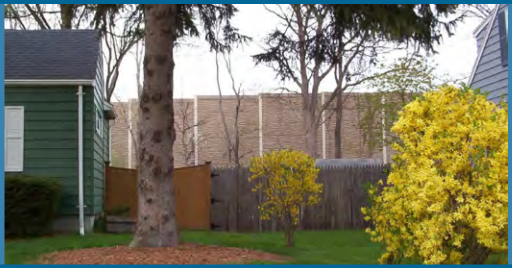
Type I and Type II Noise Program



massDOT
Massachusetts Department of Transportation

Table of Contents

Glossary of Terms

Glossary of Terms Associated with Noise Barrier Programs

Activity categories—Categories of land use and human activities that are sensitive to noise in different ways. Each type of Activity Category has a specific Noise Abatement Criterion (see Noise Analysis Process, Table 6).

Benefited receptor—A benefited receptor is defined as a noise-sensitive receptor in the study zone that attains at least a 5 dB(A) insertion loss or greater from a noise barrier. A benefited receptor does not have to be an impacted receptor.

Cost Effectiveness Index (CEI)—The CEI is one of the criteria used to determine the reasonableness of a noise barrier in the study zone. It is based on cost, average insertion loss, and the number of benefited receptors and, if applicable, average time per visit.

dBA—An A-weighted decibel unit that is used to measure noise. It 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. It is typically 10 to 20 years from the start of construction.

Impacted receptor—Any receptor that has a loudest hour Leq that approaches (within 1 dBA) or exceeds the Noise Abatement Criteria for the corresponding land use category, or exceeds the existing noise levels by 10 dBA or greater.

Insertion loss—Insertion loss is the amount of noise reduction provided by a noise barrier. Insertion loss is a function of a noise barrier's height, length, and location and is independent of the magnitude of existing or future noise levels.

Leq—Leq is an equivalent noise level that accounts for the moment to moment fluctuations in noise levels from all sources during the time period under consideration. For highway noise analyses, one hour is the typical time period used.

Noise abatement—Any measure implemented to reduce highway traffic noise levels.

Noise Abatement Criteria (NAC)—Noise Abatement Criteria are the thresholds set by the FHWA which are used to determine if there is a traffic noise impact for different Activity Categories.

Noise barrier—A noise barrier is a physical obstruction constructed between the highway and noise sensitive receptors to reduce traffic noise levels. Noise barriers may be stand alone noise walls, noise berms (made of earth or other material), or combination berm/wall systems.

Noise reduction design goal—The noise reduction design goal is the desired insertion loss. For residential areas and Activity Category C land uses, the noise reduction design goal is considered to be achieved when at least one first row benefited receptor attains a minimum of 10 dB(A) of insertion loss.

Noise-sensitive receptor—A noise-sensitive receptor is any area where a lowered noise level would benefit the activities that occur on it.

Study zone—The study zone is the area where the traffic noise impacts from a proposed project occur. A highway traffic noise model is typically used to determine the limits of the study zone.

Traffic Noise Impacts—Traffic noise impacts occur 1) when the existing noise levels or the predicted future traffic noise levels from a proposed project approach (within 1 dB(A)) or exceed the Noise Abatement Criteria, as defined by 23 CFR 772, Procedures for Abatement of Highway Traffic Noise or 2) when the predicted future traffic noise levels from a proposed project increase by 10 dB(A) or more over existing noise levels.

Type I Noise Abatement Program—The Type I Noise Abatement Program is a Federal aid highway program for Type I projects. Type I projects typically involve the construction of noise barriers as part of projects that significantly change the horizontal or vertical alignment of an existing highway or increases the number of through traffic lanes of an existing highway.

Type II Noise Abatement Program—The Type II Noise Abatement Program is a voluntary effort by MassDOT to construct noise barriers along existing interstate highways without any other associated highway improvements. Massachusetts is one of only five states that actively participate in a Type II noise program. Type II noise barrier projects compete for state funding with projects that increase highway safety, such as the replacement of structurally deficient bridges, the reconstruction of deteriorated and substandard roadways, and the reconstruction of intersections that are known to be high accident locations. Type II noise barriers are constructed as funding allows.

Introduction

Introduction

The Massachusetts Department of Transportation—Highway Division (MassDOT), in conjunction with the Federal Highway Administration (FHWA), established a statewide policy for evaluating highway noise. This policy, titled *Massachusetts Department of Transportation Type I and Type II Noise Abatement Policy and Procedures*, provides consistent criteria and procedures for performing noise analyses and for providing noise abatement. The policy includes a three-part procedure for determining if the construction of a potential noise barrier is appropriate and reasonable and feasible in accordance with State and Federal regulations. The MassDOT *Type I and Type II Noise Abatement* Policy complies with FHWA's highway traffic noise regulations (23 CFR 772, *Procedures for Abatement of Highway Traffic and Construction Noise)*.

