Type I Acoustical Study

Route 128 Bridge Over Waters River Roadway Improvement Project

Danvers/Peabody,
Massachusetts

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Boston, Massachusetts

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Introduction

The purpose of this acoustical study is to evaluate the potential noise impacts associated with the proposed roadway improvements along Route 128 in Danvers and Peabody, Massachusetts. The noise analysis was conducted following the Massachusetts Department of Transportation's (MassDOT's) *Type I and Type II Noise Abatement Policies and Procedures*[1] and the Federal Highway Administration's (FHWA's) guidelines[2]. MassDOT's procedures require that roadway sound levels associated with projects be calculated, the results be compared to the noise abatement criteria, and, if noise impacts are identified, noise mitigation measures be evaluated to reduce sound level impacts in the study area. The following sections provide a description of the Project, information on roadway traffic noise, MassDOT's noise criteria and abatement policy, the noise analysis methodology, and results of the noise analysis.

Project Description

The bridge along Route 128 over the Waters River in Danvers has been determined to be structurally deficient. The bridge is located between Exits 24 and 25. The transportation improvement project includes the replacement of the bridge and extension of existing auxiliary lanes between the access ramps. The northern terminus of the project is located between the Endicott Street overpass and the northbound on-ramp from Endicott Street. The project's southern terminus on the southbound side is located at the off-ramp to Route 114 westbound. The southern terminus on the northbound side is located at the on-ramp from Route 114 westbound. The project limits along the northbound direction is approximately 1,870 feet in length and the southbound direction is approximately 2,275 feet. The roadway project limits are depicted in Figure 1. The land uses abutting the Project limits are predominantly residential properties.

1 *Type I and Type II Noise Abatement Policies and Procedures,* effective July 31, 2011
2 *Procedures for Abatement of Highway Traffic Noise and Construction Noise*, Title 23, Code of Federal Regulations, Part 772, July 13, 2010

The Project replaces the deficient bridge structure over Waters River. In addition, the Project provides enhancements to increase safety and operations for vehicles entering and existing Route 128. Under the Existing Condition, the roadway condition provides limited distance for weaving between the ramps resulting in poor operating performance along Route 128 at the ramps. The Project will modify the roadway geometry between the ramps by connecting the acceleration and deceleration lanes. This would provide more distance for weaving and improve safety and operations along Route 128.

Noise Terminology

Noise is defined as unwanted or excessive sound. Sound becomes unwanted when it interferes with normal activities, such as sleep, work, or recreation. The individual human response to noise is subject to considerable variability since there are many emotional and physical factors that contribute to the differences in reaction to noise.

Sound (noise) is described in terms of loudness, frequency, and duration. Loudness is the sound pressure level measured on a logarithmic scale in units of decibels (dB). For community noise impact assessment, sound level frequency characteristics are based upon human hearing, using an A-weighted [dB(A)] frequency filter. The A-weighted filter is used because it approximates the way humans hear sound. Table 1 presents a list of common indoor and outdoor sound levels.

Route 128 Bridge Over Waters River | Danvers/Peabody, MA

Figure 1
Roadway Project Limits

Table 1
Indoor and Outdoor Sound Levels

Outdoor Sound Levels	Sound Pressure (μPa)		Sound Level dB(A)	Indoor Sound Levels
	6,324,555	-	110	Rock Band at 5 m
Jet Over Flight at 300 m		-	105	
	2,000,000	-	100	Inside New York Subway Train
Gas Lawn Mower at 1 m		-	95	
	632,456	-	90	Food Blender at 1 m
Diesel Truck at 15 m		-	85	
Noisy Urban Area—Daytime	200,000	-	80	Garbage Disposal at 1 m
		-	75	Shouting at 1 m
Gas Lawn Mower at 30 m	63,246	-	70	Vacuum Cleaner at 3 m
Suburban Commercial Area		-	65	Normal Speech at 1 m
	20,000	-	60	
Quiet Urban Area—Daytime		-	55	Quiet Conversation at 1 m
	6,325	-	50	Dishwasher Next Room
Quiet Urban Area—Nighttime		-	45	
	2,000	-	40	Empty Theater or Library
Quiet Suburb—Nighttime		-	35	
	632	-	30	Quiet Bedroom at Night
Quiet Rural Area—Nighttime		-	25	Empty Concert Hall
Rustling Leaves	200	-	20	
		-	15	Broadcast and Recording Studios
	63	-	10	
		-	5	
Reference Pressure Level	20	-	0	Threshold of Hearing

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

The most common way to account for the time varying nature of sound (duration) is through the equivalent sound level measurement, referred to as L_{eq}. The L_{eq} is a metric that accounts for the moment-to-moment fluctuations in sound due to all the noise sources during a specified period including background noise sources and short-term transient noise sources. The FHWA's guidelines and criteria require the use of a one-hour L_{eq} for assessing highway noise impacts on different land uses. The loudness of traffic noise is related to traffic volumes, vehicle speeds, and numbers of trucks.

