FTA ALTERNATIVES ANALYSIS
DRAFT/FINAL ENVIRONMENTAL IMPACT STATEMENT

DANBURY BRANCH IMPROVEMENT PROGRAM TASK 5

ENVIRONMENTAL TECHNICAL MEMORANDUM IMPACTS ANALYSIS

STATE PROJECT 302-008

SECTION 2: NOISE AND VIBRATION

AUGUST 2011

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1. INTRODUCTION AND SUMMARY

This report presents a noise and vibration impact assessment for the Danbury Branch Improvement Program Environmental Impact Statement (EIS). This assessment was carried out for the Connecticut Department of Transportation (CTDOT) by Harris Miller Miller & Hanson Inc. (HMMH) under subcontract to the URS Corporation. The objective of this study is to assess the potential noise and vibration impacts of the planned commuter rail alternatives at community locations along the rail study corridor between South Norwalk and New Milford, CT. The noise and vibration assessment was carried out in conformance with the procedures and criteria established in the Federal Transit Administration (FTA) guidance manual "Transit Noise and Vibration Impact Assessment" (Final Report No. FTA-VA-90-1003-06, May 2006).

The background and results of the assessment are described below. Section 2 provides a discussion of environmental noise and vibration basics, and Section 3 describes the existing noise and vibration conditions and measurement results. The criteria used to assess noise and vibration impact are presented in Section 4, and projections of future noise and vibration levels are described in Section 5. Section 6 summarizes the impact assessment, and potential mitigation measures are outlined in Section 7. **Appendix A** includes noise measurement site photographs, detailed noise data are provided in **Appendix B** and maps depicting noise and vibration impact locations are included in **Appendix C** and **Appendix D**.

1.1 Background

The study area consists of approximately 38 miles of existing rail line between Norwalk and New Milford. The 24 mile portion of the rail line between Norwalk and Danbury (the Danbury Branch Line) currently carries passenger service provided by Metro North as well as limited freight service provided by the Providence and Worcester Railroad (P&W). The 14 mile portion of the rail line between Danbury and New Milford currently carries daily freight service provided by the Housatonic Railroad Company (HRRC). All existing trains are diesel locomotive hauled, with maximum speeds of 50 mph for passenger service and 25 mph for freight service. Noise and vibration sensitive land use along the corridor includes single and multi-family residences as well as schools, churches, parks and various institutional facilities. The existing noise and vibration environment at these locations is dominated by Metro North commuter rail and freight train operations.

There are five alternatives being evaluated in the EIS as follows:

- *Alternative A: No Build*. The No-Build alternative would leave the existing railroad infrastructure and service as it is, continuing with 11 weekday and six weekend passenger trains between South Norwalk and Danbury and one freight round trip between Danbury and New Milford.

- *Alternative B: Transportation System Management (TSM)*. Under this alternative, the existing railroad infrastructure would remain as it is. Rail passenger service would be enhanced with two shuttle trains added in the morning and evening between South Norwalk and Wilton, service during the midday from South Norwalk to Danbury would be provided every two hours and more frequent rail service would be provided on weekends (a total of 10 trains in each direction each weekend day). Alternative B also includes express bus service from Danbury to New Milford along existing roadways.

- *Alternative C: South Norwalk to Danbury Improvements*: This alternative would provide improvements between South Norwalk and Danbury including track realignments that would allow for increased speeds of up to 60 mph, upgrading the rail yard and providing a new maintenance facility and electrifying the rail line. New electric multiple unit (EMU) rolling stock would be added to allow for expanded service of up to 21 trains in each direction and 10 in each direction on each weekend day.

- *Alternative D: Extension from Danbury to New Milford (Diesel and Electric)*. This alternative would extend the existing passenger service approximately 14 miles from Danbury to New Milford including constructing new track to accommodate speeds up to 60 mph and adding new stations, parking facilities, rolling stock as well as a maintenance facility and storage yard in the vicinity of New Milford. There would be 21 trains in each direction on weekdays and 10 in each direction on each weekend day. The electric version of this alternative would also include a new traction power system between Danbury and New Milford along with new EMU rolling stock.

- *Alternative E: Improvement from South Norwalk to Merritt 7/Wilton*. This alternative would provide partial electrification of the Danbury Branch for a distance of 7.5 miles from South Norwalk to Wilton. There would be 21 trains in each direction on weekdays from So. Norwalk to Wilton and 14 in each direction from Wilton to Danbury. On weekends, service would be the same as Alternatives B and C, 10 trains in each direction from So. Norwalk to Danbury each weekend day. This alternative would require a new traction power system and new rolling stock for the segment between South Norwalk and Wilton.

1.2 Summary of Results

1.2.1 Noise Impact Assessment

The noise analysis results indicate that the existing noise environment along the study corridor is dominated by noise from Metro North commuter rail and freight train operation. The total number of locations projected to experience long-term noise impacts from train operations without mitigation was calculated for each study alternative based on FTA criteria. The number of impacts is expected to be 14 for Alternative B, 1,096 for Alternative C (1,026 Moderate and 70 Severe), 2,221 for Alternative D-Diesel (1,735 Moderate and 486 Severe), 1,614 for Alternative D-Electric (1,303 Moderate and 311 Severe), and 610 for Alternative E (558 Moderate and 52 Severe). For the Build alternatives, Alternative D-Diesel is projected to have the most impacts and Alternative E is projected to have the least. There would be no impacts for Alternative A (No Build).

The noise analysis suggests that the most effective approach for mitigating long-term noise impact from train operations would be to establish quiet zones to eliminate train horn noise at at-grade crossings near affected noise-sensitive areas. This measure would be expected to eliminate all noise impacts for Alternative B and to reduce the number of noise impacts by 60 to 90 percent for the Build alternatives. To mitigate the remaining impacts, a combination of noise barriers and building sound insulation could be considered. The noise analysis will be refined during project design to determine the details of the final mitigation measures for the preferred alternative that is ultimately selected.

With regard to short-term noise impacts, the results of the assessment indicate that impact from nighttime construction could extend to residences as far as 400 feet from the track. Given that much of the construction work will need to be done at night to avoid disrupting the existing rail service, there is the potential for significant noise impact from project construction activities. Construction noise impacts and mitigation measures will need to be evaluated in detail during final design when specific construction scenarios are available. A noise control plan would be developed, including specific residential property line noise limits, and noise monitoring will be performed during construction to verify compliance with the limits.

1.2.2 Vibration Impact Assessment

Significant sources of existing vibration along the corridor are limited to train operations. Based on FTA criteria, the vibration assessment results indicate that, without mitigation, the total number of locations projected to experience vibration impacts is expected to be greatest for the alternatives that include diesel-powered trains, with Alternative D-Diesel affecting 1,122 residences, one museum and two schools and Alternative B affecting 456 residences, one museum and one school. The least amount of vibration impacts are projected for the alternatives that include electric-powered trains, with no impacts for Alternatives C and E and 218 residential impacts for Alternative D-Electric. There would be no impacts for Alternative A (No Build).

Potential vibration mitigation measures include track vibration isolation treatments, such as ballast mats, tire derived aggregate (i.e. shredded tires) and floating slabs, as well as special trackwork and property acquisitions or easements. A detailed vibration analysis would need to be carried out during project design to refine the impact projections for the preferred alternative that is ultimately selected, and appropriate mitigation measures will be developed at that time if warranted.

1.2.3 Noise and Vibration Impact Assessment for Potential Corridor Extension

Although not being evaluated quantitatively as part of the current EIS, a potential future extension of the rail passenger service along the corridor to the north, from New Milford, Connecticut to Pittsfield, Massachusetts, is also being considered. For this option, the noise and vibration impacts would be expected to be similar to those along the Danbury to New Milford portion of the rail corridor, with a potentially substantial number of impacts resulting from adding diesel-hauled commuter operations to what is currently a lightly-used freight corridor.

2. ENVIRONMENTAL NOISE AND VIBRATION BASICS

2.1 Noise Fundamentals and 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 subjective 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 0 and 120 decibels. On a relative basis, a 3-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 noise is related to the tone or pitch of the sound, 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 "dB(A)." The A-weighted sound level is widely accepted by acousticians as a proper unit for describing environmental noise. To indicate what various noise levels represent, **Figure 1** shows typical A-weighted sound levels for both rail and non-rail sources. As indicated on this figure, most commonly encountered outdoor noise sources generate sound levels within the range of 60 dB(A) to 90 dB(A) at a distance of 50 feet.

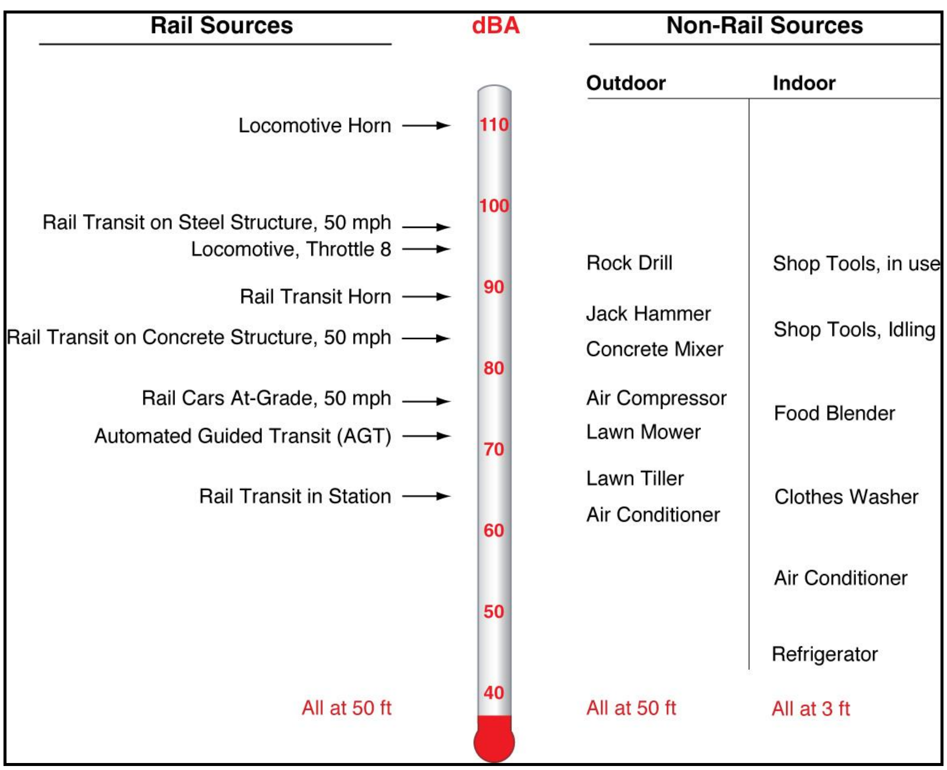


Figure 1. Typical A-Weighted Sound Levels

Because environmental noise fluctuates from moment to moment, it is common practice to condense all of this information into a single number, called the "equivalent" sound level (Leq). Leq can be thought of as the steady sound level that represents the same sound energy as the varying sound levels over a specified time period (typically 1 hour or 24 hours). Often the Leq values over a 24-hour period are used to calculate cumulative noise exposure in terms of the Day-Night Sound Level (Ldn). Ldn is the A-weighed Leq for a 24-hour period with an added 10-decibel penalty imposed on noise that occurs during the nighttime hours (between 10 P.M. and 7 A.M.). Many surveys have shown that Ldn is well correlated with human annoyance, and therefore this descriptor is widely used for environmental noise impact assessment. **Figure 2** provides examples of typical noise environments and criteria in terms of Ldn. While the extremes of Ldn are shown to range from 35 dB(A) in a wilderness environment to 85 dB(A) in noisy urban environments, Ldn is generally found to range between 55 dB(A) and 75 dB(A) in most communities. As shown in **Figure 2**, this spans the range between an "ideal" residential environment and the threshold for an unacceptable residential environment according to some U.S. Federal agency criteria.

Environmental noise can also be viewed on a statistical basis using percentile sound levels, Ln, which refer to the sound level exceeded "n" percent of the time. For example, the sound level exceeded 90 percent of the time, denoted as L90, is often taken to represent the "background" noise in a community. Similarly, the sound level exceeded 33 percent of the time (L33) is often used to approximate the Leq in the absence of loud, intermittent sources such as aircraft and trains.

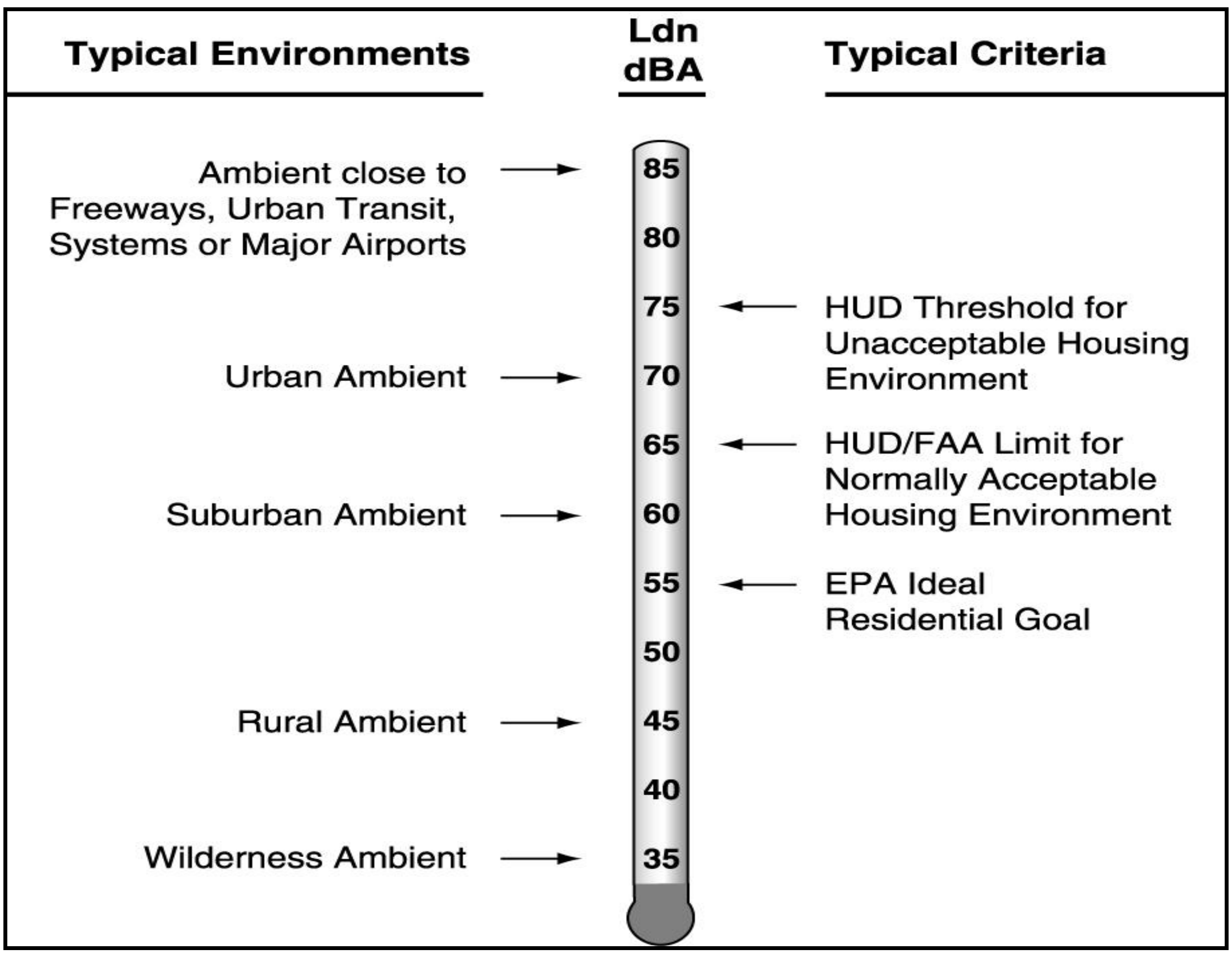


Figure 2. Examples of Typical Outdoor Noise Exposure

2.2 Vibration Fundamentals and Descriptors

Ground-borne vibration is the oscillatory motion of the ground about some equilibrium position, which can be described in terms of displacement, velocity or acceleration. Displacement refers to the distance an object moves away from its equilibrium position, velocity refers to the rate of change in displacement or the speed of this motion, and acceleration refers to the time rate of change in the velocity of the object. At any given frequency of oscillation, vibration displacement, velocity and acceleration are related by a constant factor. However, vibrations are often more complex in the environment, including components at many different frequencies. Therefore, the relationship between the overall vibration levels in terms of these descriptors depends on the frequency content of the vibration energy.

Although displacement is easier to understand than velocity or acceleration, it is rarely used for describing ground-borne vibration. One reason for this is that most sensors used for measuring ground-borne vibration are designed to provide output signals proportional to either velocity or acceleration. Even more important, the response of humans, buildings and equipment to vibration is more accurately described using velocity or acceleration. Because sensitivity to vibration has typically been found to correspond to a constant level of vibration velocity amplitude within the low frequency range of most concern for environmental vibration (roughly 5-100 Hz), vibration velocity is used in this analysis as the primary measure to evaluate the effects of vibration.

There are several different measures used to quantify vibration amplitude. One of the most common is the peak particle velocity (PPV), defined as the maximum instantaneous positive or negative peak of the vibratory motion. PPV is often used in monitoring blasting vibration since it is related to the stresses experienced by building components. Although PPV is appropriate for evaluating the potential for building damage, it is less suitable for evaluating human response, which is better related to an average vibration amplitude. Because the net average of a vibration signal about its equilibrium position is zero, the root mean square (rms) amplitude is often used to describe the "smoothed" vibration amplitude. The rms amplitude is defined as the square root of the average of the squared amplitude of the signal, and is typically evaluated over a one-second period of time.

Although vibration velocity is normally described in units of inches per second in the USA, the decibel notation, which acts to compress the range of numbers required to describe vibration, can also be used. In this notation, the vibration magnitude can be expressed in terms of velocity level, in decibels, defined as follows:

$$L_v = 20\log_{10}(v/v_{ref}), \text{ VdB}$$

where: v = rms velocity, in./sec

v_{ref} = $1\text{x}10^{-6}$ in./sec

Thus, the descriptor used for this assessment of ground-borne vibration is the rms vibration velocity level, Lv, expressed in vibration decibels (VdB) relative to one micro-inch per second. **Figure 3** illustrates typical ground-borne vibration levels for common sources as well as criteria for human and structural response to ground-borne vibration. As shown, the range of interest is from approximately 50 VdB to 100 VdB, from imperceptible background vibration to the threshold of damage. Although the threshold of human perception to vibration is approximately 65 VdB, annoyance is not usually significant unless the vibration exceeds 70 VdB.

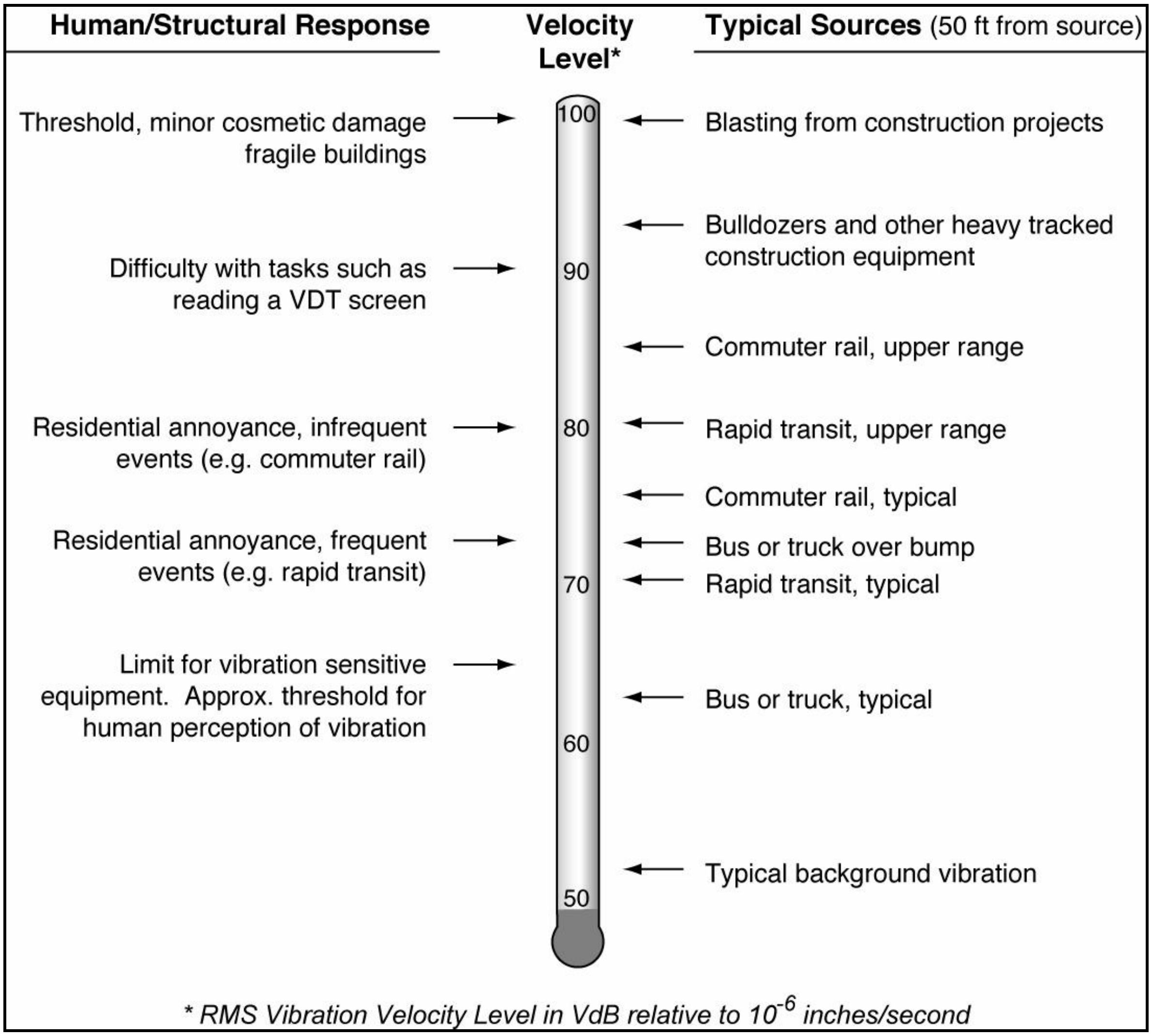


Figure 3. Typical Ground-Borne Vibration Levels and Criteria

3. EXISTING CONDITIONS

The noise and vibration sensitive land use along the study corridor was identified based on project aerial photography and mapping as well as a field survey of the corridor conducted by HMMH staff on March 16-17, 2009. Summary descriptions of the noise and vibration sensitive land use along the study corridor from south to north are as follows:

South Norwalk Station to I-95, Norwalk. The noise and vibration sensitive land use in this area includes numerous multi-family residential buildings and a park located directly adjacent to the alignment. The Norwalk Maritime Museum and some single-family residences are also located in this area and are shielded from the alignment by other buildings.

I-95 to Wall St., Norwalk. The noise and vibration sensitive land use in this area includes a playground and the Stepping Stone Museum for Children adjacent to Matthew's Park. There are also some scattered single- and multi-family residential buildings adjacent to the alignment.

Cross St. to New Canaan Ave., Norwalk. The noise and vibration sensitive land use in this area includes mostly single-family residences along both sides of the alignment on Wilton Ave. and Jefferson St.

Nearby Merritt Parkway, Norwalk. The noise and vibration sensitive land use in this area consists of several multi-family residences mixed with commercial buildings along Main Ave./Rt-7.

Norwalk/Wilton town line to Woflpit Rd., Wilton. The noise and vibration sensitive land use in this area includes a hospital and several single-family residences located on Arrowhead Rd. and Wolfpit Rd.

Wolfpit Rd. to Wilton Station, Wilton. The noise and vibration sensitive land use in this area includes multi-family residential buildings as well as a church and Schenck's Park near the Wilton town center and the Track Side Teen Center located north of Wilton Station.

Pimpewaug Rd./Mather St./Mill Rd., Wilton. The noise and vibration sensitive land use in this area consists of mainly single-family residences directly adjacent to the alignment, as well as a recreational center, two schools, and a church.

Near Branchville Station, Redding/Wilton/Ridgefield. The noise and vibration sensitive land use in this area is mixed single-family residences mixed with commercial land uses on Rt-7.

Simpaug Tpk., Ridgefield/Redding. The noise and vibration sensitive land use along this section of the corridor consists of mainly single-family residences directly adjacent to the alignment as well as a park and a church.

Near Bethel Station, Bethel. The noise and vibration sensitive land use includes numerous single-family residences, as well as a cemetery and the Bethel Public Library. There are also several multi-family residential buildings which are partially shielded by commercial buildings.

South of Danbury Station, Danbury. The noise and vibration sensitive land use in this area includes numerous single- and multi-family residential buildings and an elementary school.

North of Danbury Station, Danbury. The noise and vibration sensitive land use in this area includes some single- and multi-family residential buildings on Chapelle St., and single family residences on Beaver Brook Rd.

Stony Hill Rd. to Wisconier Rd., Brookfield. The noise and vibration sensitive land use in this area consists mainly of single-family residences on both sides of the alignment.

Wisconier Rd. to Brookfield/New Milford town line, Brookfield. The noise and vibration sensitive land use in this area consists mainly of single-family residences to the east of the alignment.

Cross Rd. to Grove St., New Milford. The noise and vibration sensitive land use in this area consists mainly of single-family residences and a park.

Near New Milford town center, New Milford. The noise and vibration sensitive land use in this area near the center of New Milford consists of single- and multi-family residential buildings along the alignment and a hotel on Bridge St.

3.1 Noise Measurements

3.1.1 Methodology

A noise measurement program was conducted by HMMH staff between April 27 and May 1, 2009. Prior to conducting field measurements, the proposed measurement locations were reviewed and approved by CTDOT. Long-term (24-hour) measurements were conducted where feasible and used to calculate the A-weighted Ldn. Additional short-term (1-hour) measurements were conducted to supplement the long-term data and estimates of the Ldn at these locations were made using the methods described in the FTA guidance manual. Specific measurement sites were selected that were representative of the existing ambient noise levels at other nearby noise sensitive locations along the corridor. The locations of the measurement sites are indicated in **Figure 4** and site photographs are included in **Appendix A**.

The noise measurements were made using Bruel & Kjaer (B&K) Model 2250 portable, automatic noise monitors that conform to ANSI Standard S1.4 for Type 1 (Precision) sound level meters. The noise monitors were used to continuously sample the A-weighted sound level (with slow response) and were programmed to record hourly results, including the maximum sound level (Lmax), the equivalent sound level (Leq) and the statistical percentile sound levels (Ln). Calibrations were carried out in the field before and after each set of measurements using acoustical calibrators.

In all cases, the measurement microphone was protected by a windscreen, and supported on a tripod at a height of 4 to 6 feet above the ground. Furthermore, the microphone was positioned to characterize the exposure of the site to the dominant noise sources in the area. For example, microphones were located at the approximate setback lines of the receptors from adjacent roads or rail lines, and were positioned to avoid acoustic shielding by landscaping, fences or other obstructions.

3.1.2 Results

Table 1 summarizes the existing ambient noise measurement results and detailed data are included in **Appendix B**. The long-term measurement results in **Table 1** indicate Ldn ranging from 51 dB(A) to 74 dB(A) along the corridor. These measurement results were used along with modeling of existing train noise levels to determine the existing noise conditions at all noise-sensitive receptors along the study corridor. The measurement locations and results are described below.

Site N-1: 77 N. Water St., Norwalk. The measured 1-hour Leq at this location was 57 dB(A) and the estimated Ldn was 59 dB(A). The ambient noise levels were dominated by Metro-North train operations on the Danbury branch.

Site N-2: Matthew's Park, Norwalk. The measured 1-hour Leq at this location was 70 dB(A) and the estimated Ldn was 72 dB(A). The ambient noise levels were dominated by Metro-North train operations and grade-crossing horns at Science Rd. and Jennings Pl.

Site N-3: 28 Wilton Ave., Norwalk. The measured Ldn at this location was 62 dB(A) and the peak-hour Leq was 59 dB(A). The ambient noise levels were dominated by Metro-North train operations and grade-crossing horns at Cross and Catherine Streets.

Site N-4: Merritt Station, Norwalk. The measured 1-hour Leq at this location was 69 dB(A) and the estimated Ldn was 72 dB(A). At this measurement location near the tracks the ambient noise levels were dominated by Metro-North train operations.

Site N-5: 51 Wolfpit Rd., Wilton. The measured Ldn at this location was 57 dB(A) and the peak-hour Leq was 53 dB(A). The ambient noise levels were dominated by Metro-North train operations.

Site N-6: Schenck's Island Park, Wilton. The measured 1-hour Leq at this location was 57 dB(A) and the estimated Ldn was 60 dB(A). The ambient noise levels were dominated by Metro-North train operations.

Site N-7: 186 Mather St., Wilton. The measured Ldn at this location was 63 dB(A) and the peak-hour Leq was 59 dB(A). The ambient noise levels were dominated by Metro-North train operations.

Site N-8: 96 Portland Ave., Wilton. The measured Ldn at this location was 63 dB(A) and the peak-hour Leq was 58 dB(A). The ambient noise levels were dominated by Metro-North train operations and grade-crossing horns at Branchville Rd.

Site N-9: 131 Simpaug Tpke., Redding. The measured Ldn at this location was 56 dB(A) and the peak-hour Leq was 54 dB(A). The ambient noise levels were dominated by Metro-North train operations.

Site N-10: 5 Taylor Ave., Bethel. The measured Ldn at this location was 67 dB(A) and the peak-hour Leq was 59 dB(A). The ambient noise levels were dominated by Metro-North train operations and horn noise at several nearby grade-crossings.

Site N-11: 63 Wildman St., Danbury. The measured 1-hour Leq at this location was 67 dB(A) and the estimated Ldn was 66 dB(A). The ambient noise levels were dominated by Metro-North train operations and horn noise at several nearby grade-crossings.

Site N-12: 51 Beaver Brook Rd., Danbury. The measured Ldn at this location was 61 dB(A) and the peak-hour Leq was 58 dB(A). The ambient noise levels were dominated by local automobile traffic and daily freight train operations.

Site N-13: 151 Pocono Rd., Brookfield. The measured Ldn at this location was 51 dB(A) and the peak-hour Leq was 48 dB(A). The ambient noise levels were dominated by daily freight train operations.

Site N-14: 16 Prospect Dr., Brookfield. The measured Ldn at this location was 57 dB(A) and the peak-hour Leq was 47 dB(A). The ambient noise levels were dominated by daily freight train operations.

Site N-15: 30 Erickson Rd., New Milford. The measured Ldn at this location was 62 dB(A) and the peak-hour Leq was 49 dB(A). The ambient noise levels were dominated by daily freight train operations.

Site N-16: 42 S. Main St., New Milford. The measured Ldn at this location was 74 dB(A) and the peak-hour Leq was 49 dB(A). The ambient noise levels were dominated by daily freight train operations and horn noise at several nearby grade-crossings.