This *Type I and Type II Noise Program Guidebook* has been created to assist members of the general public to understand highway traffic noise and the methods used to reduce its impact on residents, landowners, and users of facilities adjacent to state highways, such as parks, schools, and places of worship. The Guidebook provides a general discussion of noise and highway noise measurement techniques followed by a description of the methods used to reduce highway noise (typically, **noise barriers**), and a discussion of the process used to analyze highway noise.

Type I projects are noise barrier projects that are part of an overall highway project involving the construction of new highways or improvements to existing highways. **Type II projects** are "stand alone" projects that involve construction of noise barriers to reduce noise levels at residential areas and other sensitive land uses adjacent to existing Interstate Highways. Both policies are described in detail later in this guidebook.

Frequently asked questions about MassDOT's Noise Abatement Program are also provided in this document.

Noise Barrier - I-93 Southbound, Medford

Principles of Highway Noise

Principles of Highway Noise

To understand the effects of highway noise and the types of noise mitigation, it is necessary to understand the principles of noise. Noise is defined as unwanted or excessive sound that interferes with normal activities, such as sleep, work, or recreation. People react to noise differently, based on many emotional and physical factors, such as hearing sensitivity (the degree to which someone is accustomed to noise) or a person's ability to sleep with noise. The Federal Highway Administration (FHWA) has established Noise Abatement Criteria (NAC) based upon noise levels that interfere with speech. The Highway Noise Abatement Criteria are presented in Table 6.

Table 1
Indoor and Outdoor Sound Levels

Outdoor Sound Levels	*Indoor Sound Levels*
	Rock band at 5 m (16 ft)
Jet over flight at 300 m (1,000 ft)	
	Inside New York subway train
Gas lawn mower at 1 m (3 ft)	
	Food blender at 1 m (3 ft)
Diesel truck at 15 m (50 ft)	
Noisy urban area — daytime	Garbage disposal at 1 m (3 ft)
	Shouting at 1 m (3 ft)
Gas lawn mower at 30 m (100 ft)	Vacuum cleaner at 3 m (10 ft)
Suburban commercial area	Normal speech at 1 m (3 ft)
Quiet urban area — daytime	Quiet conversation at 1 m (3 ft)
	Dishwasher in next room
Quiet urban area — nighttime	
	Empty theater or library
Quiet Suburb — nighttime	
	Quiet bedroom at night
Quiet Rural Area — nighttime	Empty concert hall
Rustling leaves	
	Broadcast and recording studios
Reference pressure level	Threshold of hearing

mPA MicroPascals describe pressure. The pressure level is what sound level monitors measure.
dBA A-weighted decibels describe pressure logarithmically with respect to 20 mPa (the reference pressure level).
Source: Highway Noise Fundamentals, Federal Highway Administration, September 1980.

Sound levels are a measure of pressure in air from its source to the surroundings. The unit of measurement for sound is the decibel. The abbreviation for decibel is dB. Sound (noise) is often measured in decibels using an A-weighted scale (**dB(A)**) because this method approximates the way humans hear sound. Table 1 presents typical sound levels at distances measured from the source of the sound.

The typical sound levels we encounter come from a point source or from a line source. A point source is a stationary or a fixed point. For point sources, sound is radiated equally in all directions. A line source occurs when a source is moving in a line. A stream of automobiles on a roadway produces traffic noise as a line source.

Noise is measured in decibels (dB) on a logarithmic scale. Changes in sound levels are, therefore, not linear and sound levels cannot be added by ordinary arithmetic means. With a logarithmic scale; sound levels from two equal sources will result in a total sound increase of 3 decibels. For example, two trucks, each generating 60 decibels of sound, when added together, will result in a sound level of 63 decibels, not 120 decibels. Doubling of the sound source, such as doubling the number of vehicles on the highway, causes the sound levels to increase by 3 decibels. A change of 3 decibels in sound levels is barely noticeable to most people. However, an increase of 10 decibels will cause the noise to be perceived as twice as loud to the average listener.

There are many factors that affect sound levels. Sound levels are influenced by the distance and the path traveled between the source of the sound and the receptor (person). There is a natural reduction of sound levels with increasing distance between the source and the receptor. The type of ground cover between the source and the receptor also affects sound levels by disrupting or deflecting the sound wave. Hard surfaces (for example, pavement, dirt, or water) will decrease sound levels by 3 decibels for each doubling of distance. Soft surfaces (such as grass or vegetation) will decrease sound levels by 4.5 decibels for each doubling of distance. Obstacles between the source and the receptor, such as buildings, hills, or trees, will cause additional noise reductions depending upon their size, density, and location.

