Michigan Department of Transportation

Noise Analysis Report

M-59
Crooks Road to Ryan Road

Oakland and Macomb Counties, MI

September, 2008

Prepared by:
HNTB Michigan Inc.
719 Griswold, Suite 620
Detroit, MI 48226

Noise Analysis Report

Table of Contents

Tables

Figures

Noise Analysis Technical Report

1.0 EXECUTIVE SUMMARY

This report evaluates the potential noise impacts of the proposed improvements within the M-59 corridor from Crooks Road to Ryan Road in conformance with corresponding Federal regulations and guidance, and the National Environmental Policy Act (NEPA). The limits of this project are from Crooks Road in Oakland County on the west to Ryan Road in Macomb County on the east. The goal of the M-59 project is to widen and reconstruct the existing four-lane freeway section to six lanes between Crooks Road and Ryan Road.

The project is being studied as a Categorical Exclusion and is considered a capacity improvement which triggers the requirement for a noise analysis. The Federal Highway Administration (FHWA) Michigan Division's definition of a capacity improvement is a project that adds a lane in a single direction to the roadway for 1 mile or more.

The noise analysis presents the existing and future acoustical environment at various receptors located along the M-59 corridor. The determination of noise abatement measures and locations is in compliance with the Federal Highways Administration's "Procedures for Abatement of Highway Traffic Noise and Construction Noise" as presented in the Code of Federal Regulations, Title 23 Part 772, the Michigan State Transportation Commission "Policy on Noise Abatement" (Guidance Document 10136) and the Michigan Department of Transportation's (MDOT's) *Procedures and Rules for Implementation*.

Existing noise level measurements were conducted on October 30, 2007 at twelve (12) representative sites in the project vicinity. A ten or twenty-minute measurement was taken at each site. Traffic counts were taken at each site, concurrent with the noise measurements when traffic was visible from the site.

The traffic noise prediction program, TNM® v. 2.5, was used to model existing and future No-Build and Build design hour 2035 traffic noise levels within the study area. Design hour noise levels presently approach or exceed the FHWA Noise Abatement Criteria (NAC) at ninety seven (97) single family residences, twenty one (21) first floor multi-family residential units, St. Paul Albanian Catholic Church, two (2) athletic fields, one (1) tennis courts/pool, four (4) commercial properties, and the Community Clubhouse in the Country Club Village of Rochester Hills.

Future No-Build traffic noise levels within the corridor would increase 2 to 3 dBA Leq over existing condition.

Future Build design hour noise levels would approach or exceed the NAC at one hundred seventy three (173) single family residences, thirty two (32) first floor multi-family residential units, St. Paul Albanian Catholic Church, two (2) athletic fields, two (2) tennis courts/pool, four (4) commercial properties, and the Community Clubhouse in the Country Club Village of Rochester Hills. None of the residences would be exposed to noise levels that "substantially exceed existing" noise levels.

Thirteen (13) noise barriers were analyzed within the project limits. Only two noise barriers meet both MDOT's feasible and reasonable criteria. The first noise barrier is located South of M-59, between Rochester & John R Roads, and is designed to mitigate the noise impact for residences along Michelson Road and the east end of Eastlawn Drive. This noise barrier would be located at the south edge of the M-59 shoulder. It would be nine to fifteen foot high and 2,863 feet long. This barrier would provide 5 to 11 decibels of attenuation for 55 residences. The estimated cost of this barrier would be $1,685,623 with a cost of $30,648 per residence. The second noise barrier, located adjacent to the right-of-way, was modeled for the Whispering Winds development north of M-59 and west of Dequindre Road. This barrier would provide mitigation for 40 first floor multi-family residential units. The noise barrier would be fifteen to twenty four feet high and 1,689 feet in length and would provide 5 - 10 decibels of attenuation. The estimated cost of this barrier is $1,174,840 with a cost of $29,371 per residence.

The 66 dBA setback distance along M-59 would range from 280 ft to 409 ft. The range of distances is a function of a change in the terrain adjacent to the proposed improvements to M-59. The setback distance indicates that noise levels within the distance shown, measured perpendicular to the centerline of the nearest lane of the final design project in either direction, is 66 dBA or greater. This setback distance was developed to assist local planning authorities in developing land use control over the remaining undeveloped lands along the project in order to prevent further development of incompatible land use.

MDOT's policy is to install the feasible and reasonable noise barriers associated with transportation improvements. Based on the study completed, mitigation of noise impacts for the proposed M-59 project appears to be feasible and reasonable for the proposed noise barrier located north of M-59 and west of Dequindre Road in front of the Whispering Winds development.

2.0 PROJECT DESCRIPTION

M-59 is an east – west route which runs from I-96 near the City of Howell to I-94 near the City of Mount Clemens. The limits of this project are from Crooks Road in Oakland County on the west to Ryan Road in Macomb County on the east as shown in Figure 1. Throughout this segment, M-59 is a four-lane facility. The ultimate goal of the M-59 project is to widen the existing four-lane freeway section to six lanes between Crooks Road and Ryan Road. This will "fill the gap" between the existing six-lane sections west of Crooks Road and east of Ryan Road. The widening will be accomplished by adding a third lane in each direction to the median side of the existing eastbound and westbound roadways separated by a dual-faced guardrail.

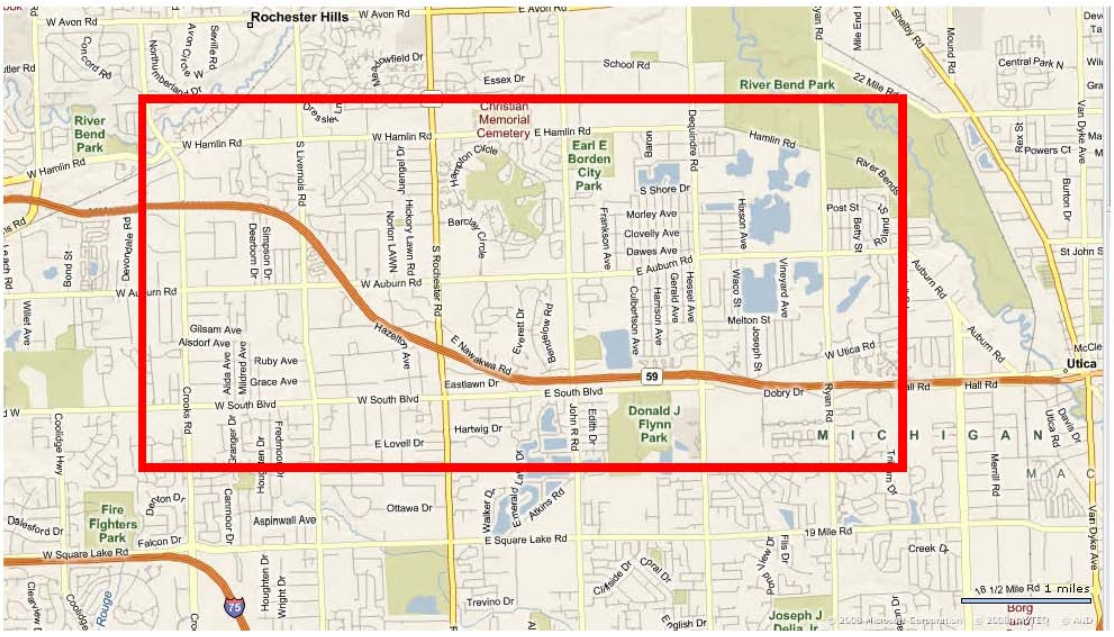


Figure 1
Project Location Map

3.0 PURPOSE OF THE REPORT

This report evaluates the potential noise impacts of the proposed improvements within the M-59 corridor from Crooks Road to Ryan Road in conformance with corresponding Federal regulations and guidance, and the National Environmental Policy Act (NEPA). The project is being studied as a Categorical Exclusion and is considered a capacity improvement which triggers the requirement for a noise analysis. The Federal Highway Administration (FHWA) Michigan Division's definition of a capacity improvement is a project that adds a lane in a single direction to the roadway for 1 mile or more.[1] The

[1] "Michigan Operation's Manual", D-106, Policy on Adding Capacity on NHS Routes, February 15, 2007

noise analysis presents the existing and future acoustical environment at various receptors located along the M-59 corridor.

