.0% of all possible points for a barrier are received on the first solicitation, a second solicitation (typically by mail) will be sent to those who did not respond to the first solicitation.

Second Solicitation - If the combination of the first and second solicitation yields responses for at least 25.0% of all possible points for a barrier, a simple majority of voting points cast will determine whether the barrier will be constructed. If fewer than 25% of total possible points for a noise barrier are received, the barrier will not be constructed. The barrier will be constructed in the case of a tie (equal number of points for and against a barrier).

See Appendix F for an example of the above method and a letter for soliciting viewpoints.

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[18] For further details, see Commercial property voting points assignment located at http://www.dot.state.mn.us/environment/noise/policy/ .

[19] The significant digits represent the precision of any scoring, voting, or analysis. E.g., 50.0% means that 49.94% would not be rounded up to 50%.

Note: For property types that do not fit the cases above, balloting procedures will be considered on a case-by-case basis. This must be done with review and approval of MnDOT Office of Environmental Stewardship noise staff, State Aid Division (for Local Agency Projects) and/or the FHWA Minnesota Division office, as appropriate.

Considering Design Alternatives

Additionally, some consideration for abatement design alternatives may be considered to accommodate reasonable requests of potentially benefited receptors in mixed-use developments may be allowed to opt-out given a reasonable compelling argument, as long as that receptor's exclusion allows the abatement element to continue to provide benefit to other receptors. This option is with the receptor opting out at the end of a noise sensitive area and noise barrier terminus can be altered as long as the conditions below are met:

1) No more than 1.0 dBA loss in attenuation for any benefited receptor;
2) No loss of benefited receptors who did not vote or voted 'yes';
3) Only those that voted 'no' at barrier terminus could be included for consideration in lessening the length of the barrier.

For example, a noise sensitive area is mostly impacted single family homes and a single front-row commercial property. If the commercial property owner believes that a noise barrier would have a considerable negative impact on the business, a barrier design alteration[20] could be considered if it meets the conditions above.

5.4 Noise Abatement Reporting

The following must be included in the environmental documentation prior to document approval[21] for a Type I project:

1) Locations where noise impacts will occur
2) Locations where noise abatement is feasible and reasonable
3) Noise impacts for which no abatement is feasible and reasonable
4) Solicitation results for submittal to FHWA only[22] shall include the following for each receptors:
    a. Receptor ID
    b. Receptor address
    c. Benefited receptor identification
    d. Receptor location
    e. Ownership identification

[20] (1) Maintain the view from the highway to the business; (2) Not interfere with adequate noise reduction for other impacted and benefited receptors.

[21] CE approval or issuance of a FONSI, ROD, or combined FEIS/ROD

[22] For more detail, see Solicitation results for submittal to FHWA only at http://www.dot.state.mn.us/environment/noise/policy/ .

f. Voting points and results

5) Statement of likelihood with preliminary locations of feasible and reasonable abatement and statement that the final recommendation will be made after the final design and public involvement processes are complete

6) For design-build projects, the preliminary technical noise study shall document all considered and proposed noise abatement measures for inclusion in the NEPA document. Final design of design-build noise abatement measures are based on the preliminary abatement design in the noise analysis and must confirm that final noise barrier heights, lengths, locations, cost-effectiveness, and acoustical effectiveness are not diminished compared to the noise mitigation in the preliminary design noise analysis. Noise abatement must conform to 40 CFR 1506.5(c) for environmental impact statements and 23 CFR 636.109 for design build projects.

5.5 Analyzing Existing Noise Barriers on Type I Projects

Type I projects proposed in areas with existing noise barriers require special consideration.

If an existing barrier needs to be removed, in full or in part, to accommodate the project, the area with the displaced barrier shall be modeled and analyzed like any other noise sensitive area. However, if the new barrier is determined to not be reasonable or feasible, the existing barrier shall be replaced to maintain or increase the acoustical effectiveness of the original.

If the project would not displace the existing barrier, the barrier remains and gets reported in the environmental document if it is at least 20' tall. If the barrier is less than 20' tall, a 20' barrier must be evaluated and constructed if feasible and reasonable (includes soliciting viewpoints). If the existing barrier is not feasible and reasonable, it remains on the project in the current state. The analyst should include removal costs of the existing barrier in cost effectiveness evaluation[23].

[23] For further details, see Noise Analysis Guidance on Addressing Existing Noise Barriers flowchart located at http://www.dot.state.mn.us/environment/noise/policy/ .

6.0 CONSTRUCTION NOISE

A qualitative assessment of construction noise is required for all Type I projects. The assessment must include the following:

1) Identify land uses or activities that may be affected by noise from project construction. Areas potentially affected by construction noise may be similar to those affected by operational traffic noise except areas near bridges and interchanges where pile-driving, bridge demolition, etc. may affect properties farther away.
2) Identify or propose measures needed to minimize or eliminate adverse construction noise effects to the community[24].

Construction noise abatement measures must be included in the plans and specifications.

[24] See MnDOT's noise website for an example construction noise write-up: http://www.dot.state.mn.us/environment/noise/policy/ .

7.0 DOCUMENTATION OF NOISE STUDY

7.1 Noise Study

All highway noise studies must be documented in the noise section of the environmental document. The noise study must specifically document the steps and results of the analysis and demonstrate that all requirements were addressed and that suitable noise abatement measures are identified. The content and organization of the noise study may vary depending on the project size, complexity, etc. However, every noise study should include, at a minimum, the following sections:

- Introduction and Project Description
- Construction Noise
- Analysis Methodology and Policies
- Existing Conditions and Noise Environment
- Future Condition and Predicted Noise Environment
- Traffic Noise Impacts
- Section 4(f) Resources Where Quiet Is Important
- Consideration of Noise Abatement
- Conclusions and Recommendations
- Appendices

An example outline for noise studies is provided in Appendix D. Local Agencies are encouraged to use the outline to facilitate review and approval of noise analysis and decisions.

Note: ***Prior to the Date of Public Knowledge:*** Receptor contact information (e.g. street addresses) shall not be included in documents viewable by the general public. However, receptor addresses must be included in the FHWA submittal[25]. ***On or After the Date of Public Knowledge:*** Receptor contact information (e.g. street addresses) may be included in documents viewable by the general public only as consistent with applicable state and federal laws.

[25] See Solicitation results for submittal to FHWA only located at: http://www.dot.state.mn.us/environment/noise/policy/.

7.2 Statement of Likelihood

Every NEPA document for a Type I Federal-aid project shall include a statement of likelihood that includes the following:

- Summary of preliminary location and physical description of any feasible and reasonable noise abatement
- Statement that final recommendations for construction of abatement will be determined during the project's final design
- Process for review and approval of any noise abatement that was initially feasible and reasonable in the NEPA process but is not (or is significantly altered) in the final design. The process must propose an approach to contacting any benefited receptors who would lose noise abatement and allow them an opportunity to respond to any proposed changes. For some projects, additional outreach to other stakeholders may be required.
- Discussion of site conditions that may affect an initial feasible and reasonable determination.

Changes to Noise Abatement in Final Design

If noise abatement that was feasible and reasonable in preliminary design is no longer feasible and reasonable during final design, the following must occur and be documented.

1) Notification of the affected benefited receptor(s) and coordination with appropriate stakeholders
2) Approval to eliminate or substantially modify a noise abatement measure(s) from any benefitted receptors in the preliminary analysis
    a. Approval may require re-soliciting benefited receptors
    b. Notification to benefited receptors must outline why noise abatement is no longer feasible and reasonable
    c. Benefited receptors who would lose the noise abatement must have at least 30 calendar-days to consider and respond to those changes

Withdrawal of a noise abatement measure determined to be reasonable and feasible during the NEPA process will be reviewed and have an approval action by the same agencies with signature authority on the NEPA document prior to considering changes. Documentation must do the following:

- Describe the site conditions assumed when the noise abatement measure was determined to be feasible and reasonable during the NEPA process.
- Outline any changes from initial assumptions and design changes implemented during final design.

- Verify that the solicitation of viewpoints process occurred.
- Document response(s) of any benefited receptors to loss or modification of abatement.

For an example Statement of Likelihood, see link to the FHWA Highway Traffic Noise: Analysis and Abatement Guidance, July, 2010, revised January 2011 in Appendix G.

8.0 INFORMATION FOR LOCAL OFFICIALS

For Type I projects where there are undeveloped lands in the noise study area, local officials will be provided with estimates of future design year noise levels and information on noise compatible land use planning concepts. Information on federal-aid non-eligibility of noise abatement for lands permitted for development after the date of public knowledge will be conveyed to local officials. The project proposer will communicate this information in the environmental documentation (EIS, EA, or Environmental Assessment worksheet), public hearings, public information meetings, and direct contact.

Appendix A. Guidance on Selection and Use of Noise Analysis Locations

This appendix includes guidance and discussion on the following topics:

- The terminology used in establishing noise analysis locations,
- Selecting appropriate noise analysis locations within the project area (where or where not on the property, areas of frequent human use, second story units, etc.), and
- Assigning noise analysis locations for special land uses.

Noise Analysis Location Terminology

The following terms are more fully defined below for use in this appendix and noise requirements with regard to noise analysis locations.

Noise Receptor (or receptor): A location that represents an individual, potentially noise sensitive land use, such as an individual home or apartment. Receptors may also include areas in open spaces (such as parks, campgrounds recreation areas, playgrounds, school yards, trails) or near the exterior areas of non-residential structures (such as school buildings, churches, hotels, libraries, etc.). In practice the term "receptor" may sometimes be used to describe the individual land use itself (e.g. 123 Main Street) or, in context, a specific location associated with such a property (e.g. the rear yard of 123 Main Street approximately 20 feet from the rear façade). Receptors are often used to represent noise measurement and prediction locations, as well as for the purpose of determining cost effectiveness (i.e., cost per benefited receptor) and solicitation of resident/owner viewpoints. When determining the number of benefited receptors for cost effectiveness and the solicitation of resident/owner viewpoints, the context and intensity of the land use must be taken into consideration. (See "Assigning Receptors for Exterior Special Land Uses" in this appendix.)

