Highway Noise Technical Report

Route 17/Route 9 (State Project #0082-0316)

Middletown, CT

PREPARED FOR

Connecticut Department of Transportation
Office of Environmental Planning
Bureau of Policy & Planning
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December 2021

This highway noise study has been carried out in accordance with Federal Highway Administration 23 CFR 772 Noise Standard at 23 Code of Federal Regulations (CFR) Part 772.

Noise Analysis Concurrence

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Concurrence: ________________________________ Date: ________________

Kurt A. Salmoiraghi, P.E.
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Executive Summary

The Reconfiguration of the Route 17 On-ramp to Route 9 Northbound Project is located in the City of Middletown. The proposed work includes providing a full-length acceleration lane for Route 17 northbound traffic to merge onto Route 9 north. Extending the on-ramp will require retaining walls on the east side to reduce impacts to wetlands and Harbor Park.

Noise monitoring and simultaneous traffic counts by vehicle classification were conducted at eight receptor locations in March of 2021 in conformance with FHWA's Noise Measurement Field Guide Report FHWA-HEP-18-066 (FHWA, 2018).

Existing (2019), design-year No Build (2045) and design-year Build (2045) noise predictions have been made using the FHWA's Traffic Noise Model (TNM) version 2.5. The sound levels and impact at noise sensitive land uses are presented in the summary table below.

Summary of Noise Levels for Noise Sensitive Land Uses

	2019 Existing		2045 No Build		2045 Build	
NAC	Sound Levels (dBA)	Impacted Receivers (Receptors)	Sound Levels (dBA)	Impacted Receivers (Receptors)	Sound Levels (dBA)	Impacted Receivers (Receptors)
B	45 – 73	27 (36)	46 – 73	39 (50)	46 – 74	64 (77)
C	47 – 78	14 (7.2)	48 – 78	14 (7.2)	48 – 78	14 (7.2)

Source: VHB, 2021.

A noise wall approximately 480 feet long and heights between 8 and 22 feet tall was evaluated to abate noise impact in the Flower Street area. A 14-foot-tall wall would have the optimal acoustical and cost effectiveness. The wall would benefit 16 receptors including 14 of the 18 impacted receptors. The wall would provide an average of 8.9 dBA of insertion loss (10.9 dBA maximum) at benefited receptors. The wall would benefit 78% of impacted receptors and achieve the Noise Reduction Design Goal (NRDG) of 7 dBA or more at 88% (14 of 16) benefitted receptors. The noise wall would cost $389,100 based on $60 per square foot which would be $24,881 per benefited receptor, which is less than the CEI of $55,000. Therefore, the noise wall would be feasible and reasonable and is recommended for construction. On behalf of CTDOT, VHB will solicit and review the viewpoints of benefitted receptors at this location to determine whether they are in favor of the noise wall being constructed. Additionally, VHB will attend public meetings to provide responses and information regarding the noise wall construction.

A noise wall approximately 970 feet long and heights between 8 and 22 feet tall was evaluated in the Maple Street area. A 16-foot-tall wall would have the optimal acoustical and cost effectiveness. The wall would benefit 12 receptors including all seven impacted receptors. The wall would provide an average of 7.0 dBA of insertion loss (9.5 dBA max) at benefited receptors. The wall would benefit 100% of impacted receptors but would achieve the NRDG of 7 dBA at only 50% (6 of 12) benefitted receptors. The noise wall would cost $933,720 based on $60 per square foot which would be $77,810 per benefited receptor which exceeds the CEI of $55,000. The noise wall would be feasible since it provides benefit to more than 2/3rds of the impact receptors but would not be reasonable since it does not achieve the NRDG at 2/3rds or more of benefited receptors and exceeds the CEI. Therefore, the noise wall would not be recommended for construction.

A noise wall approximately 2,700 feet long and heights between 6 and 22 feet tall was evaluated to abate noise impact at Harbor Park. The 10-foot-tall wall would have the optimal acoustical and cost effectiveness. The number of receptors has been determined based on the estimated hours of human use of the park. The wall would benefit 9.8 receptors including 7.2 impacted receptors and 2.6 receptors that would not be impacted. The wall would benefit 100% of the impacted receptors (which exceeds the 2/3rds minimum requirement) and would achieve the NRDG of 7 dBA at 74% of benefited receptors (which exceeds the 2/3rds minimum requirement). The wall would provide an average of 8.4 dBA of insertion loss to benefited receptors. The barrier would cost $1,662,580 based on $60 per square foot. The CEI would be $322 per decibel of insertion loss per person-hour of park use ($$/dBIL/person-hour) which exceeds the CTDOT noise policy of $170. Therefore, the noise wall would be feasible, but not reasonable, and would not be recommended for construction.

A noise wall approximately 770 feet long and heights between 8 and 22 feet tall was evaluated to abate noise impact at 111 deKoven Drive. The 22-foot-tall noise wall would have the optimal acoustical and cost effectiveness. The wall would benefit up to 41 receptors and would achieve the NRDG of 7 dBA at 18 of the 41 benefitted receptors. The 22-foot-tall noise wall would cost approximately $1,010,520 and would have a CEI of $24,647 per benefited receptor. However, the noise wall would not benefit 2/3rds or more of the impacts or meet the NRDG at 2/3rds or more of benefited receptors. Therefore, the noise wall would not be feasible or reasonable and is not recommended for construction.

A noise wall approximately 300 feet long and heights between 8 and 22 feet tall was evaluated to abate noise impact at South Main Street. The 22-foot-tall noise wall would have the optimal acoustical and cost effectiveness. The wall would benefit up to three receptors and would achieve the NRDG of 7 dBA at two of the four benefited receptors. The 22-foot-tall noise wall would cost approximately $395,940 and would have a CEI of $98,985 per benefited receptor. The noise wall would benefit 100% of the impacted receptors but would not meet the NRDG at 2/3rds or more of benefited receptors. Therefore, the noise wall would not be feasible or reasonable and is not recommended for construction.

Construction of the project would conform with the CTDOT Standard Specifications for Roads, Bridges, and Incidental Construction (Form 818).

One of the most effective means to prevent future traffic noise impacts is to promote noise-compatible land use planning for new developments. The compatibility of highways and neighboring local areas is essential for continued growth and can be achieved if local governments and developers require and practice noise-sensitive land-use planning.

The FHWA and CTDOT are responsible for all noise abatement considerations up until the "Date of Public Knowledge" of the project for all existing or permitted development. After this date, the Department is still responsible for analyzing changes in traffic noise impacts, when appropriate, but the Department is no longer responsible for providing noise abatement for new development which occurs adjacent to the proposed highway project. Provision of such noise abatement becomes the responsibility of local communities and private developers.

VHB contacted the Middletown Planning and Zoning Commission and reviewer their current application website to identify recently permitted projects that would introduce new buildings with noise-sensitive use or would modify existing buildings to facilitate noise-sensitive use. This review determined that the property at 80 East Main Street was recently approved for construction of a medical facility. This location has been evaluated as NAC D, based on the permitted land use.

Table of Contents

List of Tables

List of Figures

1. Introduction

1.1 Noise Study Overview

This technical report presents a summary of the proposed Project, noise background, regulatory context of the evaluation, noise abatement criteria, methodologies used to predict noise conditions, results of the highway noise assessment in accordance with the Connecticut Department of Transportation (CTDOT) noise policy and Federal Highway Administration's (FHWA) guidance, noise abatement recommendations, information on construction-period noise, and information for local government officials.

1.2 Project Description

The Reconfiguration of the Route 17 On-ramp to Route 9 Northbound Project is located in the City of Middletown. The proposed work includes providing a 1,000-foot, full-length, acceleration lane for Route 17 northbound traffic to merge onto Route 9 north. Extending the on-ramp will require retaining walls on the east side to reduce impacts to wetlands and Harbor Park. The longer acceleration lane will conflict with the existing Route 9 north access from Harbor Park and therefore it will be removed as part of this project. The superstructure of Bridge No. 00638 will be replaced in order to widen for the acceleration lane and to correct design elements that prevent proper bridge maintenance. With the addition of a full-length acceleration lane and the realignment of River Road, this project is a Type I Project requiring a noise abatement analysis according to Federal Highway Administration (FHWA) regulation 23 CFR 772 and the Connecticut Department of Transportation (CTDOT) Highway Traffic Noise Abatement Policy for Projects Funded by the Federal Highway Administration.

2. Noise Background and Criteria

This section presents a background on noise including the metrics used to describe noise conditions, the regulatory context of the highway noise study and the criteria used to assess potential highway noise effects and evaluate the need for noise abatement.

2.1 Noise Descriptors

Noise is typically defined as unwanted or undesirable sound, where sound is characterized by small air pressure fluctuations above and below the atmospheric pressure. The basic parameters of environmental noise that affect human response are (1) intensity or level, (2) frequency content and (3) variation with time. The first parameter is determined by how greatly the sound pressure fluctuates above and below the atmospheric pressure and is expressed on a compressed scale in units of decibels. By using this scale, the range of normally encountered sound can be expressed by values between zero and 120 decibels. On a relative basis, a three-decibel change in sound level generally represents a barely noticeable change outside the laboratory, whereas a 10-decibel change in sound level would typically be perceived as a doubling (or halving) in the loudness of a sound.

