Noise Analysis Report

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Noise Analysis Technical Report

1. EXECUTIVE SUMMARY

This study evaluated the noise environment that is located on the east side of I-75 between Northline Road and Goddard Road in Southgate, MI. The primary focus of this study is the Southampton Neighborhood but the residential community south of the Southampton Neighborhood was included for evaluation purposes. This study was completed in conformance with state and federal regulations and guidance. The goal of this study is to evaluate the existing noise environment, identify if and where noise impacts exist, evaluate how various noise mitigation measures can be implemented, and evaluate how noise mitigation affects the noise environment.

The noise analysis presents the existing (2023) and future (2045) acoustical environment at various receptors located along the I-75 corridor. Three noise barrier alignments (at shoulder, 20-foot offset, and at right of way) with two tie-in alternatives (continuous or overlapping), for a total of six alternatives were evaluated as a part of this study to identify an effective and efficient way to implement noise abatement. Based on an evaluation of design elements like safety, accessibility, drainage, vegetation impacts, and soil conditions, NB-2B was selected as the preferred alternative. NB-2B begins at the northern limit of the existing noise wall and follows an alignment that has a 20-ooft offset from the existing northbound I-75 shoulder. A section of overlapping noise walls will be located at the end of the existing noise wall to facilitate drainage and easy access to the back side of the wall.

2. PURPOSE OF THE REPORT

This study evaluates the noise environment that is located on the east side of I-75 between Northline Road and Goddard Road in Southgate, MI. This study was completed in conformance with state and federal regulations and guidance.

Various wall heights for the preferred noise barrier alignment (NB-2B) were evaluated as a part of this study to determine how noise abatement could be implemented into the study area and determine the effectiveness of each configuration. The evaluation of the noise abatement follows the Federal Highway Administration's (FHWA) *Procedures for Abatement of Highway Traffic Noise and Construction Noise* as presented in the Code of Federal Regulations, Title 23 Part 772 (23 CFR 722), and the Michigan Department of Transportation (MDOT): *Highway Noise Analysis and Abatement Handbook, July 2011*. The MDOT: *Highway Noise Analysis and Abatement Handbook* is in compliance with the MDOT *State Transportation Commission Policy 10136 Noise Abatement,* dated July 31, 2003.

3. STUDY DESCRIPTION

I-75 is a major north/south travel route that runs through Michigan. This portion of I-75 is located between Northline Road and Goddard Road in Southgate, MI. This corridor consists of a four-lane roadway (two lanes in each direction).

The goal of this study is to evaluate the noise environment, to determine if noise abatement meets MDOT cost and acoustical effectiveness criteria while also meeting objective engineering considerations such as safety, right of way, drainage, utility, and other design and construction criteria.

4. TRAFFIC NOISE CONCEPTS, POLICY, AND GUIDELINES

4.1. Basic Acoustic Concepts

Noise can be described as unwanted sound that may interfere with communication or may disturb the community. Three characteristics of noise that have been identified as being important to analyzing the subjective community response to noise include intensity, frequency and the time-varying characteristics of the noise.

Intensity is a measure of the magnitude or energy of the sound and is directly related to pressure level. The human ear is capable of sensing a wide range of pressure levels. Pressure levels are expressed in terms of a logarithmic scale with units called decibels (dB). As the intensity of a noise increases, it is judged to be more annoying.

The decibel scale is a logarithmic representation of the actual sound pressure variations. The manner in which the logarithmic nature of sound is perceived as loudness and the accompanying change in traffic volumes is depicted in Table 1.

Table 1: Logarithmic Nature of Sound

Change in L_{eq} (1h) Sound Level	Relative Loudness in the Natural Environment
+/- 3 dB(A)	Barely Perceptible Change
+/- 5 dB(A)	Readily Perceptible Change
+/- 10 dB(A)	Considered Twice or Half as Loud

Frequency is a measure of the tonal qualities of sound. The spectrum of frequencies provides the identity of a sound. People are most sensitive to sounds in the middle to high frequencies; therefore, higher frequencies tend to cause more annoyance. This sensitivity led to the use of the A-weighted sound level, which provides a single number measure that weighs different frequencies of the frequency spectrum in a manner similar to the sensitivity of the human ear. Thus, the A-weighted sound level in decibels (dB(A)) provides a simple measure of intensity and frequency that correlates well with the human response to environmental noise. Figure 1 depicts how logarithmic decibel scale relates to frequently encountered environments and noise sources.