Noise Measurement Locations: A noise measurement location is a location where noise measurements were conducted as part of the project. Noise measurements are usually conducted at a noise receptor location (as described above) but not all receptors will include noise measurements.

Noise Prediction Locations: A noise prediction location is typically a receptor location that includes a noise prediction only but did not include a noise measurement. For most studies it is expected that only a few of the receptor locations would also be noise measurement locations, with the rest being noise prediction locations only. A single noise prediction location may be used to represent several noise receptor locations where it is expected that noise levels would be similar.

Noise Sensitive Areas: A noise sensitive area (or NSA) is usually defined as a group of noise receptors that are geographically situated in a single, continuous geographic area, without large

gaps and which might reasonably be protected by a single noise barrier. A typical NSA might encompass a residential area with a few dozen homes within a few hundred feet of the highway that extend between two interchanges. It is also common that an NSA will have a fairly consistent land use (such as single family homes), but some NSAs may have mixed use areas. In this sense an NSA may consist of a single isolated noise sensitive structure, or a mile long stretch of closely spaced, uninterrupted homes alongside the project highway. The use of NSAs in a noise analysis is not required, but is encouraged in order to make the noise analysis process more organized and easier to follow by laypersons and decision makers.

Assigning Noise Receptor Locations

As discussed above, a noise receptor represents an individual land use such as a single family home, individual apartment unit or a human use area in a park, playground, school, or recreation area, and may also coincide with a noise measurement location, a noise prediction location, or both. For the purpose of conducting measurements and predictions, the receptor location is also a specific location in three-dimensional space where a noise measurement or prediction will take place and some care should be exercised in selecting the precise location.

For residential land uses appropriate choices for receptor locations may include a patio or other exterior areas of frequent human use on the side of a residential structure facing the project, but care should be taken not to select a location that is too far from the receptor structure itself. If no such area of frequent human use is evident, an exterior position approximately 20 feet from the facade of the structure closest to the project should be used. For multi-story, multifamily residential dwelling it may be required to assign receptor locations to exterior use areas such as upper story balconies if these balconies represent the sole, private exterior use for a specific unit. A measurement position at the ROW line at the back of the property is typically a poor choice since these locations rarely represent an area of frequent human use and noise abatement elements designed to provide sufficient noise reduction at this position will usually offer insufficient protection at areas nearer to the structure. Positions at the front curb or sidewalk of the receptor property are inappropriate since they generally do not represent an area of frequent use and are highly influenced by local street traffic passing within a few feet of the position.

The distance from the project highway within which to identify receptor locations is also an important consideration. FHWA guidance advises against establishing a firm screening distance within which noise impacts should be identified, however, it is also observed here that beyond some reasonable distance noise impacts become less likely to occur and increasingly difficult to reliably predict or mitigate. For example, under normal meteorological conditions it is unusual to see highway traffic noise levels exceeding noise abatement criteria levels beyond about 500 feet, and it is generally accepted that traffic noise models can reasonably predict traffic noise levels within this distance. However, beyond 500 feet absolute noise level impacts become less likely and the effectiveness of both traffic noise prediction models and typical noise abatement measures become less reliable. In some rural areas with low existing ambient noise levels

relative noise impacts (from a substantial noise increase) may still exist beyond 500 feet. Caution should be exercised in analyzing noise levels at locations greater than 500 feet from the roadway due to practical limitations in noise prediction methodology.

Assigning Noise Receptors for Activity Category C

Assigning the number and locations of receptors for Activity Category C, (such as parks, recreation areas, active sports areas, picnic areas, playgrounds, campgrounds, etc.) generally requires some special attention. A basic strategy for assigning receptor units is offered below for simple cases, and as a starting point for more complex cases.

For exterior areas under Activity Category C, assign one receptor location for each 100 feet of frontage which includes an improved area of frequent human use that would benefit from a reduced noise level within 500 feet of the project roadway, except trails, which should be assigned no more than one receptor per 250 feet of trail. Do not assign receptors for areas that do not have improved areas as described above, beyond 500 feet from the roadway, and do not include more than one receptor location per 100 feet of frontage. For further details on trail receptor assignments, see Guide to Modeling and Voting Methodologies for Trails located at http://www.dot.state.mn.us/environment/noise/policy/ .

For current guidance on motorized versus non-motorized trails see FHWA guidance at: http://www.fhwa.dot.gov/environment/noise/regulations_and_guidance/faq_nois.cfm.

For example, consider a large suburban park that extends approximately 4000 feet along the project roadway: at the easternmost 1000 foot portion of the park there is a picnic pavilion, a playground, a fountain with benches, tennis courts, a basketball court a softball field, all within 500 feet of the highway. The next 3000 feet includes a parking area and less formally developed areas with no specific areas of frequent human use. In this example one receptor could be located within each of the ten 100 foot sections of frontage with improvements, at a setback distance consistent with the improvements in that section, for a total of ten receptor units, and no additional units in the parking area or less developed area to the west, and no more than one receptor per each 100 foot frontage section. The ten identified receptor units would be used as measurement or prediction locations to determine existing and future noise levels, and used in the calculation to determine cost effectiveness of proposed noise abatement as well as the solicitation of votes from the benefited receptors.

The placement of receptor locations for the wide variety of land uses that might fall into this category, and the highly variable ways that these land uses are used by the public defies a simple description. Therefore, the number and placement of receptor units shall be handled on a case by case basis and reviewed by appropriate MnDOT staff.

For Cemeteries specifically, one (1) receptor should be counted for each area of a formalized memorial gathering facility. Individual grave sites and access ways are not considered

individually sensitive receptors or centers of human activity; however, each section of the cemetery as defined through consultation with the operator, which may have informal gathering areas, should be assigned a receptor because they are considered to meet the intent of 'centers of human activity'. If there are no formalized or operator defined informal gathering areas, a generalized receptor(s) shall be placed within the property that best represents the worst expected traffic noise condition, based on professional judgment of the noise specialist.

Assigning Noise Receptors for Activity Categories D

For institutional or commercial structures included in Activity Category D, the receptor location shall be located at an exterior area representing the façade of the building facing the project. This receptor will be used as part of the process to estimate an interior sound level. See Interior Noise Analysis Flowchart for Category D Facilities located at http://www.dot.state.mn.us/environment/noise/policy/ for guidance on estimating interior noise levels.

Assigning Noise Receptors for Activity Categories E

For institutional or commercial structures included in Activity Category E, the receptor location shall be located at the exterior area of frequent human use if one exists (such as an outdoor break area, eating area, or casual seating area). If no such area exists, an exterior area representing the façade of the building facing the project shall be selected.

Appendix B. Guidance and Procedures for Field Noise Measurements

All procedures and equipment below are reference to:

- ANSI S1.4-1983
- FHWA Measurement of Highway Related Noise
- Minnesota Statute 7030.0060 'Measurement Methodology'

Noise measurements are required for all noise studies. Consultants and agency staff conducting field noise measurement programs for noise studies are encouraged to have sound professional experience and decision making skills in addressing the various routine and non-routine issues that present themselves in all field noise measurement work. To assist in this effort this appendix provides general guidance on the following topics:

- Purpose for conducting traffic noise measurements (model validation, document existing noise levels)
- Basic procedures for conducting noise measurements (equipment type, set-up, field calibration, measurement parameters, intervals, documentation)
- Common mistakes or poor measurement conditions to avoid
- Reporting noise measurement data
- Technical references to be followed

Purpose for Conducting Noise Measurement for Traffic Noise Studies

There are two primary purposes for conducting noise measurements for traffic noise studies, and which are generally covered in this appendix:

- Validation of noise model runs
- Establish existing noise levels at areas that cannot be properly modeled

The model validation task consists of comparing measured noise levels to modeled noise levels for similar traffic conditions, and *validate* that the measured and predicted levels are within suitable agreement (typically within +/- 3dBA). Model validation measurements are typically conducted in areas near existing roadways where the traffic noise is the dominant noise source.

Existing noise level measurements are conducted to empirically determine the existing noise environment in areas where traffic is not the dominant noise source, such as for a proposed new roadway alignment (and where traffic noise prediction models cannot accurately predict existing conditions).

There are other, less routine noise measurement tasks, such as long term noise measurements to empirically demonstrate loudest noise hour, and specialized noise measurement procedures to document noise barrier performance, determine exterior to interior acoustical transmission loss of a structure, or generate reference levels for noise prediction models and pavement noise studies, but these are not covered in this section. Please see the FHWA's Measurement of Highway-Related Noise (link in Appendix G) for more information on these measurement types, or other suitable standards and references if they are required.

Basic Procedures for Conducting Noise Measurements

Field noise measurements must be taken consistent with the guidelines contained in FHWA's manual 'Measurement of Highway Related Noise', Minnesota Statute 7030.0060 'Measurement Methodology' and this appendix, as described below.

Equipment

Equipment required to conduct suitable and defensible traffic noise measurements generally include the following:

- Integrating sound level meters (SLM) with microphones classified as Type I (preferred) or Type II (ANSI S1.4-1983), fitted with an appropriate environmental windscreen,
- Field calibrator,
- Instrument tripod,
- Environmental weather meter (small hand-held versions are suitable),
- GPS transponder (optional, but highly recommended), and
- Digital camera (optional, but highly recommended).

All SLM and field calibrators must be documented to be within their one-year laboratory calibration period at the time of the measurements. For this task it would be suitable to include an equipment list with equipment model and serial numbers and last laboratory calibration date for each piece of key equipment (typically SLMs and field calibrators), and proof of calibration available and offered upon request. The use of compact "dosimeter" type sound level meters is discouraged, since these units are generally designed for indoor use and often lack appropriate measurement metrics, noise floor, dynamic range, and appropriate wind screens for outdoor environmental measurements.

Instrument Calibration

As stated above, all SLMs and field calibrators must be documented as being within their one year factory or laboratory calibration period. All laboratory calibrations should be traceable to the National Institute of Standards and Technology (NIST) in Washington, DC. In addition, a field calibration check is required before and after each field measurement session.