The following general relationships exist between noise levels and human perception:

- A 1 or 2 dB(A) increase is not perceptible to the average person.
- A 3 dB(A) increase is a doubling of acoustic energy but is just barely perceptible to the human ear.
- A 10 dB(A) increase is a tenfold increase in acoustic energy but is perceived as a doubling in loudness to the average person.

Noise Abatement Criteria

Traffic noise can adversely affect human activities, such as communication. FHWA has established Noise Abatement Criteria (NAC) to help protect the public health and welfare from excessive traffic noise in FHWA regulation 23 CF 772. Recognizing that different areas are sensitive to noise in varying ways, the NAC varies according to land use. The NAC are described in Table 2.

Table 2
Noise Abatement Criteria (NAC), dB(A)

Activity Category	$L_{eq}(h)$*	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**	67 (Exterior)	Residential.
C**	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**	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.

* 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.

** Includes undeveloped lands permitted for this Activity Category.

Source: 23 CFR Part 772, *Procedures for Abatement of Highway Traffic Noise and Construction Noise*.

MassDOT implements the FHWA's regulation and considers noise impacts to occur when existing or future sound levels approach (within 1 dB(A)) or exceed the NAC. Additionally, MassDOT considers a receptor location as impacted when future sound levels exceed the existing sound levels by 10 dB(A) or more. These criteria are the recommended levels for identifying locations that may be affected by noise.

Methodology

The noise analysis evaluated the sound levels associated with vehicular traffic under both Existing and Build roadway conditions. Sound levels associated with roadway traffic were calculated using FHWA's Traffic Noise Model (TNM) Version 2.5. Traffic parameters, such as volumes and truck percentages, were obtained from the Project design plans[3] and supplemented with data from MassDOT's traffic database[4] and count data collected during the noise measurement effort.

The traffic noise model was developed using the roadway design files that were available at the time of this study. This included information from the survey plans that were used to incorporate elevation data[5]. CAD drawings of the roadway design were used to define the build roadway geometry. Elevation data beyond the limits of the roadway project was supplemented with terrain data from MassGIS. The noise model included changes in roadway conditions, such as traffic volumes and roadway geometry, between the Existing and Build Conditions. The traffic model included peak hour volumes for the 2015 Existing Conditions and the 2036 Build Conditions. The analysis assumed truck percentages based on data presented in the design plans. Travel speeds were modeled as posted speeds of 55 miles per hour (mph) along Route 128 in both the Existing and Build Conditions. The ramps and local roadways were modeled with speeds of 35 mph. Under the Build Conditions, the noise model considered all the proposed geometric improvements, which included the roadway widening to accommodate the extension of the auxiliary associated with the ramps.

3 Route 128 Over Waters River, Peabody/Danvers, MA, Parsons Brinckerhoff, 75% Submittal, Dated July 4, 2017.

4 http://mhd.ms2soft.com/tcds

5 Route 128 Bridge No. D-03-018, Peabody/Danvers, MA, Welch Associated Land Surveyors, Inc., Dated 8-31-2017.

The noise model was used to calculate the sound levels at sensitive receptor locations along the Route 128, shown in Figures 2A and 2B. These sensitive receptor locations consisted of primarily residential uses along the project corridor. The analysis included receptor locations beyond the roadway project limits to provide continuity in assessing the neighborhoods. The sound levels calculated from the noise model were compared to MassDOT's noise impact criteria for determining potential impacts. For sensitive receptor locations that approach or exceed the NAC, noise mitigation, such as a noise barrier, was evaluated. Any proposed noise barrier must meet MassDOT's feasibility and reasonableness criteria outlined in MassDOT's Noise Abatement Policy and described in the "Noise Mitigation Guidelines" section.

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0 65 130 260 Feet

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R# Receptor Locations

Figure 2A
Tammie Lane/ Reynolds Road
Receptor Locations

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0 75 150 300 Feet

Route 128 Bridge Over Waters River | Danvers/Peabody, MA

Figure 2B
Sabino Farm Road/Sheffield Drive
Receptor Locations

R# Receptor Locations

Model Validation

Existing sound level data was collected with simultaneous traffic counts at seven locations in the vicinity of the study area during a typical weekday. Sound level measurements were conducted between the hours of 9:00 AM to 11:00 PM on January 16, 2018. These measurements were collected in conformance with the MassDOT's procedures and guidelines. The sound level measurements are shown in Figure 3 and included the following locations:

- M1 – Tammie Lane;
- M2 – Reynolds Road East;
- M3 – Reynolds Road West;
- M4 – Sabino Farm Road;
- M5 – Sheffield Drive;
- M6 – Canterbury Drive; and
- M7 – Temple B'Nai Brith Cemetery.

The purpose of the noise monitoring effort is to determine traffic sound level at representative locations where the measured sound data can be compared to the modeled sound levels to validate the traffic noise model. It is typically not possible to conduct noise monitoring at all the receptor locations in a study area due to limited resources and access. As such, FHWA and MassDOT has developed a process for creating a validated noise model. Model validation is the process of demonstrating that the TNM model is representative of the study area. The measured sound level data were used to validate the development of the FHWA's TNM for the project study area. MassDOT has established validation criteria that requires that the TNM modeled values be within ±3 dB(A) of the measured values.