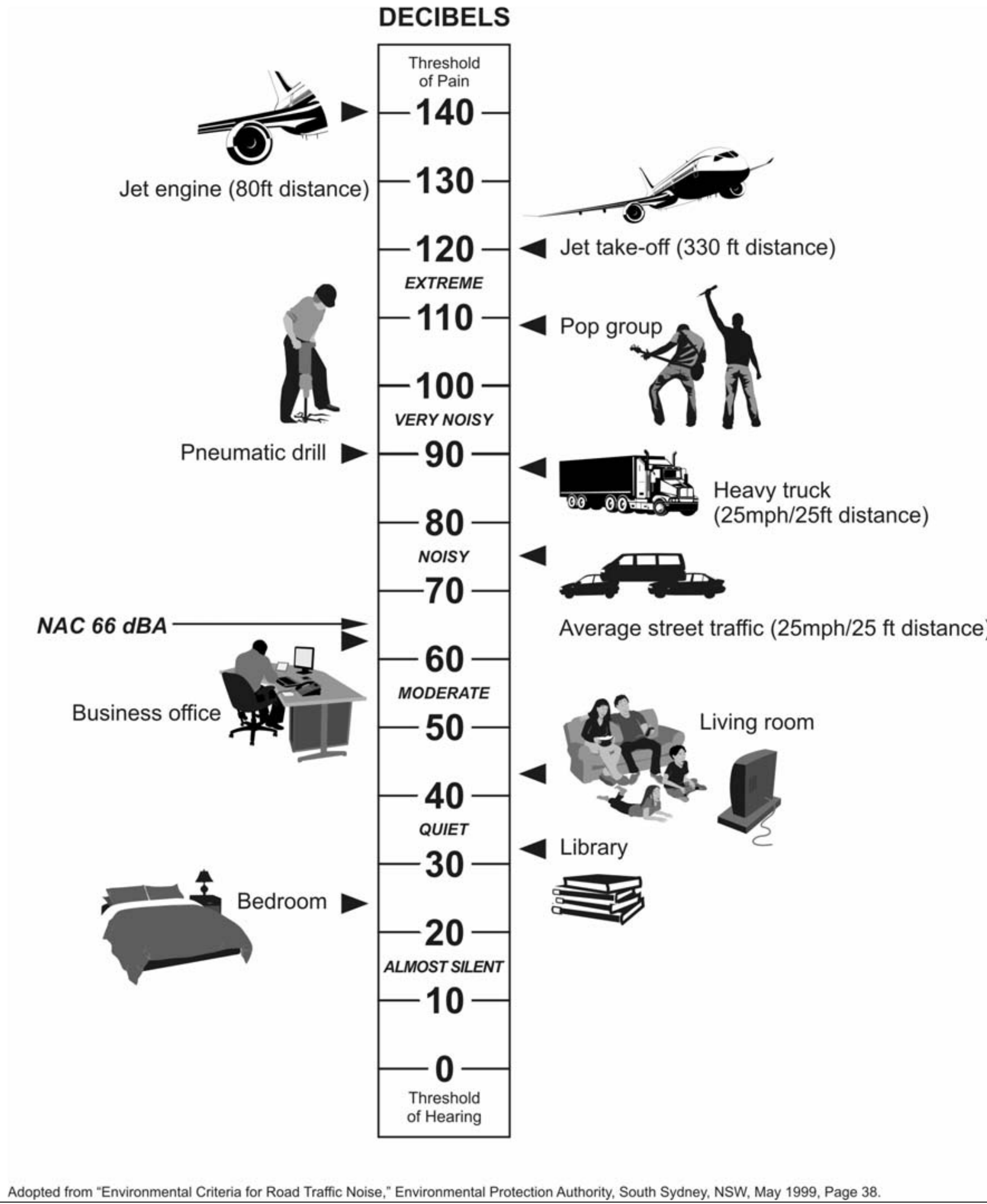

Figure 1: Sound Levels of Typical Noise Sources

It is necessary to use a method of measure that will account for the time-varying nature of sound when studying environmental noise. The equivalent sound pressure level (L_{eq}) is defined as the continuous steady sound level that would have the same total A-weighted sound energy as the real fluctuating sound measured over a given period. As a result, the three characteristics of noise combine to form a single descriptor (L_{eq} in dB(A)) that helps to evaluate human response to noise and has been chosen for use in this study. The time period used to determine noise levels is typically one hour and uses the descriptor L_{eq}(1h).

Traffic noise at a receiver is influenced by the following major factors: distance from the traffic to the receiver, volume of traffic, speed of traffic, vehicle mix and acoustical shielding.

Tire sound levels increase with vehicle speed but also depend upon road surface, vehicle weight, tread design and wear. Change in any of these can vary noise levels; however, average tire and pavement conditions are assumed in the noise prediction model. At lower speeds, especially in trucks and buses, the dominant noise source is the engine and exhaust.