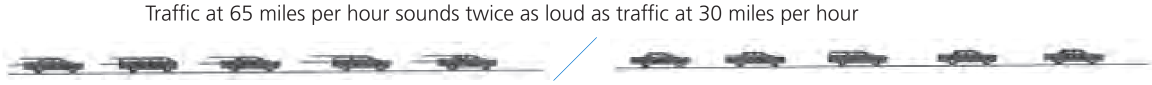
Certain atmospheric conditions, such as temperature, can increase or decrease sound levels. A clear winter night and morning are often associated with increased noise levels, while hot summer afternoons are often associated with decreased noise levels. Other conditions will also affect traffic noise levels. A steep incline along a roadway will cause heavy laboring of motor vehicle engines and, thus, increase noise levels. Vehicle noise is a combination of the noises produced by the engine, exhaust, and tires. Highway traffic noise levels constantly vary with the number, type, and speed of the vehicles that produce the noise. When conducting measurements of highway traffic noise, it is necessary to account for these varying noise levels. The most common way to account for the time varying nature of sound is through a measurement known as **Leq**. Leq averages background sound levels with short-term sound levels to provide a uniform method for comparing sound levels over time. The time period used for highway noise analyses is typically one hour. In accordance with FHWA guidelines, the one hour Leq is used for assessing highway noise impacts on different land uses.

As characterized in the figures, noise levels from highway traffic are affected by three factors: (1) the volume of the traffic, (2) the speed of the traffic, and (3) the number of trucks in the flow of traffic. Generally, the loudness of traffic noise is increased by heavier traffic volumes, higher vehicle speeds, and greater numbers of trucks.

Usually, the noisiest hour of the day or night along a highway occurs just before or after the peak hours when the vehicle volumes, speeds, and the truck-to-auto ratio are in a combined optimum condition to yield the highest hourly noise level. The noisiest hour typically does not occur during the peak traffic hour because the peak hour will have the highest traffic volumes resulting in slower speeds and, therefore, lower highway sound levels.

How Speed Affects Traffic Noise

Traffic at 65 miles per hour sounds twice as loud as traffic at 30 miles per hour

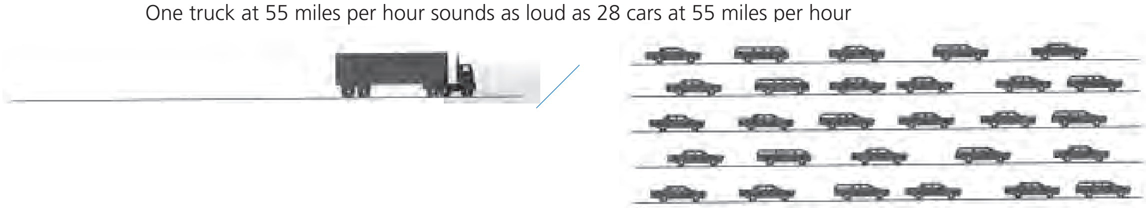


How Traffic Volume Affects Noise

2000 vehicles per hour sound twice as loud as 200 vehicles per hour

How Trucks Affect Traffic Noise

One truck at 55 miles per hour sounds as loud as 28 cars at 55 miles per hour



Methods Used to Reduce Highway Noise

Methods Used to Reduce Highway Noise

Noise barriers are the most common method used to reduce highway noise. Noise barriers are physical obstructions built between the highway and noise sensitive receptors (for example, residences, schools, or places of worship) to reduce the traffic noise levels at the noise-sensitive receptors. Often, methods other than the construction of noise barriers are found to be infeasible.

Noise barriers may be stand-alone noise walls, noise berms (made of earth or other material), or combination berm/wall systems, such as a vertical wall on top of an earth berm. Earth berms have a natural appearance, allow for plantings, and are usually attractive. However, an earth berm can require a lot of land to attain the desired height. For example, a 16 foot high earth berm would require 32 feet of width at the base. Noise walls require substantially less area.

Noise barriers can substantially reduce noise levels for people living next to highways but will not completely eliminate all highway traffic noise. Effective noise barriers reduce noise levels by 10 to 12 decibels, which reduces the perceived loudness of traffic noise by approximately half. For a noise barrier to significantly reduce highway noise, it must be high enough and long enough to block the view of the road. Generally, if a noise barrier blocks the line-of-sight between the highway noise sources and the noise-sensitive receptors, then the sound levels will be reduced by 5 decibels. Increasing the height of the noise barrier can increase the noise reductions at the rate of 1 decibel for every 2 feet of additional barrier height. Noise barriers are limited to 25 feet in height for structural and aesthetic reasons and are commonly 12 to 18 feet high. Similarly, the noise barrier should extend beyond the last protected noise-sensitive receptor at least 4 times the distance from the highway to the sensitive receptor to ensure desired noise reductions. In addition, noise barriers are most effective for the area within 200 to 300 feet of a highway (usually the first two rows of residences).

Noise barriers are designed to be aesthetically pleasing to the protected residences and travelling public. They can be built of concrete, wood, masonry, metal, or other materials and have various textures and colors. MassDOT typically constructs noise barriers made of concrete because of their effectiveness and durability.