Traffic data along roadways within the study area were also collected in conjunction with the noise measurements at each monitoring location. Each roadway that was expected to affect noise levels at each measurement location was collected during the respective measurement. The traffic data included traffic volume, the vehicle mix (automobiles, medium trucks, heavy trucks, buses and motorcycles) and travel speeds.

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M# Monitoring Locations

Figure 3
Noise Monitoring Locations

As shown in Table 3 below, the validation model results are within three dB(A) of the measured sound levels and were generally louder than the measured levels. Therefore, the developed TNM is considered representative of the study area. The sound level measurements and the model sound levels are summarized in Table 3.

Table 3 Model Validation, dB(A)

Monitoring Location	Measured Sound Level	Modeled Sound Level	Difference
M1 – Tammie Lane	62.4	65.3	2.9
M2 – Reynolds Road East	68.5	70.1	1.6
M3 – Reynolds Road West	52.3	53.8	1.5
M4 – Sabino Farm Road	62.0	64.6	2.6
M5 – Sheffield Drive	51.9	54.6	2.7
M6 – Canterbury Drive	57.1	54.3	-2.8
M7a* – Cemetery	74.6	74.0	-0.6
M7b* – Cemetery	74.2	74.6	0.4

Note: Values for M7 represents two different time periods.

Existing traffic data was incorporated into the validated TNM model and was used to calculate the 2015 existing sound levels for all receptor locations in the study area. The validated TNM model was then used as the basis for the proposed build geometry and traffic conditions to calculate the 2036 design-year build sound levels for all receptor locations.

Results

The FHWA's TNM 2.5 program was used to calculate sound levels associated with the Project under both 2015 Existing and 2036 Build Conditions. The noise analysis demonstrated that receptor locations within the project study area experience sound levels that exceed the MassDOT's NAC under the Build Conditions.

Under the Existing Conditions, the sound levels at the evaluated receptor locations ranged from approximately 48 dB(A) to approximately 74 dB(A). These sound levels indicate that 19 receptor locations are experiencing sound levels that approach or exceed MassDOT's NAC corresponding to their land use. The impacted receptor locations are primarily located in residential neighborhoods on each side of Route 128.

Under the Build Conditions, the receptor locations would experience sound levels ranging from approximately 48 dB(A) to approximately 75 dB(A), which results in five additional receptors (24 total) exceeding their respective MassDOT NAC. The project will result in an increase of up to approximately two decibels which are below MassDOT's substantial increase criterion of 10 dB(A). Receptor locations further away from the roadways would experience lower sound levels as sound waves dissipate with distance. Changes in sound levels between the Existing and Build conditions could be attributed to the alteration in vertical and horizontal roadway alignments associated with the bridge renovation. The increase in the vertical alignment alters the path of exposure between the receptor and the roadway noise sources. The sound levels for the closest receptor locations, as they would experience the greatest for potential impacts, are presented in Table 4. A complete list of receptor sound levels can be found in the Appendix.

Table 4
Sound Levels for Closest Receptor Locations, dB(A)

Receptor Number	Receptor Address	NAC Category	MassDOT Noise Criteria	2015 Existing Sound Level	2036 Build Sound Level	MassDOT Increase Limit	Sound Level Increase
1	16 TAMMIE LN	B	66	**73.1**	**74.0**	+10	0.8
2	14 TAMMIE LN	B	66	**72.7**	**73.2**	+10	0.5
3	12 TAMMIE LN	B	66	**72.1**	**71.7**	+10	-0.4
4	10 TAMMIE LN	B	66	**71.7**	**71.4**	+10	-0.3
38	7 REYNOLDS RD	B	66	59.6	60.4	+10	0.8
39	9 REYNOLDS RD	B	66	59.4	60.3	+10	0.9
40	11 REYNOLDS RD	B	66	59.9	60.8	+10	0.9
41	13 REYNOLDS RD	B	66	60.3	61.2	+10	0.9
42	15 REYNOLDS RD	B	66	60.5	61.3	+10	0.8
43	17 REYNOLDS RD	B	66	61.4	62.3	+10	0.9
44	19 REYNOLDS RD	B	66	61.9	62.7	+10	0.8
45	21 REYNOLDS RD	B	66	62.3	63.2	+10	0.9
46	23 REYNOLDS RD	B	66	63.3	64.1	+10	0.8
47	25 REYNOLDS RD	B	66	64.7	65.5	+10	0.8
48	27 REYNOLDS RD	B	66	**66.6**	**67.4**	+10	0.8
49	29 REYNOLDS RD	B	66	**70.5**	**71.4**	+10	0.9
75	6 BLAKE ST	B	66	**72.4**	**73.4**	+10	1.0
76	4 BLAKE ST	B	66	**67.8**	**68.7**	+10	0.9
79	15 TAMMIE LN	B	66	**68.9**	**70.0**	+10	1.1
93	9 TAMMIE LN	B	66	65.0	**67.3**	+10	2.3
94	11 TAMMIE LN	B	66	65.9	**67.1**	+10	1.2
107	20 SHEFFIELD DR	B	66	61.0	61.8	+10	0.8
108	18 SHEFFIELD DR	B	66	61.5	62.3	+10	0.8
109	16 SHEFFIELD DR	B	66	62.4	63.2	+10	0.8
110	14 SHEFFIELD DR	B	66	62.3	63.1	+10	0.8
111	12 SHEFFIELD DR	B	66	60.8	61.5	+10	0.7
112	10 SHEFFIELD DR	B	66	60.4	61.3	+10	0.9
127	40 SABINO FARM RD (A)	B	66	**66.2**	**67.1**	+10	0.9
129	42 SABINO FARM RD	B	66	**73.8**	**74.7**	+10	0.9
130	40 SABINO FARM RD	B	66	**68.5**	**69.3**	+10	0.8
131	38 SABINO FARM RD (R)	B	66	**66.7**	**67.6**	+10	0.9
132	36 SABINO FARM RD	B	66	60.4	61.2	+10	0.8
133	34 SABINO FARM RD	B	66	59.1	60.0	+10	0.9