The determination of noise abatement measures and locations is in compliance with the Federal Highways Administration's Procedures for Abatement of Highway Traffic Noise and Construction Noise as presented in the Code of Federal Regulations, Title 23 Part 772 (23 CFR 772), the Michigan State Transportation Commission "Policy on Noise Abatement" (Guidance Document 10136) and the Michigan Department of Transportation's *Procedures and Rules for Implementation* (MDOT Noise Policy).

4.0 SOUND AND TRAFFIC NOISE – BASIC INFORMATION

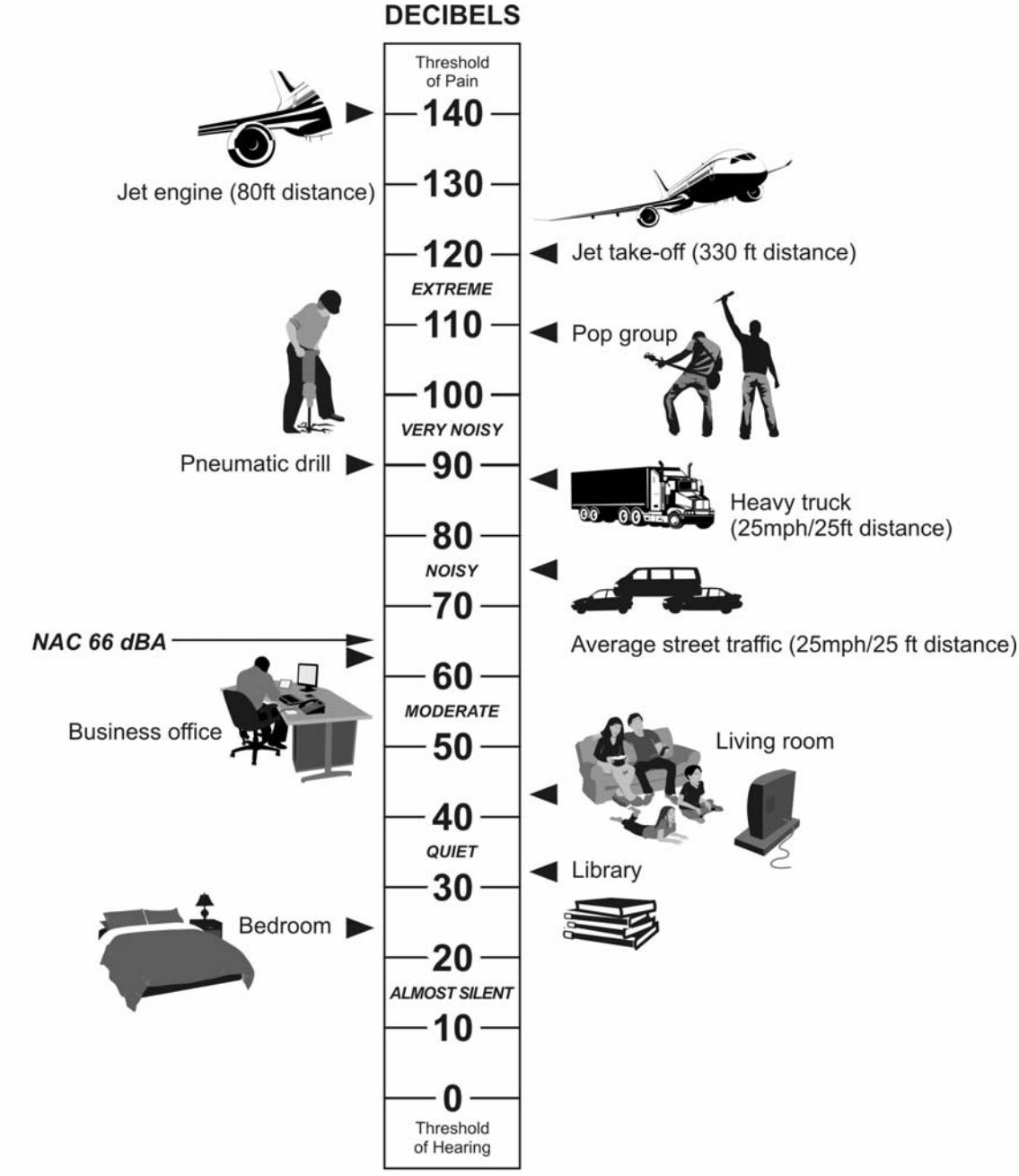
The movements of objects form vibrations or waves in air molecules moving back and forth like a spring. When the vibrations reach our ears, we hear sound. Noise is unwanted sound. The different levels of sound or noise are measured in decibels (dB). The decibel scale audible to humans spans approximately 140 dB. The sound levels of some typical sources are present in Figure 2. High and low pitch sounds are not perceptible to the human ear so those levels are adjusted in a weighting scale, called an "A" scale, to more closely resemble human hearing. The measuring unit used to reflect an "A" weighted decibel level is dBA.

The decibel scale is also a logarithmic representation of the actual sound pressure variations. Table 1 describes the logarithmic nature of sound relative to perceived loudness.

Table 1
Logarithmic Nature of Sound

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

Traffic noise is not constant. It varies as each vehicle passes a point. The time-varying characteristics of environmental noise are analyzed statistically to determine the duration and intensity of noise exposure. Traffic noise analysis is measured by averaging the noise levels over a period of time. The statistical descriptor for this measurement is L_{eq}. The period of time used to determined noise levels is typically one hour and uses the descriptor L_{eq}(1h).



Adopted from "Environmental Criteria for Road Traffic Noise," Environmental Protection Authority, South Sydney, NSW, May 1999, Page 38.

Figure 2
Sound Levels of Typical Noise Sources

The FHWA, for the purpose of highway noise abatement analysis, has divided highway traffic noise sources into five types of vehicles; automobiles (A), medium trucks (MT), heavy trucks (HT), Buses (B) and Motorcycles (M). Each vehicle type is defined as follows:[2]

- Automobiles – all vehicles with two axles and four tires, includes passenger vehicles and light trucks, less than 10,000 pounds.
- Medium trucks – all vehicles having two axles and six tires, vehicle weight between 10,000 and 26,000 pounds.
- Heavy trucks – all vehicles having three or more axles, vehicle weight greater than 26,000 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.

The three major categories for traffic noise prediction are:

- Volume of traffic
- Speed of the traffic
- Number of trucks

Tires are the dominant noise source at speeds greater than 50 mph for trucks and automobiles. 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. At lower speeds, especially in trucks and buses, the dominant noise source is the engine and related accessories.

5.0 NOISE ANALYSIS

5.1 Background

The FHWA's Procedures for Abatement of Highway Traffic Noise and Construction Noise is presented in the Code of Federal Regulations, Title 23 Part 772 (23 CFR 772). This regulation, plus other guidance documents written to explain the regulation, sets forth the process for performing a traffic noise analysis. The process includes the following:

- Identify existing and proposed land uses in the study area;
- Determine existing noise levels either:
    - through modeling, or

[2] G. S. Anderson, C.S.Y. Lee, G.G. Fleming and C. Menge, "FHWA Traffic Noise Model®, Version 1.0 User's Guide", Federal Highway Administration, January 1998, p. 60.

  - noise measurements with concurrent classification counts of vehicles passing the noise monitoring site;
- Model future design year traffic noise levels which will yield the worst hourly traffic noise on a regular basis (design hour noise levels);
- Identify locations that would be exposed to a noise impact based upon the NAC as presented in Table 2;
- Model noise abatement measures to mitigate the future traffic noise impacts; and
- Modeling must be performed with FHWA's most recent version of the Traffic Noise Model® (TNM).

MDOT's Noise Policy is the states tool for implementing 23 CFR 772. The NAC, which is presented in 23 CFR 772, establishes the noise abatement criteria for various land uses. The noise level descriptor used is the equivalent sound level, L_{eq}, defined as the steady state sound level which, in a stated time period (usually one hour) contains the same sound energy as the actual time-varying sound. The term $L_{eq}(1h)$ or "hourly L_{eq}" is used to describe the L_{eq} in an hour's time.

Noise abatement measures will be considered when the predicted noise levels approach or exceed those values shown for the appropriate activity category in Table 2, or when the predicted traffic noise levels substantially exceed the existing noise levels. MDOT has defined the approach value as being 1 dBA less than the noise levels shown in Table 2. The MDOT has defined an increase over existing noise levels of 10 decibels or more as being substantial.