Table 1: Summary of Existing Ambient Noise Measurement Results

Site No.	Measurement Location Description	Start of Measurement		Meas. Time (hrs)	Noise Exposure (dB(A))	
		Date	Time		Ldn[1]	Leq
N-1	77 N. Water St., Norwalk	4/29/09	16:17	1	59	57
N-2	Matthew's Park, Norwalk	4/29/09	16:27	1	72	70
N-3	28 Wilton Ave., Norwalk	4/27/09	15:00	24	62	59
N-4	Merritt Station, Norwalk	4/28/09	15:08	1	72	69
N-5	51 Wolfpit Rd., Wilton	4/27/09	16:00	24	57	53
N-6	Schenck's Island Park, Wilton	4/30/09	15:46	1	60	57
N-7	186 Mather St., Wilton	4/27/09	17:00	24	63	58
N-8	96 Portland Ave., Wilton	4/28/09	19:00	24	63	59
N-9	131 Simpaug Tpke., Redding	4/28/09	18:00	24	56	54
N-10	5 Taylor Ave., Bethel	4/28/09	13:00	24	67	59
N-11	63 Wildman St., Danbury	4/30/09	11:54	1	66	67
N-12	51 Beaver Brook Rd., Danbury	4/28/09	10:00	24	61	58
N-13	151 Pocono Rd., Brookfield	4/29/09	11:00	24	51	48
N-14	16 Prospect Dr., Brookfield	4/29/09	13:00	24	57	47
N-15	30 Erickson Rd., New Milford	4/30/09	10:00	24	62	49
N-16	42 S. Main St., New Milford	4/30/09	11:00	24	74	49

1. The Leq measurements at the 1-hour measurement sites were used to estimate the Ldn using FTA methodology. This approach tends to be conservative and underestimate the existing noise levels, which can result in higher levels of noise impact for a project.

Source: Harris Miller Miller & Hanson Inc., 2011

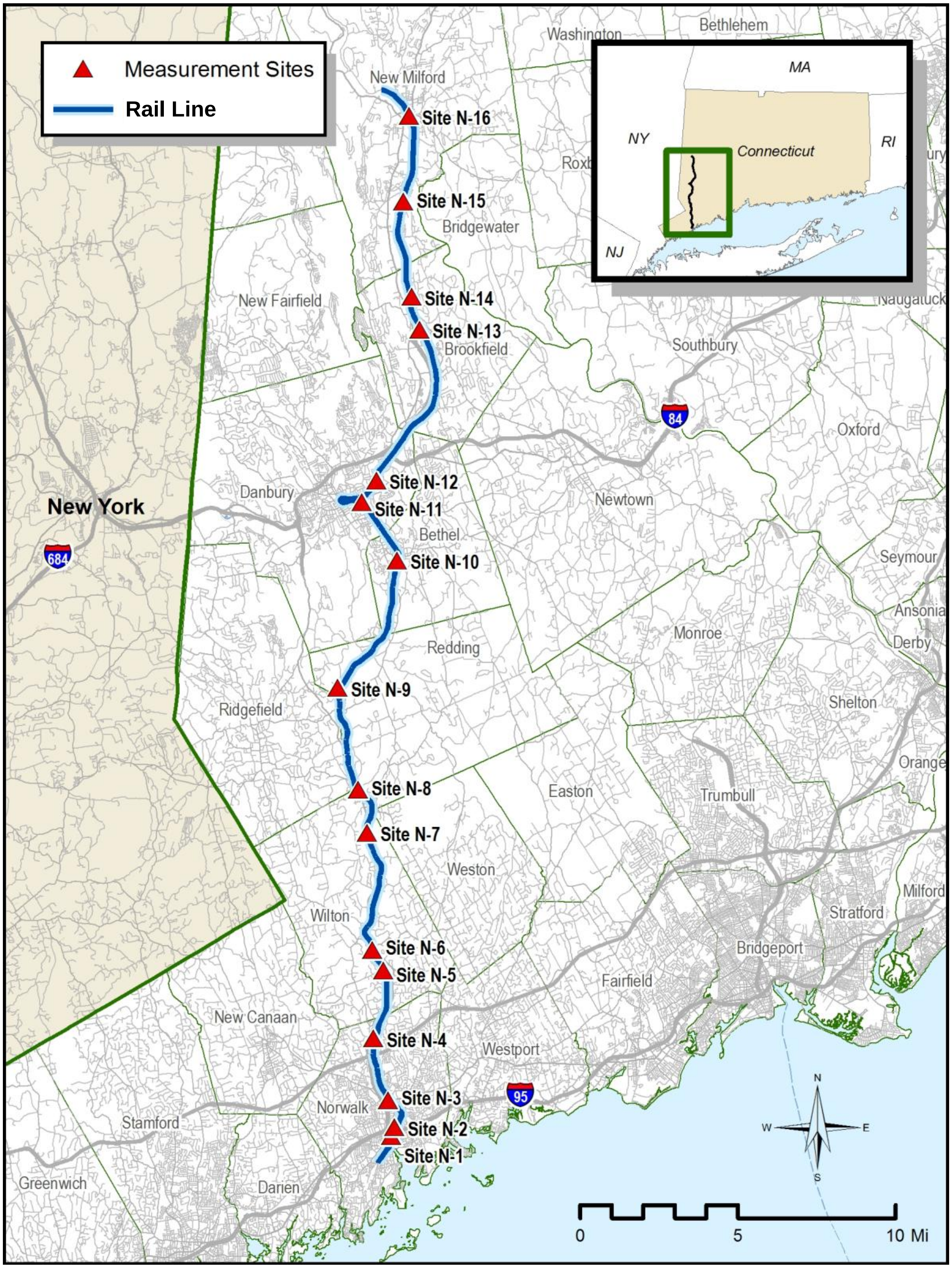


Figure 4. Existing Ambient Noise Measurement Locations

3.2 Existing Vibration Conditions

Existing sources of vibration along the study corridor include Metro-North commuter trains on the branch from Norwalk to Danbury and freight trains on the railway line from Danbury to New Milford. The existing and future vibration levels from rail operations have been estimated using the FTA general assessment methodology. Vibration measurements may be conducted for the preferred alternative that is ultimately selected during subsequent phases of the project to characterize the soil conditions along the corridor in order to refine the vibration projections at specific locations, as required.

4. NOISE AND VIBRATION IMPACT CRITERIA

Experience suggests that noise and vibration can be major public concerns with regard to the effects of a rail transit project. This section summarizes the impact limits as applicable to the Danbury Branch EIS.

4.1 Train Noise Criteria

Noise impact for this project is based on the criteria as defined in the FTA guidance manual. The FTA noise impact criteria are founded on well-documented research on community reaction to noise and are based on change in noise exposure using a sliding scale.

The FTA Noise Impact Criteria group noise sensitive land uses into the following three categories:

- Category 1: Tracts of land where quiet is an essential element in their intended purpose. This category includes lands set aside for serenity and quiet, and such land uses as outdoor amphitheaters and concert pavilions, as well as National Historic Landmarks with significant outdoor use. Also included are recording studios and concert halls.

- Category 2: Residences and buildings where people normally sleep. This category includes homes, hospitals and hotels where a nighttime sensitivity to noise is assumed to be of utmost importance.

- Category 3: Institutional land uses with primarily daytime and evening use. This category includes schools, libraries, theaters, and churches where it is important to avoid interference with such activities as speech, meditation and concentration on reading material. Places for meditation or study associated with cemeteries, monuments, museums, campgrounds and recreational facilities can also be considered to be in this category. Certain historical sites and parks are also included.

Ldn is used to characterize noise exposure for residential areas (Category 2). For other noise sensitive land uses, such as outdoor amphitheaters and school buildings (Categories 1 and 3), the maximum 1-hour Leq during the facility's operating period is used.

There are two levels of impact included in the FTA criteria. The interpretation of these two levels of impact is summarized below:

- Severe Impact: Project-generated noise in the severe impact range can be expected to cause a significant percentage of people to be highly annoyed by the new noise and represents the most compelling need for mitigation. Noise mitigation will normally be specified for severe impact areas unless there are truly extenuating circumstances which prevent it.

- Moderate Impact: In this range of noise impact, the change in the cumulative noise level is noticeable to most people but may not be sufficient to cause strong, adverse reactions from the community. In this transitional area, other project-specific factors must be considered to determine the magnitude of the impact and the need for mitigation. These factors include the existing level, the predicted level of increase over existing noise levels, the types and numbers of noise-sensitive land uses affected, the noise sensitivity of the properties, the effectiveness of the mitigation measures, community views and the cost of mitigating noise to more acceptable levels.

The noise impact criteria are summarized in graphical form in **Figure 5**. The figure shows the existing noise exposure and the additional noise exposure from a transit project that would cause either moderate or severe impact. The vertical axis along the left is used for Category 1 and 2 land uses while the vertical axis along the right is used for Category 3 land uses. The total future noise exposure would be the combination of the existing noise exposure and the additional noise exposure caused by the transit project. **Figure 6** shows the same criteria in terms of the increase in cumulative noise that can occur in the overall noise environment before impact occurs.

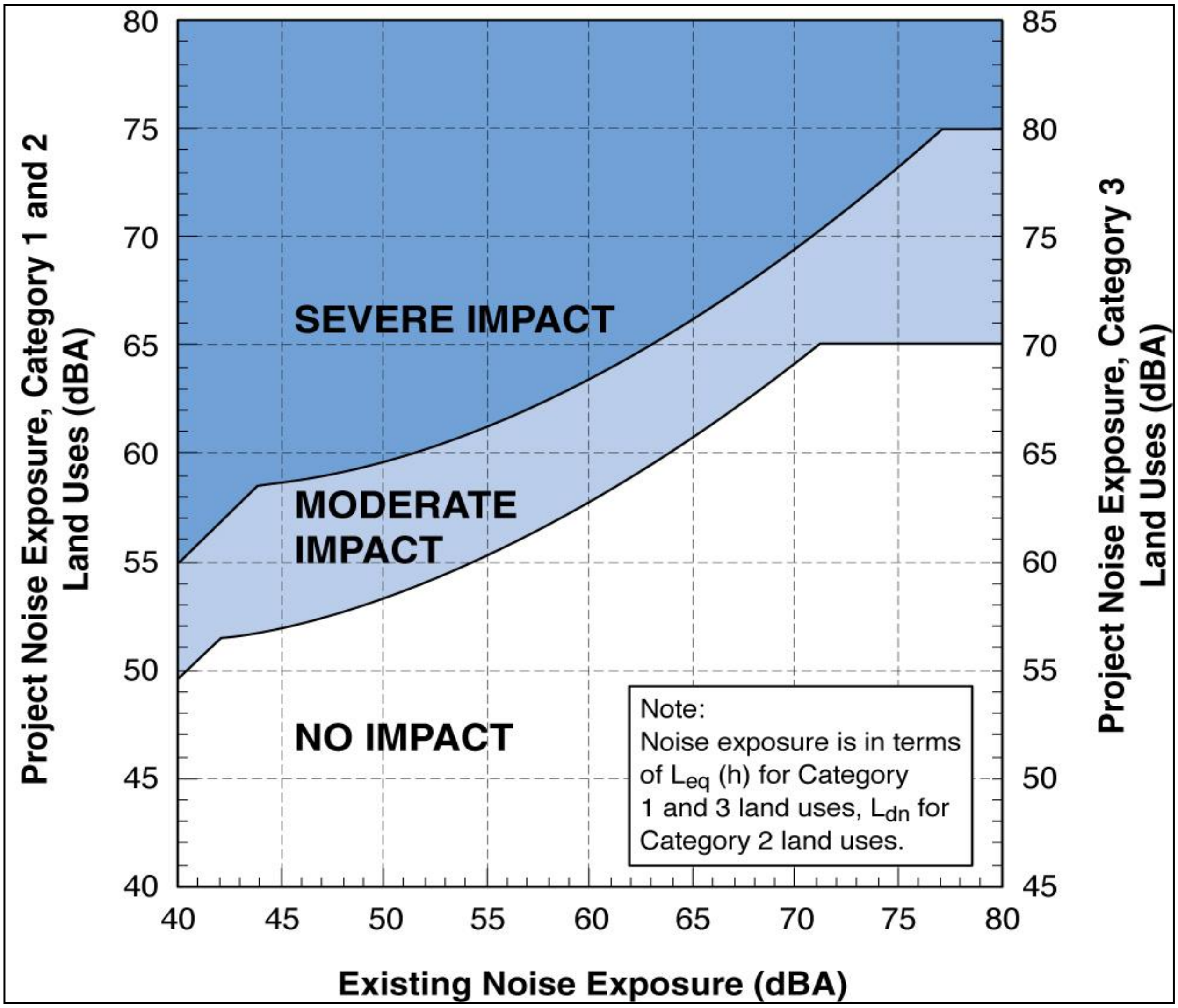


Figure 5. FTA Project Noise Impact Criteria

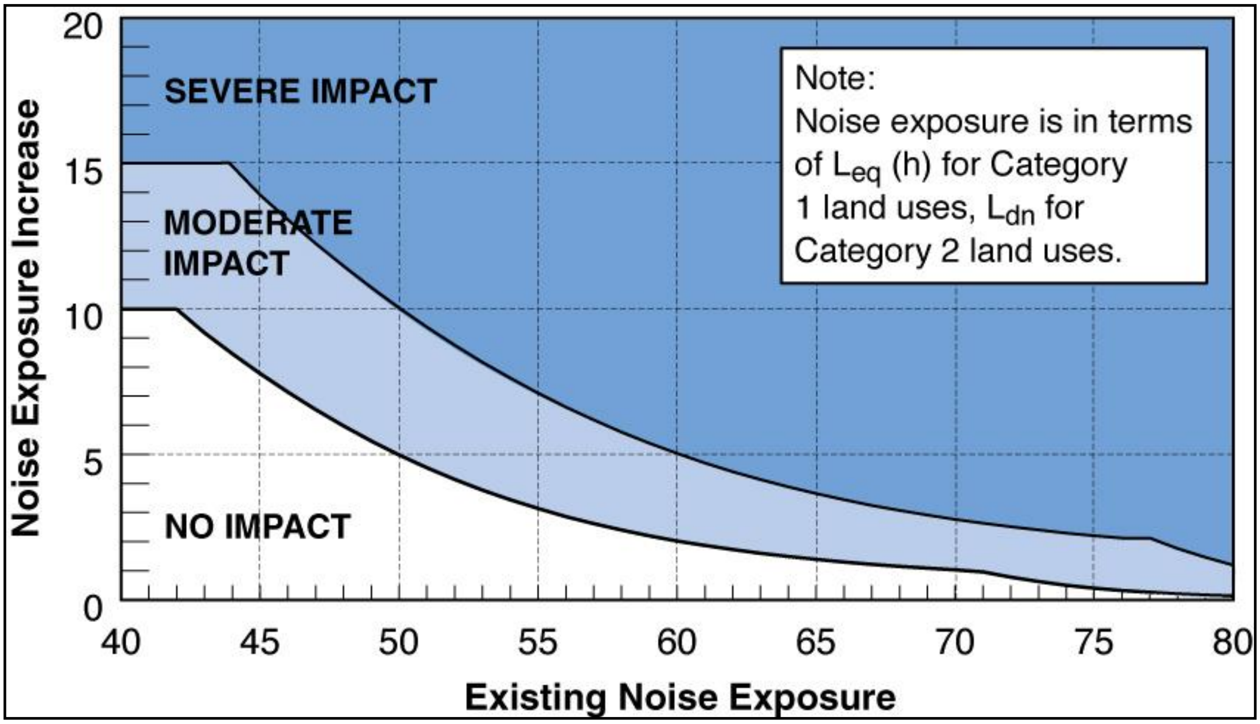


Figure 6. Increase in Cumulative Noise Exposure Allowed by FTA Criteria

4.2 Train Vibration Criteria

The FTA ground-borne vibration impact criteria are based on land use and operational frequency, as shown in Table 2 and are given in terms of the maximum RMS vibration level for an event. There are some buildings, such as concert halls, recording studios and theaters that can be very sensitive to vibration but do not fit into any of the three categories listed in Table 2. Due to the sensitivity of these buildings, they usually warrant special attention during the environmental assessment of a transit project. Table 3 gives criteria for acceptable levels of ground-borne vibration for various types of special buildings.

It should be noted that Table 2 and Table 3 include separate FTA criteria for ground-borne noise, the "rumble" that can be radiated from the motion of room surfaces in buildings due to ground-borne vibration. Although expressed in dB(A), which emphasizes the more audible middle and high frequencies, the criteria are set significantly lower than for airborne noise to account for the annoying low-frequency character of ground-borne noise. Because airborne noise often masks ground-borne noise for above ground (i.e. at-grade or elevated) transit systems, ground-borne noise criteria are primarily applied to subway operations where airborne noise is not a factor. For above-grade transit systems, ground-borne noise criteria are applied only to buildings that have sensitive interior spaces that are well insulated from exterior noise.

FTA also provides guidance on how to account for existing vibration. The FTA Noise and Vibration Assessment Methodology defines a "heavily used corridor" as one where existing train volume is more than 12 trains per day – the Danbury Branch meets this criteria. FTA indicates that if the existing train vibration exceeds the impact criteria given in Tables 2 and 3, there will be additional impact only if the project increases the number of vibration events by a factor of two or more, or if the project vibration will be 3 VdB or more higher than the existing vibration. Otherwise, the criteria in Tables 2 and 3 apply.

Table 2: FTA Ground-Borne Vibration and Ground-Borne Noise Impact Criteria

Land Use Category	Ground-Borne Vibration Impact Levels (VdB re 1 micro-inch /sec)			Ground-Borne Noise Impact Levels (dB re 20 micro Pascals)		
	Frequent Events[1]	Occasional Events[2]	Infrequent Events[3]	Frequent Events[1]	Occasional Events[2]	Infrequent Events[3]
Category 1: Buildings where vibrations would interfere with interior operations.	65 VdB[4]	65 VdB[4]	65 VdB[4]	N/A[4]	N/A[4]	N/A[4]
Category 2: Residences and buildings where people normally sleep.	72 VdB	75 VdB	80 VdB	35 dB(A)	38 dB(A)	43 dB(A)
Category 3: Institutional land uses with primarily daytime use.	75 VdB	78 VdB	83 VdB	40 dB(A)	43 dB(A)	48 dB(A)

(1) "Frequent Events" is defined as more than 70 vibration events of the same source per day. Most rapid transit projects fall into this category.

(2) "Occasional Events" is defined as between 30 and 70 vibration events of the same source per day. Most commuter trunk lines have this many operations.

(3) "Infrequent Events" is defined as fewer than 30 vibration events of the same kind per day. This category includes most commuter rail branch lines.

(4) This criterion limit is based on levels that are acceptable for most moderately sensitive equipment such as optical microscopes. Vibration-sensitive manufacturing or research will require detailed evaluation to define the acceptable vibration levels. Ensuring lower vibration levels in a building often requires special design of the HVAC systems and stiffened floors.

(5) Vibration-sensitive equipment is generally not sensitive to ground-borne noise.

Source: Federal Transit Administration, May 2006

Table 3: FTA Ground-Borne Vibration and Noise Impact Criteria for Special Buildings

Land Use Category	GBV Impact Levels (VdB re 1 micro-inch /sec)		GBN Impact Levels (dB re 20 micro Pascals)	
	Frequent Events[1]	Occasional or Infrequent Events[2]	Frequent Events[1]	Occasional or Infrequent Events[2]
Concert Halls	65 VdB	65 VdB	25 dB(A)	25 dB(A)
TV Studios	65 VdB	65 VdB	25 dB(A)	25 dB(A)
Recording Studios	65 VdB	65 VdB	25 dB(A)	25 dB(A)
Auditoriums	72 VdB	80 VdB	30 dB(A)	38 dB(A)
Theaters	72 VdB	80 VdB	35 dB(A)	43 dB(A)

(1) "Frequent Events" is defined as more than 70 vibration events of the same source per day. Most rapid transit projects fall into this category.

(2) "Occasional or Infrequent Events" is defined as fewer than 70 vibration events per day. This category includes most commuter rail systems.

(3) If the building will rarely be occupied when the trains are operating, there is no need to consider impact. As an example, consider locating a commuter rail line next to a concert hall. If no commuter trains will operate after 7 pm, it should be rare that the trains interfere with the use of the hall.

Source: Federal Transit Administration, May 2006

4.3 Construction Noise Criteria

Construction noise criteria are based on the guidelines provided in the FTA Guidance Manual. These criteria, summarized in **Table 4** below, are based on land use and time of day and are given in terms of Leq for an 8-hour work shift.

Table 4: FTA Construction Noise Criteria

Land Use	Noise Limit, 8-Hour Leq (dB(A))	
	Daytime	Nighttime
Residential	80	70
Commercial	85	85
Industrial	90	90

Source: Federal Transit Administration, May 2006

5. NOISE AND VIBRATION PROJECTIONS

This section summarizes the models used to predict existing and future noise and vibration levels for potential sources of community impact related to the Danbury Improvement Program EIS. These sources include train operation and construction activities. The projection models for these sources are described below.

5.1 Train Noise Projections

The primary components of wayside noise from train operations are horn noise, as well as engine/exhaust noise for diesel locomotives and wheel/rail noise from the steel wheels rolling on steel rails for passenger cars and EMU vehicles. Secondary sources, such as vehicle air-conditioning and other ancillary equipment, will sometimes be audible, but are not expected to be significant factors. The projection of wayside noise from Metro North train operations was carried out using the model specified in the FTA Guidance Manual, with the following assumptions:

- Based on FTA guidance, the predictions assume that a single diesel locomotive operating at 50 mph on ballast and tie track with continuous welded rail (CWR) generates a Sound Exposure Level (SEL) of 92 dB(A) at a distance of 50 feet from the track centerline.

- Based on FTA guidance, the predictions assume that a single EMU or passenger car operating at 50 mph on ballast and tie track with continuous welded rail (CWR) generates a Sound Exposure Level (SEL) of 82 dB(A) at a distance of 50 feet from the track centerline.

- The train schedules and consists are shown in detail in **Table 5**.

- Vehicle operating speeds were assumed to be the maximum operating speed. For Alternatives A and B the maximum operating speed would be 50 mph. The maximum operating speed for Alternatives C, D, and E would be 60 mph.

- Train horns, generating a sound level of 102 dB(A) at 50 feet, will be sounded within 0.25 mile of grade crossings as trains approach the crossings.

- Warning bells, generating a sound level of 73 dB(A) at 50 feet, will be sounded at all gated crossings before and after each train pass-by for a total duration of 30 seconds.

- Wheel impacts at turnouts typically cause noise increases of 6 dB.

The projected unshielded Ldn from Metro North operations, without horns and with horns, are shown in **Figure 7** and **Figure 8**, respectively, as a function of distance from the track. The projections apply to the corridor segment between South Norwalk and Wilton, which is common to all of the alternatives. The results show that the lowest noise exposure levels are associated with Alternative A, representing the Existing and No Build conditions with diesel-powered operations at 50 mph, and that the highest levels are projected for Alternative D-Diesel, with diesel-powered operations at 60 mph. The noise exposure levels for Alternative B, with a lower number of diesel-powered trains, and for Alternative C, D-Electric and E, with a higher number of electric-powered trains, fall in between. It should be noted that for the build alternatives without horns, the noise exposure levels are about three decibels higher for diesel operations than for electric operations. With horns, however, the noise levels are approximately the same for diesel and electric operations due to the dominance of horn noise over vehicle noise. Overall, the noise exposure levels in areas near grade crossings where horns are sounded are roughly 12 decibels higher than the levels in areas further away from the crossings where horns are not sounded.

Table 5: Summary of Train Schedule by Alternative

Alternative	Maximum Speed (mph)	Total No. of Daytime Trains (7am-10pm)	Total No. of Nighttime Trains (10pm-7am)	Number of Diesel Locomotives	Number of Passenger Cars/EMUs
Alternative A	50	18	4	1	3 (off-peak hours) 6-7 (peak hours)
Alternative B	50	28	4	1	3 (off-peak hours) 6-7 (peak hours)
Alternative C	60	32	10	0	4 (off-peak hours) 6-8 (peak hours)
Alternative D-Diesel	60	32	10	1	3 (off-peak hours) 6-7 (peak hours)
Alternative D-Electric	60	32	10	0	4 (off-peak hours) 6-8 (peak hours)
Alternative E	60	32	10	0	4 (off-peak hours) 6-8 (peak hours)

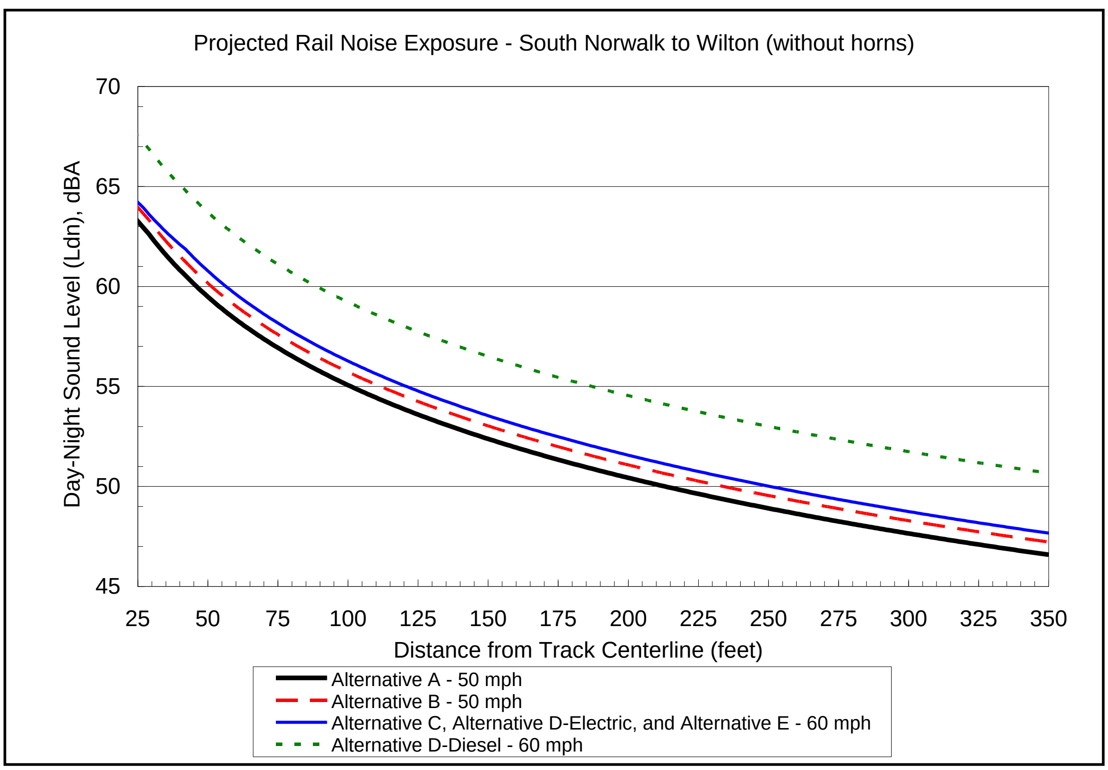


Figure 7. Projected 24-Hour Noise Exposure from Metro North Operations (Without Horns)

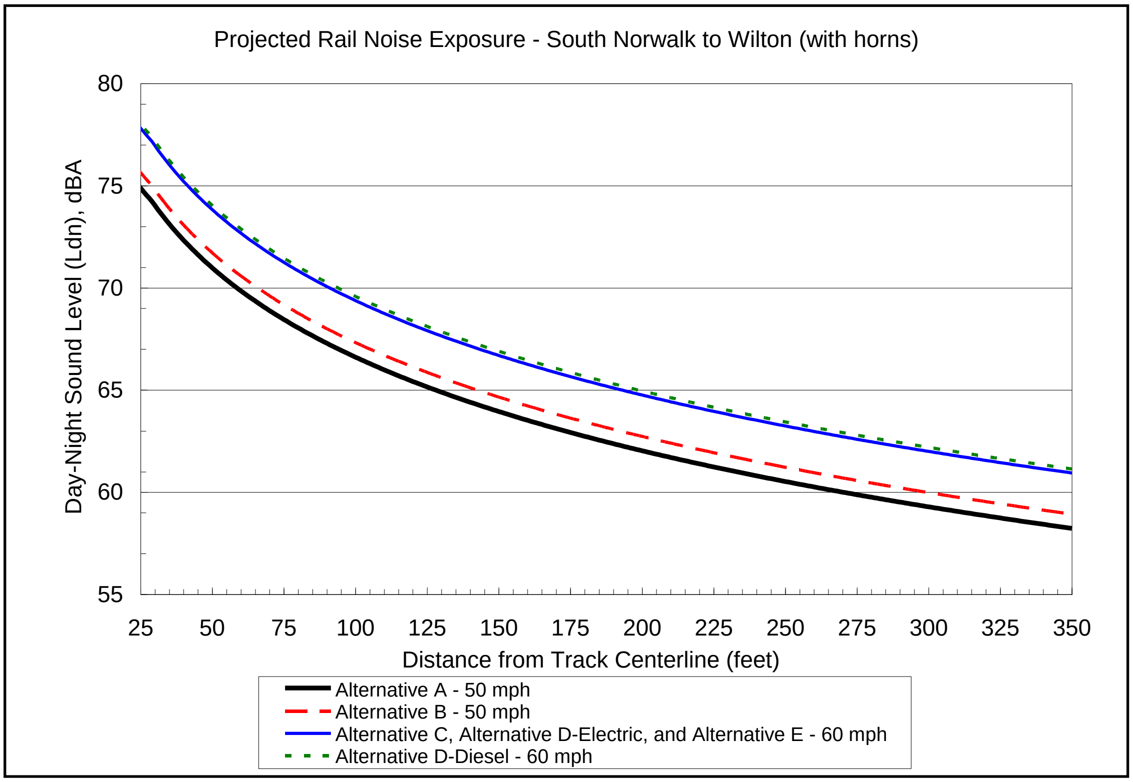


Figure 8. Projected 24-Hour Noise Exposure from Metro North Operations (With Horns)

5.2 Train Vibration Projections

The projection of ground-borne vibration from Metro North operations on the Danbury Branch corridor was based on the following:

- Vibration levels were modeled using the FTA General Vibration Assessment methodology. Maximum vibration levels from diesel locomotive-hauled trains were assumed to follow the Locomotive Powered Passenger curve in Figure 10-1 of the FTA Guidance Manual. Vibration levels from EMU trains were assumed to follow the Rapid Transit curve.

- Vehicle operating speeds were assumed to be the maximum operating speed. For Alternatives A and B, the maximum operating speed would be 50 mph. The maximum operating speed for Alternatives C, D, and E would be 60 mph.

- Wheel impacts at turnouts typically cause localized vibration increases of 10 VdB.

The resulting projections of maximum ground-borne vibration levels from Metro North train operations at the maximum speed of 60 mph for both diesel locomotive-hauled trains and EMU trains are provided in **Figure 9**. Each of the curves has a different level vs. distance characteristic, which determines the impact distance for each type of train. **Figure 9** also shows the FTA residential vibration annoyance criterion for this project (75 VdB, based on a total of 30-70 trains per day). These results indicate impact distances of approximately 50 feet for EMU trains and 150 feet for diesel locomotive-hauled trains.