Note:
Values in bold indicate sound levels above their respective criteria.

Noise Mitigation Guidelines

The noise analysis determined that receptor locations, in close proximity to the Project area, will experience sound levels that exceed MassDOT's noise impact criteria under the Build Condition. MassDOT's and FHWA's policies require that noise mitigation measures be evaluated if receptor locations within the project limits are identified to be impacted by noise associated with roadway sources. The noise evaluation must investigate the feasibility and reasonableness of potential noise abatement measures. As a result, the noise evaluation considered the following noise abatement measures:

- Traffic management measures, such as traffic control devices and signing for prohibition of certain vehicle types, time-use restrictions for certain vehicle types, reduced speed limits, and exclusive lane designations.
- Physical alteration of roadway alignments.
- Acquisition of property to serve as a buffer zone, provide landscaping and/or planting of vegetation.
- Construction of noise barriers (or sound walls).

Measures, such as, traffic management, alteration of alignment, or purchase of land for use as a buffer zone usually do not provide substantial noise reduction or are found to be not feasible and reasonable because of cost, right-of-way requirements, or project purpose. Planting of vegetation or landscaping is not an effective or acceptable noise abatement measure because only dense stands of evergreen vegetation, at least 100 feet deep will reduce noise levels. Thus, the noise abatement measure frequently used is a sound wall.

MassDOT's guidance requires that potential sound walls meet acoustical, engineering, and cost considerations to be recommended for construction. MassDOT's and FHWA's guidelines establish procedures to determine if a sound wall is feasible and reasonable. The feasibility of a sound wall is based upon engineering and acoustical attributes. The engineering considerations include the existing roadway geometry, safety issues, and other environmental impacts. The reasonableness of a sound wall is based upon its economic and social aspects. The costs of the sound wall must be reasonable for the number of receptors receiving a benefit and the amount of noise reduction being achieved.

The following criteria must be met for a sound wall to be constructed:

Feasibility

- Engineering Feasibility: The sound wall must be able to be constructed given the existing geometry and taking into consideration cross streets, driveways, safety concerns, environmental impacts, and other noise sources in the area.
- Acoustical Feasibility: The sound wall must be able to provide effective sound level reductions (more than 50 percent of the front row impacted receptor locations must receive a 5 dB(A) noise reduction).

Reasonableness

- The goal is to provide a 10 dB(A) noise reduction for at least one first row receptor location.
- The sound wall must be cost effective.
- The implementation of a sound wall must be supported by the community.

In order for MassDOT to balance its responsibility to minimize impacts with limited funding, a mathematical formula, called the Cost Effectiveness Index (CEI), is used as the primary factor when considering the reasonableness of construction of a sound wall. A sound wall with a CEI of $8,400 or less is considered cost effective. The factors that affect the CEI are the sound wall cost and average insertion loss, both of which are affected by the sound wall's height, length, and location.

The CEI is equal to $$/dBIL/unit, where:

$$ = Total barrier cost, based upon a $50[6] per square foot cost.
DBIL = Average insertion loss of protected dwelling units, in dB(A)
unit = Number of benefited dwelling units in the study zone

The CEI is calculated by dividing the sound wall cost by the average insertion loss (the average of individual insertion losses at each receptor location in the study zone with a 5 dB(A) insertion loss or greater) and by the number of dwellings in the study zone that receive a 5 dB(A) insertion loss or greater. The individual insertion losses come from modeling outputs.

The sound wall cost is determined by multiplying the square footage of the sound wall obtained from TNM by $50 per square foot. It should be noted that both the CEI of $8,400 and the wall costs of $50 per square foot were developed from construction cost from 2010.

[6] The sound wall cost of $50 per square foot is based on historical construction bid data.

Noise Abatement Evaluation

The noise analysis determined that 24 receptor locations will be impacted by highway noise under the Build condition. The noise evaluation investigated the engineering and acoustical feasibility and reasonableness of providing noise attenuation measures within the Project area following MassDOT's guidance and procedures.