The frequency content of sound is related to the tone or pitch and is expressed based on the rate of the air pressure fluctuation in terms of cycles per second (called Hertz and abbreviated as Hz). The human ear can detect a wide range of frequencies from about 20 Hz to 17,000 Hz. However, because the sensitivity of human hearing varies with frequency, the A-weighting system is commonly used when measuring environmental noise to provide a single number descriptor that correlates with human subjective response. Sound levels measured using this weighting system are called "A-weighted" sound levels and are expressed in decibel notation as "dBA." The A-weighted sound level is widely accepted by acousticians as a proper unit for describing environmental noise.

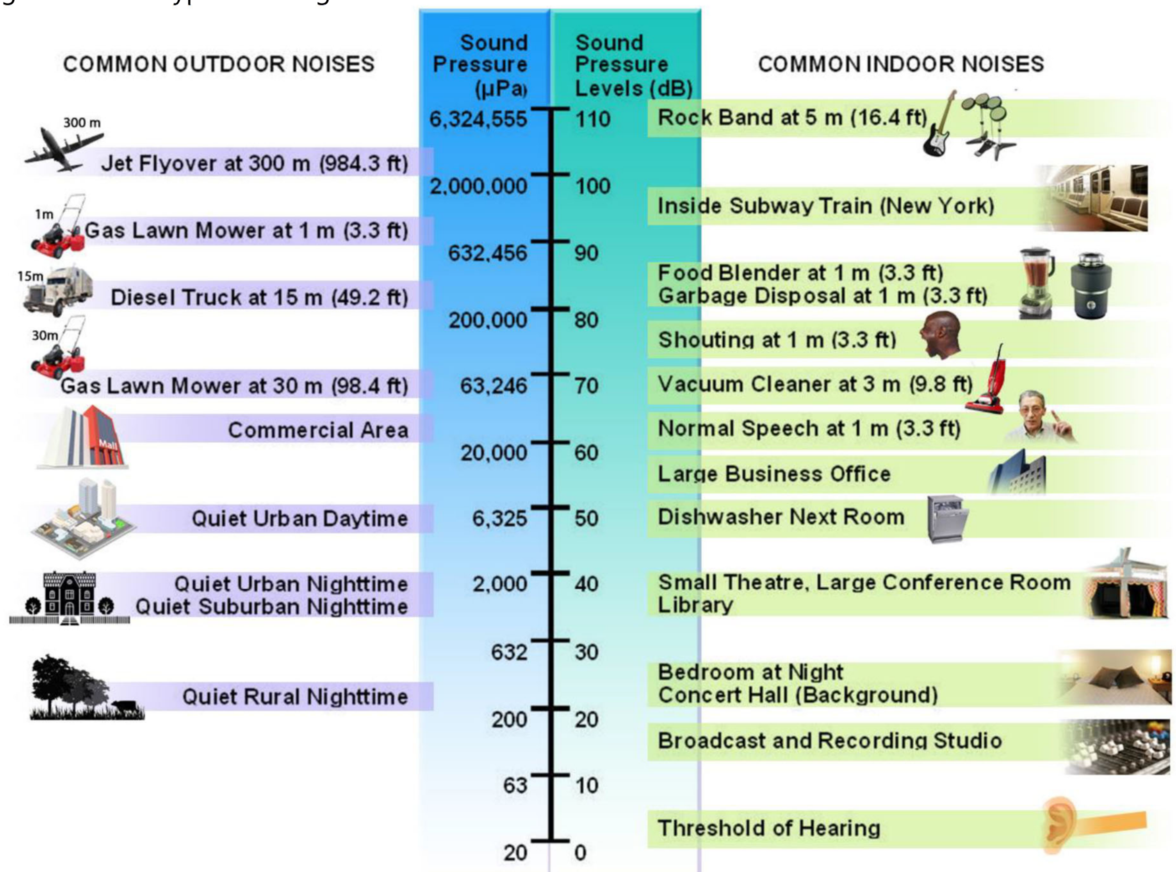
Because sound levels fluctuate from moment to moment, it is important to characterize the range of levels that may exist over a period of time. This is commonly done by using the following sound level metrics:

- **L_{max}** is the maximum instantaneous A-weighted sound level. The L_{max} represents the highest sound level generated by a source.
- **L_{eq}** is the energy-average sound level. The L_{eq} is a single value that is equivalent in sound energy to the fluctuating levels over a period of time. Leq is commonly used to describe environmental noise and relates well to human annoyance.
- Statistical sound levels such as **L_{10}, L_{50}, L_{90}** describe the sound level which are exceeded for that percent of time during a given time period. For example, the L_{10} sound level represents the higher end of the range of sound levels since sound only exceeds that level 10% of the time. Conversely, the L_{90} sound level represents the lower end of the range of sound levels.

Because sound levels are measured in decibels, adding sound levels is not linear. For example, when there are two equal sources of sound added together, the overall level increases 3 dB (e.g., 60 dB plus 60 dB equals 63 dB). Additionally, research indicates the following general relationships between A-weighted sound level and human perception:

- A 3-dB increase is a doubling of acoustic energy and is the threshold of perceptibility to the average person.
- A 10-dB increase is a tenfold increase in acoustic energy but is perceived as a doubling in loudness to the average person.

Figure 1 shows typical A-weighted maximum noise levels for common outdoor and indoor noise sources.



Source: FHWA, 2018.

Figure 1. Typical A-weighted Sound Levels

2.2 Regulatory Context

This highway noise analysis was prepared in accordance with FHWA noise regulations, 23 CFR 772 (Procedures for Abatement of Highway Traffic and Construction Noise), and the CTDOT "Highway Traffic Noise Abatement Policy for Projects Funded by the Federal Highway Administration" dated May 2017.

2.2.1 FHWA Noise Regulation and CTDOT Noise Policy

FHWA regulation 23 CFR 772 describes the procedures required for highway noise studies to help protect the public health and welfare, to supply abatement criteria, and to establish the requirements for information to be given to local officials for use in the planning and design of highways that are funded or otherwise subject to FHWA approval. This federal regulation requires CTDOT to have a noise policy that implements the requirements of the regulation.

The CTDOT highway noise policies and procedures apply to all highway construction projects that receive federal aid or are otherwise approved by the FHWA. A Type I project is defined as one that includes construction of a highway on new location, the physical alteration of an existing highway that results in substantial horizontal or vertical alterations, the addition of through-traffic lanes, the addition of auxiliary lanes, the addition or relocation of interchange lanes or ramps, restriping to add through-lane capacity, or substantial alterations to toll plaza, or rest stops. Substantial vertical alteration is defined as changes to a highway elevation that would expose line-of-sight between a receptor and the traffic noise sources. Substantial horizontal alteration is defined as relocating a highway so that the distance between the highway and the closest receptor is half that of the existing condition. If any portion of a project is determined to be a Type I project, then the entire project area is considered a Type I project.

The proposed Project meets the definition of a Type I highway project.

2.3 Noise Impact and Abatement Criteria

This section describes the noise abatement criteria that apply to the proposed project.

2.3.1 CTDOT Noise Abatement Criteria

FHWA has established Noise Abatement Criteria (NAC) to help protect public health, welfare, and livability from excessive vehicle traffic noise. The NAC are considered the upper limit of acceptable highway traffic noise for different types of land use Activity Categories. The NAC focus on levels where highway traffic noise could potentially interfere with speech communication in exterior areas and are used to evaluate whether noise abatement is needed for exterior areas of frequent human use.

In accordance with FHWA regulations, noise is evaluated at existing sensitive uses and tracts of land that have already been permitted for sensitive use. If tracts of land are not permitted for sensitive use, they are not eligible for potential noise mitigation, but future noise conditions may be evaluated for informational and development planning purposes.

Table 1 shows the FHWA Activity Categories, the description of the type of land use within the category, and the NAC based on loudest-hour Leq noise levels. When noise levels approach or exceed the NAC, then abatement must be considered. These abatement criteria apply to design-year noise conditions for a proposed Project regardless of whether the proposed Project would increase or decrease noise conditions compared to the existing or No Action condition.

CTDOT implements the NAC by defining that "approaching the NAC" means noise levels are 1 dBA below the NAC criteria. For example, if design-year noise levels would be 66 dBA (Leq) at a residential receptor, that would approach the NAC of 67 dBA (Leq) and noise abatement must be considered.

CTDOT also defines a substantial increase in noise as an increase in design-year noise levels that is greater than 15 dBA compared to existing levels. A substantial noise increase does not depend on whether the design-year noise levels approach or exceed the absolute NAC.

Potential noise abatement measures must be considered for areas where noise levels approach or exceed the NAC. Further information on noise abatement is presented in Section 6.

Table 1. Noise Abatement Criteria (NAC)

Activity Category	Loudest-Hour Noise Level (Leq)	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.

