



DESIGN NOISE REPORT

**I-40 Widening from West of NC 801 in Davie County
to East of SR 1101 (Harper Road) in Forsyth County,
and Yadkin River Bridge Replacement**

Davie & Forsyth Counties

**WBS Element No. 34147.1.2
TIP Project No. I-0911 A**

Prepared for:

**North Carolina Department of Transportation
Environmental Analysis Unit**

Submitted By:



**900 Ridgefield Drive, Suite 350
Raleigh, NC 27609**

May 2018

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EXECUTIVE SUMMARY

The North Carolina Department of Transportation (NCDOT) will widen approximately 3.78 miles of I-40 from west of NC 801 in Davie County to east of SR 1101 (Harper Road) in Forsyth County (TIP#: I-0911A). The existing four-lane divided interstate highway will be widened to a six-lane divided facility with a paved inside median divided by a concrete traffic barrier. The project will also replace the existing I-40 bridge over the Yadkin River. The speed limit and design speed throughout the project limits will be 65 and 70 miles per hour, respectively.

The National Environmental Policy Act (NEPA) document for this project is the Finding of No Significant Impact (FONSI) dated June 30, 2014. A thorough reevaluation of the project corridor was conducted to ensure that all developed lands permitted before June 30, 2014 were considered in this Design Noise Report (DNR). After that Date of Public Knowledge, federal and state governments are no longer responsible for providing noise abatement measures for new development within the noise impact area of the proposed project. It is the responsibility of local governments and private landowners to ensure noise-compatible designs are used for development with an approved building permit after the Date of Public Knowledge.

Per FHWA Procedures for Abatement of Highway Noise (23 CFR 772.5(2)) and NCDOT Traffic Noise Abatement Policy (NCDOT Policy), the proposed project is a “Type I” project. Projects with a Date of Public Knowledge on or after October 6, 2016 shall comply with the criteria of the 2016 Traffic Noise Policy. The NCDOT Traffic Noise Abatement Policy effective July 13, 2011 is applicable to projects with a Date of Public Knowledge prior to October 6, 2016 and let for construction on or after July 13, 2011. Therefore, this DNR has been prepared in accordance with 23 CFR 772, the NCDOT Traffic Noise Abatement Policy, and the accompanying NCDOT Traffic Noise Analysis and Abatement Manual, both effective July 13, 2011.

Traffic noise impacts and construction noise impacts can be a consequence of transportation projects. Loudest hourly equivalent noise levels were assessed at 472 discrete receptor locations representing 375 residences, four soccer fields, two community pools, one place of worship, and one historic property in the nine project Noise Study Areas (NSAs).

Design Year 2040 build condition traffic noise is predicted to impact 43 noise-sensitive receptors. Abatement was considered for all predicted Design Year 2040 build condition traffic noise impacts. A total of six (6) traffic noise barriers were assessed using computer models, validated where applicable to ambient noise monitoring and corresponding classified traffic count and speed data.

NCDOT Policy requires the identification as to whether it is “likely” or “unlikely” that noise abatement measures will be installed for each noise sensitive area identified. “Likely” does not mean a firm commitment; however, the FHWA has delegated acceptance of findings of this Design Noise Report to the NCDOT. Pending the required solicitation of viewpoints of property owners and residents of all benefited receptors, this DNR represents the final decision on the installation of the abatement measures. The following noise abatement measures are



considered “likely” in the vicinity of the I-40 widening and bridge replacement project (TIP#: I-0911A):

- Noise Wall 1 (NW1): 1,320 feet in length with an area of 22,830 square feet, adjacent to I-40 westbound to mitigate predicted traffic noise impacts to residences on Pinewood Lane.
- Noise Wall 5 (NW5): 840 feet in length with an area of 11,970 square feet, adjacent to I-40 westbound to mitigate the predicted traffic noise impacts to residences on Peony Way.
- Noise Wall 6 (NW6): 2,985 feet in length with an area of 45,540 square feet, adjacent to I-40 eastbound to mitigate the predicted traffic noise impacts to residences on Riverview Knoll Court, River Oaks Court, Thoroughbred Lane, Whirlaway Court, and Westridge Meadow Circle.
- Noise Wall 7 (NW7): 1,650 feet in length with an area of 32,190 square feet, adjacent to I-40 westbound to mitigate the predicted traffic noise impact to the residence on Fair Oaks Drive.

Construction noise impacts may occur due to the proximity of noise-sensitive receptors near anticipated project construction activities. All reasonable efforts should be made to minimize exposure of noise-sensitive land uses to construction noise. Such efforts may include, but are not explicitly limited to, appropriate scheduling of construction activities, noise attenuating measures on construction equipment, and a consistent and open public involvement program.

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DESIGN NOISE REPORT

I-40 Widening and Bridge Replacement Project / TIP #: I-0911A

I-40 Widening from West of NC 801 in Davie County to East of SR 1101 (Harper Road) in Forsyth County, and Yadkin River Bridge Replacement Davie and Forsyth Counties

1.0 INTRODUCTION

This DNR satisfies the requirements of the NCDOT Traffic Noise Abatement Policy effective July 13, 2011 (NCDOT Policy) for widening a 3.78-mile long section of I-40 from west of NC 801 to east of SR 1101 (Harper Road), and replacing the existing I-40 bridge over the Yadkin River. (WBS No. 34147.1.2, TIP #: I-0911A).

Per FHWA Procedures for Abatement of Highway Noise (23 CFR 772.5(2)) and NCDOT Traffic Noise Abatement Policy (NCDOT Policy), the proposed project is a “Type I” project. Projects with a Date of Public Knowledge on or after October 6, 2016 shall comply with the criteria of the 2016 Traffic Noise Policy. The NCDOT Traffic Noise Abatement Policy effective July 13, 2011 is applicable to projects with a Date of Public Knowledge prior to October 6, 2016 and let for construction on or after July 13, 2011. Therefore, this DNR has been prepared in accordance with 23 CFR 772, the NCDOT Traffic Noise Abatement Policy (Policy), and the accompanying NCDOT Traffic Noise Analysis and Abatement Manual (Manual), both effective July 13, 2011.

1.1 Project Location and Description

The existing four-lane divided interstate highway will be widened to a six-lane divided facility with a paved median divided by a concrete traffic barrier. The project will also replace the existing I-40 bridge over the Yadkin River. The speed limit and design speed throughout the project limits will be 65 and 70 miles per hour, respectively.

The National Environmental Policy Act (NEPA) document for this project is the Finding of No Significant Impact (FONSI) dated June 30, 2014. After that Date of Public Knowledge, federal and state governments are no longer responsible for providing noise abatement measures for new development within the noise impact area of the proposed project. It is the responsibility of local governments and private landowners to ensure noise-compatible designs are used for development with an approved building permit after the Date of Public Knowledge.

Per FHWA Procedures for Abatement of Highway Noise (23 CFR 772.5(2)) and NCDOT Traffic Noise Abatement Policy (NCDOT Policy), the proposed project is a “Type I” project. This DNR documents the methodologies, results, and recommendations in compliance with 23 CFR 772, NCDOT Policy, and the accompanying Manual, both effective July 13, 2011.

Ambient noise monitoring data, corresponding traffic count and vehicle speed data, photographs, event logs, and field sketches were obtained throughout the project corridor on Tuesday, November 14, 2017. Weather conditions during the ambient noise monitoring sessions were seasonally average, with temperatures between 45°F and 50°F and variable winds between 4 and 8 miles per hour.

Traffic noise impacts and construction noise impacts can be a consequence of transportation projects. Loudest hourly equivalent noise levels were assessed at 472 discrete receptor locations representing 375 residences, four soccer fields, two community pools, one place of worship, and one historic property in the nine project Noise Study Areas (NSAs).

Design Year 2040 build condition traffic noise is predicted to impact 43 noise-sensitive receptors. Abatement was considered for all predicted Design Year 2040 build condition traffic noise impacts. A total of six (6) traffic noise barriers were assessed using computer models, validated where applicable to ambient noise monitoring and corresponding classified traffic count and speed data.

1.2 Purpose

The purpose of this DNR is to document the prediction of traffic noise impacts and to make recommendations for feasible and reasonable abatement measures that represent an equitable and cost-effective expenditure of public funds. The methodologies by which this DNR has been performed, and the recommendations contained herein, are compliant with 23 CFR 772, NCDOT Policy, and the accompanying Manual, both effective July 13, 2011.

2.0 PROCEDURE

This DNR represents the analyses of the predicted traffic noise impacts of the I-40 widening and Yadkin River bridge replacement project (TIP #: I-0911A).

The Federal Highway Administration Traffic Noise Model® (FHWA TNM v.2.5) was used to predict Base Year 2016 existing, Design Year 2040 No-build, and Design Year 2040 Build-condition hourly equivalent traffic noise levels, $L_{eq(h)}$, for the potential noise-sensitive receptor locations in the vicinity of the I-40 widening and bridge replacement project (refer to Figures 1 and 2).

In addition to reporting, the procedure by which this DNR was conducted was as follows:

- *Initial project scoping*: Obtain project design; prepare field maps; review project mapping, GIS data, aerial photography, traffic data, and other available pertinent information.
- *Monitoring / fieldwork*: Identify all land uses, addresses, and locations of all noise-sensitive receptors within the project corridor; obtain ambient noise monitoring data; obtain classified vehicle count and speed data; obtain weather data for ambient noise monitoring sessions; create field data logs and site sketches; photograph noise monitoring locations and other relevant visual data; process ambient noise monitoring data (refer to section 5).
- *Baseline TNM model*: Create a comprehensive but efficient TNM model representation of the existing condition project corridor utilizing receptors, roadways, terrain lines, ground zones, barriers (to represent structures), and tree zones; validate the baseline TNM model at all ambient noise monitoring locations for which traffic noise was dominant (refer to section 6.2); process traffic data into five TNM-designated vehicle classifications; add the project design to the baseline TNM model. Refer to sections 6.1, 6.4, and 6.5 for general descriptions of the TNM model(s), and to section 6.2 for description of the TNM model validation process.
- *Impact assessment*: Input Base Year 2016 existing and Design Year 2040 No-build condition TNM traffic volumes and speeds into the validated baseline TNM model(s); calculate and document TNM-predicted traffic noise levels; evaluate loudest hourly-equivalent noise levels by screening TNM-predicted traffic noise levels against ambient noise monitoring data; assess predicted traffic noise NAC and Substantial Increase impacts (refer to section 7 and Appendix A).
- *Sound barrier analysis*: Identify areas in the vicinity of predicted Design Year 2040 traffic noise impacts for which abatement may be feasible; model traffic noise barriers; calculate TNM-predicted with-barrier traffic noise levels; evaluate with-barrier noise level reductions (NLRs) by screening TNM-predicted with-barrier traffic noise levels against the lowest quantifiable non-traffic hourly-equivalent noise levels; optimize potential sound barriers (refer to section 8, Appendix B, and Appendix C).

3.0 CHARACTERISTICS OF NOISE

Noise is defined as unwanted sound. It is emitted from many sources including airplanes, factories, railroads, commercial businesses, and highway vehicles. Highway or traffic noise is usually a composite of noises from engine exhaust, drive train, and tire-roadway interaction.

The magnitude of sound is usually described by a ratio of its sound pressure to a reference sound pressure, which is usually twenty micro-Pascals (20 μ Pa). Since the range of sound pressure ratios varies greatly – over many orders of magnitude, a base-10 logarithmic scale is used to express sound levels in dimensionless units of decibels (dB). The commonly accepted limits of detectable human hearing sound magnitudes is between the threshold of hearing at 0 decibels and the threshold of pain at 140 decibels.

Sound frequencies are represented in units of Hertz (Hz), which correspond to the number of vibrations per second of a given tone. A cumulative ‘sound level’ is equivalent to ten times the base-10 logarithm of the ratio of the sum of the sound pressures of all frequencies to the reference sound pressure. To simplify the mathematical process of determining sound levels, sound frequencies are grouped into ranges, or ‘bands.’ Sound levels are then calculated by adding the cumulative sound pressure levels within each band – which are typically defined as one ‘octave’ or ‘1/3 octave’ of the sound frequency spectrum.

The commonly accepted limitation of human hearing to detect sound frequencies is between 20 Hz and 20,000 Hz, and human hearing is most sensitive to the frequencies between 1,000 Hz – 6,000 Hz. Although people are generally not as sensitive to lower-frequency sounds as they are to higher frequencies, most people lose the ability to hear high-frequency sounds as they age. To accommodate varying receptor sensitivities, frequency sound levels are commonly adjusted, or ‘filtered’, before being logarithmically added and reported as a single ‘sound level’ magnitude of that filtering scale. The A-weighted decibel filtering scale applies numerical adjustments to sound frequencies to emphasize the frequencies at which human hearing is sensitive, and to minimize the frequencies to which human hearing is not as sensitive (refer to Table 1).

The A-weighted scale is commonly used in highway traffic noise studies because the prevalent frequency spectrum of traffic noise is higher in magnitude at the frequencies at which human hearing is most sensitive (1,000 Hz to 6,000 Hz).

As shown in the several examples of noise levels expressed in dB(A) listed in Table 2, most individuals are exposed to fairly high noise levels from many sources on a regular basis. In order to perceive sounds of greatly varying pressure levels, human hearing has a non-linear sensitivity to sound pressure exposure. For example, doubling the sound pressure results in a three decibel change in the noise level; however, variations of three decibels (3 dB(A)) or less are commonly considered “barely perceptible” to normal human hearing. A five decibel (5 dB(A)) change is more readily noticeable. By definition, a ten-fold increase in the sound pressure level correlates to a 10 decibel (10 dB(A)) noise level increase; however, it is judged by most people as only a doubling of the loudness – sounding “twice as loud”.

Table 1: Comparison: Flat vs. A-Weighted Frequency Scaling			
Octave-Band Center Frequency (Hz)	A-Weighted Adjustment ¹	Sample Frequency Sound Levels (Flat)	Sample Frequency Sound Levels (A-Weighted)
31	-39.53	90.00	50.47
63	-26.22	80.00	53.78
125	-16.19	70.00	53.81
250	-8.68	65.00	56.32
500	-3.25	60.00	56.75
1000	0.00	60.00	60.00
2000	+1.20	60.00	61.20
4000	+0.96	55.00	55.96
8000	-1.14	50.00	48.86
16000	-6.7	45.00	38.30
Overall Sound Levels:		90.48 dB ²	66.32 dB(A) ²
<p>1. Based on the ISO 226:2003 standard for normal equal-loudness contours, the A-weighted decibel network filtering scale is defined for a frequency, f, by the equation: $20 \times \log_{10} (A(f) / A(1000))$, where $A(f) = [12,200^2 \times f^4] / [(f^2 + 20.6^2) \times (f^2 + 12,200^2) \times (f^2 + 107.7^2)^{0.5} \times (f^2 + 737.9^2)^{0.5}]$.</p> <p>2. Although the energy in the flat sound source would create an <i>actual</i> sound level = 90.48 dB, it would be <i>perceived</i> as a sound level of 66.32 dB(A) by human hearing due to the decreased sensitivity of human hearing to lower sound frequencies.</p>			

The degree of disturbance or annoyance from exposure to unwanted sound – noise – depends upon three factors:

1. The amount, nature, and duration of the intruding noise
2. The relationship between the intruding noise and the existing (ambient) sound environment; and
3. The situation in which the disturbing noise is heard

In considering the first of these factors, it is important to note that individuals have varying sensitivity to noise. Loud noises bother some people more than other people, and some individuals become increasingly upset if an unwanted noise persists. The time patterns of noise also enter into perception as to whether or not a noise is offensive. For example, noises that occur during nighttime (sleeping) hours are usually considered to be more offensive than the same noises in the daytime.

With regard to the second factor, individuals tend to judge the annoyance of an unwanted noise in terms of its relationship to noise from other sources (background noise). A car horn blowing at night when background noise levels are low would generally be more objectionable than one blowing in the afternoon when background noise levels are normally higher. The response to noise stimulus is analogous to the response to turning on an interior light. During the daytime an illuminated bulb simply adds to the ambient light, but when eyes are conditioned to the dark of night, a suddenly illuminated bulb can be temporarily blinding.

Table 2: Common Indoor and Outdoor Noise Levels		
Common Outdoor Noise Levels	Noise Level (dB(A))	Common Indoor Noise Levels
	110	Rock Band
Jet Flyover at 1,000 feet	100	Inside Subway Train (NY)
Gas Lawn Mower at 3 feet		
Diesel Truck at 50 feet	90	Food Blender at 3 feet
Noisy Urban Daytime	80	Garbage Disposal at 3 feet
Gas Lawn Mower at 100 feet	70	Vacuum Cleaner at 10 feet
Commercial Area		Normal Speech at 3 feet
	60	Large Business Office
Quiet Urban Daytime	50	Dishwasher Next Room
Quiet Urban Nighttime	40	Small Theater, Large Conference Room (Background)
Quiet Suburban Nighttime		Library
	30	Bedroom at Night, Concert Hall (Background)
Quiet Rural Nighttime	20	Broadcast and Recording Studio
	10	
	0	Threshold of Hearing
Adapted from <u>Guide on Evaluation and Attenuation of Traffic Noise</u> , American Association of State Highway and Transportation Officials (AASHTO). 1974 (revised 1993).		

The third factor, situational noise, is related to the interference of noise with activities of individuals. In a 60 dB(A) environment such as is commonly found in a large business office, normal conversation would be possible, while sleep might be difficult. Loud noises may easily interrupt activities that require a quiet setting for greater mental concentration or rest; however, the same loud noises may not interrupt activities requiring less mental focus or tranquility.

Although individuals may come to accept regular or expected intrusive noise, regular exposure to loud noises still constitutes an impact to the ability to use and enjoy exterior and in some cases interior spaces. FHWA regulations and NCDOT Traffic Noise Abatement Policy adhere to impact and mitigation analysis methodologies to identify and provide relief from traffic noise impacts in every feasible and reasonable case.

4.0 NOISE ABATEMENT CRITERIA

A traffic noise impact is a condition experienced by one or more noise-sensitive land use receptors whereby traffic noise poses a potential detriment to the public's health, welfare, and / or livability. Most traffic noises do not cause traffic noise impacts because they do not have a permanent effect on the overall noise environment.

Sporadic noises such as sirens, horns, compression brakes, or loud motorcycles may be very annoying, but typically do not correlate to a consistent detriment to use and enjoyment of a noise-sensitive land use. However, heavy traffic volumes traveling at high speeds can create prolonged traffic noise levels that correlate to a consistent detriment to use and enjoyment of noise-sensitive land use areas.

4.1 Title 23 Code of Federal Regulations, Part 772 (23 CFR 772)

The Federal Highway Administration (FHWA) has developed Noise Abatement Criteria (NAC) and procedures to be used in the planning and design of highways. The purpose of 23 CFR, Part 772 is:

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

The abatement criteria and procedures are set forth in Title 23 CFR Part 772, which also states:

“...in determining traffic noise impacts, a highway agency shall give primary consideration to exterior areas where frequent human use occurs.”

A summary of the NAC for various land uses is presented in Table 3: Noise Abatement Criteria. The L_{eq} , or equivalent sound level, is the equivalent steady-state sound level which in a stated period of time contains the same acoustic energy as a time-varying sound level during the same period. With regard to traffic noise, fluctuating sound levels of traffic noise are represented in terms of L_{eq} , the steady, or ‘equivalent’, noise level with the same energy. Per 23 CFR 772, NCDOT Policy, and the Manual, all predicted noise levels, increases in predicted noise levels, noise level impacts, and noise level reduction from abatement measures are cited in this report in terms of loudest hourly equivalent noise levels, $L_{eq(h)}$.

4.2 North Carolina Department of Transportation Traffic Noise Abatement Policy

The North Carolina Department of Transportation Traffic Noise Abatement Policy effective July 13, 2011 establishes official policy on highway noise. The Policy describes the NCDOT process that is used in determining traffic noise impacts and abatement measures and the equitable and cost-effective expenditure of public funds for traffic noise abatement. Where the

FHWA has given highway agencies flexibility in implementing the 23 CFR 772 standards, this policy describes the NCDOT approach to implementation (refer to Appendix I).

Table 3: Noise Abatement Criteria			
Hourly Equivalent A-Weighted Sound Level (decibels (dB(A)))			
Activity Category	Activity Criteria¹ $L_{eq(h)}$²	Evaluation Location	Activity Description
A	57	Exterior	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B ³	67	Exterior	Residential
C ³	67	Exterior	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, daycare centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings
D	52	Interior	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios
E ³	72	Exterior	Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in A-D or F
F	--	--	Agriculture, airports, bus yards, emergency services, industrial, logging maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing
G	--	--	Undeveloped lands that are not permitted

¹ The $L_{eq(h)}$ Activity Criteria values are for impact determination only, and are not design standards for noise abatement measures.

² The equivalent steady-state sound level which in a stated period of time contains the same acoustic energy as the time-varying sound level during the same time period, with $L_{eq(h)}$ being the hourly value of L_{eq} .

³ Includes undeveloped lands permitted for this activity category.

4.3 Noise Abatement Criteria Impacts

A Noise Abatement Criteria (NAC) impact occurs when the build-condition loudest hourly equivalent traffic noise level “approaches” or exceeds the NAC noise levels defined by NCDOT Policy for the noise-sensitive land uses listed in Table 3. The ‘approach’ level is identified by NCDOT to be at least one decibel (1 dB(A)) less than the Noise Abatement Criteria for Activity Categories A to E listed in Table 3.

4.4 Substantial Increase Impacts

A substantial increase traffic noise impact occurs when the predicted design year build-condition loudest hourly equivalent traffic noise level is between 10 and 15 dB(A) or more than the loudest hourly equivalent existing (base year) noise level, as shown in Table 4.

Table 4: NCDOT “Substantial Increase” Noise Impact Criteria	
Hourly Equivalent A-Weighted Sound Level (decibels (dB(A)))	
Existing Noise Level ¹ ($L_{eq(h)}$)	Predicted Design Year Noise Level Increase ² ($L_{eq(h)}$)
50 or less	15 or more
51	14 or more
52	13 or more
53	12 or more
54	11 or more
55 or more	10 or more

¹ Loudest hourly equivalent noise level from the combination of natural and mechanical sources and human activity usually present in a particular area.

² Predicted hourly equivalent Design Year traffic noise level minus existing noise level.

5.0 MONITORING / FIELDWORK

5.1 Noise Study Areas and Receptors

NCDOT Policy defines several different types of land uses as being sensitive to noise (refer to Table 3). The term “receptor” is used to describe a discrete or representative location of a noise sensitive area(s), for any of the land uses described in Table 3. A “receptor” is a specific location in the vicinity of a home, school, place of worship, hospital, park, etc., for which high noise levels or substantial increases to existing noise levels would interfere with the desired use, or “livability”. Except for very few instances, receptor locations are exterior locations of frequent human use. The NCDOT Manual further stipulates that receptors should be modeled at the specific location of outdoor activity (e.g., swimming pool, athletic field, etc.), or the corner of the representative structure (e.g., house, place of worship, school) nearest to the primary roadway noise source.

For this DNR, predicted noise levels were assessed at a total of 472 modeled receptor locations. Table 3 defines (and limits) the noise-sensitive land uses (NAC “D”) for which interior noise levels may be evaluated in accordance with NCDOT Policy. Interior noise levels were assessed in accordance with FHWA guidance for the two modeled exterior areas at the one place of worship and the one historic property in the vicinity of the project (refer to Appendix A).

All but eight noise-sensitive receptors in the vicinity of the I-40 widening and bridge replacement project are residential. The eight non-residential noise-sensitive receptors are four soccer fields, two community pools, one place of worship, and one historic property (refer to Figures 2-5, 2-6, 2-7, 2-8, and Appendix A).

In order to reduce Traffic Noise Model (TNM) computer run times (refer to section 3.0), the project noise analysis was divided into separate sections, each referred to as a “Noise Study Area” (NSA), based upon natural boundaries, variations in land uses, and logical project divisions. The noise impact and abatement analysis for the I-40 widening and bridge replacement project (TIP #: I-0911A) is divided into the following nine NSAs:

NSA 1: NSA 1 consists of 48 individually deeded condominium residences on Pinewood Lane, adjacent to I-40 westbound just east of NC 801. All residences in NSA 1 were permitted prior to the June 30, 2014 Date of Public Knowledge.

The 48 residences in NSA 1 are arranged in 12 buildings, each with a cluster of four two-story townhouse-style condominiums. Each residential property includes a ground-level patio; however, does not include any of the common ground outside of the building and patio boundary (refer to Appendix G).

I-40 will be the dominant traffic noise source for the receptors in NSA 1 that are not shielded by building structures. Additionally, the top of the vertical slope up to I-40 shields the first row of NSA 1 receptors from I-40 traffic noise. Noise from natural and mechanical sources and human activity that is typically present throughout the densely-populated NSA 1 residential area will be the dominant source for the residences in NSA 1 that do not have a direct line-of-sight to I-40.

Due to shielding from structures and/or by topography, Design Year 2040 Build-condition I-40 traffic is predicted to impact two residences in NSA 1.

Noise Wall 1 (NW1) will be feasible and reasonable, and is recommended for construction to mitigate the two predicted NSA 1 impacts (refer to section 8.1.1 and Appendix B).

NSA 2: NSA 2 consists of commercial properties adjacent to I-40 eastbound, from east of NC 801 to west of the traffic circle near the eastern terminus of E Kinderton Way. There are no qualifying noise-sensitive receptors in NSA 2. Contours correlating to the distances from the I-40 centerline at which 66 dB(A) and 71 dB(A) traffic noise levels might occur in the vicinity of NSA 2 were predicted to assist with future land use development planning (refer to Table 11).

