I-95
Label Avenue to Forest Avenue
FINAL TYPE II NOISE ANALYSIS

Prepared For

Maine Turnpike Authority

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Final Design Noise Analysis

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Final Design Noise Analysis

1.0 EXECUTIVE SUMMARY

In response to concerns relative to traffic noise in the vicinity of Forest Avenue in Portland, the Maine Turnpike Authority (MTA) retained HNTB Corporation to conduct a Design Noise Analysis based on the Maine Turnpike October 2008 Highway Traffic Noise Policy (Noise Policy). This Policy defines two types of highway noise projects. A Type I noise project involves a new highway project and a Type II or "retrofit" noise project is a noise abatement project along an existing highway. The Policy states that a highway traffic noise analysis for Type II projects will only be performed for development that predates the existence of the highway and an impact occurs when the existing highway traffic noise levels approach within 1 dBA of the noise abatement criteria (NAC) or exceed the NAC for residences of 67 L_{eq} dBA (1h) at residences that predated the existence of the highway. MTA's policy is to add any Type II noise abatement project that is both feasible and reasonable as a candidate project during the development of the MTA's 20-year Plan. The MTA's Noise Policy has defined feasibility as "the engineering and acoustical ability of abatement measures to provide effective noise reduction" and reasonableness "implies that common sense and good judgment have been applied in arriving at a decision". Factors in this decision include social, economic and environmental effects along with the cost of the abatement measures.

When justified, the policy dictates that a study be prepared that presents the results of existing noise measurements, modeling of existing peak hour $L_{eq}(h)$ noise levels, potential noise mitigation measures and determination of feasibility and reasonableness according to the criteria set forth in the MTA's Noise Policy. Since this is not a new highway project, the Label to Forest Avenues study is a Type II Design Noise Analysis. The purpose of this analysis is to identify traffic noise impacts and determine the feasibility and reasonableness of Type II noise abatement measures for the residential areas east and west of the Maine Turnpike (Turnpike) in the vicinity of Forest Avenue from Mile Marker 49.41 to Mile Marker 50.44 in the City of Portland, ME.

Existing noise level measurements were conducted on April 13, 2010 at nine (9) locations representing seven (7) residential areas in the project vicinity. A twenty-minute measurement was taken at each location. Three measurements were taken at Field Site 6 (FS-6, FS-6A and FS-6B). The multiple locations were selected to match the locations used in previous measurements taken in 1991, 1994, 1995 and 1996 at the same residence. The traffic noise prediction program, TNM® 2.5, was used to model existing 30th highest hourly traffic volumes within the study area. These volumes are the volumes which will yield the worst hourly traffic noise on a regular basis (design hour noise levels). Design hour noise levels presently approach or exceed the MTA's Noise Abatement Criteria (NAC) for residences of 67 L_{eq} dBA (1h) at 65 single family residences or first floor multi-family residential units.

A review of the City of Portland's Tax Assessor's online database indicated that none of the front row residences west of the Turnpike (adjacent the southbound lanes) were constructed before the Turnpike and that only a few on the east side of the Turnpike predated the Turnpike. The MTA Noise Policy states "Abatement will not be considered

for any development that was planned, designed, and programmed after the original highway construction project. That is, the granting of a building permit or site approval from the local agency with jurisdiction must have occurred prior to right-of-way acquisition or construction approval of the original highway." Therefore, noise barrier analysis (abatement analysis) was limited to an area from slightly north of Wendell Street to Forest Avenue along Castine Avenue adjacent to the northbound lanes of the Turnpike where residences were constructed prior to the construction of the Turnpike.

An abatement analysis was conducted for the eligible area from slightly north of Wendell Street to Forest Avenue along Castine Avenue adjacent to the northbound lanes of the Turnpike. HNTB concluded that Noise Barrier NB-1 would provide a noise reduction of 2 to 10 decibels for the residences along Castine Avenue. The noise barrier would be 1,241 feet long ranging in height from 9 to 16 feet. The cost at $30.00 per square foot (as stated in the Noise Policy) would be $503,100. This cost does not include any additional costs that would be incurred to widen the shoulder to permit construction of the noise barrier. Sixty three percent (63%) of the front row residences would receive a 7 dBA or greater reduction in noise levels. Twelve (12) residences would receive a 5 dBA or greater reduction in noise levels with the resulting cost per residence being $41,925. NB-1 is feasible but not reasonable.

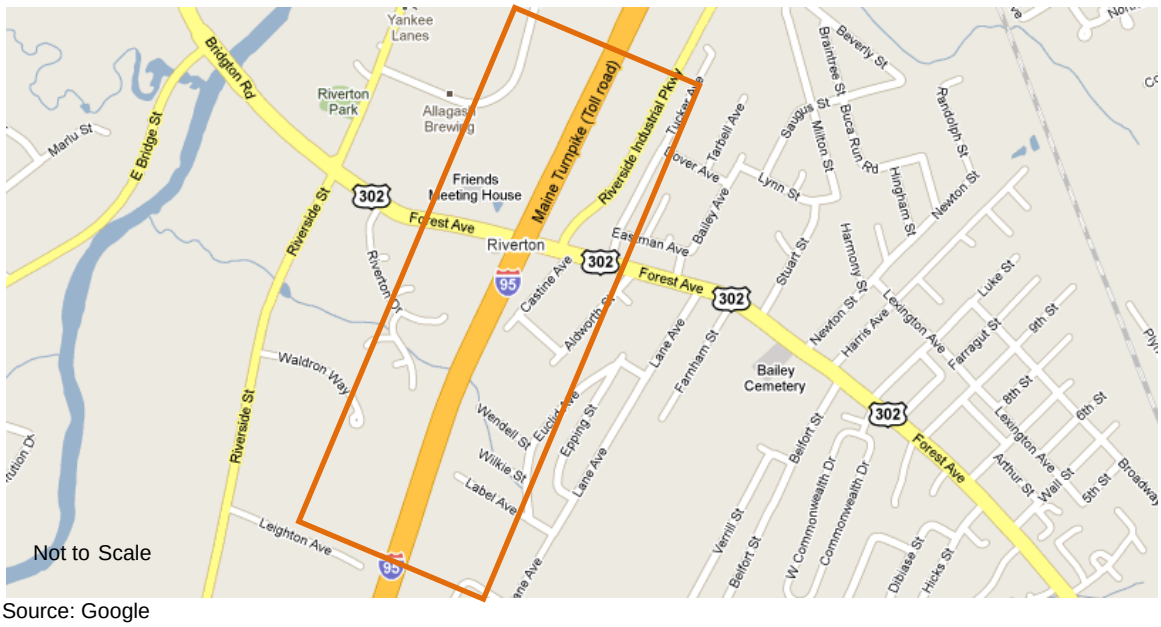
NB-1 is feasible since it would provide a 7 dBA or greater noise reduction for a majority (greater than 50%) of first row receivers, it will not create a safety issue, and it will not exceed 20 feet in height. However, the cost per residence of $41,925 exceeds the reasonableness criteria of $30,000 per residence that is stated in the Noise Policy. Therefore, this Type II noise barrier is feasible but not reasonable.

2.0 PROJECT DESCRIPTION

The Maine Turnpike (Turnpike) in the Forest Avenue area of Portland was constructed in 1955 as a four-lane divided highway. This section of the Turnpike is designated as Interstate 95 (I-95). Land use adjacent to the Turnpike in this area is a mixture of single and multifamily residences, commercial and some light industrial properties. Some residential properties were developed before or in the same time period during which the Turnpike was being constructed. However, much of the development in the area has occurred since 1971.

The Maine Turnpike Authority's (MTA) October 2008 Highway Traffic Noise Policy (Noise Policy) defines two types of highway noise projects, Type I is a new highway project that "includes the following types of proposed highway projects: the construction of a highway on new location, or the physical alteration of an existing highway that significantly changes the horizontal or vertical alignment or increases the number of through-traffic lanes." and Type II or "retrofit" projects as noise abatement projects along existing highways. The Label to Forest Avenues study is a Type II project. Type II project impacts occur when the existing highway traffic noise levels approach within 1 dBA or exceed the noise abatement criteria (NAC) for residences of 67 L_{eq} dBA (1h).

The MTA has reviewed previous noise monitoring reports for the area south of Forest Avenue along Castine Ave. The data collected to date indicates that the L_{eq}(h) noise level in this area ranges from 62.6 to 66.4 dBA. The 66.4 dBA Leq noise level is within 1 dBA of the 67 NAC for residences and appears to meet the criteria specified in section IV of the MTA Noise Policy. Therefore, this area is eligible for a Type II highway noise analysis under the 2008 Noise Policy. The project's study area for modeling purposes, extended from 1,200 feet south of Label Avenue, Mile Marker 49.41, to 2,300 feet north of Forest Avenue, Mile Marker 50.44. The study area also extended east and west of the Turnpike 500 feet from the existing edge of the pavement. The study area is shown on Figure 1.



Source: Google

Figure 1 Project Location Map

3.0 PURPOSE OF THE REPORT

The purpose of this Design Noise Analysis is to identify traffic noise impacts and determine the feasibility and reasonableness of Type II noise abatement measures for the residential areas east and west of the Turnpike in the vicinity of Forest Avenue. The analysis presents the results of existing noise measurements, modeling of existing peak hour $L_{eq}(h)$ noise levels, potential noise mitigation measures and determination of feasibility and reasonableness according to the criteria set forth in MTA's Noise Policy.