Since receptor locations within the study area were determined to experience noise impacts associated with highway traffic noise, the following potential noise mitigation strategies were evaluated:

- traffic management,
- acquisition of land for buffer, vegetation or landscaping, and
- sound walls.

Traffic management is not a feasible mitigation measure because Route 128 is a limited access principal arterial carrying over 5,000 vehicles during the peak hour. The acquisition of additional land for an earthen-berm or for a buffer zone was determined to not be feasible or reasonable due to limited space between the receptor locations and Route 128.

The feasibility and reasonableness of sound walls located on the northbound and southbound sides of Route 128, as shown in Figure 4, were evaluated following MassDOT's guidelines. Two sound walls were determined to meet MassDOT's feasibility and reasonableness criteria for providing noise abatement. With the sound walls located parallel to one another, both sound walls should have absorptive properties to minimize the reflection of sound waves across the highway. The following is a discussion of the specific criteria:

Engineering Feasibility

- There is sufficient space within the right-of-way to construct a continuous sound wall along both sides of Route 128 to protect the abutting residential neighborhoods.

Acoustical Feasibility

- Both sound walls will provide at least 5 dB(A) of reduction to more than 50 percent of front row impacted receptors as required by MassDOT's noise abatement policy.

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Figure 4
Proposed Sound Walls

Reasonableness

- Sound walls along both the northbound and southbound sides of Route 128 could be constructed to achieve MassDOT's design goal of 10 dB(A) for at least one front row receptor. With dense residential neighborhoods abutting Route 128, both sound walls would also be considered cost effective as sufficient receptor locations would achieve adequate benefits.

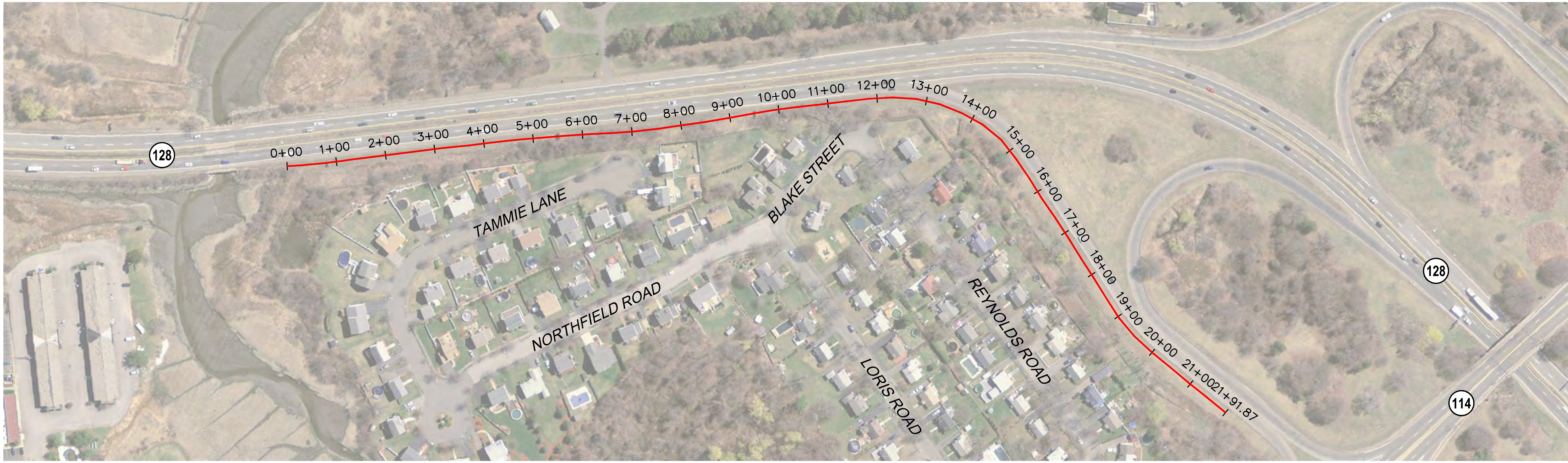
Table 5 summarizes the parameters of the proposed sound walls. Figures 5A and 5B presents profile of the proposed sound walls. Figures 6A and 6B presents the sound levels and insertion loss associated with the proposed sound walls.

Table 5
Proposed Sound Wall Parameters

Sound Wall Location	Benefited Residential Units	Average Insertion Loss, dB(A)	Average Wall Height (ft)	Wall Length (ft)	CEI	Cost Effective (< $8,400)
Tammie Ln/Reynolds Rd	38	7.6	14.7	2,192	$5,598	Yes
Sabino Farm Rd/Sheffield Dr	20	7.6	14.7	1,729	$8,361	Yes