NSA 3: NSA 3 consists of the BB&T Sports Park athletic (soccer) fields north and south of I-40, west of the Yadkin River. The athletic fields in NSA 3 were permitted prior to the June 30, 2014 Date of Public Knowledge.

Design Year 2040 Build-condition I-40 traffic noise is predicted to impact three soccer fields, represented by three equivalent receptors.

Noise abatement will not be feasible to mitigate the three predicted traffic noise impacts in NSA 3 (refer to Section 8.1.1 and Appendix B).

NSA 4: NSA 4 consists of the WinMock at Kinderton indoor and outdoor event facility adjacent to I-40 eastbound and west of Twins Way. The historic property was permitted prior to the June 30, 2014 Date of Public Knowledge.

WinMock has three structures that accommodate indoor events, and two exterior patio areas that accommodate outdoor events. One receptor located at each of the three building locations closest to I-40 was modeled to represent each of the three indoor event areas. Nine receptors were modeled in a three-by-three array at each of the two patios to ensure thorough evaluation of predicted traffic noise levels for the exterior noise-sensitive areas of frequent human use. I-40 will be the dominant traffic noise source; however, there are no predicted traffic noise impacts in NSA 4.

NSA 5: NSA 5 is adjacent to I-40 westbound east of the Yadkin River. NSA 5 consists of the single-family detached residences on Abelia Way, Peony Way, and Verbena Way. Receptors were modeled for the 36 residences in NSA 5 that were permitted prior to the June 30, 2014 Date of Public Knowledge. Receptors were not modeled for the residences at 7944 Abelia Way and 3765 Verbena Way that were permitted after June 30, 2014 (refer to Appendix E and Appendix G).

I-40 will be the dominant traffic noise source for the receptors at the southern end of Peony Way. I-40 traffic noise will be audible, but not dominant, for the receptors on Verbena Way, Abelia Way, and at the north end of Peony Way. Design year 2040 Build-condition I-40 traffic is predicted to impact two receptors in NSA 5.

Noise Wall 5 (NW 5) will be feasible and reasonable, and is recommended for construction to mitigate the predicted traffic noise impacts in NSA 5 (refer to Section 8.1.1 and Appendix B).

NSA 6: NSA 6 is adjacent to I-40 eastbound from east of the Yadkin River to west of SR 1101 (Harper Road). NSA 6 consists of two swimming pools and 265 individually deeded condominium residences on Riverview Knoll Court, Riverside Court, Riverside Drive, River Oaks Court, Old Rosebud Court, Thoroughbred Lane, Whirlaway Court, Westridge Meadow Circle, and Westridge Farm Lane. All residences in NSA 6 were permitted prior to the June 30, 2014 Date of Public Knowledge.

The residences in NSA 6 are arranged in 48 buildings consisting of two-story townhouses, single-level condominium residences in one-story structures, or single-level condominium residences in two-story structures. Each residential property includes either a ground-level patio or second-story balcony; however, does not include any of the common ground outside of the building and patio/balcony boundary (refer to Appendix G).

I-40 will be the dominant traffic noise source for the receptors in NSA 6 that are not shielded by building structures and/or topography. Noise from natural and mechanical sources and human activity that is typically present throughout the densely-populated NSA 6 residential area will be the dominant source for the residences in NSA 6 that do not have a direct line-of-sight to I-40. Design year 2040 Build-condition I-40 traffic is predicted to impact 35 residences in NSA 6.

Noise Wall 6 (NW6) will be feasible and reasonable, and is recommended for construction to mitigate the 35 predicted NSA 6 impacts (refer to section 8.1.1 and Appendix B).

NSA 7: NSA 7 is adjacent to I-40 westbound from east of Verbena Way to west of SR 1101 (Harper Road). NSA 7 consists of 15 single-family detached residences on Whitehorse Drive, Fair Oaks Drive, Lake Cliff Drive, and Gardenspring Drive. All residences in NSA 7 were permitted prior to the June 30, 2014 Date of Public Knowledge.

I-40 will be the dominant traffic noise source for the receptors in NSA 7 near the highway. Design year 2040 Build-condition I-40 traffic is predicted to impact one receptor in NSA 7.

Noise Wall 7 (NW7) will be feasible and reasonable, and is recommended for construction to mitigate the one predicted NSA 7 impact (refer to section 8.1.1 and Appendix B).

NSA 8: NSA 8 consists of the Hickory Grove A.M.E. Zion Church adjacent to I-40 westbound east of SR 1101 (Harper Road). This place of worship was permitted prior to the June 30, 2014 Date of Public Knowledge. I-40 will be the dominant traffic noise source; however, there are no predicted noise impacts in NSA 8.

NSA 9: NSA 9 is adjacent to I-40 eastbound from east of SR 1101 (Harper Road) to the eastern project limits. NSA 9 consists of 11 single-family detached residences on Rollingwood Drive. All residences in NSA 9 were permitted prior to the June 30, 2014 Date of Public Knowledge.

NSA 9 also includes an existing traffic sound barrier (noise wall) that was constructed prior to the I-40 widening and bridge replacement project (TIP#: I-0911A). I-40 will be the dominant traffic noise source; however, there are no predicted noise impacts in NSA 9.

5.2 Ambient Noise Levels and Monitoring

NCDOT defines ambient noise as the combination of all noise sources that occur, typically described for a specific environment, location, and/or period of time.

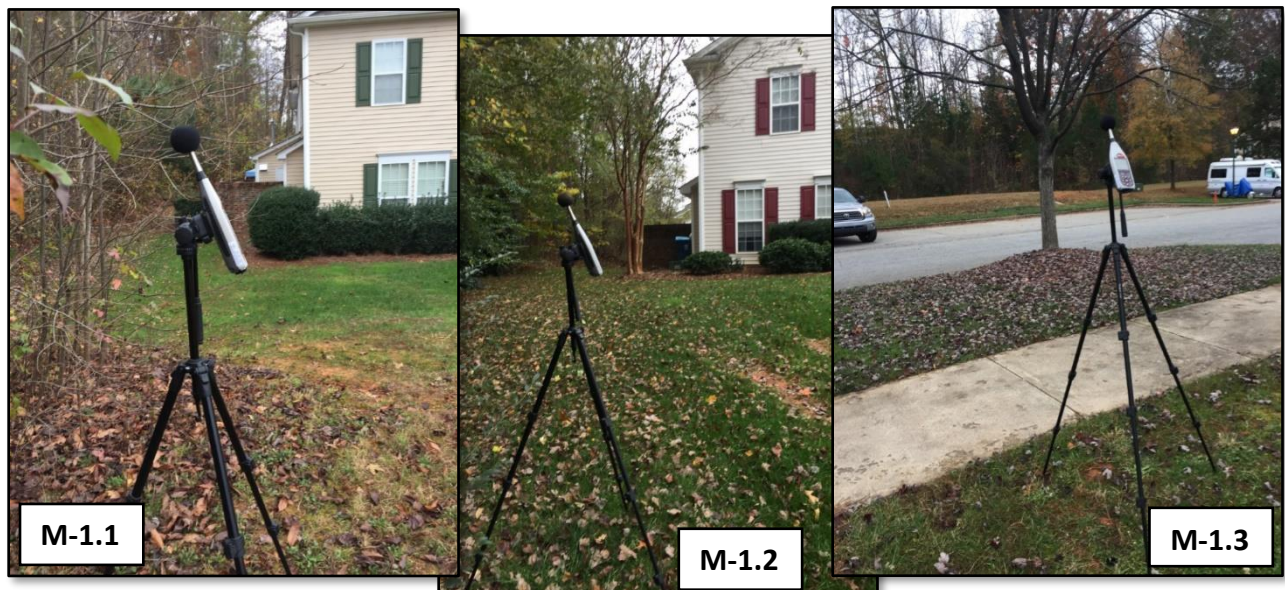
Ambient noise monitoring and field work are necessary to measure existing ambient noise levels, obtain classified vehicle counts for noise monitoring in the vicinity of existing traffic noise sources, document relevant data from study areas (e.g., property addresses), and to serve as the foundation for the creation of a validated TNM model (refer to section 6.2). Existing ambient noise measurements are obtained to quantify the existing acoustic environment and to provide a basis for assessing potential impacts due to predicted traffic noise level increases. Ambient noise levels are not necessarily representative of, and should not be confused with, loudest-hour equivalent noise levels.

Short-term ambient noise level data was acquired on Tuesday, November 14, 2017 using one ANSI S1.4-1983 Type-I SoundPro DL-1 sound level meter and two Type-II SoundPro DL-2 sound level meters, each laboratory calibrated per manufacturer's specification and field calibrated prior to every short-term noise monitoring session. Where applicable, noise level data was acquired in arrays at locations for which traffic noise was dominant for at least one noise meter site to evaluate attenuation with increased distances from the roadway noise source. Loudest-hour existing noise levels were assessed as either the TNM-predicted noise levels based on existing peak-hour traffic estimates, or the ambient noise levels obtained at representative locations in the field.

Setup #1: Pinewood Lane (NSA 1)

Simultaneous short-term noise level data, concurrent classified roadway traffic counts, and vehicle speeds were obtained along Pinewood Lane north of I-40 westbound and east of NC 801 between 8:25 a.m. – 8:45 a.m. on Tuesday, November 14, 2017. The short-term equivalent sound levels, $L_{eq(20-min)}$, at monitoring locations M-1.1, M-1.2, and M-1.3 were 60, 64, and 60 dB(A), respectively.

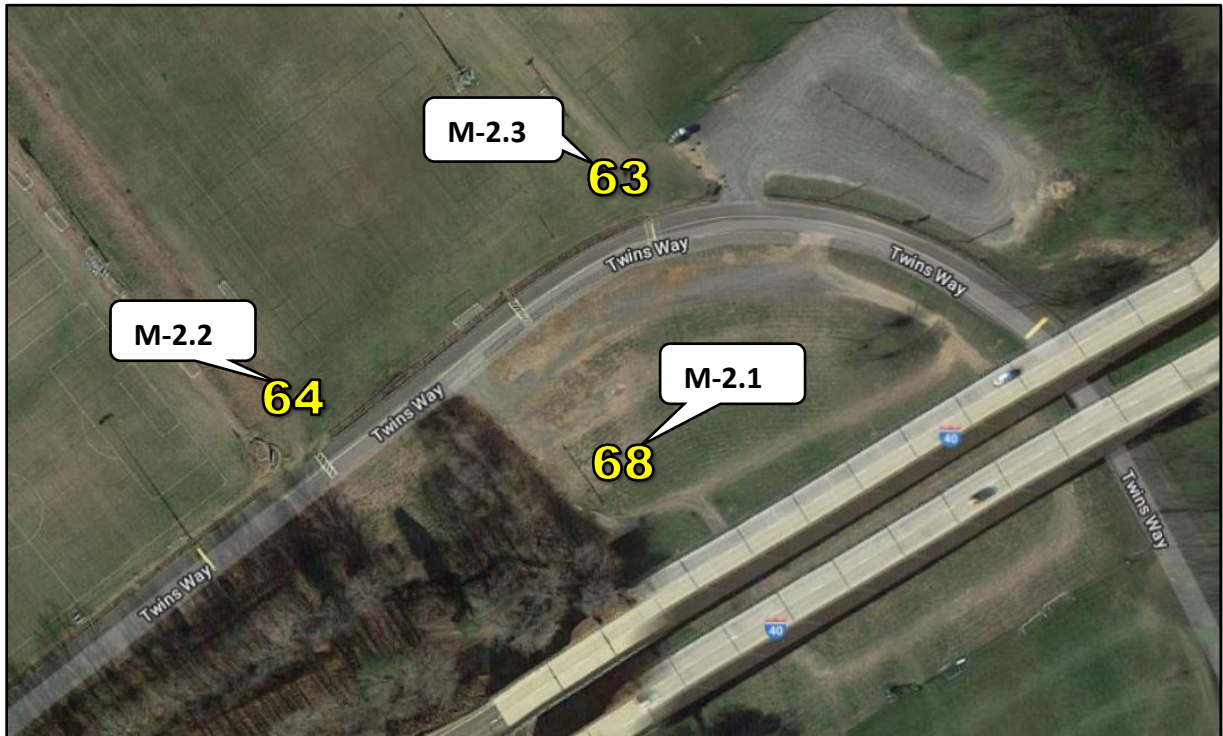
Setup #1 Noise Monitoring Locations and Short-Term Equivalent Noise Levels



Setup #2: Twins Way (NSA 3)

Simultaneous short-term noise level data, concurrent classified roadway traffic counts, and vehicle speeds were obtained near Twins Way north of I-40 westbound and west of the Yadkin River between 9:20 a.m. – 9:40 a.m. on Tuesday, November 14, 2017. The short-term equivalent sound levels, $L_{eq(20-min)}$, at monitoring locations M-2.1, M-2.2, and M-2.3 were 68, 64, and 63 dB(A), respectively.

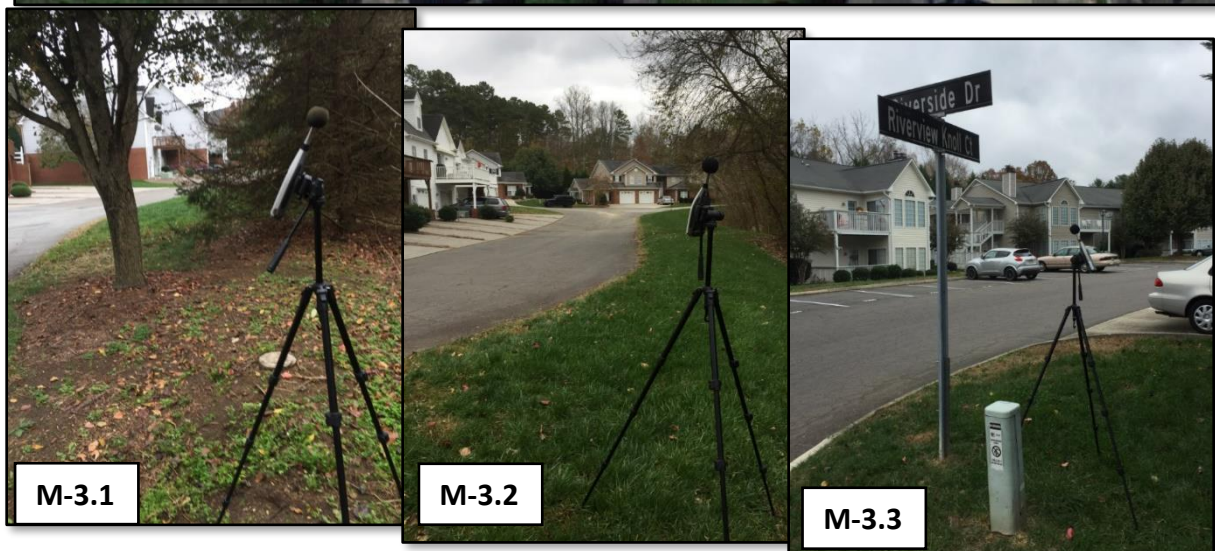
Setup #2 Noise Monitoring Locations and Short-Term Equivalent Noise Levels



Setup #3: Riverside Drive (NSA 6)

Simultaneous short-term noise level data, concurrent classified roadway traffic counts, and vehicle speeds were obtained at Riverside Drive and Riverview Knoll Court, south of I-40 eastbound and east of the Yadkin River between 10:20 a.m. – 10:40 a.m. on Tuesday, November 14, 2017. The short-term equivalent sound levels, $L_{eq(20-min)}$, at monitoring locations M-3.1, M-3.2, and M-3.3 were 67, 63, and 59 dB(A), respectively.

Setup #3 Noise Monitoring Locations and Short-Term Equivalent Noise Levels



Setup #4: River Oaks Court (NSA 6)

Simultaneous short-term noise level data, concurrent classified roadway traffic counts, and vehicle speeds were obtained in the vicinity of Riverview Knoll Court, River Oaks Court, and Thoroughbred Lane south of I-40 eastbound and east of the Yadkin River between 10:50 a.m. – 11:10 a.m. on Tuesday, November 14, 2017. The short-term equivalent sound levels, $L_{eq(20-min)}$, at monitoring locations M-4.1, M-4.2, and M-4.3 were 65, 69, and 58 dB(A), respectively.

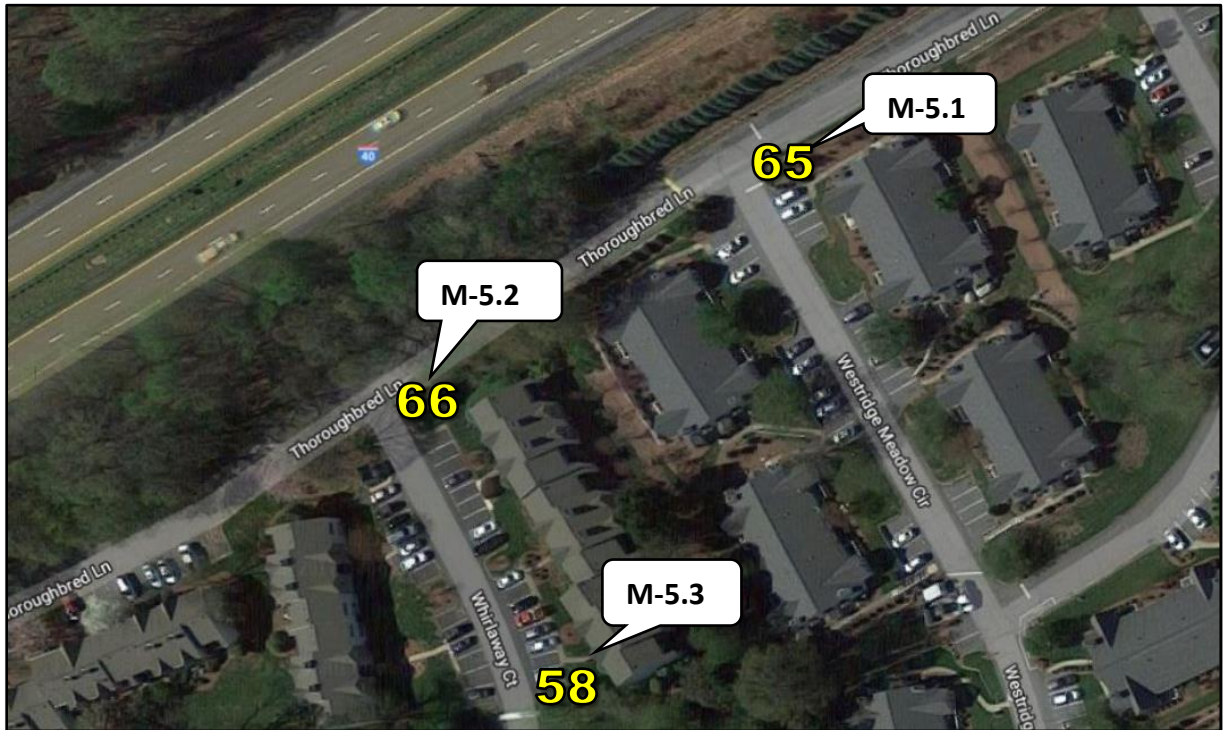
Setup #4 Noise Monitoring Locations and Short-Term Equivalent Noise Levels



Setup #5: Thoroughbred Lane (NSA 6)

Simultaneous short-term noise level data, concurrent classified roadway traffic counts, and vehicle speeds were obtained along Thoroughbred Lane and Whirlaway Court, south of I-40 eastbound and east of the Yadkin River between 11:15 a.m. – 11:35 a.m. on Tuesday, November 14, 2017. The short-term equivalent sound levels, $L_{eq(20-min)}$, at monitoring locations M-5.1, M-5.2, and M-5.3 were 65, 66, and 58 dB(A), respectively.

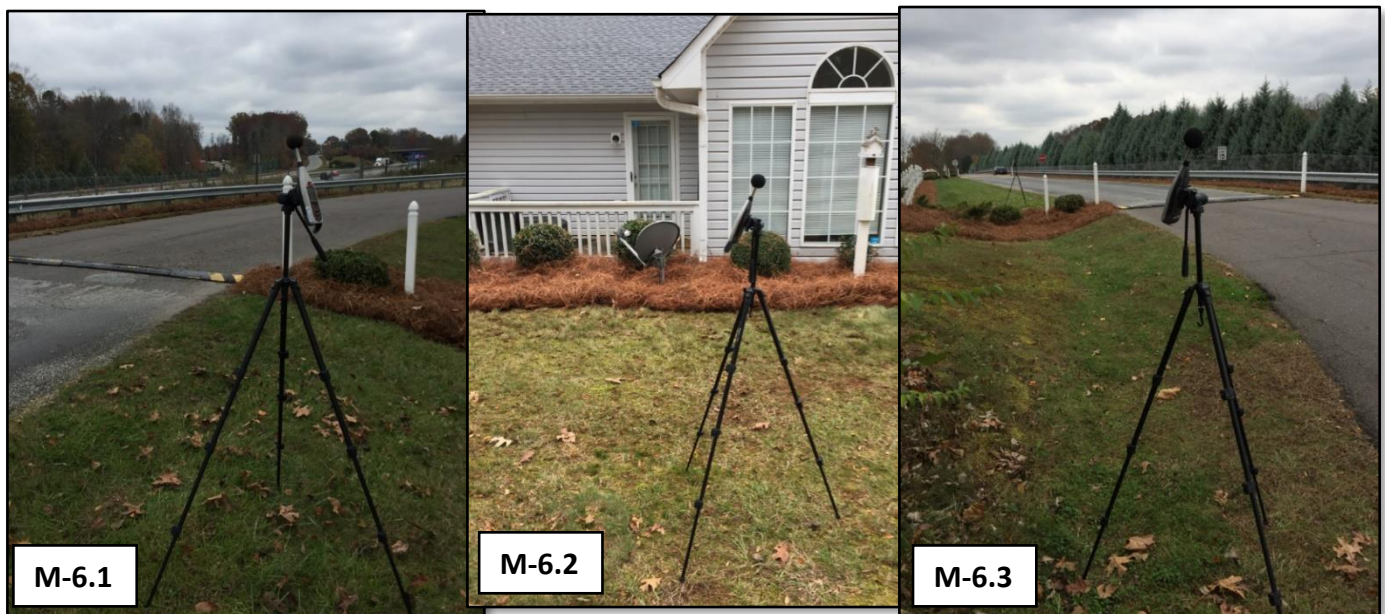
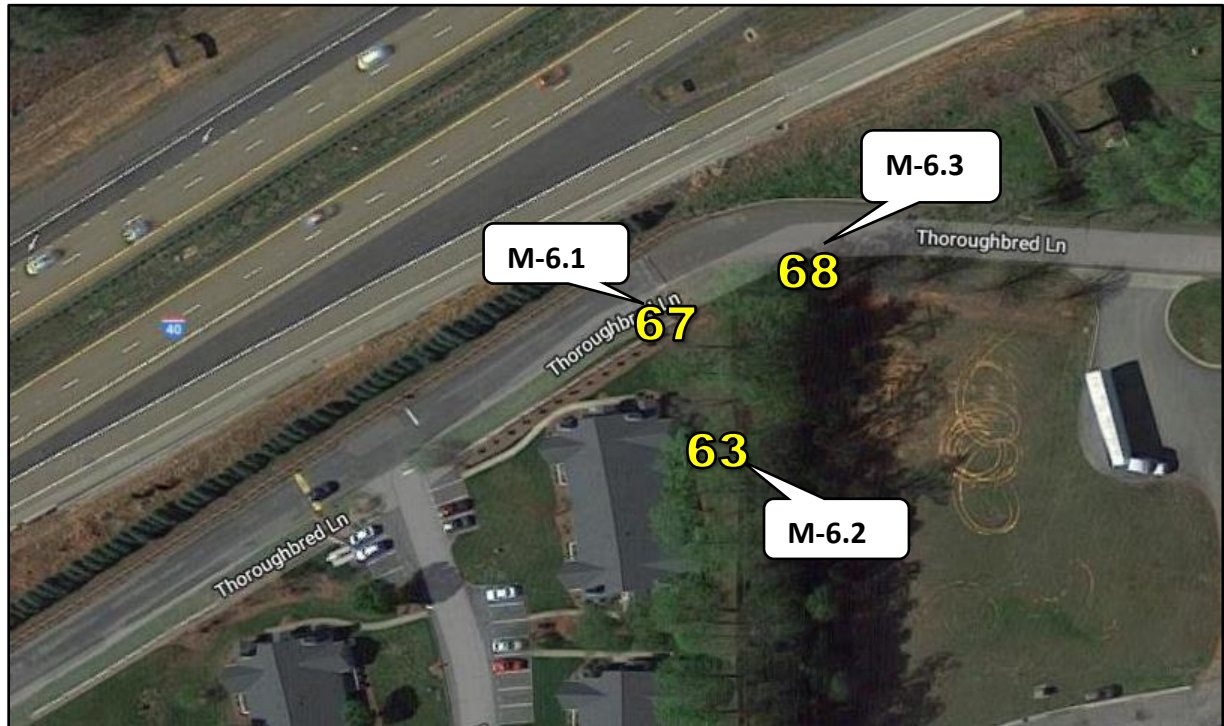
Setup #5 Noise Monitoring Locations and Short-Term Equivalent Noise Levels



Setup #6: Thoroughbred Lane (NSA 6)

Simultaneous short-term noise level data, concurrent classified roadway traffic counts, and vehicle speeds were obtained in the vicinity of Thoroughbred Lane south of I-40 eastbound and west of SR 1101 (Harper Road) between 11:45 a.m. – 12:05 p.m. on Tuesday, November 14, 2017. The short-term equivalent sound levels, $L_{eq(20-min)}$, at monitoring locations M-6.1, M-6.2, and M-6.3 were 67, 63, and 68 dB(A), respectively.