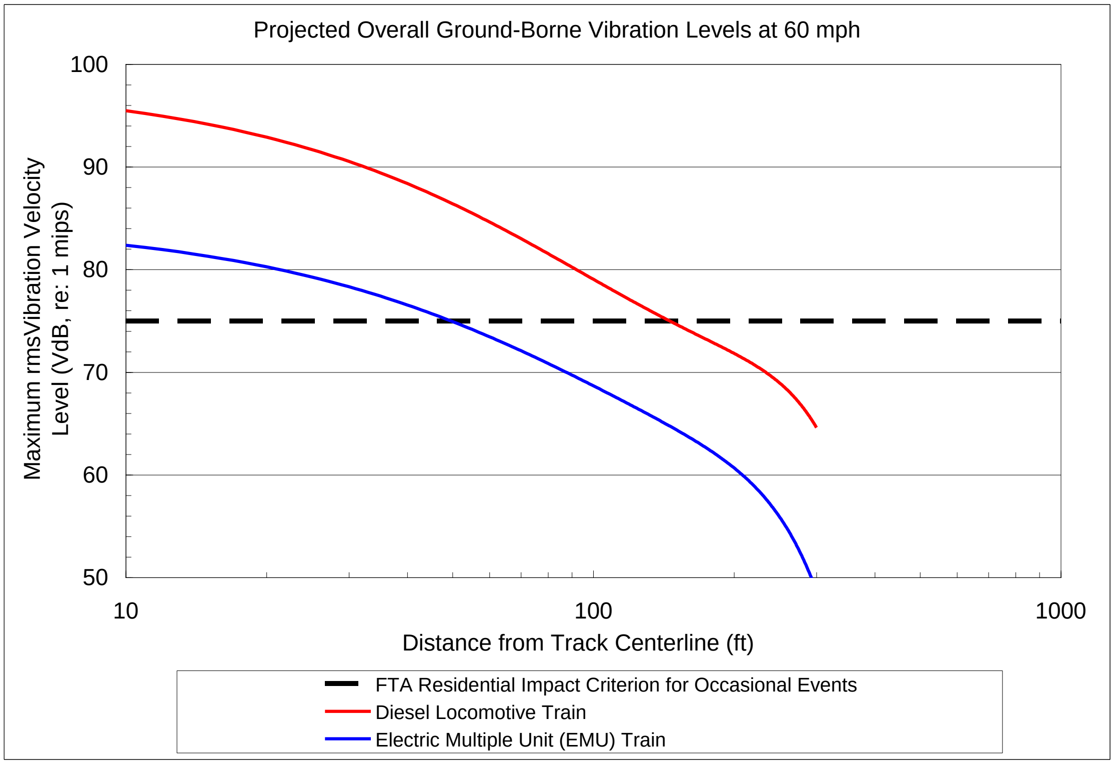


Figure 9. Projected Ground-Borne Vibration Levels

5.3 Construction Noise Projections

Construction noise varies greatly depending on the construction process, type and condition of equipment used, and layout of the construction site. Many of these factors are traditionally left to the contractor's discretion, which makes it difficult to accurately estimate levels of construction noise. Overall, construction noise levels are governed primarily by the noisiest pieces of equipment. For most construction equipment, the engine, which is usually diesel, is the dominant noise source. This is particularly true of engines without sufficient muffling. For special activities such as impact pile driving and pavement breaking, noise generated by the actual process dominates.

Table 6 summarizes some available data on noise emissions of construction equipment from the FTA Guidance Manual, in terms of averages of the Lmax values at a distance of 50 feet. Although the noise levels in the table represent typical values, there can be wide fluctuations in the noise emissions of similar equipment. Construction noise at a given noise-sensitive location depends on the magnitude of noise during each construction phase, the duration of the noise, and the distance from the construction activities.

Projecting construction noise requires a construction scenario of the equipment likely to be used and the average utilization factors or duty cycles (i.e. the percentage of time during operating hours that the equipment operates under full power during each phase). Using the typical sound emission characteristics, as given in **Table 6**, it is then possible to estimate Leq or Ldn at various distances from the construction site.

Table 6: Construction Equipment Noise Emission Levels

Equipment Type	Typical Sound Level at 50 ft (dB(A))
Backhoe	80
Bulldozer	85
Compactor	82
Compressor	81
Concrete Mixer	85
Concrete Pump	82
Crane, Derrick	88
Crane, Mobile	83
Loader	85
Pavement Breaker	88
Paver	89
Pile Driver, Impact	101
Pump	76
Roller	74
Truck	88

Source: Federal Transit Administration, May 2006

The noise impact assessment for a construction site is based on:

- an estimate of the type of equipment that will be used during each phase of the construction and the average daily duty cycle for each category of equipment,
- typical noise emission levels for each category of equipment such as those in **Table 6**, and
- estimates of noise attenuation as a function of distance from the construction site.

Construction noise estimates are always approximate because of the lack of specific information available at the time of the environmental assessment. Decisions about the procedures and equipment to be used are made by the contractor. Project designers usually try to minimize constraints on how the construction will be performed and what equipment will be used so that contractors can perform construction in the most cost effective manner.

Table 7 is an example of the noise projections for equipment that is often used during tie-and-ballast track construction. For the calculations it is assumed that all the equipment is located at the geometric center of the construction work site. Based on this scenario, an 8-hour Leq of 88 dB(A) should be expected at a distance of 50 feet from the geometric center of the work site. This calculation in **Table 7** does not assume any noise mitigation measures or any limits on the contractor about how much noise can be made. With at-grade track construction, the duration of the activities at a specific location along the alignment will be relatively limited, usually a matter of several weeks. As a result, even when there may be noise impacts, the limited duration of the construction can mean that mitigation is not cost effective.

Table 7: Typical Equipment List, At-Grade Track Construction

Equipment Item	Typical Maximum Sound Level at 50 ft (dB(A))	Equipment Utilization Factor (%)	Leq (dB(A))
Air Compressor	83	50%	80
Backhoe	80	40%	76
Crane, Derrick	82	10%	72
Dozer	85	40%	81
Generator	81	80%	80
Loader	85	40%	81
Pavement Breaker	84	4%	70
Shovel	80	40%	76
Dump Truck	88	16%	80
Total Workday Leq at 50 feet (8-hour workday)			88

Source: Harris Miller Miller & Hanson Inc., 2011

6. NOISE AND VIBRATION IMPACT ASSESSMENT

A noise and vibration impact assessment was performed based on the criteria discussed in Section 4 and on the projections described in Section 5. The assessment results are described below.

6.1 Train Noise Impact Assessment

An overall summary of the projected noise impacts for the various study alternatives is provided in **Table 8**. No noise impacts would be associated with Alternative A as there would be no change in rail operations along the corridor for the No Build alternative. Details of the noise assessments for the TSM and Build alternatives (Alternatives B, C, D-Diesel, D-Electric and E) are presented in **Tables 9-13**. In addition to the receptor locations, distances to the track and train speeds, these tables include the estimated existing and predicted future noise levels as well as the predicted noise increases due to the study alternatives. Based on a comparison of the predicted noise increases with the impact criteria, the table also includes an inventory of the number of moderate and severe noise impact locations in each city or town.

Table 8: Overall Summary of Projected Noise Impacts for Project Alternatives

Project Alternative	**Number of Residential Noise Impacts (Without Mitigation)**		
	Moderate	**Severe**	**Total Impacts**
Alternative B	14	0	14
Alternative C	1,026	70	1,096
Alternative D-Diesel	1,735	486	2,221
Alternative D-Electric	1,303	311	1,614
Alternative E	558	52	610

Source: Harris Miller Miller & Hanson Inc., 2011

The noise assessment results indicate that, without mitigation, the total number of projected noise impacts is expected to range from 14 for Alternative B to 2,221 for Alternative D-Diesel. Severe impacts for these alternatives are projected to range from 0 to 486, and moderate impacts are projected to range from 14 to 1,735. For the Build alternatives, Alternative D-Diesel is projected to have the most impacts and Alternative E is projected to have the least impacts. The affected receptors are shown in **Appendix C**.

6.2 Bus Noise Impact Assessment

For Alternative B, the TSM alternative, in addition to the changes in rail service described previously, there would also be an express bus service from Danbury to New Milford. This bus service would operate in the morning and afternoon to provide connections to the AM and PM train service and would operate on Route 7. Because there would only be five AM and five PM buses added to the existing high volume of traffic on a multilane, limited access roadway, there would be no noise impacts from bus operations for Alternative B.

Table 9: Summary of Noise Impact Projections for Alternative B (Without Mitigation)

Receptor Location	Distance to Near Track (ft)	Train Speed (mph)	Existing Noise Level[1]	Project Future Noise Level[1]	Predicted Increase in Noise due to Project[1,2]	Impact Criteria for Noise Increase[1]		Number of Impacts[3]	
						Moderate	Severe	Moderate	Severe
South Norwalk	0	0	0	0	0	0	0	0	0
Norwalk	25-44	50	73	73-74	1	1	2	12	0
Wilton	0	0	0	0	0	0	0	0	0
Georgetown	13	50	78	78	0	0	2	2	0
Ridgefield	0	0	0	0	0	0	0	0	0
West Redding	0	0	0	0	0	0	0	0	0
Bethel	0	0	0	0	0	0	0	0	0
Danbury	0	0	0	0	0	0	0	0	0
TOTAL								**14**	**0**

[1] Noise levels are based on Ldn and measured in dB(A).
[2] Predicted levels include horn and bell noise, where applicable (rounded to the nearest decibel).
[3] All impacts are residential unless otherwise noted.

Source: Harris Miller Miller & Hanson Inc., 2011

Table 10: Summary of Noise Impact Projections for Alternative C (Without Mitigation)

Receptor Location	Distance to Near Track (ft)	Train Speed (mph)	Existing Noise Level[1]	Project Future Noise Level[1]	Predicted Increase in Noise due to Project[1,2]	Impact Criteria for Noise Increase[1]		Number of Impacts[3]	
						Moderate	Severe	Moderate	Severe
South Norwalk	4-126	60	54-64	58-73	3-10	1-4	4-8	100	34
Norwalk	25-263	60	55-73	58-76	2-3	1-3	2-7	430	18
Wilton	39-281	60	56-71	59-74	2-4	1-3	3-7	62	3
Georgetown	13-300	60	55-78	59-80	2-4	0-3	2-7	37	6
Ridgefield	17-391	60	53-71	57-77	2-9	1-4	3-8	28	2
West Redding	34-371	60	58-71	61-75	2-3	1-2	3-6	11	1
Bethel	45-227	60	58-73	61-76	2-3	1-2	2-6	11	2
Danbury	47-363	60	55-73	58-75	2-3	1-3	2-7	347	4
TOTAL								**1,026**	**70**

[1] Noise levels are based on Ldn and measured in dB(A).
[2] Predicted levels include horn and bell noise, where applicable (rounded to the nearest decibel).
[3] All impacts are residential unless otherwise noted.

Source: Harris Miller Miller & Hanson Inc., 2011

Table 11: Summary of Noise Impact Projections for Alternative D-Diesel (Without Mitigation)

Receptor Location	Distance to Near Track (ft)	Train Speed (mph)	Existing Noise Level[1]	Project Future Noise Level[1]	Predicted Increase in Noise due to Project[1,2]	Impact Criteria for Noise Increase[1]		Number of Impacts[3]	
						Moderate	Severe	Moderate	Severe
South Norwalk	12-137	60	53-68	58-72	4-5	1-4	3-8	284	104
Norwalk	25-262	60	53-73	57-76	2-4	1-4	2-8	414	90
Wilton	39-415	60	53-71	57-73	2-4	1-4	3-8	185	10
Georgetown	13-300	60	52-78	57-80	2-4	0-4	2-9	41	11
Ridgefield	48-423	60	53-71	57-74	2-4	1-4	3-8	44	2
West Redding	34-371	60	53-71	57-75	2-4	1-4	3-8	22	1
Bethel	45-271	60	55-73	59-76	2-4	1-3	2-7	18	2
Danbury	13-589	60	53-73	57-83	1-17	1-4	2-8	423	79
Brookfield	42-230	60	51-57	56-66	3-15	3-4	6-9	69	7
New Milford	9-299	60	57-74	63-84	1-10	1-3	2-6	235	180
TOTAL								**1,735**	**486**

[1] Noise levels are based on Ldn and measured in dB(A).
[2] Predicted levels include horn and bell noise, where applicable (rounded to the nearest decibel).
[3] All impacts are residential unless otherwise noted.

Source: Harris Miller Miller & Hanson Inc., 2011

Table 12: Summary of Noise Impact Projections for Alternative D –Electric (Without Mitigation)

Receptor Location	Distance to Near Track (ft)	Train Speed (mph)	Existing Noise Level[1]	Project Future Noise Level[1]	Predicted Increase in Noise due to Project[1,2]	Impact Criteria for Noise Increase[1]		Number of Impacts[3]	
						Moderate	Severe	Moderate	Severe
South Norwalk	4-126	60	54-64	58-73	3-10	1-4	4-8	100	34
Norwalk	25-263	60	55-73	58-76	2-3	1-3	2-7	430	18
Wilton	39-281	60	56-71	59-74	2-4	1-3	3-7	62	3
Georgetown	13-300	60	55-78	59-80	2-4	0-3	2-7	37	6
Ridgefield	17-391	60	53-71	57-77	2-9	1-4	3-8	28	2
West Redding	34-371	60	58-71	61-75	2-3	1-2	3-6	11	1
Bethel	45-227	60	58-73	61-76	2-3	1-2	2-6	11	2
Danbury	13-589	60	55-73	58-83	1-17	1-3	2-7	364	66
Brookfield	42-153	60	51-57	56-63	3-12	3-4	6-9	41	2
New Milford	9-258	60	57-74	63-84	1-10	1-3	2-6	219	177
TOTAL								**1,303**	**311**

[1] Noise levels are based on Ldn and measured in dB(A).
[2] Predicted levels include horn and bell noise, where applicable (rounded to the nearest decibel).
[3] All impacts are residential unless otherwise noted.

Source: Harris Miller Miller & Hanson Inc., 2011

Table 13: Summary of Noise Impact Projections for Alternative E (Without Mitigation)

Receptor Location	Distance to Near Track (ft)	Train Speed (mph)	Existing Noise Level[1]	Project Future Noise Level[1]	Predicted Increase in Noise due to Project[1,2]	Impact Criteria for Noise Increase[1]		Number of Impacts[3]	
						Moderate	Severe	Moderate	Severe
South Norwalk	4-126	60	54-64	58-68	3-4	1-4	4-8	100	34
Norwalk	25-263	60	55-73	58-76	2-3	1-3	2-7	430	18
Wilton	39-213	60	58-64	62-66	3-4	2	4-6	28	0
Georgetown	0	0	0	0	0	0	0	0	0
Ridgefield	0	0	0	0	0	0	0	0	0
West Redding	0	0	0	0	0	0	0	0	0
Bethel	0	0	0	0	0	0	0	0	0
Danbury	0	0	0	0	0	0	0	0	0
TOTAL								**558**	**52**

[1] Noise levels are based on Ldn and measured in dB(A).
[2] Predicted levels include horn and bell noise, where applicable (rounded to the nearest decibel).
[3] All impacts are residential unless otherwise noted.

Source: Harris Miller Miller & Hanson Inc., 2011

6.3 Train Vibration Impact Assessment

An overall summary of the projected vibration impacts for the various study alternatives is provided in **Table 14**. As shown in this table, no vibration impacts are projected for Alternative C and Alternative E which include the conversion from heavier diesel equipment to lighter electric vehicles. In addition, no vibration impacts would be associated with Alternative A as there would be no change in rail operations along the corridor for the No Build alternative. Details of the noise assessments for the remaining TSM and Build alternatives (Alternatives B, D-Diesel and D-Electric) are presented in **Tables 15-17**. In addition to the receptor locations, distances to the track and train speeds, these tables include the estimated existing and predicted future vibration levels as well as the applicable vibration impact criteria. Based on a comparison of the predicted vibration levels with the impact criteria, the table also includes an inventory of the number of residential and non-residential impacts in each city or town.

Table 14: Overall Summary of Projected Vibration Impacts for Project Alternatives

Study Alternative	Number of Vibration Impacts (Without Mitigation)	
	Residential	Non-Residential
Alternative B	456	1 Museum + 1 School
Alternative C	0	0
Alternative D-Diesel	1,122	1 Museum + 2 Schools
Alternative D-Electric	218	0
Alternative E	0	0

Source: Harris Miller Miller & Hanson Inc., 2011

The vibration assessment results indicate that, without mitigation, the total number of projected vibration impacts is expected to be greatest for the alternatives that include diesel-powered trains, with Alternative D-Diesel affecting 1,122 residences, one museum and two schools and Alternative B affecting 456 residences, one museum and one school. The least amount of vibration impacts are projected for the alternatives that include electric-powered trains, with no impacts for Alternatives C and E and 218 residential impacts for Alternative D-Electric. The affected receptors are shown in **Appendix D**.

6.4 Construction Noise Impact Assessment

Based on the criteria in Section 4.3 and the noise projection in **Table 7**, and assuming that construction noise is reduced by 6 decibels for each doubling of distance from the center of the site, screening distances for potential construction noise impact can be estimated. These estimates suggest that the potential for noise impact from at-grade track construction will be minimal for commercial and industrial land use, with impact screening distances of 70 feet and 40 feet, respectively. For residential land use, the potential for temporary construction noise impact would be limited to locations within about 125 feet of the corridor for daytime construction. However, the potential for noise impact from nighttime construction could extend to residences as far as 400 feet. The extent of noise impacts would be roughly similar for the construction of structures (e.g. for bridges, retaining walls and storage yards) except that those impacts would likely have a greater duration than for at-grade track construction.

Given that much of the construction work will need to be done during the sensitive nighttime hours to avoid disrupting the existing rail service, there is the potential for significant noise impact from project construction activities. Potential construction noise impacts will be evaluated in detail during final design when specific construction scenarios are developed for the preferred alternative that is ultimately selected.

Table 15: Summary of Vibration Impact Projections for Alternative B (Without Mitigation)

Receptor Location	Distance To Near Track (ft)	Train Speed (mph)	Existing Vibration Level[1]	Projected Vibration Level[1]	Vibration Impact Criterion[1]	Number of Vibration Impacts[2]
South Norwalk	99-100	50	77-83	77-83	75-78	135 Residential, 1 Museum
Norwalk	81-124	50	75-80	75-80	75	128
Wilton	82-126	50	75-80	75-80	75	120
Georgetown	109-123	50	75-77	75-77	75	12
Ridgefield	82-113	50	76-80	76-80	75	7
West Redding	93-118	50	76-78	76-78	75	5
Bethel	107-152	50	75-78	75-78	75	5
Danbury	88-184	50	75-79	75-79	75-78	44 Residential, 1 School
TOTAL						**456 Residences + 1 Museum + 1 School**

[1] Overall Vibration levels are measured in VdB referenced to 1 µ-inch/second.
[2] All impacts are residential unless otherwise noted.

Source: Harris Miller Miller & Hanson Inc., 2011

Table 16: Summary of Vibration Impact Projections for Alternative D-Diesel (Without Mitigation)

Receptor Location	Distance To Near Track (ft)	Train Speed (mph)	Existing Vibration Level[1]	Projected Vibration Level[1]	Vibration Impact Criterion[1]	Number of Vibration Impacts[2]
South Norwalk	99-137	60	74-83	76-84	75-78	155 Residential, 1 Museum
Norwalk	81-132	60	75-80	76-82	75	132
Wilton	82-213	60	74-80	75-81	75-78	149 Residential, 1 School
Georgetown	109-137	60	74-77	76-78	75	19
Ridgefield	82-143	60	74-80	75-81	75	11
West Redding	93-118	60	76-78	77-80	78	5
Bethel	107-227	60	74-78	75-80	75	7
Danbury	13-589	60	68-97	75-105	75-78	193 Residential, 1 School
Brookfield	42-187	60	68-80	75-88	75	35
New Milford	9-146	60	67-93	75-101	75	416
TOTAL						**1,122 Residences + 1 Museum + 2 Schools**

[1] Overall Vibration levels are measured in VdB referenced to 1 µ-inch/second.
[2] All impacts are residential unless otherwise noted.

Source: Harris Miller Miller & Hanson Inc., 2011

Table 17: Summary of Vibration Impact Projections for Alternative D –Electric (Without Mitigation)

Receptor Location	Distance To Near Track (ft)	Train Speed (mph)	Existing Vibration Level[1]	Projected Vibration Level[1]	Vibration Impact Criterion[1]	Number of Vibration Impacts[2]
South Norwalk	42	60	96	86	75	0
Norwalk	25	60	90	79	75	0
Wilton	39	60	92	82	75	0
Georgetown	13	60	93	82	75	0
Ridgefield	17	60	85	81	75	0
West Redding	9	60	94	83	78	0
Bethel	45	60	96	86	75	0
Danbury	13-122	60	79-97	77-92	75	37
Brookfield	42-73	60	80	76-77	75	2
New Milford	9-115	60	80-93	76-88	75	179
TOTAL						**218**

[1] Overall Vibration levels are measured in VdB referenced to 1 µ-inch/second.
[2] All impacts are residential unless otherwise noted.

Source: Harris Miller Miller & Hanson Inc., 2011

7. MITIGATION MEASURES FOR NOISE AND VIBRATION IMPACTS

7.1 Train Noise Mitigation Measures

In areas where severe or moderate (where high noise levels already occur) noise impacts were identified, mitigation measures are prepared based on existing FRA-approved practices. Potential mitigation measures for reducing noise impacts from rail operations for the proposed project are described below:

Quiet Zones – FRA regulations regarding safety at grade crossings may result in noise impacts to sensitive receptors near grade crossings due to the sounding of train horns. An option for reducing such impacts under the FRA regulation would be to establish "quiet zones" at grade crossings. In a quiet zone, because of safety improvements at the at-grade crossings, train operators would sound warning devices (e.g. horns) only in emergency situations rather than as a standard operational procedure. Establishing quiet zones would require cooperative action among the municipalities along the rail right-of-way, ConnDOT, FRA, Metro North and the freight railroads. The cities and towns are key participants as they must initiate the request to establish the zone through application to FRA. In addition, to meet safety criteria, improvements are required at grade crossings; these include modifications to the streets, raised medians, warning lights and other devices.

Wayside Horns – The FRA regulation also authorizes the use of automated wayside horns at crossings with flashing lights and gates as a substitute for the train horn. While activated by the approach of trains, these devices are pole-mounted at the grade crossings, thereby limiting the horn noise exposure area to the immediate vicinity of the grade crossing. In the event that it is not possible to eliminate the sounding of train horns, horns or other warning devices with reduced sound emission can be considered.

Noise Barriers - This is a common approach to reducing noise impacts from surface transportation sources. The primary requirements for an effective noise barrier are that:

- the barrier must be high enough and long enough to break the line-of-sight between the sound source and the receiver
- the barrier must be of an impervious material with a minimum surface density of 4 lb/sq. ft.
- the barrier must not have any gaps or holes between the panels or at the bottom

Because numerous materials meet these requirements, the selection of materials for noise barriers is usually dictated by aesthetics, durability, cost, and maintenance considerations. Noise barriers for commuter rail systems typically range in height from eight to twelve feet.

Building Sound Insulation - Sound insulation of residences and institutional buildings to improve the outdoor-to-indoor noise reduction has been widely applied around airports and has seen limited application for transit projects. Although this approach has no effect on noise in exterior areas, it may be the best choice for sites where noise barriers are not feasible or desirable and for buildings where indoor sensitivity is of most concern. Substantial improvements in building sound insulation (on the order of 5 to 10 dB(A)) can often be achieved by adding an extra layer of glazing to the windows, by sealing any holes in exterior surfaces that act as sound leaks, and by providing forced ventilation and air-conditioning so that windows do not need to be opened.

Special Trackwork - Because the impacts of vehicle wheels over rail gaps at track turnout locations increases airborne noise by about six dB(A), turnouts are a major source of noise impact when they are located in sensitive areas. If turnouts cannot be relocated away from sensitive areas, another approach is to use spring-rail, flange-bearing or moveable-point frogs in place of standard rigid frogs at turnouts.

These devices allow the flangeway gap to remain closed in the main traffic direction for revenue service trains.

As discussed in Section 4.1, FTA states that in implementing noise impact criteria, severe impacts should be mitigated unless there are truly extenuating circumstances which prevent it. At the moderate impact level, more discretion should be used, and other project-specific factors should be included in the consideration of mitigation. These other factors include the existing level, the predicted level of increase over existing noise levels, the types and numbers of noise-sensitive land uses affected, the noise sensitivity of the properties, the effectiveness of the mitigation measures, community views and the cost of mitigating noise to more acceptable levels. FTA also states that there is a stronger need for mitigation if a project is proposed in an area currently experiencing high noise levels (e.g. with Ldn above 65 dB(A)) from surface transportation sources. In such cases, FTA indicates that impacts predicted in the moderate range should be treated as if they were severe in terms of mitigation.

The results of the noise analysis suggest that the most effective mitigation approach would be to establish quiet zones to eliminate train horn noise at all at-grade crossings near affected noise-sensitive areas. As indicated in **Table 18** below, this measure is expected to eliminate all noise impacts for Alternative B and to reduce the number of noise impacts by 60 to 90 percent for the Build alternatives. To mitigate the residual noise impacts shown in **Table 18**, a combination of noise barriers and building sound insulation can be considered. The noise analysis will be refined during project design to determine the details of the final mitigation measures for the preferred alternative that is ultimately selected.

Table 18: Comparison of Projected Noise Impacts With and Without Quiet Zones

Project Alternative	Moderate Impacts		Severe Impacts		Total Impacts	
	Without Mitigation	With Quiet Zones	Without Mitigation	With Quiet Zones	Without Mitigation	With Quiet Zones
Alternative B	14	0	0	0	14	0
Alternative C	1,026	108	70	34	1,096	142
Alternative D-Diesel	1,735	731	486	147	2,221	878
Alternative D-Electric	1,303	223	311	60	1,614	283
Alternative E	558	108	52	34	610	142

Source: Harris Miller Miller & Hanson Inc., 2011

7.2 Train Vibration Mitigation Measures

The assessment assumes that the vehicle wheels and track are maintained in good condition with regular wheel truing and rail grinding. Beyond this, there are several approaches to reduce ground-borne vibration from train operation, as described below.

- **Ballast Mats:** A ballast mat consists of a pad made of rubber or rubber-like material placed on an asphalt or concrete base with the normal ballast, ties, and rail on top. The reduction in ground-borne vibration provided by a ballast mat is strongly dependent on the vibration frequency content and the design and support of the mat.

- **Tire Derived Aggregate (TDA):** Also known as shredded tires, a typical TDA installation consists of an underlayment of 12 inches of nominally 3-inch size tire shreds or chips wrapped with filter fabric, covered with 12 inches of sub-ballast and 12 inches of ballast above that to the base of the ties. Tests suggest that the vibration attenuation properties of this treatment are midway between that of ballast mats and floating slab track. While this is a low-cost option, it has only recently been installed on two U.S. light rail transit systems (San Jose and Denver).

- **Floating Slabs:** Floating slabs consist of thick concrete slabs supported by resilient pads on a concrete foundation; the tracks are mounted on top of the floating slab. Most successful floating slab installations are in subways, and their use for at-grade track is less common. Although floating slabs are designed to provide vibration reduction at lower frequencies than ballast mats, they are extremely expensive.

- **Special Trackwork:** Because the impacts of vehicle wheels over rail gaps at track turnout locations increases ground-borne vibration by about 10 VdB, turnouts are a major source of vibration impact when they are located in sensitive areas. If turnouts cannot be relocated away from sensitive areas, another approach is to use spring-rail, flange-bearing or moveable-point frogs in place of standard rigid frogs at turnouts. These devices allow the flangeway gap to remain closed in the main traffic direction for revenue service trains.

- **Property Acquisitions or Easements:** Additional options for avoiding vibration impacts (and noise impacts also) are for the transit agency to purchase residences likely to be impacted by train operations or to acquire easements for such residences by paying the homeowners to accept the future train vibration conditions. These approaches are usually taken only in isolated cases where other mitigation options are infeasible, impractical, or too costly.

Vibration impacts that exceed FTA criteria are considered to be significant and to warrant mitigation, if reasonable and feasible. A detailed vibration analysis would need to be carried out during project design to refine the impact projections for the preferred alternative that is ultimately selected, and the above mitigation measures will be considered depending on the alternative option to be implemented.

7.3 Construction Noise Mitigation Measures

Construction activities will be carried out in compliance with all applicable local noise regulations. In addition, a noise control plan will be developed during final design, including specific residential property line noise limits, and noise monitoring will be performed during construction to verify compliance with the limits. Noise control measures that will be applied as needed to meet the noise limits include the following:

- Using specially quieted equipment with enclosed engines and/or high-performance mufflers
- Locating stationary construction equipment as far as possible from noise-sensitive sites
- Constructing or positioning temporary noise barriers, such as office trailer, walls, or piles of excavated material, between noisy activities and noise-sensitive receivers
- Re-routing construction-related truck traffic along roadways that will cause the least disturbance to residents

In addition to the general measures above, site-specific noise control measures will be included in the noise control plan as needed to minimize construction noise impact following CTDOT's Best Management Practices for Construction.