*Includes undeveloped lands permitted for this Activity Category

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

3. Noise Prediction Methodology

The methodology for evaluating noise includes identifying noise-sensitive land uses, conducting measurements at key receptor locations and modeling noise at all receptors within the study areas. The Study Area includes a diversity of land uses including residential, commercial, and institutional buildings. Receptors and their associated land use have been identified using statewide parcel and land use code data, aerial photography, and field visits.

Noise receptors are primarily located at ground-level outdoor areas of frequent human use. If an upper-floor multi-family residence has exterior areas such as balconies or roof decks, then receptors will be located at these upper elevations. For some institutional facilities, such as hospitals, schools, libraries, places of worship and recording studios, (Activity Category D) receptors may be located inside the building if there are no areas of frequent outdoor human use. A building noise reduction factor of 25 dBA has been applied to determine impacts at NAC D receptors as described in Table 2.

Table 2. Building Noise Reduction Factors

Building Type	Window Condition	Noise Reduction Due to Exterior of the Structure
All	Open	10 dB
Light Frame	Ordinary Sash (Closed)	20 dB
	Storm Windows	25 dB
Masonry	Single Glazed	25 dB
	Double Glazed	35 dB

Source: FHWA publication FHWA-DP-45-1R, Sound Procedures for Measuring Highway Noise: Final Report provides procedures to measure building noise reductions.

Table 3 presents the numbers of receivers (modeling locations) and receptors (a discrete or representative location of a noise sensitive area for any of the FHWA land uses) dwelling units represented by each area. Most of the receptor locations fall into the FHWA's Activity Category B, which has a noise abatement criterion of 67 dBA (Leq). Dwelling units for receptors have been determined based on field visits, desktop reviews, and supporting GIS data from the City of Middletown – GIS Application.

Noise monitoring was conducted to characterize existing sound levels in the study area. Noise monitoring was conducted at eight receptor locations which are representative of noise exposure throughout the Study Area. Noise measurements were collected in March of 2021 in conformance with FHWA noise monitoring guidelines.[1] The sound level meters used (Larson Davis SoundExpert LxT and 831)

[1] *Measurement of Highway-Related Noise*, US Department of Transportation, Federal Highway Administration, FHWA-PD-96-046, May 1996.

met the Type 1 American National Standards Institute standards and were calibrated by a laboratory traceable to the National Institute of Standards and Technology, as well as in the field prior to and after the measurements. Traffic counts were conducted during the measurements including volumes, vehicle mix (automobiles, medium trucks, and heavy trucks), and operating speeds were measured.

Existing (2019), design-year No Build (2045) and design-year Build (2045) noise predictions have been made using the FHWA's Traffic Noise Model (TNM) version 2.5. The existing TNM model has been validated by comparing model results to the measured sound level. Modeled sound levels which are within 3 dBA of measured levels demonstrate that the TNM model has been validated in accordance with FHWA and CTDOT guidance.

Table 3. Receptors and Receivers by FHWA Activity Category

Activity Category	Receiver	Receptors
A	0	0
B	197	328
C	47	37.8
D	5	5
E	1	1
F	71	0
G	1	0

Source: VHB, 2021.

4. Existing Conditions

This section of the report includes a description of the existing noise conditions in the study area. Existing conditions have been evaluated based on noise measurements and a validated TNM. Noise and vibration-sensitive receptors in the study area primarily includes residences, commercial properties, and schools.

4.1 Existing Noise Conditions

4.1.1 Noise Measurement Results

Noise monitoring has been conducted at specific locations where measurements can be used to validate noise predictions from TNM. The sound level meters used met the Type 1 American National Standards Institute standards and were calibrated by a laboratory traceable to the National Institute of Standards and Technology, as well as in the field prior to and after the measurements. It is typically not possible to conduct noise monitoring at all receptor locations in a study area due to limited resources or access. As such, FHWA and CTDOT have developed a process for creating a validated noise model which demonstrates that the TNM results are accurate. The measurements will validate the accuracy of the TNM when the results are within 3 dBA. If the measurements and modeling are not within 3 dBA, the model may need to be adjusted (i.e., including terrain lines or intervening buildings) to validate the model.

Table 4 presents the results of the noise monitoring and the predicted results from the TNM at the monitoring locations with the traffic conditions that existed during the measurements. As shown in Table 4, the model and measurement results are within 3 dBA at all locations and the existing TNM provides accurate results.

Table 4. Noise Model Validation Data

		Noise Levels dBA		
Site	**Location**	**Measured**	**Predicted**	**Difference**
M1	Maplewood Terrace	61.2	61.7	0.5
M2	Maple Street	58.1	59.4	1.3
M3	Flower Street	62.2	62.8	0.6
M4	Hubbard Park	56.5	55.9	-0.6
M5a	Main Street North	66.7	65.2	-1.5
M5b	Main Street South	65.5	64.0	-1.5
M6	River Street	61.1	61.3	0.2
M7	Harbor Park	65.4	64.7	-0.7

Note: Difference is the predicted level minus monitored level.

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Traffic Noise Analysis
State Project No. 0082-0316
Middletown, Connecticut

Figure 2
Noise Measurement Locations
December 2021

4.1.2 Existing Noise Predictions

Loudest-hour existing (2019) traffic data was incorporated into the validated TNM model and was used to calculate the existing noise levels for all receptor locations in the study area. The results presented in Table 5 summarize the range of existing noise-sensitive land use for each Activity Category. The highest noise levels generally occur at front-row receptors adjacent to Main Street and the lower noise levels occur farther from major roadways behind intervening objects such as terrain lines and buildings. Overall, existing noise levels range from 45 to 78 dBA.

Table 5 also presents the number of receptors and receivers that approach or exceed the NAC by Activity Category. This table shows that sound levels generally range from 45 to 73 dBA at Activity Category B land uses with 27 receivers and 36 receptors currently approaching or exceeding the NAC. Sound levels range from 47 to 78 dBA at Activity Category C land uses with 14 receivers and 7.2 receptors currently approaching or exceeding the NAC.

See the Appendix for existing (2019), design-year (2045) No Build, and design-year (2045) Build sound levels for each receptor.

Table 5. Existing Noise Level Summary

Activity Category	Existing Noise Levels (dBA, Leq)	Receivers Approaching or Exceeding NAC	Receptors Approaching or Exceeding NAC
A	N/A	0	0
B	45 to 73	27	36
C	47 to 78	14	7.2
D	56 to 64 (exterior) 31 to 39 (interior)	0	0
E	63	0	0
F	46 to 70	N/A	N/A
G	62	N/A	N/A

Source: VHB, 2021.

5. Noise Analysis

5.1 No Build Alternative

Noise levels for the design-year No Build (2045) condition would be similar to Existing conditions ranging from 46 to 78 dBA Leq at all receptors. General background growth in traffic volumes would result in a minimal increase in noise of up to 1 dBA. Table6summarizes the range of No Build noise levels at each Activity Category and the number of receivers and receptors that would approach or exceed the NAC. This table shows that No Build sound levels generally range from 46 to 73 dBA at Activity Category B land uses with 39 receivers and 50 receptors currently approaching or exceeding the NAC. Sound levels range from 48 to 78 dBA at Activity Category C land uses with 14 receivers and 7.2 receptors currently approaching or exceeding the NAC.

Table 6. No Build Noise Level Summary

Activity Category	No Build Noise Levels (dBA, Leq)	Receivers Approaching or Exceeding NAC	Receptors Approaching or Exceeding NAC
A	N/A	0	0
B	46 to 73	39	50
C	48 to 78	14	7.2
D	56 to 65 (exterior) 31 to 40 (interior)	0	0
E	64	0	0
F	47 to 71	N/A	N/A
G	63	N/A	N/A

Source: VHB, 2021.

5.2 Build Alternative

This section presents the results of the highway noise analysis for the design-year build (2045) traffic volumes. Table 7 presents the range of design-year build noise levels, the applicable threshold to approach or exceed the NAC, and an assessment of whether noise levels would exceed the NAC. This table shows that Build condition sound levels generally range from 46 to 74 dBA at Activity Category B land uses with 64 receivers and 77 receptors currently approaching or exceeding the NAC. Sound levels range from 48 to 78 dBA at Activity Category C land uses with 14 receivers and 7.2 receptors currently approaching or exceeding the NAC.

Table 7. Build Noise Level Summary

Activity Category	Build Noise Levels (dBA, Leq)	Receivers Approaching or Exceeding NAC	Receptors Approaching or Exceeding NAC
A	N/A	0	0
B	46 to 74	64	77
C	48 to 78	14	7.2
D	57 to 65 (exterior) 32 to 40 (interior)	0	0
E	64	0	0
F	48 to 71	N/A	N/A
G	62	N/A	N/A

Source: VHB, 2021.

The following describes the noise analysis results by project area.

Western Project Terminus to Main Street

Noise receptors in this area primarily include residences on Cooley Street, Silver Street, Pleasant Street, Crescent Street, and Main Street and commercial/retail properties (Activity Category F) on Main Street, Pleasant Street, and Crescent Street. The Middlesex Hospital (Activity Category D) is in this area. Design-year Build noise levels at some of the residences on Main Street approach or exceed the NAC due to the contribution of noise from that roadway, but all other receptors do not approach or exceed the NAC. Noise barriers for impacts on Main Street would not be feasible due to sidewalks and access to driveways.