4.2. Federal Regulations and Guidance

4.2.1. Stand-Alone Barrier Analysis

FHWA's *Procedures for Abatement of Highway Traffic Noise and Construction Noise*, 23 CFR 772, requires the following during the planning and design of a highway project.

1) Identification of highway traffic noise impacts;
2) Examination of potential abatement measures;
3) Gather viewpoints of benefiting receptors for noise abatement measures found to be reasonable and feasible;
4) Incorporation of reasonable and feasible highway traffic noise abatement measures into the highway project;
5) Coordination with local officials to provide helpful information on compatible land use planning and control; and
6) Identification and incorporation of necessary measures to abate construction noise

The highway traffic noise impact identification process involves a review of the existing land use activity categories that parallel the roadway corridor and determining existing and future noise levels within those areas. Existing land use of developed lands is identified by inspecting aerial photography and verified with site reconnaissance. Highway traffic noise analyses are also performed for undeveloped lands when they are considered permitted developments in accordance with the development's permitted Noise Abatement Criteria (NAC).

The existing noise levels are then determined based on a noise model validation process that compares modeled noise levels to actual measured noise levels. The existing noise environment is determined by gathering noise measurements and concurrent site and traffic information. The FHWA recommends the use of the most recent version of the Traffic Noise Model® (TNM) software be used to construct these models. TNM 2.5 was used to construct these models. Additional information concerning TNM software is provided in Section 5.1 of this report. The noise model must predict noise levels that are within 3 dB(A) of the actual levels in order to be considered valid. Future design year traffic is applied to a model that has been validated for the existing condition to estimate future 2045 noise levels.

A traffic noise impact is defined as a future noise level that approaches or exceeds the FHWA NAC; or a future noise level that creates a substantial noise increase over existing noise levels. An approaching noise level is defined as being 1 dB(A) less than, equal to, or greater than the noise level value listed in the NAC for Activity Category A through E listed in Table 2. The FHWA allows states to define a substantial noise increase as an increase of anywhere between 5 and 15 dB(A).

The NAC, presented in 23 CFR 772, establishes the noise abatement criteria for various land uses, and is presented in Table 2.

Table 2: Noise Abatement Criteria [1]

Activity Category	Activity Criteria[2]		Evaluation Location	Description of Activity Category
	L_{eq} (1h)[3]	L_{10} (1h)[4]		
A	57	60	Exterior	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B[5]	67	70	Exterior	Residential.
C[5]	67	70	Exterior	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, daycare centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings.
D	52	55	Interior	Auditoriums, daycare 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	72	75	Exterior	Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in A–D or F.
F	-	-	-	Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing.
G	-	-	-	Undeveloped lands that are not permitted.

1) MDOT defines a noise impact as a 10 dB(A) increase between the existing noise level to the design year predicted noise level OR a predicted design year noise level that is 1 dB(A) less than the levels shown in Table 3.
2) Either L_{eq}(h) or L_{10}(h) (but not both) may be used on a project. MDOT only uses L_{eq}(h). The L_{eq}(h) and L_{10}(h) Activity Criteria values are for impact determination only and are not design standards for noise abatement measures.
3) L_{eq} is the equivalent steady-state sound level that in a stated period of time contains the same acoustic energy as the time-varying sound level during the same time period, with L_{eq}(h) being the hourly value of L_{eq}.
4) L_{10} is the sound level that is exceeded 10 percent of the time (90th percentile) for the period under consideration, with L_{10}(h) being the hourly value of L_{10}.
5) Includes undeveloped lands permitted for this activity category.

The potential abatement alternatives are examined after the traffic noise impacts are identified. The following abatement alternatives, which are listed in 23 CFR 772.15(c), are permitted and can be evaluated where applicable:

1) Construction of noise barriers including acquisition of property rights, either within or outside the highway right of way;
2) Traffic management measures;
3) Alteration of horizontal and vertical alignments;
4) Acquisition of real property or interests therein to serve as a buffer zone to preempt development;
5) Noise insulation of Activity Category D land use facilities listed in Table 2.

At a minimum, state highway agencies are required to consider noise abatement in the form of noise barriers.

FHWA defines feasible highway traffic noise abatement as abatement that meets objective engineering considerations (e.g., barrier be built given the topography of the location; substantial noise reduction be achieved given certain access, drainage, safety or maintenance requirements; isolation from other noise sources in the area, etc.). An abatement measure must also achieve a noise reduction of at least 5 dB(A) to be considered feasible, according 23 CFR 772.13 (d)(1)(i). MDOT's feasibility criteria are provided in Section 4.3.