TNM® is FHWA's "computer program for highway traffic noise prediction and analysis."[3] The following parameters are used in this model to calculate an hourly $L_{eq}(1h)$ at a specific receiver location:

- Distance between roadway and receiver;
- Relative elevations of roadway and receiver;
- Hourly traffic volume in light-duty (two axles, four tires), medium-duty (two axles, six tires), and heavy-duty (three or more axles) vehicles;
- Vehicle speed;
- Ground absorption; and
- Topographic features, including retaining walls and berms.

[3] Ibid, Report Documentation Page.

Table 2
Noise Abatement Criteria
Hourly A-Weighted Sound Level-Decibels (dBA)

Activity Category	L_{eq}(1h)	Description of Activity Category / Land Uses
A	57 dBA (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 lands are to continue to serve their intended purpose.
B	67 dBA (Exterior)	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries and hospitals.
C	72 dBA (Exterior)	Developed lands, properties or activities not included in Categories A or B above.
D	---	Undeveloped lands.
E	52 dBA (Interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals and auditoriums.

Source: Code of Federal Regulations, Title 23 Part 772, Revised April 2005

5.2 Analysis

5.2.1 Measured Levels

Land use in the project area is a mixture of single and multi-family residential, commercial, a church, a park, a school, and scattered undeveloped parcels zoned as residential or commercial/office.

Existing noise level measurements were conducted on October 30, 2007 at twelve (12) representative sites in the project vicinity. A ten or twenty-minute measurement was taken at each site. The measurements were made in accordance with FHWA and MDOT guidelines using an integrating sound level analyzer meeting ANSI and IEC Type 1 specifications. Traffic counts were taken at each site, concurrent with the noise measurements when traffic was visible from the site. Traffic data were obtained at nine (9) of the twelve (12) field sites. The data collected at the twelve sites are presented in Table 3. The noise measurement sites are identified on Figures 3 - 9.

Table 3
Measured Existing Noise Levels
M-59 Crooks Road to Ryan Road
Oakland and Macomb Counties, MI

Field Site #	Figure #	Site Description and Distance From Road[a]	Date	Start Time	Duration	Traffic[b]						Noise Level, dBA $L_{eq}(1h)$
						Direction M-59	A	MT	HT	Buses	Speed mph	
1	3, 4	Open field, 146 ft north of M-59 and 30 ft west of Rochelle Park Dr.	10/30/07	08:00	20 min.		--	--	--	--	60-70	67
2	3, 4	Residence, 2542 Dover Drive, 182 north of M-59 and 8 ft west of Dover Dr.	10/30/07	08:25	20 min.	EB WB	592 1112	28 24	32 28	-- --	60-70	71
3	3, 4	Lutheran High School Northwest, Athletic Field, 311 ft south of M-59 and 445 ft west of Livernois Rd.	10/30/07	08:58	20 min.	EB WB	638 876	16 14	22 42	-- 2	60-70	66
4		Pine Ridge Apartment Homes, 2830 Lower Ridge Dr., 133 ft south of M-59 and 807 ft north of Auburn Rd.	10/30/07	09:33	20 min.	EB WB	810 878	44 24	30 38	-- 4	60-70	66
5	5	Residence, 3126 Grand Park, 277 ft west of M-59 and 666 ft south of Auburn Rd.	10/30/07	10:12	20 min.	EB WB	--	--	--	--	60-70	58
6	6	Residence, 3555 Hazelton Avenue, 130 ft south of M-59 and 8 ft north of Hazelton Ave.	10/30/07	11:10	20 min.	EB WB	752 606	28 16	30 40	-- --	60-70	67
7	6	Residence, 322 Michelson Road, 138 ft south of M-59 and 14 ft south of Michelson Rd.	10/30/07	12:01	20 min.	EB WB	712 760	34 30	18 14	-- --	60-70	69
8	8, 9	Residence, 45197 Gable Inn, 225 ft north of M-59 6 ft west of Gable Inn.	10/30/07	12:46	20 min.	EB WB	692 658	22 18	40 32	-- --	60-70	69
9	7	Spencer Park Picnic Area, 835 ft north of M-59 and 1,195 ft east of John R.	10/30/07	13:26	10 min	EB WB	--	--	--	--	60-70	60
10	7	Residence, 3751 Hogan Cir., 125 ft north of Michelson Road and 16 ft west of Connors Dr.	10/30/07	13:48	20 min	EB WB	877 749	27 20	31 26	-- --	60-70	64
11	6, 7	Residence, 637 E. Nawakwa Road, 328 ft north of M-59 and 15 ft west of E. Nawakwa Rd.	10/30/07	14:25	20 min.	EB WB	1062 840	32 22	22 20	-- --	60-70	68
12	5	St. Paul Albanian Catholic Church, 277 ft north of M-59 and 545 ft south of Auburn Rd.	10/30/07	15:04	20 min.	EB WB	1078 924	16 14	32 32	2 --	60-70	68

a. Receivers 1 through 7 and 9 through 12 are located in Rochester Hills. Receiver 8 is located in Shelby Township.
b. Vehicle counts classified as follows: Autos (A) defined as 2-axle, 4-tire; medium trucks (MT) as 2-axle, 6-tire; heavy trucks (HT) as 3 or more axles; buses vehicles carrying more than 9 passengers.
Source: HNTB, October 2007

5.2.2 Measured vs. Modeled

TNM® 2.5 was used to model the field measurements, using the traffic count information, to determine the applicability of the model to the specific project environment. Comparing the modeled noise levels to the measured noise levels confirms the applicability of the computer model to the specific project. Traffic counts concurrent with the noise measurements were taken at nine (9) of the 12 measurement sites. The traffic data from these nine (9) sites were used in the model. All the modeled data compared within 0-3 dB of the measured levels. This represents reasonable correlation since the human ear can barely distinguish a 3 dBA change in the L_{eq}(1h) noise level in the urban environment. The site by site comparison is presented in Table 4.

Table 4
Comparison of Measured and Modeled Noise Levels
M-59 Crooks Road to Ryan Road
Oakland and Macomb Counties, MI

Field Site[a]	Figure #	Noise Level, dBA L_{eq}(1h)		Difference in Noise Level, dBA L_{eq}(1h) (Modeled Minus Measured)
		Measured	Modeled	
1	3, 4	67	67[b]	0
2	3, 4	71	70	-1
3	3, 4	66	64	-2
4	4	66	69	3
5	5	58	60[c]	2
6	6	67	68	1
7	6	69	71	2
8	8, 9	69	67	-2
9	7	60	58[d]	-2
10	7	64	61	-3
11	6, 7	68	65	-3
12	5	68	66	-2

a. Sites 1, 5, and 9 were modeled with traffic data counted during similar time periods at adjacent sites.
b. Site 3 was used as surrogate for traffic
c. Site 7 was used as surrogate for traffic
d. Site 12 was used as surrogate for traffic
Source: HNTB, October 2007

5.2.3 Predicted Traffic Noise Levels

The traffic noise prediction program, TNM® 2.5, was used to model existing and future No-Build and Build design hour 2035 traffic noise levels within the study area. The traffic volumes used in the noise modeling are presented in Table 5. These volumes are the volumes which will yield the worst hourly traffic noise on a regular basis (design hour noise levels).

Table 5
Future (2035) TNM® Traffic Volumes
M-59 Crooks Road to Ryan Road
Oakland and Macomb Counties, MI

Roadway Segment	Figure #	Total Traffic Volume	Volumes by Vehicle Type		
			Autos[a]	Medium Trucks[b]	Heavy Trucks[b]
EB M-59 Crooks Road to Rochester Road.	2-5	6280	5495	353	432
EB M-59 Rochester Road to Dequindre Road.	5-7	6320	5530	356	435
EB M-59 Dequindre Road to Ryan Road	7-8	7000	6125	394	481
WB M-59 Ryan Road to Dequindre Road	7-8	4450	4088	163	199
WB M-59 Dequindre Road to Rochester Road	5-7	4620	4245	169	207
WB M-59 Rochester Road to Crooks Road	2-5	4590	4217	168	205
EB off ramp to Rochester Road.	5	744	651	42	51
NB to EB on ramp from Rochester Road.	5	575	503	32	40
SB to EB on ramp from Rochester Road	5	378	331	21	26
WB off ramp to Rochester Road.	5	806	741	29	36
SB to WB on ramp from Rochester Road.	5	381	350	14	17
NB to WB on ramp from Rochester Road.	5	228	209	8	10
EB off ramp to South Blvd.	7	623	545	35	43
EB on ramp from Dobry Dr.	7	606	530	34	42
WB off ramp to Dequindre Road.	7	524	481	19	23
WB on ramp from Dequindre Road.	7	566	520	21	25

a. Future truck percentages were developed by increasing the existing eastbound and westbound truck percentages of 10.0% and 6.5% respectively, by 1.12% per year, based on a November 9, 2006 MDOT Office Memorandum, resulting in eastbound and westbound truck percentages of 12.5% and 8.125 % respectively
b. 45% Medium Trucks and 55% Heavy Trucks, developed from data in Table 3.