APPENDIX A. NOISE MEASUREMENT SITE PHOTOGRAPHS

Figure A-1: Site N-1, 77 N. Water Street – Norwalk

Figure A-2: Site N-2, Matthew's Park - Norwalk

Figure A-3: Site N-3, 28 Wilton Avenue – Norwalk

Figure A-4: Site N-4, Merritt Station - Norwalk

Figure A-5: Site N-5, 51 Wolfpit Road – Wilton

Figure A-6: Site N-6, Schenk's Island Park – Wilton

Figure A-7: Site N-7, 186 Mather Street – Wilton

Figure A-8: Site N-8, 96 Portland Avenue - Wilton

Figure A-9: Site N-9, 131 Simpaug Turnpike – Redding

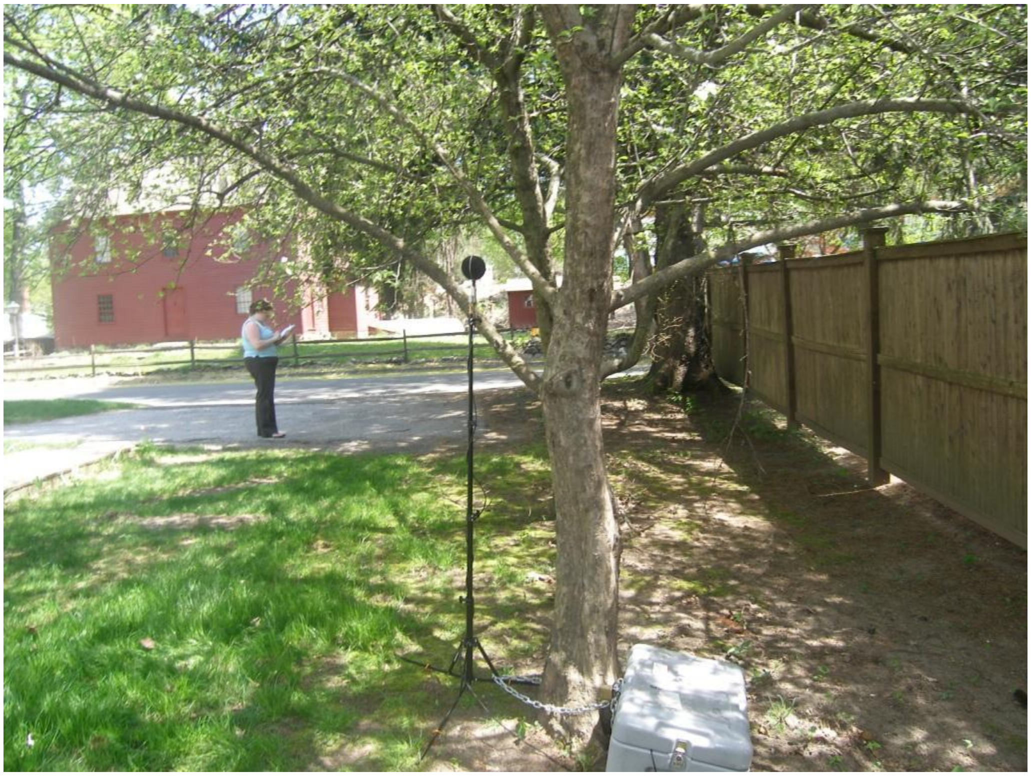


Figure A-10: Site N-10, 5 Taylor Avenue - Bethel

Figure A-11: Site N-11, 63 Wildman Street – Danbury

Figure A-12: Site N-12, 51 Beaver Brook Road - Danbury

Figure A-13: Site N-13, 151 Pocono Road – Brookfield

Figure A-14: Site N-14, 16 Prospect Drive - Brookfield

Figure A-15: Site N-15, 30 Erickson Road – New Milford

Figure A-16: Site N-16, 42 S. Main Street – New Milford

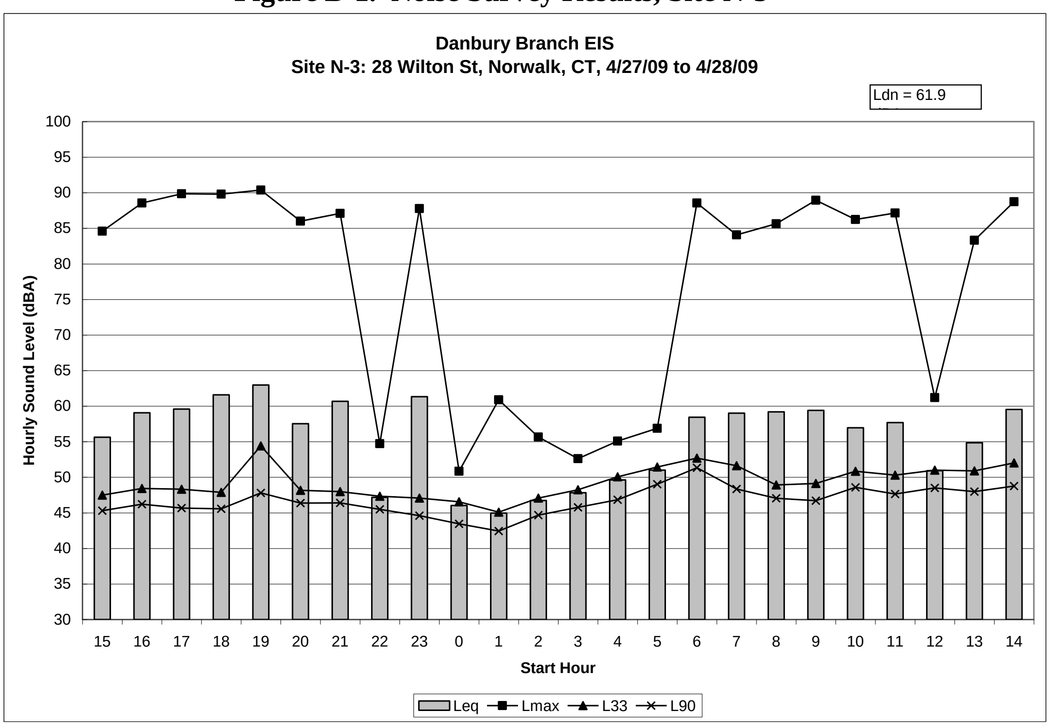
APPENDIX B. LONG-TERM NOISE MEASUREMENT DATA

Site N-3: 28 Wilton Avenue – Norwalk, CT	**Ldn: 62 dB(A) (April 27-28, 2009)**

Table B-1: Noise Survey Results, Site N-3

Start Hour	LEQ	LMAX	L1	L10	L33	L50	L90	L99
15:00	55.6	84.6	60.4	50.9	47.5	46.7	45.3	44.5
16:00	59.1	88.5	64.0	51.3	48.4	47.7	46.2	45.5
17:00	59.6	89.8	60.2	51.3	48.3	47.4	45.7	44.8
18:00	61.6	89.8	69.3	51.0	47.9	47.0	45.6	44.8
19:00	63.0	90.4	71.7	61.4	54.4	51.2	47.8	46.6
20:00	57.5	86.0	58.5	50.1	48.2	47.6	46.4	45.7
21:00	60.7	87.1	69.8	49.8	48.0	47.5	46.4	45.6
22:00	47.2	54.7	51.0	48.5	47.3	46.8	45.5	44.5
23:00	61.3	87.8	68.4	49.1	47.1	46.3	44.6	43.9
0:00	46.0	50.8	49.5	48.1	46.6	45.6	43.5	42.8
1:00	45.0	60.9	50.0	46.3	45.1	44.5	42.4	41.6
2:00	46.7	55.7	50.5	48.4	47.1	46.4	44.7	43.6
3:00	47.8	52.6	50.9	49.4	48.2	47.6	45.8	43.9
4:00	49.6	55.1	53.2	51.7	50.1	49.2	46.8	45.1
5:00	51.0	56.9	54.1	52.4	51.4	50.9	49.0	47.7
6:00	58.5	88.6	60.4	53.5	52.7	52.3	51.3	50.5
7:00	59.0	84.1	68.9	52.9	51.6	50.9	48.3	47.0
8:00	59.2	85.6	66.0	52.1	48.9	48.2	47.0	46.4
9:00	59.4	88.9	61.7	51.4	49.1	48.4	46.7	45.5
10:00	57.0	86.2	56.9	52.7	50.9	50.2	48.6	47.3
11:00	57.7	87.1	63.0	52.8	50.3	49.5	47.6	46.6
12:00	50.9	61.2	56.0	52.7	51.0	50.3	48.5	47.2
13:00	54.8	83.3	57.7	52.4	50.9	50.1	48.0	46.5
14:00	59.5	88.7	61.0	55.0	52.0	50.9	48.8	47.3

Figure B-1. Noise Survey Results, Site N-3

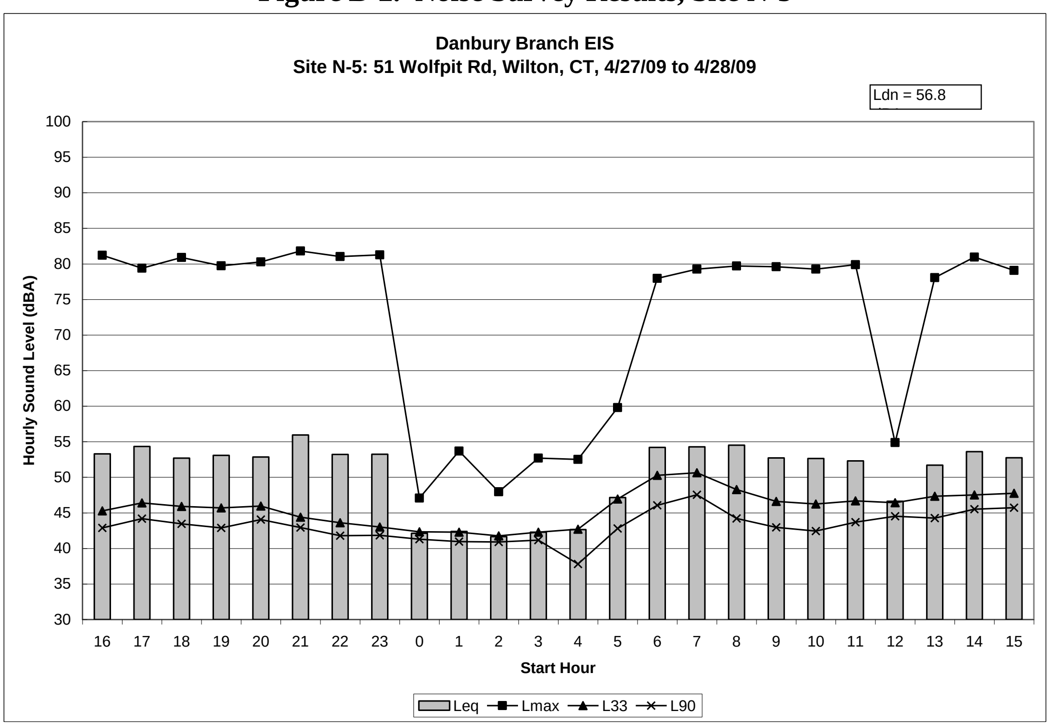


Site N-5: 51 Wolfpit Road – Wilton, CT	Ldn: 57 dB(A) (April 27-28, 2009)

Table B-2: Noise Survey Results, Site N-5

Start Hour	LEQ	LMAX	L1	L10	L33	L50	L90	L99
16:00	53.3	81.2	55.4	47.8	45.3	44.6	42.9	41.7
17:00	54.3	79.4	61.6	49.4	46.4	45.7	44.2	43.1
18:00	52.7	80.9	56.3	48.0	45.9	45.3	43.5	42.0
19:00	53.1	79.7	58.6	48.6	45.7	44.9	42.9	41.6
20:00	52.8	80.3	59.7	48.7	45.9	45.3	44.1	43.5
21:00	56.0	81.8	61.1	46.3	44.4	44.0	42.9	42.3
22:00	53.2	81.0	56.7	45.9	43.6	43.2	41.8	41.2
23:00	53.3	81.3	53.6	44.1	43.0	42.7	41.8	41.4
0:00	42.1	47.1	44.1	43.0	42.3	42.0	41.3	40.8
1:00	42.4	53.7	48.6	43.2	42.3	41.7	41.0	40.5
2:00	41.7	48.0	43.6	42.5	41.8	41.5	40.9	40.6
3:00	42.3	52.7	46.2	43.2	42.3	41.8	41.2	40.8
4:00	42.6	52.5	49.5	44.6	42.7	42.1	37.8	35.6
5:00	47.2	59.8	53.5	49.9	46.9	45.9	42.8	39.5
6:00	54.2	78.0	59.7	52.6	50.3	49.2	46.1	44.3
7:00	54.3	79.3	61.2	52.4	50.6	49.8	47.6	46.0
8:00	54.5	79.7	59.6	51.0	48.3	47.0	44.2	43.0
9:00	52.7	79.6	56.0	49.2	46.6	45.6	43.0	41.1
10:00	52.6	79.3	61.5	49.0	46.2	45.4	42.4	40.2
11:00	52.3	79.9	57.2	50.8	46.7	45.6	43.7	42.8
12:00	46.6	54.9	52.3	48.6	46.4	45.7	44.5	43.5
13:00	51.7	78.1	59.7	51.2	47.3	46.1	44.3	43.5
14:00	53.6	81.0	58.2	49.9	47.5	46.9	45.5	44.6
15:00	52.7	79.1	58.3	49.9	47.7	47.0	45.7	45.0

Figure B-2. Noise Survey Results, Site N-5

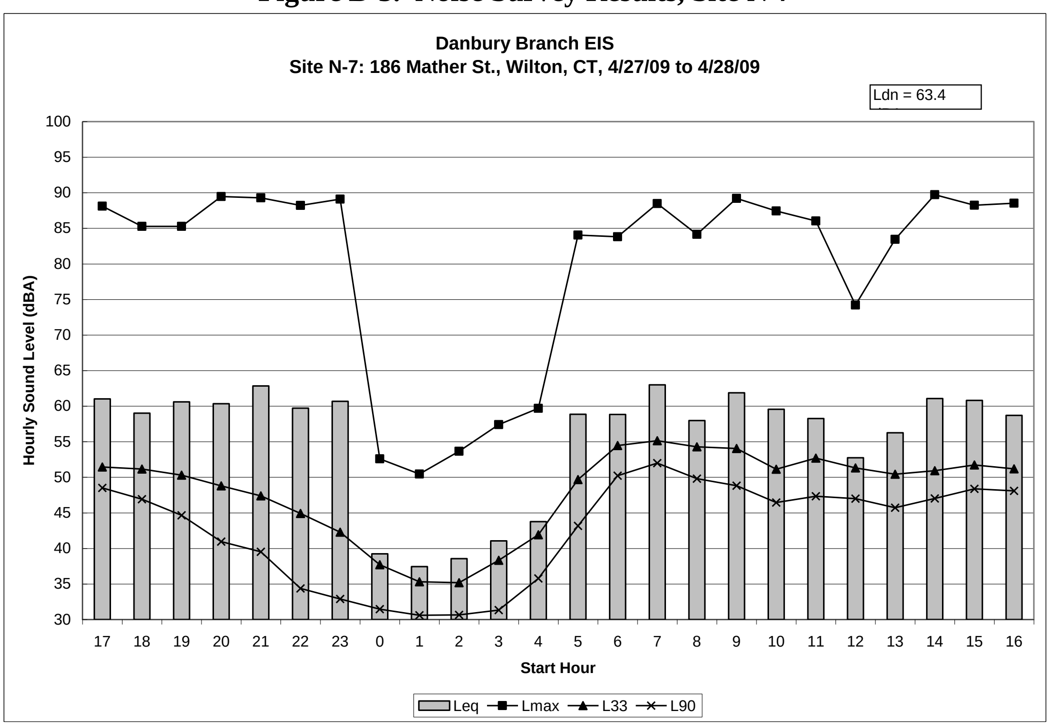


Site N-7: 186 Mather Street – Wilton, CT	Ldn: 63 dB(A) (April 27, 2009)

Table B-3. Noise Survey Results, Site N-7

Start Hour	LEQ	LMAX	L1	L10	L33	L50	L90	L99
17:00	61.0	88.1	64.1	53.3	51.4	50.8	48.5	44.5
18:00	59.0	85.3	63.5	52.8	51.2	50.4	46.9	42.2
19:00	60.6	85.3	67.7	52.3	50.3	49.2	44.7	40.1
20:00	60.3	89.5	59.0	51.1	48.8	47.2	41.0	36.5
21:00	62.9	89.3	64.4	50.1	47.4	45.4	39.5	35.1
22:00	59.7	88.2	55.4	48.8	44.9	42.2	34.4	32.2
23:00	60.7	89.1	54.2	46.4	42.3	38.8	32.9	31.2
0:00	39.3	52.6	48.0	43.5	37.7	34.9	31.5	30.5
1:00	37.5	50.5	47.6	41.2	35.3	33.2	30.6	30.2
2:00	38.6	53.7	49.3	41.9	35.2	32.8	30.7	30.3
3:00	41.1	57.4	51.5	44.4	38.3	35.9	31.3	30.7
4:00	43.8	59.7	53.4	46.9	41.9	39.8	35.8	33.4
5:00	58.9	84.1	67.9	53.0	49.7	48.0	43.2	39.7
6:00	58.8	83.8	65.7	56.5	54.5	53.5	50.2	47.0
7:00	63.0	88.5	72.4	57.1	55.1	54.4	52.0	49.8
8:00	58.0	84.2	66.4	57.2	54.3	53.3	49.8	46.1
9:00	61.9	89.2	68.5	59.9	54.0	52.4	48.8	44.8
10:00	59.6	87.4	61.8	53.6	51.1	50.0	46.5	41.8
11:00	58.3	86.0	65.8	57.5	52.7	51.0	47.3	43.6
12:00	52.7	74.2	61.2	53.7	51.3	50.3	47.0	44.1
13:00	56.3	83.4	66.6	53.4	50.4	49.3	45.7	43.1
14:00	61.1	89.7	63.7	53.5	50.9	49.9	47.0	44.1
15:00	60.8	88.3	67.9	53.7	51.7	51.0	48.4	44.3
16:00	58.7	88.5	61.8	53.0	51.2	50.5	48.1	45.2

Figure B-3. Noise Survey Results, Site N-7

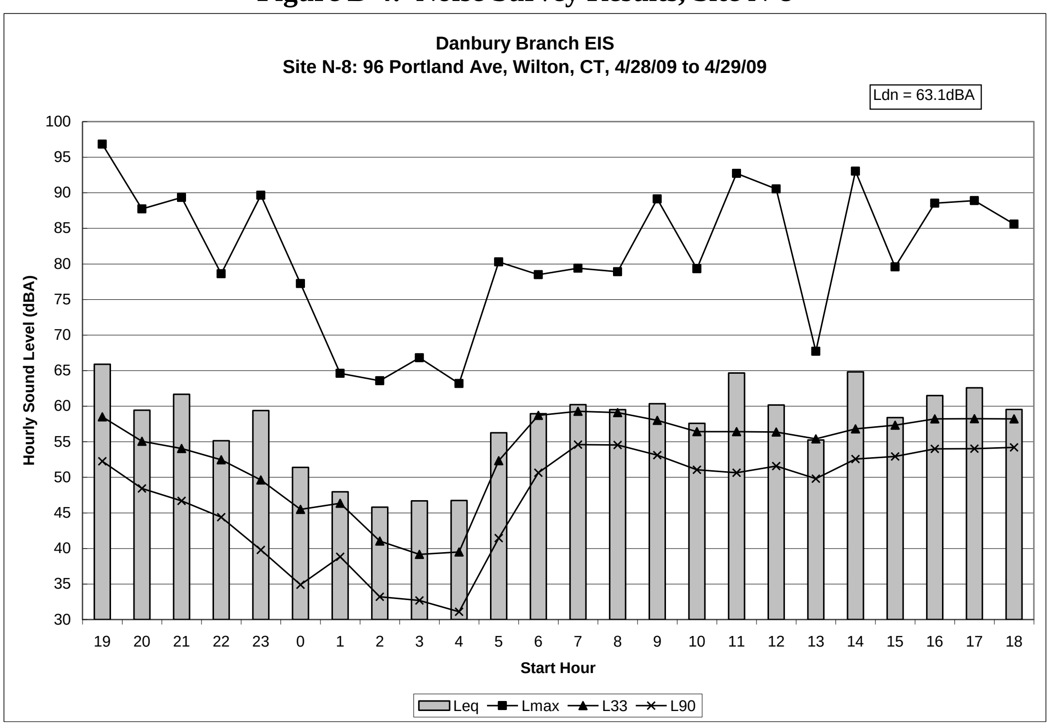


Site N-8: 96 Portland Avenue – Wilton, CT	**Ldn: 63 dB(A) (April 28-29, 2009)**

Table B-4: Noise Survey Results, Site N-8

Start Hour	LEQ	LMAX	L1	L10	L33	L50	L90	L99
19:00	65.9	96.8	71.7	61.0	58.5	57.3	52.3	46.9
20:00	59.4	87.7	61.0	57.3	55.1	53.6	48.4	45.6
21:00	61.7	89.3	69.1	56.6	54.1	52.3	46.7	45.5
22:00	55.2	78.6	61.1	55.9	52.5	50.3	44.4	41.0
23:00	59.4	89.7	60.9	54.0	49.6	46.9	39.8	36.1
0:00	51.4	77.2	59.7	51.5	45.5	41.7	34.9	32.3
1:00	48.0	64.6	57.5	51.1	46.3	44.2	38.8	36.2
2:00	45.8	63.6	57.1	49.1	41.0	38.6	33.2	32.1
3:00	46.7	66.8	58.4	49.8	39.2	36.1	32.7	31.3
4:00	46.7	63.2	58.2	51.2	39.5	35.3	31.1	30.1
5:00	56.3	80.3	62.5	57.1	52.3	49.8	41.5	33.4
6:00	58.9	78.5	64.8	60.7	58.7	57.4	50.6	43.8
7:00	60.2	79.4	68.6	61.2	59.3	58.3	54.6	49.8
8:00	59.5	78.9	65.0	60.8	59.1	58.1	54.6	49.8
9:00	60.3	89.1	63.6	60.1	58.0	57.0	53.1	47.1
10:00	57.6	79.3	64.9	59.1	56.4	55.1	51.0	46.7
11:00	64.7	92.7	68.5	59.5	56.4	55.2	50.6	45.5
12:00	60.2	90.5	63.0	58.7	56.4	55.2	51.6	45.9
13:00	55.3	67.7	61.7	57.9	55.4	54.3	49.8	41.9
14:00	64.8	93.0	69.5	59.1	56.8	55.8	52.6	47.2
15:00	58.4	79.6	64.8	59.2	57.3	56.3	52.9	47.9
16:00	61.5	88.5	64.4	60.0	58.2	57.4	54.0	50.6
17:00	62.6	88.9	66.8	59.9	58.2	57.4	54.0	49.8
18:00	59.5	85.6	63.3	59.7	58.2	57.3	54.2	50.7

Figure B-4: Noise Survey Results, Site N-8

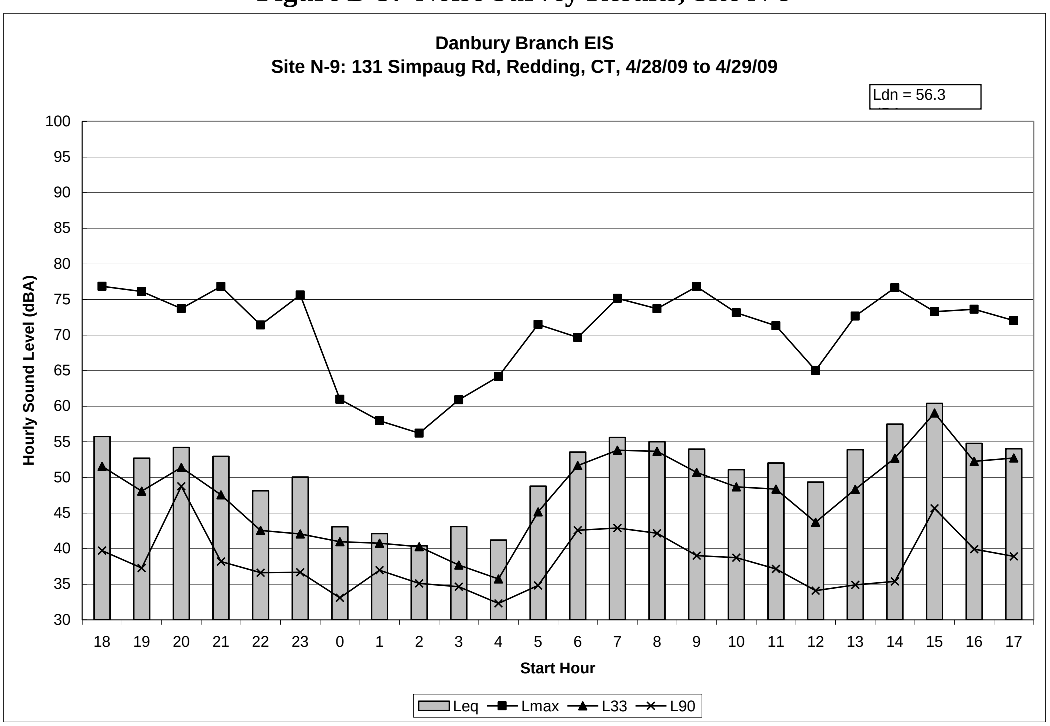


Site N-9: 131 Simpaug Turnpike – Redding, CT	**Ldn: 56 dB(A) (April 28-29, 2009)**

Table B-5: Noise Survey Results, Site N-9

Start Hour	LEQ	LMAX	L1	L10	L33	L50	L90	L99
18:00	55.7	76.8	68.0	57.8	51.5	47.2	39.7	37.3
19:00	52.7	76.1	60.9	54.7	48.1	44.3	37.3	34.7
20:00	54.2	73.7	63.1	54.5	51.4	50.9	48.7	47.6
21:00	53.0	76.8	62.2	53.0	47.5	46.0	38.2	34.8
22:00	48.1	71.4	58.4	48.8	42.6	40.4	36.6	35.0
23:00	50.0	75.6	55.0	45.8	42.0	40.4	36.7	34.3
0:00	43.1	61.0	54.4	45.2	41.0	37.9	33.1	31.9
1:00	42.1	58.0	52.1	44.4	40.8	39.5	36.9	35.7
2:00	40.4	56.2	48.1	43.0	40.3	38.4	35.1	33.5
3:00	43.1	60.9	55.6	43.8	37.7	36.6	34.6	33.1
4:00	41.2	64.2	53.8	38.2	35.7	35.0	32.3	30.8
5:00	48.8	71.5	59.0	49.7	45.1	43.2	34.8	32.6
6:00	53.6	69.7	63.6	57.2	51.7	48.9	42.6	38.5
7:00	55.6	75.2	64.6	59.2	53.8	50.4	42.9	38.3
8:00	55.0	73.7	63.4	58.9	53.7	50.7	42.2	37.1
9:00	54.0	76.8	62.2	56.8	50.7	47.3	39.0	35.6
10:00	51.1	73.1	59.5	53.5	48.7	45.8	38.7	34.3
11:00	52.0	71.3	63.3	55.6	48.4	45.3	37.1	33.3
12:00	49.3	65.0	60.2	54.0	43.7	39.7	34.1	31.3
13:00	53.9	72.7	64.0	58.6	48.3	42.1	34.9	30.5
14:00	57.5	76.6	69.7	60.2	52.7	46.8	35.4	31.9
15:00	60.4	73.3	71.0	63.5	59.0	56.3	45.7	39.7
16:00	54.8	73.6	64.4	58.1	52.3	48.9	39.9	36.8
17:00	54.0	72.0	62.6	58.4	52.7	48.6	38.9	35.6

Figure B-5: Noise Survey Results, Site N-9

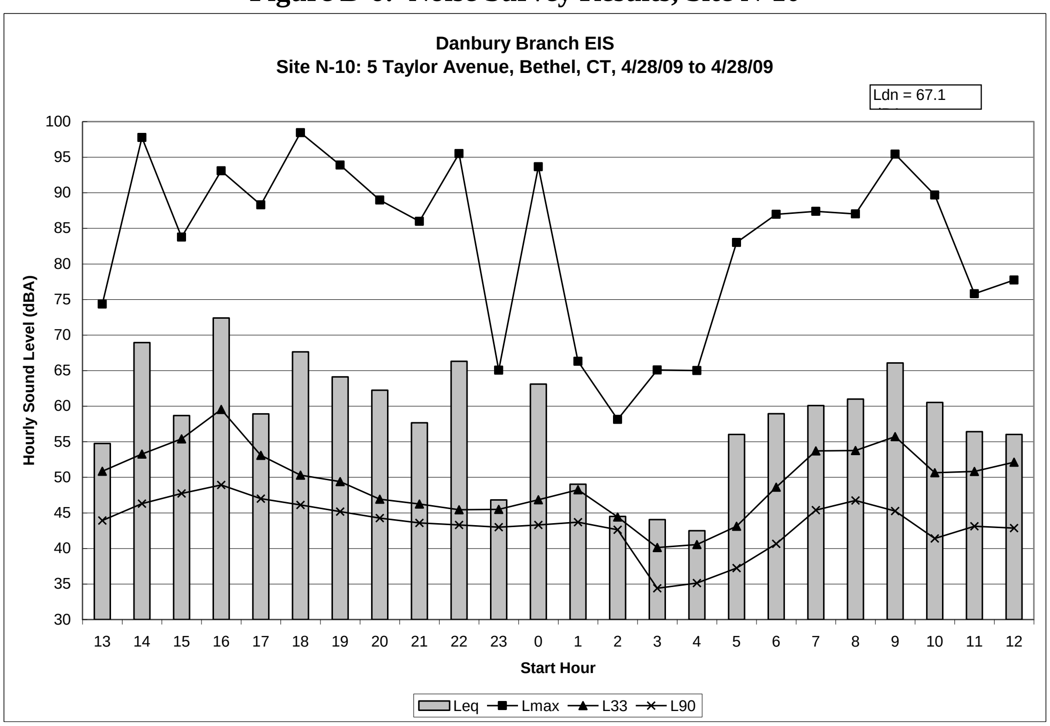


Site N-10: 5 Taylor Avenue – Bethel, CT	**Ldn: 67 dB(A) (April 28-29, 2009)**

Table B-6: Noise Survey Results, Site N-10

Start Hour	LEQ	LMAX	L1	L10	L33	L50	L90	L99
13:00	54.8	74.3	67.0	56.7	50.8	48.4	43.9	41.6
14:00	68.9	97.8	71.5	58.1	53.3	51.1	46.3	43.0
15:00	58.7	83.8	70.5	60.3	55.4	53.2	47.7	45.5
16:00	72.4	93.1	85.4	75.0	59.5	55.3	48.9	45.8
17:00	58.9	88.3	66.3	57.8	53.1	51.1	47.0	45.2
18:00	67.6	98.4	75.0	55.4	50.3	48.8	46.1	45.0
19:00	64.1	93.9	65.7	55.7	49.4	47.5	45.2	43.8
20:00	62.2	89.0	72.3	52.0	46.9	45.9	44.3	43.5
21:00	57.7	86.0	67.2	49.6	46.3	45.2	43.6	42.9
22:00	66.3	95.5	73.6	49.5	45.4	44.6	43.3	42.6
23:00	46.8	65.0	56.4	47.9	45.5	44.7	43.0	42.3
0:00	63.1	93.7	59.9	50.8	46.8	45.4	43.3	42.6
1:00	49.0	66.3	57.0	52.1	48.2	46.4	43.7	42.6
2:00	44.5	58.1	49.2	46.0	44.4	43.8	42.6	42.0
3:00	44.1	65.1	58.1	43.7	40.1	37.5	34.4	33.1
4:00	42.5	65.0	51.1	44.2	40.5	38.5	35.1	33.3
5:00	56.0	83.0	67.7	48.7	43.1	41.1	37.2	35.0
6:00	58.9	87.0	70.8	56.4	48.6	45.6	40.6	38.7
7:00	60.1	87.4	71.6	60.4	53.7	50.9	45.4	41.4
8:00	61.0	87.0	72.6	59.7	53.8	51.1	46.7	44.7
9:00	66.1	95.4	72.4	61.5	55.7	53.7	45.2	42.3
10:00	60.5	89.7	70.9	58.3	50.6	47.1	41.4	38.8
11:00	56.4	75.8	69.0	58.2	50.8	47.9	43.1	39.5
12:00	56.0	77.7	67.7	58.2	52.1	49.0	42.9	39.1

Figure B-6: Noise Survey Results, Site N-10

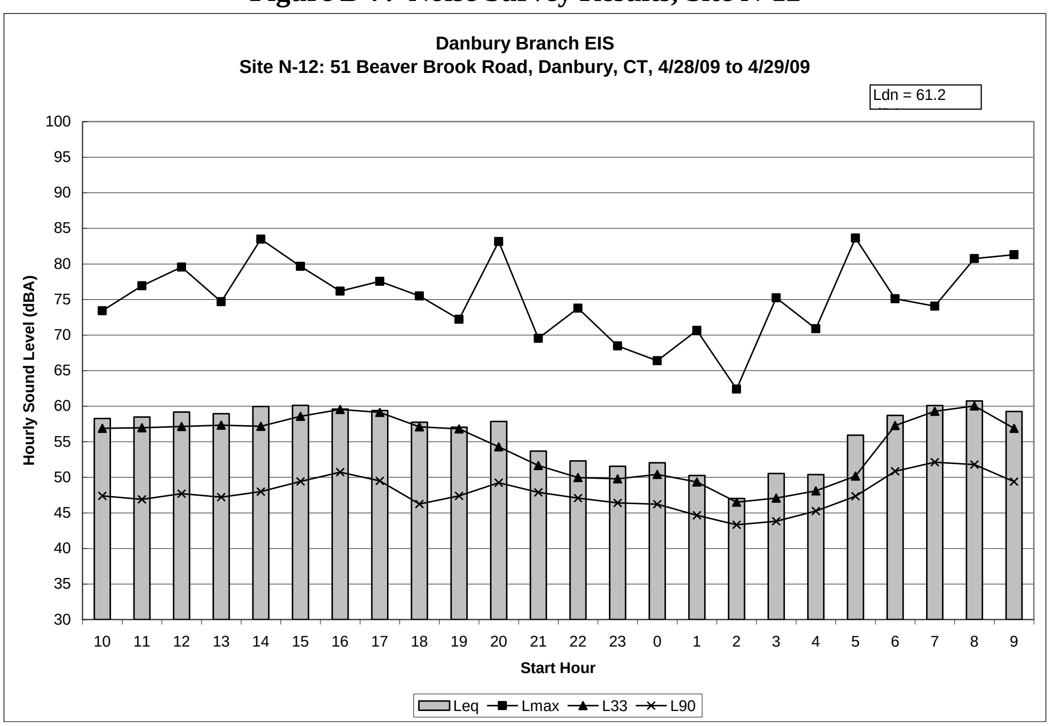


Site N-12: 51 Beaver Brook Road – Danbury, CT	**Ldn: 61 dB(A) (April 28-29, 2009)**