Route 128
Peabody Noise Barrier

Figure 5A
Tammie Lane/Reynolds Road Sound Wall Profile

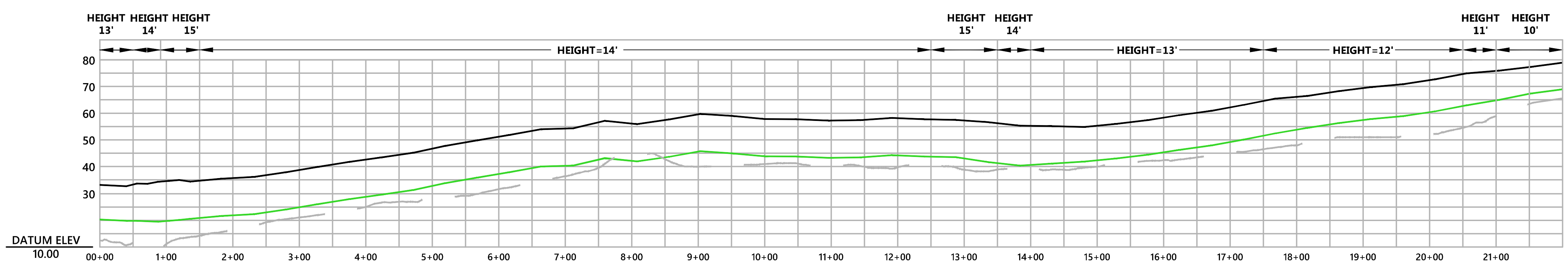


Plan View

0 100 200 Feet

LEGEND

- BARRIER LOCATION
- BARRIER BASE
- BARRIER TOP
- 100' OFFSET FROM BARRIER



Profile

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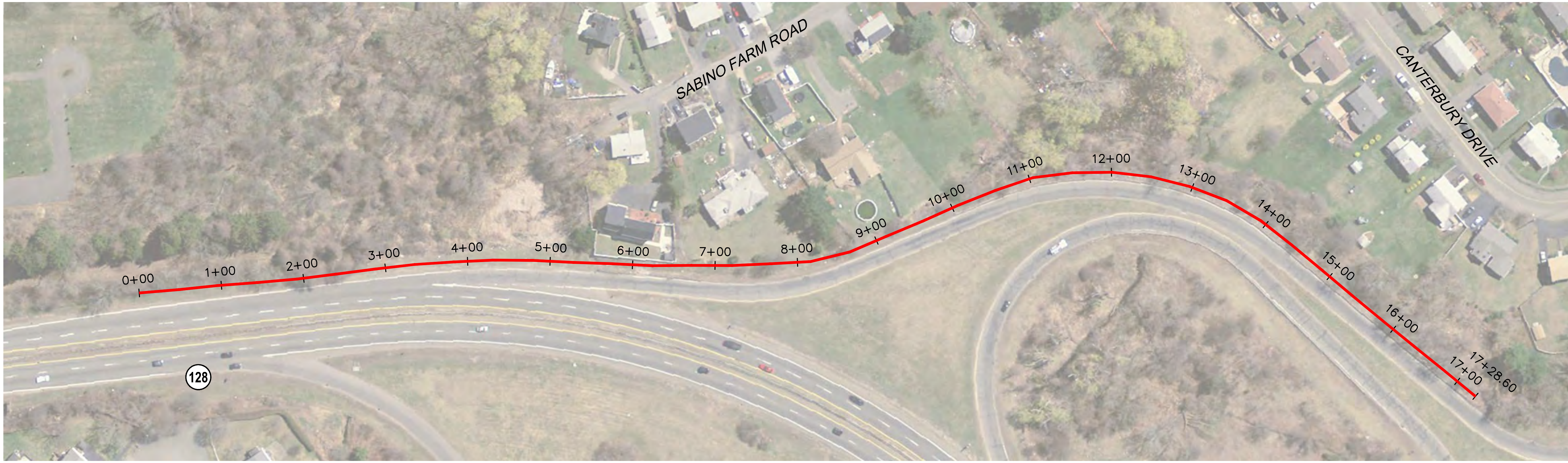
Route 128 Peabody Noise Barrier