4.0 SOUND AND TRAFFIC NOISE – BASIC INFORMATION

Noise is defined as any unwanted sound. The ear is sensitive to this pressure variation and perceives it as sound. The intensity of these pressure variations causes the ear to discern different levels of loudness. These pressure differences are most commonly measured in decibels.

The decibel (dB) is the unit of measurement for sound. The decibel scale audible to humans spans approximately 140 dB. A level of zero decibels corresponds to the lower limit of audibility, while 140 decibels produces a sensation more akin to pain than sound. The decibel scale is a logarithmic representation of the actual sound pressure variations. Therefore, a 26 percent change in the energy level only changes the sound level one dB. The human ear would not detect this change except in an acoustical laboratory. A doubling of the energy level would result in a three-dB increase, which would be barely perceptible in the natural environment. A tripling in energy sound level would result in a clearly noticeable change of five-dB in the sound level. A change of ten times the energy level would result in a ten-dB change in the sound level. This would be perceived as a doubling (or halving) of the apparent loudness.

The human ear has a non-linear sensitivity to noise. To account for this in noise measurements, electronic weighting scales are used to define the relative loudness of different frequencies. The "A" weighting scale is widely used in environmental work because it closely resembles the non-linearity of human hearing. Therefore, the unit of measurement for an A-weighted noise level is dBA.

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. In an urban environment, noise is made up of two distinct parts. One is ambient or background noise. Wind noise and distant traffic noise make up the acoustical environment surrounding the project. These sounds are not readily recognized, but combine to produce a non-irritating ambient sound level. This background sound level varies throughout the day, being lowest at night and highest during the day. The other component of urban noise is intermittent and louder than the background noise. Transportation noise (motor vehicles, trains, airplanes, etc.) and local industrial noise are examples of this type of noise. It is for these reasons that environmental noise is analyzed statistically.

The statistical descriptor used for traffic noise is L_{eq}. L_{eq} is the constant, average sound level, which over a period of time contains the same amount of sound energy as the varying levels of the traffic noise. The L_{eq} correlates reasonably well the effects of noise

on people. It is also easily measurable with integrating sound level meters. The time period for traffic noise is 1-hour. Therefore, the unit of measure for traffic noise is L_{eq}(1h) dBA.

Highway noise sources have been divided 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:[1]

- 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.

Noise levels produced by highway vehicles can be attributed to three major categories:

- Running gear and accessories (tires, drive train, fan and other auxiliary equipment)
- Engine (intake and exhaust noise, radiation from engine casing)
- Aerodynamic and body noise

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 MTA is an independent quasi-state agency receiving no state or federal funds for its construction and maintenance, and as such, the MTA is not subject to regulation by the Maine Department of Transportation (MaineDOT) or Federal Highway Administration (FHWA). However, the MTA and MaineDOT work closely with each other to provide consistent regulation of roadways. As a result, the MTA and MaineDOT have developed a uniform noise policy that benefits users and abutters along their principle roadways and provides consistent and well defined actions as it relates to highway traffic noise.

The MTA has used the requirements of Title 23, Part 772 of the U.S. Code of Federal Regulations (23 CFR 772) and the noise related requirements of the National Environmental Policy Act (NEPA) of 1969 as guidelines in its development of the MTA Noise Policy. The MTA's Noise Policy defines two types of highway noise projects, Type I is a new highway project that "includes the following types of proposed highway projects: the construction of a highway on new location, or the physical alteration of an

[1] 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.

existing highway that significantly changes the horizontal or vertical alignment or increases the number of through-traffic lanes." and Type II or "retrofit" projects as noise abatement projects along existing highways. The Label to Forest Avenues study is a Type II project. The Type II noise analysis process as outlined in the MTA Noise Policy includes the following:

- Identify existing and proposed land uses in the study area;
- Determine existing noise levels either:
    - noise measurements with concurrent classification counts of vehicles passing the noise monitoring site, or
    - through modeling of existing peak hour traffic 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 Noise Abatement Criteria (NAC) as presented in Table 1;
- 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).

The Noise Abatement Criteria (NAC), which is presented in Table 1, 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 for a Type II noise analysis when the predicted noise levels approach, are at or exceed those values shown for the appropriate activity category in Table 1. The MTA has defined the approach value as being 1 dBA less than the noise levels shown in Table 1. A complete copy of the MTA Noise Policy is presented in Attachment A.

Table 1 Noise Abatement Criteria
Hourly A-Weighted Sound Level-Decibels (dBA)

Activity Category	Leq(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 area is to continue to serve its 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: Maine Turnpike Authority Highway Traffic Noise Policy, Appendix B, September 2008

The traffic noise computer model, TNM® is FHWA's "computer program for highway traffic noise prediction and analysis".[2] 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.

5.2 Analysis

5.2.1 Measured Noise Levels

Land use along the northbound lanes of the Turnpike from Label Avenue to Forest Avenue consists primarily of single family homes. North of Forest Avenue commercial and light industrial properties are adjacent to the Turnpike right-of-way with residences located east of Riverside Industrial Parkway along Tucker Avenue. West of the Turnpike, along the southbound lanes, the land use adjacent to the Turnpike is commercial and light industrial north of Forest Avenue. South of Forest Avenue the land use is primarily multi-family with two light industrial properties at the south end of the study area.

[2] Ibid, Report Documentation Page.

Existing noise level measurements were conducted on April 13, 2010 at nine (9) locations representing seven (7) residential areas in the project vicinity. A twenty-minute measurement was taken at each location. Three measurements were taken at Field Site 6 (FS-6, FS-6A and FS-6B). The multiple locations were selected to match the locations used in previous measurements taken in 1991, 1994, 1995 and 1996 at the same residence. The measurements were made in accordance with the standard procedures of the FHWA guidelines using an integrating sound level analyzer meeting ANSI and IEC Type 1 specifications. Traffic was counted in each direction on the Turnpike, concurrent with the noise measurements. The data collected at the nine (9) locations are presented in Table 3. The noise measurement sites are identified on Figure 2 in Attachment B.

Table 2 Measured Existing Noise Levels
I-95 Label Avenue to Forest Avenue
Portland, ME

Field Site #	Figure #	Site Description	Date	Start Time	Duration	Traffic[1]						Noise Level, dBA L_{eq}(1h)
						Direction I-95	A[a]	MT[b]	HT[c]	Buses[d]	Speed mph	
1	2	Apartment Building paralleling I-95, Southeast end of Springbrook Way, 28 ft South of Apartment and 41 ft East of Right-of-Way Fence	4/13/10	07:15	20 min.	NB SB	990 2403	48 90	117 39	3	55-65 55-65	62
2	2	8 Unit Apartment Building at the South End of Wellesley Estates, 37.5 ft South of Southeast Corner of Building, 30 ft Southwest of Southwest Corner of Play Area	4/13/10	07:47	20 min	NB SB	1182 2634	63 102	105 36	 3	55-65 55-65	68
3	2	Multi-Family Residence, 1808 Forest Avenue, 42 ft South of Southeast Corner of Building, 10 ft from Right-of-Way Fence.	4/13/10	08:17	20 min	NB SB	822 1656	42 81	174 78	6 3	55-65 55-65	66
4	2	Vacant lot, Residence, 105 ft South of Residence at 14 Castine Avenue, and 16 Ft East of Castine Avenue Pavement	4/13/10	08:47	20 min	NB SB	753 1257	51 93	117 48	3 9	55-65 55-65	60
5	2	Residence, 41 Castine Ave, 2 ft from Right-of-Way Fence, 50.5 ft West of Castine Avenue Pavement, In-line with the South Edge of Wyndam Street	4/13/10	09:12	20 min	NB SB	678 1029	39 72	99 51	 3	55-65 55-65	67
6	2	Residence, 57 Castine Avenue, 35 ft from Northwest Corner of Residence, 17 ft from Southwest edge of Driveway	4/13/10	09:37	20 min.	NB SB	624 939	36 105	111 54		55-65 55-65	66
6A	2	Residence, 57 Castine Avenue, On the Northwest Corner of Porch	4/13/10	10:00	20 min.	NB SB	624 768	45 132	138 48		55-65 55-65	66
6B	2	Service Road East of 57 Castine Avenue, 5 ft from Right-of-Way Fence, In-line with Northwest Corner of Residence	4/13/10	10:24	20 min.	NB SB	681 813	30 135	147 81	 3	55-65 55-65	68
7	2	Residence, 74 Label Avenue, Center of Label Avenue, 47 ft from Right-of-Way Fence	4/13/10	10:58	20 min.	NB SB	684 702	27 153	117 78	 3	55-65 55-65	69

1) Vehicle counts classified as follows:
   a. Autos (A) defined as vehicles with 2-axles and 4-tires.
   b. Medium trucks (MT) defined as vehicles with 2-axles and 6-tires.
   c. Heavy trucks (HT) defined as vehicles with 3 or more axles.
   d. Buses defined as vehicles carrying more than 9 passengers.