Table B-7: Noise Survey Results, Site N-12

Start Hour	LEQ	LMAX	L1	L10	L33	L50	L90	L99
10:00	58.3	73.4	69.4	61.6	56.9	53.3	47.4	44.6
11:00	58.5	76.9	68.7	61.9	57.0	53.0	46.9	44.5
12:00	59.2	79.5	70.2	61.7	57.2	53.8	47.7	45.7
13:00	58.9	74.7	70.1	62.0	57.3	53.5	47.2	45.2
14:00	59.9	83.5	69.1	61.5	57.2	53.5	48.0	46.4
15:00	60.1	79.6	70.5	62.5	58.6	55.5	49.4	47.4
16:00	59.6	76.2	68.1	62.8	59.5	57.1	50.7	48.4
17:00	59.4	77.6	67.7	62.3	59.1	56.5	49.5	46.7
18:00	57.8	75.5	67.7	61.4	57.1	52.4	46.2	43.8
19:00	57.0	72.2	64.7	60.7	56.8	54.2	47.4	44.9
20:00	57.9	83.1	64.9	59.3	54.3	52.1	49.2	47.4
21:00	53.7	69.5	62.6	57.6	51.6	50.1	47.9	46.9
22:00	52.3	73.8	61.4	55.1	50.0	49.0	47.1	45.8
23:00	51.6	68.5	61.1	53.8	49.8	48.8	46.4	45.1
0:00	52.0	66.4	61.8	55.3	50.4	48.9	46.2	44.6
1:00	50.3	70.6	57.7	52.2	49.3	48.1	44.7	43.0
2:00	47.0	62.4	53.9	49.0	46.5	45.5	43.3	42.2
3:00	50.5	75.2	60.7	49.0	47.1	46.2	43.8	42.4
4:00	50.4	70.9	60.4	50.8	48.1	47.3	45.3	43.8
5:00	55.9	83.6	63.2	53.6	50.2	49.3	47.3	46.1
6:00	58.7	75.1	68.3	62.2	57.3	54.3	50.9	48.2
7:00	60.1	74.1	69.6	63.4	59.3	56.2	52.1	50.7
8:00	60.7	80.7	69.9	63.6	60.0	57.1	51.8	49.8
9:00	59.2	81.3	69.0	62.2	56.9	53.1	49.4	48.3

Figure B-7: Noise Survey Results, Site N-12

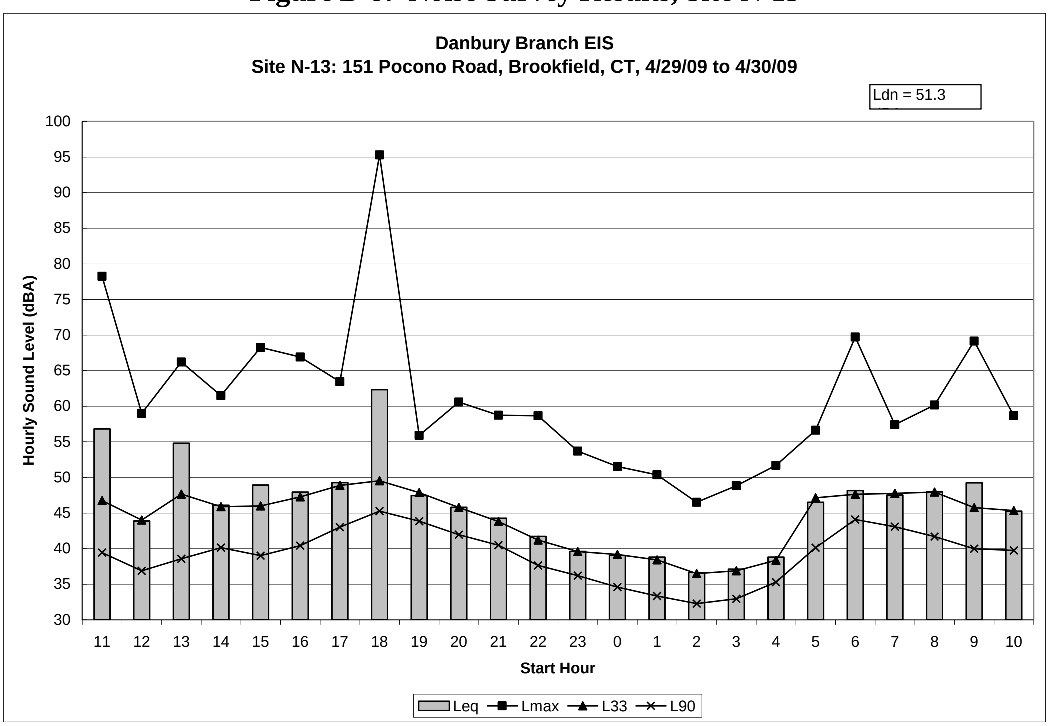


Site N-13: 151 Pocono Road – Brookfield, CT	Ldn: 51 dB(A) (April 29-30, 2009)

Table B-8: Noise Survey Results, Site N-13

Start Hour	LEQ	LMAX	L1	L10	L33	L50	L90	L99
11:00	56.8	78.3	68.6	58.0	46.7	43.5	39.4	37.6
12:00	43.9	59.0	51.6	46.9	44.0	42.3	36.9	34.6
13:00	54.8	66.2	63.2	60.6	47.7	44.4	38.6	36.1
14:00	46.1	61.5	53.9	48.7	45.9	44.3	40.1	36.3
15:00	48.9	68.3	60.7	49.6	46.0	44.0	39.0	35.7
16:00	47.9	66.9	55.8	50.0	47.3	45.8	40.4	35.0
17:00	49.3	63.4	57.9	51.5	48.9	47.5	43.0	39.2
18:00	62.3	95.3	61.6	52.3	49.5	48.3	45.3	43.8
19:00	47.4	55.9	52.1	49.8	47.9	46.8	43.8	42.2
20:00	45.8	60.6	52.0	48.0	45.8	44.6	41.9	40.6
21:00	44.3	58.7	51.3	46.5	43.8	42.9	40.5	38.9
22:00	41.7	58.7	49.1	43.5	41.2	40.4	37.6	35.5
23:00	39.6	53.7	46.1	41.5	39.6	38.8	36.2	34.3
0:00	39.0	51.5	45.7	41.3	39.2	38.0	34.6	32.5
1:00	38.8	50.3	46.8	41.8	38.4	36.8	33.3	31.4
2:00	36.6	46.5	43.7	39.6	36.5	35.1	32.3	31.0
3:00	37.1	48.8	44.6	39.5	36.9	35.7	32.9	31.5
4:00	38.8	51.7	46.6	40.9	38.4	37.3	35.3	33.6
5:00	46.5	56.6	52.7	49.2	47.1	45.8	40.1	38.4
6:00	48.2	69.7	54.9	50.3	47.6	46.4	44.1	42.4
7:00	47.5	57.4	53.1	50.5	47.8	46.4	43.1	41.5
8:00	48.0	60.2	56.2	50.9	47.9	46.1	41.7	39.5
9:00	49.2	69.2	63.0	49.0	45.8	44.1	40.0	38.5
10:00	45.3	58.7	52.5	48.1	45.3	43.7	39.7	38.4

Figure B-8: Noise Survey Results, Site N-13

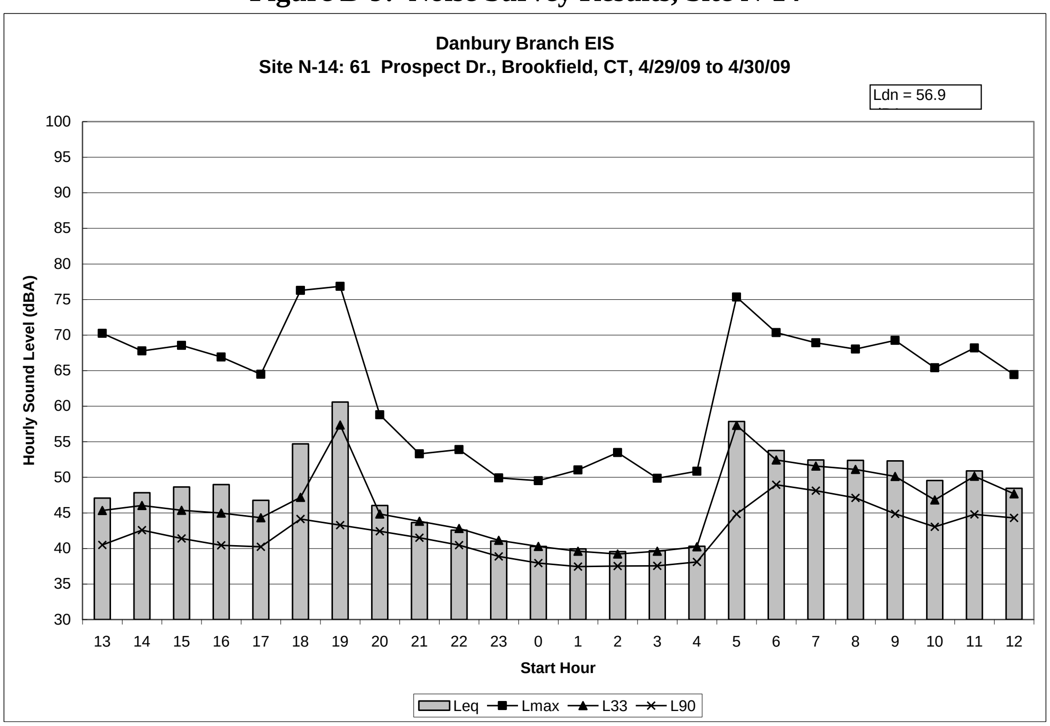


Site N-14: 16 Prospect Drive – Brookfield, CT	**Ldn: 57 dB(A) (April 29-30, 2009)**

Table B-9: Noise Survey Results, Site N-14

Start Hour	LEQ	LMAX	L1	L10	L33	L50	L90	L99
13:00	47.1	70.2	54.9	49.1	45.3	43.4	40.5	38.8
14:00	47.8	67.8	58.1	49.0	46.0	44.9	42.6	40.8
15:00	48.6	68.5	61.4	49.2	45.4	44.2	41.4	39.8
16:00	49.0	66.9	61.2	50.1	45.0	43.4	40.4	38.3
17:00	46.8	64.5	57.9	48.7	44.3	43.1	40.2	38.5
18:00	54.7	76.3	65.6	59.2	47.2	45.9	44.1	43.0
19:00	60.6	76.8	70.6	65.3	57.3	49.6	43.3	42.0
20:00	46.0	58.8	54.0	49.0	44.8	44.1	42.4	41.3
21:00	43.6	53.3	47.3	45.4	43.8	43.2	41.5	40.1
22:00	42.6	53.9	46.8	44.0	42.8	42.1	40.5	39.5
23:00	41.0	49.9	46.0	42.7	41.2	40.5	38.9	38.0
0:00	40.3	49.5	45.7	42.2	40.3	39.5	37.9	37.2
1:00	39.9	51.0	46.8	41.9	39.6	38.7	37.4	37.0
2:00	39.6	53.5	45.9	41.2	39.2	38.6	37.5	37.0
3:00	39.7	49.9	45.4	41.5	39.6	38.8	37.5	37.0
4:00	40.3	50.9	45.4	42.4	40.2	39.4	38.1	37.4
5:00	57.9	75.3	67.0	61.6	57.3	54.8	44.8	41.4
6:00	53.8	70.3	63.7	56.0	52.4	51.3	49.0	47.4
7:00	52.4	68.9	61.4	54.7	51.6	50.4	48.1	46.9
8:00	52.4	68.0	61.0	55.4	51.1	49.6	47.1	45.7
9:00	52.3	69.3	63.6	53.9	50.1	49.0	44.9	43.0
10:00	49.5	65.4	61.1	50.8	46.8	45.6	43.0	41.5
11:00	50.9	68.2	59.8	53.5	50.2	48.3	44.8	43.2
12:00	48.4	64.4	57.0	50.8	47.7	46.5	44.3	43.0

Figure B-9: Noise Survey Results, Site N-14

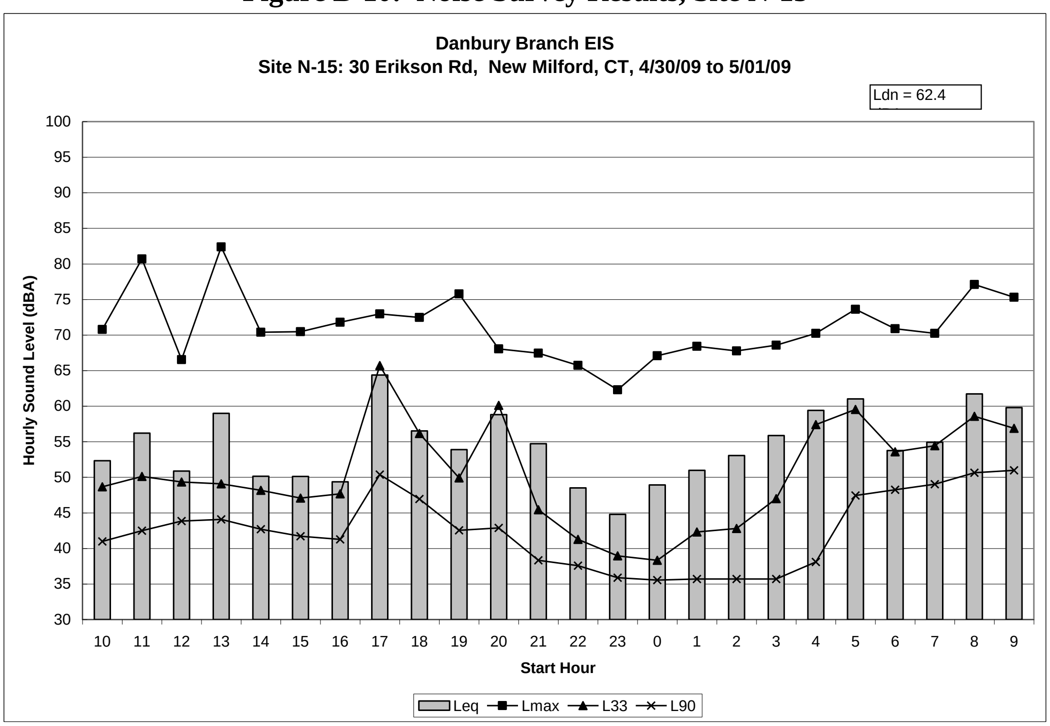


Site N-15: 30 Erickson Road – New Milford, CT	**Ldn: 62 dB(A) (April 30-May 1, 2009)**

Table B-10: Noise Survey Results, Site N-15

Start Hour	LEQ	LMAX	L1	L10	L33	L50	L90	L99
10:00	52.3	70.8	64.1	55.2	48.7	46.0	41.0	38.9
11:00	56.2	80.7	65.2	54.4	50.1	48.4	42.5	40.0
12:00	50.9	66.5	61.3	53.0	49.3	47.5	43.8	41.6
13:00	59.0	82.4	66.2	58.1	49.1	47.3	44.1	42.4
14:00	50.1	70.4	60.5	52.0	48.2	46.5	42.7	40.9
15:00	50.1	70.5	62.1	51.9	47.1	45.3	41.7	39.3
16:00	49.4	71.8	59.8	51.9	47.7	45.5	41.3	39.3
17:00	64.4	73.0	71.4	68.5	65.7	59.9	50.4	43.7
18:00	56.5	72.5	64.8	60.2	56.1	54.1	46.9	43.4
19:00	53.9	75.8	64.6	57.3	49.9	47.1	42.5	41.0
20:00	58.8	68.1	65.7	63.0	60.1	55.4	42.9	40.0
21:00	54.7	67.5	64.7	61.1	45.4	41.2	38.3	37.3
22:00	48.5	65.7	62.8	46.5	41.3	39.7	37.6	36.6
23:00	44.8	62.3	59.1	45.1	39.0	37.4	35.9	35.3
0:00	48.9	67.1	63.8	47.4	38.3	36.8	35.6	35.0
1:00	51.0	68.4	65.2	47.5	42.3	37.5	35.7	35.0
2:00	53.1	67.8	65.8	54.3	42.8	37.6	35.7	35.0
3:00	55.9	68.6	65.5	62.0	47.0	42.2	35.7	34.9
4:00	59.4	70.2	67.7	64.6	57.4	52.4	38.1	35.5
5:00	61.0	73.6	69.2	66.0	59.5	56.2	47.4	44.4
6:00	53.8	70.9	61.8	56.5	53.6	51.7	48.2	46.6
7:00	54.9	70.2	64.2	57.5	54.4	52.8	49.0	47.1
8:00	61.7	77.1	72.6	65.2	58.6	56.2	50.6	48.0
9:00	59.8	75.3	70.4	63.4	56.9	54.8	51.0	48.4

Figure B-10: Noise Survey Results, Site N-15

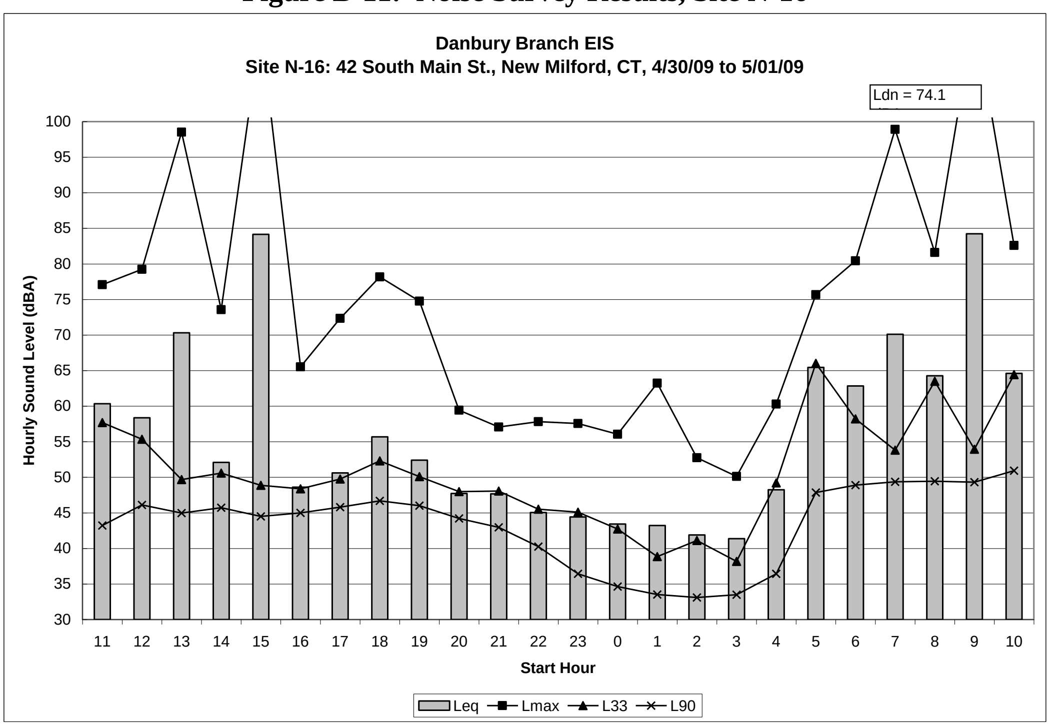


Site N-16: 42 S. Main Street – New Milford, CT	**Ldn: 74 dB(A) (April 30-May 1, 2009)**

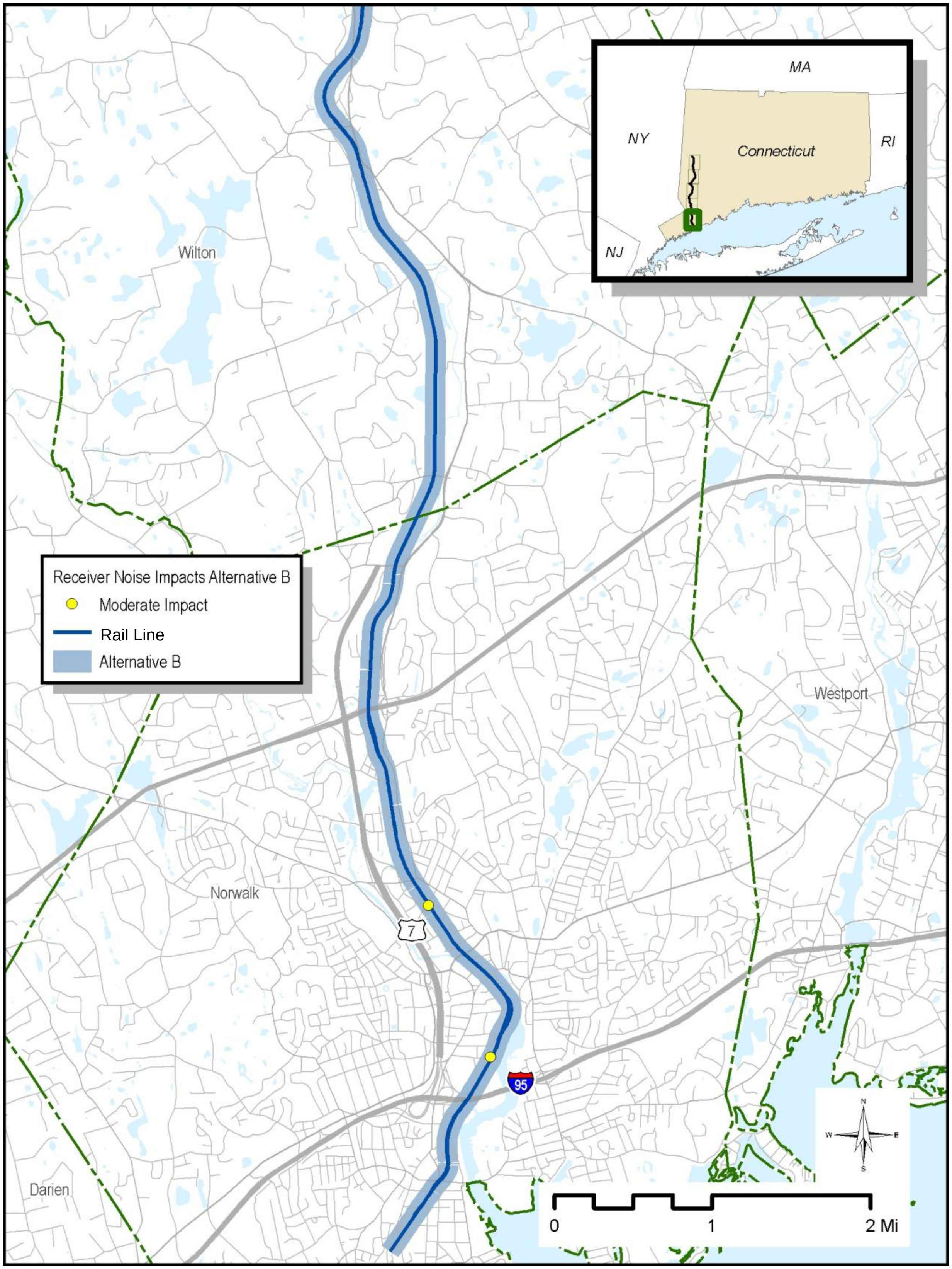
Table B-11: Noise Survey Results, Site N-16

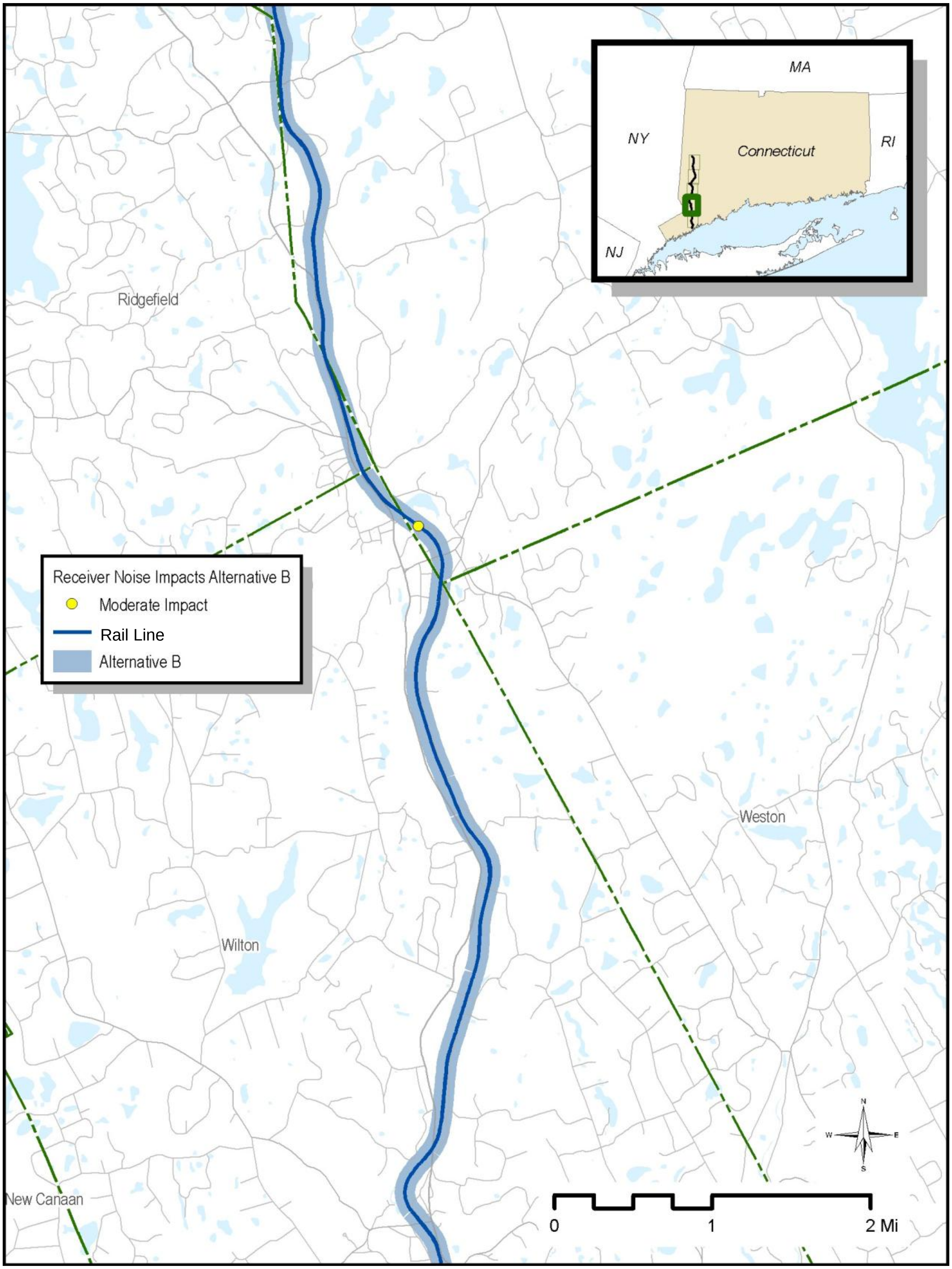
Start Hour	LEQ	LMAX	L1	L10	L33	L50	L90	L99
11:00	60.3	77.1	70.4	65.5	57.7	49.2	43.2	41.2
12:00	58.4	79.2	68.3	60.5	55.4	51.0	46.1	43.4
13:00	70.3	98.5	80.7	54.1	49.7	48.3	45.0	43.2
14:00	52.1	73.6	62.3	53.6	50.6	49.3	45.7	43.9
15:00	84.2	113.0	80.0	52.0	48.9	47.6	44.5	42.8
16:00	48.6	65.5	55.6	50.4	48.4	47.5	45.0	43.4
17:00	50.6	72.3	57.8	52.1	49.8	48.7	45.8	43.7
18:00	55.7	78.2	66.6	58.1	52.3	50.5	46.7	44.5
19:00	52.4	74.8	63.7	52.6	50.1	49.2	46.0	44.2
20:00	47.7	59.4	53.6	49.8	48.0	47.0	44.2	42.4
21:00	47.7	57.1	53.1	50.2	48.1	46.8	43.0	41.1
22:00	45.0	57.8	50.5	47.9	45.5	43.6	40.2	38.7
23:00	44.4	57.6	52.0	48.9	45.1	40.4	36.4	35.0
0:00	43.4	56.1	51.3	48.0	42.7	37.0	34.6	33.2
1:00	43.2	63.2	53.4	46.1	38.8	36.3	33.5	32.1
2:00	41.9	52.8	48.0	46.4	41.1	37.3	33.1	31.7
3:00	41.4	50.1	48.1	46.7	38.2	36.1	33.5	32.4
4:00	48.3	60.3	52.1	50.8	49.2	48.6	36.4	34.0
5:00	65.4	75.7	73.1	70.4	66.0	52.7	47.9	45.3
6:00	62.8	80.4	73.3	67.5	58.2	54.1	48.9	46.4
7:00	70.1	98.9	78.8	62.8	53.8	52.4	49.4	46.7
8:00	64.3	81.6	73.5	68.8	63.5	54.9	49.4	47.1
9:00	84.2	115.0	76.1	61.5	53.9	52.3	49.3	47.6
10:00	64.6	82.6	72.8	68.8	64.4	59.4	50.9	48.6

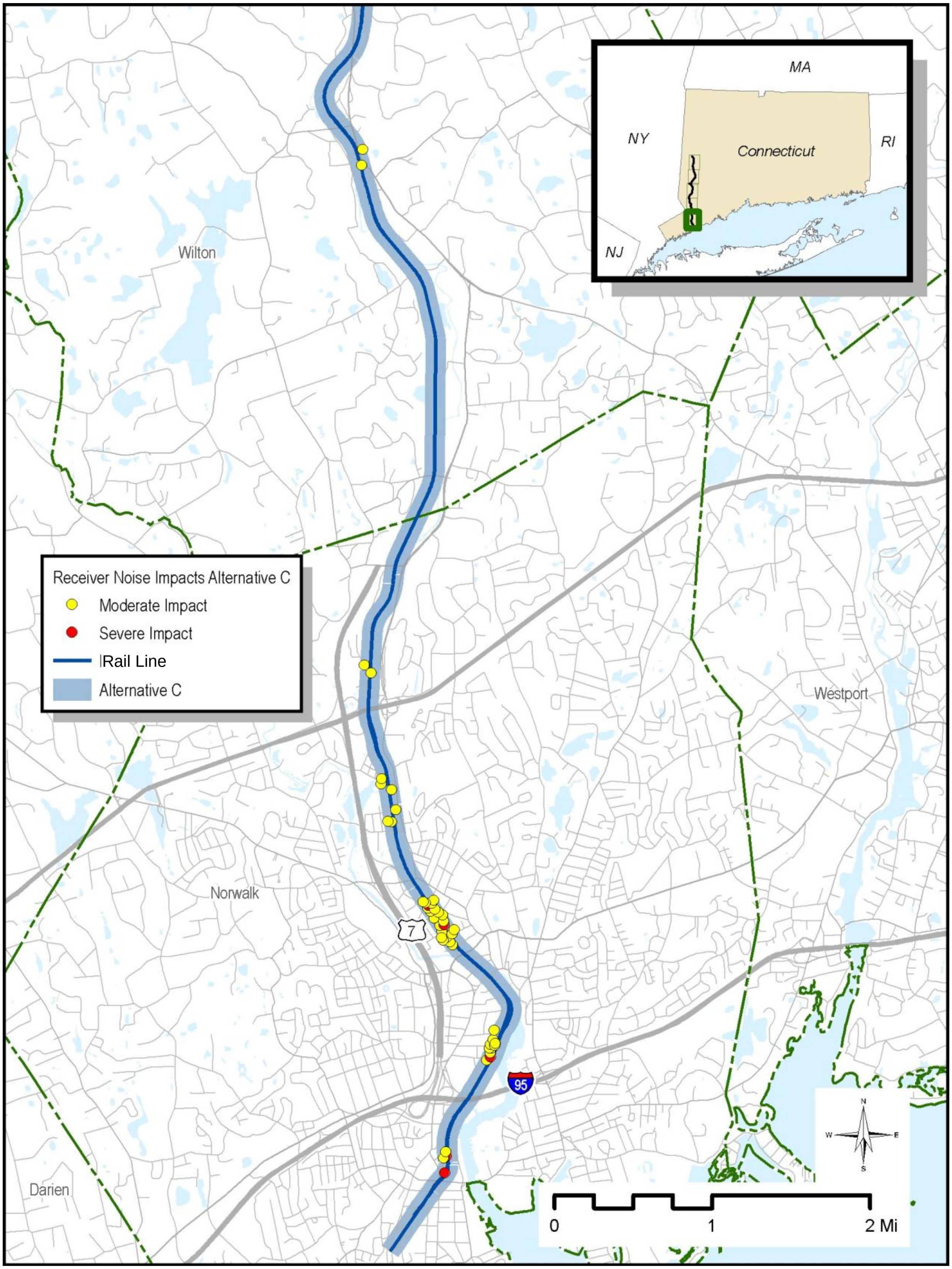
Figure B-11: Noise Survey Results, Site N-16