The FHWA lists three required reasonableness factors when considering noise barriers: cost effectiveness, viewpoints of benefitting receptors, and achievement of noise reduction design goals. For reasonableness, 23 CFR 772.13 (d)(2)(iii) requires state departments of transportation (DOTs) to define design year reduction goals somewhere between 7 and 10 dB(A). FHWA lists optional reasonableness factors that can be added to but not overrule the required reasonableness factors. MDOT's reasonableness criteria are provided in Section 4.3.

4.2.2. Retrofitted Barrier Analysis

In addition to analyzing potential barriers as stand-alone barriers, the potential barriers were analyzed as retrofitted versions of the existing noise barrier. The process for analyzing the feasibility and reasonableness of retrofitted barriers was completed in compliance with FHWA's "Consideration of Existing Noise Barrier in a Type I Noise Analysis" (FHWA-HEP-12-051). The noise analysis process involves comparing the noise levels associated with a condition where the existing wall does not exist and a condition where the existing wall and wall extensions exist. With the conceptual removal of the existing wall, the values associated with impacted receives and benefited receives will be elevated. These elevated numbers are evaluated against the cost of the existing and proposed barriers. The reasonableness and feasibility metrics associated with retrofitted barriers match the metrics associated with stand-alone barriers. The elevated impacts, benefits and conceptual costs associated with the retrofitted barrier analysis may produce results that vary from the stand-alone barrier results.

4.3. State Rules and Procedures

MDOT's *Highway Noise Analysis and Abatement Handbook* is the state's tool for implementing 23 CFR 772, which was discussed in Section 4.2. The *Highway Noise Analysis and Abatement Handbook* expands on 23 CFR 772 by refining definitions and establishing milestones within the design phase for the completion of noise impact analysis and mitigation development.

The *Highway Noise Analysis and Abatement Handbook* includes the following definitions:

Common Noise Environment (CNE): A group of receptors within the same Activity Category (Table 2) that are exposed to similar noise sources and levels; traffic volumes, traffic mix, and speed; and topographic features. Generally, common noise environments occur between two secondary noise sources such as interchanges, intersections and crossroads.

Noise Impact: A substantial noise increase or a predicted design year noise level that is 1 dB(A) less, equal to or greater than the NAC level.

Substantial Noise Increase: A 10 dB(A) or greater increase between the existing noise level and the design year predicted noise level.

Feasible Noise Barrier: A barrier that has no construction impediments, meets safety requirements for the traveling public, and provides at least 5 dB(A) noise reduction at 75 percent of the impacted receptors.

Reasonable Noise Barrier: A barrier that is cost-effective, favorable to benefitting receptors, and achieves noise reduction design goals by meeting or exceeding the reasonableness factor.

Cost-Effective Noise Barrier: A noise barrier analyzed for environmental clearance with a preliminary construction cost that is not more than 3 percent above the allowable cost per benefited receptor unit (CPBU) of $52,248 (year 2023), assuming a $45 per square foot noise barrier construction cost.

Benefited Receptor: A receptor that receives a 5 dB(A) or greater insertion loss as a result of a proposed noise barrier.

Attenuation Requirement: Reduce design year traffic noise by 10 dB(A) for at least one benefited receptor and provide at least a 7 dB(A) reduction for 50 percent or more of the benefitted receptor sites.

Permitted Development: Any presently undeveloped lands that have received a building permit from the local township or municipality.

Dwelling Unit Equivalent (DUE): The receptor count for public areas such as parks, schools, libraries and churches, which is determined based on the number of employees or attendees and frequency of used. See the *Highway Noise Analysis and Abatement Handbook* for examples of how DUE are calculated.

5. NOISE ANALYSIS

5.1. FHWA Traffic Noise Model (TNM)

TNM is FHWA's computer program for highway traffic noise prediction and analysis. State and federal regulations require the use of the most recent version of TNM® software for all traffic noise related studies. TNM 2.5 was used for this study. The following parameters are used in this model to calculate an hourly L_{eq} at a specific receiver location:

- Distance between roadway and receiver;
- Relative elevations of roadway and receiver;
- Hourly traffic volumes by classification;
- Vehicle speeds;
- Ground absorption;
- Weather conditions; and
- Topographic features, including retaining walls and berms.