Noise Barrier along I-95 in Chelmsford

Regulatory Context

Regulatory Context

Massachusetts uses federal funding to pay for a large percentage of the cost of many highway improvement projects. Federal funds can account for 80 percent of the cost of highway projects with state funds accounting for the remaining 20 percent. The Federal Highway Administration (FHWA) is the federal agency responsible for administering the federal-aid highway program.

FHWA's noise regulations (23 CFR 772, *Procedures for Abatement of Highway Traffic and Construction Noise*) define two types of highway noise projects, Type I Projects and Type II Projects, which are described in the following sections. FHWA's noise regulations require the following actions during consideration of a noise barrier project:

1. Identification of highway traffic noise impacts
2. Examination of potential noise abatement measures
3. Incorporation of feasible and reasonable highway traffic noise abatement measures into the highway project
4. Coordination with local officials to provide helpful information on compatible land use planning and control and, in the case of a Type II project, to provide information on eligibility requirements for Federal-aid participation and
5. Identification and incorporation of necessary measures to abate construction noise.

The steps to completing the process are described in the Noise Analysis Process section.

Construction of Noise barrier along I-93 Southbound in Lynnfield

Type I Projects

Type I Projects

A Type I project is a project that involves:

- The construction of a highway on a new location
- A substantial alteration of the horizontal or vertical alignment of an existing highway
- The addition of through travel lane(s)
- The addition of an auxiliary lane, except for when the auxiliary lane is a turn lane
- The addition or relocation of interchange lanes or ramps to complete an existing partial interchange
- Restriping existing pavement for the purpose of adding a through traffic lane or an auxiliary lane or
- The addition of a new or substantial alteration of a weigh station, rest stop, ride share lot, or toll plaza.

If any segment or component of a project is determined to be a Type I project under this definition, then a highway traffic noise analysis is required for the entire project. A noise analysis is required for all Type I projects regardless of whether the project occurs on a controlled access highway or an uncontrolled access highway.

MassDOT's Type I and Type II Noise Abatement Policies and Procedures (effective July 13, 2011) describe Type I projects in detail. A copy of the policy is provided at the end of the text portion of this document. The procedures that MassDOT follows to determine if noise abatement is reasonable and feasible are described in the Noise Analysis Process section.

Table 2 presents upcoming Type I noise barrier projects. Table 3 provides a list of all Type I noise barriers constructed in Massachusetts (1975–2012). The noise barrier locations listed on Tables 2 and 3 are shown on the figure titled Type I Noise Barriers Constructed (1975–2016) located at the end of this document.

Table 2
Upcoming Type I Noise Barrier Projects

Highway	City	Neighborhood	Estimated Construction	Length (feet)	Height (feet)
I-95	Needham	River Park Street	2012–2013	2,100	17
I-95	Needham	Saint Mary Street	2012–2013	1,700	18
I-95	Needham	Reservoir Street	2012–2013	1,100	16
I-95	Needham	Hunting Road	2014–2016	3,800	15
I-93	Methuen	Noyes Street	2015–2016	1,850	24
I-93	Methuen	Smith Avenue	2015–2016	1,230	25

Type I Projects

Noise abatement is funded by FHWA under two programs, the Type I and Type II Noise Abatement Programs. MassDOT uses these federal programs to mitigate traffic noise impacts. These programs are each described in the following sections.

Table 3
Type I Noise Barriers Constructed in Massachusetts (1975–2012)

Highway	City	Year Built	Length (feet)	Height (feet)
Route 128	Danvers	2012	850	18
Route 128	Danvers	2012	700	21
Route 128	Danvers	2012	1,650	15
I-93	Andover	2012	5,900	16
I-95	Westwood	2010	1,300	16
I-95	Dedham	2008	2,000	16
I-95/Route 3	Lexington	2008	3,100	18
I-95	Westwood/Dedham	2007	5,000	14
I-95	Dedham	2007	1,200	18
I-95	Dedham	2007	1,600	17
I-95	Dedham	2007	2,000	17
Route 3	Billerica	2006	2,800	13
Route 3	Chelmsford	2004	1,000	15
Route 3	Chelmsford	2004	1,900	15
Route 3	Chelmsford	2004	900	13
Route 3	Chelmsford	2004	1,100	15
Route 3	Chelmsford	2004	1,700	15
Route 3	Lowell	2004	3,000	23
Route 44	Plymouth	2002	900	17
Route 44	North Carver	2002	1,600	12
Route 128	Peabody	1987	500	10
Route 128	Peabody	1987	800	10
Route 140	Mansfield	1983	1,300	10
I-495	Raynham	1981	2,500	10
I-190	West Boylston	1981	950	13
I-190	Leominster	1980	200	7
I-495	Mansfield/Norton	1980	2,700	10
I-495	Norton	1980	2,400	16
I-190	Worcester	1980	800	16
I-190	Lancaster	1979	800	3

(Continued on next page)