Setup #6 Noise Monitoring Locations and Short-Term Equivalent Noise Levels



Setup #7: Peony Way (NSA 5)

Simultaneous short-term noise level data, concurrent classified roadway traffic counts, and vehicle speeds were obtained along Peony Way north of I-40 westbound and east of the Yadkin River between 1:30 p.m. – 1:50 p.m. on Tuesday, November 14, 2017. The short-term equivalent sound levels, $L_{eq(20-min)}$, at monitoring locations M-7.1, M-7.2, and M-7.3 were 62, 57, and 51 dB(A), respectively.

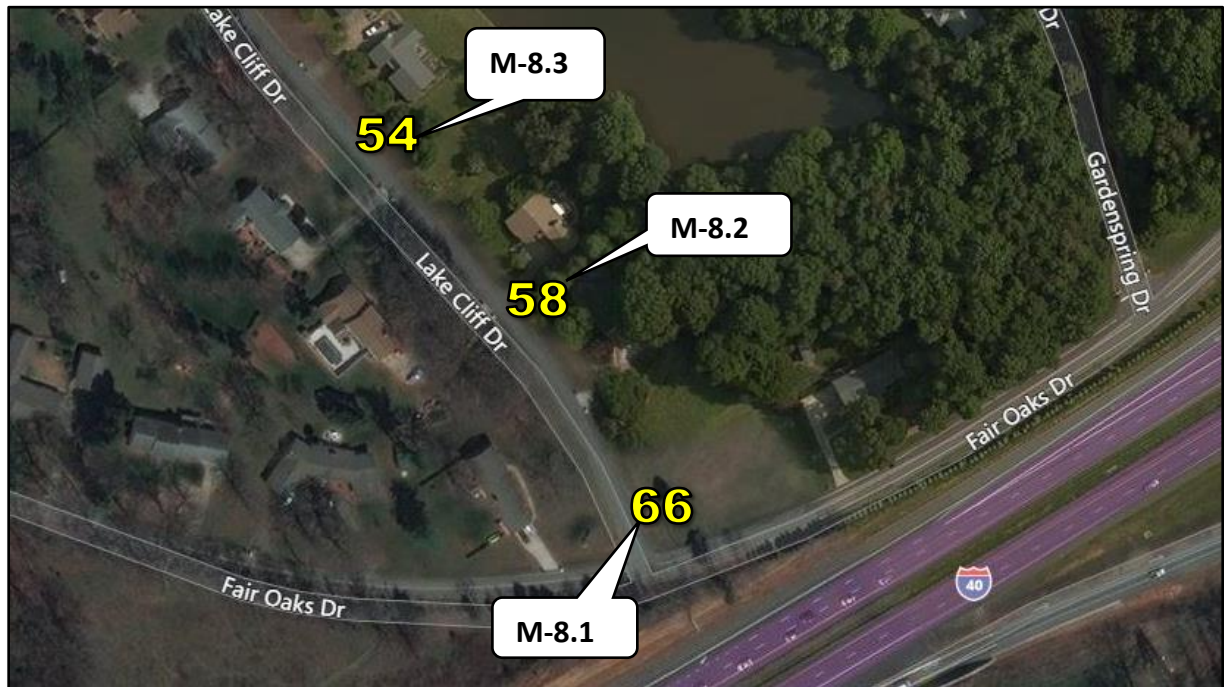
Setup #6 Noise Monitoring Locations and Short-Term Equivalent Noise Levels



Setup #8: Lake Cliff Drive (NSA 7)

Simultaneous short-term noise level data, concurrent classified roadway traffic counts, and vehicle speeds were obtained along Lake Cliff Dr., north of SR 1100 (Fair Oaks Dr.) and I-40 westbound, between 2:05 p.m. – 2:25 p.m. on Tuesday, November 14, 2017. The short-term equivalent sound levels, $L_{eq(20-min)}$, at monitoring locations M-8.1, M-8.2, and M-8.3 were 66, 58, and 54 dB(A), respectively.

Setup #6 Noise Monitoring Locations and Short-Term Equivalent Noise Levels



Setup #9: Gardenspring Drive (NSA 7)

Simultaneous short-term noise level data, concurrent classified roadway traffic counts, and vehicle speeds were obtained along Gardenspring Dr., north of SR 1100 (Fair Oaks Dr.) and I-40 between 2:45 p.m. – 3:05 p.m. on Tuesday, November 14, 2017. The short-term equivalent sound levels, $L_{eq(20-min)}$, at monitoring locations M-9.1, M-9.2, and M-9.3 were 64, 62, and 60 dB(A), respectively.

Setup #6 Noise Monitoring Locations and Short-Term Equivalent Noise Levels

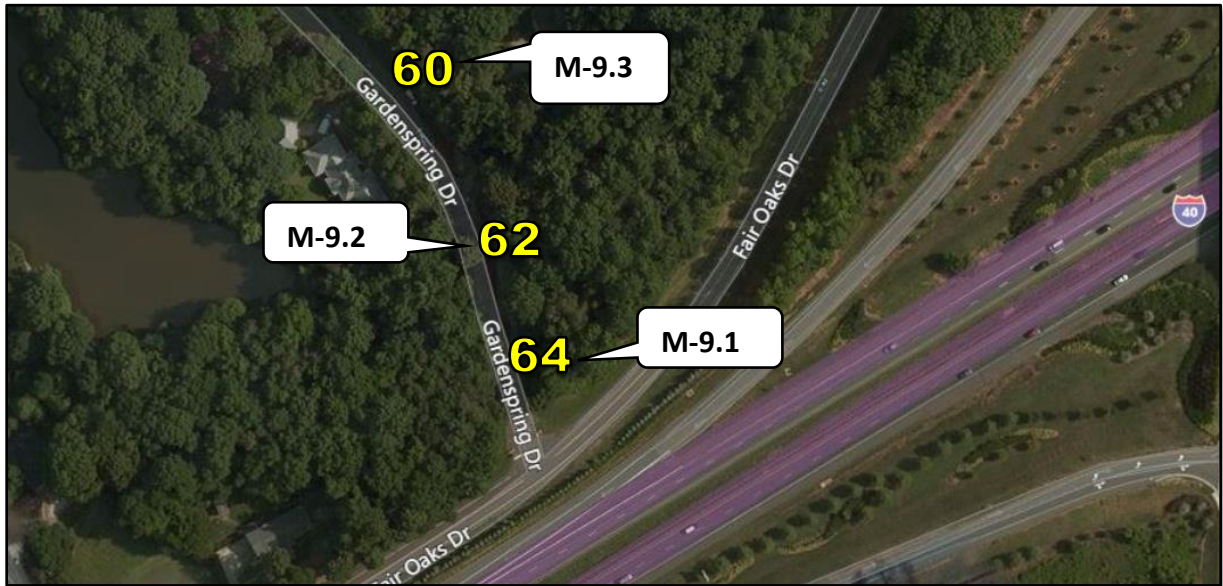
















Table 5: I-40 Widening and Bridge Replacement Project (TIP#: I-0911A) Ambient Hourly-Equivalent Sound Levels, L _{eq(h)} ¹					
Setup	Receptor	Land Use	Roadway Noise Source(s)	Date Start / Stop Time	L _{eq(h)} (dB(A))
1	1.1	Res	I-40	11/14/2017 8:25 a.m. – 8:45 a.m.	60
	1.2	Res			64
	1.3	Res			60
2	2.1	Athletic	I-40	11/14/2017 9:20 a.m. – 9:40 a.m.	68
	2.2	Athletic			64
	2.3	Athletic			63
3	3.1	Res	I-40	11/14/2017 10:20 a.m. – 10:40 a.m.	67
	3.2	Res			63
	3.3	Res			59
4	4.1	Res	I-40	11/14/2017 10:50 a.m. – 11:10 a.m.	65
	4.2	Pool			69
	4.3	Res			58
5	5.1	Res	I-40	11/14/2017 11:15 a.m. – 11:35 a.m.	65
	5.2	Res			66
	5.3	Res			58
6	6.1	Res	I-40	11/14/2017 11:45 a.m. – 12:05 p.m.	67
	6.2	Res			63
	6.3	Res			68
7	7.1	Res	I-40	11/14/2017 1:30 p.m. – 1:50 p.m.	62
	7.2	Res			57
	7.3	Res			51
8	8.1	Res	I-40	11/14/2017 2:05 p.m. – 2:25 p.m.	66
	8.2	Res			58
	8.3	Res			54
9	9.1	Res	I-40	11/14/2017 2:45 p.m. – 3:05 p.m.	64
	9.2	Res			62
	9.3	Res			60
1. In accordance with FHWA guidance and accepted industry standards, hourly equivalent sound levels, L _{eq(h)} , were extrapolated from short-term data collection monitoring sessions, and are expressed in units of A-weighted decibels (dB(A)) rounded to the nearest whole number.					

5.3 Traffic Counts

The significance of the noise monitoring data is not only the actual noise levels, but the ability to quantify and replicate the *relationship* between the noise levels and traffic. Accurate and adequate noise monitoring *and* traffic data is the basis for precise computer modeling of the traffic-to-noise level relationship, predicted noise levels, impacts, and abatement design.

Classified traffic counts and vehicle speeds were obtained concurrently with all noise monitoring data (refer to Table 7). The FHWA standard vehicle classification scheme defines 13 different vehicle types. Because the traffic noise level emissions from several of the 13 different vehicle types are somewhat similar, the TNM model algorithm combines the 13 types of vehicles into 5 classifications: automobiles, medium trucks, heavy trucks, buses, and motorcycles (refer to Table 6).

FHWA Vehicle Classifications Chart

1. Motorcycles 2 axles, 2 or 3 tires	2. Passenger Cars 2 axles, can have 1- or 2-axle trailers	3. Pickups, Panels, Vans 2 axles, 4-tire single units Can have 1 or 2 axle trailers	4. Buses 2 or 3 axles, full length
			
5. Single Unit 2-Axle Trucks 2 axles, 6 tires (dual rear tires), single-unit	6. Single Unit 3-Axle Trucks 3 axles, single unit	7. Single Unit 4 or More-Axle Trucks 4 or more axles, single unit	8. Single Trailer 3- or 4-Axle Trucks 3 or 4 axles, single trailer
			
9. Single Trailer 5-Axle Trucks 5 axles, single trailer	10. Single Trailer 6 or More-Axle Trucks 6 or more axles, single trailer		
			
11. Multi-Trailer 5 or Less-Axle Trucks 5 or less axles, multiple trailers			12. Multi-Trailer 6-Axle Trucks 6 axles, multiple trailers
			
13. Multi-Trailer 7 or More-Axle Trucks 7 or more axles, multiple trailers			
			

Source: TXDOT *Traffic Recorder Instruction Manual*. February 01, 2012

Table 6: Traffic Noise Model (TNM) Vehicle Types		
TNM Vehicle Type	Description	FHWA Vehicle Classification
Autos	All vehicles with two axles and four tires, including passenger cars and light trucks, weighing 10,000 pounds or less ¹	2, 3
Medium Trucks	All vehicles having two axles and six tires, weighing between 10,000 and 26,000 pounds ¹	5
Heavy Trucks	All vehicles having three or more axles, weighing more than 26,000 pounds ¹	6 – 13
Buses	All vehicles designed to carry more than nine passengers	4
Motorcycles	All vehicles with two or three tires and an open-air driver / passenger compartment	1
1. Since the January 1998 publication of the <i>FHWA Traffic Noise Model User's Guide</i> , the FHWA GVWR have been restored from metric to the English weights cited above. As noted in the <i>Guide</i> preface, the English values for the metric weights cited for Automobiles, Medium Trucks, and Heavy Trucks were “generally” <9,900 lb., 9,900 lb. – 26,400 lb., and >26,400 lb., respectively.		

Sources: FHWA Measurement of Highway-Related Noise, § 5.1.3 Vehicle Types.
FHWA Traffic Monitoring Guide, § 4.1 Classification Schemes

Table 7: I-40 Widening and Bridge Replacement Project (I-0911A) Ambient Noise Monitoring Observed Traffic Volumes and Vehicle Mixes									
Monitoring Session	Vehicle Counts (Vehicles Per Hour) ^{1,2}				Classified Truck Percentages			Speeds ³ (mph)	
	Autos	Med. Trucks	Heavy Trucks	Total	% Med. Trucks	% Heavy Trucks	% Total Trucks	EB	WB
Setup 1	2,880	180	210	3,270	5.5%	6.4%	11.9%	63.2	58.6
Setup 2	2,475	147	306	2,928	5.0%	10.5%	15.5%	60.7	59.2
Setup 3	2,577	177	291	3,045	5.8%	9.6%	15.4%	57.8	51.9
Setup 4	2,430	153	363	2,946	5.2%	12.3%	17.5%	54.3	57.0
Setup 5	2,346	189	318	2,853	6.6%	11.1%	17.7%	55.9	55.4
Setup 6	2,433	126	306	2,865	4.4%	10.7%	15.1%	58.1	62.9
Setup 7	2,676	126	261	3,063	4.1%	8.5%	12.6%	51.8	56.7
Setup 8	2,835	153	339	3,327	4.6%	10.2%	14.8%	63.1	58.8
Setup 9	2,829	117	297	3,243	3.6%	9.2%	12.8%	62.9	57.9
1. Extrapolated to 60-minute equivalent traffic volumes from short-term monitoring session data. 2. Total vehicles for both directions of roadway travel lanes. 3. Average of a minimum of 12 vehicle directional speed samples acquired with a Bushnell Velocity model #101911 radar speed detection device.									

5.4 Weather

Weather can be a substantial factor in the propagation of traffic noise for nearby noise-sensitive receptors. Precipitation affects sound propagation by absorbing sound energy, but it can also be a secondary noise source when the precipitate (rain, sleet, snow, etc.) contacts the ground and other surfaces. For distances over approximately 150 feet, the principal effect of weather upon sound propagation is refraction, or the change in the direction of sound waves, caused by changes in temperature over different heights above the ground and/or the direction of wind relative to the noise source and receptor(s).

During normal daytime conditions, air temperatures are warmer closer to the ground than at higher elevations. At night, temperatures are typically cooler near the ground than at higher elevations. This nighttime temperature gradient is called a “temperature inversion”. When ground temperatures are cooler than atmospheric temperatures above¹, noise propagation to near-ground receptors increases (sound travels better).

Wind also refracts sound waves. Downwind, sound waves are refracted downward toward the ground. This means that sound waves that usually radiate in an upward direction are bent back toward the ground, and can be heard by noise-sensitive receptors. Upwind, sound waves are refracted upward away from the ground. This means that sound waves that might otherwise be heard by near-ground noise-sensitive receptors are bent upward toward the atmosphere.

Since wind, temperature inversions, and precipitation can have varying effects upon sound propagation, fair-weather is desirable for ambient noise monitoring.

Table 8: I-40 Widening and Bridge Replacement Project (I-0911A)
Noise Monitoring Sessions Weather Data¹

Setup	Temp. (°F)	Dew Point (°F)	Pressure (in)	Wind Dir.	Wind Speed (mph)	Relative Humidity	Precip. (in)
1	45.0	37.9	30.35	NE	4.6	76%	N/A
2	45.5	39.5	30.36	NE	6.9	80%	N/A
3	46.5	39.9	30.36	NE	6.2	79%	N/A
4	46.9	39.7	30.35	ENE	4.6	77%	N/A
5	47.5	39.3	30.34	ENE	7.5	74%	N/A
6	48.0	39.0	30.33	ENE	8.1	71%	N/A
7	50.0	37.9	30.28	NNE	5.8	63%	N/A
8	48.9	37.0	30.27	ENE	6.9	66%	N/A
9	50.0	37.0	30.26	E	3.5	61%	N/A

1. Source: Weather Underground

¹ “Temperature inversions” are commonly more pronounced on clear or mostly-clear nights during the spring and fall seasons in temperate zones.

6.0 PROCEDURE FOR PREDICTING FUTURE NOISE LEVELS

The FHWA Traffic Noise Model (FHWA TNM v2.5) is the only approved tool for predicting traffic noise levels, for assessing traffic noise impacts, and for determining abatement measure effectiveness. In accordance with industry standards, accepted best-practices, and the NCDOT Manual, detailed computer models were created using the Federal Highway Administration Traffic Noise Model® (FHWA TNM v.2.5), and were used to predict traffic noise levels for receptor locations in the vicinity of the proposed project.

Traffic noise consists of three primary parts: tire-pavement interaction noise, engine noise, and exhaust noise. Of these sources, tire-pavement interaction noise is usually the most offensive at unimpeded travel speeds. Sporadic traffic noises such as horns, squealing brakes, screeching tires, etc. are considered aberrant and are not included within the predictive model algorithm.

Traffic noise emission – how traffic noise is created – is dependent upon several variables, including the number, types, and travel speeds of the vehicles, pavement type(s), tires, as well as the geometry of the roadway(s) on which the vehicles travel.

Traffic noise propagation – how traffic noise spreads from vehicle(s) to noise sensitive receptors – is dependent upon variables such as weather and intervening topography.

Traffic noise is not constant; it varies in time depending upon the number, speed, type, and frequency of vehicles that pass by a given receptor.

The TNM modeling software considers the traffic noise source, the noise propagation path, and the receptor. To predict traffic noise levels, the TNM algorithm assesses the numbers, types, and speeds of vehicles on the planned roadway, the physical characteristics of the road (curves, hills, depressions, elevations, etc.), the physical characteristics between the roadway and the receptor (ground type, terrain, elevation, attenuating structures, vegetation, etc.), and receptor location and height, and, if applicable, barrier type, barrier ground elevation, and barrier segment top elevations.

6.1 Baseline Traffic Noise Model

Within the TNM model, roadway elements, terrain lines, barriers, tree zones, building rows, and ground zones are used to represent the existing and build-condition topography of the project and noise study areas. With the exception of ground zones, each of these elements defines the horizontal (x, y) and vertical (z) coordinates for the model. The discrete point locations at which TNM calculates traffic noise levels are modeled as receptors. The horizontal and vertical coordinates define a point for each modeled receptor; however, TNM does not interpolate ground elevations between receptors as it does between terrain lines, roads, tree zones, barriers, and building rows.

To increase efficiency in TNM calculations (decreasing TNM model “run-times”), traffic noise models are reduced in size to one smaller TNM model per each NSA. A single project-wide existing condition, or “baseline”, TNM model is created to ensure that all modeled elements are identical in each of the smaller NSA models (refer to Appendix E).

6.2 Validation

TNM model validation is the process by which the precision of the modeled relationship between traffic and equivalent noise levels is refined and/or confirmed. If the TNM model is well-constituted, it should generate predicted traffic noise levels that are similar to the ambient noise levels obtained in the field. If the tolerance between TNM-predicted and ambient noise monitored noise levels is not within ± 3.0 dB(A), then the model must be adjusted, as appropriate. A TNM model is considered to be validated if it is a reasonable representation of the existing noise study area and/or project area, *and* the TNM-predicted noise levels are within ± 3.0 dB(A) (preferably ± 1.7 dB(A)) at all monitoring locations for which traffic was the dominant noise source. TNM models validated ambient noise level data to within acceptable tolerance levels for the 21 modeled ambient monitoring locations for which traffic was the dominant noise source (refer to Table 9).

6.3 Traffic

Traffic volumes for the base year existing, design year 2040 no-build, and 2040 build condition TNM models was obtained from the I-40 at NC 801 & SR 1101 traffic forecasts dated January 9, 2017 (refer to Appendix F).

However, numerous empirical evaluations and theoretical assessments have confirmed a widely accepted relationship between the loudest traffic hour and the cap of “Level of Service” (LOS) C traffic volumes. When traffic volumes exceed LOS C, vehicles must slow down, and noise emissions are reduced.

In accordance with section 8.4 of the Manual, the number of automobiles, medium trucks, and heavy trucks for a given roadway segment were calculated as the Average Annual Daily Traffic multiplied by the Design Hour Volume (AADT x DHV). Truck restrictions are not anticipated for any travel lanes throughout the project; therefore, predicted volumes of the three vehicle classifications were distributed evenly across all modeled lanes for each roadway segment.

6.4 Build-Condition TNM Models

The I-40 widening and bridge replacement project build-condition TNM models were created by adding the project design to the existing-condition models. All travel lanes for which traffic volumes were input were modeled as separate TNM roadway elements. As applicable, local roadways and other paved areas without traffic input were modeled as several lanes per TNM roadway element.

6.5 With-Barrier TNM Models

Abatement was considered for all predicted Design Year 2040 Build-condition traffic noise impacts (reference Table 12 and Appendix B).

**Table 9: I-40 Widening and Bridge Replacement Project (I-0911A)
TNM Validation Table**

Receptor	TNM-Predicted $L_{eq(h)}$ dB(A) ¹	Measured $L_{eq(h)}$ dB(A) ¹	Validation Delta (Pred. – Meas.) ¹	TNM Validation Run
1.1	58.5	59.9	-1.4	0 Val1 r0
1.2	65.0	64.2	0.8	
1.3	61.3	59.7	1.6	
2.1	68.4	68.2	0.2	0 Val2 r1
2.2	64.7	63.5	1.2	
2.3	64.5	62.5	2.0	
3.1	68.1	66.5	1.6	0 Val3 r0
3.2	63.4	63.4	0.0	
3.3	55.1	59.1	-4.0 ²	
4.1	67.7	64.8	2.9	0 Val4 r2
4.2	69.9	68.5	1.4	
4.3	52.6	57.5	-4.9 ²	
5.1	65.7	64.8	0.9	0 Val5 r1
5.2	65.5	65.7	-0.2	
5.3	50.0	57.9	-7.9 ²	
6.1	68.7	67.0	1.7	0 Val6 r0
6.2	62.0	63.0	-1.0	
6.3	67.1	67.5	-0.4	
7.1	63.8	62.4	1.4	0 Val7 r1
7.2	57.4	57.0	0.4	
7.3	39.1	51.3	-12.2 ²	
8.1	66.3	66.2	0.1	0 Val8 r0
8.2	56.4	57.7	-1.3	
8.3	49.5	54.3	-4.8 ²	
9.1	65.5	64.0	1.5	0 Val9 r0
9.2	59.1	61.7	-2.6	
9.3	53.8	59.7	-5.9 ²	

1. Hourly equivalent noise levels, $L_{eq(h)}$, are expressed to the nearest one-tenth decibels to ensure that TNM-predicted noise levels validate to within ± 3.0 dB(A) of measured noise levels without the benefits of rounding.
2. TNM predicted traffic noise levels at monitoring receptor locations M-3.3, M-4.3, M-5.3, M-7.3, M-8.3, and M-9.3 was not within the ± 3.0 dB(A) tolerance limits because TNM can only predict traffic noise levels, and at these six monitoring locations traffic noise was not the dominant source. The ambient noise environments at these six monitoring locations were comparable to each other, and indicative of typical non-traffic noise sources usually present in a residential neighborhood. I-40 traffic noise was audible at each of these locations; however, the sum of local community non-traffic-related noise sources such as human activity (not mechanized), air conditioning units, insects, and birds was dominant. Conversely, TNM-predicted traffic noise levels at all modeled receptors representing ambient monitoring locations dominated by traffic noise validated to within the ± 3.0 dB(A) tolerance limits, and to within ± 1.7 dB(A) at M-1.1, M-1.2, M-1.3, M-2.1, M-2.2, M-3.1, M-3.2, M-4.2, M-5.1, M-5.2, M-6.1, M-6.2, M-6.3, M-7.2, M-8.1, M-8.2, and M-9.1.

6.6 Interior Noise Levels (NAC D)

In the absence of discrete interior-exterior field measurements for individual buildings, or calculations from detailed acoustical analyses, interior noise levels for NAC D receptors are computed by subtracting the appropriate building noise reduction factor from the predicted exterior levels (refer to Table 10 and Appendix A).

Table 10: Building Noise Reduction Factors		
Building Type	Window Condition	Noise Reduction Due to Exterior of Structure (dB)
All	Open	-10
Light Frame	Ordinary Sash (closed)	-20
	Storm Windows	-25
Masonry	Single Glazed	-25
	Double Glazed	-35
*The windows shall be considered open unless there is firm knowledge that the windows are in fact kept closed almost every day of the year.		

Source: FHWA-PD-96-046, *Measurement of Highway-Related Noise, Final Report, May 1996.*

7.0 TRAFFIC NOISE IMPACTS AND NOISE CONTOURS

Final roadway design was used to assess Design Year 2040 traffic noise levels. Per FHWA guidance, the predictions documented in this report are based upon the potential project Design Year 2040 Build-condition traffic conditions resulting in the loudest predicted hourly-equivalent traffic noise levels for each receptor. Refer to Appendix A for a comprehensive list of traffic noise level receptors, and existing and predicted Design Year 2040 hourly equivalent traffic noise levels.

7.1 Existing Base Year 2015 Noise Levels

Existing base year noise levels are assessed as the loudest-hour equivalent noise level, which is either the TNM-predicted noise levels based on existing peak noise-hour traffic estimates, or the ambient noise levels obtained at representative locations in the field.²

Existing base year loudest hourly equivalent noise levels were measured or are predicted to approach or exceed the levels at which NAC impacts would occur at 37 noise-sensitive receptors in the vicinity of the proposed project.

7.2 Design Year 2040 No-Build Predicted Noise Levels

Design Year 2040 No-build loudest hourly-equivalent noise levels are predicted to approach or exceed the levels at which NAC impacts would occur at 46 noise-sensitive receptors in the vicinity of the proposed project.

7.3 Design Year 2040 Build Condition Predicted Traffic Noise Impacts

Design Year 2040 predicted loudest hourly-equivalent noise levels were assessed as the TNM-predicted noise levels based on Design Year 2040 Build-condition peak noise-hour traffic estimates, screened as applicable for LOS C. Design Year 2040 Build-condition loudest hourly-equivalent noise levels are predicted to approach or exceed the levels at which NAC impacts occur at 43 noise-sensitive receptors in the vicinity of the proposed project.