Hourly traffic volumes have been divided into five vehicle classifications: automobiles (A); medium trucks (MT); heavy trucks (HT); Buses (B); and Motorcycles (M). Each vehicle class is defined by the *FHWA Traffic Noise Model, User's Guide, (February 1998); TNM v2.5 Update Sheet, Technical Manual: Part 1* as follows:

- Automobiles: All vehicles with two axles and four tires, includes passenger vehicles and light trucks, less than 9,900 pounds.
- Medium trucks: All vehicles having two axles and six tires, vehicle weight between 9,900 and 26,400 pounds.
- Heavy trucks: All vehicles having three or more axles, vehicle weight greater than 26,400 pounds.
- Buses: All vehicles designed to carry more than nine passengers.
- Motorcycles: All vehicles with two or three tires and an open-air driver/passenger compartment.

5.2. Analysis

5.2.1. Land Use and Field Measured Levels

Land use in the study area consists of single-family residential properties bordered by a few commercial and vacant properties.

Field measurements with concurrent traffic counts were taken to compare with modeled noise levels to validate the TNM for use on this study to predict existing (2023) and future (2045) noise levels. Existing noise level measurements were conducted on June 7 and 8, 2023, at nine representative sites in the study vicinity. All the measurements were completed during free traffic flow conditions. Refer to Appendix A for site and measurement related information. Refer to Appendix C for a map that includes the location of these sites.

Fifteen-minute measurements were taken at each site during peak and off-peak traffic time periods. The measurements were conducted in accordance with FHWA and MDOT guidelines using an integrating sound level analyzer. Traffic counts were taken at each site, concurrent with the noise measurements. Posted traffic speeds in the study area were verified using the floating car method during the site visits. The floating car method involves driving a vehicle with traffic and observing average speeds. Concurrent weather readings were obtained from the weather station at the Detroit Metropolitan Wayne County Airport Station for accurate modeling purposes. The data collected at the nine sites are presented in Table 5. The average observed speed for this vehicle on I-75 matches the posted speed limit (70 mph). The average observed speed for this vehicle on Goddard Road and Old Goddard Road matches the posted speed limit (45 mph and 35 mph, respectfully).

Table 3: Measured Existing Noise Levels

Field Site ID (CNE)	Date	Period	Traffic[2]						Measured Noise Level, dB(A) L_{eq}
			Roadway, Direction[1]	Autos	Medium Trucks	Heavy Trucks	Buses	Motor-cycles	
1	June 8, 2023	AM	Northbound I-75 Southbound I-75	2,136 1,792	108 92	636 576	0 16	8 0	71
	June 7, 2023	Off	Northbound I-75 Southbound I-75	1,452 1,612	68 36	508 532	8 8	0 0	66
2	June 7, 2023	AM	Northbound I-75 Southbound I-75	2,508 1,664	140 76	480 400	8 4	0 0	73
	June 7, 2023	Off	Northbound I-75 Southbound I-75	1,592 1,760	48 40	636 596	8 8	4 0	71
3	June 7, 2023	AM	Northbound I-75 Southbound I-75	2,308 1,984	128 64	524 532	24 8	0 4	66
	June 7, 2023	Off	Northbound I-75 Southbound I-75	1,528 1,652	88 44	624 588	4 4	0 0	64
4	June 8, 2023	AM	Northbound I-75 Southbound I-75	2,324 1,768	120 56	576 500	4 24	0 24	66
	June 7, 2023	Off	Northbound I-75 Southbound I-75	1,596 1,420	60 44	632 596	4 0	0 0	63
5	June 7, 2023	AM	Northbound I-75 Southbound I-75	1,936 1,628	88 60	524 572	0 12	0 4	58
	June 7, 2023	Off	Northbound I-75 Southbound I-75	1,256 1,356	68 40	616 644	0 4	4 4	57
6	June 7, 2023	AM	Northbound I-75 Southbound I-75 Goddard Road	2,120 1,900 972	116 64 32	548 460 0	0 0 0	4 4 0	61
	June 7, 2023	Off	Northbound I-75 Southbound I-75 Goddard Road	182 1,652 860	48 28 16	620 660 4	4 4 0	4 0 0	61
7	June 7, 2023	AM	Northbound I-75 Southbound I-75 Goddard Road	1,916 1,448 836	80 72 36	572 556 0	4 4 0	0 0 0	63
	June 7, 2023	Off	Northbound I-75 Southbound I-75 Goddard Road	1,804 1,640 1,044	76 32 28	636 624 0	4 0 0	12 0 8	66
8	June 8, 2023	AM	Northbound I-75 Southbound I-75	1,808 1,616	92 72	576 564	4 0	0 0	78
	June 8, 2023	Off	Northbound I-75 Southbound I-75	1,696 1,536	100 72	568 548	0 4	0 4	78
Park	June 8, 2023	Off	Northbound I-75 Southbound I-75	1,672 1,768	16 40	636 548	4 4	4 0	56

1) Vehicle traffic on insignificant roadways has not been included.
2) Hourly traffic volumes listed.