Type I Projects

Table 3 (Continued)
Type I Noise Barriers Constructed in Massachusetts (1975–2012)

Highway	City	Year Built	Length (feet)	Height (feet)
I-190	Leominster	1979	2,300	3
I-190	Leominster	1976	250	7
I-190	Leominster	1976	2,600	7
Route 2	Leominster	1976	400	7
I-95	Boxford	1975	1,250	7
I-95	Boxford	1975	3,300	10
I-95	Boxford	1975	1,650	10
I-95	Newburyport	1975	1,150	7
I-95	Newburyport	1975	1,650	7
I-95	Newburyport	1975	1,700	7
I-95	Newburyport	1975	850	7

Noise barrier along I-95 northbound in Wakefield

1 MassHighway's Type I Noise Abatement Guidelines defines "approach" as being within 1 dBA of FHWA's Noise Abatement Criteria (*i.e.,* at 66 decibels for residential areas).

Type II Projects

Type II Projects

Type II projects are 'stand alone' projects that involve construction of noise barriers to reduce noise levels at residential areas (and other sensitive land uses) adjacent to existing highways.
Type II projects are not constructed as mitigation for new or expanded highway construction.
The development and implementation of Type II projects are not mandatory requirements of Federal law or regulation and is strictly an optional decision by a State. MassDOT has a Type II Noise Abatement Program that is limited to noise impacts from Interstate Highways under its jurisdiction.

The former Massachusetts Highway Department (MHD) and the former Massachusetts Turnpike Authority (MTA) conducted comprehensive noise studies along Interstate highways within their jurisdictions and established Final Priority Lists of potential noise barrier locations along those highways. The MHD Type II Priority List is included as Table 4 and the MTA Type II Priority List is included as Table 5. The noise barrier locations listed on Tables 4 and 5 are shown on the figure titled Type II Noise Barrier Locations located at the end of this document. Each barrier location listed on Tables 4 and 5 are also shown on individual figures at the of end of this this document.

Following the passage of the Massachusetts Transportation Reform Act in 2009, all Massachusetts transportation agencies were consolidated into MassDOT, which now administers both programs.

All potential noise barrier locations identified in Tables 4 and 5 must undergo (or have already undergone) further study to determine if noise abatement meets Federal and State reasonableness and feasibility criteria.

If any locations on the Type II Noise Barrier Priority lists are within the study areas of future Type I projects, MassDOT will consider noise abatement at those locations as part of the Type I projects.

Table 4
Sites on MassDOT's Type II Priority List (former MassHighway)

Priority No.	City/Town	Location	Status
1	Quincy	Northbound I-93 at California Avenue	Constructed
2	Milton	Northbound I-93 at Granite Ave	Constructed
3	Milton/Quincy	Southbound I-93 at Bryant Street	Constructed
4	Boston	Southbound I-93 at Colombia Road	Studied–Not Reasonable
5	Boston	Northbound I-93 at Savin Hill Avenue	Constructed
6	Lynnfield	Southbound I-95 at Moulton Drive	Constructed
7	Woburn	Southbound I-93 at Salem Street	Under Design
8	Wellesley/Newton	Northbound I-95 at Quinobequin Road	Constructed
9	Lynnfield/Peabody	Northbound I-95 at Salem Street	Constructed
10	Wakefield	Northbound I-95 at Salem Street	Constructed
11	Fall River	Eastbound I-195 at East Warren Street	Under Design
12	Wellesley	Southbound I-95 between Route 16 & Route 9	Under Design
13	Medford	Southbound I-93 at Brookside Parkway	Constructed

(Continued on next page)

Table 4 (continued)
Sites on MassDOT's Type II Priority List (former MassHighway)