Source: HNTB, May 2010

5.2.2 Measured vs. Modeled

The traffic noise prediction computer model, 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. Turnpike traffic within the study corridor was counted during the same 20-minute time periods as the nine (9) noise measurements. The traffic data for each twenty minute period was then used in the model to develop a modeled noise level to compare with the measured noise level. 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 3.

Table 3 Comparison of Measured and Modeled Noise Levels
I-95 Label Avenue to Forest Avenue
Portland, ME

Field Site[a]	Figure #	Noise Level, dBA L_{eq}(1h)		Difference in Noise Level, dBA L_{eq}(1h) (Modeled Minus Measured)
		Measured	Modeled	
FS-1	2	70	69	1
FS-2	2	65	68	-3
FS-3	2	67	66	1
FS-4	2	63	60	3
FS-5	2	67	67	0
FS-6	2	68	66	2
FS-6A	2	67	66	1
FS-6B	2	70	68	2
FS-7	2	69	69	0

Source: HNTB May 2010

5.2.3 Modeled Traffic Noise Levels

The traffic noise prediction program, TNM® 2.5, was used to model the worst hourly traffic noise that occurs on a regular basis (design hour noise levels) within the study area. Design hour traffic volumes, typically defined as the 30th highest hour, were used in TNM to model both the northbound and southbound 30th highest hourly traffic noise levels. A comparison of the noise levels created with each scenario indicated that the northbound traffic volumes typically created noise levels one (1) decibel greater than the southbound condition. Therefore, the northbound 30th highest hourly traffic volumes, as presented in Table 4, are the volumes which will yield the worst hourly traffic noise on a regular basis.

Table 4 Existing (2010) TNM® Traffic Volumes
I-95 Label Avenue to Forest Avenue
Portland, ME

Roadway Segment	Total Traffic Volume	Volumes by Vehicle Type			
		Autos	Medium Trucks	Heavy Trucks	Buses
NB 30th Highest Hourly Traffic Volumes					
NB Maine Turnpike (I-95)	2601	2252	224	120	5
SB Maine Turnpike (I-95)	1900	1554	86	258	2
SB 30th Highest Hourly Traffic Volumes					
NB Maine Turnpike (I-95)	1399	1145	63	190	1
SB Maine Turnpike (I-95)	2601	2252	224	120	5

Source; HNTB May 2010

One hundred twenty eight (128) representative receiver locations, N1 through N119 and FS-1 through FS-6, FS-6A, FS-6B and FS-7 were selected to illustrate the noise impacts at the Friends Church, residences and commercial properties adjacent to the Turnpike. The receiver locations are identified on Figures 2 and 3, Attachment B. The results of the computer modeling are presented in Table 5 in Attachment C.

Design hour noise levels presently approach or exceed the NAC at 65 single family residences or first floor multi-family residential units. Noise abatement for these properties will be addressed according to MTA's Noise Policy

5.3 Mitigation Measures

The MTA's Noise Policy states the criteria for determining where a Type II noise study will be performed and when noise abatement will be considered as a candidate project during the development of the MTA's 20-year plan. Noise abatement could include a noise barrier wall or earth berm constructed between the highway and noise-sensitive land uses (such as homes and schools) along the highway to reduce traffic noise levels at the sensitive land uses, A complete copy of this policy is provided in Attachment A. The policy is summarized as follows:

- A Type II project noise impact occurs when the existing highway traffic noise levels approach within 1 dBA of the NAC or exceed the NAC, Table 1.
- Abatement will not be considered for any development that was planned, designed, and programmed after the original highway construction project. That is, the granting of a building permit or site approval from the local agency with jurisdiction must have occurred prior to right-of-way acquisition or construction approval of the original highway.
- Noise abatement must be feasible and reasonable.

- Can a 7 dBA or greater noise reduction be achieved? Abatement measures are not feasible if a 7 dBA noise reduction cannot be achieved for a majority (greater than 50%) of first row receivers.
- Will the noise barrier, or other measure, create a safety issue?
- Noise barrier height cannot exceed 20 feet.
- Other issues including, but not limited to, maintenance, drainage, snow removal, ROW acquisition and environmental impacts will also be considered when determining the feasibility of abatement.
- The maximum cost of abatement is $30,000 per benefited receiver. (Note - this reasonableness criterion of $30,000 is from the noise policy and may not be the construction costs of a noise barrier at this location). All ground level receivers that pre-existed the highway construction within the study area attaining at least a 5 dBA reduction will be counted as "benefited" and included in the cost calculation.
- Total noise barrier cost will be based on $30.00 per square foot. (Note - this $30.00 per square foot cost is from the noise policy and may not be the construction costs of a noise barrier at this location). However, additional project costs, not included in the $30.00 per square foot figure, may occur as a result of unique physical or natural conditions when modeling and designing a noise abatement barrier or other measure.

Using the above noted criteria as stated in the Noise Policy, various methods were reviewed to mitigate the noise impact of the proposed improvements. Among those considered were reduction of speed limits, 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 nonprofit institutional 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. There is no public use or nonprofit institutional structures exposed to a noise impact that would benefit from noise insulation. 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

The section of the Maine Turnpike in this area of Portland was completed in 1955. A review of the City of Portland's Tax Assessor's online database indicated that none of the front row residences along the southbound lanes predated the Turnpike and only 26 residential structures and one church were built in 1955 or earlier within the entire study area. These residences exist primarily along Forest Avenue, Castine Avenue and a few along Tucker Avenue. Since none of the noise levels along Tucker Avenue approach or exceed 66 dBA L_{eq}(1h) the noise barrier analysis was limited to an area from slightly north of Wendell Street to Forest Avenue along the northbound lanes of the Turnpike.

The results of the noise barrier analysis for NB-1, including barrier location, existing L_{eq}(1h) noise levels without and with a barrier, noise level reduction (insertion loss), percentage of front row residences receiving 7 dBA or greater noise reduction, number of residences receiving a 5 dBA or greater noise reduction, barrier length and height,

estimated cost (based on $30.00 per square foot of noise wall), and the cost per residence are presented in Table 5, Attachment C. Noise Barrier NB-1 would provide a noise reduction of 2 to 10 decibels for the residences along Castine Avenue. The noise barrier would be 1,241 feet long ranging in height from 9 to 16 feet. The cost at $30.00 per square foot would be $503,100. This cost does not include any additional costs that would be incurred to widen the shoulder to permit construction of the noise barrier.

Sixty three percent (63%) of the front row residences that pre-existed the highway construction would receive a 7 dBA or greater reduction in noise levels. Twelve (12) residences that pre-existed the highway construction would receive a 5 dBA or greater reduction in noise levels with the resulting cost per residence being $41,925. NB-1 is feasible but not reasonable.

6.0 CONCLUSION

MTA's policy is to add any Type II noise abatement project that is both feasible and reasonable as a candidate project during the development of the MTA's 20-year Plan. A noise barrier along the southbound lanes of the Turnpike does meet MTA criteria as none of the front row properties predated the Turnpike. Therefore, a noise barrier was not analyzed for this area. NB-1, along the northbound lanes of the Turnpike, is feasible since it would provide a 7 dBA or greater noise reduction for a majority (greater than 50%) of first row receivers, it will not create a safety issue, and it will not exceed 20 feet in height. However, the cost per residence of $41,925 exceeds the reasonableness criteria of $30,000 per residence. (Note that the reasonableness criteria of $30,000 is from the noise policy and may not be the estimated construction costs of a noise barrier at this location) Therefore, this Type II noise barrier is feasible but not reasonable

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.

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.

"Highway Traffic Noise Policy", Maine Turnpike Authority, October 2008.

ATTACHMENT A
Maine Turnpike Authority Highway Traffic Noise Policy

MAINE TURNPIKE AUTHORITY

HIGHWAY TRAFFIC NOISE POLICY

OCTOBER, 2008

CONTENTS

EXECUTIVE SUMMARY

The Maine Turnpike Authority (MTA) is an independent quasi-state agency receiving no state or federal funds for its construction and maintenance, and as such, the MTA is not subject to regulation by the Maine Department of Transportation (MaineDOT) or Federal Highway Administration (FHWA). However, the MTA and MaineDOT work closely with each other to provide consistent regulation of roadways. As a result, the MTA and MaineDOT have developed a uniform noise policy that benefits users and abutters along their principle roadways and provides consistent and well defined actions as it relates to highway traffic noise.

This document serves as the Maine Turnpike Authority's policy on the evaluation and abatement of highway traffic noise impacts. The MTA's original highway traffic noise policy was adopted in 2000. This policy updates several areas of the 2000 policy including the reasonable cost threshold for abatement and sets a three year timeline for subsequent review.

Noise abatement measures are evaluated in two separate categories. Type I highway noise evaluations are conducted for new highway or capacity adding projects (i.e. additional travel lanes) to existing highways. Type II noise evaluations may be conducted for noise abatement measures along existing highways, under certain circumstances as outlined in Section IV, that are not being undertaken as a part of a highway improvement project[1].