Three hundred thirty eight (338) representative receiver locations, N1 through N326 and FS-1 through FS-12 were selected to illustrate the noise impacts at St. Paul Albanian Catholic Church, Lutheran High School NW, Spencer Park, residences and commercial properties adjacent to the proposed project. The receiver locations are identified on Figures 3 through 9. The results of the computer modeling are presented in Table 6. The TNM® 2.5 input and output files have been provided to MDOT on a CD.

Design hour noise levels presently approach or exceed the NAC at ninety seven (97) single family residences, twenty one (21) first floor multi-family residential units, St. Paul Albanian Church, two (2) athletic fields, one (1) tennis courts/pool, four (4) commercial properties, and the Community Clubhouse in the Country Club Village of Rochester Hills.

Future No-Build traffic noise levels within the corridor would increase 2 to 3 dBA Leq over existing condition.

Future design hour noise levels would approach or exceed the NAC at one hundred seventy three (173) single family residences, thirty two (32) first floor multi-family residential units, St. Paul Albanian Catholic Church, two (2) athletic fields, two (2) tennis courts/pool, four (4) commercial properties, and the Community Clubhouse in the Country Club Village of Rochester Hills. None of the residences would be exposed to noise levels that “substantially exceed existing” noise levels.

Table 6
Design Hour Noise Levels, dBA L_{eq}(1h)
M-59 Crooks Road to Ryan Road
Oakland and Macomb Counties, MI

Receiver Location	Figure #	Land Use[a]	Dwelling Units	FHWA/MDOT NAC	Noise Level, L_{eq}(1h) (dBA)		
					Existing Noise Levels (2006)	No-Build (2035)	Build (2035)
N1	3	Res.	1	67	***67***	***69***	***69***
N2	3	Res.	1	67	***70***	***72***	***72***
N3	3, 4	Res.	1	67	***71***	***73***	***73***
N4	3, 4	Res.	1	67	***72***	***74***	***75***
N5	3, 4	Res.	1	67	***73***	***75***	***75***
N6	3, 4	Res.	1	67	***73***	***75***	***75***
N7	3, 4	Res.	1	67	***69***	***72***	***72***
N8	3, 4	School	10	67	***68***	***71***	***71***
FS-3	3, 4			67	***66***	***68***	***68***
N9	3, 4			67	62	64	64
N10	4	Multi Fam Res.	1	67	***72***	***74***	***74***
N11	4	Multi Fam Res.	1	67	***71***	***73***	***74***
N12	4	Multi Fam Res.	1	67	***66***	***68***	***68***
N13	4	Multi Fam Res.	1	67	***66***	***68***	***69***
FS-4	4	Multi Fam Res.		67	***72***	***74***	***76***
N14	4, 5	Multi Fam Res.	1	67	61	63	63
N15	5	Res.	1	67	64	***66***	***66***
N16	5	Res.	1	67	***71***	***73***	***73***
N17	5	Res.	2	67	***71***	***73***	***75***
FS-5	5	Res.	6	67	63	65	***66***
N18	5	Res.	2	67	***71***	***73***	***75***
N19	5	Res.	1	67	***66***	***68***	***69***
N20	5	Res.	1	67	61	63	64
N21	5	Res.	3	67	62	64	64
N22	5	Res.	2	67	***69***	***71***	***73***
N23	5	Res.	1	67	***71***	***73***	***74***
N24	5	Res.	3	67	65	***68***	***68***
N25	5	Res.	2	67	***69***	***71***	***72***
N26	5	Res.	5	67	***70***	***72***	***73***
N27	5	Res.	2	67	***69***	***71***	***72***
FS-6	6	Res.	1	67	***71***	***73***	***74***
N28	6	Res.	1	67	***71***	***73***	***75***
N29	6	Res.	1	67	***69***	***71***	***73***
N30	6	Res.	1	67	***66***	***68***	***70***
N31	6	Res.	1	67	***67***	***69***	***71***
N32	6	Res.	4	67	61	63	63

a. Res - Residential, COM – Commercial, Multi Fam Res. – Apartments or Condominiums
66 – Noise levels that approach or exceed the NAC

Receiver Location	Figure #	Land Use[a]	Dwelling Units	FHWA/MDOT NAC	Noise Level, L_{eq}(1h) (dBA)		
					Existing Noise Levels (2006)	No-Build (2035)	Build (2035)
N33	6	Res.	2	67	63	65	***66***
N34	6	Res.	2	67	62	64	64
N35	6	Res.	2	67	58	60	61
N36	6	Res.	4	67	56	58	58
N37	6	Res.	2	67	59	61	63
N38	6	Res.	2	67	62	64	***66***
N39	6	Res.	4	67	64	***66***	***66***
N40	6	Res.	4	67	***69***	***71***	***72***
N41	6	Res.	1	67	***73***	***75***	***77***
FS-7	6	Res.	1	67	***71***	***73***	***74***
N42	6	Res.	3	67	***69***	***71***	***72***
N43	6	Res.	3	67	***67***	***69***	***70***
N44	6	Res.	1	67	***66***	***68***	***68***
N46	7	Com.	4	72	***71***	***73***	***73***
N47	7	Res.	1	67	***68***	***71***	***71***
N48	7	Res.	3	67	***66***	***69***	***69***
N49	8	Res.	1	67	***71***	***73***	***74***
N52	9	Res.	2	67	62	64	65
N53	9	Res.	1	67	62	64	64
N54	9	Zoned Res.	1	67	65	***67***	***67***
N55	9	Zoned Res.	1	67	***66***	***69***	***70***
N56	9	Zoned Res.	1	67	62	65	***66***
N57	9	Res.	1	67	65	***68***	***68***
N58	9	Res.	1	67	58	61	63
N59	9	Res.	1	67	59	61	63
N60	9	Res.	1	67	60	62	64
N61	9	Res.	1	67	60	63	64
N62	9	Res.	2	67	63	***66***	***67***
N63	9	Res.	2	67	***67***	***69***	***71***
N64	9	Res.	1	67	***70***	***72***	***74***
N65	9	Res.	1	67	***68***	***70***	***72***
FS-8	8, 9	Res.	1	67	***67***	***70***	***71***
N66	8, 9	Res.	1	67	68	70	***72***
N67	8	Multi Fam Res.	6	67	66	69	***70***
N68	8	Com.	1	72	66	68	69
N69	8	Multi Fam Res.	2	67	61	63	64
N70	8	Com.	1	72	64	66	67
N71	8	Pool, Tennis Court	1	67	65	***67***	***68***
N72	8	Multi Fam Res.	1	67	***67***	***69***	***70***
N73	8	Multi Fam Res.	4	67	***66***	***69***	***70***

a. Res - Residential, COM – Commercial, Multi Fam Res. – Apartments or Condominiums