Main Street to East Main Street

Noise receptors in this area include residences on Flower Street adjacent to the Route 17 eastbound on-ramp, Main Street, East Main Street, Mill Street, MacDonough Place (assisted living facility), West Silver Street, Chestnut Street, and Union Street. There is a medical office (Activity Category D) located here. Design-year Build noise levels would approach or exceed the NAC at a few residences on Main Street and on Flower Street adjacent to the Route 17 eastbound on-ramp. Noise barriers for impacts on Main Street would not be feasible due to sidewalks and access to driveways, but noise abatement, including a noise barrier, has been evaluated for impacts on Flower Street (see Section 6, Noise Wall 1). Noise levels would not approach or exceed the NAC at the Hubbard Park.

East Main Street to Walnut Street (South of Route 9)

Noise receptors in this area include residences on Maple Street, Walnut Street and Maple Place. There are commercial (Activity Category F) receptors on Maple Street and East Main Street as well as undeveloped residential lots (Activity Category G) on Maple Place. Design-year Build noise levels would approach or exceed the NAC at residences on the north side of Maple Street. Receptors have been modeled approximately 300 feet beyond the physical extent of the project to include all potential noise impacts and to evaluate noise abatement for this group of residences. A noise wall (Noise Wall 2) has been evaluated for residential impacts in this area.

North of Route 9 and Route 17 Interchange to Northern Project Terminus

Noise receptors in this area include commercial (Activity Category F) properties on East Main Street and Court Street and a multi-family residential building at 111 deKoven Drive. Activity Category C land use includes Harbor Park and the boat loading dock area.

Design-year Build noise levels would approach or exceed the NAC at 40 upper floor dwelling units at the multi-family building at 111 deKoven Drive and portions of Harbor Park. Design-year Build noise levels would approach or exceed the NAC at Harbor Park. Noise abatement has been evaluated for noise impacts at Harbor Park (Noise Wall 3) and the multi-family building (Noise Wall 4) as presented in Section 6.

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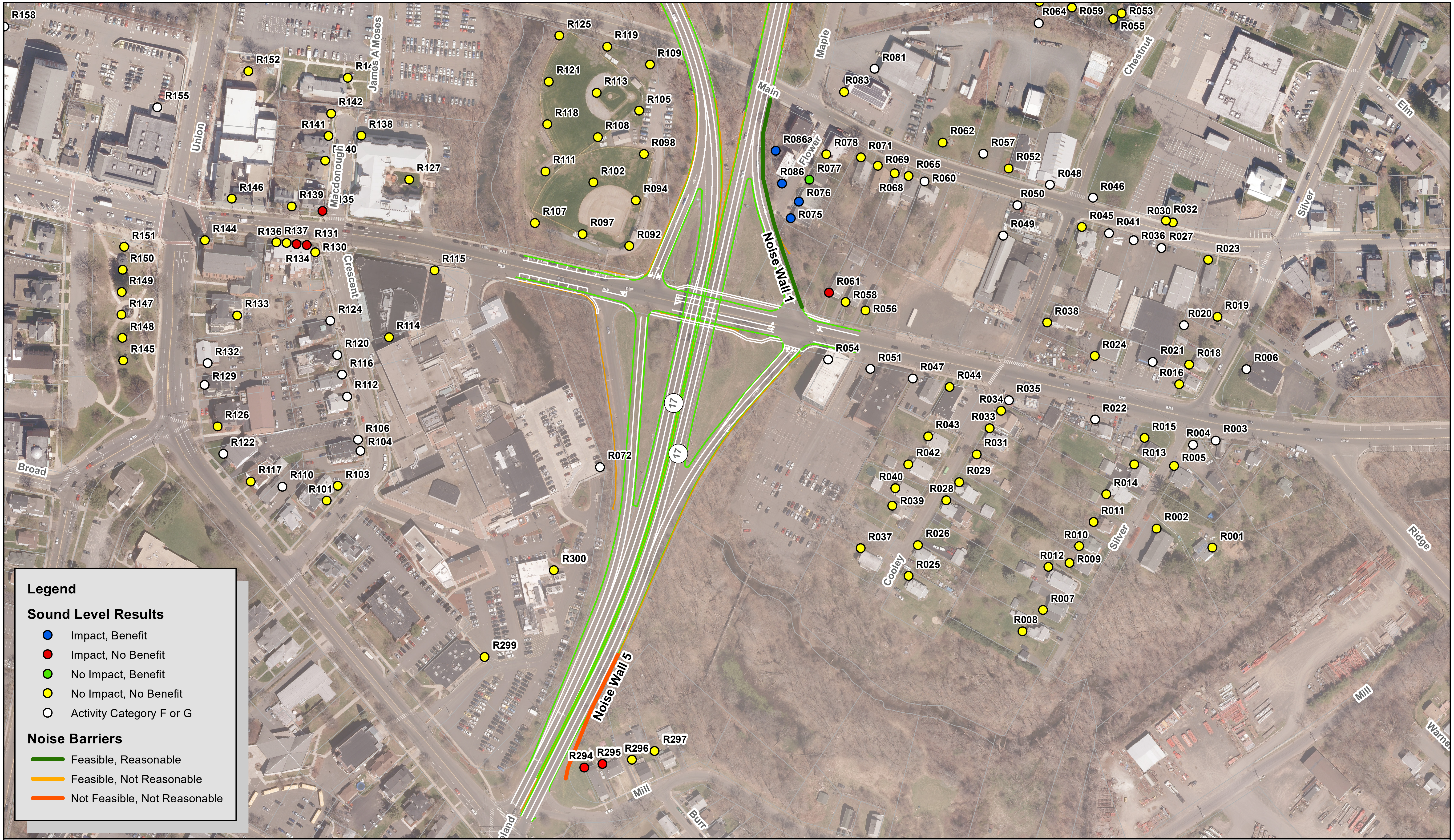

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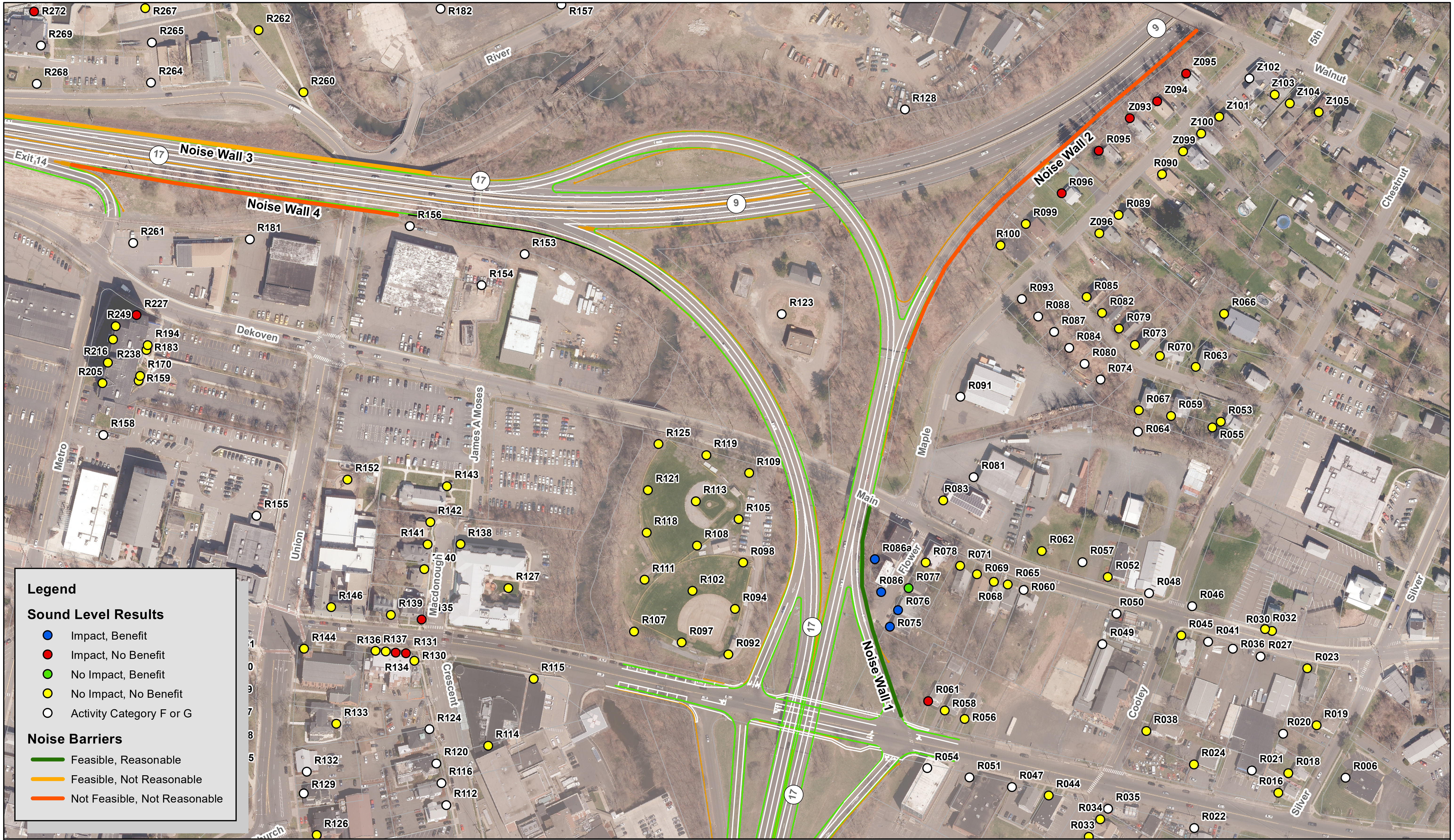
Traffic Noise Analysis
State Project No. 0082-0316
Middletown, Connecticut