Priority No.	City/Town	Location	Status
14	Stoneham	Northbound I-93 at Marble Street	To Be Studied
15	Boston	Southbound I-93 at Gallivan Boulevard	To Be Studied
16	Lowell	Southbound I-495 at Woburn Street	To Be Studied
17	Boston	Northbound I-93 at Andrew Square	To Be Studied
18	Wakefield	Northbound I-95 at Outlook Road	To Be Studied
19	Lynnfield	Northbound I-95 at Walnut Street	To Be Studied
20	Boston	Northbound I-93 at Tenean Street	To Be Studied
21	Wakefield	Southbound I-95 at Bay Street	To Be Studied
22	Boston	Southbound I-93 at Freeport Street	To Be Studied
23	Lynnfield	Northbound I-95 at Salem Street	To Be Studied
24	Lynnfield/Wakefield	Southbound I-95 between Walnut Street and Audubon Road	To Be Studied
25	Newton	Southbound I-95 at Grove Street	To Be Studied
26	Woburn/Reading	Southbound I-93 in the Dragon Court	To Be Studied
27	Wakefield	Southbound I-95 at Putnam Avenue	To Be Studied
28	Lynnfield/Wakefield	Northbound I-95 at Vernon Street	To Be Studied
29	Reading	Southbound I-95 at Heather Drive	To Be Studied
30	Chelmsford	Southbound I-495 at Chelmsford Street	To Be Studied
31	Wakefield/Reading	Southbound I-95 at Line Road	To Be Studied
32	Wakefield	Northbound I-95 in the Winnisimette Avenue	To Be Studied
33	Lynnfield/Wakefield	Southbound I-95 at Bay State Road	To Be Studied
34	Chelmsford	Southbound I-495 at Clover Hill Road	To Be Studied
35	Medford	Northbound I-93 between Route 60 and Route 28	To Be Studied
36	Lowell	Northbound I-495 at Woburn Street	To Be Studied
37	Wilmington	Southbound I-93 at High Street	To Be Studied
38	Wilmington	Northbound I-93 at Woburn Street	To Be Studied
39	Wilmington	Southbound I-93 in the vicinity Lockwood Road	To Be Studied
40	Chelmsford	Northbound I-495 at Golden Cove Road	To Be Studied
41	Reading	Northbound I-93 at West Street	To Be Studied
42*	Methuen	Northbound I-93 at Riverside Drive	To Be Studied
43	Chelmsford/Westford	Southbound I-495 at Pine Hill Road	To Be Studied
44	Randolph/Quincy	Northbound I-93 at Martindale Street	To Be Studied
45	Chelmsford/Westford	Northbound I-495 at Littleton Road	To Be Studied
46	Chelmsford	Southbound I-495 at North Road	To Be Studied
47	Methuen	Southbound I-93 at Riverside Drive	Studied-Not Reasonable
48	Chelmsford	Northbound I-495 at Riverneck Road	To Be Studied
49	Wilmington	Northbound I-93 between Route 62 and Route 125	To Be Studied
50	Chelmsford	Southbound I-495 at Lowell Connector	To Be Studied
51	Medford	Northbound I-93 at Riverside Avenue	To Be Studied
52	Medford	Southbound I-93 between Route 60 and Route 16	To Be Studied
53	Braintree	Northbound I-93 at North Street	To Be Studied

*Under design as a Type I Noise Barrier as a portion of I-93 Methuen Rotary Project

Table 5
Sites on MassDOT's Type II Priority List on I-90 (formerly Massachusetts Turnpike)

Priority No.	City/Town	Location	Status
1	Newton	Barnes Road/Hunnewell Avenue	Constructed
2	Newton	Bowers Street	Constructed
3	Newton	Curve/Crescent Street	Constructed
4	Newton	Charlesbank Street	To Be Studied
5	Newton	Charles Street	To Be Studied
6	Newton	Austin Street	To Be Studied
7	Ludlow	Cady Street	Constructed[1]
8	Brighton	Riverview Road	To Be Studied
9	Allston	Lincoln/Franklin Street	To Be Studied
10	Natick	Hammond Road	Constructed
11	Brighton	Lincoln/S. Waverly Street	To Be Studied
12	Newton	Auburn/Central Street	Constructed
13	Ludlow	West Avenue	Constructed
14	Newton	Washington/Brookside Avenue	To Be Studied
15	Framingham	Westgate Road	Constructed
16	Ludlow	Davis/Fuller Street	Constructed
17	Chicopee	Whitin Street	To Be Studied

1 Constructed berm with landscaping per community wishes

Noise barrier along I-90 northbound in Ludlow

Noise Analysis Process

Noise Analysis Process

Noise Analysis Process

The Massachusetts Department of Transportation Type I and Type II Noise Abatement Policy and Procedures establish consistent criteria and procedures for performing noise analyses and for providing noise abatement. These policy and procedures are consistent with FHWA noise regulations, policy, and guidance. A three-part procedure is used for determining if the construction or installation of Type I or Type II noise abatement is appropriate. These three procedures are:

- Analysis of highway traffic noise impacts;
- Determination of the feasibility of noise abatement; and
- Determination of the reasonableness of noise abatement.

Careful adherence to these procedures is vital to obtaining federal funding for proposed noise barriers and for the fair and equitable administration of the Type I and Type II Noise Abatement Programs.

Highway Traffic Noise Impact Analysis

To complete the highway traffic noise analysis for both Type I and Type II projects, MassDOT must first evaluate the noise levels based on the FHWA's Noise Abatement Criteria (NAC), then complete a noise impact determination using the FHWA Traffic Noise Model (TNM).

Noise Abatement Criteria

FHWA has established Noise Abatement Criteria (NAC) to help protect public health, welfare, and livability from excessive vehicle traffic noise. These NAC are described in Table 6. The NAC are based upon noise levels associated with the interference of speech and differ according to land use. Type I and Type II noise analyses evaluate noise levels in each Activity Category in a study zone (except Activity Category F). Federal noise regulations (23 CFR 772) require that the NAC are compared to noise measurements taken (or modeled) at exterior areas where frequent human use occurs, such as a ground-level yard, patio, playground, or picnic area. Interior noise levels are not typically used in the noise analysis.