66 – Noise levels that approach or exceed the NAC

Receiver Location	Figure #	Land Use[a]	Dwelling Units	FHWA/MDOT NAC	Noise Level, L_{eq}(1h) (dBA)		
					Existing Noise Levels (2006)	No-Build (2035)	Build (2035)
N74	8	Multi Fam Res.	4	67	***66***	***68***	***71***
N75	8	Multi Fam Res.	3	67	59	62	63
N76	7	Athletic Field Park	10	67	***68***	***70***	***71***
FS-9	7			67	58	60	61
N77	7	Res.	2	67	63	***66***	***67***
N78	7	Res.	2	67	65	***67***	***68***
N79	7	Res.	1	67	65	***68***	***68***
N80	7	Res.	1	67	***66***	***68***	***68***
N81	7	Res.	1	67	***66***	***68***	***68***
N82	7	Res.	1	67	65	***68***	***68***
N83	7	Res.	8	67	61	64	64
N84	7	Res.	2	67	61	64	64
N85	7	Res.	2	67	62	64	65
N86	7	Res.	1	67	***68***	***71***	***71***
N87	7	Res.	2	67	***69***	***71***	***72***
N88	6	Res.	2	67	***68***	***70***	***72***
N89	6	Res.	2	67	***69***	***71***	***73***
N90	6	Res.	2	67	***69***	***71***	***73***
N91	6	Res.	2	67	***69***	***71***	***73***
N92	6	Res.	2	67	***69***	***71***	***73***
N93	6	Res.	2	67	61	63	63
N94	6	Res.	1	67	60	62	62
N95	5, 6	Res.	1	67	62	64	65
N96	5, 6	Res.	2	67	65	***67***	***68***
N97	5, 6	Res.	2	67	65	***67***	***68***
N98	5, 6	Res.	1	67	***69***	***71***	***73***
N99	5, 6	Res.	1	67	***73***	***75***	***77***
N100	5	Res.	3	67	***69***	***71***	***73***
N101	5	Res.	1	67	***73***	***75***	***77***
N102	5	Res.	2	67	***68***	***70***	***72***
N103	5	Res.	1	67	63	65	***67***
N104	5	Res.	2	67	59	61	63
FS-12	5	St. Paul Albanian Church	10	67	***66***	***68***	***69***
N105	5			67	***67***	***69***	***70***
N106	5			67	65	***67***	***68***
N107	4, 5	Res.	1	67	58	61	62
N108	4, 5	Res.	1	67	62	64	65
N109	4	Res.	1	67	64	***67***	***67***
N110	4	Res.	2	67	64	***66***	***67***
N111	4	Res.	1	67	61	63	65
N112	4	Res.	1	67	59	61	62

a. Res - Residential, COM – Commercial, Multi Fam Res. – Apartments or Condominiums

66 – Noise levels that approach or exceed the NAC

Receiver Location	Figure #	Land Use[a]	Dwelling Units	FHWA/MDOT NAC	Noise Level, L_{eq}(1h) (dBA)		
					Existing Noise Levels (2006)	No-Build (2035)	Build (2035)
N113	4	Res.	4	67	57	59	60
N114	4	Res.	2	67	59	62	62
N115	4	Res.	2	67	56	59	59
N116	4	Res.	2	67	58	60	60
N117	4	Res.	1	67	56	58	59
N118	4	Res.	2	67	55	57	57
N119	4	Res.	1	67	57	59	60
N120	4	Res.	2	67	59	61	62
N121	4	Res.	3	67	58	60	59
N122	4	Res.	2	67	59	61	60
N123	4	Res.	2	67	60	62	60
N124	4	Res.	1	67	61	64	60
N125	4	Res.	1	67	62	64	62
N126	4	Res.	1	67	63	65	61
N127	4	Res.	1	67	62	64	59
N128	4	Res.	1	67	65	***67***	***66***
N129	3, 4	Res.	1	67	65	***67***	***67***
N130	3, 4	Res.	2	67	***69***	***71***	***72***
N131	3, 4	Res.	1	67	***70***	***72***	***72***
FS-2	3, 4	Res.	1	67	***71***	***73***	***74***
N132	3	Res.	3	67	***70***	***72***	***72***
N133	3	Res.	1	67	***69***	***71***	***72***
N134	3	Res.	1	67	***70***	***72***	***73***
FS-1	3			67	***66***	***69***	***69***
N135	3	Res.	2	67	63	***66***	***66***
N136	3	Res.	2	67	61	63	63
N137	3	Res.	5	67	58	60	60
N138	3	Res.	5	67	58	60	60
N139	3	Res.	6	67	58	60	60
N140	3	Tennis Court	1	67	***67***	***69***	***69***
N141	3	Res.	1	67	58	60	61
N142	3	Res.	5	67	58	60	62
N143	3	Res.	4	67	59	61	62
N144	3	Com.	1	72	66	68	69
N145	5	Res.	1	67	***68***	***70***	***68***
N146	5	Res.	1	67	***72***	***74***	***75***
N147	5	Res.	1	67	***74***	***76***	***78***
N148	5	Res.	2	67	***73***	***75***	***77***
N149	5	Res.	1	67	***72***	***75***	***76***
N150	5	Res.	1	67	***68***	***70***	***71***
N151	5	Res.	1	67	62	64	65

a. Res - Residential, COM – Commercial, Multi Fam Res. – Apartments or Condominiums

66 – Noise levels that approach or exceed the NAC

Receiver Location	Figure #	Land Use[a]	Dwelling Units	FHWA/MDOT NAC	Noise Level, L_{eq}(1h) (dBA)		
					Existing Noise Levels (2006)	No-Build (2035)	Build (2035)
N152	7	Res.	2	67	64	***67***	***67***
N153	7	Res.	2	67	***67***	***69***	***69***
N154	7	Res.	1	67	61	63	64
N155	7	Res.	2	67	63	65	***66***
FS-10	7	Res.	1	67	61	63	65
N156	7	Res.	1	67	62	65	***66***
N157	7	Community Club/Pool	1	67	***69***	***71***	***73***
N158	7	Res.	1	67	64	66	***67***
N159	7	Res.	6	67	61	63	64
N160	7	Res.	1	67	***68***	***70***	***72***
FS-11	7	Res.	2	67	64	***66***	***68***
N161	6	Res.	2	67	64	***66***	***67***
N162	6	Res.	1	67	62	64	65
N163	6	Res.	1	67	60	62	64
N164	7	Res.	3	67	59	61	63
N165	6	Multi Fam Res.	4	67	58	60	60
N166	6	Multi Fam Res.	6	67	59	61	61
N167	6	Multi Fam Res.	6	67	55	57	59
N168	6	Multi Fam Res.	4	67	54	56	57
N169	6	Res.	2	67	56	59	59
N170	5	Res.	3	67	60	62	63
N171	3	Res.	5	67	61	63	63
N172	3	Res.	4	67	65	***67***	***67***
N173	8	Multi Fam Res.	1	67	64	***66***	***68***
N174	8	Multi Fam Res.	4	67	59	61	62
N175	8	Multi Fam Res.	5	67	58	61	62
N176	8	Multi Fam Res.	1	67	64	***66***	***66***
N177	8	Multi Fam Res.	4	67	56	59	60
N178	8	Multi Fam Res.	2	67	55	57	59
N179	4	Multi Fam Res.	1	67	***68***	***70***	***70***
N180	4	Multi Fam Res.	2	67	***63***	***66***	***66***
N181	4	Multi Fam Res.	2	67	62	64	65
N182	4	Multi Fam Res.	2	67	57	59	59
N183	4	Multi Fam Res.	1	67	***68***	***70***	***71***
N184	4	Multi Fam Res.	2	67	62	65	64
N185	4	Multi Fam Res.	2	67	61	63	64
N186	4	Multi Fam Res.	2	67	56	58	59
N187	4	Multi Fam Res.	2	67	57	59	60
N188	4	Multi Fam Res.	2	67	56	58	58
N189	4	Multi Fam Res.	2	67	55	57	57

a. Res - Residential, COM – Commercial, Multi Fam Res. – Apartments or Condominiums

66 – Noise levels that approach or exceed the NAC

Receiver Location	Figure #	Land Use[a]	Dwelling Units	FHWA/MDOT NAC	Noise Level, L_{eq}(1h) (dBA)		
					Existing Noise Levels (2006)	No-Build (2035)	Build (2035)
N190	4	Multi Fam Res.	2	67	56	58	59
N191	4	Multi Fam Res.	2	67	57	59	59
N192	4	Multi Fam Res.	2	67	61	63	63
N193	4	Multi Fam Res.	1	67	61	64	64
N194	4	Multi Fam Res.	2	67	58	60	60
N195	4	Multi Fam Res.	2	67	52	54	55
N196	4	Multi Fam Res.	2	67	49	51	51
N197	4	Pool	1	67	53	56	56
N198	4	Tennis Court	1	67	55	58	58
N199	4	Multi Fam Res.	2	67	59	62	62
N200	4	Multi Fam Res.	1	67	65	***67***	***68***
N201	4	Multi Fam Res.	2	67	62	64	65
N202	4	Multi Fam Res.	2	67	58	60	60
N203	4	Multi Fam Res.	1	67	65	***68***	***68***
N204	4	Multi Fam Res.	2	67	61	64	64
N205	4	Multi Fam Res.	2	67	58	60	62
N206	4	Multi Fam Res.	2	67	55	58	59
N207	4	Multi Fam Res.	2	67	55	57	58
N208	4	Multi Fam Res.	2	67	53	55	56
N209	4	Multi Fam Res.	2	67	54	57	57
N210	4	Multi Fam Res.	2	67	53	55	56
N211	4	Multi Fam Res.	2	67	52	55	55
N212	4	Multi Fam Res.	2	67	50	52	53
N213	4	Multi Fam Res.	2	67	52	54	54
N214	4	Multi Fam Res.	2	67	51	53	53
N215	4, 5	Multi Fam Res.	4	67	51	53	53
N216	4, 5	Multi Fam Res.	2	67	48	50	51
N217	4, 5	Multi Fam Res.	2	67	47	49	49
N218	4, 5	Multi Fam Res.	2	67	53	55	54
N219	4, 5	Multi Fam Res.	2	67	51	53	53
N220	4, 5	Multi Fam Res.	2	67	50	53	52
N221	4, 5	Multi Fam Res.	2	67	52	54	54
N222	4, 5	Multi Fam Res.	2	67	53	56	56
N223	4, 5	Multi Fam Res.	2	67	51	54	54
N224	4, 5	Multi Fam Res.	2	67	53	55	56
N225	4, 5	Multi Fam Res.	2	67	56	58	59
N226	4, 5	Multi Fam Res.	1	67	58	60	61
N227	4, 5	Multi Fam Res.	2	67	56	58	58
N228	8	Multi Fam Res.	2	67	58	60	60
N229	8	Multi Fam Res.	2	67	57	59	60
N230	8	Multi Fam Res.	2	67	58	61	61