Figure 3
Noise Abatement Analysis
December 2021



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Traffic Noise Analysis
State Project No. 0082-0316
Middletown, Connecticut

Figure 4
Noise Abatement Analysis
December 2021

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Traffic Noise Analysis
State Project No. 0082-0316
Middletown, Connecticut

Figure 5
Noise Abatement Analysis
December 2021

6. Noise Abatement

6.1 Noise Abatement Evaluation Methodology

Noise abatement must be considered for areas where there are receptors which exceed the CTDOT Noise Abatement Criteria (NAC). Potential noise abatement measures include traffic management measures, traffic control devices, vehicle-type restrictions, nighttime-use restrictions, reducing speeds, designated lanes, alteration of the horizontal or vertical alignment, construction of noise walls or berms, or noise insulation of public-use or non-profit institutional structures.

The feasibility and reasonableness of noise walls is evaluated according to CTDOT criteria in the Noise Policy. These criteria have been established to provide a consistent approach and procedure for providing noise abatement across the entire state. CTDOT's feasibility and reasonableness criteria address the following factors:

Engineering feasibility: A noise wall must be able to be constructed given the topography, roadway geometry, potential conflicts with utilities, access requirements, and maintenance needs. The noise wall must maintain safety requirements regarding clear zones, redirection of crash vehicles, snow removal, adequate sight distances, and fire access. Typically, a minimum of 10 feet is provided between the roadway and the noise wall for snow storage. The noise wall design should also consider potential environmental impacts to wetlands, historic properties, and park lands.

Acoustic feasibility: Noise abatement must provide 5 dBA of noise reduction or more to a minimum of 2/3rds of the impacted receptors to be acoustically effective.

Reasonableness: In accordance with 23 CFR 772 and CTDOT's Highway Traffic Noise Policy, the following combination of social, economic, and environmental factors must be evaluated for abatement to be considered reasonable.

- Benefited receptors are those that achieve a minimum noise reduction of 5 dBA.
- The Noise Reduction Design Goal (NRDG) of 7 dBA must be achieved by a minimum of 2/3rds of benefited receptors.
- Viewpoints of the benefited property owners and residents shall be solicited, and 2/3rds of the returned solicited viewpoints must be in favor of the abatement.
- For Activity Category B land use, the noise wall must have a Cost Effectiveness Index (CEI) of $55,000 per benefited receptor or less based on a cost of $60 per square foot.
- For Activity Category C, D, and E land uses, the noise wall must have a CEI of $170 per decibel of insertion loss per person-hour of usage.

Viewpoints of Benefitted Receptors: FHWA requires that the viewpoints of impacted residents be considered when reaching a decision on the reasonableness of an abatement measure chosen to reduce roadway noise. FHWA allows the Department to decide the methods used for obtaining the viewpoints of benefitted receptors and weighing their input to determine the reasonableness of an abatement measure.

Public involvement with a community regarding traffic noise impacts and possible noise abatement shall occur at the start of the noise study process and continue throughout the development of the project. CTDOT will present information on the nature of highway traffic noise impacts and discuss the effectiveness of noise abatement measures in attenuating traffic noise and the types of noise abatement measures that may be considered during the public informational meetings. Public involvement is conducted, and the concerns of the benefited property owners and residents are considered in the process for determining the likelihood of noise abatement measures. To date, two Public Information Meetings have been held - one in 2014 and one in 2016. No comments were received from the public regarding noise. A survey will be sent to the benefitted receptors within the project corridor to solicit viewpoints on the inclusion of proposed noise abatement under this Project.

6.2 Noise Abatement Analysis

The following summarizes the noise abatement analysis for all locations where design-year noise levels approach or exceed the NAC.

6.2.1 Flower Street – Noise Wall 1

A noise wall approximately 480 feet long and heights between 8 and 22 feet tall was evaluated to abate noise impact in the Flower Street area. There would be 18 impacted dwelling units at multi-family residences on Flower Street and a single-family residence on Main Street. The noise wall would be located along the shoulder of the Route 9/17 Northbound on-ramp.

A 14-foot-tall wall would have the optimal acoustical and cost effectiveness. The wall would benefit 16 receptors including 14 of the impacted receptors. The wall would provide an average of 8.9 dBA of insertion loss (10.9 dBA maximum) at benefited receptors. The wall would benefit 78% of impacted receptors and achieve the NRDG of 7 dBA or more at 88% (14 of 16) benefitted receptors.

The noise wall would cost $389,100 based on $60 per square foot which would be $24,881 per benefited receptor which is less than the CEI of $55,000. Therefore, the noise wall would be feasible and reasonable and is recommended for construction. On behalf of CTDOT, VHB will solicit and review the viewpoints of benefitted receptors at this location to determine whether they are in favor of the noise wall being constructed. Additionally, VHB will prepare information for public comments and responses regarding the noise wall construction. See Table9in the appendix for detailed information on the northing, easting, noise wall base elevation, and top of wall elevation.

6.2.2 Maple Street – Noise Wall 2

A noise wall approximately 970 feet long and heights between 8 and 22 feet tall was evaluated in the Maple Street area. There would be three impacted single-family and two-family residences on Maple Street. The noise wall would be located along the shoulder of the Route 9 southbound on-ramp from Route 17.

A 16-foot-tall wall would have the optimal acoustical and cost effectiveness. The wall would benefit 12 receptors including all seven impacted receptors. The wall would provide an average of 7.0 dBA of insertion loss (9.5 dBA max) at benefited receptors. The wall would benefit 100% of impacted receptors but would achieve the NRDG of 7 dBA at only 50% (6 of 12) benefitted receptors.

The noise wall would cost $933,720 based on $60 per square foot which would be $77,810 per benefited receptor which is greater than the CEI of $55,000. The noise wall would not be feasible since it does not provide benefit to more than 2/3rds of the impacted receptors and would not be reasonable since it does not achieve the NRDG at 2/3rds or more of benefited receptors. Therefore, the noise wall would not be recommended for construction.

6.2.3 Harbor Park– Noise Wall 3

A noise wall approximately 2,700 feet long and heights between 6 and 22 feet tall was evaluated to abate noise impact at Harbor Park. The noise wall would be located along the shoulder of Route 9/17 from approximately 200 feet south of the Union Street overpass to the northern grassy end of Harbor Park.

There would be impact at 14 of the 19 modeled receivers at the portions of Harbor Park nearest to Route 9/17. Based on the CTDOT noise policy, the CEI for barriers for Activity Category C, D, or E use is based on the person-hours of use of the park.

Observations of Harbor Park use were made during the field visit and the Middletown Department of Parks and Recreation was contacted to understand the amount of use the park typically has. While detailed usage data were not available, it has been assumed that there are approximately 600 person-hours of use throughout Harbor Park during a typical day. This is equivalent to 50 people being at Harbor Park on average during all daylight hours (12) per day.

For reference, a residential receptor is assumed to have 2.55 people per dwelling unit based on U.S. Census Bureau American Community Survey data for Connecticut between 2013 and 2017. To correlate person-hours of use of Activity Category C land uses with receptors, most state DOTs assume that each receptor is equivalent to the average number of people per dwelling unit for 24 hours of use per day. For Connecticut that equates to one receptor for each 61 person-hours of use. Based on this this, the 19 total receivers are representative of approximately 9.8 receptors and the 14 impacted receivers are representative of 7.2 receptors.

The 10-foot-tall wall would have the optimal acoustical and cost effectiveness. The wall would benefit all 19 receivers (9.8 receptors or 600 person-hours) including 14 impacted receivers (7.2 receptors or 442 person-hours). The wall would benefit 100% of the impacted receptors and would achieve the NRDG of 7 dBA at 74% of benefited receptors (which exceeds the 2/3rds minimum requirement). The wall would provide an average of 8.4 dBA of insertion loss to benefited receptors. The barrier would cost $1,662,580 based on $60 per square foot.

CEI = $1,662,580/8.4 dBIL/600 person-hours = $321

The CEI would be $322 which exceeds the CTDOT noise policy of $170. Therefore, the noise wall would be feasible but not reasonable and would not be recommended for construction based on the CTDOT Noise Policy.