The numbers of noise sensitive land use receptors predicted to become impacted by Design Year 2040 build-condition loudest hourly-equivalent traffic noise levels are shown in the table below. The predicted numbers of Design Year 2040 Build-condition traffic noise impacts are limited to loudest hourly equivalent noise levels that approach or exceed the NCDOT Noise Abatement Criteria. There are no impacts predicted due to Substantial Increase in Design Year 2040 Build-condition over Existing loudest-hourly equivalent sound levels.

² Per 23 CFR 772.5, existing noise levels are defined by “the worst noise hour resulting from the combination of natural and mechanical sources and human activity usually present in a particular area.” If the TNM-predicted loudest-hour *traffic* noise levels are lower than the hourly-equivalent noise levels obtained in the field, then the loudest-hour existing noise levels are assessed as the latter.

**Table 11: I-40 Widening and Bridge Replacement Project (I-0911A)
Predicted Traffic Noise Impacts**

Project Condition	Noise Abatement Criteria Impact by Activity Categories ¹					Substantial Increase Impacts ²	Total Impacts ³
	B	C	D ⁴	E	F, G		
Existing	32	5	0	0	0	N/A	37
No-Build	41	5	0	0	0	0	46
Build	39 ⁵	4 ⁶	0	0	0	0	43 ^{5,6}

1. Predicted traffic noise impacts due to loudest hourly equivalent noise levels that approach or exceed Noise Abatement Criteria (refer to Table 3).
2. Predicted traffic noise impacts due to Design Year loudest hourly equivalent noise levels that are a “Substantial Increase” over existing base year levels (refer to Table 4).
3. A receptor is counted only as one impact if predicted loudest hourly equivalent noise levels approach or exceed Noise Abatement Criteria and constitute a Substantial Increase impact.
4. Loudest hourly equivalent Interior noise levels were assessed per FHWA guidance for the one place of worship and one historic property in the vicinity of the project. The building structures were assessed in accordance with the material of construction for each structure, per Table 6 on page 30 of FHWA Traffic Noise: Analysis and Abatement Guidance (FHWA HEP 10-025).
5. Design Year 2040 Build-condition traffic is predicted to impact two fewer residences in NSA 1 than Design Year 2040 No-build condition traffic due to the addition of the solid concrete median barrier to the I-40 typical section.
6. Design Year 2040 Build-condition traffic is predicted to impact one less soccer field at BB&T Sports Park in NSA 3 than Design Year 2040 No-build condition traffic due to the addition of three concrete traffic barriers to the I-40 typical section, and removal of the gap between I-40 westbound and eastbound directions over the Yadkin River bridge.

Per TNM®2.5 and in accordance with 23 CFR Part 772

7.4 Noise Contours

Predicted build-condition traffic noise level contours are not a definitive means by which to assess traffic noise level impacts. Although FHWA regulation prohibits the use of noise level contours for traffic noise impact prediction, noise level contours can aid in future land use planning efforts in presently undeveloped areas (NAC “G”).

A 71 dB(A) hourly-equivalent noise level correlates to the NCDOT impact threshold for a NAC “E” land use. An hourly-equivalent noise level of 66 dB(A) correlates to the NCDOT impact threshold for NAC “B” and “C” land uses. In accordance with Manual §12.9, Table 11 defines the distances from the project centerline at which 71 dB(A) and 66 dB(A) hourly-equivalent traffic noise levels are predicted to occur.

Per 23 CFR 772.9(c) and NCDOT Policy, noise contour lines shall not be used for determining highway traffic noise impacts. However, the 71 dB(A) and 66 dB(A) noise level contour information should assist local authorities in exercising land use control over the remaining undeveloped lands, so as to avoid development of lands for use by incompatible activities adjacent to the roadways within local jurisdiction.

Table 12: I-40 Widening and Bridge Replacement Project (I-0911A)
Predicted Traffic Noise Contour Distances¹

NSA	Project Noise Contour Segment	Dist-66² dB(A) (ft)	Dist-71² dB(A) (ft)
2 ³	I-40 from NC 801 to the Yadkin River	283	220
5 ⁴	I-40 from east of the Yadkin River to SR 1101 (Harper Road)	349	221
<p>1. The contour distances correlating to 66 dB(A) and 71 dB(A) NAC criteria are presented for consideration of land use control in undeveloped areas in which future development of NAC category B, C, and/or E noise-sensitive land use receptors may occur (refer to Table 3).</p> <p>2. In accordance with Manual §12.9, noise contour distances to 66 dB(A) and 71 dB(A) are the distances between the project centerline and modeled receptors for which predicted traffic noise levels were 66.0 dB(A) and 71.0 dB(A), respectively, in Design Year 2040 build-condition TNM models for the indicated NSAs and project segments. The distances should not be assumed to infer exact traffic noise levels for specific location(s) adjacent to the I-40 widening and bridge replacement project. The distances to the 71 dB(A) and 66 dB(A) contours, as well as the distances between the 71 dB(A) and 66 dB(A) contours, vary according to the specific acoustically-relevant features of each NSA.</p> <p>3. NSA 2 represents the only area with undeveloped lands in the indicated project noise contour segment.</p> <p>4. NSA 5 represents the only area with undeveloped lands in the indicated project noise contour segment.</p>			

8.0 ABATEMENT ANALYSIS

FHWA regulation and NCDOT Policy require that feasible and reasonable measures be considered to mitigate noise impacts at the impacted receptors. Noise abatement measures must be considered for all receptors that are predicted to experience a traffic noise impact.

8.1 Acceptable Noise Abatement Measures

Acceptable noise abatement measures considered include noise barriers, traffic management measures (traffic systems management), highway alignment alteration / selection, establishment of buffer zones, and insulation of NAC category D land use facilities. Consideration for noise abatement measures was given to all impacted receptors.

8.1.1 Noise Barriers

Passive noise abatement measures are effective because they absorb, reflect, and/or diffract (redirect) sound energy, and because they extend the source-to-receptor sound propagation path. Sound absorption and reflection are functions of abatement medium (e.g. earth berms absorb more sound energy than comparably tall concrete sound barriers because earth berms are substantially more massive). Sound diffraction is a function of the abatement medium and shape. The source-to-receptor path is extended by placement of an obstacle – such as a concrete wall – that blocks the propagation of sound waves except for those waves that travel from the source, over the obstacle, and to the receptor.

Highway sound barriers are primarily constructed as earth berms or solid-mass walls, between partial, de-facto, or full control of access roadways and noise-sensitive land uses. To be effective, a sound barrier must be long enough and have a sufficient vertical profile to shield the impacted receptor(s). Sound barriers are typically not reasonable for isolated or low-density land-use areas because the area of a noise wall or volume and footprint of an earth berm would not be economical.

With respect to the potential use of earth berms for the I-40 widening and bridge replacement project, adverse impacts that would be created to property access and/or to streams, wetlands, and other natural features will prevent the feasibility of earth berms. Furthermore, earth berms will not be reasonable due to the cost of right-of-way acquisition in comparison to the expense of solid-mass noise walls. Six potentially feasible noise abatement measures were evaluated using TNM models for the abatement of predicted Design Year 2040 build-condition traffic noise impacts. Considerations of abatement for all predicted traffic noise impacts is as follows:

- NSA 1:** Noise Wall 1 (NW1) is recommended for construction to mitigate the two residential traffic noise impacts on Pinewood Lane (refer to Table B.1 and Figures 2-3 and 2-4). NW1 is predicted to benefit 11 receptors, and to provide at least a 7-decibel (7 dB(A)) noise level reduction to both first-row impacted receptors.

Although the only predicted traffic noise impacts are to two first-row residences in the eastern end of NSA 1, NW1 is recommended for construction along the entire adjacency of NSA 1 to meet Manual guidance that sound barriers facilitate similar with-barrier noise levels throughout the noise study area.

At 1,320 feet in length, with a total area of 22,830 square feet, and an area per benefited receptor of 2,075 square feet, NW1 is considered feasible and reasonable.

NSA 3: Noise Walls 3A and 3B (NW3A & NW3B) were evaluated for the potential mitigation of traffic noise impacts to three athletic fields at BB&T Sports Park. The maximum reasonable NW3A & NW3B area based on allowable 2,500 square feet per benefit times a maximum of four benefits = 10,000 square feet. The maximum height of NW3A & NW3B, accounting for 900 linear feet ground-mounted and 2,200 feet extending above the I-40 bridge traffic barrier would be 5.72 feet.

At the height correlating to the maximum reasonable area, NW3A & NW3B would not provide any -5dB(A) Noise Level Reduction benefits; therefore, NW3A and NW3B will not meet NCDOT Policy noise level reduction feasibility and reasonableness criteria (refer to Figures 2-5 and 2-6, and Table B.2).

NSA 5: Noise Wall 5 (NW5) is recommended for construction to mitigate the two residential traffic noise impacts on Peony Way (refer to Table B.3 and Figures 2-3 and 2-4). NW5 is predicted to benefit four receptors, and to provide at least a 7-decibel (7 dB(A)) noise level reduction to both first-row impacted receptors.

NW5 and NW6 will be parallel to each other on opposing sides of I-40. Using the TNM Parallel Barrier Analysis module, the increase in predicted with-barrier noise levels at receptors benefited by NW5 due to reflections from NW6 is predicted to be between +0.2 dB(A) and +0.3 dB(A). The NW5 design includes consideration of reflected traffic noise from NW6 (refer to Table B.3).

At 840 feet in length, with a total area of 11,970 square feet, and an area per benefited receptor of 2,993 square feet, NW5 is considered feasible and reasonable by NCDOT Policy Quantity Averaging provision.

NSA 6: Noise Wall 6 (NW6) is recommended for construction to mitigate the predicted traffic noise impacts to 34 residences and one pool on Riverview Knoll Court, River Oaks Court, Thoroughbred Lane, Whirlaway Court, and Westridge Meadow Circle (refer to Table B.4 and Figures 2-6 and 2-7). NW6 is predicted to benefit 39 receptors, and to provide at least a 7-decibel (7 dB(A)) noise level reduction to all 17 first-row receptors.

NW5 and NW6 will be parallel to each other on opposing sides of I-40. Using the TNM Parallel Barrier Analysis module, the increase in predicted with-barrier noise levels at receptors benefited by NW6 due to reflections from NW5 is predicted to be between +2.0 dB(A) and +3.1 dB(A). The NW6 design includes consideration of reflected traffic noise from NW5 (refer to Table B.4).

At 2,985 feet in length, with a total area of 45,540 square feet, and an area per benefited receptor of 1,168 square feet, NW6 is considered feasible and reasonable.

NSA 7: Noise Wall 7 (NW7) is recommended for construction to mitigate the one residential traffic noise impact on Fair Oaks Lane (refer to Table B.5 and Figure 2-7). NW7 is predicted to provide at least a 7-decibel (7 dB(A)) noise level reduction to the one impacted first-row receptor.

At 1,650 feet in length, with a total area of 32,190 square feet, and an area per benefited receptor of 4,024 square feet, NW7 is considered feasible and reasonable by NCDOT Policy Quantity Averaging provision.

Table 13: I-40 Widening and Bridge Replacement Project (I-0911A)
Noise Barrier Analysis Summary

Noise Wall	Noise Analysis Summary			Abatement Analysis Summary				
	Impacts	Benefits		Length (ft)	Area (ft ²)	Area / Benefit (ft ²)	Allowed Area / Benefit (ft ²)	Feasible & Reasonable
		<7 dB(A)	≥7 dB(A)					
NW1	2	8	3	1,320	22,830	2,075	2,500	YES
NW3A	2	0	0	1,800 ¹	6,432 ¹	N/A	2,500	NO
NW3B	1	0	0	1,300 ¹	3,568 ¹	N/A	2,500	NO
NW5	2	2	2	840	11,970	2,993 ²	2,570	YES ²
NW6	35	12	27	2,985	45,540	1,168	2,500	YES
NW7	1	3	5	1,650	32,190	4,024 ³	2,605	YES ³
Totals	43	25	37	6,795¹	112,530¹			

1. Total length and area are quantified for feasible and reasonable noise abatement measures only.
2. NW5 is recommended for construction in accordance with the Quantity Averaging provision of the 2011 Policy. The 2,993 square feet per NW5 benefit is less than two times the 2,500 square feet per benefit base quantity reasonableness criteria, and collectively the 1,759 square feet area per benefit of NW5 + NW6 + NW7 in the same Common Noise Environment (CNE) does not exceed the 2,500 square feet per benefit base quantity reasonableness criteria.
3. NW7 is recommended for construction in accordance with the Quantity Averaging provision of the 2011 Policy. The 4,024 square feet per NW7 benefit is less than two times the 2,500 square feet per benefit base quantity reasonableness criteria, and collectively the 1,759 square feet area per benefit of NW5 + NW6 + NW7 in the same Common Noise Environment (CNE) does not exceed the 2,500 square feet per benefit base quantity reasonableness criteria.

For the sound barrier analysis modeled in TNM, Design Year 2040 with-barrier traffic noise levels were calculated by adding detailed barrier elements to the build-condition TNM models. Because barriers can only reduce *traffic* noise levels, noise level reductions were assessed as the TNM-predicted insertion loss, screened against measured or otherwise quantified ambient noise sources. The result of the sound barrier analysis is that four noise walls meet NCDOT Policy feasibility and reasonableness criteria and are recommended for construction pending solicitation of the viewpoints of the property owners and residents of all benefited receptors.

8.1.2 Traffic Management Measures

Traffic management measures such as prohibition of truck traffic, lowering speed limits, limiting traffic volumes, and/or limiting time of operation were considered as possible traffic noise impact abatement measures. Prohibition of truck traffic, reduction of the speed limit below the proposed 65 miles per hour, or screening total traffic volumes would diminish the functional capacity of the roadway and are not considered practicable.

8.1.3 Highway Alignment Selection

Highway alignment selection for traffic noise abatement measures involves modifying the horizontal and/or vertical geometry of the proposed facility to minimize traffic noise to noise-sensitive receptors. For noise abatement, horizontal alignment selection is primarily a matter of locating the roadway at a sufficient distance from noise sensitive receptors. Appreciable reductions in traffic noise transmissions to sensitive receptors can be made by adjusting the vertical highway alignment and/or section geometry. For example, lowering a roadway below existing grade creates a cut section which could act similarly as an earth berm, depending upon the relative location(s) of noise-sensitive receptor(s).

Where possible, the I-40 widening and Yadkin River Bridge replacement project (TIP#: I-0911A) highway horizontal alignment and vertical profile were developed in consideration of the effects of traffic noise. Although additional horizontal alignment and vertical profile modification specifically for mitigating noise impacts will not be practicable, the effect of the project final design in comparison to project preliminary design is that the project final design will impact one fewer residence in NSA 1 and two fewer residences in NSA 6.

8.1.4 Establishment of Buffer Zones

Buffer zones are typically not practical and/or cost effective for noise mitigation due to the substantial amount of right-of-way required. Buffer zones would not be a feasible and reasonable noise mitigation measure for this project because there is not sufficient undeveloped right-of-way between the project and noise-sensitive land uses throughout the urban project corridor.

8.1.5 Noise Insulation of Category D Land Use Facilities

Certain indoor areas may be impacted by exterior traffic noise (refer to Table 3). If impacted, an assessment as to whether building noise insulation meets applicable feasibility and reasonableness criteria shall be made. Traffic noise is not predicted to impact the interior spaces of the one place of worship or the one historic property near the proposed project; therefore, consideration of noise insulation as a means of noise abatement was not warranted.

8.2 Statement of Likelihood

NCDOT Policy requires the identification as to whether it is “likely” or “unlikely” that noise abatement measures will be installed for each noise sensitive area identified. “Likely” does not mean a firm commitment. The FHWA has delegated acceptance of findings of this Design Noise Report to the NCDOT. Therefore, this Design Noise Report represents the final decision on the installation of the abatement measures unless there are substantial changes in project design or forecasted traffic volumes. The following noise abatement measures are considered “likely” in the vicinity of the I-40 widening and bridge replacement project (TIP#: I-0911A):

- Noise Wall 1 (NW1): 1,320 feet in length with an area of 22,830 square feet, adjacent to I-40 westbound to mitigate predicted traffic noise impacts to residences on Pinewood Lane.
- Noise Wall 5 (NW5): 840 feet in length with an area of 11,970 square feet, adjacent to I-40 westbound to mitigate the predicted traffic noise impacts to residences on Peony Way.
- Noise Wall 6 (NW6): 2,985 feet in length with an area of 45,540 square feet, adjacent to I-40 eastbound to mitigate the predicted traffic noise impacts to residences on Riverview Knoll Court, River Oaks Court, Thoroughbred Lane, Whirlaway Court, and Westridge Meadow Circle.
- Noise Wall 7 (NW7): 1,650 feet in length with an area of 32,190 square feet, adjacent to I-40 westbound to mitigate the predicted traffic noise impact to the residence on Fair Oaks Drive.

9.0 CONSTRUCTION NOISE

The predominant construction activities associated with this project are expected to be earth removal, hauling, grading, and paving. Relatively loud construction noise activities such as usage of pile-drivers and impact-hammers (jack hammer, hoe-ram) may create sporadic, temporary, and substantial construction noise impacts to nearby noise-sensitive receptors. In the vicinity of numerous noise-sensitive receptors within the project corridor, temporary and localized construction noise impacts may occur as a result of these activities (refer to Table 13). During daytime hours, the predicted effects of these impacts will be temporary speech interference for passers-by and those individuals living or working near the project. During evening and nighttime hours, steady-state construction noise emissions such as from paving operations will be audible, and may cause impacts to activities such as sleep. Sporadic evening and nighttime construction equipment noise emissions such as from backup alarms, lift gate closures (“slamming” of dump truck gates), etc., will be perceived as distinctly louder than the steady-state acoustic environment, and will likely cause substantial impacts to the general peace and usage of noise-sensitive areas.

Consistent with NCOT Policy, construction noise impacts were assessed in a general capacity with respect to likely project construction activities. Low-cost and easy-to-implement construction noise control measures should be incorporated into the project plans and specifications (e.g. work-hour limits, equipment exhaust muffler requirements, haul-road locations, elimination of “tail gate banging”, ambient-sensitive backup alarms, construction noise complaint mechanisms, and consistent and transparent community communication / rapport).

The demolition of the existing eastbound and westbound I-40 bridge spans, and the construction of the new single I-40 bridge span over the Yadkin River are anticipated to require usage of equipment that may create sporadic, temporary, and substantial construction noise impacts to nearby noise-sensitive receptors. While noise from these construction activities is not anticipated to negatively affect activities at the BB&T Sports Park on Twins Way, they may negatively affect worship at the Church of the Good Shepherd and/or events at the WinMock at Kinderton facility at 168 E Kinderton Way. Coordinating bridge demolition and construction activities around worship services at the Church of the Good Shepherd and the WinMock at Kinderton event schedule is recommended.

Consideration of potential construction noise impacts was assessed for all noise-sensitive land uses in the vicinity of the project. Although construction noise impact mitigation should not place an undue burden upon safety, the financial cost of the project, or the project construction schedule, pursuant to the requirements of 23 CFR 772.19, it is the recommendation of this DNR that:

- The Department utilize the public involvement process to ensure the public is aware of the schedule of project activities that may create construction noise impacts.
- Construction noise impacts associated with pile-driving and impact hammers – if required – should be thoroughly evaluated in conjunction with development of the construction plan.

- Earth removal, grading, hauling, and paving activities near any residences in the vicinity of project construction activities (including construction haul routes) should be limited to weekday daytime hours.
- The Policy requirement to “identify land uses or activities that may be affected by noise from construction of the project” includes land uses in the vicinity of construction haul routes and/or any locations in which project-related construction activities may occur beyond the project corridor. Evaluation of project haul routes and locations in which project-related construction activities are occurring or may occur beyond the project corridor did not identify any potential construction impacts.
- If meeting the project schedule requires that earth removal, grading, hauling or paving must occur during evening, nighttime or weekend hours in the vicinity of any residences, the Contractor shall notify NCDOT as soon as possible. In such instance(s), all reasonable attempts shall be made to notify and to make appropriate arrangements for the mitigation of the predicted construction noise impacts upon the affected property owners and/or residents.
- If construction noise activities must occur during context-sensitive hours near noise-sensitive areas, construction noise abatement measures, including, but not limited to portable noise barriers and/or other equipment-quieting devices shall be considered.

Table 14: Construction Equipment Typical Noise Level Emissions ¹					
Equipment	Noise Level Emissions (dB(A)) at 50 Feet From Equipment ²				
	70	80	90	100	
Pile Driver ³					
Jack Hammer					
Tractor					
Road Grader					
Backhoe					
Truck					
Paver					
Pneumatic Wrench					
Crane					
Concrete Mixer					
Compressor					
Front-End Loader					
Generator					
Saws					
Roller (Compactor)					
<ol style="list-style-type: none"> Adapted from <i>Noise Construction Equipment and Operations, Building Equipment, and Home Appliances</i>. U.S. Environmental Protection Agency. Washington D.C. 1971. Cited noise level ranges are typical for the equipment cited. Noise energy dissipates as a function of distance between the source and the receptor. For example, if the noise level from a pile driver at a distance of 50 feet = 100 decibels (dB(A)), then at 400 feet, it might be 82 decibels (dB(A)) or less. Due to project safety and potential construction noise concerns, pile driving activities are customarily limited to daytime hours. 					

For additional information on construction noise, please refer to the FHWA Construction Noise Handbook (FHWA-HEP-06-015) and the Roadway Construction Noise Model (RCNM), available online at: http://www.fhwa.dot.gov/environment/noise/cnstr_ns.htm.

10.0 CONCLUSION

Traffic noise and temporary construction noise impacts can be a consequence of transportation projects. This DNR utilized computer models created with the FHWA Traffic Noise Model software (TNM 2.5) to predict future noise levels and define impacted receptors.

Design Year 2040 build condition traffic noise is predicted to impact 43 noise-sensitive receptors. Abatement was considered for all predicted Design Year 2040 build condition traffic noise impacts. The following noise abatement measures considered to be “likely” for the proposed I-40 widening and bridge replacement project:

- Noise Wall 1 (NW1): 1,320 feet in length with an area of 22,830 square feet, adjacent to I-40 westbound to mitigate predicted traffic noise impacts to residences on Pinewood Lane.
- Noise Wall 5 (NW5): 840 feet in length with an area of 11,970 square feet, adjacent to I-40 westbound to mitigate the predicted traffic noise impacts to residences on Peony Way.
- Noise Wall 6 (NW6): 2,985 feet in length with an area of 45,540 square feet, adjacent to I-40 eastbound to mitigate the predicted traffic noise impacts to residences on Riverview Knoll Court, River Oaks Court, Thoroughbred Lane, Whirlaway Court, and Westridge Meadow Circle.
- Noise Wall 7 (NW7): 1,650 feet in length with an area of 32,190 square feet, adjacent to I-40 westbound to mitigate the predicted traffic noise impact to the residence on Fair Oaks Drive.

Finally, construction noise impacts may occur due to the proximity of noise-sensitive receptors near anticipated project construction activities. It is the recommendation of this DNR that all reasonable efforts should be made to minimize exposure of noise-sensitive areas to construction noise impacts.