a. Res - Residential, COM – Commercial, Multi Fam Res. – Apartments or Condominiums

66 – Noise levels that approach or exceed the NAC

Receiver Location	Figure #	Land Use[a]	Dwelling Units	FHWA/MDOT NAC	Noise Level, L_{eq}(1h) (dBA)		
					Existing Noise Levels (2006)	No-Build (2035)	Build (2035)
N231	8	Multi Fam Res.	2	67	60	63	63
N232	8	Multi Fam Res.	2	67	56	59	58
N233	8	Multi Fam Res.	2	67	58	61	61
N234	8	Multi Fam Res.	2	67	55	57	58
N235	8	Multi Fam Res.	2	67	57	59	60
N236	8	Multi Fam Res.	2	67	62	64	65
N237	8	Multi Fam Res.	1	67	63	***66***	***66***
N238	8	Multi Fam Res.	2	67	62	65	65
N239	8	Multi Fam Res.	2	67	60	62	63
N240	8	Multi Fam Res.	2	67	59	61	62
N241	8	Multi Fam Res.	2	67	57	59	60
N242	8	Multi Fam Res.	2	67	56	58	60
N243	8	Multi Fam Res.	2	67	55	57	60
N244	8	Multi Fam Res.	2	67	54	57	58
N245	8	Multi Fam Res.	2	67	54	57	58
N246	8	Multi Fam Res.	2	67	55	57	59
N247	8	Multi Fam Res.	2	67	57	59	62
N248	8	Multi Fam Res.	2	67	59	61	64
N249	8	Multi Fam Res.	2	67	56	58	60
N250	8	Multi Fam Res.	2	67	54	56	57
N251	8	Multi Fam Res.	2	67	57	59	60
N252	8	Multi Fam Res.	2	67	55	57	59
N253	8	Multi Fam Res.	2	67	56	58	60
N254	8	Multi Fam Res.	2	67	60	62	63
N255	8	Multi Fam Res.	2	67	63	65	***66***
N256	8	Multi Fam Res.	2	67	60	63	64
N257	8	Multi Fam Res.	2	67	63	65	***67***
N258	8	Multi Fam Res.	2	67	55	57	59
N259	8	Multi Fam Res.	2	67	55	58	59
N260	8	Multi Fam Res.	2	67	45	48	48
N261	8	Multi Fam Res.	2	67	46	48	48
N262	8	Multi Fam Res.	2	67	56	58	59
N263	8	Multi Fam Res.	2	67	59	61	62
N264	8	Multi Fam Res.	1	67	58	61	62
N265	8	Multi Fam Res.	2	67	54	56	58
N266	8	Multi Fam Res.	2	67	54	56	57
N267	8	Multi Fam Res.	2	67	52	54	55
N268	8	Multi Fam Res.	2	67	60	62	64
N269	8	Multi Fam Res.	2	67	57	59	61
N270	8	Multi Fam Res.	2	67	51	54	54
N271	8	Multi Fam Res.	2	67	47	49	49

a. Res - Residential, COM – Commercial, Multi Fam Res. – Apartments or Condominiums

66 – Noise levels that approach or exceed the NAC

Receiver Location	Figure #	Land Use[a]	Dwelling Units	FHWA/MDOT NAC	Noise Level, L_{eq}(1h) (dBA)		
					Existing Noise Levels (2006)	No-Build (2035)	Build (2035)
N272	8	Multi Fam Res.	2	67	54	56	58
N273	8	Multi Fam Res.	2	67	55	57	60
N274	8	Multi Fam Res.	2	67	55	57	59
N275	8	Multi Fam Res.	2	67	55	57	59
N276	8	Multi Fam Res.	2	67	54	57	58
N277	8	Multi Fam Res.	2	67	55	58	59
N278	8	Multi Fam Res.	2	67	46	49	49
N279	8	Multi Fam Res.	2	67	49	51	52
N280	8	Multi Fam Res.	2	67	57	60	61
N281	8	Multi Fam Res.	2	67	60	63	64
N282	8	Multi Fam Res.	2	67	52	54	56
N283	8	Multi Fam Res.	2	67	56	58	60
N284	8	Multi Fam Res.	2	67	57	59	61
N285	8	Multi Fam Res.	2	67	54	56	58
N286	8	Multi Fam Res.	2	67	58	60	62
N287	8	Multi Fam Res.	2	67	55	57	58
N288	8	Multi Fam Res.	2	67	54	56	57
N289	8	Multi Fam Res.	2	67	52	55	57
N290	8	Multi Fam Res.	2	67	48	50	51
N291	8	Multi Fam Res.	2	67	49	52	53
N292	8	Multi Fam Res.	2	67	54	57	59
N293	8	Multi Fam Res.	4	67	54	56	58
N294	8	Multi Fam Res.	2	67	51	54	54
N295	8	Multi Fam Res.	2	67	51	53	54
N296	8	Multi Fam Res.	2	67	56	58	60
N297	8	Multi Fam Res.	2	67	57	59	61
N298	8	Multi Fam Res.	1	67	59	61	63
N299	6	Res.	2	67	60	62	63
N300	6	Res.	3	67	61	63	64
N301	6	Res.	3	67	63	65	***66***
N302	6	Res.	4	67	65	***67***	***69***
N303	6	Res.	5	67	56	58	59
N304	6	Res.	4	67	58	60	62
N305	6	Res.	4	67	61	63	65
N306	6	Res.	5	67	65	***67***	***69***
N307	6	Res.	4	67	58	60	61
N308	6	Res.	4	67	61	64	65
N309	6	Res.	4	67	64	67	***67***
N310	5	Res.	3	67	59	61	62
N311	5	Res.	2	67	63	***66***	***66***
N312	5	Res.	1	67	64	***66***	***66***

a. Res - Residential, COM – Commercial, Multi Fam Res. – Apartments or Condominiums

66 – Noise levels that approach or exceed the NAC

Receiver Location	Figure #	Land Use[a]	Dwelling Units	FHWA/MDOT NAC	Noise Level, L_{eq}(1h) (dBA)		
					Existing Noise Levels (2006)	No-Build (2035)	Build (2035)
N313	6	Res.	4	67	65	***67***	***68***
N314	6	Res.	3	67	60	62	63
N315	6	Res.	4	67	62	65	65
N316	6	Res.	2	67	60	63	64
N317	6	Res.	1	67	57	60	60
N318	6	Res.	2	67	56	58	59
N319	6	Res.	4	67	58	60	61
N320	6	Res.	3	67	55	57	57
N321	6	Res.	4	67	54	56	56
N322	6	Res.	3	67	59	61	62
N323	6	Res.	2	67	57	59	60
N324	6	Res.	3	67	56	58	58
N325	6	Res.	1	67	58	61	61
N326	6	Res.	3	67	58	60	60

a. Res - Residential, COM – Commercial, Multi Fam Res. – Apartments or Condominiums

66 – Noise levels that approach or exceed the NAC

5.3 Mitigation Measures

MDOT's Noise Policy has established the criteria for determining where noise abatement should be provided. A complete copy of this policy is provided in Appendix B. The policy is summarized as follows:

- Where negative noise impacts are expected to occur, noise abatement will be considered and will be implemented if found feasible and reasonable for existing developments, and future developments were approved before the date of public knowledge. After the date of public knowledge, MDOT will not be responsible for providing noise abatement for new developments. The date of the clearance of the Categorical Exclusion will be the date of public knowledge. The provision of noise abatement for new developments becomes the responsibility of local governments and private developers.
- All sites will be considered. However, it is generally known that commercial and industrial sites prefer that there be no interference with the view to their establishments. Therefore, when commercial and residential sites expected to convert to a commercial or industrial land use (e.g., some of the residential units have converted to commercial/industrial, or the area has been rezoned commercial) are found to be reasonable and feasible, they will be asked if they want noise abatement. If they do not want it, it will not be provided.
- Feasible - This refers to engineering considerations, such as can a noise barrier be built given the topography of the location; can a substantial noise reduction be achieved given certain access, drainage, safety, or maintenance requirements; are other noise sources present 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 dBA noise reduction.
- Reasonable - Noise mitigation will be considered reasonable if the comparative construction cost will be $38,060 or less (in 2007 dollars) per benefiting dwelling unit.[4] Additionally, the local jurisdiction(s) must have entered into the required agreements with MDOT regarding maintenance, land use policy, and funding participation. A majority of the affected residents must be in favor of abatement.
- Dwelling Unit – Any room or set of rooms used as living space by one or more persons. Public use areas such as parks, schools, libraries, and churches shall be counted as 10 dwelling units for each occurrence when they are within or adjacent to residential dwelling unit boundaries.

Within the framework of MDOT's criteria, various methods were reviewed to mitigate the noise impact of the proposed improvements. Among those considered were reduction of speed limits, restriction of truck traffic to specific times of the day, a total prohibition of trucks, alteration of horizontal and vertical alignments, property acquisition for construction of noise barriers or berms, acquisition of property to create buffer zones to prevent development that could be adversely impacted, noise insulation of public use or

[4] Thomas Hanf (HanfT@michigan.gov), "Re: Blue Water Bridge – Noise Barrier Costs", e-mail message, June 7, 2007.

nonprofit institutional structures and in certain circumstances, residential structures, the use of berms, and the use of sound barriers.

Reductions of speed limits, although acoustically beneficial, are seldom practical unless the design speed of the proposed roadway is also reduced. Restriction or prohibition of trucks is counter to the project purpose and need. Design criteria and recommended termini for the proposed project preclude substantial horizontal and vertical alignment shifts that would produce noticeable changes in the projected acoustical environment. The construction of noise berms is neither feasible nor reasonable because of the amount of space that would be required. Therefore, only the construction of noise barriers was reviewed.

5.3.1 Noise Barrier Analysis

Thirteen (13) noise barriers were analyzed within the project limits. The results of the barrier analysis, including barrier location, future L_{eq}(1h) noise levels without and with a barrier, barrier length and height, estimated cost (based on $25.50 per square foot of noise wall plus $250.00 per lineal foot for foundations[5]), the number of residential units benefited, the noise reduction provided by the barrier and the cost per residential unit are presented in Table 7. Noise Barrier Number 8 is the only noise barrier that meets both MDOT's feasible and reasonable criteria. The noise barrier locations are presented on Figures 3-9.

Noise Barrier Number 8 was analyzed for the Whispering Winds development north of M-59 and west of Dequindre Road. This barrier would provide mitigation for 40 first floor multi-family residential units. The noise barrier would be fifteen to twenty four feet high and 1,689 feet in length and would provide 5 - 10 decibels of attenuation. The estimated cost of this barrier is $1,174,840 with a cost of $29,371 per residence.

Two noise barrier locations were modeled for the residential area south of M-59 between Rochester Road and John R. Road in attempt to find the best location, 6 and 6a. Since M-59 is a rural freeway section utilizing open channel ditch drainage the noise barrier was modeled along the right-of-way. Noise Barrier 6, located at the right of way, would provide attenuation for fifty three (53) residences. This noise barrier resulted in being fifteen to twenty one feet high, 3,050 feet in length and would provide 5 to 13 decibels of attenuation. The estimated cost for this barrier is $2,224,135. The cost per residence would be $41,965, which exceeds MDOT's reasonability criteria.

In this particular location, the noise barrier would be more efficient at the edge of the shoulder. Therefore, Noise Barrier 6a, located at the south edge of the M-59 shoulder would be nine to fifteen foot high and 2,863 feet long. This barrier would provide 5 to 11 decibels of attenuation for 55 residences. The estimated cost of this barrier would be $1,685,623 with a cost of $30,648 per residence. This barrier meets MDOT's criteria for feasible and reasonable noise mitigation.

The remaining 11 noise barriers shown in Table 7 meet MDOT's criteria for feasibility but would exceeds MDOT's reasonability criteria.

[5] Ibid.

There are other areas along the M-59 corridor were individual receptors exceed the NAC. However, it is impossible to design a barrier for single receptors that would meet MDOT's cost criteria of $38,060.

The 66 dBA setback distance along M-59 would range from 280 ft to 409 ft. The range of distances is a function of a change in the terrain adjacent to the proposed improvements to M-59. The setback distance indicates that noise levels within the distance shown, measured perpendicular to the centerline of the nearest lane of the final design project in either direction, is 66 dBA or greater. This setback distance was developed to assist local planning authorities in developing land use control over the remaining undeveloped lands along the project in order to prevent further development of incompatible land use. The setback distances are presented on Figures 3-9.

Table 7
Acoustical Mitigation
Noise Barrier Locations Analyzed
M-59 Crooks Road to Ryan Road
Oakland and Macomb Counties, MI

Noise Barrier Number	Figure #	Locations	Existing L_{eq}(1h) Noise Levels, dBA	Range of Future L_{eq}(1h) Noise Levels, dBA		Noise Reduction (dB)	Barrier Characteristics		Cost[a]	Number of Units Attenuated	Cost/ Unit
				w/o Barrier	Barrier		Length (ft)	Height (ft)			
NB-1	3, 4	South of M-59, Dearborn to Simpson Dr	70 – 73	72 - 75	65 - 67	7 - 10	1,132	9 - 18	$702,543	7	$100,365
NB-2	3, 4	South of M-59, Lutheran High School NW, west of Livernois Rd.	66 – 68	68 - 71	61	7 - 10	1,434	12 - 21	$1,036,382	10	$103,640
NB-3	4, 5	South of M-59, between Livernois Rd. and Auburn Rd.	66 – 72	64 - 76	59 - 65	5 - 12	1,608	12 - 18	$943,674	14	$67,405
NB-4	5	West of M-59 and south of Auburn Rd.	63 – 71	66 - 75	61 - 65	5 - 10	1,701	6 - 15	$929,041	19	$48,900
NB-5	5, 6	South of M-59, between Auburn Rd. and Rochester Rd.	63 – 71	65 - 75	60 - 67	5 - 10	2,853	9 -15	$1,644,989	28	$58,750
NB-6	6	South of M-59, between Rochester Rd. & John R, located at right-of-way.	58 – 73	62 - 77	57 - 64	5 - 13	3,050	15 - 21	$2,224,135	53	$41,965
NB-6a	6	South of M-59, between Rochester Rd. & John R, located along edge of shoulder.	58 - 73	61 - 76	56 - 65	5 - 11	2,863	9 - 15	$1,685,623	55	$30,648

a Based on $25.50 per square foot and additional cost of $250.00 per foot

Noise Barrier Number	Figure #	Locations	Existing L_{eq}(1h) Noise Levels, dBA	Range of Future L_{eq}(1h) Noise Levels, dBA		Noise Reduction (dB)	Barrier Characteristics		Cost[a]	Number of Units Attenuated	Cost/ Unit
				w/o Barrier	Barrier		Length (ft)	Height (ft)			
NB-7	8, 9	North of M-59, between Ryan Rd. and Dequindre Rd.	63 – 70	67 - 74	62 - 64	5 - 11	2,119	12 - 21	$1,438,578	17	$84,622
NB-8	8	North of M-59, between Dequindre Rd. and Thelma G Spencer Park	54 – 67	57 - 71	52 - 65	5 -10	1,689	15 - 24	$1,174,840	40	$29,371
NB-9	7, 8	North of M-59, between Thelma G Spencer Park and John R.	58 - 68	61 - 71	56 - 63	5 - 10	2,783	12 - 21	$1,856202	18	$103,122
NB-10	6, 7	North of M-59, between John R. and Joshua Dr.	59 – 69	63 - 74	57 - 68	5 - 10	4,562	9 - 15	$2,603,612	35	$74,389
NB-11	5, 6	North of M-59 and west of Rochester Rd.	63 – 73	67 - 77	63 - 65	5 - 13	2,083	12 - 18	$1,294,407	13	$99,570
NB-12	5	East of M-59, St. Paul Albanian Catholic Church, south of Auburn Rd.	65 – 67	68 - 70	61 - 63	6 - 8	1,069	21	$839,630	10	$83,963
NB-13	3, 4	North of M-59, west of Livernois Road.	63 – 71	66 - 74	61 - 65	5 - 10	1,555	12 - 18	$971,385	15	$64,759