5.2.2. Field Measured Versus Modeled Noise Levels

TNM 2.5 was utilized to compare the field measurements to the model using the traffic count information. Comparing the modeled noise levels to the measured noise levels validates the TNM 2.5 model for use on the specific study. To maximize the accuracy of the TNM, three techniques for modeling the existing houses were explored. The first technique utilizes “building rows” to represent a string of houses. The second technique utilizes “barriers” placed at the top of the roof line to signify each house. The third technique involves “barriers” placed around the perimeter of a house to represent each house.

Table 4 presents a site-by-site comparison of noise levels from measurement sites and model validation sites. As shown in Table 4, the perimeter barrier scenario provides excessive noise shielding and shouldn’t be used. Both the building row and the roof barrier scenarios produce results that would validate the TNM analysis. A comparison between the building row and the roof barrier scenarios revealed that the roof barrier scenario produces slightly more accurate results. This scenario was used to evaluate the existing and future noise levels throughout this study.

Table 4: Comparison of Measured and Modeled Noise Levels

Field Site ID (Technic)	Noise Level, dB(A) L_{eq} (1h)				Difference in Noise Level, dB(A) L_{eq} (1h)	
	Measured		Modeled		(Modeled Minus Measured)	
	AM	Off	AM	Off	AM	Off
1 (Building Row)	71	66	68	67	-3	+1
1 (Roof Barrier)			68	67	-3	+1
1 (Perimeter Barrier)			68	67	-3	+1
2 (Building Row)	73	71	70	71	-3	0
2 (Roof Barrier)			70	71	-3	0
2 (Perimeter Barrier)			70	71	-3	0
3 (Building Row)	66	64	64	65	-2	+1
3 (Roof Barrier)			63	63	-3	-1
3 (Perimeter Barrier)			58	58	-8	-6
4 (Building Row)	66	63	66	66	0	+3
4 (Roof Barrier)			65	65	-1	+2
4 (Perimeter Barrier)			60	60	-6	-3
5 (Building Row)	58	57	59	60	+1	+3
5 (Roof Barrier)			56	56	-2	-1
5 (Perimeter Barrier)			52	53	-6	-4
6 (Building Row)	61	61	63	63	+2	+2
6 (Roof Barrier)			63	63	+2	+2
6 (Perimeter Barrier)			63	63	+2	+2
7 (Building Row)	63	66	64	64	+1	-2
7 (Roof Barrier)			64	64	+1	-2
7 (Perimeter Barrier)			64	64	+1	-2
8 (Building Row)	78	78	78	78	0	0
8 (Roof Barrier)			78	78	0	0
8 (Perimeter Barrier)			78	78	0	0
Park (Building Row)		56		55		-1
Park (Roof Barrier)				51		-5
Park (Perimeter Barrier)				47		-9

* Highlighted values indicate results that exceed the 3 dB(A) validation threshold.

5.2.3. Predicted Traffic Noise Levels and Noise Impact Analysis

The traffic noise prediction program, TNM 2.5, was used to model traffic noise levels for both the existing (2023) and future (2045) conditions within the study area. The traffic data for existing and future conditions were obtained from MDOT and their analysis of traffic counts that were taken between 2015 and 2019. These counts occurred prior to the traffic reductions that are associated with the COVID pandemic and represent a worst case condition. The future traffic volumes that were used are based on a 0.3 percent growth rate and the assumption that traffic will return to a pre-COVID condition in the future.

MDOT-provided vehicle class distributions included automobiles, medium trucks and heavy trucks and omitted buses and motorcycles. Based on vehicle class distributions information gathered during the noise measurements, buses and motorcycles accounted for 0.2 percent and 0.1 percent of the distribution, respectively. Due to the relatively small percentages and the similarities in noise profiles, the bus and motorcycle vehicle classes have been lumped into the medium truck class. The existing (2023) and future (2045) traffic volumes that were used in the modeling are shown in Table 5 through Table 8. In accordance with Section 2.5.2 of the *Highway Noise Analysis and Abatement Handbook*, the existing and future traffic volumes operate under free-flow conditions with a LOS of C or better.

The noise model encompassed a total of 362 receiver locations, which represent frequently used outdoor areas at residential properties. Some of these receivers are beyond the accuracy limits of the TNM analysis. Based on prior studies, TNM has been found to produce accurate results up to 500 feet from the edge of the roadway. Noise levels beyond this 500-foot buffer zone are less accurate and receptors may be subject to a secondary noise source. All the receivers that were included in the model represent existing sites. For additional information concerning the receiver locations and noise barriers, refer to the figures in Appendix C.