6.2.4 111 deKoven Drive – Noise Wall 4

A noise wall approximately 770 feet long and heights between 8 and 22 feet tall was evaluated to abate noise impact at 111 deKoven Drive. There would be 47 impacted receptors at upper floors of the multi-family building. The noise wall would be located along the shoulder of Route 9/17 southbound from the existing Exit 14 off-ramp to deKoven Drive to 100 feet south of the Union Street overpass.

The 22-foot-tall noise wall would have the optimal acoustical and cost effectiveness. The wall would benefit 28% of impacted receptors and achieve the NRDG of 7 dBA or more at 44% (18 of 41) benefitted receptors. The 22-foot-tall noise wall would cost approximately $1,010,520 and would have a CEI of $24,647 per benefited receptor. However, the noise wall would not benefit 2/3rds or more of the impacts or meet the NRDG at 2/3rds or more of benefited receptors. Therefore, the noise wall would not be feasible or reasonable and is not recommended for construction.

6.2.5 South Main Street – Noise Wall 5

A noise wall approximately 300 feet long and heights between 8 and 22 feet tall was evaluated to abate noise impact at South Main Street. There would be two impacted receptors at residences along Mill Street. The noise wall would be located along the shoulder of SR 9/17, beginning just north of Mill Street.

A 22-foot-tall noise wall would have the optimal acoustical and cost effectiveness. The wall would benefit up to four receptors, including both impacted receptors, and would achieve the NRDG of 7 dBA at two of the 4 benefited receptors. The 22-foot-tall noise wall would cost approximately $395,940 and would have a CEI of $98,985 per benefited receptor, which is greater than the CEI of $55,000. The noise wall would benefit 100% of the impacted receptors but would not meet the NRDG at 2/3rds or more of benefited receptors. Therefore, the noise wall would not be feasible or reasonable and is not recommended for construction.

7. Construction Noise

Construction of the project would conform with the CTDOT Standard Specifications for Roads, Bridges, and Incidental Construction (Form 818) which defines construction noise impact and abatement as follows:

Specification 1.10.05 - Construction Noise Pollution: The Contractor shall take measures to minimize the noise caused by its construction operations, including but not limited to noise generated by equipment used for drilling, pile-driving, blasting, excavation or hauling. All methods and devices employed to minimize noise shall be subject to the continuing approval of the Engineer. The maximum allowable level of noise at the residence or occupied building nearest to the Site shall be 90 decibels on the "A" weighted scale (dBA). The Contractor shall halt any Project operation that violates this standard at any time until the Contractor develops and implements a methodology that enables it to keep the noise from its Project operations within the 90-dBA limit.

The ground clearing and earthwork phases of construction are typically the loudest. Table 8 presents the maximum noise levels of typical construction equipment used during highway improvement projects.

Table 8. Noise Levels of Typical Highway Construction Equipment

Equipment	Maximum Noise Level at 50 feet (dBA)
Backhoe	80
Compactor	80
Air Compressor	80
Dozer	85
Dump Truck	84
Excavator	85
Hoe Ram	90
Paver	85
Rock Drill	85
Scraper	85

Source: Federal Highway Administration, Roadway Construction Noise Model, 2006.

Construction practices should be used to minimize construction noise as feasible and reasonable including the following:

- Assuring that equipment is functioning properly and is equipped with mufflers and other noise-reducing features.
- Locating especially noisy equipment as far from sensitive receptors as possible
- Using quieter construction equipment and methods, as feasible.
- Using path noise control measures such as temporary sound walls, portable enclosures for small equipment (i.e., jackhammers and concrete saws)
- Replacing back up alarms with strobes, as allowed within OSHA regulations, to eliminate the annoying impulsive sound.

- Maintaining strong communication and public outreach with adjacent neighbors is a critical step in minimizing impact.

8. Information for Local Government Officials

The following information is provided for local government officials in consideration of noise-compatible planning and highway noise abatement responsibility.

8.1 Noise-Compatible Land Use Planning

The prevention of future impacts is one of the most important aspects of noise control. Local development and highways can co-exist, but local government officials need to know what noise levels to expect from a highway and what type of development will be compatible with it.

One of the most effective means to prevent future traffic noise impacts is to promote noise-compatible land use planning for new developments. The compatibility of highways and neighboring local areas is essential for continued growth and can be achieved if local governments and developers require and practice noise-sensitive land-use planning.

Although regulation of land use is not within the purview of CTDOT, some widely accepted techniques for noise-sensitive land use planning in the vicinity of existing and proposed highway facilities include:

- Locating commercial retail, industrial, manufacturing, warehouses, and other noise-compatible land-uses adjacent to highways
- Incorporating effective traffic noise mitigating features, such as earth berms and solid-mass noise walls, as part of residential developments
- Utilization of noise-sensitive architectural design and site planning, such as the orientation of quiet spaces away from roadways
- Required use of sound insulating building materials and construction methods

8.2 Estimated Distances to Noise Abatement Criteria

The distances from the edge of pavement where noise levels under the Build Condition will approach or exceed the NAC for Route 17 and Route 9 have been computed for the vacant parcels. As shown in Figure 6, these contours represent the approximate distance from the edge of the nearest travel lane, not including any shielding of noise provided by intervening objects or terrain. To minimize the potential for incompatible land use, noise sensitive land uses should be located beyond these distances. The distance to the NAC is 200 feet for Activity Category B and C land use and 75 feet for Activity Category E land use.

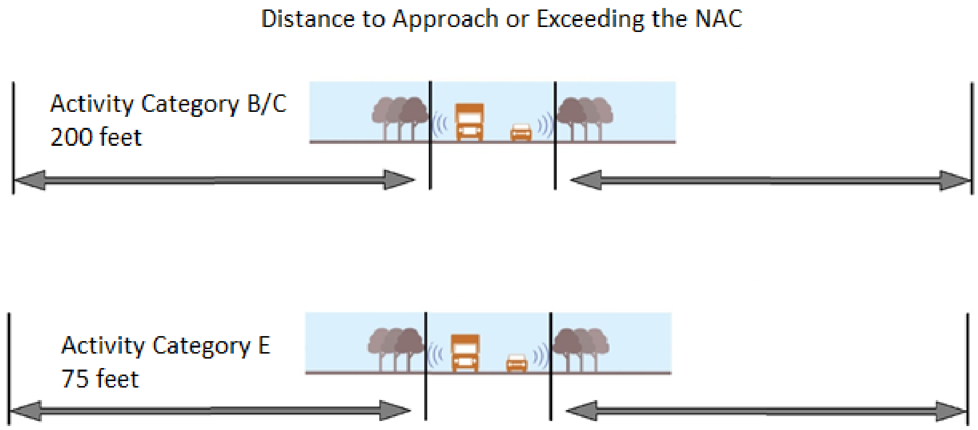

Figure 6. Distance to Noise Levels Approaching or Exceeding NAC

8.3 Noise Abatement Responsibility

The FHWA and CTDOT are responsible for all noise abatement considerations up until the "Date of Public Knowledge" of the project for all existing or permitted development. After this date, the Department is still responsible for analyzing changes in traffic noise impacts, when appropriate, but the Department is no longer responsible for providing noise abatement for new development which occurs adjacent to the proposed highway project. Provision of such noise abatement becomes the responsibility of local communities and private developers.

The Middletown Planning and Zoning Commission Application website has been reviewed for recently permitted projects to identify new noise-sensitive construction and land use changes. One property within the study area was identified. The property located at 80 East Main Street was previously non-noise sensitive and is now approved as a medical facility which. This location has been evaluated as NAC D, based on the permitted land use.