Measurement Locations and Set up

Traffic noise measurements are typically conducted at representative locations within the project area. If possible, locations along the alignment should be chosen that represent potentially impacted noise sensitive receptors and that have a noise environment similar to other areas along that section of the alignment. Selecting the precise number and locations of representative locations requires some level of professional experience and judgment. In general, it is expected that at least one measurement location should be conducted for each noise sensitive area (collection of receptor sites or residences that might be expected to be protected behind a single noise barrier) and that the measurement location should be representative of an exterior area of frequent human use. Appropriate choices for measurement positions may include an exterior patio or other areas of frequent human use on the side of a residential structure facing the project, but care should be taken not to select a location that is too far from the receptor structure itself. If no such area of frequent human use is evident, a position approximately 20 feet from the facade of the structure closest to the project should be used. A measurement position at the ROW line at the back of the property is typically a poor choice since abatement elements designed to provide sufficient noise reduction at this position will usually offer insufficient protection at areas nearer to the structure. Measurement positions at the front curb or sidewalk of the receptor property are inappropriate since they generally do not represent an area of frequent use and are highly influenced by local street traffic passing within a few feet of the microphone.

Once the precise measurement site and position are selected, the SLM should be set up on a tripod with the microphone set to a height of approximately 5 feet above the ground. The SLM should be set to "A-weighting" and "Fast" response, and fitted with an appropriate foam wind screen in good condition (typically 3.5 inch diameter). Before beginning measurements the SLM should undergo a field calibration check, with the results documented in a field data sheet.

Measurement Times and Durations

At least one reading shall be conducted at each selected location during a period representative of the worst hourly traffic noise condition. At each measurement location, a 30 minute measurement should be conducted, although a shorter 15 minute measurement time period may be appropriate for busy highways with a constant flow of traffic.

Documentation

All field noise measurements must be accompanied by an appropriate and legible field data sheet. In order for noise measurements to be in compliance with recognized standards the field data sheet should include the following items:

- Name, location and land use of field measurement site (such as a residential address, or name of commercial or institutional locations), including measurement site ID name/number if applicable,
- Date and time of the measurement,

- Name and affiliation (agency or company) of the person conducting the measurement,
- SLM settings (weighting network, response setting),
- Results of pre- and post-measurement field calibration check,
- Meteorological conditions (temperature, wind speed, %RH, precipitation, cloud cover), including an observation of roadway conditions (confirm dry roadways),
- Terrain conditions (hilly/flat, hard/soft/mixed, presence of ice or snow, etc.),
- A measurement site sketch (indicating SLM position, nearby buildings and structures, relevant terrain features, distance from SLM to permanent landmarks, direction and approximate distance to dominant sound sources including roadways, etc.). A general rule of thumb is that the site sketch should be detailed enough that someone else following the notes should be able to replicate the measurement position within a few feet.
- Notes on dominant and observed noise sources during the measurement. Also a listing with approximate times of significant transient events that could influence the noise measurement (such as passing emergency vehicles, dogs barking nearby, operator noise, audible aircraft over-flights, etc.).
- Notes on the actual measured sound levels. Although the Leq metric is used for impact assessment, other metrics including L10, L50, L90, Lmax and Lmin for the time measurement period should also be recorded, if available.
- Classified traffic counts (autos/medium trucks/heavy trucks). It may be difficult to collect traffic data for the entire measurement period, but it is recommended to collect an approximate classified traffic count for at least a limited, representative portion of the measurement, perhaps 5 minutes, for comparison to traffic volume assumptions used for the analysis.
- GPS coordinates of the SLM position (optional, but highly recommended).
- A list of photos taken of the measurement set-up. It is recommended that two photos be taken at each measurement site, one showing the SLM mounted on its tripod with the receptor location in the background, and another of the SLM with the dominant noise source (typically the subject roadway) in the background (optional, but highly recommended).

A sample data sheet is provided in this appendix.

Interaction with Residents and Property Owners

Interacting with residents and property owners is an important part of the field measurement process. In any such interaction with residents or property owners, the noise measurement staff must exercise a high level of respect and professionalism. Since measurements need to be conducted at an area of frequent human use or near the structure it is typically required that the

measurements be conducted on private property. Permission to conduct measurements on private property must be obtained from the resident or owner. One exception to this requirement is when the desired measurement position is freely accessible to the public, such as a common use area at a large apartment complex or commercial area, but even here, permission to access the property should be sought if possible. Any area specifically signed as "Private Property" or "Do Not Enter" should not be accessed without specific permission from the owner or resident. To assist in obtaining owner or resident permission to access private property it is often useful to have proper documentation including proper personal documentation, a business card, associated project documents, and if possible, a letter on agency letterhead referencing the project and respectfully requesting voluntary cooperation in allowing the measurements to be conducted on their property.

In addition to obtaining proper permission to conduct measurements on private property, it is also important that the noise measurement staff not overstep their project role in their communications with owners and residents. Some residents may have questions related to the project such as various project alternatives or timing. Field measurement staff should not attempt to answer these questions (unless they are specifically authorized to do so), but rather, should direct such inquires to the overall project manager, or the project's public interaction or public relations staff.

Common Mistakes and Poor Measurement Conditions to Avoid

Avoid conducting noise measurements under any of the following conditions:

- Any type of active precipitation (rain, snow, sleet, etc.).
- In the presence of significant snow or ice cover between noise source (roadway) and measurement location.
- During periods when roadway pavement is wet (such as from recent precipitation or snow melt).
- With wind speeds greater than 12 mph.
- On extremely hot or cold days (typically greater than 100 degrees or below 20 degrees F.)
- When relative humidity is greater than 90% or less that 5%.
- In the presence of atypical or temporary noise sources, including those caused by, or due to the presence of the operator (such as dogs barking at the operator, conversation with the operator, etc.) but also including other temporary sources such as nearby lawn maintenance/landscaping activity, nearby construction activity, children playing, etc.
- In the immediate vicinity of highly localized noise sources, such as a window air conditioner or pool pump/filter equipment, keeping in mind that these types of noise sources may cycle on and off.
- In the immediate presence of large acoustically reflective surfaces (should be at least 20 feet from building walls) or near/behind large temporary shielding objects (such as behind a large van or truck) blocking line-of-sight to the primary noise source.
- When ambient noise measuring and traffic counts cannot be done simultaneously.

In addition, for noise measurements to be used for noise model run validation it is especially important to reduce the influence of non-highway noise sources, since these are not taken into consideration by the noise model. However, for cases where noise measurements are being conducted for new highway alignments and traffic noise is not the dominant existing noise source, other non-highway noise sources are more likely to control the existing acoustical environment and should be included in the measurement.

And, of course, it is important for the noise measurement staff members to avoid contaminating the measurements by talking near the measurement equipment while it is operating, or allowing others to do so, or by coughing or sneezing, or by standing directly in front of the meter during measurements. Frequently during a measurement a homeowner or interested passer-by may wish to ask some questions. In this case, silently direct the interested person away from the meter to a more distant location away from the SLM where you can have a quiet conversation without influencing measured noise levels. In general, it is good practice to stand several feet away from, or to the side of, the SLM during the measurement period.

Reporting Measurement Data

The field noise measurement data sheets, if completed properly, provide ample detail regarding the noise measurement effort. It is recommended that copies of the data sheets be included in an appendix along with indexed photos of the measurement positions, and that a table summarizing the pertinent measurement data be included in the noise analysis. The table should include for each measurement the site ID, brief site description, measurement time and duration, and measured noise levels (Leq). See the table below as one example of a simple noise measurement summary table:

Example Noise Measurement Summary Table

Site ID	*Location Description*	*Measurement Time*		*Measured Level, dBA**
		Start	*End*	*Leq*
ML1	Single family home, (rear yard)	10:00 AM	10:30 AM	63.0
ML2	Four unit apartment, (common rear yard)	1:00 PM	1:15 PM	64.0
ML3	Public Park, (picnic area)	2:00 PM	2:30 PM	59.0

*Level should be reported to the nearest one-tenth decibel

Noise Model Validation

The field noise measurements can be used to compare the modeled noise levels for existing conditions to measured levels. If the difference between the modeled predictions and the existing measured levels exceeds 3 dBA, the modeling site input parameters must be checked for consistency with actual site conditions and modified as appropriate prior to the prediction of the design year noise levels. If there is still a difference of more than 3 dBA between measured and modeled noise levels an appropriate adjustment factor should be applied or the measured noise level must be used to represent the existing noise level (use of adjustment factors should be reviewed with MnDOT noise staff).

Sample Data Sheet

SLM Settings:
Time: Slow ___ Fast ___
Weighting: Lin. ___ A ___
Mic. Setting: Fr__ Rnd___
FSD Calib.____ Meas____
Microphone K-factor:____

Environmental Analysis
Mn/DOT
Noise Survey

Name: _____
S.P. No. _____
Job/Act. _____
Speed Limit _____
Site Code _____

Acoustics Equipment Kit No. ____

EQUIPMENT:	Type	Serial No.	Cal. Date	Miles	Homes
Sound Level Meter					
Microphone					
Calibrator					

Location:	Mile Point :

Measurement Information

TEST NUMBER	1	2	3	4	5	6
Date						
Start Time						
Weather						
Temperature ° F						
Wind in MPH						
Wind Direction						
Pre-Calibration						
Event Duration						
TRAFFIC	Total					
Autos						
Medium Trucks						
Heavy Trucks						
Buses						
Motorcycles						
Other						

L_n Results (dBA)

L_n /Test>	1	2	3	4	5
L_{10}					
L_{50}					
L_{90}					
L_{eq}					

NOISFORM.DOC

See the Other Side For PLAN and Cross-Section Sketches

Appendix C. Guidance on Determining Worst Noise Hour

The following page is an excerpt from a Federal Highway Administration document entitled "Interim Guidance on the Application of Travel and Land Use Forecasting in NEPA", March 2010 (Section 2.6.1).