The outcome of the noise impact analysis is presented in Appendix D. The addresses provided have been obtained from the GIS sites for Wayne County.

Table 5: Existing 2023 Traffic Volumes (AM Peak)

Roadway	Volumes by Vehicle Type [1, 2]		
	Autos	Medium Trucks	Heavy Trucks
Northbound I-75	2,933	79	424
Southbound I-75	1,639	67	514
Goddard Road	855	26	1

1) See Appendix B for additional traffic information.
2) Hourly traffic volumes listed.

Table 6: Existing 2023 Traffic Volumes (PM Peak)

Roadway	Volumes by Vehicle Type [1, 2]		
	Autos	Medium Trucks	Heavy Trucks
Northbound I-75	2,342	64	457
Southbound I-75	3,674	82	483
Goddard Road	1,574	48	2

1) See Appendix B for additional traffic information.
2) Hourly traffic volumes listed.

Table 7: Future 2045 Traffic Volumes (AM Peak)

Roadway	Volumes by Vehicle Type [1, 2]		
	Autos	Medium Trucks	Heavy Trucks
Northbound I-75	3,132	84	453
Southbound I-75	1,750	72	549
Goddard Road	913	28	1

1) See Appendix B for additional traffic information.
2) Hourly traffic volumes listed.

Table 8: Future 2045 Traffic Volumes (PM Peak)

Roadway	Volumes by Vehicle Type [1, 2]		
	Autos	Medium Trucks	Heavy Trucks
Northbound I-75	2,501	68	488
Southbound I-75	3,924	88	516
Goddard Road	1,681	51	2

1) See Appendix B for additional traffic information.
2) Hourly traffic volumes listed.

The results of the TNM analysis found 26 sites that approach or exceed the NAC, under existing conditions during AM and PM peak hours. Based on this comparison, the PM peak hour was determined to be the loudest noise hour. The TNM analysis of the future PM peak hour found that:

- The predicted traffic growth will result in noise levels that will increase from 0 to 1 dB(A) greater that the existing noise levels.
- The predicted noise levels range from 46 dB(A) to 77 dB(A).

6. ABATEMENT MEASURES

6.1. Federal and State Abatement Guidance

MDOT's metrics for determining if noise barriers are feasible and reasonable were used to evaluate various noise barrier heights for the preferred noise barrier alignment (NB-2B). MDOT's definition of feasible and reasonable noise barriers is as follows:

- Feasible: This refers to engineering considerations such as constructability of a noise barrier on the existing topography, achievement of substantial noise reductions, the presence of other noise sources in the area, and the ability to maintain access, drainage, safety and utilities in the area. While every reasonable effort should be made to obtain a substantial noise reduction, a noise abatement measure is not feasible if it cannot achieve at least a 5 dB(A) noise reduction for 75 percent of impacted receivers during design year traffic noise.

- Reasonable: Noise mitigation will be considered reasonable if:
    - The preliminary cost per benefiting unit is less than 3 percent above allowable per benefitting unit level (maximum allowable $53,815 based on a $45 per square foot unit cost);
    - The public viewpoint reasonableness factor for the environmental clearance phase receives a majority of positive comments from the benefiting units; and
    - The noise barrier provides a design year traffic noise reduction of 10 dB(A) for at least one benefitted unit and at least a 7 dB(A) for 50 percent or more of the benefitted units.

Highway traffic noise abatement alternatives, which are listed in 23 CFR 772.15(c), include:

1) Construction of noise barriers including acquisition of property rights, either within or outside the highway right of way;
2) Traffic management measures;
3) Alteration of horizontal and vertical alignments;
4) Acquisition of real property or interests therein to serve as a buffer zone to preempt development;
5) Noise insulation of Activity Category D land use facilities listed in Table 3

The review of the listed abatement alternatives has determined that reductions of speed limits, although acoustically beneficial, are seldom practical unless the design speed of the proposed roadway is also reduced. The restriction or prohibition of trucks is extremely undesirable because I-75 is a major freeway in Michigan. Existing site restrictions preclude any horizontal and vertical alignment shifts that could potentially produce noticeable changes in some of the areas adjacent to the I-75 corridor. The cost restrictions typically prohibit the acquisition of property for any reason. The construction of a noise berm would impact the existing ditches and flow of stormwater runoff through the area. Therefore, the construction of noise barriers within the existing right of way was the only mitigation measure that received in-depth evaluation.

6.2 Noise Barrier Analysis

Several wall height alternatives (10, 1', 20 and 25 feet) for the NB-2B alignment were analyzed in accordance with the minimum requirement established by the MDOT: *Highway Noise Analysis and Abatement Handbook*. The alignment of the preferred noise barrier (NB-2B) is depicted in Figure 2 below as well as Appendix C.