Figure 5B Sabino Farm Road/Sheffield Drive Sound Wall Profile

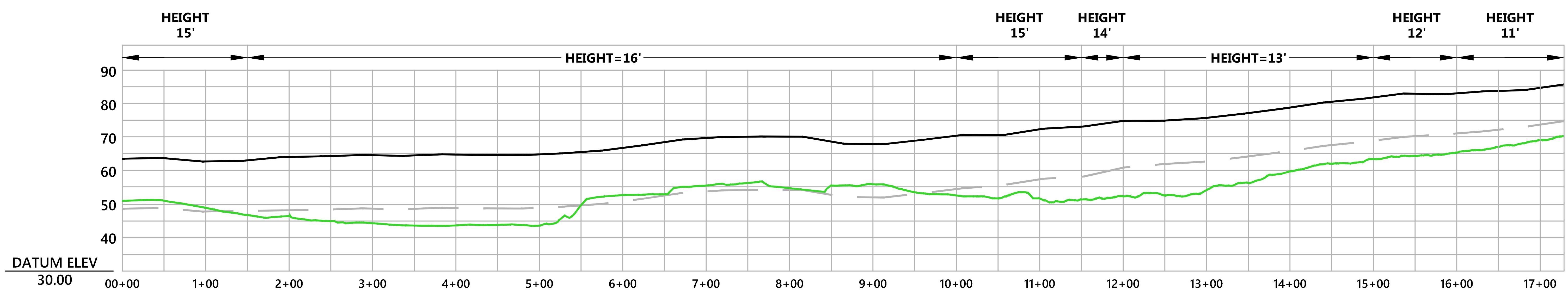


LEGEND

- BARRIER LOCATION
- BARRIER BASE
- BARRIER TOP
- 20' OFFSET FROM BARRIER

Plan View

0 60 120 Feet



Profile

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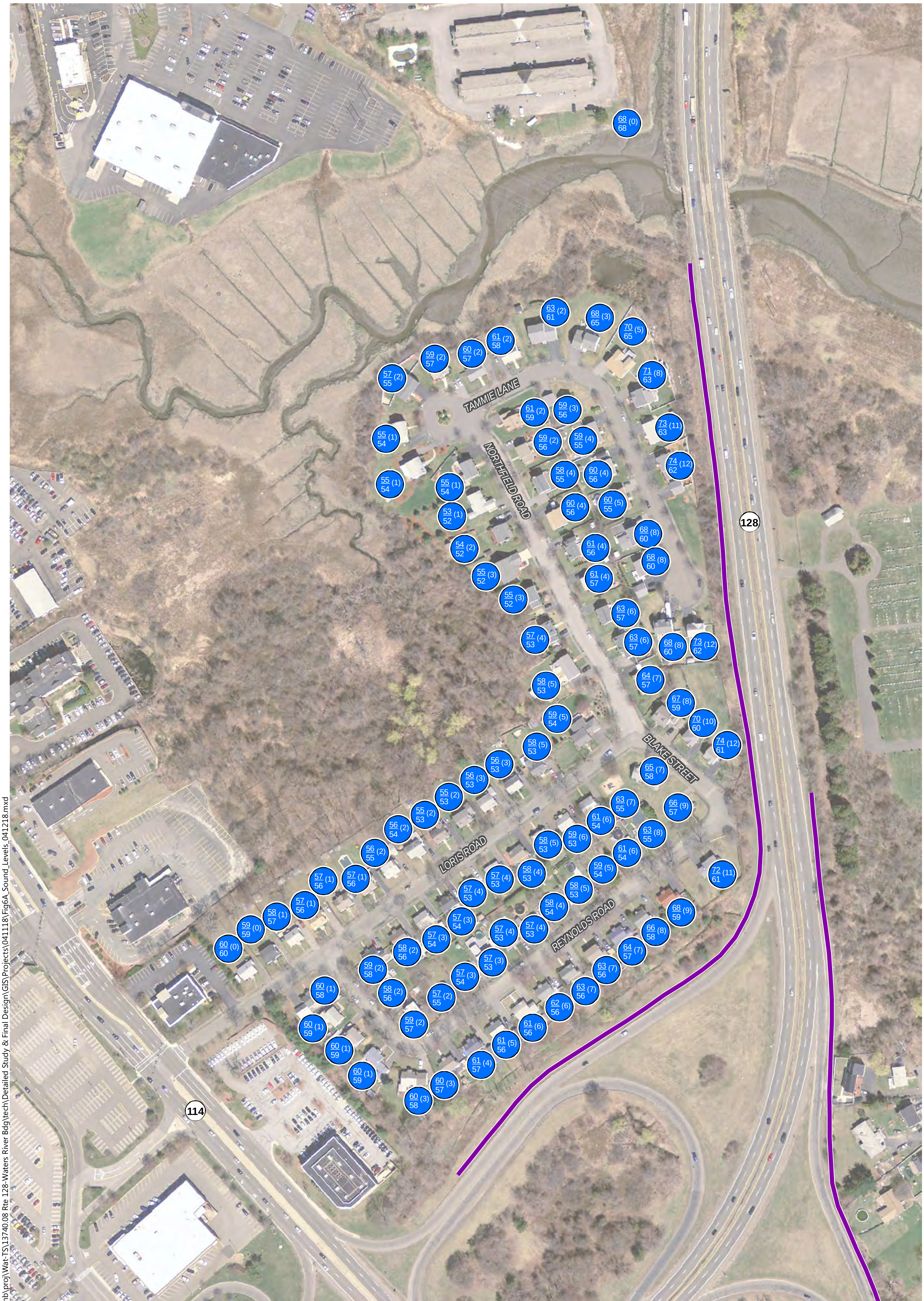