The results of travel demand forecasts are used as inputs to noise analyses routinely conducted as part of the NEPA process. The procedures used to identify and estimate noise impacts are found in 23 CFR Part 772, the FHWA regulations for the evaluation and mitigation of traffic noise in the planning and design of Federal funded highway projects. This regulation establishes:

1. Methodologies for conducting a traffic noise analysis, and

2. Guidelines and requirements for the consideration of noise abatement measures.

In preparing traffic projections for NEPA documents, it is important to understand certain requirements of the FHWA regulations with respect to traffic volume estimation and modeling:

- *Noise levels are established for the existing condition and a no-build and build scenario in the design year. The "design year" is "[t]he future year used to estimate the probable traffic volume for which a highway is designed" and is usually consistent with the design year established for other impact analyses in the EIS process.*
- *Noise impacts are measured during the one-hour period where the worst-case noise levels are expected to occur. This may or may not be the peak hour of traffic. That is, higher traffic volumes can lead to higher congestion and lower operating speeds. Since higher speeds lead to higher noise emissions from motor vehicles, the worst-case noise levels may occur in hours with lower volumes and higher speeds. In addition, vehicle mix may also change hourly. On many highways, the percentage of heavy trucks is reduced during peak hour. Since heavy trucks have greater sound emissions than passenger cars, vehicle mix is an important component in determining the peak hour of noise impact. It may be necessary to conduct screening runs on several hours to determine which combination of traffic volume, speed, and vehicle mix yields the greatest impact. It may be the case that the peak hour of noise impact changes as the result of the proposed project. For example, the introduction of a multimodal facility like a freight terminal could introduce a large volume of heavy trucks during off-peak hours. In this case, a different analysis hour could be evaluated for the no-build and build alternative scenarios.*

If the hour to be modeled is not included as a direct output of the travel demand forecasting model, then adjustments can be considered based on factors developed for similar types of roads. For example, if a transportation model is used to develop annual average daily traffic (AADT),

then adjustment factors based on automatic traffic recorders (ATRs) could be used to estimate time-of-day hourly volumes and vehicle mix. The methodology for adjustments of model volumes used in the noise analysis should be consistent with that used in other sections of the EIS, and should be documented.

Example traffic breakdown sheet

HOURLY TRAFFIC BREAKDOWNS

Location: **TH 100, No. of TH 55 (Vehicle Classification Site #7726)**

Beg. Hour	Hourly % of ADT	Hourly Direct. Distrib.		% of Hourly ADT that are Trucks (HCADT)	Truck Splits	
		SB	NB		Single Units	Semi's
0:00	.063 %	33 %	67 %	2.13 %	50 %	50 %
1:00	.49 %	28 %	72 %	7.55 %	25 %	75 %
2:00	.32 %	40 %	60 %	9.72 %	29 %	71 %
3:00	.36 %	54 %	46 %	9.64 %	25 %	75 %
4:00	.68 %	71 %	29 %	6.00 %	25 %	75 %
5:00	2.37 %	77 %	23 %	3.94 %	44 %	56 %
6:00	6.44 %	71 %	29 %	1.78 %	57 %	43 %
7:00	8.78 %	65 %	35 %	1.65 %	63 %	37 %
8:00	6.93 %	66 %	34 %	2.30 %	59 %	41 %
9:00	4.90 %	57 %	43 %	4.25 %	65 %	35 %
10:00	4.15 %	53 %	47 %	5.02 %	72 %	28 %
11:00	4.58 %	50 %	50 %	3.85 %	73 %	27 %
12:00	4.48 %	49 %	51 %	2.96 %	77 %	23 %
13:00	5.32 %	49 %	51 %	3.68 %	71 %	29 %
14:00	6.05 %	48 %	52 %	2.59 %	59 %	41 %
15:00	7.42 %	42 %	58 %	1.99 %	62 %	38 %
16:00	7.71 %	42 %	58 %	2.45 %	49 %	51 %
17:00	7.90 %	42 %	58 %	1.79 %	61 %	39 %
18:00	6.21 %	45 %	55 %	2.13 %	60 %	40 %
19:00	4.11 %	42 %	58 %	2.16 %	69 %	31 %
20:00	3.57 %	43 %	57 %	1.94 %	75 %	25 %
21:00	3.26 %	45 %	55 %	2.21 %	67 %	33 %
22:00	2.13 %	42 %	58 %	2.70 %	45 %	55 %
23:00	1.23 %	33 %	67 %	5.38 %	25 %	75 %

Note:

ADT = Average Daily Traffic

HCADT = Heavy Commercial Average Daily Traffic

Example Write-up for Loudest Traffic Noise Hour

Traffic Noise Analysis

Worst Hourly Traffic Noise Analysis

In general, higher traffic volumes, vehicle speeds, and numbers of heavy trucks increases the loudness of highway traffic noise. The worst hourly traffic noise impact typically occurs when traffic is flowing more freely and when heavy truck volumes are the greatest. For determining the worst-case traffic noise hour, traffic noise levels for three time periods were modeled at six representative receptor locations along the project corridor under existing conditions, taking into account the appropriate vehicle mix (i.e., cars, medium trucks, heavy trucks), seasonal traffic variations where appropriate, and directional split in traffic volume (i.e., northbound versus southbound).

The Leq level for each of the three modeled time periods are summarized in the Table below, along with the daytime monitored noise levels at each of the six representative receptor locations. Based on this analysis, it was determined that the time period from 9:00 AM to 10:00 AM represents the worst-case traffic noise hour.

TABLE "X"
EXAMPLE WORST HOURLY TRAFFIC NOISE SUMMARY

Receptor ID	Monitored Level (dBA) Leq	Modeled Level (dBA) by Time Period		
		9:00-10:00 AM Leq	3:00-4:00 PM Leq	PM Peak Hour Leq
35	63.0	64.9	64.1	62.2
46	63.0	63.3	62.6	61.0
52	**70.3**	**69.6**	**68.8**	**67.2**
57	57.5	59.9	59.1	57.1
66	60.0	63.9	63.7	61.9
78	**70.5**	**72.1**	**71.2**	**69.9**

Bold numbers are approach or exceed Federal noise abatement criteria B (NAC B). NAC B is the appropriate category for all of the receptors in this sample scenario.

Appendix D. Guidance on Traffic Noise Analysis Documentation

This appendix provides an example expanded outline for a typically acceptable noise analysis documentation. Normally, a noise analysis can be summarized and documented in the required environmental document, provided that the following main sections are all adequately addressed and approved by MnDOT and FHWA.

1.) Introduction
   a. General Project Description
   b. Background information on noise explaining fundamental concepts and noise metrics. Also explain that complying with the FHWA analysis requirements fulfill the statutory exemption required by MN state noise laws/rules.
   c. Construction Noise
      - Identification of land uses affected by project construction noise.
      - Identify typical construction equipment and processes to be used in the construction of the project.
      - Identify or propose measures that are needed to minimize or eliminate adverse construction noise impacts.
   d. Review of Federal Traffic Noise Policy

2.) Analysis Methodology
   a. Affected Environment

      Include a brief description of the Project and define its limits. See Section 3.7 Determining Noise Analysis Limits Beyond Project Termini for methodology and guidance on determining noise analysis limits at project termini.
   b. Noise Monitoring

      Describe monitored locations and noise measurement methodology, such as when the monitoring took place, what equipment was used (include serial numbers), and give a summary of the minimum and maximum range of monitored levels.
   c. Document methodology and data to support selection of worse case noise hour (see Appendix C).

3.) Predicted Noise Levels and Noise Impacts
   a. Noise Receptors

      Provide a general description of the identified noise receptors, such as how many total receptors were modeled, if they are solely residential receptors or not, where the greatest concentration of receptors is located, and provide a figure of the monitored and modeled receptors.
   b. Noise Model Results

Provide a summary of noise modeling assumptions and inputs (including traffic volume and mix, speeds, etc.), and a description of both existing and future modeled noise levels. Give the range of levels, state whether or not they approach or exceed FHWA NAC guidelines for noise impacts, or both, and provide any details on existing noise barriers or other mitigation that may be affecting the noise levels. For both future no build and future build noise levels, state the range of increase over existing noise levels. Provide tables for only the worst noise hour. Tables should provide the following information:

- Receptor ID or name
- Monitored/Measured Noise Level in Leq.
- Modeled Existing Noise Level in Leq.
- Modeled Future No-Build Level in Leq.
- Difference between Modeled Existing and Future No-build.
- Modeled Future Build Noise Level in Leq.
- Difference between Modeled Existing and Future Build.

Indicate which receptors exceed FHWA NAC (such as with Bold Font) as well as areas which would cross 23 CFR 774.15 thresholds. An Example Noise Results Table is provided below.

Example Modeled Noise Results Table

Table 3. I-90 Lane Additions, Noise Model Results

Receptor ID	*Monitored 2017*	*Modeled Existing 2017*	*Modeled No Build 2037*	*Difference between Existing 2017 and No build 2037*	*Modeled Build 2037*	*Difference between Existing 2017 and Build 2037*
	Leq	*Leq*	*Leq*	*Leq*	*Leq*	*Leq*
NSA B: I-90 WB Main to Elm						
B-1 (R)		62.0	63.0	1.0	64.0	2.0
B-2 (R)	62.0	61.0	64.0	1.0	**66.0**	5.0
B-3 (R)		**69.0**	**70.0**	1.0	**74.2**	5.2
C-1 (C)		63.2	65.4	2.2	***68.5***	5.3

Bold Numbers are approach or exceed Federal Noise Abatement Criteria.
Underline numbers are receptors that have substantial increase in noise levels.
Italic numbers exceed 23 CFR 774.15.
(R) designates residential. (C) designates campground.

4.) Consideration of Noise Abatement

a. Include a description of acceptable noise abatement measures.

b. Noise Barrier Evaluation

i. Include a description of reasonableness and feasibility requirements, as well as any cost-effectiveness information (cost per square foot, cost per benefited receptor, the definition of a benefited receptor, etc.). Be explicit, what, if any, costs were included beyond the standard $36/SF on a wall-by-wall basis. Only include costs incurred directly due to the construction of the noise barrier itself, i.e., right-of-way, guardrail, etc. Provide a figure with all modeled noise barriers. Provide a table for each proposed noise abatement element indicating which receptors were benefited with the minimum noise reduction of 5 dBA and which met the noise abatement design goal of 7 dBA. Provide a table showing the cost-effectiveness results.

ii. Provide a detailed description of each Noise Sensitive Area that will be affected by an individual barrier, including information such as the length and height of the barrier, the total number of receptors in the area (include identifying information, i.e. the name of the receptor), the number of benefited receptors, cost information, and the noise reduction range. If a barrier is not recommended in the area, describe the reasoning behind it. If there are multiple alignment or height options for a barrier within an area, describe those individually.

c. Noise Barrier Cost-Effectiveness

Describe the Cost-Effectiveness for each barrier and whether or not any of the modeled barriers meet the criteria. State whether the barriers are not recommended or recommended after this analysis.

d. Other Noise Mitigation Techniques (if applicable)
State whether or not each applicable mitigation technique is feasible and reasonable for the Project and provide reasoning for this decision.