APPENDIX C. NOISE IMPACT LOCATIONS


MA
NY
Connecticut
RI
NJ
Wilton
Receiver Noise Impacts Alternative B
Moderate Impact
Rail Line
Alternative B
Westport
Norwalk
7
95
Darien
N
W
E
S
0
1
2 Mi


MA
NY
Connecticut
RI
NJ
Ridgefield
Receiver Noise Impacts Alternative B
Moderate Impact
Rail Line
Alternative B
Weston
Wilton
New Canaan
0
1
2 Mi


Wilton
Norwalk
Westport
Darien
7
95
Receiver Noise Impacts Alternative C
Moderate Impact
Severe Impact
Rail Line
Alternative C
MA
NY
Connecticut
RI
NJ
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W
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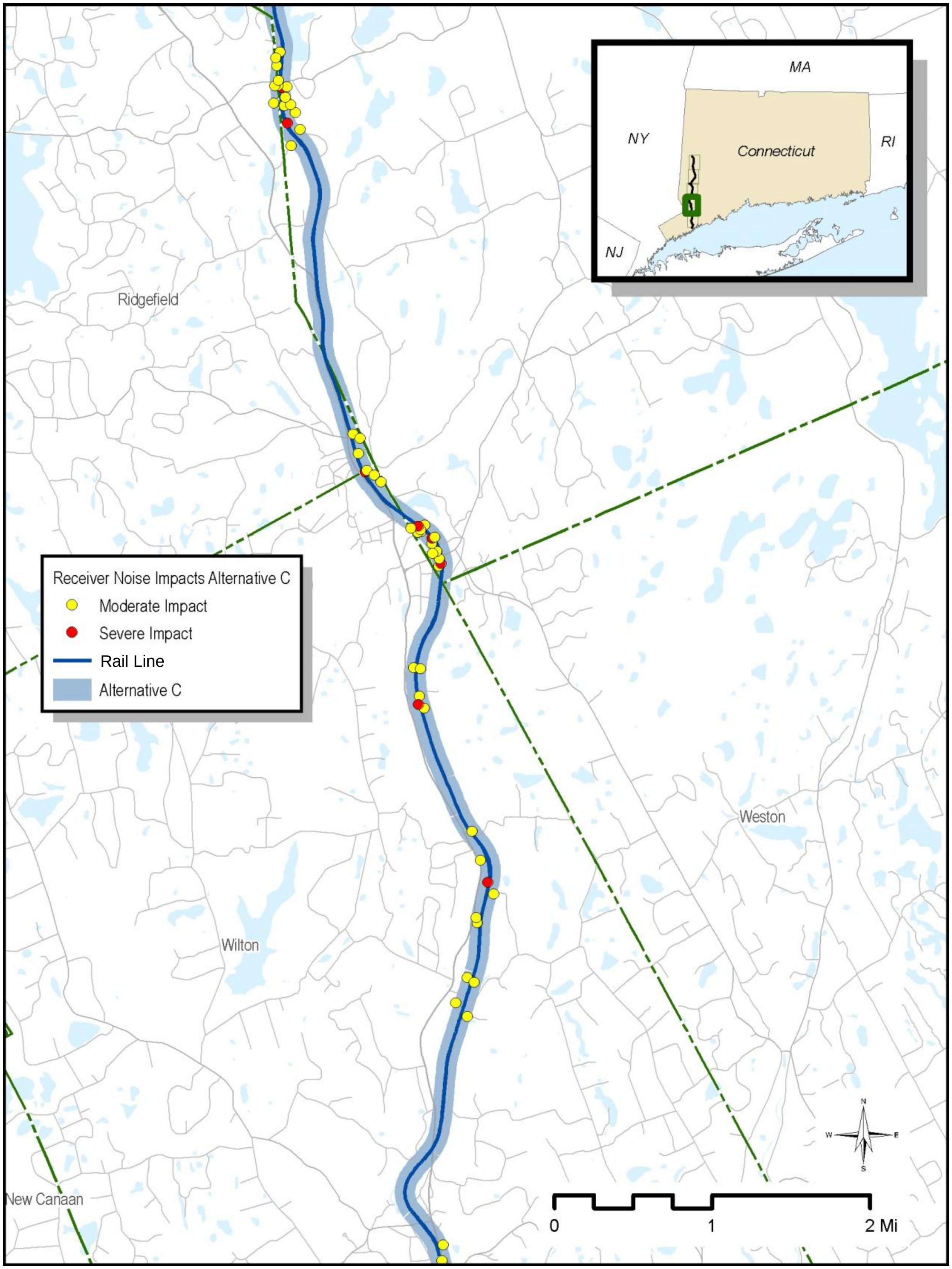
MA
NY
Connecticut
RI
NJ
Ridgefield
Receiver Noise Impacts Alternative C
Moderate Impact
Severe Impact
Rail Line
Alternative C
Weston
Wilton
New Canaan
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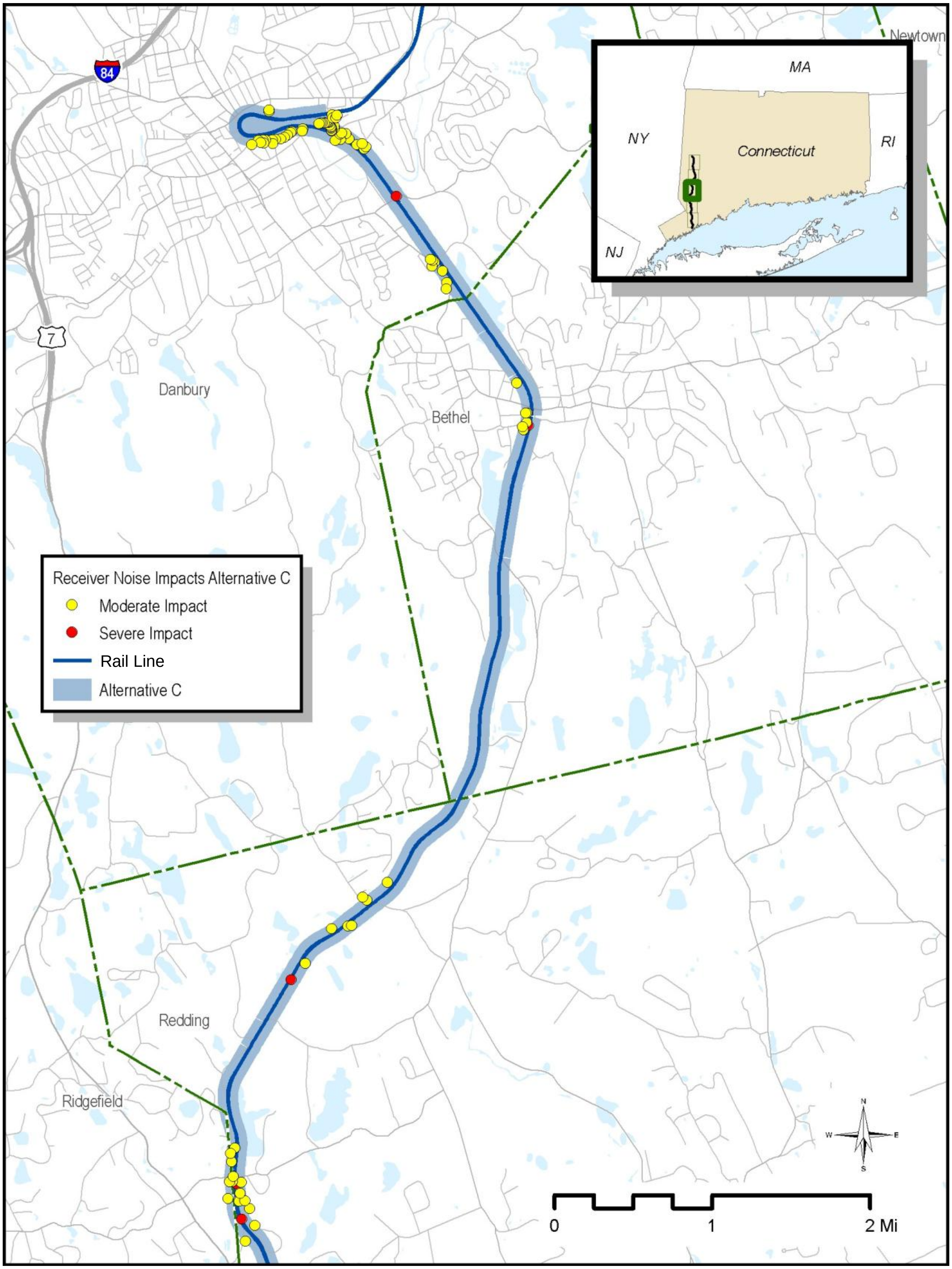
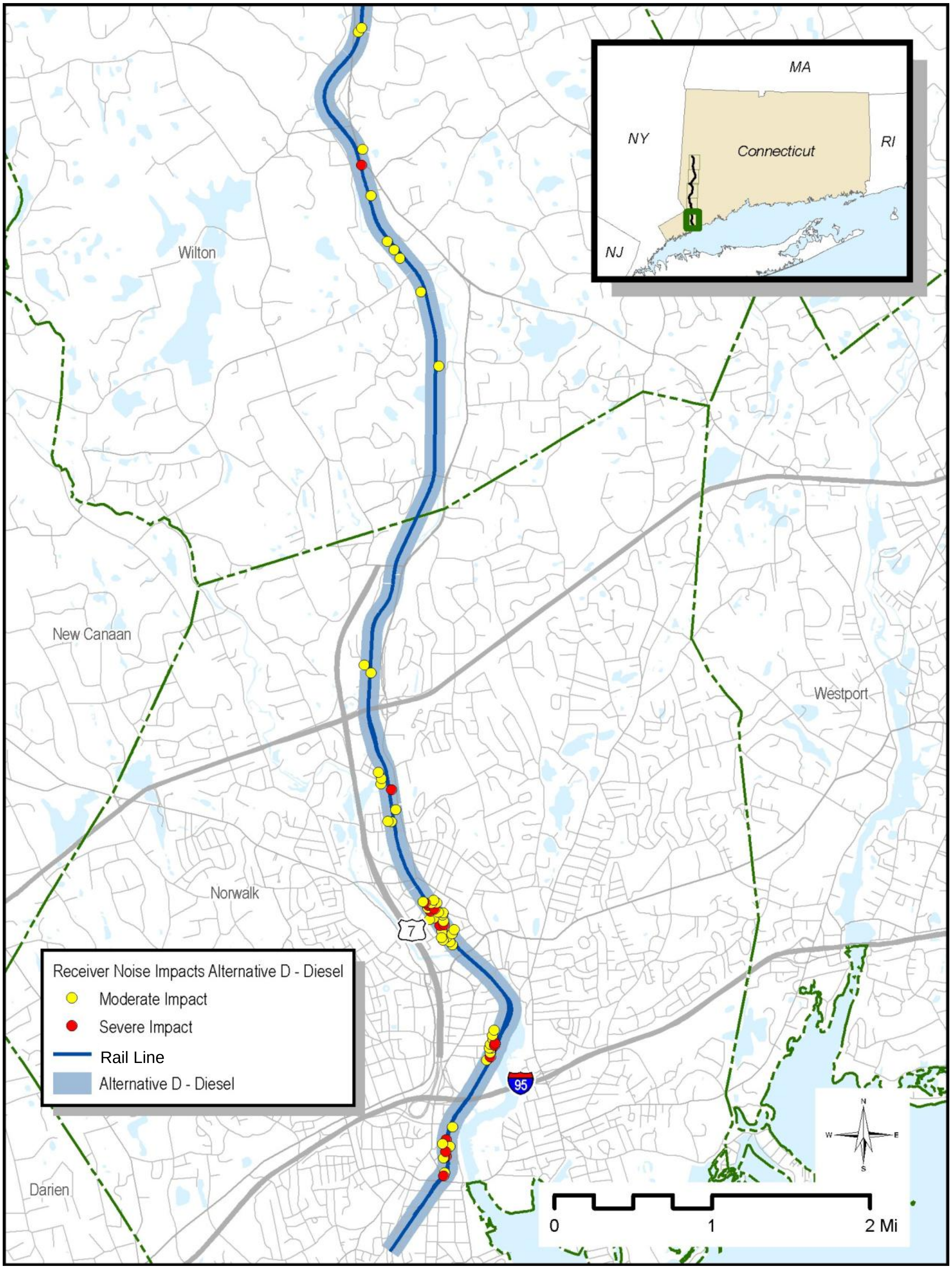
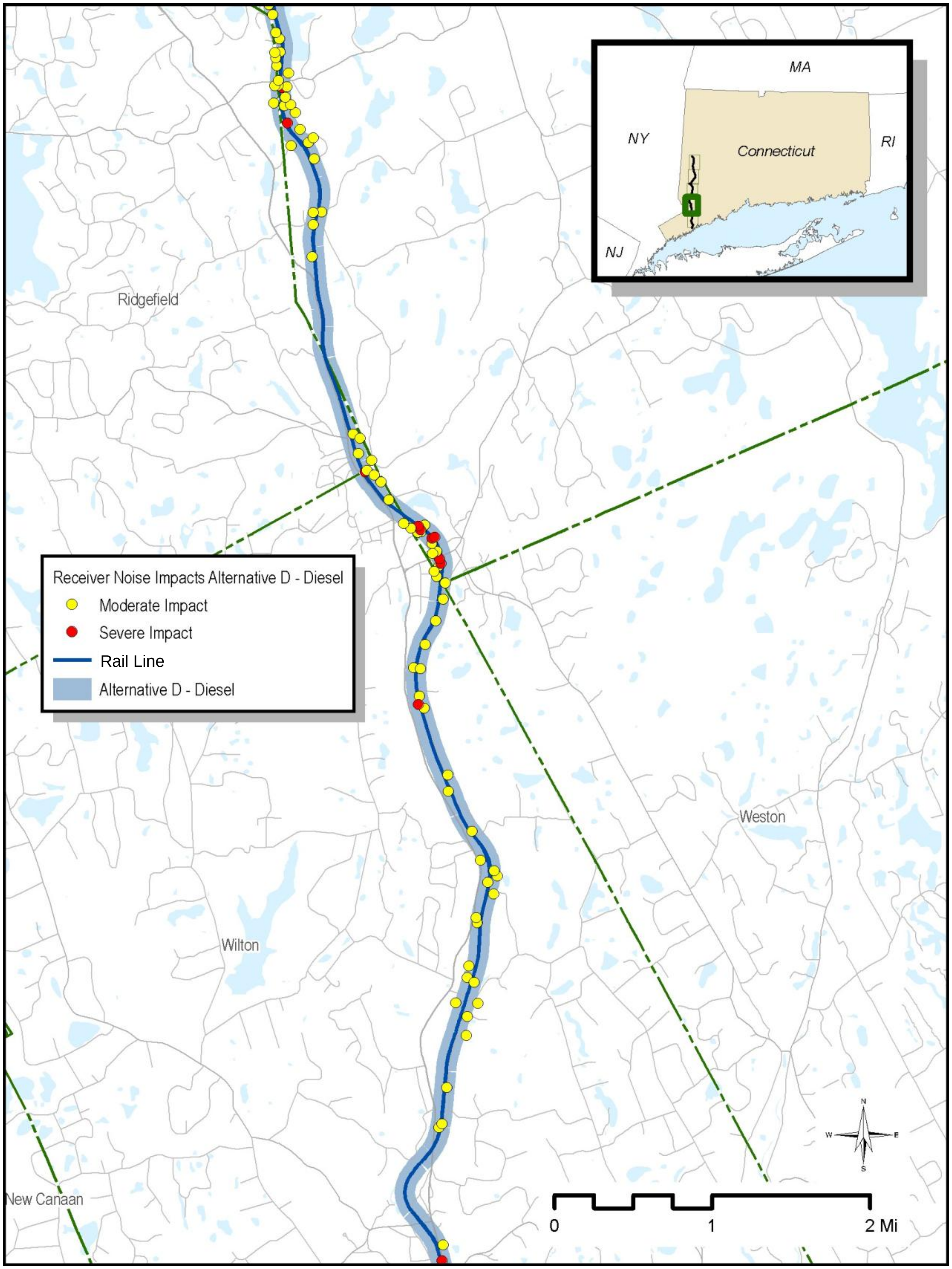
2 Mi


Newtown
MA
NY
Connecticut
RI
NJ
Danbury
Bethel
Redding
Ridgefield
Receiver Noise Impacts Alternative C
Moderate Impact
Severe Impact
Rail Line
Alternative C
0
1
2 Mi


MA
NY
Connecticut
RI
NJ
Wilton
New Canaan
Westport
Norwalk
7
95
Darien
Receiver Noise Impacts Alternative D - Diesel
Moderate Impact
Severe Impact
Rail Line
Alternative D - Diesel
0
1
2 Mi


MA
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Connecticut
RI
NJ
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New Canaan
Receiver Noise Impacts Alternative D - Diesel
Moderate Impact
Severe Impact
Rail Line
Alternative D - Diesel
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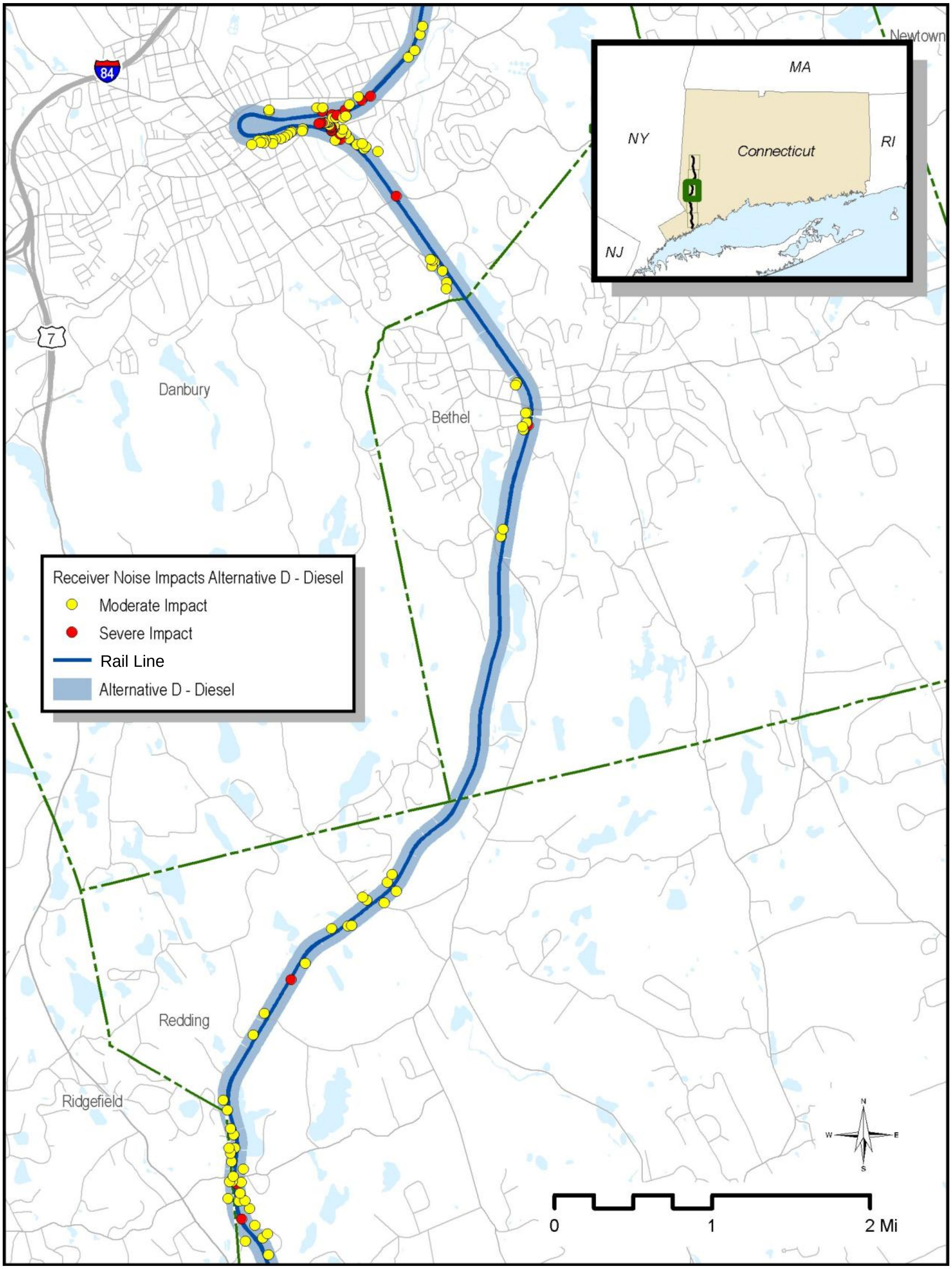
Receiver Noise Impacts Alternative D - Diesel
Moderate Impact
Severe Impact
Rail Line
Alternative D - Diesel
Newtown
84
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Danbury
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Redding
Ridgefield
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Connecticut
RI
NJ
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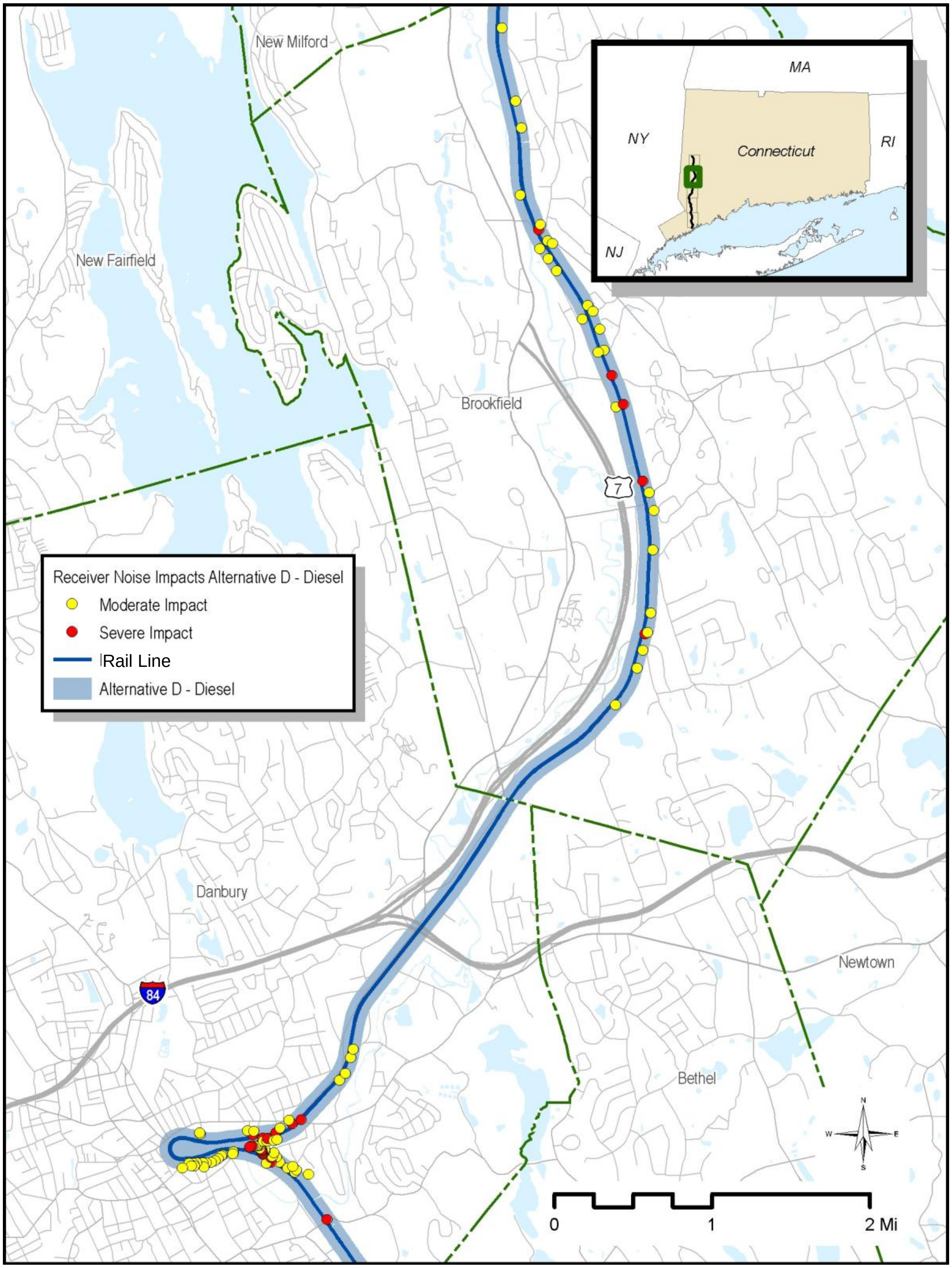
S
W
E