The purpose of a highway traffic noise analysis is to identify impacted land uses (homes, schools, business, etc) and determine the feasibility and reasonableness of abatement measures. The terms "feasibility" and "reasonableness" are terms commonly used in highway traffic noise analysis to determine, among other things, the effectiveness (in terms of noise reduction) and the acceptable cost for any noise abatement measure. All noise abatement measures are evaluated based on the feasibility and reasonableness criteria identified in this policy.

Appropriate land-use strategies along Maine's highways can be an effective means of avoiding highway traffic noise impacts. MTA encourages municipalities to establish appropriate land use controls over undeveloped lands adjacent to highways to prevent the development of incompatible activities along existing highways. Municipalities must have previously adopted an ordinance requiring developers or individuals to include noise abatement in their plans for new development along existing highways before MTA will conduct a Type II noise analysis.

Appendix A provides useful information regarding the basics of sound, the fundamentals of highway traffic noise, and strategies for highway traffic noise abatement and control. Appendix B provides a glossary of specific terms used throughout the policy.

[1] For a complete definition of Type I and II noise projects, please see Sections III and IV.

I. INTRODUCTION

This document details the Maine Turnpike Authority's (MTA's) policy on noise impacts as it relates to the Turnpike roadway. This policy mirrors federal and state noise policies, which are advisory for the MTA as the Authority does not receive state or federal funds, and provides foundation materials on the properties and nature of sound with regard to the Turnpike.

The Maine Turnpike Authority (MTA) is an independent quasi-state agency receiving no state or federal funds for its construction and maintenance, and as such, the MTA is not subject to regulation by the Maine Department of Transportation (MaineDOT) or Federal Highway Administration (FHWA)

The MTA will use the following guidelines to determine the need, feasibility, and reasonableness of noise abatement or reduction measures along existing highways or proposed highway construction projects. This policy is based on established principles, practices, and procedures used by federal and state transportation agencies to assess highway-related noise levels.

The MTA will use the requirements of Title 23, Part 772 of the U.S. Code of Federal Regulations (23 CFR 772) and the noise related requirements of the National Environmental Policy Act (NEPA) of 1969 as guidelines to its interpretation of this policy. This policy is applicable to Type I and Type II projects as defined in Sections III and IV. However, the implementation of a Type II program is not required by federal or state statute or FHWA regulation. MTA and the MaineDOT will review this policy every three years and adopt appropriate revisions when necessary. The MTA will also consider revisions to this policy whenever federal or state statutory, regulatory or policy changes make such a review appropriate.

II. HIGHWAY TRAFFIC NOISE ANALYSIS

MTA's Engineering and Planning staff will perform or oversee the highway traffic noise analysis for both Type I and Type II projects[2]. Requirements for the analysis and abatement of highway construction noise are discussed in Section IX. ***The purpose of a highway traffic noise analysis for either type of project is to identify impacted land uses based on the Noise Abatement Criteria (NAC) and determine the feasibility and reasonableness of abatement measures.***

For Type I Projects, highway traffic noise analysis will be performed for developed lands and undeveloped lands for which development is planned, designed, and programmed. Development will be deemed to be planned, designed, and programmed if a land use[3],

[2] For a complete definition of Type I and II noise projects, please see Sections III. and IV.
[3] See Appendix B, *Table B-1 Noise Abatement Criteria (NAC)* for a list of land uses and activities

such as, but not limited to residences, schools, churches, hospitals, or libraries, has received site approval or a building permit from the local agency with jurisdiction prior to the approval of the highway project's environmental document, i.e., the date of approval of the Categorical Exclusion (CE), Finding of No Significant Impact (FONSI) or Record of Decision (ROD). Subsequent to this date, the MTA is not responsible for providing noise abatement for new development. Highway traffic noise analysis for Type II projects will only be performed for development that predated the existence of the highway and has not previously been analyzed as a part of a previous Type I or Type II project.

A highway traffic noise analysis will include the following steps.

A. Determination of Existing Noise Levels.

Existing noise levels will be determined throughout the highway traffic noise study area through a combination of Leq noise measurements and computer modeling. The study area is defined as 500' from the current edge of pavement for Type II analyses and 500' from the proposed edge of pavement for Type I analyses. All computer modeling will be done using the most current readily available version of the FHWA Traffic Noise Model (FHWA TNM).

B. Prediction of Future Noise Levels

For Type I projects only, future highway traffic noise levels will be predicted for the design year, usually twenty years in the future, for each alternative under detailed study, including the "no-build" alternative, within the study area.

C. Determination of Impacts

Highway traffic noise impacts will be determined for each Type I or Type II project. Type I project impacts occur when the predicted future highway traffic noise levels approach within 1 dBA or exceed the NAC or when the predicted future highway traffic noise levels exceed the existing levels by at least 15 dBA. Type II project impacts occur when the existing highway traffic noise levels approach within 1 dBA or exceed the (NAC). (See Appendix B, Table B-1 for the NAC)

D. Evaluation of Abatement Measures

If a highway traffic noise impact is identified, the following abatement measures will be evaluated:

1. Traffic management measures such as 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.
2. Alteration of the highway project's horizontal and vertical alignments.
3. Construction of noise barriers (including landscaping for aesthetic purposes and the acquisition of property rights) within or outside the highway right-of-way.

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 public use or non-profit institutional structures only, such as, but not limited to churches, schools, hospitals, or libraries.

E. Incorporation of Feasible and Reasonable Criteria

All Type I and Type II noise abatement measures will be evaluated based upon Feasible and Reasonable criteria in Sections V and VI.

F. Selection of Abatement Measures

The last step of the analysis will include selection of the noise abatement measures to be used, if abatement has met all the necessary criteria.

G. Completion of Follow-up Measures

After abatement is complete, follow-up noise measurements will be taken to determine the effectiveness of the abatement and to verify the noise model analysis. MTA will provide the necessary maintenance to ensure the effectiveness of any abatement measure. However, MTA will not maintain the noise insulation of publicly owned buildings, such as schools, or any other noise abatement measures not constructed by MTA.

III. TYPE I PROJECT REQUIREMENTS

A Type I project includes the following types of proposed highway projects: the construction of a highway on new location, or the physical alteration of an existing highway that significantly changes the horizontal or vertical alignment or increases the number of through-traffic lanes. Most MTA projects require an Army Corps of Engineers permit and also must satisfy the requirements of the State of Maine's Sensible Transportation Policy Act (STPA). The need for noise abatement is evaluated for each individual highway project. Noise abatement measures for Type I projects will be funded as part of the proposed highway project.

An area or site must satisfy the following criteria to be eligible for noise abatement for a Type I project:

A. Noise abatement must be reasonable and feasible as defined in Sections V and VI.

IV. TYPE II PROJECT REQUIREMENTS

Type II or "retrofit" projects are noise abatement projects along existing highways. Any Type II noise abatement project that meets the requirements of this policy will become a candidate project during the development of the MTA's 20-year Plan.

An area or site must satisfy the following criteria to be eligible for noise abatement for a Type II Project:

A. Noise abatement must be reasonable and feasible as defined in Sections V and VI.

B. Abatement will not be considered for any development that was planned, designed, and programmed after the original highway construction project. That is, the granting of a building permit or site approval from the local agency with jurisdiction must have occurred prior to right-of-way acquisition or construction approval of the original highway.

C. Type II noise abatement will not be considered for highway projects approved after November 28, 1995[4].

D. Noise abatement measures will not be approved at locations where such measures were previously determined not to be reasonable and feasible for a Type I or Type II project.

V. FEASIBILITY CRITERIA

Feasibility is defined as the engineering and acoustical ability of abatement measures to provide effective noise reduction. When noise abatement measures are evaluated, feasibility criteria will include the following:

A. Noise Reduction

Can a 7 dBA or greater noise reduction be achieved? Abatement measures are not feasible if a 7 dBA noise reduction cannot be achieved for a majority (greater than 50%) of first row receivers.

B. Safety

Will the barrier, or other measure, create a safety issue? If so, the abatement measures are not feasible. Safety factors that should be considered in the design of the barrier include maintaining a clear recovery zone, redirection of crash vehicles, adequate sight distance, and emergency vehicle access.

C. Barrier Height

The maximum height of a noise barrier allowed under this policy is 20 feet.

D. Other Considerations

Other issues including, but not limited to, maintenance, drainage, snow removal, ROW acquisition and environmental impacts will also be considered when determining the feasibility of abatement. For any other considerations that may arise, MTA will make a feasibility determination based on best engineering practices

and anticipated cost. For example, it is possible that a noise barrier, or other abatement measure, may satisfy Parts A, B and C of this Section, but, not be feasible if wetland mitigation, additional ROW acquisition, or substantial fill and drainage were needed to complete the project.

VI. REASONABLENESS CRITERIA

Reasonableness implies that common sense and good judgment have been applied in arriving at a decision. The overall noise abatement benefits must outweigh the overall adverse social, economic, and environmental effects and the costs of the abatement measures. When noise abatement measures are considered, reasonableness criteria will include the following:

A. Maximum Cost of Abatement

The maximum cost of abatement is $30,000 per benefited receiver. All ground level receivers within the study area, as defined in Section II A, attaining at least a 5 dBA reduction will be counted as "benefited" and included in the cost calculation. All abatement measures will be designed to protect ground level exterior activity. For Type II projects, only receivers that preexisted the highway construction will be included in the cost calculation.