Noise barrier along I-95 northbound in Wakefield (viewed from residential side of barrier)

Table 6
Noise Abatement Criteria (NAC) One-Hour, A-Weighted[1] Noise Levels in Decibels (dB(A))

Activity Category	$L_{eq}(h)^2$	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 purposes.
B[2]	67 (Exterior)	Residential.
C[3]	67 (Exterior)	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, daycare centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings.
D	52 (Interior)	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios.
E[2]	72 (Exterior)	Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in Categories A-D or F.
F	--	Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing.
G	--	Undeveloped lands that are not permitted.

Source: 23 CFR Part 772, Procedures for Abatement of Highway Traffic Noise and Construction Noise.
1. Sound level based on the A-weighted filter correlates to the characteristics of the human hearing.
2. Leq (h) is an energy averaged, one-hour, A-weighted noise level in decibels (dB(A)). The Leq(h) Activity Criteria values are for impact determination only, and are not design standards for noise abatement measures.
3. Includes undeveloped lands permitted for this Activity Category.

MassDOT has different thresholds for traffic noise impacts depending upon whether the project is Type I or Type II. For a Type I project, MassDOT defines a traffic noise impact as:

- When the computed existing or future (design year) noise levels approach (within 1 decibel) or exceed the NAC for Activity Categories A through E. (For example, the NAC for residential areas is 67 decibels. MassDOT defines an impact for residential areas when noise levels equal to or exceed 66 decibels); or
- When the computed future (design year) noise levels exceed the loudest existing noise levels by 10 decibels or more in Activity Categories A through E.

For a Type II project, MassDOT defines a traffic noise impact as:

- When the computed existing or future noise levels approach (within 1 decibel) or exceed the NAC for Activity Categories A through E. To make this determination, all noise analyses must be conducted using the latest version of the FHWA Traffic Noise Model (TNM). A TNM noise analysis generally consists of the following steps:

a) Identification of existing activities, developed land, and undeveloped land to detemine each Activity Category in the study zone
b) On-site collection of traffic and noise measurements to determine the existing noise levels in the loudest hour of the day and to validate or calibrate the computer noise prediction model results
c) Calculation of the existing and future noise levels based on the proposed roadway design and the forecasted traffic levels for the project's design year
d) Consideration of the feasibility and reasonableness of constructing a noise barrier if there are traffic noise impacts

If traffic noise impacts are expected, noise reduction measures must be considered. The most common noise reduction method used is noise barriers. As discussed in the following sections of this document, noise abatement measures (noise barriers) will typically be provided if it is determined by MassDOT to meet State and Federal criteria for reasonableness and feasibility.

Determination of Feasibility of Constructing a Noise Barrier

If the noise analysis shows that there are traffic noise impacts, MassDOT then considers engineering and acoustical factors in evaluating the feasibility of constructing a noise barrier. Feasibility involves determining whether it is possible to build a noise barrier given the site constraints (engineering feasibility) and whether the noise barrier provides a minimum reduction in noise levels (acoustical feasibility).

The engineering feasibility of constructing a noise barrier considers whether the project area is affected by noise sources other than the highway, such as local streets. Safety and environmental impacts are also important factors in determining whether a barrier is feasible. For example, a noise barrier should not block a motorist's line of sight, require substantial impacts to environmental resources, and must provide adequate area adjacent to the highway for snow storage.

The acoustical feasibility of constructing a noise barrier takes into account whether a noticeable noise reduction can be achieved given the existing site conditions, such as roadway geometry and existing topography. MassDOT considers a noise barrier to be acoustically feasible when it reduces traffic noise by at least 5 decibels at more than 50 percent of the impacted receptors in the front row. Blocking the line of sight between the noise source and a receptor usually provides a 5 decibel noise reduction.

A potential noise barrier must be found feasible from both an engineering and acoustical perspective to proceed to the analysis of reasonableness.

Determination of the Reasonableness of Constructing a Noise Barrier

The determination of the reasonableness of a noise barrier is based on three mandatory criteria:

- The noise barrier must meet MassDOT's noise reduction design goal;
- The noise barrier must be cost effective; and
- The property owners and residents of the benefited receptors must be in favor of the noise barrier. If the noise barrier does not meet all three reasonableness criteria, it will not be constructed.

Noise Reduction Design Goal

The noise reduction design goal is the desired amount of noise reduction provided by a noise barrier. For residential areas and for other types of land uses, such as recreation areas, schools, and places of worship, MassDOT considers the noise reduction design goal to be achieved when at least one first row benefited receptor attains a minimum of 10 decibels of noise reduction, which reduces the perceived loudness of the traffic noise by approximately half.

Cost Effectiveness Determination

MassDOT must balance its available funds and statewide highway safety responsibilities. Therefore, it uses a mathematical formula, called the Cost Effectiveness Index (CEI), to determine the cost effectiveness of each CEI calculation. The individual noise reduction values come from the TNM (noise model) output files.