11.0 REFERENCES

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FIGURES

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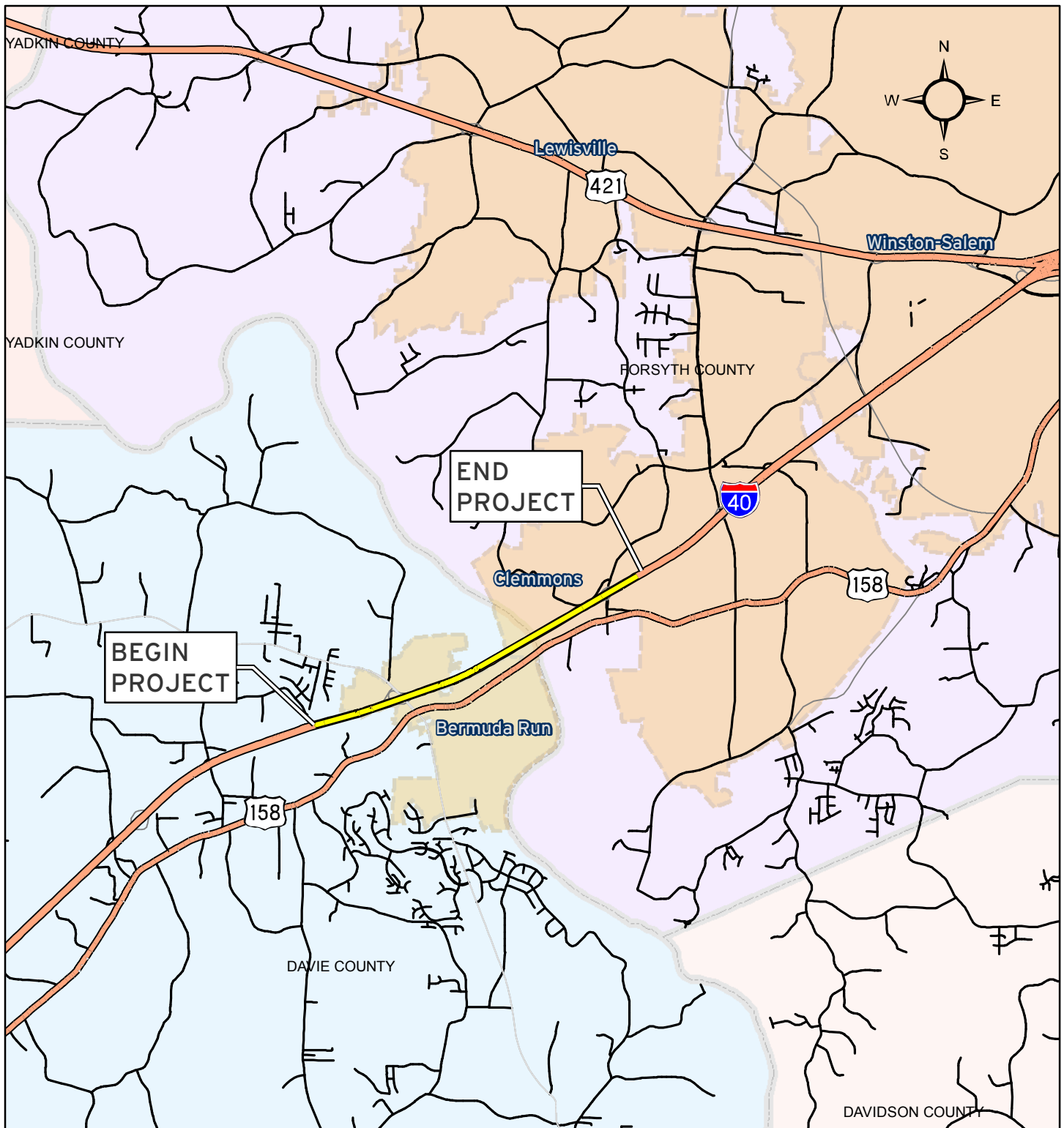


FIGURE 1

TIP #: I-0911A

MAY 2018

Vicinity Map

I-40 Widening from West of NC 801 in Davie County to East of SR 1101 (Harper Road) in Forsyth County, and Yadkin River Bridge Replacement

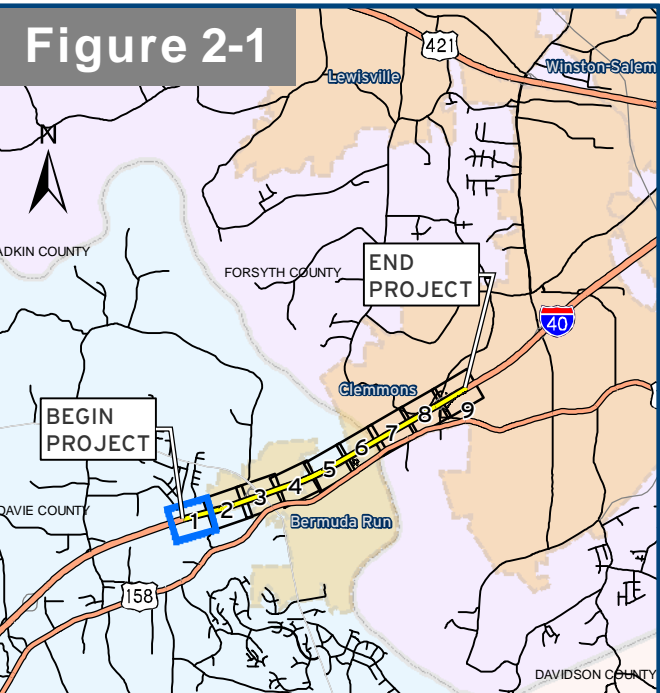
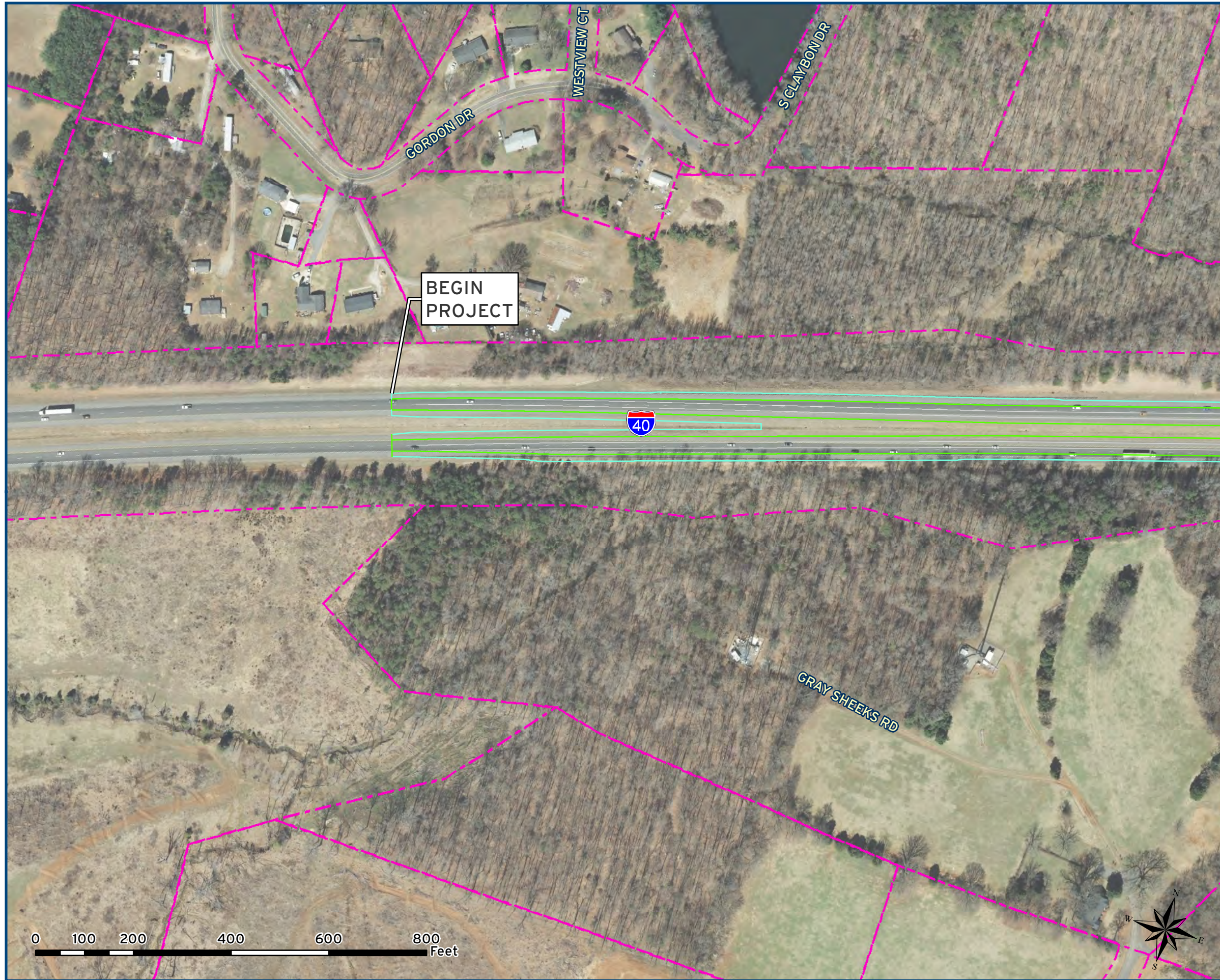


Davie and Forsyth Counties, North Carolina

0 1 2 3 4 Miles



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LEGEND

- Not Impacted or Benefited Receptor (Yellow circle)
- Impacted but not Benefited Receptor (Red circle)
- Not Impacted but Benefited Receptor (Green circle)
- Impacted and Benefited Receptor (Blue circle)
- Monitoring Location (White circle)
- Noise Study Areas (Red outline)


ROADWAY DESIGN

- Proposed EOT (Green line)
- Proposed Paved Shoulder (Cyan line)
- Proposed Lane Lines (Blue line)
- Proposed Roadway Bridge (Red line)

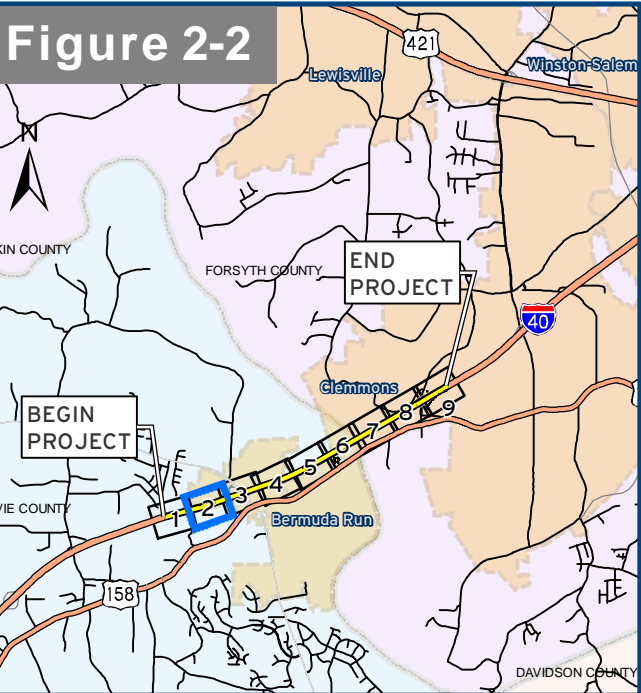
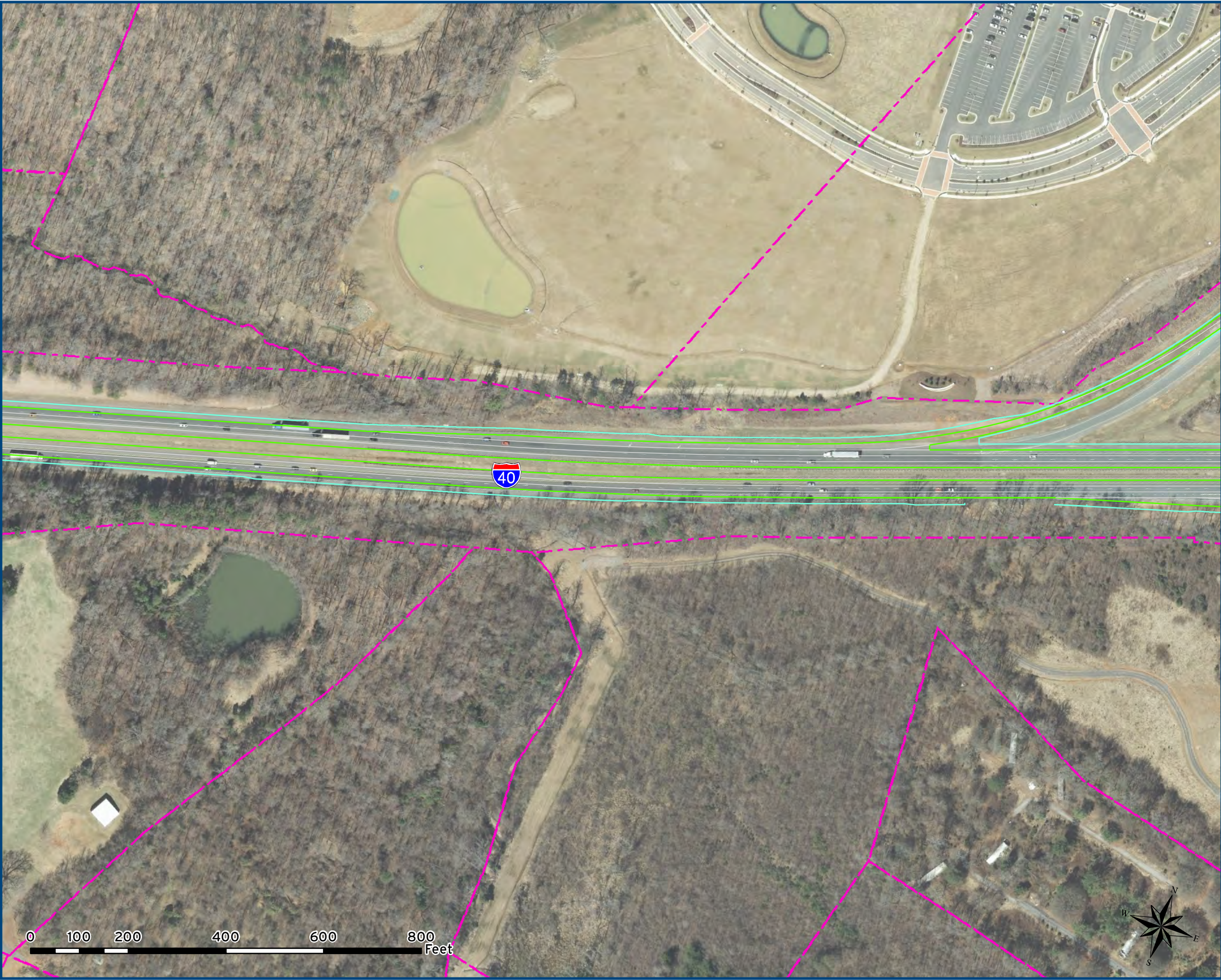
**DESIGN NOISE REPORT
DETAILED STUDY AREA MAPS
TIP #: I-0911A**

I-40 Widening from NC 801
in Davie County to SR 1101 (Harper Rd)
in Forsyth County

Davie and Forsyth Counties, North Carolina



North Carolina Department of Transportation
Environmental Analysis Unit
Traffic Noise & Air Quality Group



LEGEND

- Not Impacted or Benefited Receptor (Yellow circle)
- Impacted but not Benefited Receptor (Red circle)
- Not Impacted but Benefited Receptor (Green circle)
- Impacted and Benefited Receptor (Blue circle)
- Monitoring Location (White circle)
- Noise Study Areas (Pink outline)


ROADWAY DESIGN

- Proposed EOT (Green line)
- Proposed Paved Shoulder (Cyan line)
- Proposed Lane Lines (Blue line)
- Proposed Roadway Bridge (Red line)

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I-40 Widening from NC 801
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in Forsyth County

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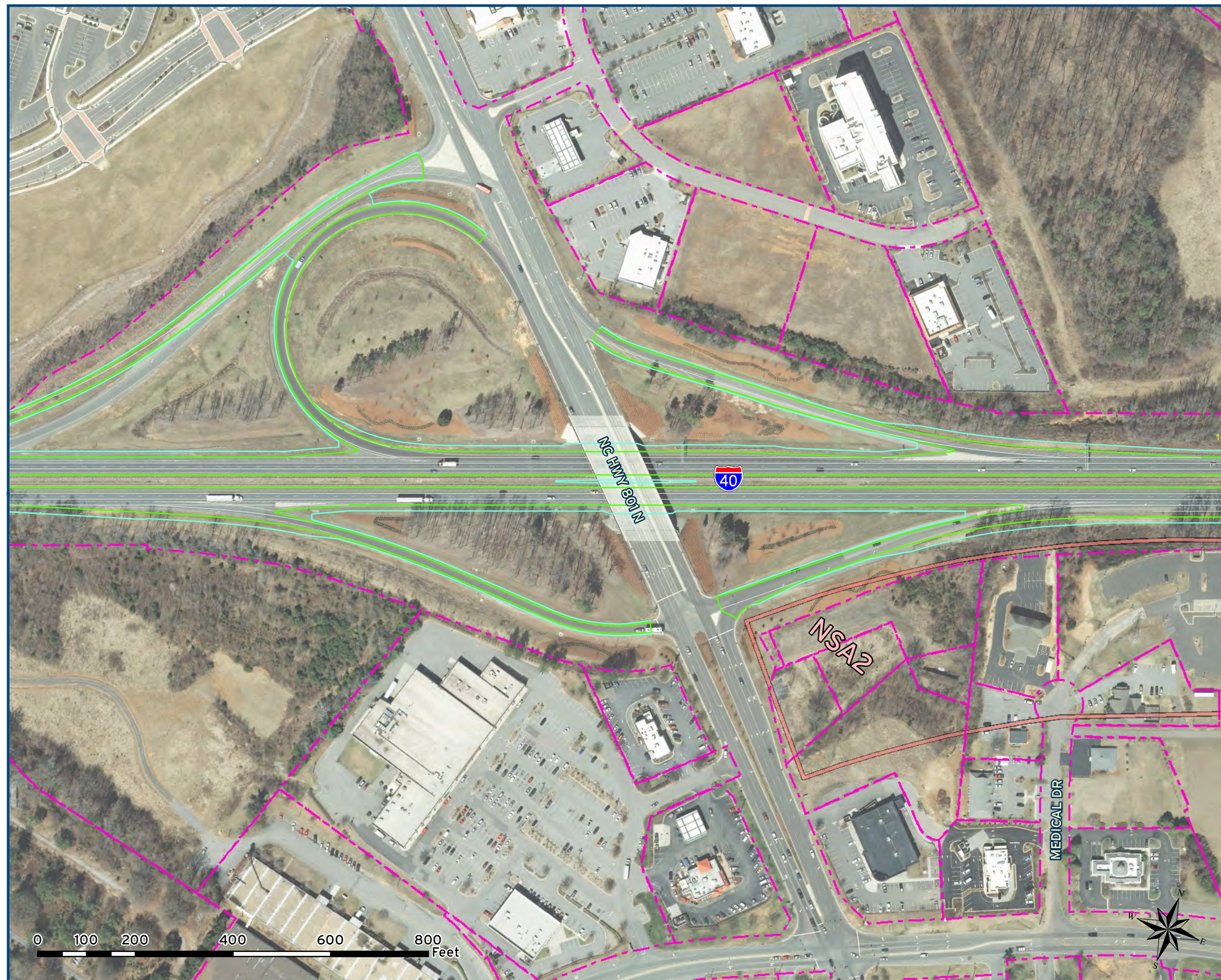
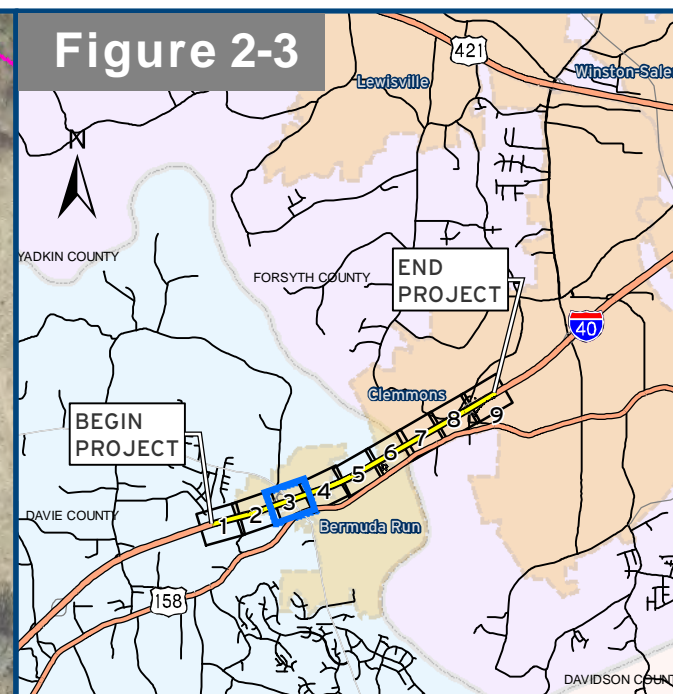


Figure 2-3



LEGEND

- Not Impacted or Benefited Receptor (Yellow dot)
- Impacted but not Benefited Receptor (Red dot)
- Not Impacted but Benefited Receptor (Green dot)
- Impacted and Benefited Receptor (Blue dot)
- Monitoring Location (White dot)
- Noise Study Areas (Red outline)

ROADWAY DESIGN

- Proposed EOT (Green line)
- Proposed Paved Shoulder (Cyan line)
- Proposed Lane Lines (Blue line)
- Proposed Roadway Bridge (Red line)

DESIGN NOISE REPORT
DETAILED STUDY AREA MAPS
TIP #: I-0911A

I-40 Widening from NC 801
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in Forsyth County

Davie and Forsyth Counties, North Carolina



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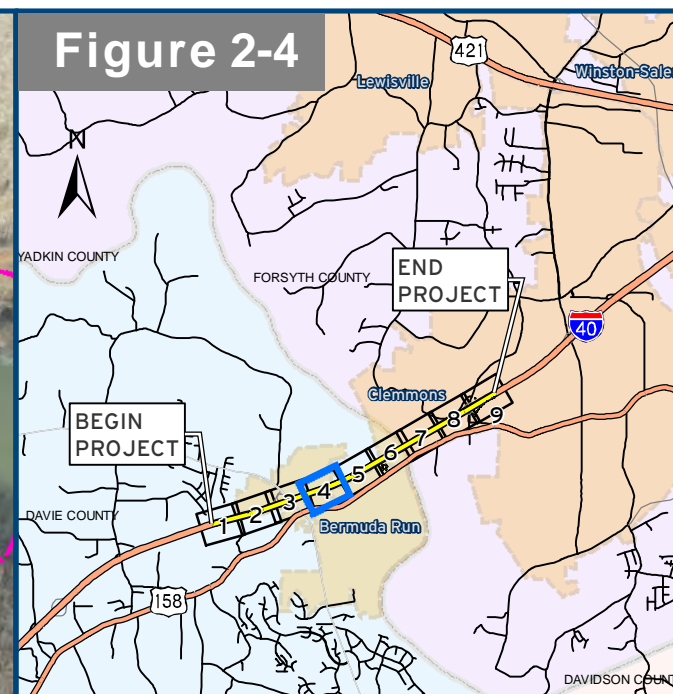
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Traffic Noise & Air Quality Group

May 2018

Prepared by: **RK&K**



Figure 2-4



LEGEND

- Not Impacted or Benefited Receptor ●
- Impacted but not Benefited Receptor ●
- Not Impacted but Benefited Receptor ●
- Impacted and Benefited Receptor ●
- Monitoring Location ○
- Noise Study Areas
- Proposed Noise Wall

ROADWAY DESIGN

- Proposed EOT —
- Proposed Paved Shoulder —
- Proposed Lane Lines —
- Proposed Roadway Bridge —

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I-40 Widening from NC 801
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in Forsyth County

Davie and Forsyth Counties, North Carolina



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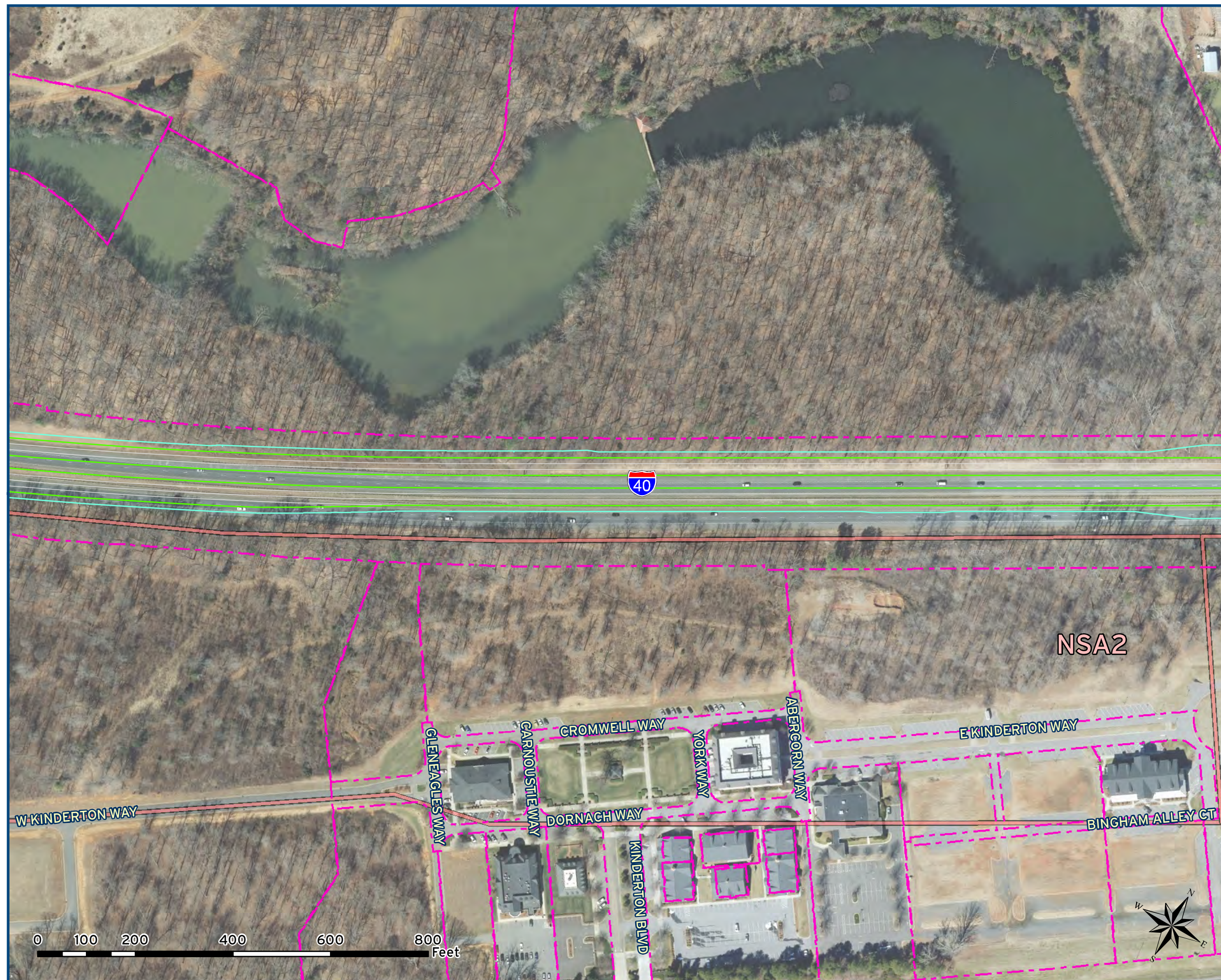
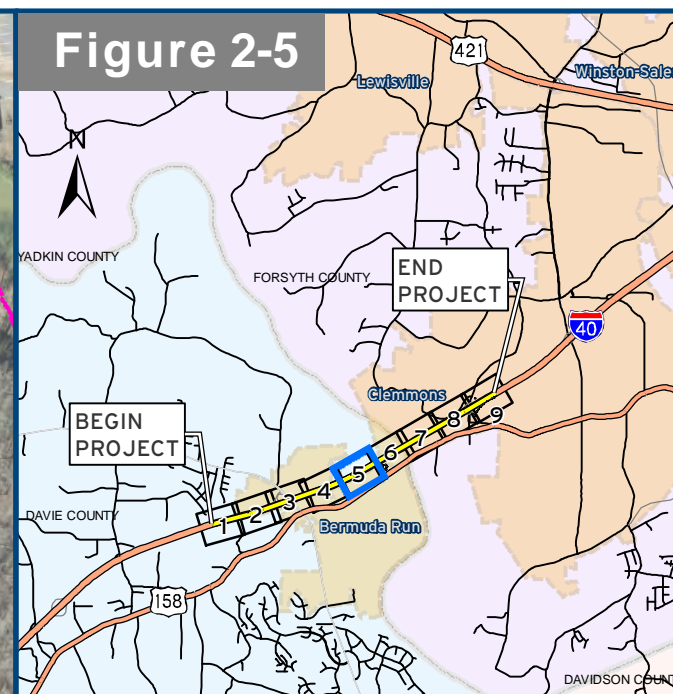