For the purposes of developing the total barrier cost, a cost of $30.00 per square foot will be used, realizing that actual costs will vary. However, additional project costs, not included in the $30.00 per square foot figure, may occur as a result of unique physical or natural conditions when modeling and designing a noise abatement barrier or other measure. Section V. D of this policy addresses “other considerations” that will be evaluated when determining the feasibility of proposed noise abatement measures. Both the unit cost and cost per benefited receiver will be updated when the policy is reviewed as defined in Section I to reflect actual barrier costs.

The MTA may allow a municipality, or other interested party, to pay the difference above the allowable cost to satisfy this reasonableness criterion. No barrier will be funded by the MTA, regardless of contribution sharing, which does not meet the "Feasibility" requirements.

B. Land Use

Prior to conducting a Type II noise analysis, municipalities must have adopted appropriate land use strategies affecting undeveloped lands adjacent to existing highways to manage development of incompatible activities and avoid future public costs associated with mitigating highway traffic noise impacts. Incompatible activities include the most noise-sensitive land uses (such as homes, schools, hospitals, daycare centers, and nursing homes) and, generally correspond to the

NAC Activity Categories A & B identified in Appendix B, Table B-1.

MTA defines “appropriate land use strategies” to mean:

1. The municipality has adopted a zoning ordinance, subdivision ordinance, performance standard or other land use management strategy that addresses the manner in which any allowed/permitted activity must be designed, sited or constructed to protect the property or its users from noise impacts that may arise from the adjacent transportation use.

   (a) For example, the municipality has adopted zoning that restricts development around Interstate highways, freeways, expressways and divided highways to less noise-sensitive uses such as commercial, industrial, or agricultural land uses, or;

   (b) The locality has adopted an ordinance, building code, or other noise management or abatement strategy that does not allow the proposed new activity to be impacted by adjacent interstate, freeway, expressway and divided highway or approved highway corridor noise levels that approach within 1 dBA or exceed the Noise Abatement Criteria in Appendix B, Table B-1. An approved highway corridor is one in which an ACOE permit has been issued for a specific project.

2. The ordinance must be in effect prior to the municipality’s request of MTA for a Type II noise analysis and must require that all noise abatement measures constructed by developers, at a minimum, not allow the proposed new activity to be impacted by adjacent transportation noise levels that approach within 1 dBA or exceed the Noise Abatement Criteria in Appendix B, Table B-1 for each noise sensitive land use. Developers should use the most current version of the FHWA Traffic Noise Model (FHWA TNM) to verify the maximum allowable noise levels.

C. Residents’ Desires

A noise barrier will not be considered reasonable if fewer than 75% of the impacted receivers approve of the construction of a noise barrier. In the case of rental or leased properties, the views of the owner of the impacted receiver will be solicited to determine reasonableness. The MTA will establish the approval rate of a noise barrier for impacted receivers by conducting a survey through certified or registered mail and a self-addressed stamped envelop.

D. Extenuating Circumstances

Extenuating circumstances may arise where unique or unusual conditions warrant special consideration of highway traffic noise impacts and/or implementation of abatement measures. Instances of extenuating circumstances could involve:

receivers that are extremely noise sensitive, sites where severe noise impacts are predicted, or sites containing unique resources. Extenuating circumstances will be considered on an individual project basis.

VII. LOCAL COORDINATION & COMMUNITY INVOLVEMENT

Coordination with local agencies and community involvement is an important part of highway traffic noise control and the prevention of future impacts. Highway traffic noise impacts can be most effectively reduced through a program of shared responsibility. Local governments should use their power to regulate land development in such a way that particularly noise sensitive land uses are either prohibited from being located adjacent to a highway or that developments are planned, designed, and constructed so that highway traffic noise impacts are minimized.

Upon completion of the highway traffic noise analysis, information shall be provided to local government agencies within whose jurisdiction the highway project is located as to the implications of the project on that particular local community in the future. At a minimum, this will include modeled future highway traffic noise levels for both developed and undeveloped lands in the immediate vicinity of the project. The information will be disseminated through the distribution of highway project environmental documents and noise analysis reports and informational public meetings. The overall goal of this effort will be to prevent future highway traffic noise impacts on currently undeveloped lands and to promote noise compatible planning.

Decisions concerning noise abatement will include involvement from the local community. Impacted receivers input will be solicited for every project for which abatement measures are recommended. Based on the Reasonableness criteria in this policy, a majority (75%) of the owners of impacted receivers must approve the construction of a noise barrier; however, all members of the community at large will be given the opportunity to provide input.

Education will be provided to members of the general public within the scope of public meetings and publications that describe noise, noise-related impacts, highway traffic noise mitigation, and enforcement issues. Various publications are available on the FHWA web site (http://www.fhwa.dot.gov/environment/noise/index.htm) that explains many of these concepts.

VIII. LOCAL/PRIVATE PROJECTS

The use of MTA's right-of-way for local/private noise abatement projects is prohibited.

IX. CONSTRUCTION NOISE

The following general steps are to be performed for all Type I and Type II projects:

A. Identify land uses or activities which may be affected by noise during construction of the project. Typical land uses or activities affected by construction

noise include, but are not limited to, NAC Activity Categories A & B identified in Appendix B, Table B-1. This identification is to be performed during the planning studies and will be documented by the MTA.

B. Projects that are anticipated to have substantial construction noise impacts will include a construction noise analysis based on the most current version of the FHWA Roadway Construction Noise Model (FHWA RCNM).

C. Determine the measures which are practical in the plans and specifications to minimize or eliminate adverse construction noise impacts to the community. This determination will include a weighing of the benefits achieved and the overall adverse social, economic, and environmental effects and the costs of the abatement measures.

D. Incorporate the needed abatement measures in the plans and specifications.

E. If it is determined that abatement measures are practical and feasible using the criteria in Section IX C., the contractor shall take measures to control the noise created by construction operations and equipment including, but not limited to, equipment used for drilling, pile driving, blasting, excavation, and hauling.

F. All methods and devices employed to minimize construction noise shall be subject to the continuing approval of the MTA project resident.

APPENDIX A. HIGHWAY NOISE FUNDAMENTALS

The Basics of Sound

The decibel (dB) is the unit of measurement for sound. The decibel scale audible to humans spans approximately 140 decibels. A level of 0 decibels corresponds to the threshold of human hearing, while 140 decibels produces a sensation more akin to pain than sound, similar to standing near a jet engine as it takes off. Table A-1 shows sound levels for some common noise sources.

Table A-1 Typical Sound Levels[5]

NOISE SOURCE OR ACTIVITY	SOUND LEVEL dBA
Jet engine at takeoff	140
Fire engine siren	130
Jackhammer	120
Rock Concert	110
Circular Saw	100
Heavy truck or motorcycle	90
Garbage disposal	80
Busy restaurant	70
Normal Speech	60
Background music	50
Bedroom, Bird song	40
Quiet library, soft whisper	30
Quiet basement w/o mechanical equipment	20
Human breathing	10
Threshold of Hearing	0

The decibel scale is logarithmic rather than arithmetic. Consequently, traffic sound levels cannot be added by ordinary arithmetic means. For instance, two noise sources, each producing 90 dBA, will combine to produce 93 dBA, not 180 dBA. In other words, a doubling of the noise source produces only a 3 dBA increase in the sound pressure level. Studies have shown that this increase is barely detectable by the human ear. Furthermore, an increase or decrease of 5 dB would result in a clearly noticeable change in the sound level. A change of 10 dB in the sound pressure level will be perceived by an observer to be a doubling or halving of the sound.

The "A" weighting scale for decibel measurement is widely used in environmental work because it closely resembles the ear's sensitivity to high frequency noise. Therefore the unit of measurement for highway traffic noise becomes dBA. The noise descriptor used for environmental analysis is the equivalent sound level, Leq. The equivalent sound level is the steady sound level that has the same acoustic energy as the time varying sound level over the same time period.

Highway Traffic Noise

Sound can be either desirable or undesirable. Music is an example of desirable sound. Sound generated by motor vehicles traveling along highways is, generally, undesirable and is referred to in this policy as highway traffic noise.

Highway traffic noise is generated by four major sources: engine/drivetrain, exhaust,

[5] Actual sound levels may vary depending on a number of factors, including the distance between source and receiver, intensity of the particular activity, and the degree of background noise.

aerodynamics, and tire-to-pavement friction. Recent research indicates that tires are the dominant noise source at speeds greater than 20 mph for cars and 30 mph for trucks. Tire sound levels increase with vehicle speed but also depend upon road surface, vehicle weight, tread design and wear. Changes in any of these factors can vary highway traffic noise levels. At lower speeds especially in trucks and buses, the dominant noise source is the engine and related accessories.

The level of highway traffic noise depends on three things: (1) the volume of free flow traffic, (2) the speed of the traffic, and (3) the number of trucks in the flow of traffic. Generally, the loudness of highway traffic noise is increased by heavier traffic volumes, higher speeds, and greater numbers of trucks. The loudness of highway traffic noise can also be increased by defective or modified exhaust systems and other faulty equipment on vehicles. Any condition (such as a steep incline) that causes heavy laboring of motor vehicle engines will also increase highway traffic noise levels. Other physical and environmental factors, such as distance from source to receiver, terrain, vegetation, and natural and manmade obstacles, also affect the loudness of highway traffic noise.