5.) Conclusions and Recommendations

Provide a general description of overall results and state whether or not any noise mitigation has been recommended. Results of public participation efforts and formal voting results are required for final environmental documents.

Project information to be retained in project files includes the following:

- Field measurement data sheets, photographs of the monitored locations, and any other pertinent information related to the noise monitoring for the project.
- Modeled data, such as traffic data and barrier design information (if applicable).

- Print-outs of any applicable modeling data, such as barrier information, receptor information (including location and results), and traffic information.
- Solicitation results for submittal to FHWA only.

Appendix E. Guidance on Public Involvement Related to Noise Studies

Public involvement is an important part of highway improvement projects. With the emphasis on considering viewpoints of benefited receptors (owners and residents), the need for effective public interaction is critical.

This appendix includes discussion on the following topics:

- The purpose of the public involvement process for highway noise studies
- Common public involvement tools and techniques
- The desired timing and outcome of the public participation process

Purpose

The purpose of the public involvement process for highway noise studies is twofold:

1) Inform the public about the various elements of the project, including potential noise impacts and noise abatement options, and
2) Collect input from the public regarding their input and desire for reasonable and feasible noise abatement options.

Some of the important information that the public interaction process can provide and collect includes the following:

- The elements of the proposed project (new alignments, new lane additions, new interchanges, traffic control devices, landscaping, safety enhancements, reduction in traffic congestion, etc.)
- Predicted existing and future noise levels and assessed noise impacts associated with proposed improvements.
- Proposed noise abatement for the project, including visual depictions of noise walls and barriers (including any proposed aesthetic enhancements), and expected acoustical performance at specific noise receptor locations.
- Communicate the requirement to take into account viewpoints of residents and property owners of benefited receptors before making a final decision on implementing noise abatement elements, and ultimately, collecting that viewpoint or opinion.

In relaying expected existing and future noise levels as well as expected noise reduction provided by proposed noise abatement, it is critical to realize that understanding noise levels and changes in noise levels is far from intuitive, and most lay-persons can be easily confused by the use of

decibels and different measurement metrics. It is recommended that special care be taken to adequately relay this information to owners and residents that are asked to express a viewpoint or opinion on proposed noise abatement in a way that they can comprehend.

Public Interaction Tools and Techniques

A variety of public interaction methods and tools are available for presenting information to, and collecting opinions from, the interested public. Depending on the particular aspects of the project (including project size, number and demographics of the potentially impacted public, and level of project controversy) some combination of public involvement techniques may be used to best achieve the goals of the project. Project proposers should be aware of any language barriers and provide effective methods of communicating, for example, interpreters, bilingual materials alternate formats, etc. Some of the more frequently employed tools and techniques are described below:

Noise Advisory Committee

The Noise Advisory Committee provides two-way communication between the community and the project team regarding traffic noise. Meetings will educate committee members (usually a small group of citizens, council members, and city staff) regarding the noise evaluation process and will assist the project team in understanding community issues and perspectives. The Committee will review noise analysis methodology and results of noise impact and mitigation analyses. The Committee will also provide feedback to the city council and communicate project information to neighborhood residents.

Public Meetings

Public meetings are one of the primary and most frequently used tools for public interaction and can be useful for both providing project information to the public as well as soliciting opinions and viewpoints.

Public meetings can be presented in a variety of formats, including the following:

1) Seminar Format: Where a speaker presents information to an audience of stakeholders or area residents with a question and answer session afterwards. An advantage of this format is that all visitors receive the same information and questions asked and answered provided during the QA session are open for all to hear. A disadvantage of this method is some visitors to the presentation will be too intimated to ask critical questions, relative to more direct contact with project personnel.
2) Open House Format: Displays, literature and project personnel are available in different stations in an open room where visitors can move from station to station to learn about different aspects of the project, speak directly with project personnel and fill out a comment card expressing their opinion or requesting additional information. An advantage is that this format provides visitors with more hands-on access to displays and

staff allowing for interactive presentation of project information and allows them to visit on their own schedule and absorb information at their own pace, and ask questions; but the lack of a formal presentation requires visitors to visit all stations/displays to get all the relevant information to make informed decisions.

3) Seminar / Open House Combination: A hybrid between the seminar and open house concepts where visitors can sit in on a prepared presentation and then have direct access to project personnel and additional displays and information. This approach may take more time and planning than either a seminar or open house meeting alone but can offer the advantages of both.

Regardless of the type of public meeting format to be used, it will need to be properly promoted, and possibly presented more than once at different locations and times to ensure that all interested parties can participate.

Appropriate locations for public meetings are public meeting venues in or near the project areas. These may include the following:

- A local agency project office
- A local church or school, or community center
- Town hall meeting room, or training room
- A local hotel meeting room

Public meetings are best held in the early evening hours, after work, and when families with children can attend. For some larger projects it may be appropriate to hold more than one meeting on different nights, to give local residents and property owners a choice of when they can attend.

Direct Mail and Door Hangers

Direct mailing or door hangers can be an effective method to deliver project information to stakeholders and interested parties. Mailers to area residents and property owners can also announce public meetings or solicit opinions on project abatement measures. However, when using direct mail methods special attention shall be paid to making the materials appear official, using official agency mailing envelopes and stationary so that they will not be mistakenly discarded as unsolicited junk mail.

Telephone Surveys and Information Lines

Telephone surveys can sometimes be used to alert area residents and property owners to important upcoming public meetings or as reminders to respond to direct mail surveys, but telephone surveys are usually not an effective choice as the primary method for informing

residents and property owners about project details. Telephone call-in numbers can sometimes be set up as an option for property owners and residents to call in to ask project related questions or to officially express their opinion on noise abatement elements in response to a public meeting or receiving an informational mailing.

Internet Web Pages

A well designed project webpage can be a highly effective method of disseminating project information, announcing public meetings or allowing residents and property owners to state their opinions regarding noise abatement elements. However, this method should always be offered in addition to more traditional interactive methods since all interested parties may not have convenient access to on-line resources.

Door to Door Canvassing

Door to door interaction can sometimes be used to communicate project information, or collect feedback from area residents when other methods have failed to solicit participation, or in some cases, where the number of potentially impacted receptors is very small and a public meeting may not be appropriate.

Media Announcements

Media announcements in local newspapers and radio and television stations might be used to promote public meetings for larger projects, however, this is usually not a good method for relaying detailed project information.

Public Interaction Timing

Planning Stage

The planning stage of a project, including the MnDOT scoping process, shall limit the public interaction process to informing the public about which alternative(s) are Type I/III and outline the steps and scheduling of the noise process that takes place during the later NEPA stage. This includes situations when NEPA considerations are being incorporated into the scoping process.

NEPA Stage

Various aspects of the public participation process, including soliciting the viewpoints and opinions of the benefited property owners/residents, may take place at various times during the life of the project. However, for the purpose of informing property owners and residents about noise impacted properties and proposed noise abatement, the public interaction shall be conducted sometime after the preliminary noise analysis has been conducted, and before the final design process has begun, (in effect, during the NEPA process). The NEPA documentation will need to state if noise abatement will be provided. For projects with multiple build alternatives,

the proposed noise abatement and associated costs may help determine which alternative will be selected.

A key outcome of the public interaction process is to collect and document the viewpoints and opinions of the owners and residents of benefited receptor units regarding proposed noise abatement measures, as specified in Section 5.3 and Appendix F of this document.

Appendix F. Guidance for Evaluating Viewpoints of Benefited Receptors

Although the noise analysis must be completed for all reasonable build alternatives under consideration, the solicitation of votes from the benefited receptors shall only be conducted on the preferred alternative.

This appendix includes a sample letter that can be used for soliciting viewpoints from benefited receptors and an illustrated example of viewpoint vote counting. The input of a benefited receptor must be documented in a manner that ties the input to the benefited receptor's street address (such as on a ballot or sign-in/response sheet). The ballots and response sheets are to be retained as part of the project file.

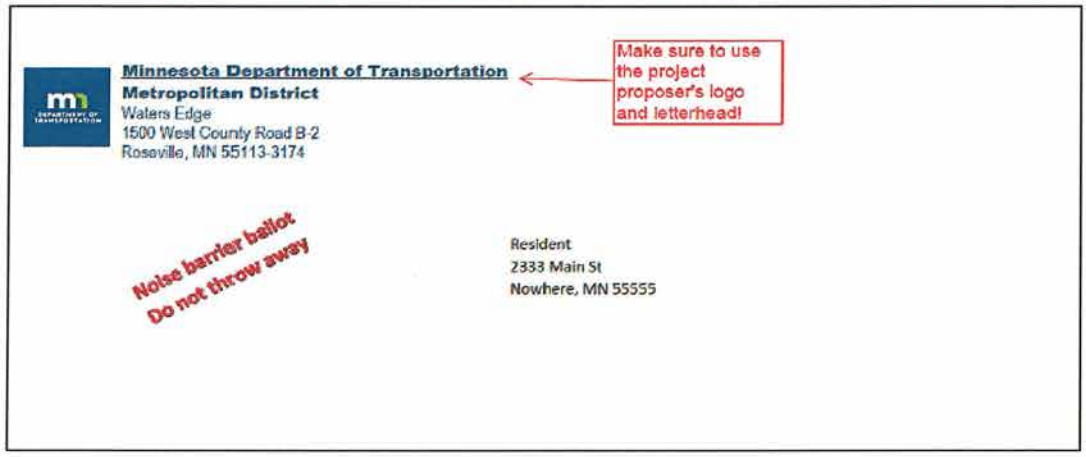
Voting points are assigned and voting results evaluated as described in Section 5.3.3

Sample Letter Soliciting Owner/Resident Viewpoint.

This section includes a recommended sample envelop format, solicitation letter template and blank ballot for use in soliciting viewpoints of benefited receptors.