New Milford
New Fairfield
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Receiver Noise Impacts Alternative D - Diesel
Moderate Impact
Severe Impact
Rail Line
Alternative D - Diesel
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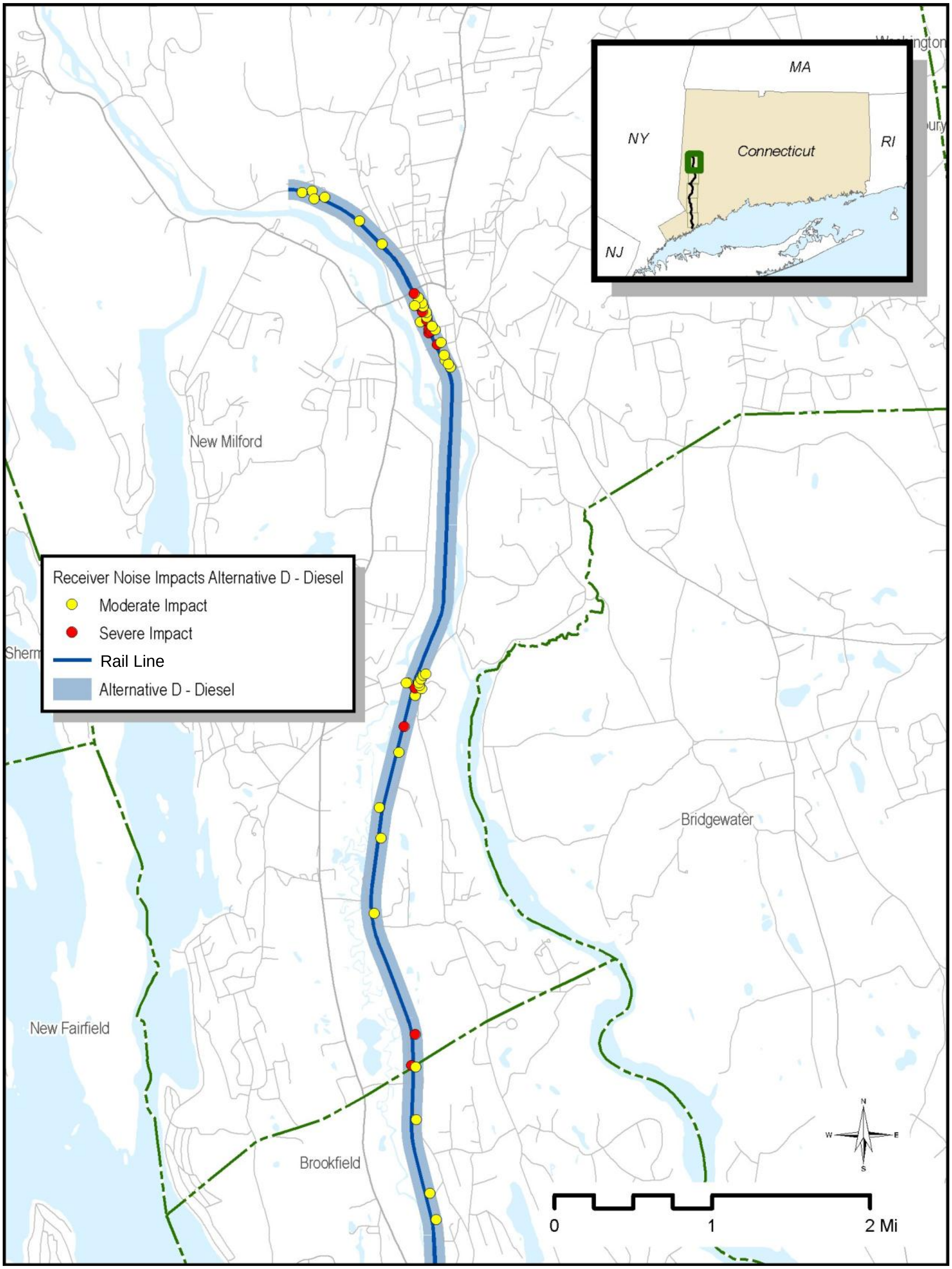
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Connecticut
RI
NJ
New Milford
Receiver Noise Impacts Alternative D - Diesel
Moderate Impact
Severe Impact
Rail Line
Alternative D - Diesel
Bridgewater
New Fairfield
Brookfield
0
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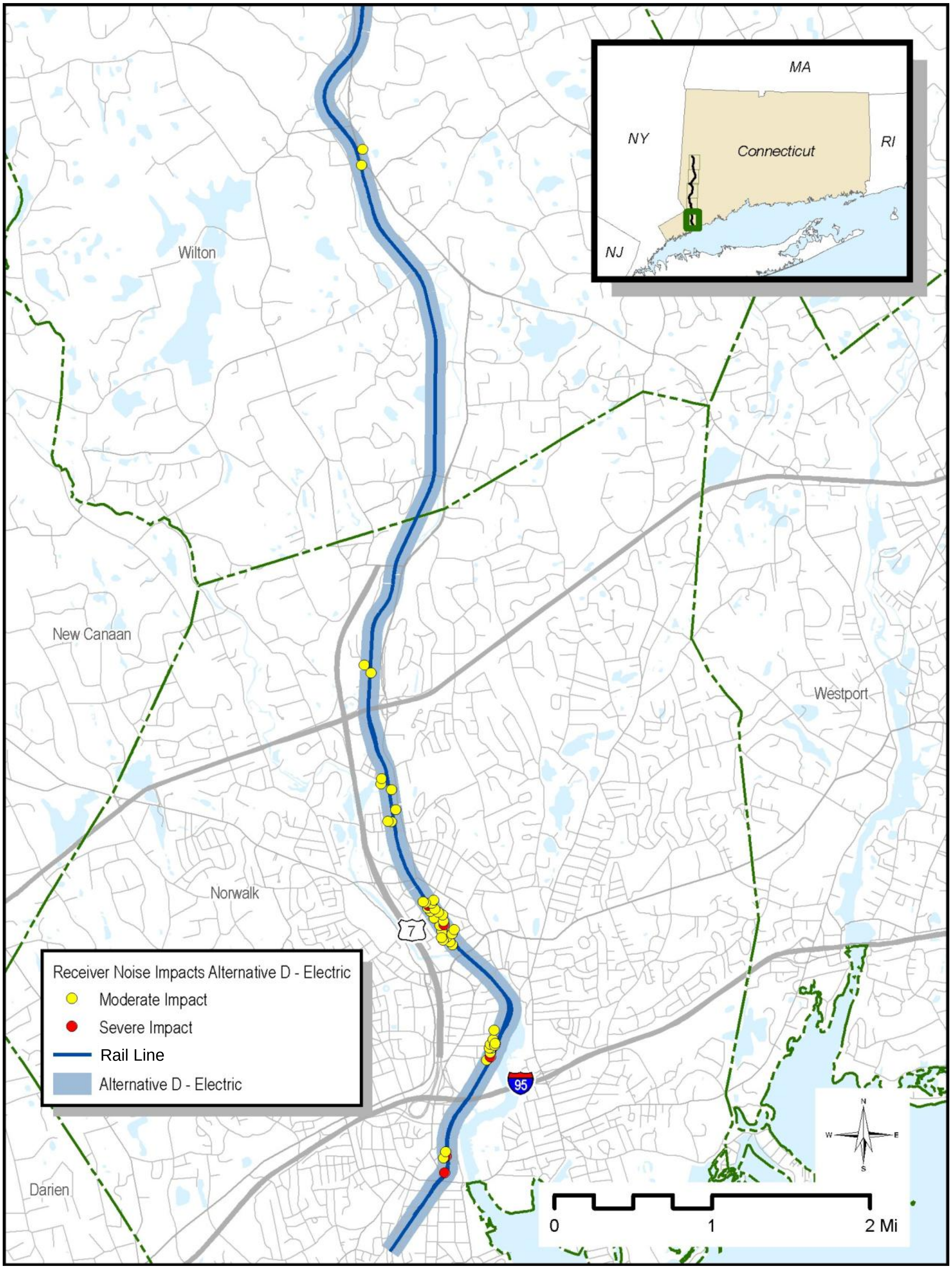
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NY
Connecticut
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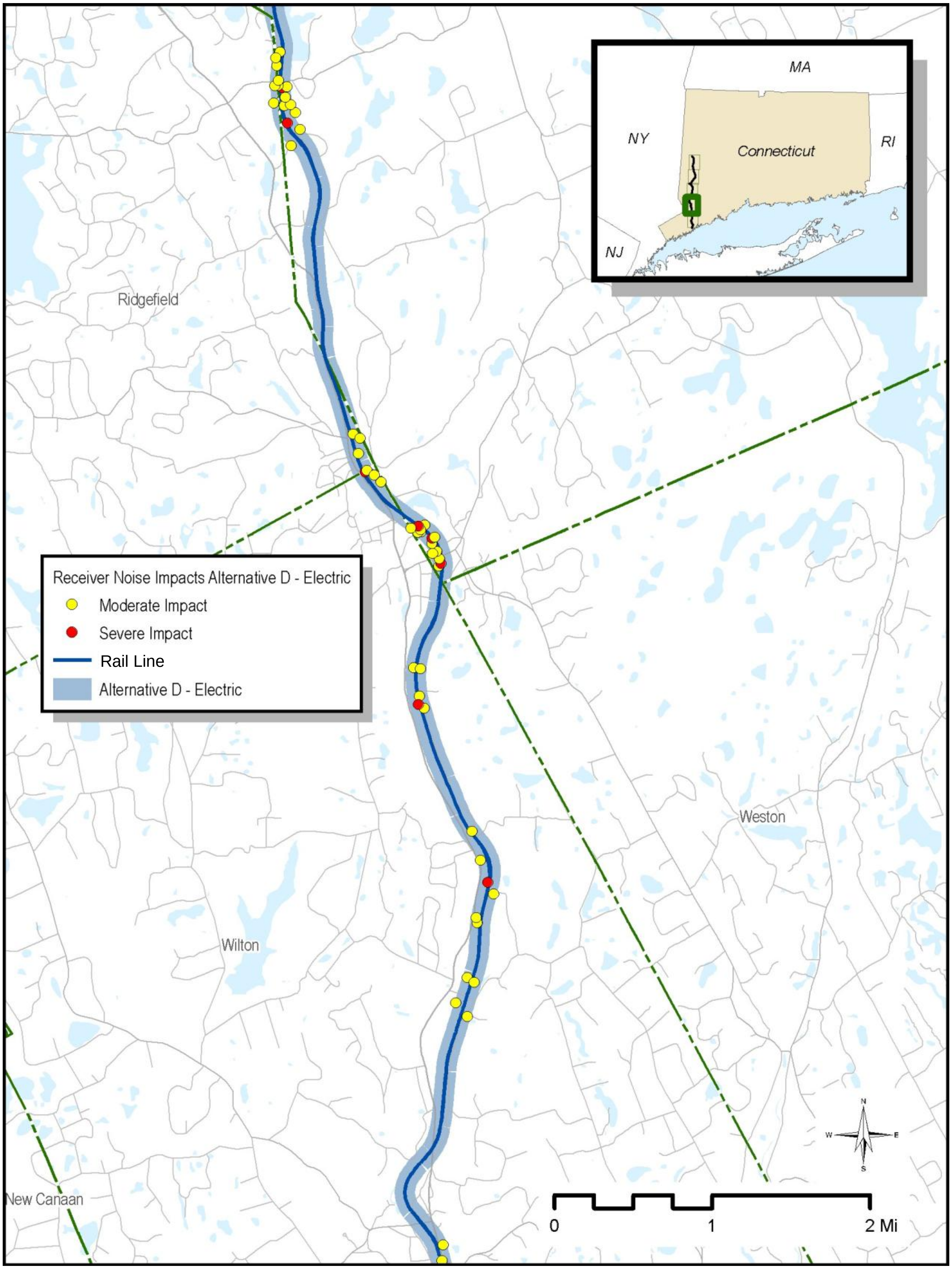
NJ
Wilton
New Canaan
Westport
Norwalk
Darien
7
95
Receiver Noise Impacts Alternative D - Electric
Moderate Impact
Severe Impact
Rail Line
Alternative D - Electric
0
1
2 Mi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Connecticut
RI
NJ
Ridgefield
Receiver Noise Impacts Alternative D - Electric
Moderate Impact
Severe Impact
Rail Line
Alternative D - Electric
Weston
Wilton
New Canaan
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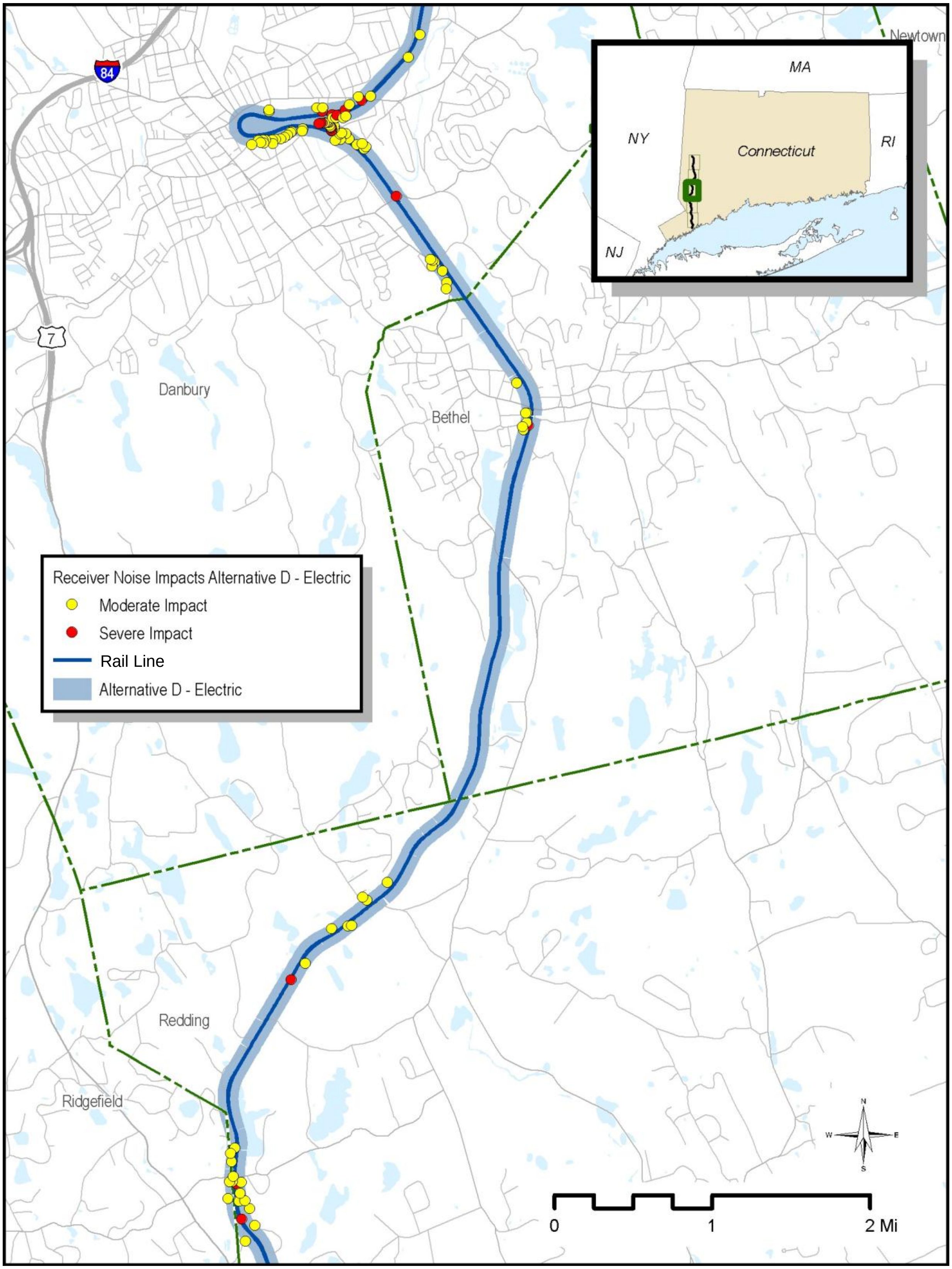
1
2 Mi


Newtown
84
7
Danbury
Bethel
Redding
Ridgefield
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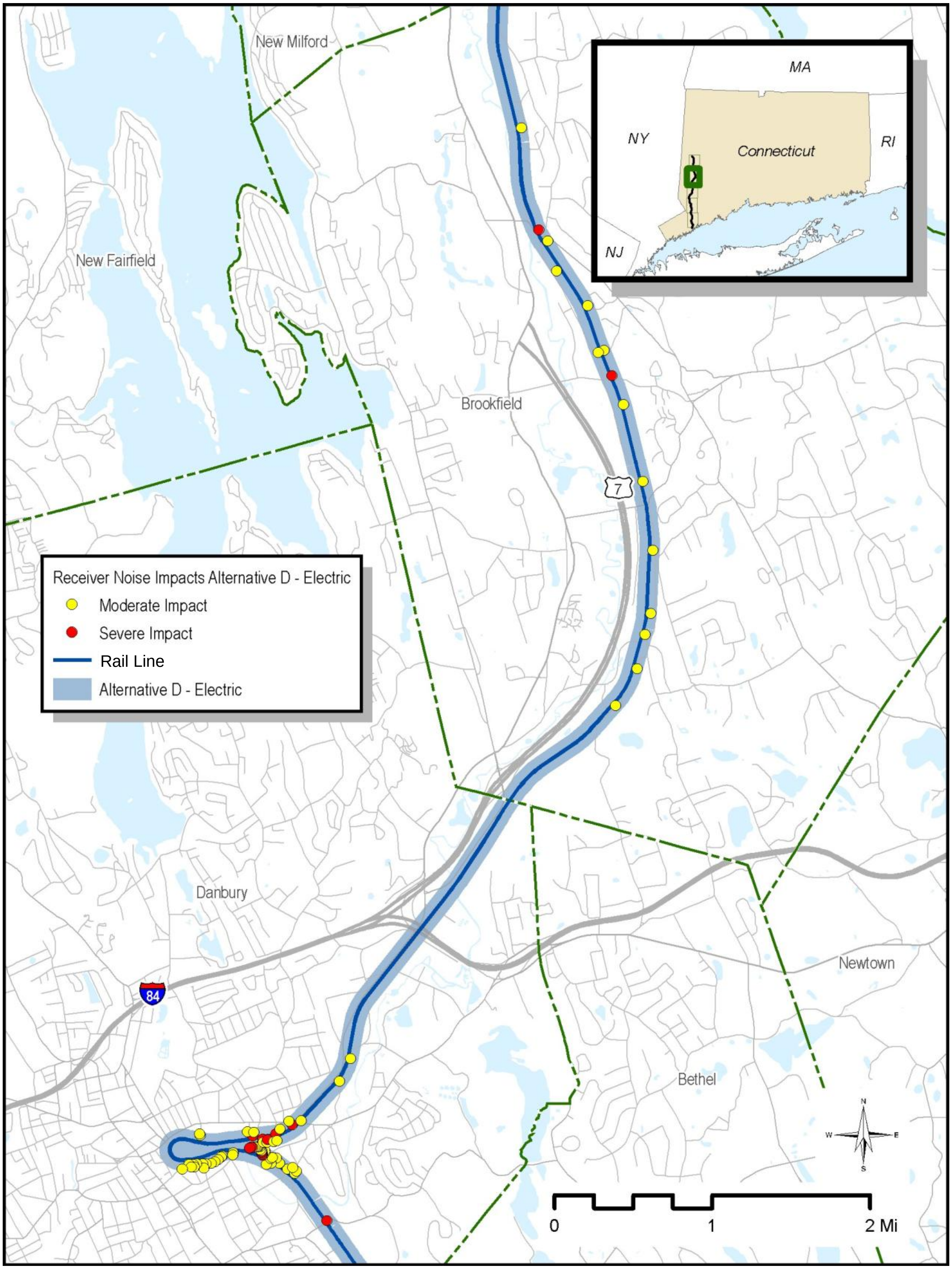
RI
NJ
Receiver Noise Impacts Alternative D - Electric
Moderate Impact
Severe Impact
Rail Line
Alternative D - Electric
0
1
2 Mi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New Fairfield
Brookfield
Danbury
Newtown
Bethel
7
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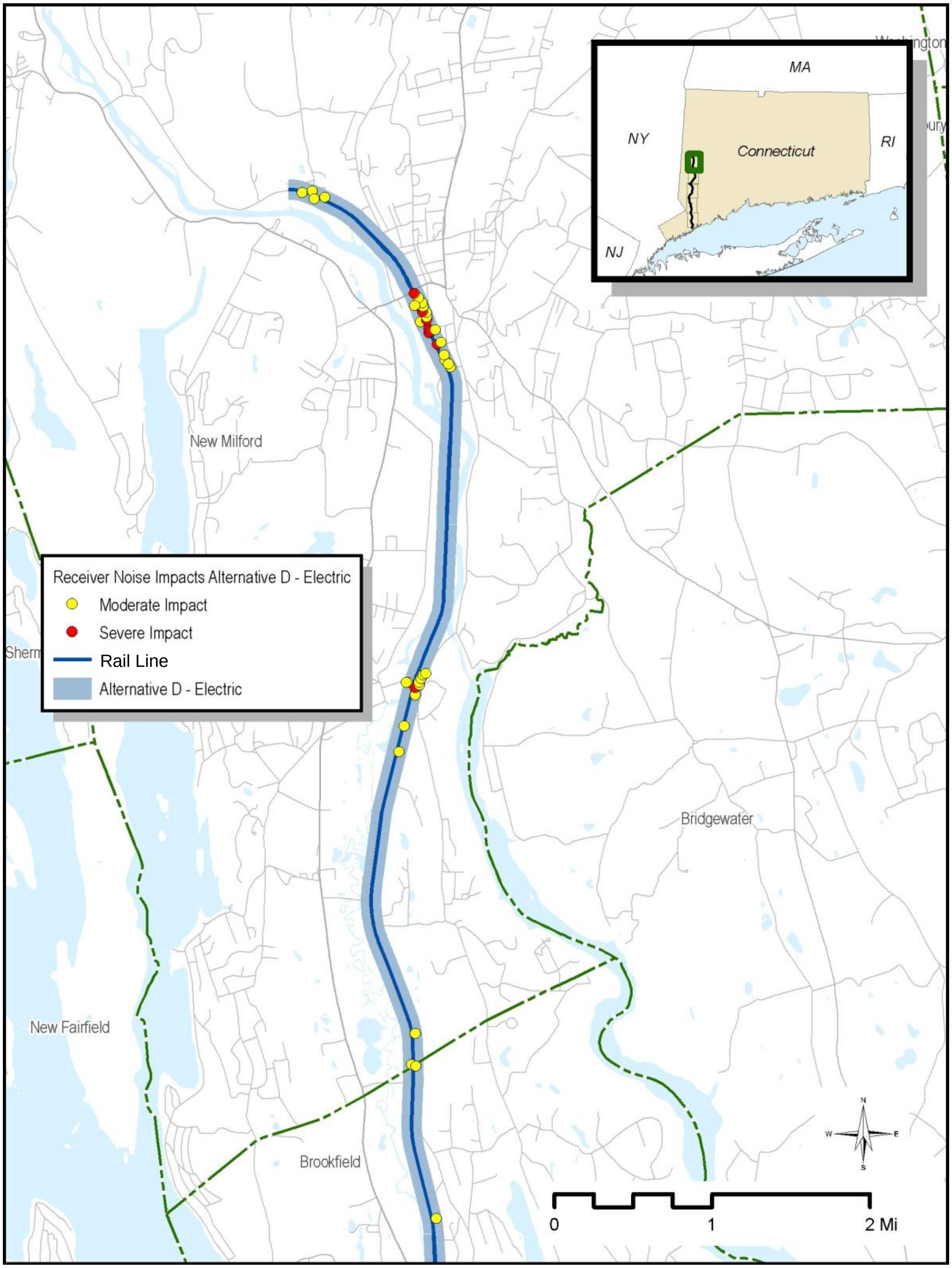
MA
NY
Connecticut
RI
NJ
Receiver Noise Impacts Alternative D - Electric
Moderate Impact
Severe Impact
Rail Line
Alternative D - Electric
0
1
2 Mi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NJ
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Bridgewater
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Brookfield
Receiver Noise Impacts Alternative D - Electric
Moderate Impact
Severe Impact
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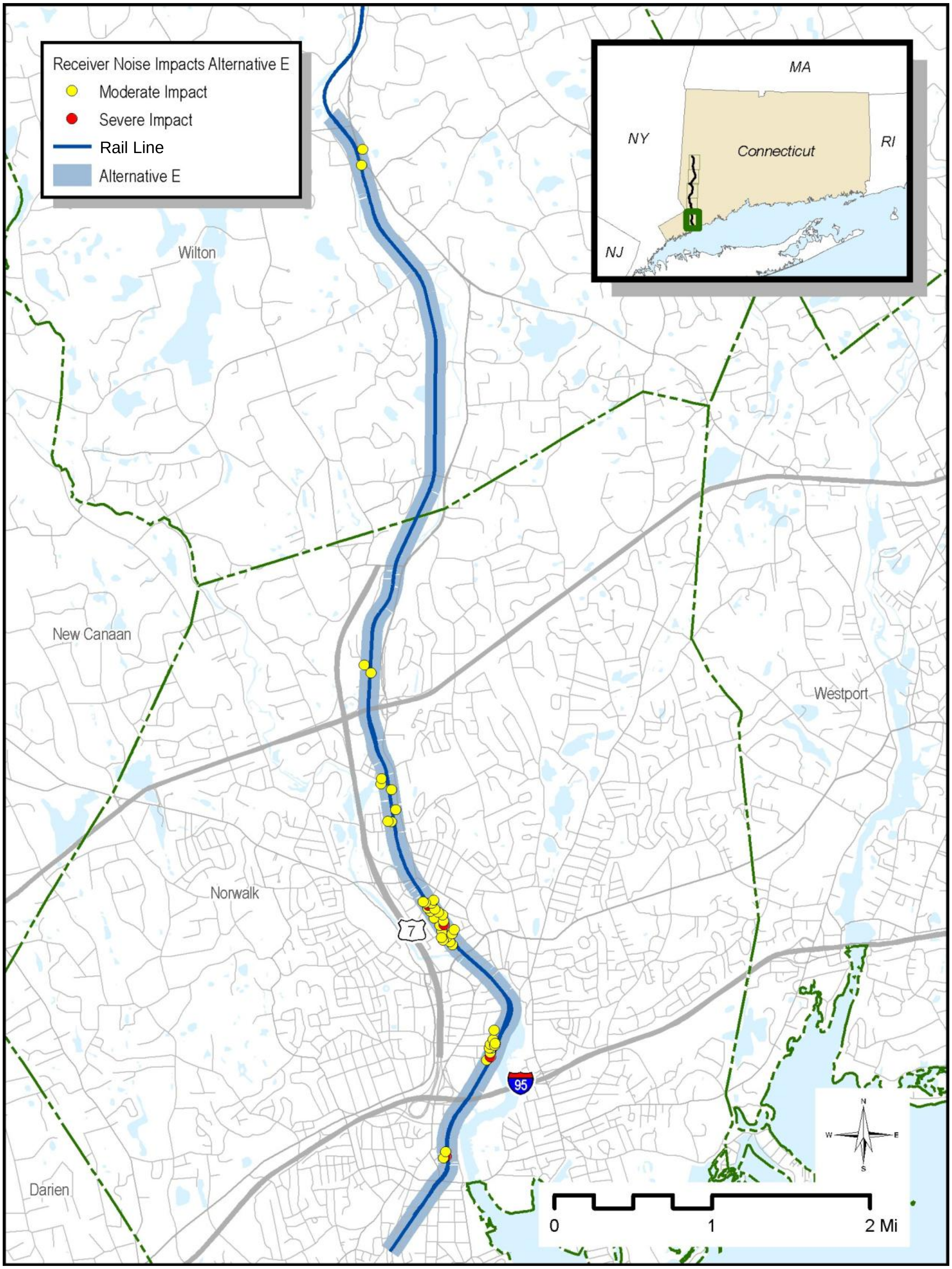
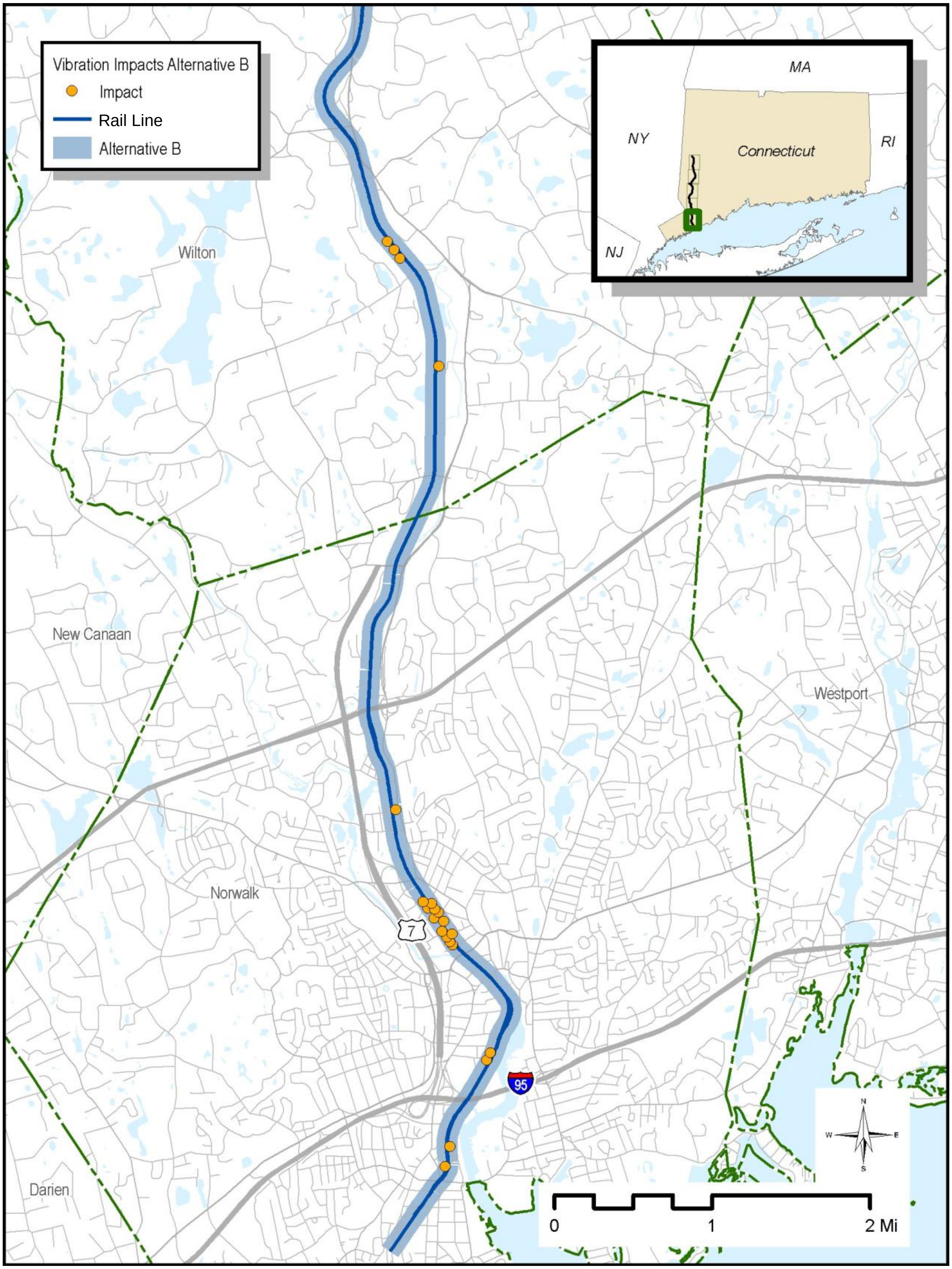
Alternative D - Electric
0
1
2 Mi


Receiver Noise Impacts Alternative E
Moderate Impact
Severe Impact
Rail Line
Alternative E
MA
NY
Connecticut
RI
NJ
Wilton
New Canaan
Westport
Norwalk
7
95
Darien
0
1
2 Mi

APPENDIX D. VIBRATION IMPACT LOCATIONS


Vibration Impacts Alternative B
Impact
Rail Line
Alternative B
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Wilton
New Canaan
Westport
Norwalk
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Darien
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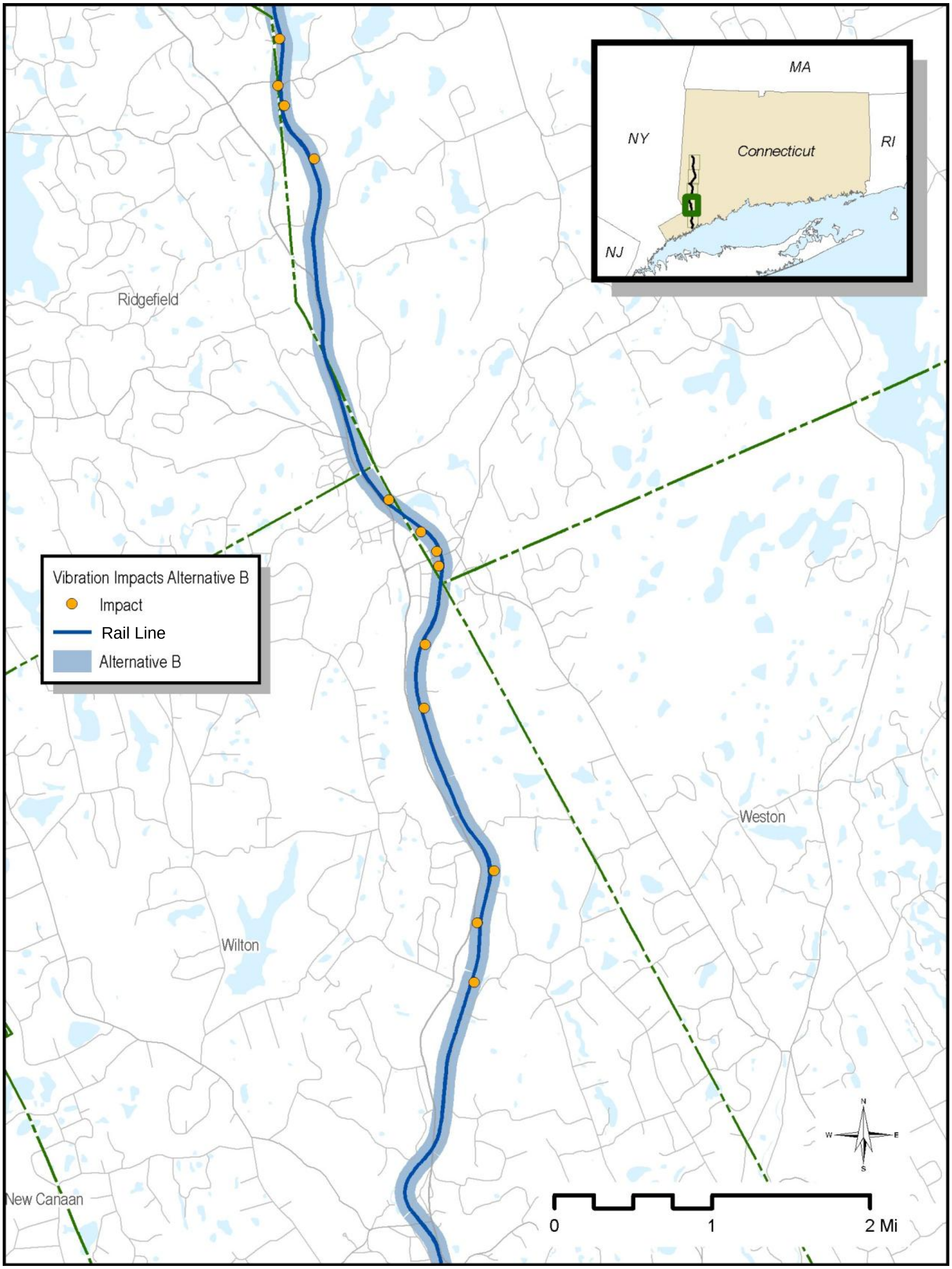
2 Mi