Highway Traffic Noise Strategies

Highway traffic noise can be addressed by a number of different strategies including: motor vehicle control, land use control, highway planning and design, and abatement. The responsibilities for implementing these strategies are shared by all levels of government: federal, state, and local.

Motor vehicle control

The State of Maine requires[6] that all automobiles (excluding motorcycles) must be equipped with a muffler in good working order and prohibits amplification of exhaust noise above that emitted by the muffler originally installed on the vehicle. However, modifications are allowed if the muffler or exhaust system does not emit noise in excess of 95 decibels. In general, quieter vehicles would bring about a substantial reduction in highway traffic noise along Maine's roads and streets. MTA does not have the authority to regulate motor vehicles. The Environmental Protection Agency (EPA) has issued regulations that limit the noise levels for new trucks with a gross vehicle weight rating (GVWR) of more than 10,000 pounds. In addition, many local governments have passed some form of community noise ordinance.

Land use control

Proper land use control along Maine's highways is an effective means of controlling the impacts of highway traffic noise. The MTA encourages municipalities to plan, design, and construct new development projects and roadways that minimize potential highway traffic noise impacts. More specifically, municipalities are encouraged to establish building setbacks and vegetative buffer zones along existing highways. Noise-compatible planning encourages the location of less noise-sensitive land uses near

[6]MRSA 29-A§ 1912

highways, promotes the use of berms and open space separating roads from developments, and suggests special construction techniques that minimize the impact of highway traffic noise.

According to FHWA, there are several hundred thousand miles of existing highways in this country bordered by vacant land which may some day be developed. Proper land use control can help to prevent many future highway traffic noise problems in these areas. For more information about noise compatible planning, visit FHWA's website at http://www.fhwa.dot.gov/environment/comgrwth.htm.

MTA also requires that local authorities have established appropriate land use controls over undeveloped lands adjacent to highways, prior to the implementation of a Type II noise analysis. See Section VI. B of this policy for a complete list of land use requirements for Type II projects.

Highway planning and design

Early in the highway planning and design stages, MTA evaluates highway traffic noise and construction noise as part of the NEPA process. The purpose of this study is to determine if any of the proposed project alternatives will create noise impacts. MTA will use the procedures outlined in Section II to identify noise impacts (if any) and evaluate potential abatement measures. Any noise abatement measures that satisfy all the requirements of this policy will be implemented as part of a Type I or Type II project.

Abatement

Noise barrier walls and earth berms are frequently used to provide abatement for highway traffic noise. Noise barriers are solid walls built between the highway and noise-sensitive land uses (such as homes and schools) along the highway. Barriers can be formed from earth mounds along the road (earth berms) or from high, vertical walls. MTA limits noise walls to a maximum of 20 feet in height for safety and structural concerns. Noise walls can be built from a variety of materials, including, but not limited to: wood, concrete, masonry, and metal.

Openings in noise walls for driveways, business entrances, or intersecting streets defeat the effectiveness of noise barriers. In many areas of Maine, homes are scattered too far apart to permit highway noise barriers to be built at a reasonable cost.

See Section II. D of this policy for the list of eligible noise abatement measures.

APPENDIX B. GLOSSARY

Abatement. A reduction in sound levels.

Benefited Receiver. A receiver that is expected to receive a minimum noise reduction of 5 dBA from the proposed abatement measure.

dBA. A-weighted decibel unit used to measure sound that best corresponds to the frequency response of the human ear.

Design Year. The future year used to estimate the probable traffic volume for which a highway is designed. For highway projects, the "Design Year" is determined to be 20 years from the completion date (construction complete) of the proposed project.

Existing Noise Level. The noise, resulting from the natural and mechanical sources and human activity, present in a particular area.

First Row Receiver. A receiver that is directly adjacent to the highway or proposed highway project.

Impacted Receiver. Any receiver which approaches (within 1 dBA) or exceeds the NAC for the corresponding land use category, or any receiver that exceeds existing noise levels by 15 dBA.

Insertion Loss (IL). The actual acoustical benefit derived from the implementation of abatement measures. Insertion loss is calculated by subtracting the sound level with abatement from the sound level without the abatement.

Leq. 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.

Leq (h). The hourly value of Leq.

National Environmental Policy Act (NEPA). Federal legislation that establishes environmental policy for the nation for federally funded projects. It provides an interdisciplinary framework to ensure that decision-makers adequately take environmental factors into account.

Noise Barrier. A natural or man-made object that interrupts the path of sound. A barrier could be a wall, an earth berm, or a combination of both.

Noise. Any unwanted sound.

Noise Abatement Criteria (NAC). FHWA-determined noise levels for various land uses and activities used to identify traffic noise impacts. The NAC are listed in Table B-1.

Table B-1 Noise Abatement Criteria (NAC)

NOISE ABATEMENT CRITERIA (NAC)		
ACTIVITY CATEGORY	Leq(h) dBA	DESCRIPTION OF ACTIVITY CATEGORY
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	67 Exterior	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals.
C	72 Exterior	Developed lands, properties, or activities not included in Categories A or B above.
D	----------	Undeveloped lands.
E	52 Interior	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums.

Public Use or Nonprofit Institutional Structure. Any facility either owned by the public or owned by a nonprofit organization.

Highway Traffic Noise Impacts. Impacts which occur when the predicted highway traffic noise levels approach or exceed the noise abatement criteria (Table B-1 - above), or when the predicted highway traffic noise levels substantially exceed the existing noise levels.

Twenty--Year Plan. The twenty-year plan is a dynamic document that represents MTA's entire 20-year capital program and includes all existing projects in production.

Type I Projects. A proposed highway project for the construction of a highway on new location or the physical alteration of an existing highway which substantially changes either the horizontal or vertical alignment or increases the number of through-traffic lanes.

Type II Projects. A proposed project for noise abatement along an existing highway.

Receiver. The technical term used to describe the location of any properties included in the noise analysis. Only ground floor properties are counted as receivers.

Severe noise impacts. A severe impact occurs when absolute noise levels reach or exceed 75 dBA Leq or there is an increase of 30 dBA or more over existing noise levels.

Study Area. The study area is defined as 500' from the *current* edge of pavement for Type II analyses and 500' from the *proposed* edge of pavement for Type I analyses.

Substantial Increase. A 15 dBA increase in noise levels predicted for the design year of a proposed highway project.

APPENDIX C. FHWA HIGHWAY TRAFFIC NOISE REGULATION

23 CF PART 772—PROCEDURES FOR ABATEMENT OF HIGHWAY TRAFFIC NOISE AND CONSTRUCTION NOISE

Section Contents

Authority: 23 U.S.C. 109(h), 109(i); 42 U.S.C. 4331, 4332; sec. 339(b), Pub. L. 104–59, 109 Stat. 568, 605; 49 CFR 1.48(b).

Source: 47 FR 29654, July 8, 1982; 47 FR 33956, Aug. 5, 1982, unless otherwise noted.

§ 772.1 Purpose.
To provide procedures for noise studies and noise abatement measures to help protect the public health and welfare, to supply noise abatement criteria, and to establish requirements for information to be given to local officials for use in the planning and design of highways approved pursuant to title 23 U.S.C.

§ 772.3 Noise standards.
The highway traffic noise prediction requirements, noise analyses, noise abatement criteria, and requirements for informing local officials in this regulation constitute the noise standards mandated by 23 U.S.C. 109(i). All highway projects which are developed in conformance with this regulation shall be deemed to be in conformance with the Federal Highway Administration (FHWA) noise standards.

§ 772.5 Definitions.
(a) Design year. The future year used to estimate the probable traffic volume for which a highway is designed. A time, 10 to 20 years, from the start of construction is usually used.

(b) Existing noise levels. The noise, resulting from the natural and mechanical sources and human activity, considered to be usually present in a particular area.

(c) L10. The sound level that is exceeded 10 percent of the time (the 90th percentile) for the period under consideration.

(d) L10(h). The hourly value of L10.

(e) Leq —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.

(f) Leq (h). The hourly value of Leq.

(g) Traffic noise impacts. Impacts which occur when the predicted traffic noise levels approach or exceed the noise abatement criteria (Table 1), or when the predicted traffic noise levels substantially exceed the existing noise levels.

(h) Type I projects. A proposed Federal or Federal-aid highway project for the construction of a highway on new location or the physical alteration of an existing highway which significantly changes either the horizontal or vertical alignment or increases the number of through-traffic lanes.

(i) Type II projects. A proposed Federal or Federal-aid highway project for noise abatement on an existing highway.

§ 772.7 Applicability.
(a) Type I projects. This regulation applies to all Type I projects unless it is specifically indicated that a section applies only to Type II projects.

(b) Type II projects. The development and implementation of Type II projects are not mandatory requirements of 23 U.S.C. 109(i) and are, therefore, not required by this regulation. When Type II projects are proposed for Federal-aid highway participation at the option of the highway agency, the provisions of §§772.9(c), 772.13, and 772.19 of this regulation shall apply.