Figure 2-5



LEGEND

- Not Impacted or Benefited Receptor (Yellow dot)
- Impacted but not Benefited Receptor (Red dot)
- Not Impacted but Benefited Receptor (Green dot)
- Impacted and Benefited Receptor (Blue dot)
- Monitoring Location (White circle)
- Noise Study Areas (Red outline)

ROADWAY DESIGN

- Proposed EOT (Green line)
- Proposed Paved Shoulder (Cyan line)
- Proposed Lane Lines (Blue line)
- Proposed Roadway Bridge (Red line)

DESIGN NOISE REPORT
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TIP #: I-0911A

I-40 Widening from NC 801
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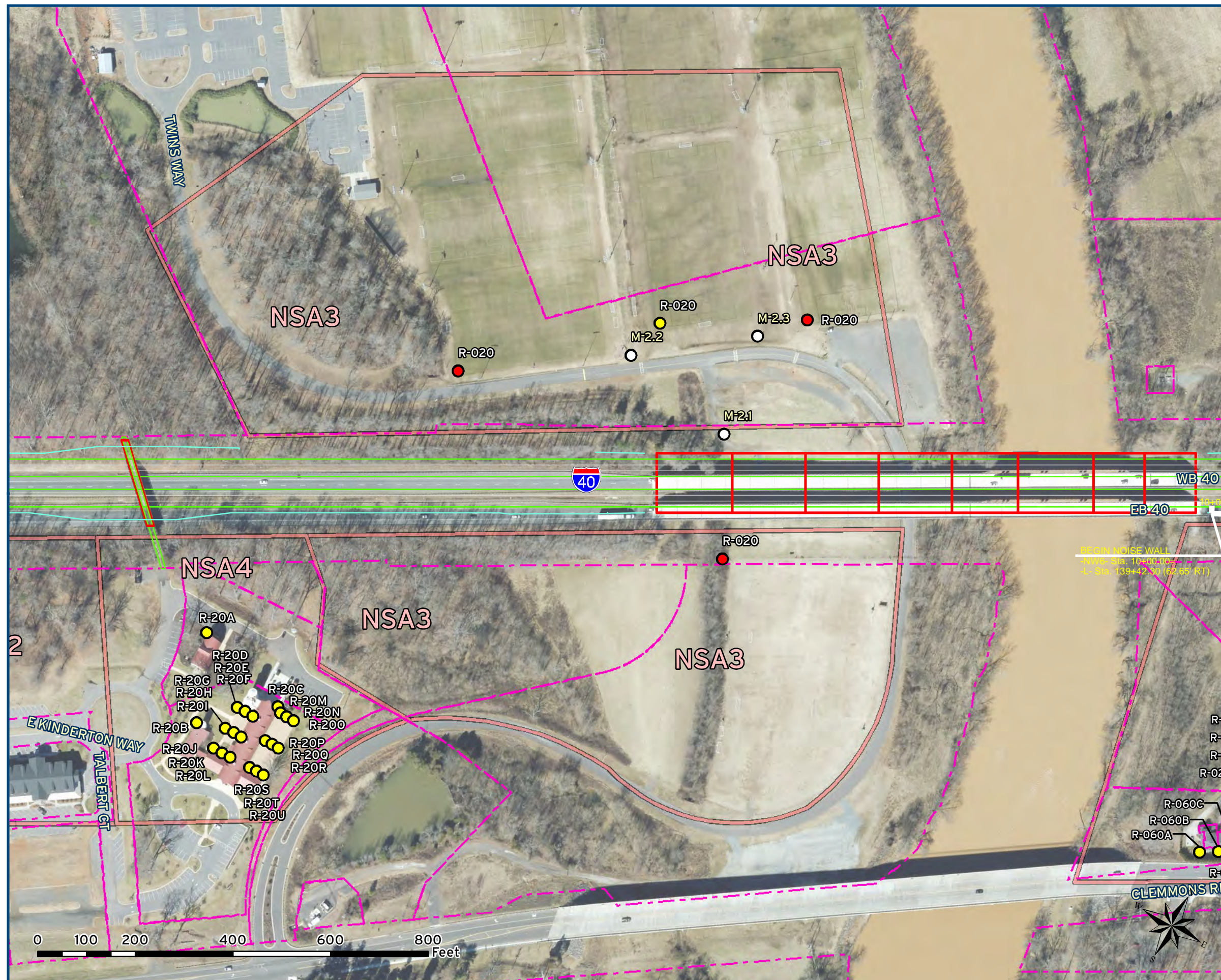
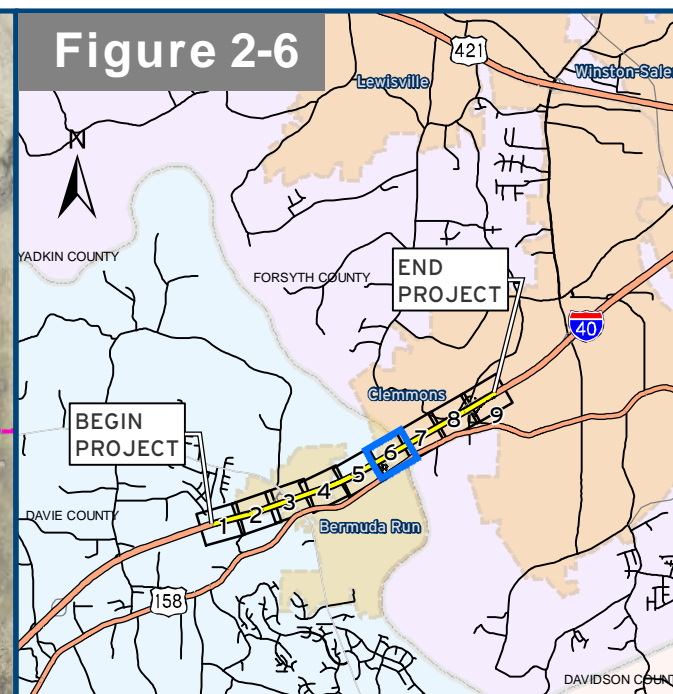


Figure 2-6



LEGEND

- Not Impacted or Benefited Receptor ●
- Impacted but not Benefited Receptor ●
- Not Impacted but Benefited Receptor ●
- Impacted and Benefited Receptor ●
- Monitoring Location ○
- Noise Study Areas
- Proposed Noise Wall

ROADWAY DESIGN

- Proposed EOT
- Proposed Paved Shoulder
- Proposed Lane Lines
- Proposed Roadway Bridge

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I-40 Widening from NC 801
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in Forsyth County

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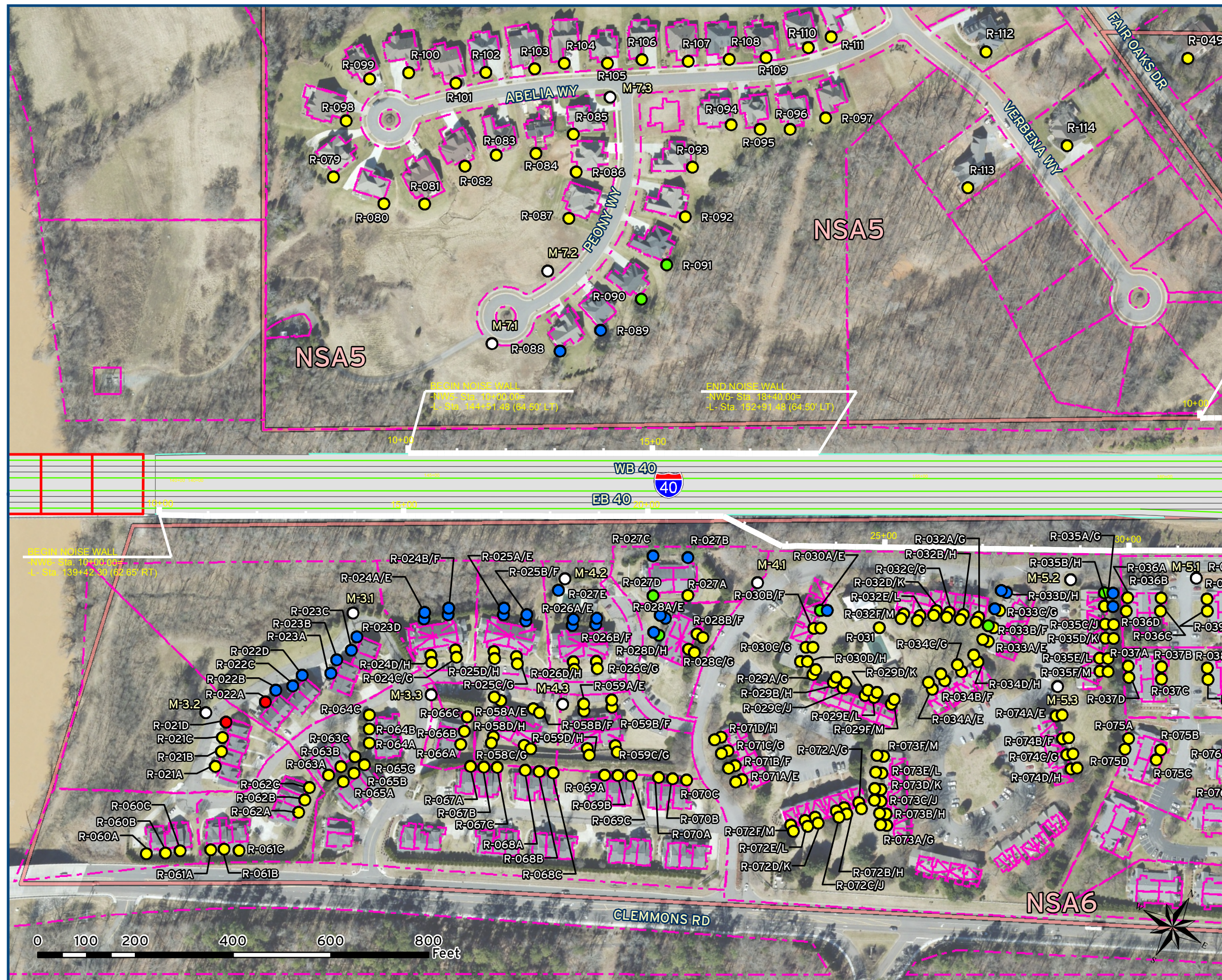
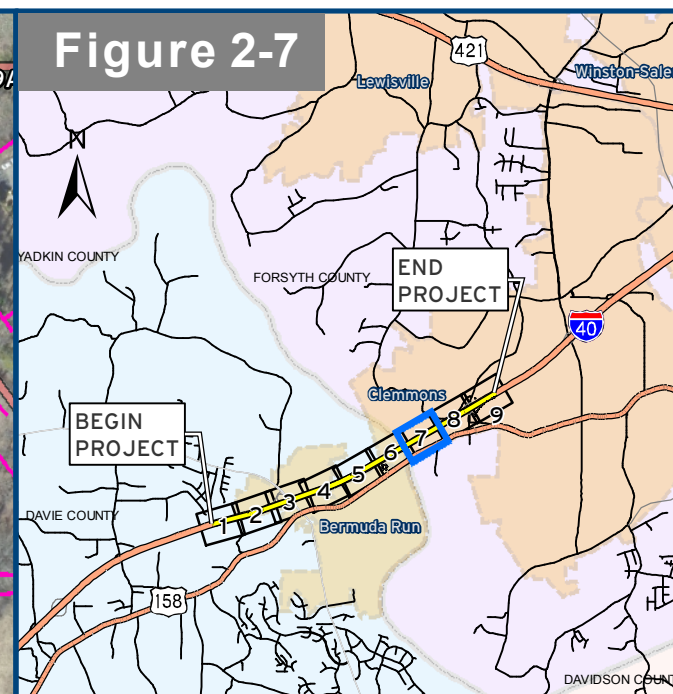


Figure 2-7



LEGEND

- Not Impacted or Benefited Receptor
- Impacted but not Benefited Receptor
- Not Impacted but Benefited Receptor
- Impacted and Benefited Receptor
- Monitoring Location
- Noise Study Areas
- Proposed Noise Wall
- ROADWAY DESIGN**
- Proposed EOT
- Proposed Paved Shoulder
- Proposed Lane Lines
- Proposed Roadway Bridge

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in Forsyth County**

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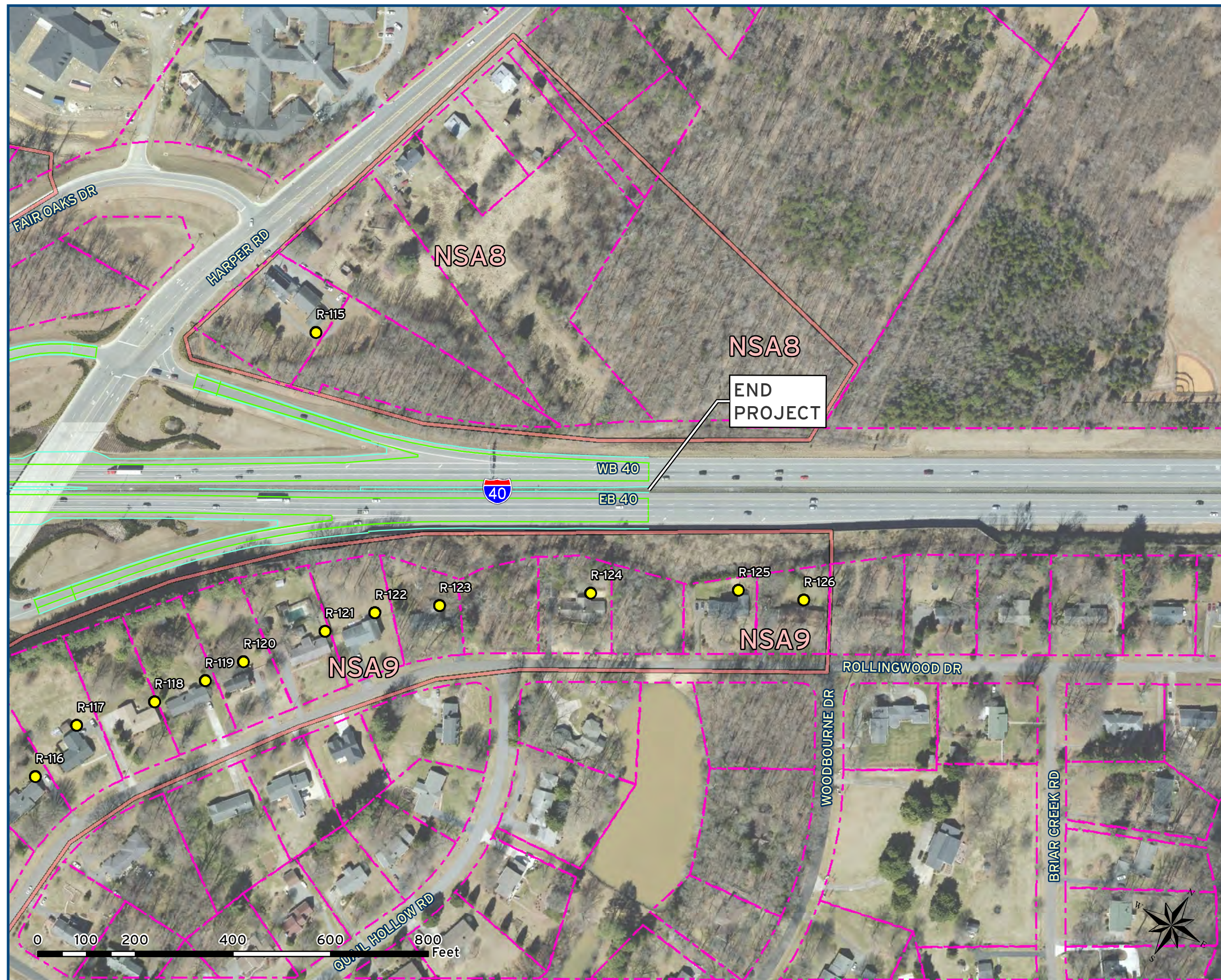
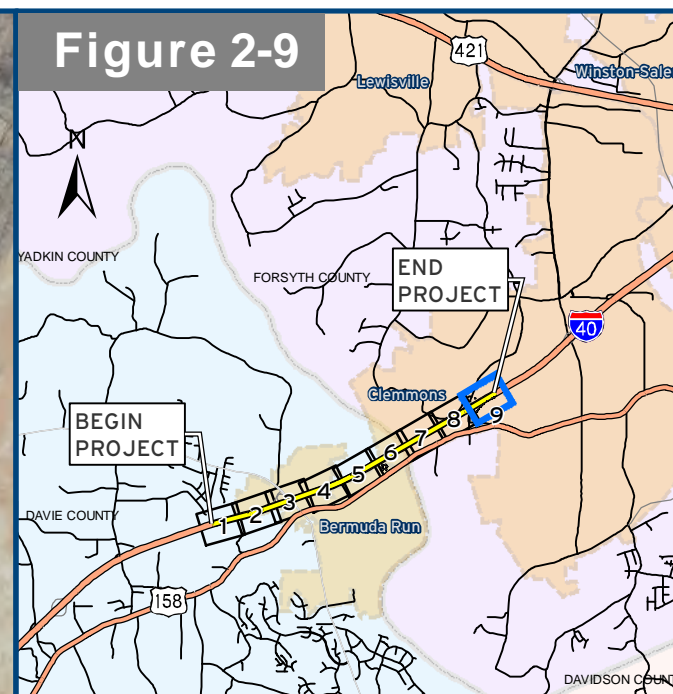


Figure 2-9



LEGEND

- Not Impacted or Benefited Receptor (Yellow dot)
- Impacted but not Benefited Receptor (Red dot)
- Not Impacted but Benefited Receptor (Green dot)
- Impacted and Benefited Receptor (Blue dot)
- Monitoring Location (White dot)
- Noise Study Areas (Red outline)

ROADWAY DESIGN

- Proposed EOT (Green line)
- Proposed Paved Shoulder (Cyan line)
- Proposed Lane Lines (Blue line)
- Proposed Roadway Bridge (Red line)

**DESIGN NOISE REPORT
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Appendix A

HOURLY EQUIVALENT NOISE LEVELS

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The noise levels presented in the following tables are the loudest-hour predicted noise levels for the 472 receptor locations assessed in the 9 Noise Study Areas (NSAs) in the vicinity of the I-40 widening and bridge replacement project (TIP#: I-0911A).

Because TNM can only calculate traffic noise levels, proper representation of predicted loudest-hourly equivalent noise levels will sometimes differ from the hourly-equivalent traffic noise levels calculated in TNM. Unless there is a reason to expect a reduction in ambient noise levels, reported noise levels are the greater of TNM-calculated or field-monitored ambient noise levels for the no-build and build-conditions, as well as the existing condition. From the definition for Noise Level Reduction (NLR) on pages 5 and 6 of the Manual, build-condition noise levels are “screened against measured or otherwise quantified noise sources.”

Table A.1: I-40 Widening & Bridge Replacement (TIP#: I-0911A)
NSA 1 Noise-Sensitive Receptors and Hourly Equivalent Noise Levels

Receptors					Predicted Noise Levels, $L_{eq(h)}$ (dB(A))			
Rec. No.	Use	NAC	D.U.s	Address	Ex.	No-Bld.	Bld.	Δ
R-008A	Res	B	1	189 Pinewood Ln #104	61	62	62	1
R-008B	Res	B	1	189 Pinewood Ln #102	58 ¹	58 ¹	58 ¹	0
R-008C	Res	B	1	189 Pinewood Ln #101	58 ¹	58 ¹	58 ¹	0
R-008D	Res	B	1	189 Pinewood Ln #103	61	62	62	1
R-009A	Res	B	1	178 Pinewood Ln #101	64	65	65	1
R-009B	Res	B	1	178 Pinewood Ln #103	58	59	60	2
R-009C	Res	B	1	178 Pinewood Ln #104	58 ¹	58	59	1
R-009D	Res	B	1	178 Pinewood Ln #102	64	65	64	0
R-010A	Res	B	1	172 Pinewood Ln #101	63	64	64	1
R-010B	Res	B	1	172 Pinewood Ln #103	58 ¹	58 ¹	58 ¹	0
R-010C	Res	B	1	172 Pinewood Ln #104	58 ¹	58 ¹	58 ¹	0
R-010D	Res	B	1	172 Pinewood Ln #102	63	64	64	1
R-011A	Res	B	1	164 Pinewood Ln #101	62	63	63	1
R-011B	Res	B	1	164 Pinewood Ln #103	58 ¹	58 ¹	58 ¹	0
R-011C	Res	B	1	164 Pinewood Ln #104	58 ¹	58 ¹	58 ¹	0
R-011D	Res	B	1	164 Pinewood Ln #102	62	63	63	1
R-012A	Res	B	1	156 Pinewood Ln #101	62	63	63	1
R-012B	Res	B	1	156 Pinewood Ln #103	58 ¹	58 ¹	58 ¹	0
R-012C	Res	B	1	156 Pinewood Ln #104	58 ¹	58 ¹	58 ¹	0
R-012D	Res	B	1	156 Pinewood Ln #102	62	63	63	1
R-013A	Res	B	1	148 Pinewood Ln #101	61	62	63	2
R-013B	Res	B	1	148 Pinewood Ln #103	58 ¹	58 ¹	58 ¹	0
R-013C	Res	B	1	148 Pinewood Ln #104	58 ¹	58 ¹	58 ¹	0
R-013D	Res	B	1	148 Pinewood Ln #102	61	62	63	2

Table A.1: I-40 Widening & Bridge Replacement (TIP#: I-0911A)
NSA 1 Noise-Sensitive Receptors and Hourly Equivalent Noise Levels

Receptors					Predicted Noise Levels, $L_{eq(h)}$ (dB(A))			
Rec. No.	Use	NAC	D.U.s	Address	Ex.	No-Bld.	Bld.	Δ
R-014A	Res	B	1	140 Pinewood Ln #101	62	63	63	1
R-014B	Res	B	1	140 Pinewood Ln #103	58 ¹	58 ¹	58 ¹	0
R-014C	Res	B	1	140 Pinewood Ln #104	58 ¹	58 ¹	58 ¹	0
R-014D	Res	B	1	140 Pinewood Ln #102	63	64	64	1
R-015A	Res	B	1	132 Pinewood Ln #101	65	66	65	0
R-015B	Res	B	1	132 Pinewood Ln #103	58 ¹	58 ¹	58 ¹	0
R-015C	Res	B	1	132 Pinewood Ln #104	58 ¹	58 ¹	58 ¹	0
R-015D	Res	B	1	132 Pinewood Ln #102	65	66	65	0
R-016A	Res	B	1	157 Pinewood Ln #104	61	62	62	1
R-016B	Res	B	1	157 Pinewood Ln #102	58 ¹	58 ¹	58 ¹	0
R-016C	Res	B	1	157 Pinewood Ln #101	58 ¹	58 ¹	58 ¹	0
R-016D	Res	B	1	157 Pinewood Ln #103	61	62	62	1
R-017A	Res	B	1	149 Pinewood Ln #104	61	62	62	1
R-017B	Res	B	1	149 Pinewood Ln #102	58 ¹	58 ¹	58 ¹	0
R-017C	Res	B	1	149 Pinewood Ln #101	58 ¹	58 ¹	58 ¹	0
R-017D	Res	B	1	149 Pinewood Ln #103	61	62	63	2
R-018A	Res	B	1	141 Pinewood Ln #104	63	64	64	1
R-018B	Res	B	1	141 Pinewood Ln #102	58 ¹	58 ¹	58 ¹	0
R-018C	Res	B	1	141 Pinewood Ln #101	58 ¹	58 ¹	58 ¹	0
R-018D	Res	B	1	141 Pinewood Ln #103	63	64	65	2
R-019A	Res	B	1	127 Pinewood Ln #104	67	68	67	0
R-019B	Res	B	1	127 Pinewood Ln #102	61	63	63	2
R-019C	Res	B	1	127 Pinewood Ln #101	62	63	64	2
R-019D	Res	B	1	127 Pinewood Ln #103	68	69	68	0
NSA 1 Predicted Traffic Noise Impacts					2 ²	4 ²	2 ²	0 ³

Impact=

1. Traffic is not the dominant noise source. $L_{eq(h)} = 58$ dB(A) based on monitored ambient sound levels in comparable land use and acoustic environment at M-4.3 and M-5.3. Sound levels for which TNM predicted traffic noise levels rounded to 58 dB(A) that are equal to or greater than monitored at M-4.3 and M-5.3 are not indicated by this footnote.
2. Predicted traffic noise level impact due to approaching or exceeding NAC.
3. Predicted "substantial increase" traffic noise level impact.