MA
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RI
NJ
Ridgefield
Vibration Impacts Alternative B
Impact
Rail Line
Alternative B
Weston
Wilton
New Canaan
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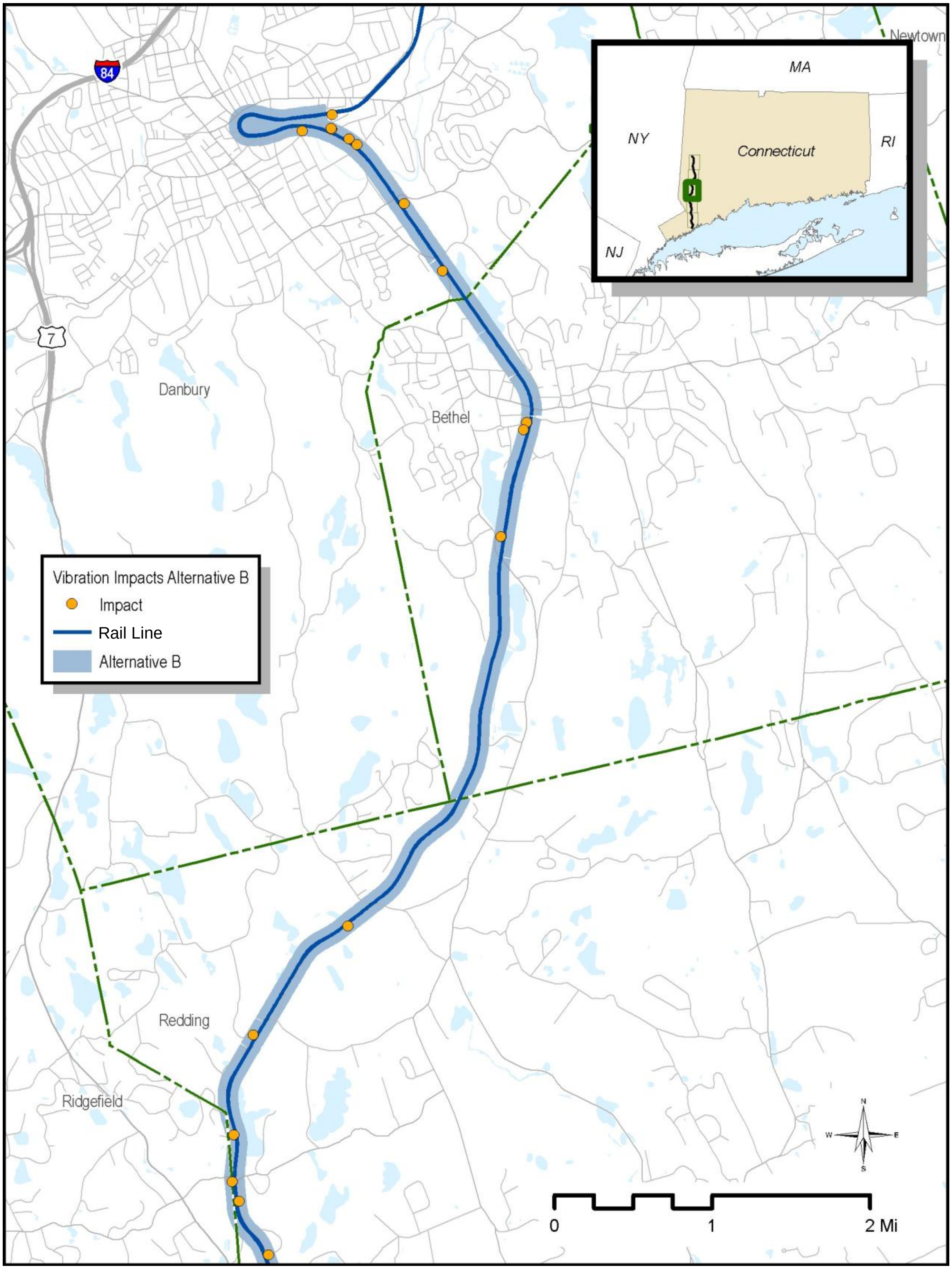
Newtown
MA
NY
Connecticut
RI
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Danbury
Bethel
Redding
Ridgefield
Vibration Impacts Alternative B
Impact
Rail Line
Alternative B
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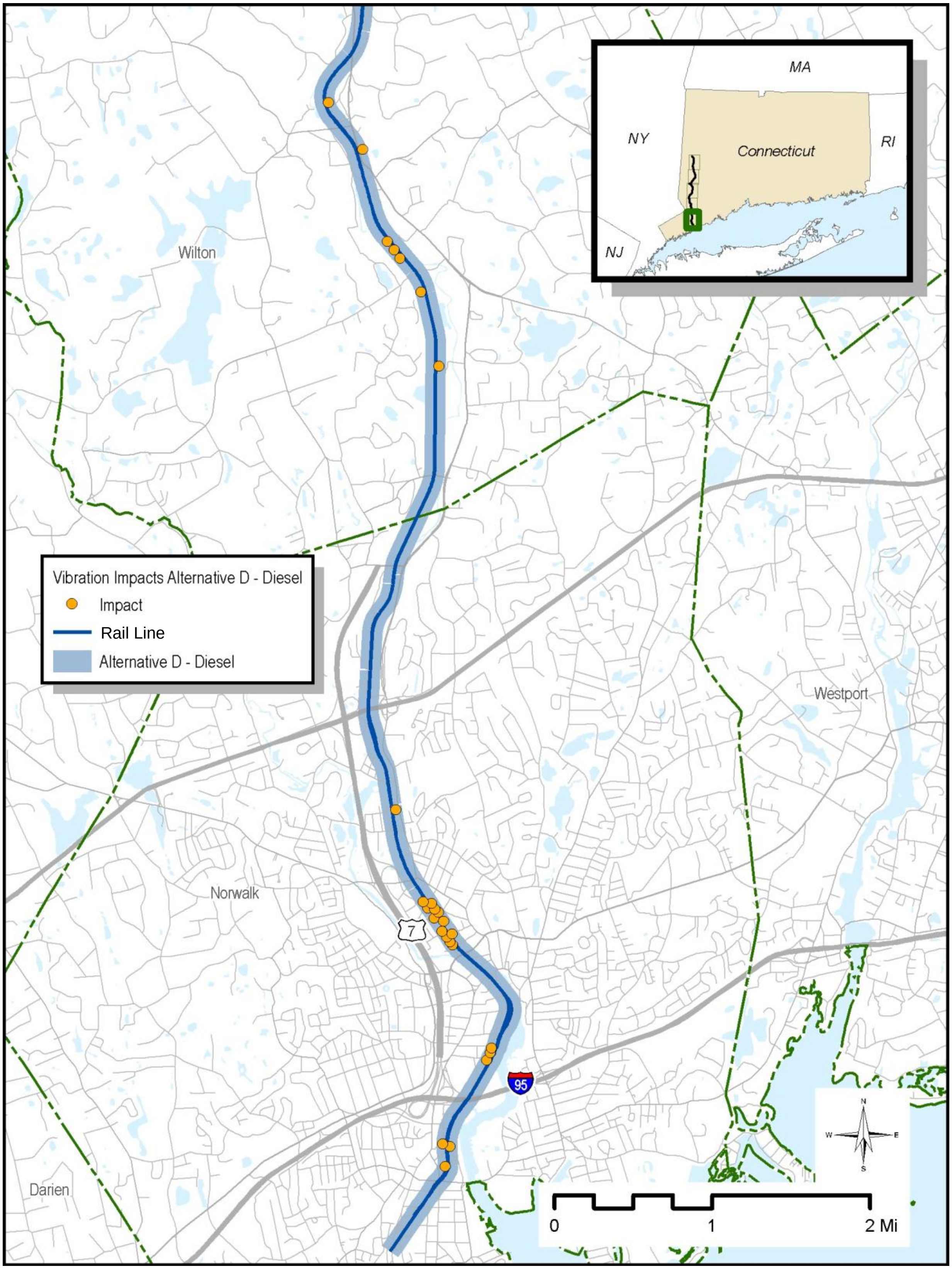
MA
NY
Connecticut
RI
NJ
Wilton
Vibration Impacts Alternative D - Diesel
Impact
Rail Line
Alternative D - Diesel
Westport
Norwalk
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Darien
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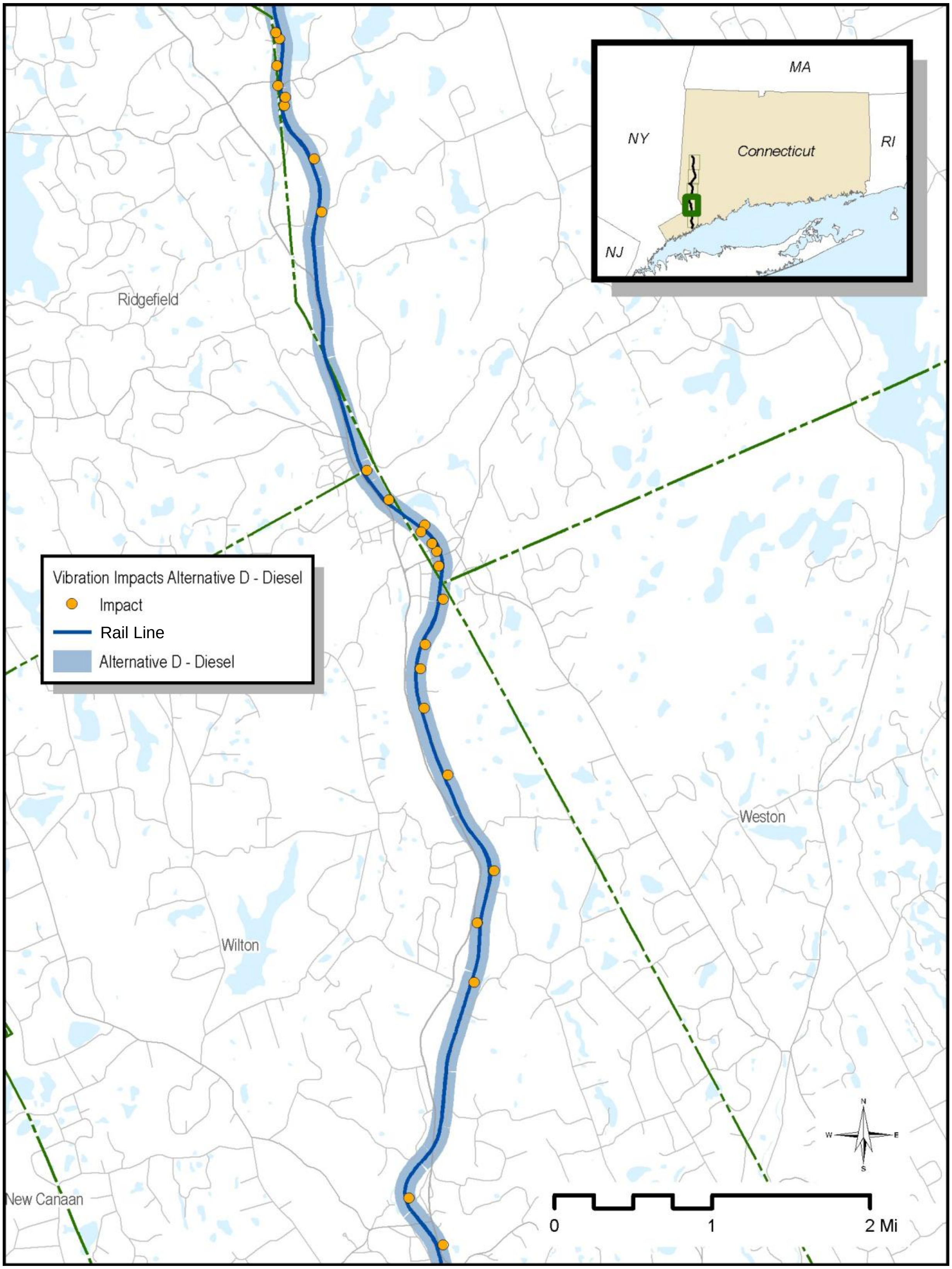
2 Mi


MA
NY
Connecticut
RI
NJ
Ridgefield
Vibration Impacts Alternative D - Diesel
Impact
Rail Line
Alternative D - Diesel
Weston
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New Canaan
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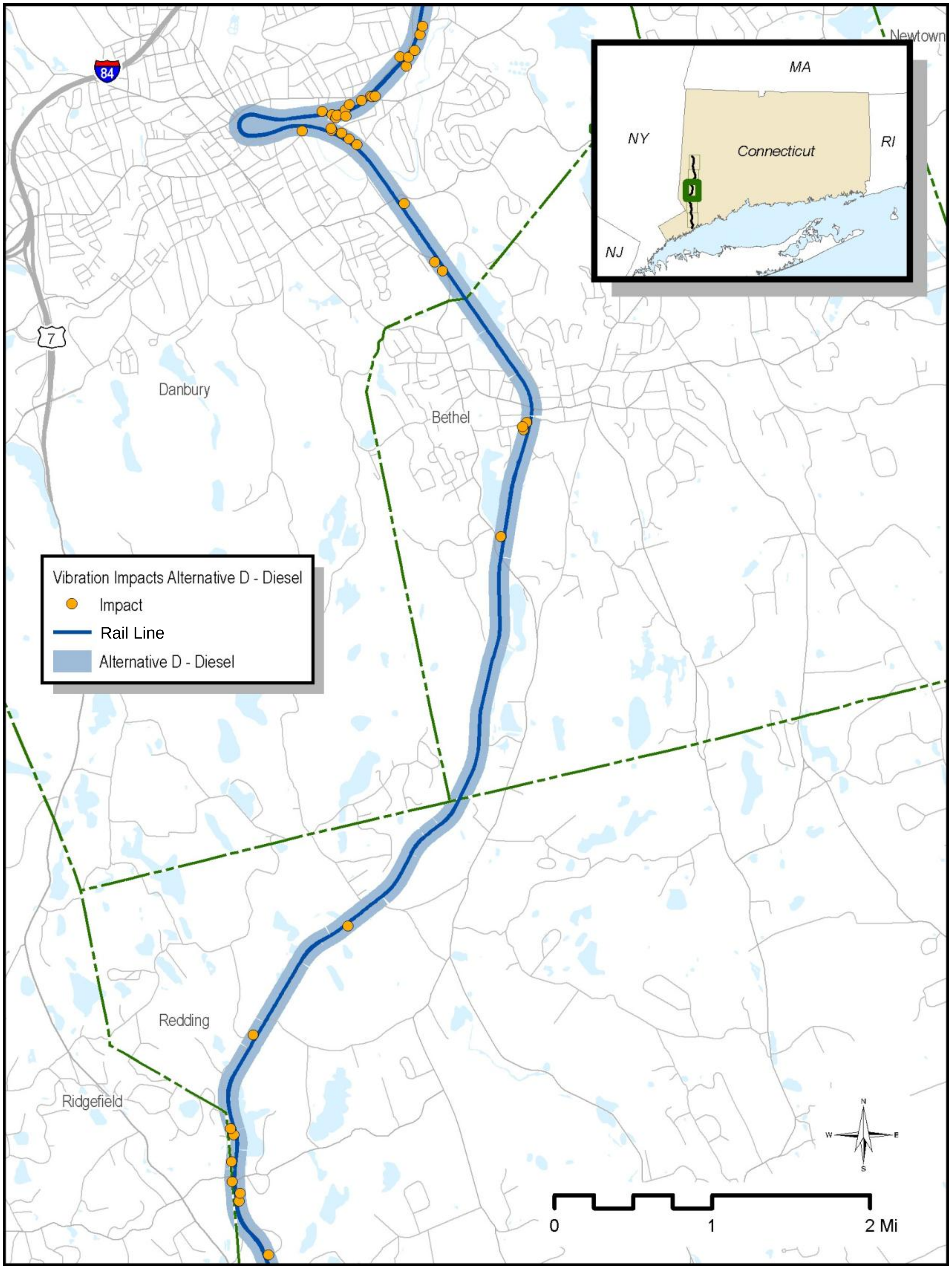
Newtown
MA
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Connecticut
RI
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Danbury
Bethel
Redding
Ridgefield
Vibration Impacts Alternative D - Diesel
Impact
Rail Line
Alternative D - Diesel
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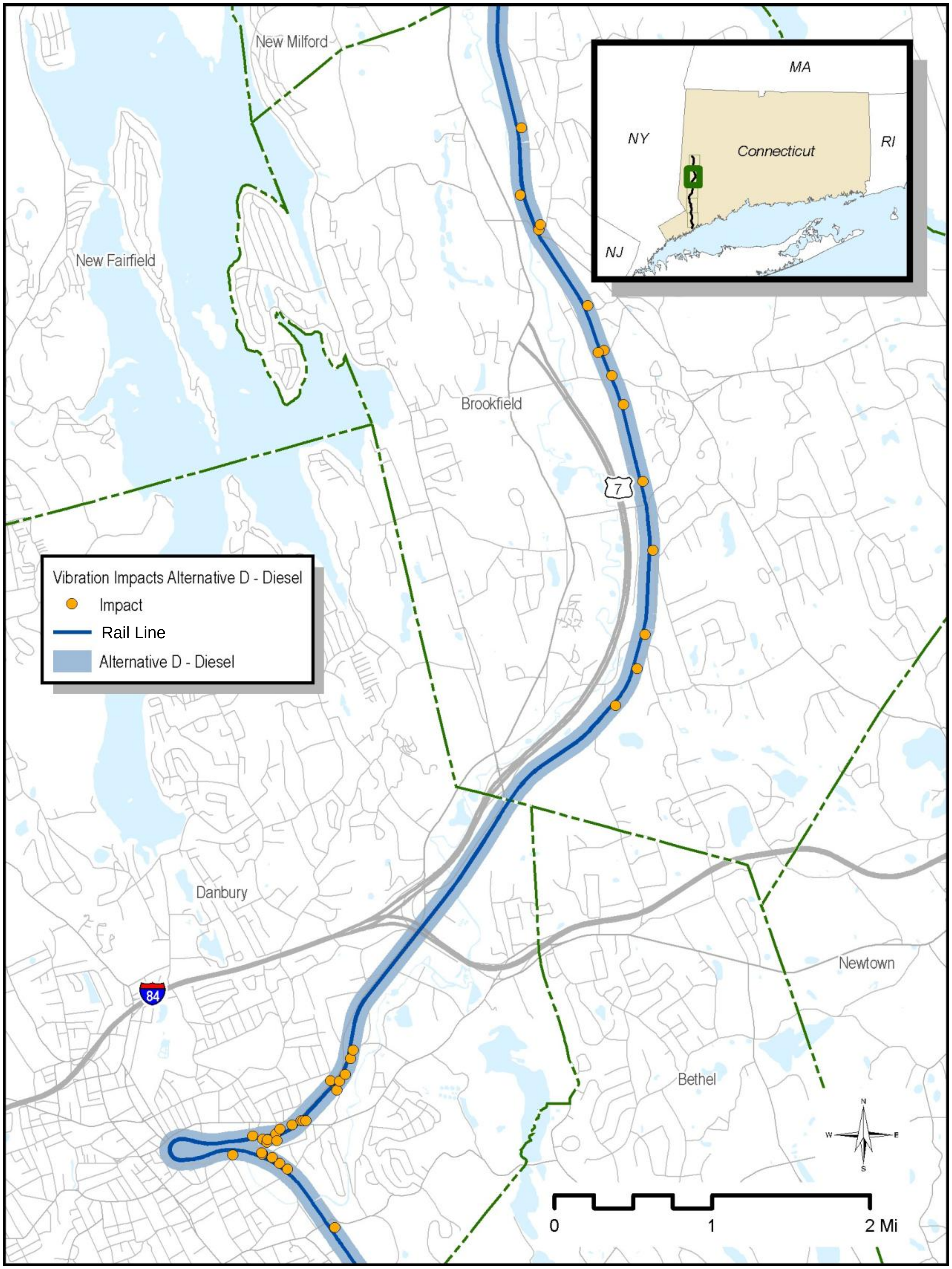
2 Mi


New Milford
New Fairfield
Brookfield
Danbury
Newtown
Bethel
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MA
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RI
Connecticut
NJ
Vibration Impacts Alternative D - Diesel
Impact
Rail Line
Alternative D - Diesel
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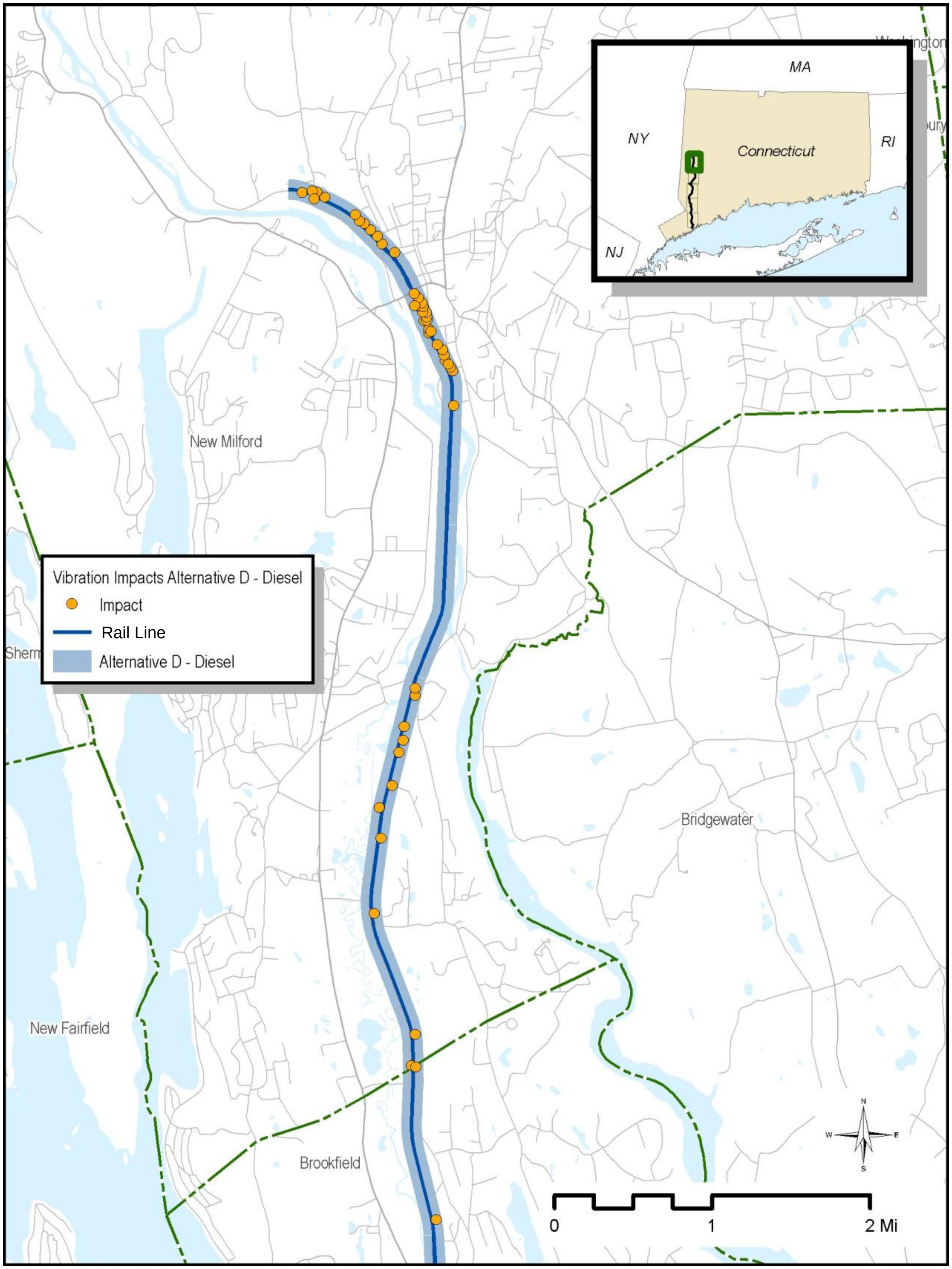
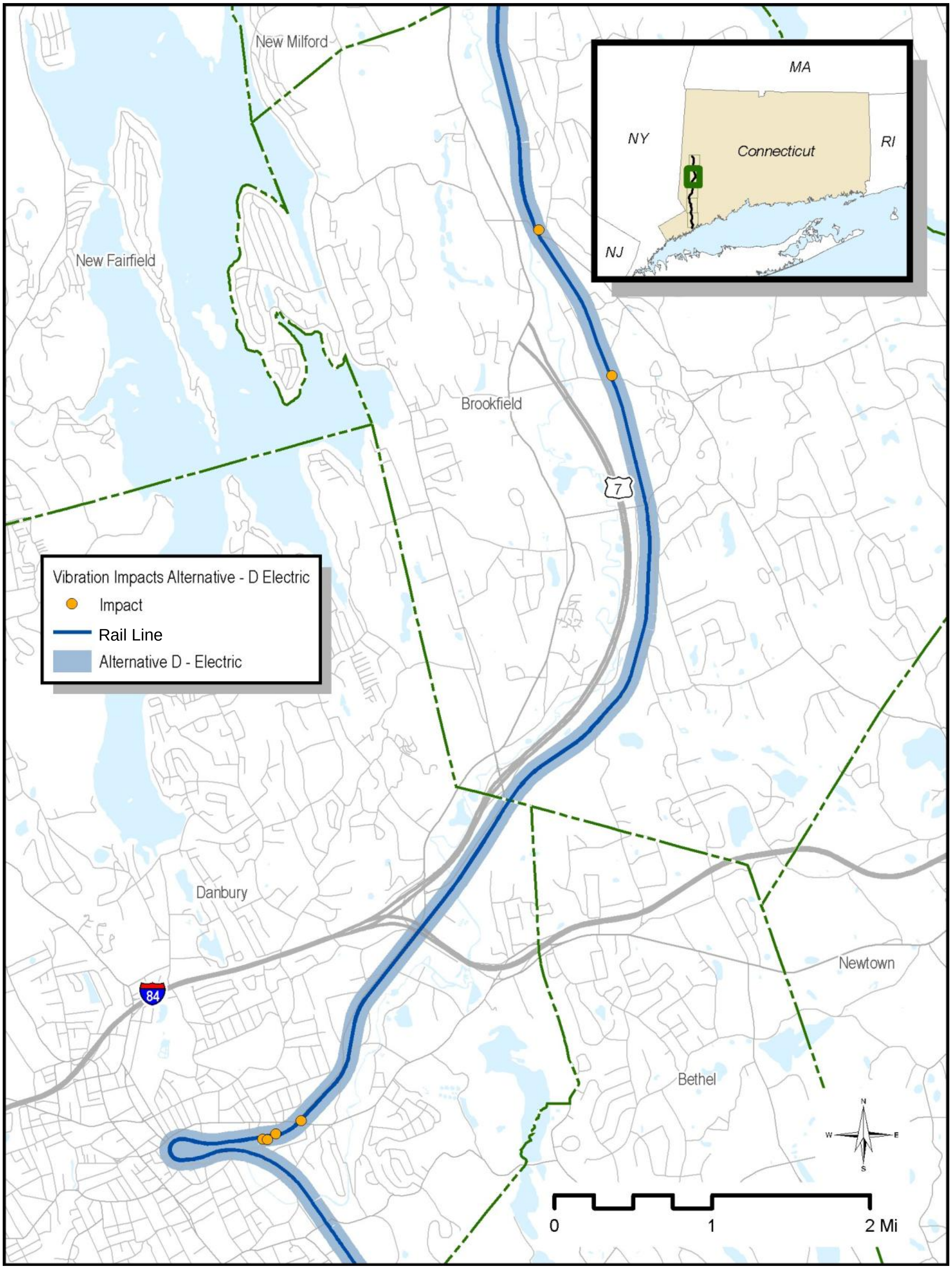

MA
NY
Connecticut
RI
NJ
New Milford
Vibration Impacts Alternative D - Diesel
Impact
Rail Line
Alternative D - Diesel
Bridgewater
New Fairfield
Brookfield
0
1
2 Mi


New Milford
New Fairfield
Brookfield
Danbury
Newtown
Bethel
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MA
NY
RI
NJ
Connecticut
Vibration Impacts Alternative - D Electric
Impact
Rail Line
Alternative D - Electric
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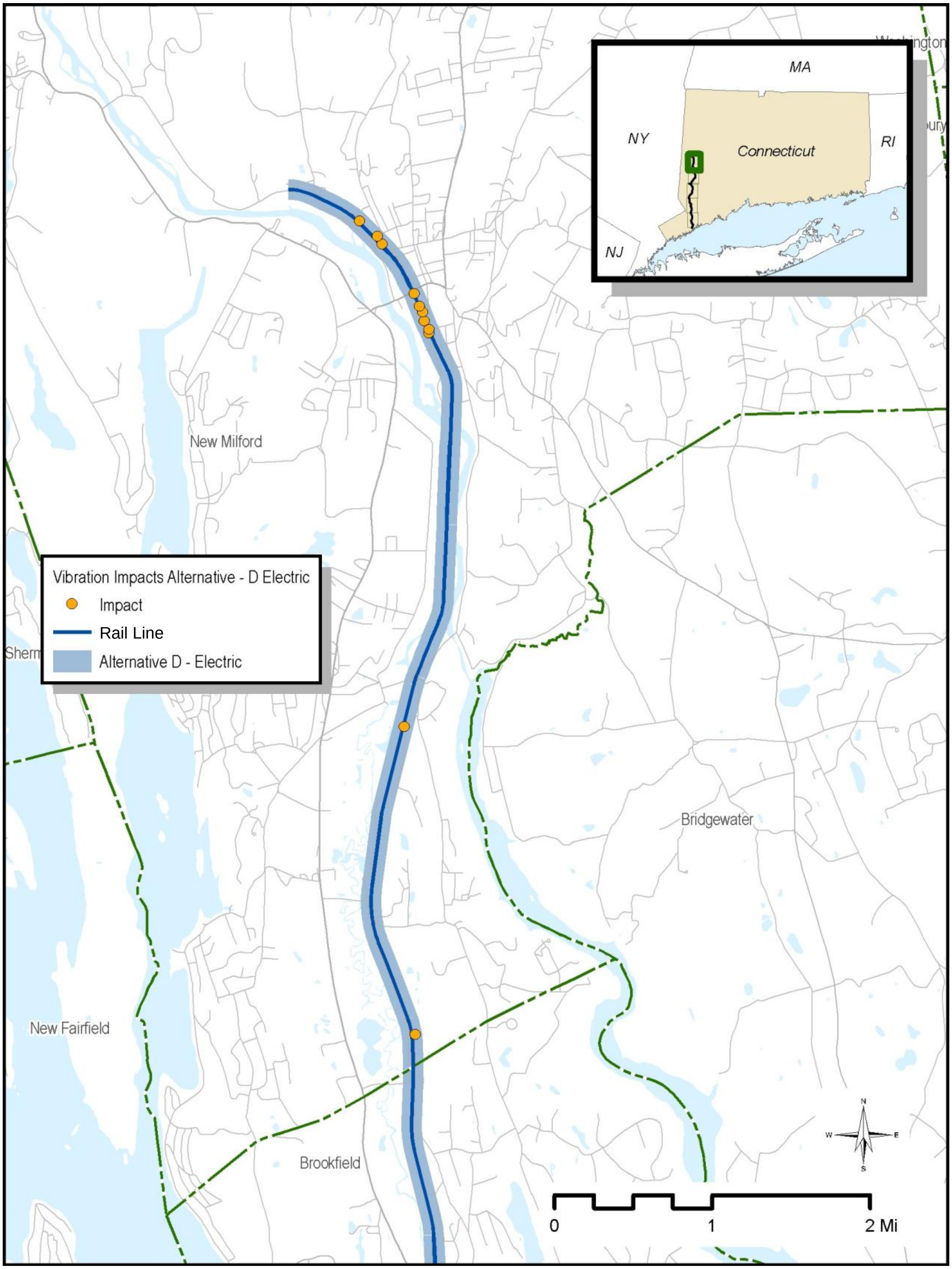
2 Mi


MA
NY
Connecticut
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NJ
New Milford
Vibration Impacts Alternative - D Electric
Impact
Rail Line
Alternative D - Electric
Bridgewater
New Fairfield
Brookfield
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2 Mi