§ 772.9 Analysis of traffic noise impacts and abatement measures.
(a) The highway agency shall determine and analyze expected traffic noise impacts and alternative noise abatement measures to mitigate these impacts, giving weight to the benefits and cost of abatement, and to the overall social, economic and environmental effects.

(b) The traffic noise analysis shall include the following for each alternative under detailed study:

(1) Identification of existing activities, developed lands, and undeveloped lands for which development is planned, designed and programmed, which may be affected by noise from the highway;

(2) Prediction of traffic noise levels;

(3) Determination of existing noise levels;

(4) Determination of traffic noise impacts; and

(5) Examination and evaluation of alternative noise abatement measures for reducing or eliminating the noise impacts.

(c) Highway agencies proposing to use Federal-aid highway funds for Type II projects shall perform a noise analysis of sufficient scope to provide information needed to make the determination required by §772.13(a) of this chapter.

§ 772.11 Noise abatement.
(a) In determining and abating traffic noise impacts, primary consideration is to be given to exterior areas. Abatement will usually be necessary only where frequent human use occurs and a lowered noise level would be of benefit.

(b) In those situations where there are no exterior activities to be affected by the traffic noise, or where the exterior activities are far from or physically shielded from the roadway in a manner that prevents an impact on exterior activities, the interior criterion shall be used as the basis of determining noise impacts.

(c) If a noise impact is identified, the abatement measures listed in §772.13(c) of this chapter must be considered.

(d) When noise abatement measures are being considered, every reasonable effort shall be made to obtain substantial noise reductions.

(e) Before adoption of a final environmental impact statement or finding of no significant impact, the highway agency shall identify:

(1) Noise abatement measures which are reasonable and feasible and which are likely to be incorporated in the project, and

(2) Noise impacts for which no apparent solution is available.

(f) The views of the impacted residents will be a major consideration in reaching a decision on the reasonableness of abatement measures to be provided.

(g) The plans and specifications will not be approved by FHWA unless those noise abatement measures which are reasonable and feasible are incorporated into the plans and specifications to reduce or eliminate the noise impact on existing activities, developed lands, or undeveloped lands for which development is planned, designed, and programmed.

§ 772.13 Federal participation.
(a) Federal funds may be used for noise abatement measures where:

(1) A traffic noise impact has been identified,

(2) The noise abatement measures will reduce the traffic noise impact, and

(3) The overall noise abatement benefits are determined to outweigh the overall adverse social, economic, and environmental effects and the costs of the noise abatement measures.

(b) For Type II projects, noise abatement measures will only be approved for projects that were approved before November 28, 1995, or are proposed along lands where land development or substantial construction predated the existence of any highway. The granting of a building permit, filing of a plat plan, or a similar action must have occurred prior to right-of-way acquisition or construction approval for the original highway. Noise abatement measures will not be approved at locations where such measures were previously determined not to be reasonable and feasible for a Type I project.

(c) The noise abatement measures listed below may be incorporated in Type I and Type II projects to reduce traffic noise impacts. The costs of such measures may be included in Federal-aid participating project costs with the Federal share being the same as that for the system on which the project is located.

(1) Traffic management measures (e.g., 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).

(2) Alteration of horizontal and vertical alignments.

(3) Acquisition of property rights (either in fee or lesser interest) for construction of noise barriers.

(4) Construction of noise barriers (including landscaping for aesthetic purposes) whether within or outside the highway right-of-way.

(5) 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.

(6) Noise insulation of public use or nonprofit institutional structures.

(d) There may be situations where severe traffic noise impacts exist or are expected, and the abatement measures listed above are physically infeasible or economically unreasonable. In these instances, noise abatement measures other than those listed in paragraph (c) of this section may be proposed for Types I and II projects by the highway agency and approved by the FHWA on a case-by-case basis when the conditions of paragraph (a) of this section have been met.

[47 FR 29654, July 8, 1982; 47 FR 33956, Aug. 5, 1982, as amended at 61 FR 45321, Aug. 29, 1996; 70 FR 16710, Apr. 1, 2005]

§ 772.15 Information for local officials.
In an effort to prevent future traffic noise impacts on currently undeveloped lands, highway agencies shall inform local officials within whose jurisdiction the highway project is located of the following:

(a) The best estimation of future noise levels (for various distances from the highway improvement) for both developed and undeveloped lands or properties in the immediate vicinity of the project,

(b) Information that may be useful to local communities to protect future land development from becoming incompatible with anticipated highway noise levels, and

(c) Eligibility for Federal-aid participation for Type II projects as described in §772.13(b) of this chapter.

§ 772.17 Traffic noise prediction.
(a) Any analysis required by this subpart must use the FHWA Traffic Noise Model (FHWA TNM), which is described in "FHWA Traffic Noise Model" Report No. FHWA–PD–96–010, including Revision No. 1, dated April 14, 2004, or any other model determined by the FHWA to be consistent with the methodology of the FHWA TNM. These publications are incorporated by reference in accordance with 5 U.S.C. 552(a) and 1 CFR part 51 and are on file at the National Archives and Record Administration (NARA). For information on the availability of this material at NARA call (202) 741–6030, or go to http://www.archives.gov/federal_register/code_of_federal_regulations/ibr_locations.html. These documents are available for copying and inspection at the Federal Highway Administration, 400 Seventh Street, SW., Room 3240, Washington, DC 20590, as provided in 49 CFR part 7. These documents are also available on the FHWA's Traffic Noise Model Web site at the following URL: http://www.trafficnoisemodel.org/main.html.

(b) In predicting noise levels and assessing noise impacts, traffic characteristics which will yield the worst hourly traffic noise impact on a regular basis for the design year shall be used.

[47 FR 29654, July 8, 1982; 47 FR 33956, Aug. 5, 1982, as amended at 70 FR 16710, Apr. 1, 2005]

§ 772.19 Construction noise.
The following general steps are to be performed for all Types I and II projects:

(a) Identify land uses or activities which may be affected by noise from construction of the project. The identification is to be performed during the project development studies.

(b) Determine the measures which are needed in the plans and specifications to minimize or eliminate adverse construction noise impacts to the community. This determination shall include a weighing of the benefits achieved and the overall adverse social, economic and environmental effects and the costs of the abatement measures.

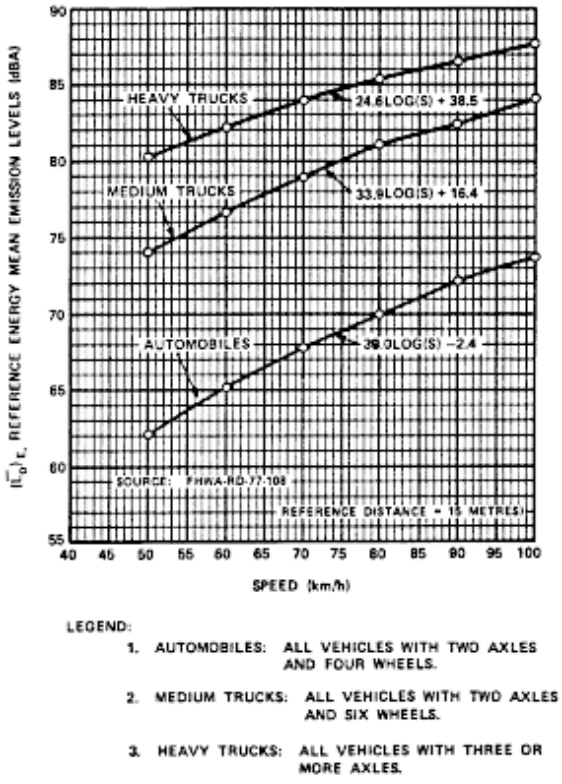
(c) Incorporate the needed abatement measures in the plans and specifications.

Table 1 to Part 772—Noise Abatement Criteria
[Hourly A-Weighted Sound Level—decibels (dBA)[1]]

Activity Category	Leq(h)	L10(h)	Description of activity category
A	57 (Exterior)	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	67 (Exterior)	70 (Exterior)	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals.
C	72 (Exterior)	75 (Exterior)	Developed lands, properties, or activities not included in Categories A or B above.
D			Undeveloped lands.
E	52 (Interior)	55 (Interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums.

[1]Either L10(h) or Leq(h) (but not both) may be used on a project.