0 50 100 200 Feet

Route 128 Bridge Over Waters River | Danvers/Peabody, MA

Figure 6A
Tammie Lane/Reynolds Road
Sound Levels

X/Y (Z) Receptor Location Sound Levels

Proposed Sound Wall

X: Future Build Sound Level
Y: Sound Level With Sound Wall
Z: Insertion Loss

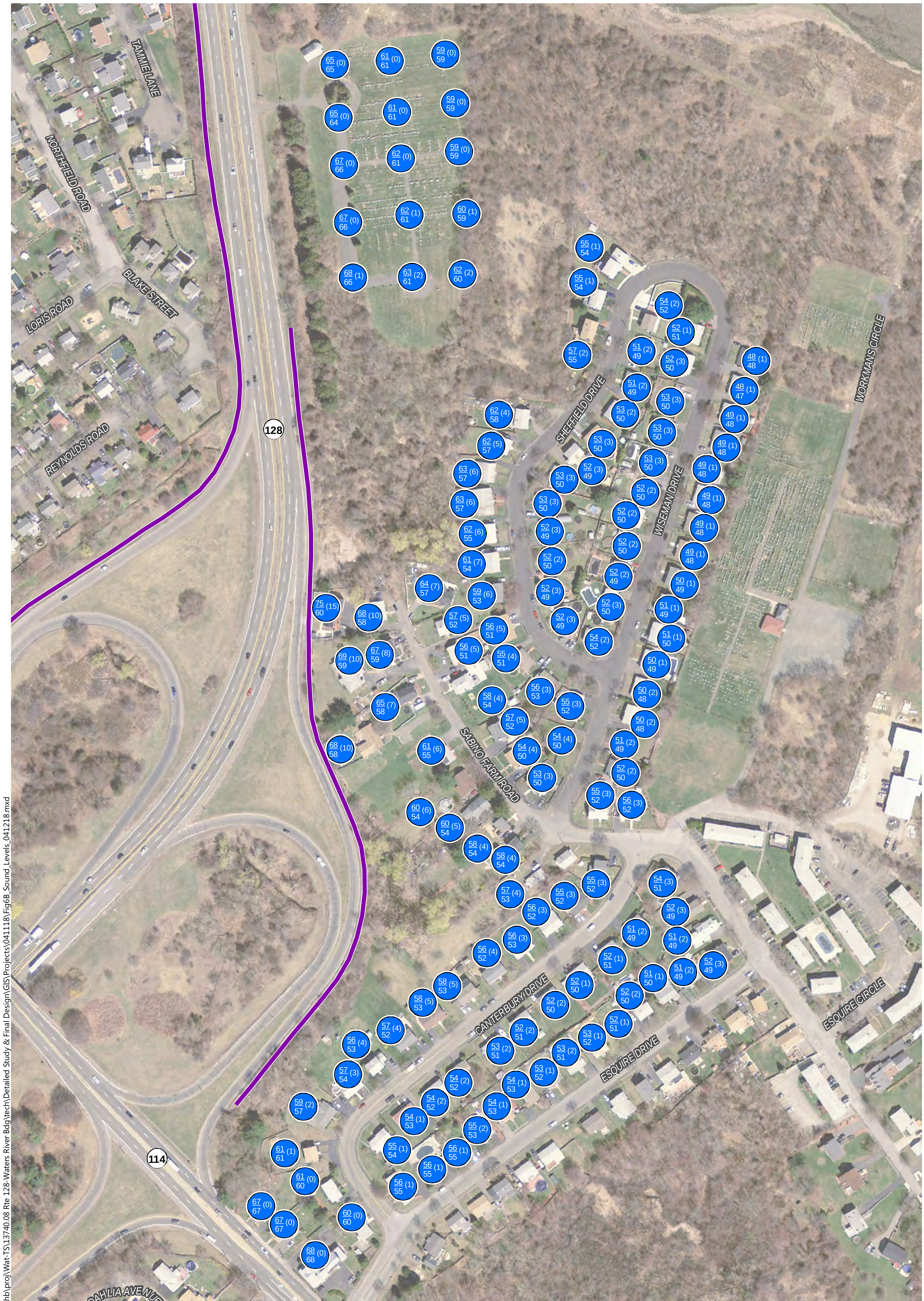

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Figure 6B
Sabino Farm Road/Sheffield Drive
Sound Levels

X/Y (Z) Receptor Location Sound Levels

Proposed Sound Wall

X: Future Build Sound Level
Y: Sound Level With Sound Wall
Z: Insertion Loss

Conclusion

The noise analysis evaluated sound levels associated with the proposed bridge improvement project along Route 128 in Peabody and Danvers. The noise analysis identified 24 impacted receptor locations under the 2036 Build Condition.

Since the sound levels exceed MassDOT's NAC, noise mitigation measures were evaluated in accordance with MassDOT's guidelines. Two sound walls were determined to meet MassDOT's feasibility and reasonableness criteria. Therefore, these two sound walls are recommended for construction as part of the roadway improvement project. Absorptive material should be incorporated into the design to minimize potential reflections of sound waves attributed to the parallel sound walls.

However, a factor, not discussed above, in determining the reasonableness of the proposed sound walls is the viewpoint of the benefitted receptors in the abutting neighborhoods. MassDOT will only construct the sound walls if 67 percent of the weighted total number of property owners/residents votes in favor of the sound walls. A public informational meeting will be held to present and discuss the noise impacts from the project and to obtain the benefitted property owners/residents' inputs in the development of the sound walls. A survey of the desires of the benefitted property owners/residents will be conducted by mail. The proposed sound walls will not be considered a reasonable noise abatement measures unless 67 percent votes are in favor of the proposed measures.