The CEI is equal to $$/dBIL/unit, where:
$$ = Total noise barrier cost, based upon a $50 per square foot cost dBIL = Average noise reduction (insertion loss) of benefited receptors, in decibels Unit = Number of benefited receptors protected in the study zone For residential areas,

MassDOT considers a noise barrier to be cost effective if, based on the CEI, it costs $8,400 or less per decibel reduction per benefited receptor.

Public Involvement

The third factor in determining the reasonableness of potential noise barriers is the opinion of property owners and residents in noise-affected residential areas about whether they want the noise barriers constructed. After a determination that the noise reduction design goal can be met and that the noise barrier is cost effective, a public informational meeting is held in the municipality(s) of the proposed noise barrier to present and discuss the noise impacts from the project and to provide an opportunity for local input in the development of the proposed noise barrier. MassDOT notifies the property owners in each Activity Category in Table 6 of the public informational meeting and of its intent to install a noise barrier in the noise affected residential area. After presenting the project information at the project informational meeting, a survey of the desires of the property owners and of the residents of the benefited receptors is conducted by mail. Table 7 presents the number of votes allocated to each type of benefited receptor in the study zone.

MassDOT will provide noise barriers if at least two-thirds (67 percent) of the weighted total number of residential votes are in favor of it, otherwise a noise barrier will not be built. If a noise barrier is proposed for parks, schools, or other Activity Category C land uses, then each individual property owner (that is, each owner of the Activity Category C land use) must be in favor of it, otherwise, the noise barrier would not be considered as a reasonable noise abatement measure.

Table 7
Number of Votes Allocated to Benefited Receptors Surveyed

Land Use	Occupancy	Row	Number of Votes
Existing Residential	Owner	First	5
Existing Residential	Owner	Second, Third, etc.	3
Existing Residential	Renter	First, Second, Third, etc.	1
Existing Activity Category C or D	Owner	Not Applicable	1
Undeveloped Land Permitted for Development (Residential)	Owner	First	5
Undeveloped Land Permitted for Development (Residential)	Owner	Second, Third, etc.	3

Frequently Asked Questions

Frequently Asked Questions

If my neighborhood is not adjacent to at Type I highway project or a location on the Type II Priority List can I still request or petition for MassDOT to construct a noise barrier?

In accordance with Federal regulations, MassDOT is not able to construct noise barriers that are not part of a Type I highway project or are on either the former MHD or MTA Type II Priority Lists.

I just moved to a new development and I find the noise from the highway to be very annoying. Will MassDOT build a noise barrier to reduce this noise?

Unless there is a highway project that meets the definition of a Type I project as discussed in Section 5.0 above, the construction of a noise barrier under the MassDOT Type I Noise Abatement Policy is not possible.

Further, unless the new development is in an area that adjacent to a Type I highway project or is on either the former MHD or MTA Type II Priority List, MassDOT cannot build a noise barrier. In addition, FHWA requires that the Type II Noise Abatement Program is restricted to locations along highways where at least one residence existed before November 28, 1995.

Does construction of a noise barrier increase noise levels on the opposite side of the highway?

Residents adjacent to a highway sometimes believe that their noise levels have increased substantially because of the construction of a noise barrier on the opposite side of the highway with no barrier on their side. However, field studies have shown that this is not true. If all the noise striking a noise barrier were reflected to the other side of the highway, noise levels there could theoretically increase by as much as 3 decibels. In practice, not all of the acoustical energy (noise) is reflected to the other side of the highway. Some of the noise goes over the barrier, some is reflected into the air, or is scattered by grass, shrubs, or is blocked by the vehicles on the highway.

Additionally, MassDOT only constructs absorptive noise barriers. An absorptive noise barrier is built of materials that are non-reflective, therefore, noise would not reflected to the other side of the highway.

Can trees be planted to act as a noise barrier?

Vegetation is not an effective or an acceptable noise abatement measure for two reasons. First, space limitation and costs usually make it impossible to plant enough trees and shrubs along a highway to achieve any noise reduction. Vegetation, in the form of trees and shrubs, must be a minimum of 100 feet thick, a minimum of 20 feet high, and sufficiently dense so that it cannot be seen through in order to provide a 5 decibel noise reduction.Second, since a substantial noise reduction does not occur until vegetation matures, FHWA does not consider the planting of vegetation to be a highway traffic noise abatement measure.

While the planting of trees and shrubs may provide psychological benefits by providing visual screening, privacy, or aesthetic treatment, they do not provide highway traffic noise abatement.

MassDOT Type I and Type II
Noise Abatement Policies and Procedures

OMassDOT Type I and Type II
Noise Abatement Policies and
Procedures

MassDOT Type I and Type II Noise Abatement Policies and Procedures

A copy of MassDOT's Type I and Type II Noise Abatement Policies and Procedures is provided in the following pages.