Sample Outreach Letter Envelop Format

Please update with appropriate logo and return address for your project!



Example Blank Ballot

Project Name:

Owner _____ Resident _____ Owner/Resident_____

Name _____

Address _____

City State _____

Ballot due back by _____

Please mark with an "X" one of boxes below:

By submitting this ballot, the voter acknowledges that this vote represents the owner's selection or the consensus selection of the owners or all of the residents.

Yes, I want the noise barrier ☐

No, I do not want the noise barrier ☐

Solicitation Letter Template, Page 1

<Project> Proposed Noise Walls/Barriers

additional project area description

Why you are receiving this information

The Minnesota Department of Transportation (MnDOT) recently conducted a noise study along <location> and determined a noise wall constructed at <location> would reduce the traffic noise level at your property, unit or business by at least 5 decibels.

Vote on the proposed noise wall

Property owners and residents who will experience a 5-decibel reduction in noise as a result of a noise wall can vote for or against the proposed noise wall along the <location>.

Your vote can make a difference

Cast your vote on the noise wall that affects you by completing the enclosed voting ballot and mailing it back by <date>

Translation Available

Para solicitar esta información en otro idioma, por favor comuníquese con Janet Miller a través del 651-366-4720 o janet.rae.miller@state.mn.us

Si aad u codsato akhbaartan iyadoo afka kale ku qoran, fadlan la soo xiriir Janet Miller oo laga helo khadka 651-366-4720. Ama janet.rae.miller@state.mn.us

Yog xav tau cov xov no yam siv lwm hom lus hu rau Janet Miller ntawm 651-366-4720 los yog janet.rae.miller@state.mn.us

How voting works

You can vote for or against the noise wall that affects your property, unit or business. MnDOT uses a weighted voting system to ensure residents and property owners are given appropriate influence on the outcome of the noise wall. How much you influence the outcome of the noise wall is based on how much your property/unit is affected by the noise wall and whether or not you own the property/unit.

Proximity to Noise Wall	Points Awarded		
	Resident	Owner	Both
Property/unit is immediately adjacent to the noise wall	2	4	6
Property/unit is not immediately adjacent to the noise wall	1	2	3

Only the units in apartments/multi-family residential buildings that receive a 5 decibel reduction of noise get to vote. Businesses, churches and schools receive a vote equal to that of a property owner. The table above is an example of the voting system. Please see MnDOT's Noise Requirements for additional information about the voting process.

If 50 percent or more of all possible voting points from eligible voters are received after the first request for votes, the majority of points (based upon the votes received) determine the outcome of the noise wall. If less than 50 percent of the possible voting points for a wall are received after the first request, a second ballot will be mailed to the eligible voters who did not respond.

If 25 percent or more of all possible points for a wall are received after the second request for votes, then the outcome is determined by the majority of votes received. If less than 25 percent of total possible points for a noise wall are received after the second request for votes, then the wall will NOT be constructed. If there is a tie, where there are equal numbers of points for and against a noise wall, the noise wall WILL be constructed.

Upcoming neighborhood noise wall meetings

When: <date><time>
Where: <location>
<Address>

Solicitation Letter Template, Page 2

Computer Generated Visualizations

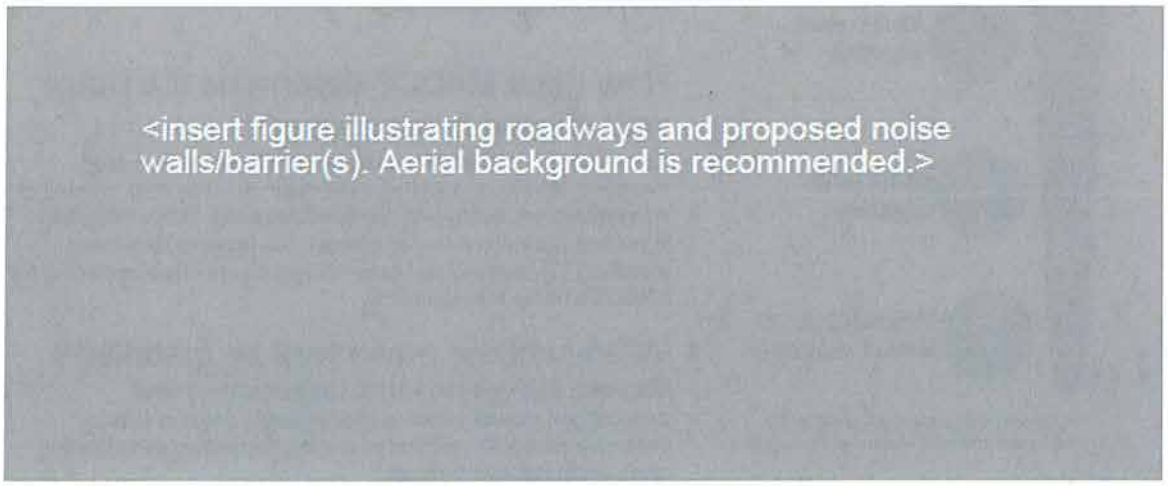
What will the noise wall look like?

The noise wall will be <x feet tall>, built with <material type>. The visuals below are based on the information available <date> and should not be interpreted as an exact design of this project.

<area description>

View from <location>

View from <location>

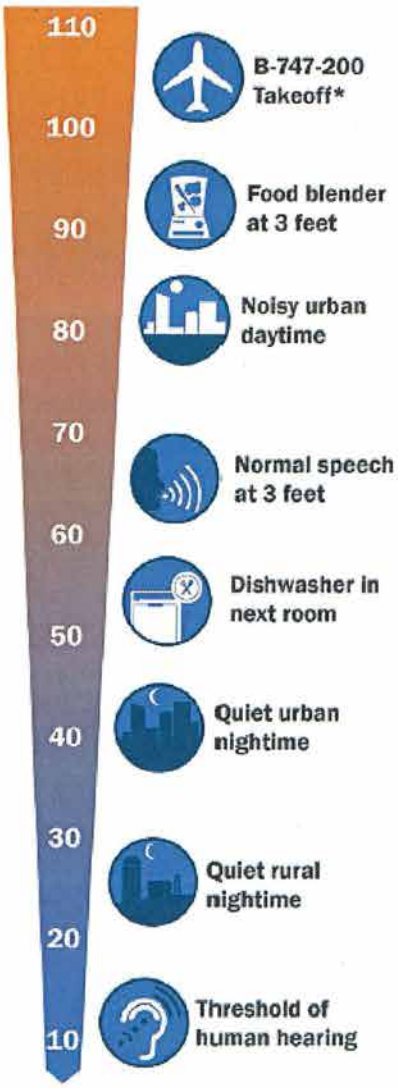


Solicitation Letter Template, Page 3

Frequently-Asked Questions

COMPARISON OF NOISE LEVELS

Measured in dB(A)



* As measured along the takeoff path 2 miles from the overflight end of the runway

Why are noise walls being proposed as part of the <project name>

MnDOT conducted a noise study along <location> to determine if noise walls would reduce the level of noise in the community adjacent to the project. Currently, traffic noise along <roadway> approachs and/or exceeds the Fedral Highway Criteria and a noise wall would reduce the noise levels at certain locations in the community by at least 5 decibels. MnDOT must comply with the noise limit requirements set by the Federal Highway Administration (23 CFR 772).

Studies have shown that changes in noise levels of less than 3 decibels are not typically noticeable by the average human ear. An increase of 5 decibels is generally noticeable by anyone, and a 10-decibel increase is usually "twice as loud."

Why does MnDOT conduct noise studies?

MnDOT assesses existing noise levels and predicts future noise levels and noise impacts of proposed construction projects. If noise impacts are identified, MnDOT is required to consider noise mitigation measures, such as installing noise walls. All traffic noise studies and analyses must follow the requirements established by federal law, Federal Highway Administration Noise Abatement Criteria, and MnDOT's Noise Requirements and noise analysis guidelines.

How does MnDOT determine if a noise wall should be proposed?

Constructing a noise wall must be feasible and reasonable. Feasibility and reasonableness are determined by cost, amount of noise reduction, safety and site considerations. Noise mitigation is not automatically provided where noise impacts have been identified. Decisions about noise mitigation are made according to MnDOT's Noise Requirements.

When will the noise wall be installed?

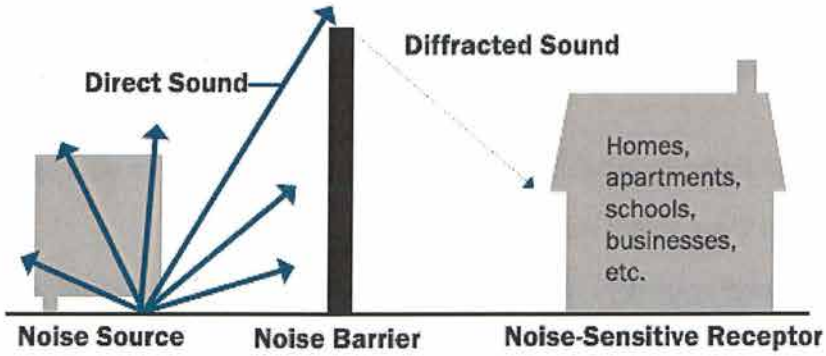
The noise wall would be installed as part of the overall construction project, which is anticipated to begin in <date> (tentative schedule - subject to change depending upon funding and project delivery method).

Solicitation Letter Template, Page 4

Frequently-Asked Questions

How do noise walls reduce noise?

Noise walls do not eliminate all noise. Noise walls reduce noise by blocking the direct path of sound waves to a home or business. **To be considered effective, a noise wall must reduce noise levels by at least 5 decibels.**



Can noise levels increase as sound waves pass over a noise wall?

No, noise levels do not increase as sound waves pass over a wall. Noise levels are reduced the further the sound waves travel.

Could trees be planted to block traffic noise?

There is not enough space to plant the amount of and size of trees needed to reduce traffic noise. To effectively reduce traffic noise, there needs to be room for at least 100 feet of dense evergreen trees that are 15 feet tall or more. Additionally, if trees are used to reduce traffic noise, they need to be maintained. MnDOT lacks the necessary resources to maintain trees or other vegetation.