Appendix

Table 9. Receptor Noise Levels

Receptor	Address	Activity Category	Dwelling Units	Noise Level (Leq, dBA)		
				Existing	No Build	Build
R001	21 WEST SILVER ST	B	1	46.7	47.5	47.8
R002	33 WEST SILVER ST	B	5	48	48.8	49.2
R003	197 MAIN ST EXT	F	0	63.7	64.6	64.7
R004	13 WEST SILVER ST	F	0	61.3	62.2	62.3
R005	15 WEST SILVER ST	B	1	54.6	55.5	55.7
R006	0 WEST SILVER ST	F	0	55.1	56	56.2
R007	32 WEST SILVER ST	B	1	49.3	50.2	50.8
R008	34 WEST SILVER ST	B	1	49.1	49.9	50.5
R009	28 WEST SILVER ST	B	1	49.7	50.6	51.2
R010	26 WEST SILVER ST	B	1	50.3	51.2	51.8
R011	24 WEST SILVER ST	B	1	51	51.8	52.4
R012	30 WEST SILVER ST	B	1	50.1	51	51.6
R013	18 WEST SILVER ST	B	2	53.7	54.6	54.9
R014	22 WEST SILVER ST	B	1	51.7	52.6	52.9
R015	16 WEST SILVER ST	B	1	60	60.9	61
R016	186 MAIN ST EXT	B	2	61.4	62.3	62.5
R018	8 WEST SILVER ST	B	1	55.8	56.7	56.9
R019	2 WEST SILVER ST	B	2	53.1	53.8	54.4
R020	6 WEST SILVER ST	F	0	53.4	54.2	54.7
R021	180 MAIN ST EXT	F	0	57.3	58.2	58.4
R022	169 MAIN ST EXT	F	0	62	63	63.1
R023	159 EAST MAIN ST	B	4	59.9	60.6	61.7
R024	172 MAIN ST EXT	B	2	59	59.9	60.1
R025	33 COOLEY AVE	B	1	49.6	50.5	51.1
R026	31 COOLEY AVE	B	2	49.7	50.5	51.1
R027	153 EAST MAIN ST	F	0	60.1	60.8	62
R028	27 COOLEY AVE	B	2	50.6	51.5	52
R029	25 COOLEY AVE	B	1	51.3	52.2	52.8
R030	150 EAST MAIN ST	B	1	62.6	63.4	64
R031	23 COOLEY AVE	B	1	53.1	54	54.4
R032	148 EAST MAIN ST	B	1	62.7	63.5	64.1
R033	21 COOLEY AVE	B	1	55.6	56.5	56.8
R034	17/19 COOLEY AVE	B	2	59.1	60	60.2
R035	159 MAIN ST EXT	F	0	62.5	63.4	63.5
R036	143 EAST MAIN ST	F	0	60.2	60.9	62
R037	30 COOLEY AVE	B	2	51.8	52.7	53.4
R038	7 COOLEY AVE	B	2	55.7	56.5	56.8
R039	28 COOLEY AVE	B	1	52.1	52.9	53.4
R040	24 COOLEY AVE	B	2	52.3	53.2	53.6
R041	137 EAST MAIN ST	F	0	60.3	61	62.1
R042	22 COOLEY AVE	B	1	52.2	53	53.5
R043	20 COOLEY AVE	B	2	52.6	53.5	53.9
R044	139 MAIN ST EXT	E	1	62.8	63.7	63.8

Receptor	Address	Activity Category	Dwelling Units	Noise Level (Leq, dBA)		
				Existing	No Build	Build
R045	131 EAST MAIN ST	B	3	59.9	60.6	61.7
R046	132 EAST MAIN ST	F	0	62	62.7	63.4
R047	131 MAIN ST EXT	F	0	63	63.9	64.1
R048	0 EAST MAIN ST	F	0	62.5	63.2	63.9
R049	0 COOLEY AVE	F	0	56	56.8	57.6
R050	117 EAST MAIN ST	F	0	60.9	61.6	62.7
R051	121 MAIN ST EXT	F	0	63.6	64.5	64.7
R052	122 EAST MAIN ST	B	1	61.5	62.2	62.9
R053	42 CHESTNUT ST	B	2	51.6	52.4	53.4
R054	117 MAIN ST EXT	F	0	64	64.9	65.3
R055	40 CHESTNUT ST	B	2	52	52.8	53.7
R056	108 MAIN ST EXT	B	1	62.2	63.1	63.6
R057	0 EAST MAIN ST	F	0	53.2	54	55
R058	102 MAIN ST EXT	B	1	62.6	63.5	64.4
R059	12 MAPLE PL	B	1	52.5	53.3	54.2
R060	99 EAST MAIN ST-VACANT	F	0	61.2	61.9	63
R061	96 MAIN ST EXT	B	1	63.8	64.7	66.1
R062	92 EAST MAIN ST	C	1	55.4	56.2	57.3
R063	40 MAPLE PL	B	2	53.2	54	55.2
R064	0 CHESTNUT ST	F	0	55.1	55.9	56.9
R065	91 EAST MAIN ST	B	1	61.4	62.2	63.3
R066	62 CHESTNUT ST	B	4	56	56.7	57.5
R067	35 MAPLE PL	B	2	53.9	54.7	55.6
R068	87 EAST MAIN ST	B	2	61.3	62	63.1
R069	83 EAST MAIN ST	B	2	61.5	62.3	63.4
R070	13 MAPLE PL	B	2	54.6	55.4	55.7
R071	79 EAST MAIN ST	B	3	62	62.8	64
R072	28 CRESCENT ST	F	0	61.9	62.6	62
R073	11 MAPLE PL	B	2	55.6	56.4	57.3
R074	0 MAPLE PL-VACANT	F	0	54.1	55	56.3
R075	7 FLOWER ST	B	2	65.5	66.4	68.5
R076	5 FLOWER ST	B	3	64	64.9	66.9
R077	3 FLOWER ST	B	2	62	62.8	64.4
R078	71 EAST MAIN ST	B	1	61.4	62.3	63.7
R079	9 MAPLE PL	B	2	55.9	56.7	57.8
R080	0 MAPLE PL-VACANT	F	0	54.9	55.7	56.8
R081	0 EAST MAIN ST REAR	F	0	57.5	58.4	60.4
R082	7 MAPLE PL	B	2	56.5	57.3	58.3
R083	80 EAST MAIN ST	D	1	61	61.8	63.4
R084	6 MAPLE PL-VACANT	F	0	54.9	55.8	56.6
R085	5 MAPLE PL	B	2	56.2	57	58.2
R086	0 DEKOVEN DR	B	3	65	66	68.2
R086a	0 DEKOVEN DR	B	3	68	68.9	71
R087	4 MAPLE PL-VACANT	F	0	55.1	56	56.9

Receptor	Address	Activity Category	Dwelling Units	Noise Level (Leq, dBA)		
				Existing	No Build	Build
R088	2 MAPLE PL-VACANT	F	0	55.6	56.4	57.3
R089	16 MAPLE ST	B	1	59.7	60.4	60.7
R090	14 MAPLE ST	B	1	62.3	63	63.2
R091	31 MAPLE ST	F	0	57.2	58.1	59.6
R092	25 EAST MAIN ST	C	1	60.4	61.2	61.1
R093	2 MAPLE PL-VACANT	F	0	56.3	57.1	57.7
R094	25 EAST MAIN ST	C	1	60.1	60.9	61
R095	20 MAPLE ST	B	1	71.1	71.8	72.1
R096	15 MAPLE ST	B	1	67.7	68.4	68.3
R097	25 EAST MAIN ST	C	1	58.6	59.4	59.6
R098	25 EAST MAIN ST	C	1	60.4	61.2	61.4
R099	9 MAPLE ST	B	2	60.4	61.2	61.6
R100	7 MAPLE ST	B	2	58.8	59.6	59.2
R101	11 CRESCENT ST	B	2	47.4	48.2	48.5
R102	25 EAST MAIN ST	C	1	59	59.9	60.1
R103	15 CRESCENT ST	B	1	47.2	48	48.3
R104	29 CRESCENT ST	F	0	46.3	47	47.7
R105	25 EAST MAIN ST	C	1	61.2	62	62.4
R106	31 CRESCENT ST	F	0	46.5	47.3	48
R107	25 EAST MAIN ST	C	1	57.3	58.1	58.4
R108	25 EAST MAIN ST	C	1	59.6	60.4	60.8
R109	25 EAST MAIN ST	C	1	63.4	64.2	64.9
R110	36 SOUTH MAIN ST	F	0	46.7	47.5	48.1
R111	25 EAST MAIN ST	C	1	57.9	58.7	59.2
R112	41 CRESCENT ST	F	0	51.8	52.5	53.1
R113	25 EAST MAIN ST	C	1	60.2	61.1	61.5
R114	28 CRESCENT ST	D	1	55.6	56.4	56.9
R115	28 CRESCENT ST	D	1	63.2	64.1	64.6
R116	45 CRESCENT ST	F	0	52.8	53.5	54.1
R117	30 SOUTH MAIN ST	B	2	45.3	46	46.4
R118	25 EAST MAIN ST	C	1	58.5	59.3	60
R119	25 EAST MAIN ST	C	1	62.4	63.2	64.1
R120	49 CRESCENT ST	F	0	53.7	54.4	54.9
R121	25 EAST MAIN ST	C	1	59.2	60	60.7
R122	22 SOUTH MAIN ST	F	0	46.9	47.6	48
R123	34 EAST MAIN ST	F	0	64.9	65.7	66.3
R124	55 CRESCENT ST	F	0	55.2	56	56.5
R125	25 EAST MAIN ST	C	1	61.6	62.4	63.2
R126	33 PLEASANT ST	C	1	46.9	47.6	47.9
R127	1 MACDONOUGH PL	C	1	56.6	57.4	57.9
R128	50 WALNUT ST	F	0	70	70.7	69
R129	27 PLEASANT ST	F	0	48.6	49.3	49.8
R130	71 CRESCENT ST	B	1	63.3	64	64.5
R131	77 CRESCENT ST	B	1	64.9	65.6	66