Appendix A to Part 772—National Reference Energy Mean Emission Levels as a Function of Speed



National Reference Energy Mean Emission Levels as a Function of Speed

ATTACHMENT B
Figures 2 and 3 Noise Receptors and Noise Barrier Location

Legend

- FS-1 Field Measurement Site
- N-1 Noise Modeling Site
- NB-1 Modeled Barrier
- Edge of Fill

0 100 200 400

Feet

FIGURE 2

FOREST AVENUE AREA NOISE ANALYSIS

Maine Turnpike (I-95)

Label Avenue to Dover Avenue

Portland, ME

Legend

- FS-1 Field Measurement Site
- N-1 Noise Modeling Site
- NB-1 Modeled Barrier
- Edge of Fill

0 100 200 400
Feet

FIGURE 3

FOREST AVENUE AREA NOISE ANALYSIS

Maine Turnpike (I-95)

Label Avenue to Dover Avenue

Portland, ME

ATTACHMENT C

Table 5 Design Hour Noise Levels, dBA L_{eq} (1h) and Noise Barrier Analysis

Table 5 Design Hour Noise Levels, dBA Leq(1H) and Noise Barrier Analysis
I95 Label Avenue to Forest Avenue
Portland, ME

East Side of I-95 Maine Turnpike between Label Ave and Dover Avenue

Receptor ID	Figure #	Land Use	Number of Residences	Year of Construction	Residences Built Before Highway	MTA NAC	Noise Levels Leq(1h) dBA		Reduction with Noise Barrier	Residences Built Before Highway => 5dB IL	Front Row	Count Front Row Residences Built Before Highway	Front Row Residences => 7 dB IL	Total Number of Front Row Residences	Total Number of Front Row Residences => 7 dB IL	% Front Row Residences => 7 dB IL	Number of Affected Residences => 5 dB IL	Noise Barrier Length (ft)	Noise Barrier Height (ft)	Noise Barrier Area (sq-ft)	Noise Barrier Total Cost @ $30/sq.ft	Cost / Residence
							Existing	With Noise Barrier														
N-1	2	Res.	1	1989		67	73															
FS-7							72															
N-2	2	Res.	1	1999		67	69															
N-3	2	Res.	1	1985		67	64															
N-4	2	Res.	1	1985		67	62															
N-5	2	Res.	1	1998		67	70															
N-6	2	Res.	1	1997		67	67															
N-7	2	Res.	1	1986		67	63															
N-8	2	Res.	1	1987		67	62															
N-9	2	Res.	1	1985		67	63															
N10	2	Res.	1	1997		67	72															
N-11	2	Res.	1	1997		67	71															
N-12	2	Res.	1	1985		67	63															
N-13	2	Res.	1	1998		67	62															
N-14	2	Res.	1	1989		67	72															
N-15	2	Res.	1	1995		67	68															
N-16	2	Res.	1	1989		67	65															
N-17	2	Res.	1	1988		67	63															
N-18	2	Res.	1	1989		67	63															
N-19	2	Res.	1	1991		67	64															
N-20	2	Res.	1	1989		67	66															
N-21	2	Res.	1	1987		67	68															
N-22	2	Res.	1	1995		67	70															
Type II Noise Barrier (NB-1, Figure 2, East Side of I-95 Maine Turnpike, 100 feet North of Wendall Street to 50 feet North of Forest Avenue)																						
N-23	2	Res.	1	1955	1	67	70	63	7	1	x	1	1	8	5	63%	12	1,241	9-16	16,770	$503,100	$41,925
FS-6							71	63	8													
FS-6A							69	63	6													
FS-6B							72	64	8													
N-25	2	Res.	1	1946	1	67	62	58	4													
N-26	2	Res.	1	1952	1	67	62	58	4													
N-27	2	Res.	1	1952	1	67	63	58	5	1												
N-28	2	Res.	1	1911	1	67	65	59	6	1												
N-29	2	Res.	1	1980		67	67	60	7													
N-30	2	Res.	1	1959		67	70	61	9		x											
N-31	2	Res.	1	1952	1	67	63	58	5	1												
N-32	2	Res.	1	1910	1	67	65	59	6	1												
N-33	2	Res.	1	1952	1	67	68	60	8	1	x	1	1									
N-34	2	Res.	1	1990		67	69	61	8		x											
FS-5							70	61	9													
N-35	2	Res.	1	1917	1	67	68	61	7	1	x	1	1									
N-36	2	Res.	1	1955	1	67	68	61	7	1	x	1	1									
N-37	2	Res.	1	1955	1	67	68	61	7	1	x	1	1									
N-38	2	Res.	1	1955	1	67	67	62	5	1	x	1										
N-39	2	Res.	1	1955	1	67	67	62	5	1	x	1										
N-40	2	Res.	1	1962		67	66	63	3		x											
N-41	2	Res.	1	1935	1	67	69	65	4		x	1										
N-42	2	Res.	1	1935	1	67	66	60	6	1												
FS-4		Vacant				67	66	61	5													
N-43	2	Res.	1	NA		67	64	60	4													
N-44	2	Res.	1	1940	1	67	65	61	4													
N-45	3	Res.	1	1980		67	63	62	1													
N-46	3	Res.	1	1957		67	64	62	2													
N-47	3	Res.	1	1957		67	65	63	2													
N-48	3	Res.	1	1965		67	62	61	1													
N-49	3	Res.	1	1940	1	67	62	61	1													
N-50	3	Res.	1	1959		67	62	61	1													
N-51	3	Com.	1	1996		72	68	67	1													
N-52	3	Res.	1	1929	1	67	61	61	0													
N-53	3	Res.	1	1991		67	61	61	0													
N-54	3	Res.	1	1900	1	67	61	60	1													
N-55	3	Res.	1	1983		67	61	60	1													
N-56	3	Res.	1	1918	1	67	61	60	1													
N-57	3	Com.	1	1996		72	68	67	1													

NA Tax Data Not Available
66 Noise levels that approach or exceed the NAC

Table 5 Design Hour Noise Levels, dBA Leq(1H) and Noise Barrier Analysis
I95 Label Avenue to Forest Avenue
Portland, ME

West Side of I-95 Maine Turnpike between Waldron Way and Evergreen Drive

Receptors	Figure #	Land Use	Nunber of Residences	Year of Construction	Residences Built Before Highway	MTA NAC	Noise Levels Leq(1h) dBA		Reduction with Noise Barrier	Residences Built Before Highway => 5dB IL	Front Row	Count Front Row Residences Built Before Highway	Front Row Residences => 7 dB IL	Total Number of Front Row Residences	Total Number of Front Row Residences => 7 dB IL	% Front Row Residences => 7 dB IL	Number of Affected Residences => 5 dB IL	Noise Barrier Length (ft)	Noise Barrier Height (ft)	Noise Barrier Area (sq-ft)	Noise Barrier Total Cost @ $30/sq.ft	Cost / Residence
							Existing	With Noise Barrier														
N-58	3	Com.	1	1996		72	68															
N-59	3	Com.	1	1996		72	61															
N-60	3	Church	1	1824	1	67	63															
N-61	2	Res.	2	1920	2	67	70															
FS-3							69															
N-62	2	Res.	1	1900	1	67	67															
N-63	2	Res.	1	1950	1	67	65															
N-64	2	Com.	1	1900	1	72	63															
N-65	2	Com.	1	1917	1	72	60															
N-66	2	Res.	2	2003		67	68															
N-67	2	Res.	2	2003		67	69															
N-68	2	Res.	2	2003		67	64															
N-69	2	Res.	4	2003		67	66															
N70	2	Res.	2	2003		67	67															
FS-2						67	67															
N-71	2	Play Area	0	2003		67	69															
N-72	2	Res.	2	2003		67	65															
N-73	2	Res.	4	2003		67	62															
N-74	2	Res.	2	2003		67	61															
N-75	2	Res.	2	2003		67	59															
N-76	2	Res.	2	2003		67	57															
N-77	2	Res.	2	2003		67	57															
N-78	2	Res.	3	2003		67	58															
N-79	2	Res.	3	2003		67	59															
N-80	2	Res.	4	2003		67	59															
N-81	2	Res.	3	1971		67	70															
N-82	2	Res.	3	1971		67	69															
N-83	2	Res.	2	1971		67	69															
N-84	2	Res.	2	1971		67	70															
N-85	2	Res.	2	1971		67	69															
N-86	2	Res.	2	1971		67	67															
N-87	2	Res.	2	1971		67	65															
N-88	2	Res.	2	1971		67	63															
N-89	2	Res.	2	1971		67	55															
N-90	2	Res.	2	1971		67	55															
N-91	2	Res.	2	1971		67	56															
N-92	2	Res.	1	1971		67	58															
N-93	2	Res.	2	1971		67	57															
N-94	2	Res.	2	1971		67	55															
N-95	2	Res.	2	1971		67	54															
N-96	2	Res.	1	1971		67	56															
N-97	2	Res.	2	1971		67	60															
N-98	2	Res.	2	1971		67	62															
N-99	2	Res.	2	1971		67	64															
N-100	2	Res.	2	1971		67	69															
N-101	2	Res.	2	1971		67	67															
N-102	2	Res.	2	1971		67	66															
N-103	2	Res.	2	1971		67	71															
N-104	2	Res.	2	1971		67	72															
N-105	2	Res.	2	1971		67	72															
FS-1						67	71															
N-106	2	Res.	2	1971		67	67															
N-107	2	Res.	2	1971		67	63															
N-108	2	Res.	2	1971		67	60															
N-109	2	Res.	2	1971		67	59															
N-110	2	Res.	2	1971		67	57															
N-111	2	Res.	2	1971		67	54															
N-112	2	Res.	2	1971		67	59															
N-113	2	Res.	2	1971		67	58															
N-114	2	Res.	2	1971		67	57															
N-115	2	Res.	2	1971		67	59															
N-116	2	Res.	2	1971		67	56															
N-117	2	Res.	2	1971		67	54															
N-118	2	Com.	1	1990		72	68															
N-119	2	Com.	1	1990		72	61															

NA Tax Data Not Available
66 Noise levels that approach or exceed the NAC