How is the location of the noise wall determined?

MnDOT studied various location options to determine the height, length and location which provides the greatest level of noise reduction.

Do noise walls affect property values?

There have not been any studies that link property values to the presence of noise walls.

Where can I find more information about MnDOT's noise requirements?

Visit MnDOT's noise website at **http://www.dot.state.mn.us/environment/noise/index.html.**

Where can I find more information about the <project name>?

Visit MnDOT's project website at **<project web site address>**

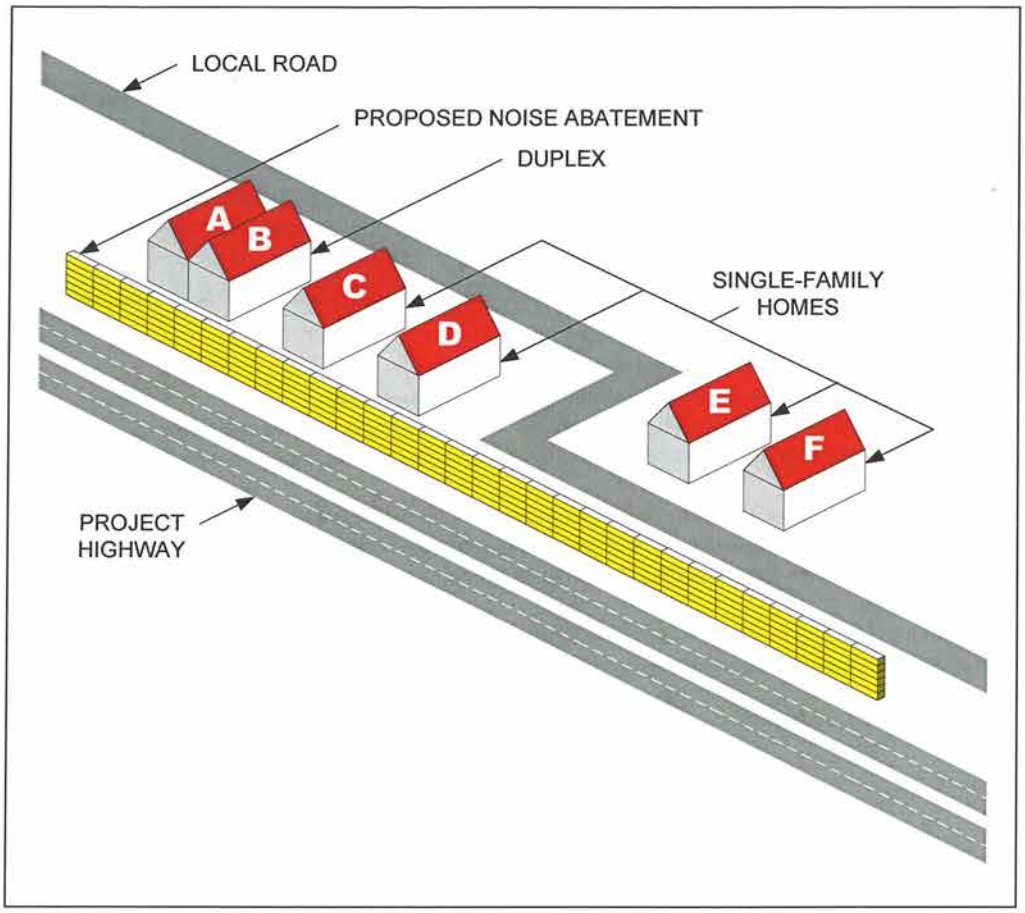
Example of Resident/Owner Viewpoint Point Counting

This section includes a simple theoretical example for the implementation of the benefited receptor viewpoint assessment method presented in Section 5.3.3. In the example below, there are six benefited receptors in the NSA with the proposed noise abatement, a noise barrier. Note the following characteristics of the receptors in the NSA relative to this example:

- Receptors A, B, C, and D are on the Highway side of the local road, making them abutting properties of the project highway. Receptors E and F are on the opposite side of the local road, and therefore are non-abutting properties.
- Receptors A and B are two residential units within the same duplex and therefore count as two separate benefited receptors, the resident in unit B owns both units, and rents out Unit A.
- Receptors C and E are single-family owner occupied units (owner plus resident).
- Receptors D and F are rental units.
- All benefited receptor owners and residents voted except for the Receptor D resident.

The theoretical voted viewpoints for the owners and residents for this example are shown in the table below, with some owners and residents voting for and some against the proposed noise abatement and one resident not voting. The resulting voting points are tallied and calculated as a percentage of all received voting points (assuming up to two separate solicitations, as needed to achieve minimum required voting points received). If the required percentage of voting points are received (25% or greater of total possible points for a barrier after two solicitations) and the percentage of those voting points in favor of the barrier is equal to or greater than 50% of the total voting points cast, the barrier would be advanced to the final design stage.

For guidance on assigning trail receptors and voting points see "Guide to Modeling and Voting Methodologies for Trails" located at http://www.dot.state.mn.us/environment/noise/policy/ .



Sample Noise Sensitive Area (NSA) for Viewpoint counting example

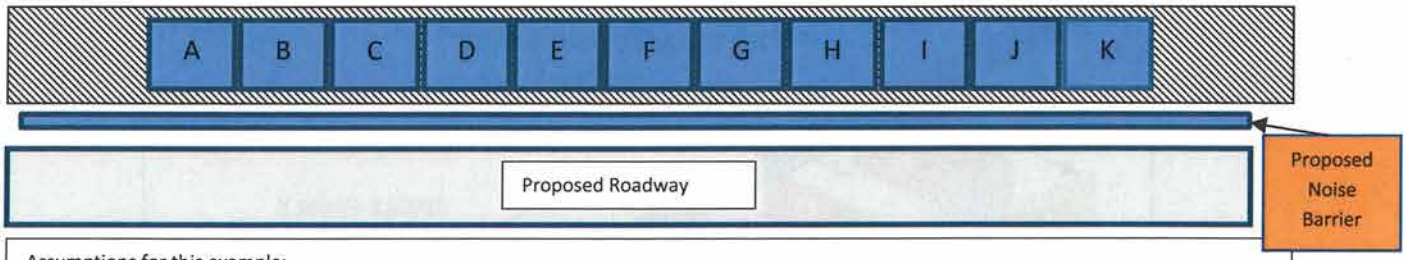
Vote Tally Table for Benefited Viewpoint Counting Example

Benefited Receptor ID	*Owner or Resident*	*Barrier Abutter?*	*In favor of Abatement?*	*Points Available*	*Points for*	*Points against*
A	Owner	Yes	Yes	4	4	
A	Resident	Yes	No	2		2
B	Owner/Res.	Yes	Yes	6	6	
C	Owner/Res.	Yes	Yes	6	6	
D	Owner	Yes	No	4		4
D	Resident	Yes	Yes	2*		
E	Owner/Res.	No	No	3		3
F	Owner	No	No	2		2
F	Resident	No	Yes	1	1	
Total				**30**	**17**	**11**
Percentage	**(93% of total possible points received)**				**61%**	**39%**

* Unit D was vacant at the time of the vote, so 30 points possible, 28 received.

2017 MnDOT Noise Requirements

Voting of Benefited Receptors When There is Common Land Ownership by a Townhome Association



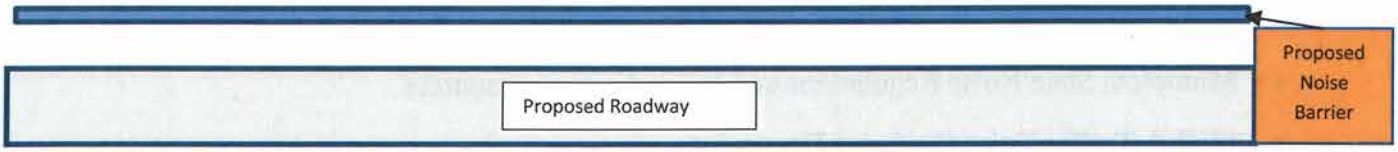
Assumptions for this example:

1. Type I project with only one row of homes that are benefitted receptors.
2. Hatched area represents land that is commonly owned by a townhome association.
3. All of the homes are part of a townhome association in which there is common land ownership by the townhome association. In this example, the townhome association owns the land around and/or underneath the homes but does not own the homes. Each home is owned by an individual.
4. Prior to public input results, the proposed noise barrier is otherwise reasonable and feasible.
5. All 11 homes (A through K) are owner/resident; i.e. the individual that lives in the home is also the owner. This means 6 points per benefited receptor under the REQUIREMENTS. For each unit where the property is owned by the Association, 4 points per benefited receptor will be given.
6. This is a convenient example to illustrate a point...do not get caught up in realities like looking at options to split this into two barriers or a project proposer demonstrating diligence in getting a response.

Voting Scenarios

Home	Voting Scenario I	Voting Scenario II	Voting Scenario III	Voting Scenario IV	Voting Scenario V	Voting Scenario VI
A	Yea	Yea	NR	NR	NR	Yea
B	Yea	Yea	NR	NR	NR	Nay
C	Nay	No response (NR)	NR	Yea	Nay	Nay
D	Nay	Nay	Nay	Nay	Nay	NR
E	Yea	Yea	Yea	Yea	Nay	Nay
F	Yea	Nay	Nay	Yea	Yea	NR
G	Yea	Nay	Nay	NR	NR	Nay
H	Yea	Nay	Nay	NR	NR	Nay
I	Nay	NR	NR	NR	NR	Yea
J	Yea	Yea	Yea	NR	NR	Nay
K	Yea	Yea	Yea	NR	NR	Yea
Association (11 Units)	11 Yeas @ 4 each	11 Yeas @ 4 each	11 Nays @ 4 each	11 Yeas@4 each	11 Nays@4 each	11 Yeas@4 each
Owner/Resident Total	8 Yeas@6each 3 Nays@6each	5 Yeas @6each 4 Nays@6each 2 NR	3 Yeas@6each 4 Nays@6each 4 NR	3 Yeas@6each 1 Nay@6each 7 NR	1 Yea@6each 3 Nays@6each 7 NR	3 Yeas@6each 6 Nays@6each 2 NR
Association, Total	44 Yeas	44 Yeas	44 Nays	44 Yeas	44 Na	44 Yeas
Total Possible Points (TPP)	110	110	110	110	110	110
Total Points received	110	98	86	68	68	98
>25% of TPP received?	Yes	Yes	Yes	Yes	Yes	Yes
Points for Yeas	92	74	18	62	6	62
Points for Nays	18	24	68	6	62	36

50% of received Points	55	49	43	34	34	49	
Does the barrier					No	Yes	
A	B	C	D	E	F	G	H	I	J	K



Assumptions for this example:

1. Type I project with only one row of homes that are benefitted receptors.
2. Prior to public input results, the proposed noise barrier is otherwise reasonable and feasible.
3. All 11 homes (A through K) are owner/resident; i.e. the individual that lives in the home is also the owner. This means 6 points per benefitted receptor under the proposed REQUIREMENTS.
4. This is a convenient example to illustrate a point...do not get caught up in realities like looking at options to split this into two barriers or a project proposer demonstrating diligence in getting a response.