Receptor	Address	Activity Category	Dwelling Units	Noise Level (Leq, dBA)		
				Existing	No Build	Build
R132	21 PLEASANT ST	F	0	49.3	50	50.4
R133	15 PLEASANT ST	B	8	51.2	51.8	52.5
R134	79 CRESCENT ST	B	1	64.3	65	65.5
R135	0 MACDONOUGH PL	B	1	65.2	65.7	66.2
R136	81 CRESCENT ST	B	1	63.8	64.5	65
R137	85 CRESCENT ST	B	1	63.3	64	64.5
R138	1 MACDONOUGH PL - ALF	B	67	59.4	60.1	60.9
R139	80 CRESCENT ST	B	1	63.6	64.2	64.7
R140	8 MACDONOUGH PL	B	2	57.7	58.3	59.2
R141	12 MACDONOUGH PL	B	2	57.9	58.7	59.6
R142	16 MACDONOUGH PL	B	2	58.2	59	59.9
R143	16 JAMES A MOSES AVE	C	1	59.6	60.3	61.4
R144	9 PLEASANT ST	C	1	61.9	62.7	62.9
R145	0 MAIN ST	C	1	47.7	48.3	48.7
R146	99 UNION ST	C	1	61.6	62.1	62.5
R147	0 MAIN ST	C	1	51.2	51.8	52
R148	0 MAIN ST	C	1	48.8	49.4	49.8
R149	0 MAIN ST	C	1	51.9	52.4	52.6
R150	0 MAIN ST	C	1	54.3	54.8	55
R151	0 MAIN ST	C	1	57.4	58	58.4
R152	85 UNION ST	C	1	59.9	60.6	61.4
R153	30 DEKOVEN DR	F	0	64.3	65	65.1
R154	0 DEKOVEN DR	F	0	62.4	63.1	64.8
R155	10 MAIN ST	F	0	58.9	59.5	60.1
R156	60 DEKOVEN DR	F	0	67.8	68.5	64
R157	0 RIVER RD	F	0	61.6	62.3	60.5
R158	100 MLK JR WAY	F	0	57.5	58.2	59.2
R159	111 DEKOVEN DR U1007	B	1	57.6	58.3	60.1
R170	111 DEKOVEN DR U1007	B	1	57.8	58.5	60.2
R181	40 UNION ST	F	0	65.1	65.8	66.7
R182	0 RIVER RD	G	0	62	62.7	62
R183	111 DEKOVEN DR U1007	B	1	58.9	59.6	60.9
R194	111 DEKOVEN DR U1007	B	1	59.2	59.9	61.1
R205	111 DEKOVEN DR U1007	B	1	55.3	55.9	56.8
R216	111 DEKOVEN DR U1007	B	1	56.4	57.1	58.3
R227	111 DEKOVEN DR U1007	B	1	64.1	64.8	65.5
R238	111 DEKOVEN DR U1007	B	1	58.6	59.3	60.3
R249	111 DEKOVEN DR U1007	B	1	60.1	60.8	61.8
R260	0 HARBOR DR	C	1	66	66.8	63.9
R261	100 DEKOVEN DR	F	0	65.9	66.6	67.6
R262	0 HARBOR DR	C	1	63.8	64.5	63.7
R263	0 HARBOR DR	C	1	62.8	63.5	62.8
R264	0 HARBOR DR	C	1	66.1	66.8	65.4
R265	0 HARBOR DR	C	1	64.1	64.9	65.2

Receptor	Address	Activity Category	Dwelling Units	Noise Level (Leq, dBA)		
				Existing	No Build	Build
R266	130 MAIN ST	F	0	68.4	69.3	69.8
R267	0 HARBOR DR	C	1	62.9	63.6	63.1
R268	80 HARBOR DR	C	1	67.5	68.3	67.5
R269	80 HARBOR DR	C	1	65.3	66	65.5
R270	292 MAIN ST	F	0	52.8	53.5	54.3
R271	DINGWALL DR	F	0	60.7	61.5	61.7
R272	80 HARBOR DR	C	1	64.5	65.2	65.5
R273	HARBOR PARK	C	1	69.6	70.3	68.9
R274	HARBOR PARK	C	1	66.7	67.5	66.2
R275	HARBOR PARK	C	1	65	65.7	65.3
R276	195 DEKOVEN DR	F	0	67.6	68.3	67.8
R277	106 COURT ST	F	0	52	52.7	52.5
R278	102 COURT ST	F	0	52.5	53.2	52.9
R279	90 COURT ST	F	0	53.4	54.1	53.1
R280	0 HARBOR DR	C	1	74.8	75.5	74.8
R281	1 COURT ST	F	0	57.9	58.6	59.2
R282	0 HARBOR DR	C	1	67.5	68.2	66.9
R283	74 COURT ST	F	0	55.3	56	55.1
R284	1 COURT ST	F	0	70	70.8	70.5
R285	HARBOR PARK	C	1	64.7	65.4	63.8
R286	245 DEKOVEN DR & COURT ST	F	0	66.5	67.2	66.9
R287	HARBOR PARK	C	1	76.1	76.9	75.9
R288	HARBOR PARK	C	1	68.1	68.8	67.3
R289	HARBOR PARK	C	1	67.8	68.6	67.1
R290	0 DEKOVEN DR	F	0	69.8	70.6	69.5
R291	HARBOR PARK	C	1	77.6	78.4	78
R292	HARBOR PARK	C	1	72	72.7	72.2
R293	HARBOR PARK	C	1	69.1	69.8	69.1
Z093	106 MAPLE ST	B	2	72.5	73.2	73.6
Z094	108 MAPLE ST	B	2	71.9	72.5	72.9
Z095	29 MAPLE ST	B	1	72.5	73.2	73.6
Z096	14 MAPLE ST	B	1	58.3	59.1	59.8
Z099	25 MAPLE ST	B	1	62.1	62.8	62.8
Z100	28 MAPLE ST	B	1	62.2	62.9	63
Z101	30 MAPLE ST	B	2	62.1	62.8	62.9
Z102	27 WALNUT ST	F	0	59.3	60	60
Z103	25 WALNUT ST	B	1	61.4	62.1	62.3
Z104	23 WALNUT ST	B	1	60.7	61.4	61.7
Z105	21 WALNUT ST	B	1	59.1	59.8	60
Z303	HARBOR PARK	C	1	76.1	76.8	76.7
Z304	HARBOR PARK	C	1	70.9	71.6	71
Z305	HARBOR PARK	C	1	76.2	76.9	76.5
Z306	HARBOR PARK	C	1	70.8	71.5	70.7

Receptor	Address	Activity Category	Dwelling Units	Noise Level (Leq, dBA)		
				Existing	No Build	Build
Z307	HARBOR PARK	C	1	69	69.7	67.9
Z308	HARBOR PARK	C	1	65.1	65.8	63.9
Z309	HARBOR PARK	C	1	64	64.7	62.8
R294	86 MILL STREET	B	1	68.3	69.2	69.8
R295	84 MILL STREET	B	1	65.4	66.2	66.9
R296	74 MILL STREET	B	1	61.7	62.6	63.2
R297	68 MILL STREET	B	1	60.3	61.1	61.6
R298	142 S MAIN STREET	B	1	59.5	60.3	60.8
R299	90 S MAIN STREET	D	1	60.0	60.9	60.8
R300	28 CRESCENT ST	D	1	64.2	65.1	64.9

Source: VHB, 2021.

Table 10. Noise Wall 1

Post	Easting (feet) NAD 83 SPF	Northing (feet) NAD 83 SPF	Wall Base Elevation (feet)	Top of Wall Elevation (feet)
1	1,028,870.5	762,404.1	35.0	49.0
2	1,028,879.1	762,418.4	35.3	49.3
3	1,028,887.7	762,432.7	35.7	49.7
4	1,028,896.3	762,447.0	36.0	50.0
5	1,028,904.9	762,461.3	36.3	50.3
6	1,028,913.5	762,475.5	36.7	50.7
7	1,028,922.1	762,489.8	37.0	51.0
8	1,028,931.0	762,503.9	37.7	51.7
9	1,028,939.8	762,518.1	38.4	52.4
10	1,028,948.7	762,532.1	39.2	53.2
11	1,028,957.5	762,546.3	39.9	53.9
12	1,028,966.4	762,560.4	40.6	54.6
13	1,028,975.2	762,574.5	41.3	55.3
14	1,028,985.1	762,587.9	41.7	55.7
15	1,028,995.0	762,601.3	42.1	56.1
16	1,029,004.9	762,614.6	42.5	56.5
17	1,029,014.9	762,627.9	42.9	56.9
18	1,029,024.8	762,641.3	43.3	57.3
19	1,029,034.7	762,654.7	43.7	57.7
20	1,029,047.5	762,665.3	43.7	57.7
21	1,029,060.3	762,675.8	43.6	57.6
22	1,029,073.1	762,686.4	43.6	57.6
23	1,029,086.0	762,697.0	43.6	57.6
24	1,029,098.8	762,707.6	43.5	57.5
25	1,029,111.6	762,718.1	43.5	57.5
26	1,029,124.9	762,725.1	43.2	57.2
27	1,029,138.1	762,732.2	42.9	56.9
28	1,029,151.4	762,739.2	42.6	56.6
29	1,029,164.6	762,746.3	42.3	56.3
30	1,029,177.4	762,753.0	42.1	56.1

Source: VHB, 2021.