Table A.2: I-40 Widening & Bridge Replacement (TIP#: I-0911A)
NSA 3 Noise-Sensitive Receptors and Hourly Equivalent Noise Levels

Receptors					Predicted Noise Levels, $L_{eq(h)}$ (dB(A))			
Rec. No.	Use	NAC	D.U.s	Address	Ex.	No-Bld.	Bld.	Δ
R-020	Athletic	C	1	428 Twins Way – Fields 7 & 8	67	68	69	2
R-020	Athletic	C	1	428 Twins Way – Field 11	67	68	65	-2 ¹
R-020	Athletic	C	1	428 Twins Way – Field 14	67	68	66	-1 ¹
R-020	Athletic	C	1	428 Twins Way – Field 15	72	73	67	-5 ¹
NSA 3 Predicted Traffic Noise Impacts					4 ²	4 ²	3 ²	0 ³

Impact=

1. Design year 2040 build-condition traffic noise levels are predicted to be lower than existing for the soccer fields nearly under the existing I-40 bridge due to build-condition design parameters. The existing I-40 bridge configuration permits traffic noise to pass between the open space between the two 2-lane bridge spans. The build-condition I-40 bridge will have a single span with a solid median. The existing I-40 bridge has open railings along the inside and outside shoulders of the two bridge spans. The build-condition I-40 bridge will have three solid concrete traffic barriers along the two outside shoulders and median. Although shorter in height than typical noise walls, each of the solid concrete traffic barriers will attenuate tire-pavement interaction noise from propagating away from I-40 and down to the soccer fields below.
2. Predicted traffic noise level impact due to approaching or exceeding NAC.
3. Predicted “substantial increase” traffic noise level impact.

Table A.3: I-40 Widening & Bridge Replacement (TIP#: I-0911A)
NSA 4 Noise-Sensitive Receptors and Hourly Equivalent Noise Levels

Receptors					Predicted Noise Levels, $L_{eq(h)}$ (dB(A))			
Rec. No.	Use	NAC	D.U.s	Address	Ex.	No-Bld.	Bld.	Δ
R-020a	Historic	D	0.38	168 E Kinderton Way	45 ¹	47 ¹	46 ¹	1
R-020b	Historic	D	0.38	168 E Kinderton Way	39 ¹	39 ¹	39 ¹	0
R-020c	Historic	D	0.38	168 E Kinderton Way	41 ¹	42 ¹	42 ¹	1
R-020d	Historic	C	0.38	168 E Kinderton Way, W. Patio	57	58	59	2
R-020e	Historic	C	0.38	168 E Kinderton Way, W. Patio	55	55	55	0
R-020f	Historic	C	0.38	168 E Kinderton Way, W. Patio	55	56	57	2
R-020g	Historic	C	0.38	168 E Kinderton Way, W. Patio	55	56	57	2
R-020h	Historic	C	0.38	168 E Kinderton Way, W. Patio	55	55	56	1
R-020i	Historic	C	0.38	168 E Kinderton Way, W. Patio	55	55	55	0
R-020j	Historic	C	0.38	168 E Kinderton Way, W. Patio	55	55	55	0
R-020k	Historic	C	0.38	168 E Kinderton Way, W. Patio	55	55	55	0
R-020l	Historic	C	0.38	168 E Kinderton Way, W. Patio	55	55	55	0
R-020m	Historic	C	0.38	168 E Kinderton Way, E. Patio	64	65	65	1
R-020n	Historic	C	0.38	168 E Kinderton Way, E. Patio	64	65	65	1
R-020o	Historic	C	0.38	168 E Kinderton Way, E. Patio	64	66	65 ²	1
R-020p	Historic	C	0.38	168 E Kinderton Way, E. Patio	61	62	62	1
R-020q	Historic	C	0.38	168 E Kinderton Way, E. Patio	62	63	63	1
R-020r	Historic	C	0.38	168 E Kinderton Way, E. Patio	62	63	63	1
R-020s	Historic	C	0.38	168 E Kinderton Way, E. Patio	60	61	61	1
R-020t	Historic	C	0.38	168 E Kinderton Way, E. Patio	60	62	61	1
R-020u	Historic	C	0.38	168 E Kinderton Way, E. Patio	61	62	62	1
NSA 4 Predicted Traffic Noise Impacts					0³	1³	0³	0⁴

1. Interior noise level for NAC D receptor, calculated as a 25-decibel reduction (-25 dB(A)) from exterior noise levels per applicable Building Noise Reduction Factor (refer to Table 10).
2. Predicted traffic noise level impact due to approaching or exceeding NAC.
3. Design Year 2040 build-condition traffic noise levels are predicted to be 1 decibel (-1 dB(A)) lower than Design Year 2040 no-build condition traffic noise levels at the northeast corner of the east patio at 168 E Kinderton Way because the build-condition design will shift the I-40 alignment approximately 30 feet farther from NSA 4 than the no-build condition, and will replace the open traffic barriers with solid-concrete traffic barriers that will attenuate tire-pavement interaction noise from vehicles crossing the I-40 Yadkin River bridge.
4. Predicted "substantial increase" traffic noise level impact.

Table A.4: I-40 Widening & Bridge Replacement (TIP#: I-0911A)
NSA 5 Noise-Sensitive Receptors and Hourly Equivalent Noise Levels

Receptors					Predicted Noise Levels, $L_{eq(h)}$ (dB(A))			
Rec. No.	Use	NAC	D.U.s	Address	Ex.	No-Bld.	Bld.	Δ
R-079	Res	B	1	7986 Abelia Way	61	62	61	0
R-080	Res	B	1	7980 Abelia Way	60	61	60	0
R-081	Res	B	1	7974 Abelia Way	59	60	59	0
R-082	Res	B	1	7966 Abelia Way	53	54	55	2
R-083	Res	B	1	7962 Abelia Way	55	56	56	1
R-084	Res	B	1	7956 Abelia Way	56	57	57	1
R-085	Res	B	1	3702 Peony Way	54	55	55	1
R-086	Res	B	1	3714 Peony Way	56	57	56	0
R-087	Res	B	1	3738 Peony Way	59	60	60	1
R-088	Res	B	1	3775 Peony Way	69	70	70	1
R-089	Res	B	1	3763 Peony Way	66	67	68	2
R-090	Res	B	1	3751 Peony Way	63	64	64	1
R-091	Res	B	1	3739 Peony Way	58	60	60	2
R-092	Res	B	1	3727 Peony Way	55	56	56	1
R-093	Res	B	1	3715 Peony Way	51 ¹	51 ¹	51	0
R-094	Res	B	1	7932 Abelia Way	53	54	53	0
R-095	Res	B	1	7926 Abelia Way	51 ¹	52	52	1
R-096	Res	B	1	7920 Abelia Way	51 ¹	52	52	1
R-097	Res	B	1	7914 Abelia Way	51 ¹	52	52	1
R-098	Res	B	1	7985 Abelia Way	57	58	58	1
R-099	Res	B	1	7979 Abelia Way	51 ¹	51 ¹	51 ¹	0
R-100	Res	B	1	7973 Abelia Way	51 ¹	52	52	1
R-101	Res	B	1	7967 Abelia Way	54	55	54	0
R-102	Res	B	1	7961 Abelia Way	52	53	53	1
R-103	Res	B	1	7957 Abelia Way	53	54	53	0
R-104	Res	B	1	7949 Abelia Way	53	54	53	0
R-105	Res	B	1	7943 Abelia Way	51 ¹	52	51	0
R-106	Res	B	1	7937 Abelia Way	51 ¹	52	51 ¹	0
R-107	Res	B	1	7931 Abelia Way	51 ¹	52	51 ¹	0
R-108	Res	B	1	7927 Abelia Way	51 ¹	52	51	0
R-109	Res	B	1	7919 Abelia Way	52	53	52	0
R-110	Res	B	1	7913 Abelia Way	51 ¹	52	51	0
R-111	Res	B	1	7907 Abelia Way	51 ¹	51 ¹	51 ¹	0
R-112	Res	B	1	3737 Verbena Way	51 ¹	52	53	2
R-113	Res	B	1	3744 Verbena Way	51 ¹	51 ¹	51	0



**Table A.4: I-40 Widening & Bridge Replacement (TIP#: I-0911A)
NSA 5 Noise-Sensitive Receptors and Hourly Equivalent Noise Levels**

Receptors					Predicted Noise Levels, $L_{eq(h)}$ (dB(A))			
Rec. No.	Use	NAC	D.U.s	Address	Ex.	No-Bld.	Bld.	Δ
R-114	Res	B	1	3757 Verbena Way	51 ¹	51 ¹	51 ¹	0
NSA 5 Predicted Traffic Noise Impacts					2 ²	2 ²	2 ²	0 ³
Impact= [REDACTED]								
<p>1. Traffic is not the dominant noise source. $L_{eq(h)} = 51$ dB(A) based on monitored ambient sound levels in comparable land use and acoustic environment at M-7.3. Sound levels for which TNM predicted traffic noise levels rounded to 51 dB(A) that are equal to or greater than monitored at M-7.3 are not indicated by this footnote.</p> <p>2. Predicted traffic noise level impact due to approaching or exceeding NAC</p> <p>3. Predicted “substantial increase” traffic noise level impact</p>								

Table A.5: I-40 Widening & Bridge Replacement (TIP#: I-0911A)
NSA 6 Noise-Sensitive Receptors and Hourly Equivalent Noise Levels

Receptors					Predicted Noise Levels, $L_{eq(h)}$ (dB(A))			
Rec. No.	Use	NAC	D.U.s	Address	Ex.	No-Bld.	Bld.	Δ
R-021A	Res	B	1	7645 Riverview Knoll Ct	63	64	63	0
R-021B	Res	B	1	7641 Riverview Knoll Ct	64	65	63	-1
R-021C	Res	B	1	7637 Riverview Knoll Ct	64	66	64	0
R-021D	Res	B	1	7633 Riverview Knoll Ct	66	67	66	0
R-022A	Res	B	1	7629 Riverview Knoll Ct	67	68	67	0
R-022B	Res	B	1	7625 Riverview Knoll Ct	67	68	67	0
R-022C	Res	B	1	7621 Riverview Knoll Ct	67	68	67	0
R-022D	Res	B	1	7617 Riverview Knoll Ct	67	68	67	0
R-023A	Res	B	1	7613 Riverview Knoll Ct	67	68	67	0
R-023B	Res	B	1	7609 Riverview Knoll Ct	67	68	68	1
R-023C	Res	B	1	7605 Riverview Knoll Ct	68	69	68	0
R-023D	Res	B	1	7601 Riverview Knoll Ct	69	70	69	0
R-024A	Res	B	1	7508 Riverview Knoll Ct	70	72	71	1
R-024B	Res	B	1	7504 Riverview Knoll Ct	70	72	71	1
R-024C	Res	B	1	7502 Riverview Knoll Ct	58 ¹	58 ¹	58 ¹	0
R-024D	Res	B	1	7506 Riverview Knoll Ct	58 ¹	58 ¹	58 ¹	0
R-024E	Res	B	1	7528 Riverview Knoll Ct	73	74	72	-1
R-024F	Res	B	1	7524 Riverview Knoll Ct	73	74	72	-1
R-024G	Res	B	1	7522 Riverview Knoll Ct	58 ¹	58 ¹	58 ¹	0
R-024H	Res	B	1	7526 Riverview Knoll Ct	58 ¹	58 ¹	58 ¹	0
R-025A	Res	B	1	7308 Riverview Knoll Ct	70	72	71	1
R-025B	Res	B	1	7304 Riverview Knoll Ct	69	71	70	1
R-025C	Res	B	1	7302 Riverview Knoll Ct	58 ¹	58 ¹	58 ¹	0
R-025D	Res	B	1	7306 Riverview Knoll Ct	58 ¹	58 ¹	58 ¹	0
R-025E	Res	B	1	7328 Riverview Knoll Ct	73	74	72	-1
R-025F	Res	B	1	7324 Riverview Knoll Ct	72	74	72	0
R-025G	Res	B	1	7322 Riverview Knoll Ct	58 ¹	58 ¹	58 ¹	0
R-025H	Res	B	1	7326 Riverview Knoll Ct	58 ¹	58 ¹	58 ¹	0
R-026A	Res	B	1	7108 Riverview Knoll Ct	68	69	69	1
R-026B	Res	B	1	7104 Riverview Knoll Ct	67	68	68	1
R-026C	Res	B	1	7102 Riverview Knoll Ct	58 ¹	58 ¹	58 ¹	0
R-026D	Res	B	1	7106 Riverview Knoll Ct	58 ¹	58 ¹	58 ¹	0
R-026E	Res	B	1	7128 Riverview Knoll Ct	72	73	71	-1
R-026F	Res	B	1	7124 Riverview Knoll Ct	72	73	71	-1
R-026G	Res	B	1	7122 Riverview Knoll Ct	58 ¹	58 ¹	58 ¹	0



Table A.5: I-40 Widening & Bridge Replacement (TIP#: I-0911A)
NSA 6 Noise-Sensitive Receptors and Hourly Equivalent Noise Levels

Receptors					Predicted Noise Levels, $L_{eq(h)}$ (dB(A))			
Rec. No.	Use	NAC	D.U.s	Address	Ex.	No-Bld.	Bld.	Δ
R-026H	Res	B	1	7126 Riverview Knoll Ct	58 ¹	58 ¹	58 ¹	0
R-027A	Res	B	1	208 River Oaks Court	58 ¹	58 ¹	58 ¹	0
R-027B	Res	B	1	204 River Oaks Court	73	74	73	0
R-027C	Res	B	1	202 River Oaks Court	75	76	75	0
R-027D	Res	B	1	206 River Oaks Court	63	64	64	1
R-027E	Pool	C	1	River Oaks Ct Pool	72	73	72	0
R-028A	Res	B	1	106 River Oaks Court	65	66	66	1
R-028B	Res	B	1	108 River Oaks Court	58 ¹	58 ¹	58 ¹	0
R-028C	Res	B	1	104 River Oaks Court	58 ¹	58 ¹	58 ¹	0
R-028D	Res	B	1	102 River Oaks Court	64	66	65	1
R-028E	Res	B	1	126 River Oaks Court	70	71	70	0
R-028F	Res	B	1	128 River Oaks Court	58	59	59	1
R-028G	Res	B	1	124 River Oaks Court	58 ¹	58 ¹	58 ¹	0
R-028H	Res	B	1	122 River Oaks Court	69	70	69	0
R-029A	Res	B	1	3801 Old Rosebud Ct Unit A	58 ¹	58 ¹	58 ¹	0
R-029B	Res	B	1	3801 Old Rosebud Ct Unit B	58 ¹	58 ¹	58 ¹	0
R-029C	Res	B	1	3801 Old Rosebud Ct Unit C	58 ¹	58 ¹	58 ¹	0
R-029D	Res	B	1	3801 Old Rosebud Ct Unit D	58 ¹	58 ¹	58 ¹	0
R-029E	Res	B	1	3801 Old Rosebud Ct Unit E	58 ¹	58 ¹	58 ¹	0
R-029F	Res	B	1	3801 Old Rosebud Ct Unit F	58 ¹	58 ¹	58 ¹	0
R-029G	Res	B	1	3801 Old Rosebud Ct Unit G	60	61	61	1
R-029H	Res	B	1	3801 Old Rosebud Ct Unit H	59	60	60	1
R-029J	Res	B	1	3801 Old Rosebud Ct Unit J	58 ¹	58 ¹	59	2
R-029K	Res	B	1	3801 Old Rosebud Ct Unit K	58 ¹	58 ¹	58	0
R-029L	Res	B	1	3801 Old Rosebud Ct Unit L	58 ¹	58 ¹	58 ¹	0
R-029M	Res	B	1	3801 Old Rosebud Ct Unit M	58 ¹	58 ¹	58 ¹	0
R-030A	Res	B	1	5000 Thoroughbred Ln Unit A	61	62	63	2
R-030B	Res	B	1	5000 Thoroughbred Ln Unit B	58	58	58	0
R-030C	Res	B	1	5000 Thoroughbred Ln Unit C	58	58	58	0
R-030D	Res	B	1	5000 Thoroughbred Ln Unit D	58	58	58	0
R-030E	Res	B	1	5000 Thoroughbred Ln Unit E	68	69	70	2
R-030F	Res	B	1	5000 Thoroughbred Ln Unit F	59	60	61	2
R-030G	Res	B	1	5000 Thoroughbred Ln Unit G	58 ¹	58 ¹	58	0
R-030H	Res	B	1	5000 Thoroughbred Ln Unit H	58 ¹	58 ¹	58 ¹	0
R-031	Pool	C	1	Thoroughbred Lane Pool	58	59	60	2
R-032A	Res	B	1	5020 Thoroughbred Ln Unit A	58 ¹	58 ¹	58 ¹	0



Table A.5: I-40 Widening & Bridge Replacement (TIP#: I-0911A)
NSA 6 Noise-Sensitive Receptors and Hourly Equivalent Noise Levels

Receptors					Predicted Noise Levels, $L_{eq(h)}$ (dB(A))			
Rec. No.	Use	NAC	D.U.s	Address	Ex.	No-Bld.	Bld.	Δ
R-032B	Res	B	1	5020 Thoroughbred Ln Unit B	58 ¹	58 ¹	58 ¹	0
R-032C	Res	B	1	5020 Thoroughbred Ln Unit C	58 ¹	58 ¹	58 ¹	0
R-032D	Res	B	1	5020 Thoroughbred Ln Unit D	58 ¹	58 ¹	58 ¹	0
R-032E	Res	B	1	5020 Thoroughbred Ln Unit E	58 ¹	58 ¹	58 ¹	0
R-032F	Res	B	1	5020 Thoroughbred Ln Unit F	58 ¹	58 ¹	58 ¹	0
R-032G	Res	B	1	5020 Thoroughbred Ln Unit G	58 ¹	58 ¹	58 ¹	0
R-032H	Res	B	1	5020 Thoroughbred Ln Unit H	58 ¹	58 ¹	58 ¹	0
R-032J	Res	B	1	5020 Thoroughbred Ln Unit J	58 ¹	58 ¹	58 ¹	0
R-032K	Res	B	1	5020 Thoroughbred Ln Unit K	58 ¹	58 ¹	58 ¹	0
R-032L	Res	B	1	5020 Thoroughbred Ln Unit L	58 ¹	58 ¹	58 ¹	0
R-032M	Res	B	1	5020 Thoroughbred Ln Unit M	58 ¹	58 ¹	58 ¹	0
R-033A	Res	B	1	4000 Whirlaway Ct Unit A	58 ¹	58 ¹	58 ¹	0
R-033B	Res	B	1	4000 Whirlaway Ct Unit B	58 ¹	58 ¹	58 ¹	0
R-033C	Res	B	1	4000 Whirlaway Ct Unit C	59	60	61	2
R-033D	Res	B	1	4000 Whirlaway Ct Unit D	64	65	66	2
R-033E	Res	B	1	4000 Whirlaway Ct Unit E	58	59	59	1
R-033F	Res	B	1	4000 Whirlaway Ct Unit F	60	61	63	3
R-033G	Res	B	1	4000 Whirlaway Ct Unit G	66	67	67	1
R-033H	Res	B	1	4000 Whirlaway Ct Unit H	71	72	73	2
R-034A	Res	B	1	4010 Whirlaway Ct Unit A	58 ¹	58 ¹	58 ¹	0
R-034B	Res	B	1	4010 Whirlaway Ct Unit B	58 ¹	58 ¹	58 ¹	0
R-034C	Res	B	1	4010 Whirlaway Ct Unit C	58 ¹	58 ¹	58 ¹	0
R-034D	Res	B	1	4010 Whirlaway Ct Unit D	58 ¹	58 ¹	58 ¹	0
R-034E	Res	B	1	4010 Whirlaway Ct Unit E	58 ¹	58 ¹	58 ¹	0
R-034F	Res	B	1	4010 Whirlaway Ct Unit F	58 ¹	58 ¹	58 ¹	0
R-034G	Res	B	1	4010 Whirlaway Ct Unit G	58 ¹	58	58	0
R-034H	Res	B	1	4010 Whirlaway Ct Unit H	58 ¹	58	58	0
R-035A	Res	B	1	4001 Whirlaway Ct Unit A	63	64	65	2
R-035B	Res	B	1	4001 Whirlaway Ct Unit B	58	59	59	1
R-035C	Res	B	1	4001 Whirlaway Ct Unit C	58 ¹	58 ¹	58 ¹	0
R-035D	Res	B	1	4001 Whirlaway Ct Unit D	58 ¹	58 ¹	58 ¹	0
R-035E	Res	B	1	4001 Whirlaway Ct Unit E	58 ¹	58 ¹	58 ¹	0
R-035F	Res	B	1	4001 Whirlaway Ct Unit F	58 ¹	58 ¹	58 ¹	0
R-035G	Res	B	1	4001 Whirlaway Ct Unit G	71	72	72	1
R-035H	Res	B	1	4001 Whirlaway Ct Unit H	65	66	67	2
R-035J	Res	B	1	4001 Whirlaway Ct Unit J	61	62	62	1

Table A.5: I-40 Widening & Bridge Replacement (TIP#: I-0911A)
NSA 6 Noise-Sensitive Receptors and Hourly Equivalent Noise Levels

Receptors					Predicted Noise Levels, $L_{eq(h)}$ (dB(A))			
Rec. No.	Use	NAC	D.U.s	Address	Ex.	No-Bld.	Bld.	Δ
R-035K	Res	B	1	4001 Whirlaway Ct Unit K	58	59	60	2
R-035L	Res	B	1	4001 Whirlaway Ct Unit L	58 ¹	58 ¹	58 ¹	0
R-035M	Res	B	1	4001 Whirlaway Ct Unit M	58 ¹	58 ¹	58 ¹	0
R-036A	Res	B	1	3904 Westridge Meadow Cir	60	61	62	2
R-036B	Res	B	1	3902 Westridge Meadow Cir	59	60	62	3
R-036C	Res	B	1	3900 Westridge Meadow Cir	58 ¹	58	60	2
R-036D	Res	B	1	3906 Westridge Meadow Cir	58	59	59	1
R-037A	Res	B	1	3912 Westridge Meadow Cir	58 ¹	58 ¹	58 ¹	0
R-037B	Res	B	1	3908 Westridge Meadow Cir	58 ¹	58 ¹	58 ¹	0
R-037C	Res	B	1	3910 Westridge Meadow Cir	58 ¹	58 ¹	58 ¹	0
R-037D	Res	B	1	3914 Westridge Meadow Cir	58 ¹	58 ¹	58 ¹	0
R-038A	Res	B	1	3909 Westridge Meadow Cir	58 ¹	58 ¹	58 ¹	0
R-038B	Res	B	1	3913 Westridge Meadow Cir	58 ¹	58 ¹	58 ¹	0
R-038C	Res	B	1	3915 Westridge Meadow Cir	58 ¹	58 ¹	58 ¹	0
R-038D	Res	B	1	3911 Westridge Meadow Cir	58 ¹	58 ¹	58 ¹	0
R-039A	Res	B	1	3901 Westridge Meadow Cir	58 ¹	59	60	2
R-039B	Res	B	1	3905 Westridge Meadow Cir	58 ¹	58 ¹	58 ¹	0
R-039C	Res	B	1	3907 Westridge Meadow Cir	58 ¹	58 ¹	58 ¹	0
R-039D	Res	B	1	3903 Westridge Meadow Cir	58 ¹	58 ¹	58	0
R-040A	Res	B	1	3804 Westridge Farm Ln	58 ¹	58 ¹	58	0
R-040B	Res	B	1	3800 Westridge Farm Ln	58 ¹	58 ¹	58 ¹	0
R-040C	Res	B	1	3802 Westridge Farm Ln	58 ¹	58 ¹	58 ¹	0
R-040D	Res	B	1	3806 Westridge Farm Ln	58 ¹	58 ¹	58 ¹	0
R-041A	Res	B	1	3801 Westridge Farm Ln	59	60	60	1
R-041B	Res	B	1	3805 Westridge Farm Ln	61	62	63	2
R-041C	Res	B	1	3807 Westridge Farm Ln	59	60	60	1
R-041D	Res	B	1	3803 Westridge Farm Ln	58	59	60	2
R-042A	Res	B	1	3809 Westridge Farm Ln	58 ¹	58 ¹	58 ¹	0
R-042B	Res	B	1	3813 Westridge Farm Ln	58 ¹	58 ¹	58 ¹	0
R-042C	Res	B	1	3815 Westridge Farm Ln	58 ¹	58 ¹	58 ¹	0
R-042D	Res	B	1	3811 Westridge Farm Ln	58 ¹	58 ¹	58 ¹	0
R-043A	Res	B	1	3947 Westridge Meadow Cir	58 ¹	58 ¹	58 ¹	0
R-043B	Res	B	1	3943 Westridge Meadow Cir	58 ¹	58 ¹	58 ¹	0
R-043C	Res	B	1	3941 Westridge Meadow Cir	58 ¹	58 ¹	58 ¹	0
R-043D	Res	B	1	3945 Westridge Meadow Cir	58 ¹	58 ¹	58 ¹	0
R-044A	Res	B	1	3955 Westridge Meadow Cir	58 ¹	58 ¹	58 ¹	0



Table A.5: I-40 Widening & Bridge Replacement (TIP#: I-0911A)
NSA 6 Noise-Sensitive Receptors and Hourly Equivalent Noise Levels