a Based on $25.50 per square foot and additional cost of $250.00 per foot

5.4 Conclusion

MDOT's policy is to install the feasible and reasonable noise barriers associated with transportation improvements. Based on the study completed, mitigation of noise impacts for the proposed M-59 project appears to be feasible and reasonable for Noise Barriers 6a and 8 in Table 5. Noise Barrier 6a is located South of M-59, between Rochester & John R Roads, and designed to mitigate the noise impact for residences along Michelson Road and the east end of Eastlawn Drive. Noise Barrier 8 is located north of M-59 and west of Dequindre Road in front of the Whispering Winds development.

If during final design, the project cost becomes not reasonable (construction costs exceed the total benefited amount of $38,060 per unit), the local jurisdiction(s) will be asked if they wish to increase their financial participation in the noise abatement project to cover the excess cost per dwelling unit (the amount over $38,060 per unit), or have noise abatement dropped from further consideration.

6.0 CONSTRUCTION NOISE

The major construction elements of this project are expected to be demolition, hauling, grading, paving, and bridge construction. Construction of the proposed improvements will result in a temporary increase in the ambient noise level along the M-59 corridor. General construction noise impacts for passerby and those individuals living or working near the project can be expected particularly from demolition, earth moving and paving operations. Equipment associated with construction generally includes backhoes, graders, pavers, concrete trucks, compressors, and other miscellaneous heavy equipment. Table 8 lists some typical peak operating noise levels at a distance of 15 m (50 feet), grouping construction equipment according to mobility and operating characteristics. Considering the relatively short-term nature of construction noise, impacts are not expected to be substantial. The transmission loss characteristics of nearby structures are believed to be sufficient to moderate the effects of intrusive construction noise.

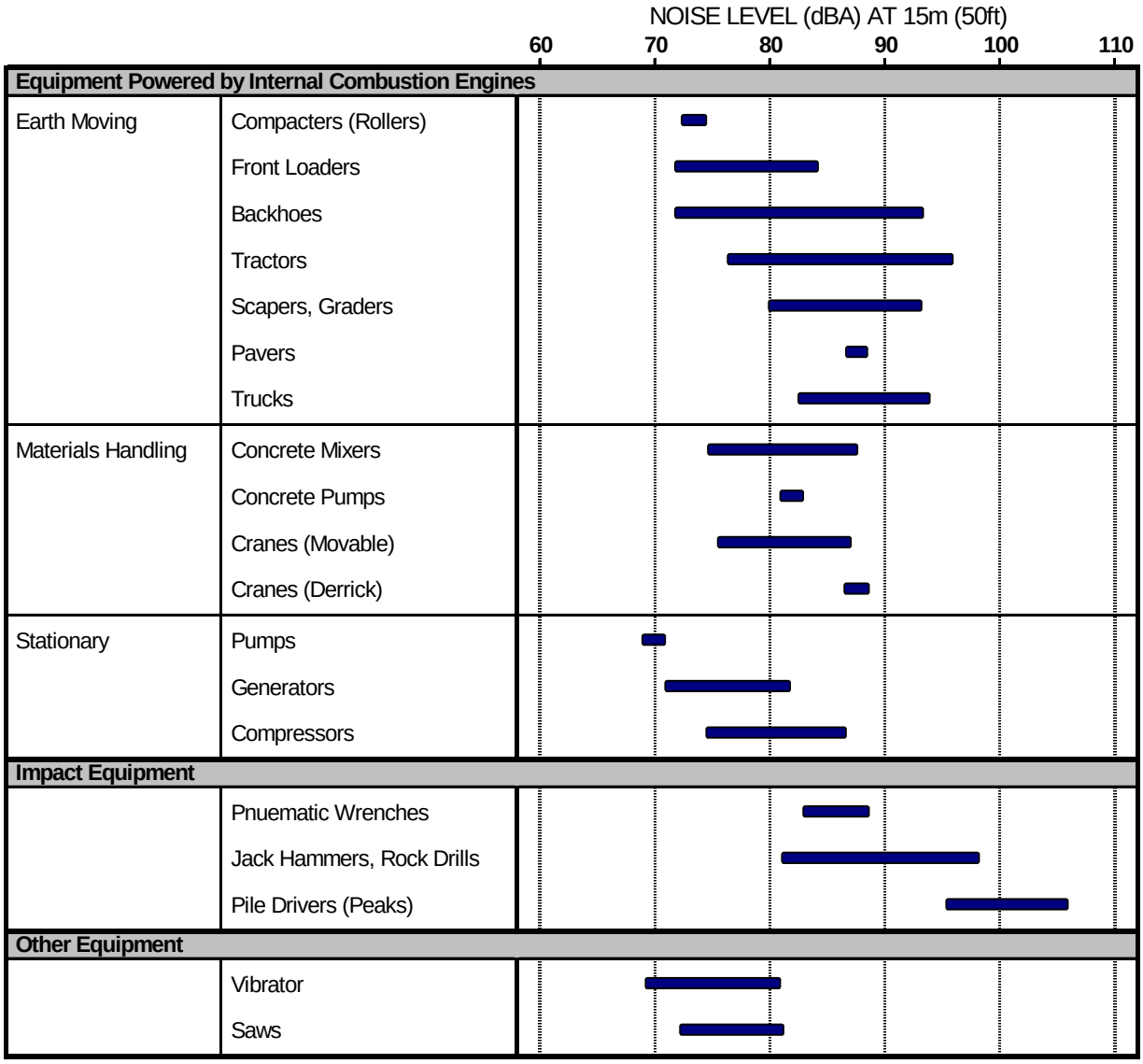
Construction noise on this project should be controlled by measures including but not limited to the following:[6]

- The construction contract specifications should require that the contractor adhere with all Federal, state, and local noise abatement and control requirements.
- Construction activity in the vicinity of residences should be limited to the hours between 7:00 am and 7:00 pm or as specified by local requirements.
- A responsive communication process should be established with local residents. A telephone number should be posted at the construction site for inquiries concerning project activity.
- Construction equipment should be in good repair and fitted with "manufacturer recommended" mufflers.

[6] Thomas Hanf (HanfT@Michigan.gov), "Re: Blue Water Bridge – Construction Noise", June 14, 2007.

- Equipment such as generators, which may be used during the nighttime hours, should be enclosed.
- Local or state jurisdictions should monitor construction noise and advise the contractor of any violation of maximum allowable noise levels.

Table 8
Construction Equipment Sound Levels



SOURCE: U.S. Report to the President and Congress on Noise, February, 1972.

7.0 REFERENCES

Anderson, G. S., C.S.Y. Lee, G.G. Fleming and C. Menge, "FHWA Traffic Noise Model®, Version 1.0 User's Guide", Federal Highway Administration, January 1998, p. 60.

Hanf, Thomas (HanfT@michigan.gov), "Re: Blue Water Bridge – Noise Barrier Costs", e-mail message, June 7, 2007

Hanf, Thomas (HanfT@Michigan.gov), "Re: Blue Water Bridge – Construction Noise", e-mail message, June 14, 2007.

Lau, Michael C., Cynthia S. Y. Lee, Gregg G. Judith L. Rochat, Eric R. Boeker, and Gregg C. Fleming. FHWA Traffic Noise Model® Users Guide (Version 2.5 Addendum). Federal Highway Administration, April 2004.

"Michigan Operation's Manual", D-106, Policy on Adding Capacity on NHS Routes, February 15, 2007

"Policy on Noise Abatement", (Guidance Document 10136), Michigan Transportation Commission, Michigan Department of Transportation, July 31, 2003.

"Procedures and Rules for Implementation of State Transportation Commission Policy 10136, Noise Abatement, Michigan Department Of Transportation's, July 31, 2003.