Voting Scenarios

Home	Voting Scenario I	Voting Scenario II	Voting Scenario III	Voting Scenario IV	Voting Scenario V	Voting Scenario VI
A	Yea	Yea	NR	NR	NR	Yea
B	Yea	Yea	NR	NR	NR	Nay
C	Nay	No response (NR)	NR	Yea	Nay	Nay
D	Nay	Nay	Nay	Nay	Nay	NR
E	Yea	Yea	Yea	Yea	Nay	Nay
F	Yea	Nay	Nay	Yea	Yea	NR
G	Yea	Nay	Nay	NR	NR	Nay
H	Yea	Nay	Nay	NR	NR	Nay
I	Nay	NR	NR	NR	NR	Yea
J	Yea	Yea	Yea	NR	NR	Nay
K	Yea	Yea	Yea	NR	NR	Yea
Totals	8 Yeas, 3 Nays	5 Yeas, 4 Nays, 2 NR	3 Yeas, 4 Nays, 4 NR	3 Yeas, 1 Nay, 7 NR	1 Yea, 3 Nays, 7 NR	3 Yeas, 6 Nay, 2 NR
Total Possible Points (TPP)	66	66	66	66	66	66
Total points received	66	54	42	24	24	54
>25% TPP received?	Yes	Yes	Yes	Yes	Yes	Yes
Points for Yeas	48	30	18	18	6	18
Points for Nays	18	24	24	6	18	36
50% of received Points	33	27	21	12	12	27
Does barrier get built?	Yes	Yes	No	Yes	No	No

Appendix G. References and Links to Additional Requirements, Guidance and Standards

This Appendix includes a brief synopsis and on-line links to a number of useful resources related to Highway Noise Analysis including the following:

- Minnesota State Noise Regulations and Noise Analysis resources
- FHWA Traffic Noise Guidance Document
- FHWA/Volpe Highway Noise Measurement Manual
- FHWA Noise Barrier Design Handbook
- FHWA Construction Noise Handbook
- FHWA Highway Traffic Noise resource website

Minnesota State Noise Regulations

https://www.revisor.mn.gov/statutes/?id=116.07

https://www.revisor.mn.gov/statutes/?id=161.125

This link accesses the relevant Minnesota State Statutes (including Statute 116.07 which discusses applicable projects, and 161.125 which discusses sound abatement requirements).

MnDOT Noise Analysis Resources

http://www.dot.state.mn.us/environment/noise

This website provides access to the updated MnDOT's REQUIREMENTS and various guidance documents related to highway noise analysis.

FHWA Traffic Noise Guidance Document

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

This document serves as a companion document to the 2010 update for the FHWA Noise Standard 23 CFR 772 providing additional explanations, examples, and guidance. It generally follows along the same sectioning format as the Standard with more detailed explanations of policy issues and technical approaches. In many cases the technical information in this document goes into much greater detail than the official code.

FHWA/Volpe Measurement of Highway-Related Noise

http://www.fhwa.dot.gov/environment/noise/measurement/measure.cfm

This document, developed by the USDOT Volpe Transportation Systems Center Acoustics Facility, provides significant detail for procedures and practices in the measurement of highway related noise. In addition to providing procedures for noise measurements suitable for noise model validation and documenting existing environmental noise levels at typical receptor locations, this document also includes techniques and procedures for measurement of tire/pavement noise, building transmission loss, noise barrier performance, noise model emission levels, and construction equipment.

FHWA Noise Barrier Design Handbook

http://www.fhwa.dot.gov/environment/noise/noise_barriers/design_construction/design/index.cfm

This document contains a wide range of information with regard to the design, construction and maintenance of highway noise barriers. These include design considerations such as acoustical performance, safety, aesthetics, materials, drainage, barriers on structures, and maintenance.

FHWA Construction Noise Handbook

http://www.fhwa.dot.gov/environment/noise/construction_noise/handbook/

This handbook provides information and guidance on a range of topics related to highway construction noise prediction and abatement.

FHWA Noise and Environmental website

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

This website serves as a repository for a variety of information for FHWA policy and guidance for highway environmental issues, including noise. The site includes updated links to many of the above references and others, as well as a discussion bulletin board in which individual participants can ask questions or engage in related technical and policy discussions.

Appendix H. Commissioners' Letters

Minnesota Department of Transportation
395 John Ireland Boulevard
Saint Paul, MN 55155

Date: November 21, 2016

John Linc Stine
Commissioner
Minnesota Pollution Control Agency
520 Lafayette Road N
St. Paul, MN 55155-4194

RE: Statute 116.07 Subd. 2a. Exemption from Minnesota State Noise Standards

Dear Commissioner Stine:

The Minnesota Department of Transportation (MnDOT) believes that applying traffic noise regulations and mitigation requirements from the Federal Highway Administrations (FHWA) to all applicable projects will meet, or exceed, requirements for a statutory exemption from Minnesota State Noise Standards. Minnesota statute *116.07 Subd. 2a. Exemptions from standards* allows exemptions when all "reasonably available noise mitigation measures" are addressed on a transportation project.

> *No standards adopted by any state agency for limiting levels of noise in terms of sound pressure which may occur in the outdoor atmosphere shall apply to ... (2) an existing or newly constructed segment of a highway, provided that all reasonably available noise mitigation measures, as approved by the commissioners of the Department of Transportation and Pollution Control Agency, are employed to abate noise...*

MnDOT requires application of the most current FHWA Traffic Noise Regulation, which is considered industry best-practice. The regulation requires analysis of worst-case noise impact scenarios using the hourly equivalent continuous sound level ($L_{eq}(h)$), to evaluate feasible and reasonable noise mitigation and requires MnDOT to solicit public input when/if mitigation (e.g., noise barriers) is recommended. FHWA traffic noise regulations and standards are already used as the primary determinant for noise mitigation decisions in all 49 other states. In past practice, the FHWA requirements have been the primary driver for noise mitigation decisions for highway projects in Minnesota.

MnDOT also supports environmental justice through every stage of its planning, construction and maintenance processes, including its noise mitigation analyses. The environmental justice analysis that is part of the National Environmental Policy Act

(NEPA) process and MnDOT's noise ana ysis work hand-in-hand. MnDOT and FHWA staff collaborate to explore alternative(s) to avoid a noise-based disproportionate and adverse impact to environmental justice populations. For example, a barrier to ameliorate an otherwise disproportionate and adverse impact may be possible as environmental justice mitigation. This approach is part of demonstrating Minnesota's commitment to addressing impacts to mirority and low-income populations to achieve an equitable distribution of benefits and burdens.

Minnesota Statute 116.07 requires the Commissioners of MnDOT and the Minnesota Pol ution Control Agency (MPCA) to agree on criteria for demonstrating that "all reasonably available noise mitigation measures, are employed." MnDOT and MPCA staff recommend that application of the FHWA traffic noise regulations for existing and newly constructed segments of highway projects under MnDOT's jurisdiction represents the employment of all reasonably available noise mitigation measures . This letter is a formal request for concurrence with that recommendation.

Please contact Peter Wasko, MnDOT Office of Environmental Stewardship, (651) 366-5801, with questions.

Sincerely,

Charles A. Zelle
Commissioner
Minnesota Department of Transportation

cc:

Peter Wasko, MnDOT Office of Environmental Stewardship
Tim Sexton, MnDOT Office of Environ nental Stewardship
Lynn Clarkowski, MnDOT Office of Environmenta Stewardship
Nancy Daubenberger, Assistant Commissioner Engineering Services

Minnesota Pollution Control Agency
520 Lafayette Road North | St. Paul, Minnesota 55155-4194 | 651-296-6300
800-657-3864 | Use your preferred relay service | info.pca@state.mn.us | Equal Opportunity Employer

December 13, 2016

Commissioner Charles A. Zelle
Minnesota Department of Transportation
395 John Ireland Boulevard
St. Paul, MN 55155

RE: Minn. Stat. § 116.07, subd. 2a Exemption from Minnesota State Noise Standards

Dear Commissioner Zelle:

Thank you for your November 21, 2016 letter regarding the Minnesota Department of Transportation's (MnDOT) recommendation for updated criteria for demonstrating that "all reasonably available noise mitigation measures are employed" per the requirements of Minn. Stat. § 116.07, subd. 2a Exemption from Minnesota State Noise Standards.

The Minnesota Pollution Control Agency (MPCA) concurs that the traffic noise regulations and mitigation requirements from the Federal Highway Administration (FHWA) to all applicable projects will meet the requirements for a statutory exemption from the Minnesota State Noise Standards. As you note, the most current FHWA Traffic Noise Regulation is considered best-practice for considering worst-case noise impact scenarios, evaluating feasible and reasonable noise mitigation, and soliciting public input if/when noise mitigation is recommended.

The MPCA would like to emphasize the importance of incorporating environmental justice into noise mitigation analyses. In conducting noise analyses, the MPCA strongly supports MnDOT's efforts to decrease existing disproportionate negative impacts on communities of color and low income and avoid creating new disproportionate burdens on these communities.

If you have any questions, please contact Amanda Jarrett Smith at 651-757-2486 or by email at amanda.smith@state.mn.us with any questions.

Sincerely,

John Linc Stine
Commissioner

JLS/AS:vs