A preliminary analysis of the alignments found that wall segments between the Goddard Road bridge approach and a point 450 feet south of Goddard Road bridge approach provide little to no acoustical benefits because they are outside the wall's limits of influence. As a result of this analysis, noise walls have been omitted in the vicinity of the Goddard Road bridge for all the alternatives. The results of the evaluated barriers, including existing and future L_{eq}(1h) noise levels without and with a barrier, barrier length and height, and the noise reduction provided by the barrier are presented in Table 9. A wall height of 25 feet was found to be the size that provided the most benefits while still meeting criteria for feasibility and reasonableness.

The following information is presented for the 25-foot-tall barrier in Table 10 through Table 11:

- The number of substantial noise reduction locations.
- The number of locations with more than 7 dB(A) attenuation.
- The total estimated cost (based on $45 per square foot).
- The number of benefited receptors (i.e., residential, commercial and equivalent).
- The cost per benefited receptor (maximum allowable $53,815).
- The feasibility determination.
- The reasonableness determination.

Table 9: Evaluated Noise Barriers

Noise Barrier ID	Existing L_{eq} (1hr) Noise Levels, dB(A)		Range of Future L_{eq}(1hr) Noise Levels, dB(A)			Noise Reduction (dB(A))		Barrier Characteristics	
	Without Existing Barrier	With Existing Barrier	Without Existing Barrier	Without Proposed Barrier	With Barrier	With Existing Barrier	With Proposed Barrier	Length (Feet)	Average Height (Feet)
NB-2B	46-76	46-76	46-77	46-77	46-72	0-7	0-7	1,615	10
NB-2B	46-76	46-76	46-77	46-77	46-67	0-7	0-10	1,615	15
NB-2B	46-76	46-76	46-77	46-77	45-67	0-7	0-13	1,615	20
NB-2B	46-76	46-76	46-77	46-77	45-67	0-7	0-13	1,615	25

Table 10: Noise Barrier Feasibility and Reasonableness (Retrofit Condition)[1]

Noise Barrier ID	# of Impacted Sites[2]	Number of Attenuated Sites							Cost [3,4]	Cost / Benefited	Feasible	Reasonable
		# of Sites Benefited (≥ 5 dB(A))	# of Impacted Sites being Benefited	% of Impacted Sites being Benefited	# of Benefited Sites with ≥ 7 dB(A) Reduction	% of Benefited Sites with ≥ 7 dB(A) Reduction	# Benefited Sites with ≥ 10 dB(A) Reduction				(Y/N)	(Y/N)
NB-2B (25 feet)	32	106	31	97%	53	50%	20		$2,744,505	$25,890	Y	Y

1) Analysis based on FHWA-HEP-12-051 procedure.
2) Site 308 has been excluded because it is impacted by traffic on Old Goddard Road, not I-75.
3) The construction cost of noise barriers is $45 per square feet.
4) Includes the cost of the existing wall ($923,535).

Table 11: Noise Barrier Feasibility and Reasonableness (Stand-alone Condition)[1]

Noise Barrier ID	# of Impacted Sites[2]	Number of Attenuated Sites						Cost [3]	Cost / Benefited	Feasible	Reasonable
		# of Sites Benefited (≥ 5 dB(A))	# of Impacted Sites being Benefited	% of Impacted Sites being Benefited	# of Benefited Sites with ≥ 7 dB(A) Reduction	% of Benefited Sites with ≥ 7 dB(A) Reduction	# Benefited Sites with ≥ 10 dB(A) Reduction			(Y/N)	(Y/N)
NB-2B (25 feet)	25	69	21	84%	44	64%	18	$1,820,970	$26,390	Y	Y

1) Analysis based on 23-CFR-Part 772 procedure.
2) Site 308 has been excluded because it is impacted by traffic on Old Goddard Road, not I-75.
3) The construction cost of noise barriers is $45 per square feet.

Figure 2: Noise Barrier 2B Alignment

7. CONCLUSIONS AND RECOMMENDATIONS

Based on the information provided in Table 10 and Table 11, the preferred wall height for NB-2B alignment is 25 feet. The height and alignment of NB-2B alignment will benefit many of the impacted receivers, is highly cost-effective, meets design criterion, provides easy access to the back of the wall, and minimizes impacts on the existing drainage features. An engineering assessment of the NB-2B alignment needs to be completed to determine if there are any elements, like poor soils, that would interfere with construction. If restrictions are identified, an alternative alignment should be investigated.

8. REFERENCES

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