Receptors					Predicted Noise Levels, $L_{eq(h)}$ (dB(A))			
Rec. No.	Use	NAC	D.U.s	Address	Ex.	No-Bld.	Bld.	Δ
R-044B	Res	B	1	3951 Westridge Meadow Cir	58 ¹	58 ¹	58 ¹	0
R-044C	Res	B	1	3949 Westridge Meadow Cir	58 ¹	58 ¹	58 ¹	0
R-044D	Res	B	1	3953 Westridge Meadow Cir	58 ¹	58 ¹	58 ¹	0
R-045A	Res	B	1	3963 Westridge Meadow Cir	61	62	62	1
R-045B	Res	B	1	3959 Westridge Meadow Cir	58	58	60	2
R-045C	Res	B	1	3957 Westridge Meadow Cir	58	58	58	0
R-045D	Res	B	1	3961 Westridge Meadow Cir	59	61	61	2
R-046A	Res	B	1	3998 Westridge Meadow Cir	65	66	67	2
R-046B	Res	B	1	4002 Westridge Meadow Cir	62	63	65	3
R-046C	Res	B	1	4000 Westridge Meadow Cir	61	62	63	2
R-046D	Res	B	1	3996 Westridge Meadow Cir	64	65	66	2
R-047A	Res	B	1	3990 Westridge Meadow Cir	58	58	59	1
R-047B	Res	B	1	3994 Westridge Meadow Cir	58	59	59	1
R-047C	Res	B	1	3992 Westridge Meadow Cir	58	59	59	1
R-047D	Res	B	1	3988 Westridge Meadow Cir	58	58	58	0
R-048A	Res	B	1	3982 Westridge Meadow Cir	58 ¹	58 ¹	58 ¹	0
R-048B	Res	B	1	3986 Westridge Meadow Cir	58 ¹	58 ¹	58 ¹	0
R-048C	Res	B	1	3984 Westridge Meadow Cir	58 ¹	58 ¹	58 ¹	0
R-048D	Res	B	1	3980 Westridge Meadow Cir	58 ¹	58 ¹	58 ¹	0
R-058A	Res	B	1	7406 Riverview Knoll Ct	58 ¹	58 ¹	58 ¹	0
R-058B	Res	B	1	7402 Riverview Knoll Ct	58 ¹	58 ¹	58 ¹	0
R-058C	Res	B	1	7404 Riverview Knoll Ct	58 ¹	58 ¹	58 ¹	0
R-058D	Res	B	1	7408 Riverview Knoll Ct	58 ¹	58 ¹	58 ¹	0
R-058E	Res	B	1	7426 Riverview Knoll Ct	59	61	60	1
R-058F	Res	B	1	7422 Riverview Knoll Ct	59	60	60	1
R-058G	Res	B	1	7424 Riverview Knoll Ct	58 ¹	58 ¹	58 ¹	0
R-058H	Res	B	1	7428 Riverview Knoll Ct	58 ¹	58 ¹	58 ¹	0
R-059A	Res	B	1	7406 Riverview Knoll Ct	58 ¹	58 ¹	58 ¹	0
R-059B	Res	B	1	7402 Riverview Knoll Ct	58 ¹	58	58	0
R-059C	Res	B	1	7404 Riverview Knoll Ct	58 ¹	58 ¹	58 ¹	0
R-059D	Res	B	1	7408 Riverview Knoll Ct	58 ¹	58 ¹	58 ¹	0
R-059E	Res	B	1	7426 Riverview Knoll Ct	58	59	59	1
R-059F	Res	B	1	7422 Riverview Knoll Ct	61	62	61	0
R-059G	Res	B	1	7424 Riverview Knoll Ct	58 ¹	58 ¹	58 ¹	0
R-059H	Res	B	1	7428 Riverview Knoll Ct	58 ¹	58 ¹	58 ¹	0
R-060A	Res	B	1	7654 Riverview Knoll Ct	61	63	60	-1

Table A.5: I-40 Widening & Bridge Replacement (TIP#: I-0911A)
NSA 6 Noise-Sensitive Receptors and Hourly Equivalent Noise Levels

Receptors					Predicted Noise Levels, $L_{eq(h)}$ (dB(A))			
Rec. No.	Use	NAC	D.U.s	Address	Ex.	No-Bld.	Bld.	Δ
R-060B	Res	B	1	7650 Riverview Knoll Ct	58 ¹	58 ¹	58 ¹	0
R-060C	Res	B	1	7646 Riverview Knoll Ct	58 ¹	58 ¹	58 ¹	0
R-061A	Res	B	1	7642 Riverview Knoll Ct	58 ¹	58 ¹	58 ¹	0
R-061B	Res	B	1	7638 Riverview Knoll Ct	58 ¹	58 ¹	58 ¹	0
R-061C	Res	B	1	7634 Riverview Knoll Ct	58 ¹	58 ¹	58 ¹	0
R-062A	Res	B	1	7630 Riverview Knoll Ct	58 ¹	58 ¹	58 ¹	0
R-062B	Res	B	1	7626 Riverview Knoll Ct	58 ¹	58 ¹	58 ¹	0
R-062C	Res	B	1	7622 Riverview Knoll Ct	58 ¹	58 ¹	58 ¹	0
R-063A	Res	B	1	7618 Riverview Knoll Ct	58 ¹	58 ¹	58 ¹	0
R-063B	Res	B	1	7614 Riverview Knoll Ct	58 ¹	58 ¹	58 ¹	0
R-063C	Res	B	1	7610 Riverview Knoll Ct	58 ¹	58 ¹	58 ¹	0
R-064A	Res	B	1	4320 Riverside Dr	58 ¹	58 ¹	58 ¹	0
R-064B	Res	B	1	4324 Riverside Dr	58 ¹	58 ¹	58 ¹	0
R-064C	Res	B	1	4328 Riverside Dr	58	60	59	1
R-065A	Res	B	1	4308 Riverside Dr	58 ¹	58 ¹	58 ¹	0
R-065B	Res	B	1	4312 Riverside Dr	58 ¹	58 ¹	58 ¹	0
R-065C	Res	B	1	4316 Riverside Dr	58 ¹	58 ¹	58 ¹	0
R-066A	Res	B	1	4321 Riverside Dr	58 ¹	58 ¹	58 ¹	0
R-066B	Res	B	1	4325 Riverside Dr	58 ¹	58 ¹	58 ¹	0
R-066C	Res	B	1	4329 Riverside Dr	58 ¹	58	58	0
R-067A	Res	B	1	7545 Riverside Ct	58 ¹	58 ¹	58 ¹	0
R-067B	Res	B	1	7541 Riverside Ct	58 ¹	58 ¹	58 ¹	0
R-067C	Res	B	1	7537 Riverside Ct	58 ¹	58 ¹	58 ¹	0
R-068A	Res	B	1	7533 Riverside Ct	58 ¹	58 ¹	58 ¹	0
R-068B	Res	B	1	7529 Riverside Ct	58 ¹	58 ¹	58 ¹	0
R-068C	Res	B	1	7525 Riverside Ct	58 ¹	58 ¹	58 ¹	0
R-069A	Res	B	1	7521 Riverside Ct	58 ¹	58 ¹	58 ¹	0
R-069B	Res	B	1	7517 Riverside Ct	58 ¹	58 ¹	58 ¹	0
R-069C	Res	B	1	7513 Riverside Ct	58 ¹	58 ¹	58 ¹	0
R-070A	Res	B	1	7509 Riverside Ct	58 ¹	58 ¹	58 ¹	0
R-070B	Res	B	1	7505 Riverside Ct	58 ¹	58 ¹	58 ¹	0
R-070C	Res	B	1	7501 Riverside Ct	58 ¹	58 ¹	58 ¹	0
R-071A	Res	B	1	3800 Old Rosebud Ct Unit A	58 ¹	58 ¹	58 ¹	0
R-071B	Res	B	1	3800 Old Rosebud Ct Unit B	58 ¹	58 ¹	58 ¹	0
R-071C	Res	B	1	3800 Old Rosebud Ct Unit C	58 ¹	58 ¹	58 ¹	0
R-071D	Res	B	1	3800 Old Rosebud Ct Unit D	58 ¹	58 ¹	58 ¹	0

Table A.5: I-40 Widening & Bridge Replacement (TIP#: I-0911A)
NSA 6 Noise-Sensitive Receptors and Hourly Equivalent Noise Levels

Receptors					Predicted Noise Levels, $L_{eq(h)}$ (dB(A))			
Rec. No.	Use	NAC	D.U.s	Address	Ex.	No-Bld.	Bld.	Δ
R-071E	Res	B	1	3800 Old Rosebud Ct Unit E	58	59	59	1
R-071F	Res	B	1	3800 Old Rosebud Ct Unit F	58	60	59	1
R-071G	Res	B	1	3800 Old Rosebud Ct Unit G	59	60	60	1
R-071H	Res	B	1	3800 Old Rosebud Ct Unit H	60	62	61	1
R-072A	Res	B	1	3800 Old Rosebud Ct Unit A	58 ¹	58 ¹	58 ¹	0
R-072B	Res	B	1	3800 Old Rosebud Ct Unit B	58 ¹	58 ¹	58 ¹	0
R-072C	Res	B	1	3800 Old Rosebud Ct Unit C	58 ¹	58 ¹	58 ¹	0
R-072D	Res	B	1	3800 Old Rosebud Ct Unit D	58 ¹	58 ¹	58 ¹	0
R-072E	Res	B	1	3800 Old Rosebud Ct Unit E	58 ¹	58 ¹	58 ¹	0
R-072F	Res	B	1	3800 Old Rosebud Ct Unit F	58 ¹	58 ¹	58 ¹	0
R-072G	Res	B	1	3800 Old Rosebud Ct Unit G	58 ¹	58 ¹	58 ¹	0
R-072H	Res	B	1	3800 Old Rosebud Ct Unit H	58 ¹	58 ¹	58 ¹	0
R-072J	Res	B	1	3800 Old Rosebud Ct Unit J	58 ¹	58 ¹	58 ¹	0
R-072K	Res	B	1	3800 Old Rosebud Ct Unit K	58 ¹	58 ¹	58 ¹	0
R-072L	Res	B	1	3800 Old Rosebud Ct Unit L	58 ¹	58 ¹	58 ¹	0
R-072M	Res	B	1	3800 Old Rosebud Ct Unit M	58 ¹	58 ¹	58 ¹	0
R-073A	Res	B	1	4020 Whirlaway Ct Unit A	58 ¹	58 ¹	58 ¹	0
R-073B	Res	B	1	4020 Whirlaway Ct Unit B	58 ¹	58 ¹	58 ¹	0
R-073C	Res	B	1	4020 Whirlaway Ct Unit C	58 ¹	58 ¹	58 ¹	0
R-073D	Res	B	1	4020 Whirlaway Ct Unit D	58 ¹	58 ¹	58 ¹	0
R-073E	Res	B	1	4020 Whirlaway Ct Unit E	58 ¹	58 ¹	58 ¹	0
R-073F	Res	B	1	4020 Whirlaway Ct Unit F	58 ¹	58 ¹	58 ¹	0
R-073G	Res	B	1	4020 Whirlaway Ct Unit G	58 ¹	58 ¹	58 ¹	0
R-073H	Res	B	1	4020 Whirlaway Ct Unit H	58 ¹	58 ¹	58 ¹	0
R-073J	Res	B	1	4020 Whirlaway Ct Unit J	58 ¹	58 ¹	58 ¹	0
R-073K	Res	B	1	4020 Whirlaway Ct Unit K	58 ¹	58 ¹	58 ¹	0
R-073L	Res	B	1	4020 Whirlaway Ct Unit L	58 ¹	58 ¹	58 ¹	0
R-073M	Res	B	1	4020 Whirlaway Ct Unit M	58 ¹	58 ¹	58 ¹	0
R-074A	Res	B	1	4011 Whirlaway Ct Unit A	58 ¹	58 ¹	58 ¹	0
R-074B	Res	B	1	4011 Whirlaway Ct Unit B	58 ¹	58 ¹	58 ¹	0
R-074C	Res	B	1	4011 Whirlaway Ct Unit C	58 ¹	58 ¹	58 ¹	0
R-074D	Res	B	1	4011 Whirlaway Ct Unit D	58 ¹	58 ¹	58 ¹	0
R-074E	Res	B	1	4011 Whirlaway Ct Unit E	58 ¹	58 ¹	58 ¹	0
R-074F	Res	B	1	4011 Whirlaway Ct Unit F	58 ¹	58 ¹	58 ¹	0
R-074G	Res	B	1	4011 Whirlaway Ct Unit G	58 ¹	58 ¹	58 ¹	0
R-074H	Res	B	1	4011 Whirlaway Ct Unit H	58 ¹	58 ¹	58 ¹	0



Table A.5: I-40 Widening & Bridge Replacement (TIP#: I-0911A)
NSA 6 Noise-Sensitive Receptors and Hourly Equivalent Noise Levels

Receptors					Predicted Noise Levels, $L_{eq(h)}$ (dB(A))			
Rec. No.	Use	NAC	D.U.s	Address	Ex.	No-Bld.	Bld.	Δ
R-075A	Res	B	1	3920 Westridge Meadow Circle	58 ¹	58 ¹	58 ¹	0
R-075B	Res	B	1	3916 Westridge Meadow Circle	58 ¹	58 ¹	58 ¹	0
R-075C	Res	B	1	3918 Westridge Meadow Circle	58 ¹	58 ¹	58 ¹	0
R-075D	Res	B	1	3922 Westridge Meadow Circle	58 ¹	58 ¹	58 ¹	0
R-076A	Res	B	1	3827 Westridge Farm Ln	58 ¹	58 ¹	58 ¹	0
R-076B	Res	B	1	3825 Westridge Farm Ln	58 ¹	58 ¹	58 ¹	0
R-076C	Res	B	1	3829 Westridge Farm Ln	58 ¹	58 ¹	58 ¹	0
R-076D	Res	B	1	3831 Westridge Farm Ln	58 ¹	58 ¹	58 ¹	0
R-077A	Res	B	1	3817 Westridge Farm Ln	58 ¹	58 ¹	58 ¹	0
R-077B	Res	B	1	3821 Westridge Farm Ln	58 ¹	58 ¹	58 ¹	0
R-077C	Res	B	1	3823 Westridge Farm Ln	58 ¹	58 ¹	58 ¹	0
R-077D	Res	B	1	3819 Westridge Farm Ln	58 ¹	58 ¹	58 ¹	0
R-078A	Res	B	1	3974 Westridge Meadow Circle	58 ¹	58 ¹	58 ¹	0
R-078B	Res	B	1	3978 Westridge Meadow Circle	58 ¹	58 ¹	58 ¹	0
R-078C	Res	B	1	3976 Westridge Meadow Circle	58 ¹	58 ¹	58 ¹	0
R-078D	Res	B	1	3972 Westridge Meadow Circle	58 ¹	58 ¹	58 ¹	0
NSA 6 Predicted Traffic Noise Impacts					30²	35²	35²	0³
Impact= [REDACTED]								
<p>1. Traffic is not the dominant noise source. $L_{eq(h)} = 58$ dB(A) based on monitored ambient sound levels in comparable land use and acoustic environment at M-4.3 and M-5.3. Sound levels for which TNM predicted traffic noise levels rounded to 58 dB(A) that are equal to or greater than monitored at M-4.3 and M-5.3 are not indicated by this footnote.</p> <p>2. Predicted traffic noise level impact due to approaching or exceeding NAC.</p> <p>3. Predicted “substantial increase” traffic noise level impact.</p>								

Table A.6: I-40 Widening & Bridge Replacement (TIP#: I-0911A)
NSA 7 Noise-Sensitive Receptors and Hourly Equivalent Noise Levels

Receptors					Predicted Noise Levels, $L_{eq(h)}$ (dB(A))			
Rec. No.	Use	NAC	D.U.s	Address	Ex.	No-Bld.	Bld.	Δ
R-049A	Res	B	1	7750 Whitehorse Dr	52	53	53	1
R-049B	Res	B	1	7745 Fair Oaks Drive	53	54	55	2
R-049C	Res	B	1	7735 Fair Oaks Drive	57	59	59	2
R-049	Res	B	1	7725 Fair Oaks Drive	59	60	60	1
R-050	Res	B	1	7715 Fair Oaks Drive	57	58	59	2
R-051B	Res	B	1	4256 Lake Cliff Drive	51 ¹	51 ¹	52	1
R-051A	Res	B	1	4264 Lake Cliff Drive	55	56	56	1
R-051	Res	B	1	4272 Lake Cliff Drive	58	59	60	2
R-052	Res	B	1	4280 Lake Cliff Drive	64	65	65	1
R-053A	Res	B	1	4263 Lake Cliff Drive	52	53	54	2
R-053	Res	B	1	4271 Lake Cliff Drive	54	55	55	1
R-054	Res	B	1	4279 Lake Cliff Drive	60	61	62	2
R-055	Res	B	1	7685 Fair Oaks Drive	67	68	70	3
R-056	Res	B	1	4260 Gardenspring Drive	55	57	58	3
R-057	Res	B	1	4267 Gardenspring Drive	55	56	57	2
NSA 7 Predicted Traffic Noise Impacts					1 ²	1 ²	1 ²	0 ³
Impact= 								
<p>1. Traffic is not the dominant noise source. $L_{eq(h)} = 51$ dB(A) based on monitored ambient sound levels in comparable land use and acoustic environment at M-7.3. Sound levels for which TNM predicted traffic noise levels rounded to 51 dB(A) that are equal to or greater than monitored at M-7.3 are not indicated by this footnote.</p> <p>2. Predicted traffic noise level impact due to approaching or exceeding NAC</p> <p>3. Predicted “substantial increase” traffic noise level impact</p>								

Table A.7: I-40 Widening & Bridge Replacement (TIP#: I-0911A)
NSA 8 Noise-Sensitive Receptors and Hourly Equivalent Noise Levels

Receptors					Predicted Noise Levels, $L_{eq(h)}$ (dB(A))			
Rec. No.	Use	NAC	D.U.s	Address	Ex.	No-Bld.	Bld.	Δ
R-115	Worship	D	1	3791 Harper Rd	41 ¹	42 ¹	43 ¹	2
NSA 8 Predicted Traffic Noise Impacts					0 ²	0 ²	0 ²	0 ³
1. Interior noise level for NAC D receptor, calculated as a 25-decibel reduction from predicted exterior noise level, per applicable Building Noise Reduction Factor (refer to Table 10). 2. Predicted traffic noise level impact due to approaching or exceeding NAC 3. Predicted "substantial increase" traffic noise level impact								

Table A.8: I-40 Widening & Bridge Replacement (TIP#: I-0911A)
NSA 9 Noise-Sensitive Receptors and Hourly Equivalent Noise Levels

Receptors					Predicted Noise Levels, $L_{eq(h)}$ (dB(A))			
Rec. No.	Use	NAC	D.U.s	Address	Ex.	No-Bld.	Bld.	Δ
R-116	Res	B	1	6862 Rollingwood Dr	53	54	56	3
R-117	Res	B	1	6858 Rollingwood Dr	54	55	56	2
R-118	Res	B	1	6854 Rollingwood Dr	54	55	56	2
R-119	Res	B	1	6850 Rollingwood Dr	55	56	56	1
R-120	Res	B	1	6848 Rollingwood Dr	55	56	56	1
R-121	Res	B	1	6842 Rollingwood Dr	57	58	59	2
R-122	Res	B	1	6838 Rollingwood Dr	58	58	59	1
R-123	Res	B	1	6834 Rollingwood Dr	56	57	58	2
R-124	Res	B	1	6826 Rollingwood Dr	57	58	58	1
R-125	Res	B	1	6818 Rollingwood Dr	56	57	58	2
R-126	Res	B	1	6814 Rollingwood Dr	56	57	58	2
NSA 9 Predicted Traffic Noise Impacts					0 ¹	0 ¹	0 ¹	0 ²
1. Predicted traffic noise level impact due to approaching or exceeding NAC 2. Predicted "substantial increase" traffic noise level impact								

Appendix B

ABATEMENT ANALYSIS

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Noise Wall 1 (NW1):

Location: Adjacent to I-40 westbound lanes, east of NC 801.

NW1 meets NCDOT noise abatement feasibility and reasonableness criteria.

NW1 is recommended for construction.

TNM Run: "4 NW1 r2 LTSD" / SBA: "NW1 LTSD"

Table B.1: I-40 Widening and Bridge Replacement (TIP#: I-0911A) Noise Wall 1							
NW1 Acoustical Performance Summary							
Impacts: 2				Avg. Increase @ Impacts: 0 dB(A)			
1 st -Row Receivers: 10				1 st -Row -7 dB(A): 2			
Total Benefits: 11				Total -7 dB(A): 3			
NW1 Parameters							
Terminus (West): -NW1- Sta. 10+00.00 / -L- Sta. 72+00.08 64.50' LT							
Terminus (East): -NW1- Sta. 23+20.00 / -L- Sta. 85+22.21 64.53' LT							
Length: 1,320 ft				Area / Benefit: 2,075 ft ²			
Area: 22,830 ft ²				Allowable Area / Benefit: 2,500 ft ²			
Receptors					Noise Wall Performance		
Rec. No.	Use	NAC	D.U.s	Address	Build	With Barrier	NLR
R-008A	Res	B	1	189 Pinewood Ln #104	62	58	4
R-008D	Res	B	1	189 Pinewood Ln #103	62	58	4
R-009A	Res	B	1	178 Pinewood Ln #101	65	58	7
R-009D	Res	B	1	178 Pinewood Ln #102	64	58	6
R-010A	Res	B	1	172 Pinewood Ln #101	64	58	6
R-010D	Res	B	1	172 Pinewood Ln #102	64	58	6
R-011A	Res	B	1	164 Pinewood Ln #101	63	58	5
R-011D	Res	B	1	164 Pinewood Ln #102	63	58	5
R-012A	Res	B	1	156 Pinewood Ln #101	63	59	4
R-012D	Res	B	1	156 Pinewood Ln #102	63	59	4
R-013A	Res	B	1	148 Pinewood Ln #101	63	60	3
R-013D	Res	B	1	148 Pinewood Ln #102	63	60	3
R-014A	Res	B	1	140 Pinewood Ln #101	63	61	2
R-014D	Res	B	1	140 Pinewood Ln #102	64	61	3
R-015A	Res	B	1	132 Pinewood Ln #101	65	62	3
R-015D	Res	B	1	132 Pinewood Ln #102	65	62	3
R-016A	Res	B	1	157 Pinewood Ln #104	62	58	4
R-016D	Res	B	1	157 Pinewood Ln #103	62	58	4
R-017A	Res	B	1	149 Pinewood Ln #104	62	58	4

Table B.1: I-40 Widening and Bridge Replacement (TIP#: I-0911A) Noise Wall 1							
R-017D	Res	B	1	149 Pinewood Ln #103	63	58	5
R-018A	Res	B	1	141 Pinewood Ln #104	64	59	5
R-018D	Res	B	1	141 Pinewood Ln #103	65	59	6
R-019A	Res	B	1	127 Pinewood Ln #104	67	59	8
R-019D	Res	B	1	127 Pinewood Ln #103	68	61	7
NW1 Predicted Traffic Noise Level Reduction Benefits ¹							11
Impact= 5 to 7 dB(A) ≥ 7 dB(A) NLR= 							
1. A receptor is considered “benefited” if the predicted Noise Level Reduction (NLR) is at least 5 dB(A).							

Noise Wall 3A & Noise Wall 3B (NW3A & NW3B):

Location: Adjacent to both directions of I-40, and mounted on the I-40 bridge traffic barrier.

NW3A & NW3B do not meet NCDOT abatement feasibility and reasonableness criteria.
NW3A & NW3B are not recommended for construction.

TNM Run: "4 NW3 r0" / SBA: "NW3 Max. Reasonable Ht."

Table B.2: I-40 Widening & Bridge Replacement (TIP#: I-0911A) Noise Wall 3A&3B							
NW3A Acoustical Performance Summary							
Impacts: 3				Avg. Increase @ Impacts: 0 dB(A)			
1 st -Row Receivers: 4				1 st -Row -7 dB(A): 0			
Total Benefits: 0				Total -7 dB(A): 0			
NW3A Parameters							
Terminus (West): -NW3A- Sta. 10+00.00 / -L- Sta. 121+02.02 72.50' LT							
Terminus (East): -NW3A- Sta. 28+00.00 / -L- Sta. 139+00.63 62.50' LT							
Length: 1,800 ft				Area / Benefit: N/A ft ²			
Area ¹ : 6,432 ft ²				Allowable Area / Benefit: 2,500 ft ²			
NW3B Parameters							
Terminus (West): -NW3B- Sta. 10+00.00 / -L- Sta. 125+98.83 66.50' RT							
Terminus (East): -NW3B- Sta. 23+00.00 / -L- Sta. 138+96.63 62.50' RT							
Length: 1,300 ft				Area / Benefit: N/A ft ²			
Area ¹ : 3,568 ft ²				Allowable Area / Benefit: 2,500 ft ²			
Receptors					Noise Wall Performance		
Rec. No.	Use	NAC	D.U.s	Address	Build	With Barrier	NLR
R-020	Ath.	C	1	428 Twins Way – Fields 7 & 8	69	65	4
R-020	Ath.	C	1	428 Twins Way – Field 11	65	63	2
R-020	Ath.	C	1	428 Twins Way – Field 14	66	64	2
R-020	Ath.	C	1	428 Twins Way – Field 15	67	66	1
NW3A & NW3B Predicted Traffic Noise Level Reduction Benefits ¹							0
Impact= <div></div>							
1. The maximum reasonable NW3A & NW3B area based on allowable 2,500 square feet per benefit times a maximum of four benefits = 10,000 square feet. The maximum height of NW3A & NW3B, accounting for 900 linear feet ground-mounted and 2,200 feet extending above the I-40 bridge traffic barrier would be 5.72 feet. At the height correlating to the maximum reasonable area, NW3A & NW3B would not provide any - 5dB(A) Noise Level Reduction benefits.							

Noise Wall 5 (NW5):

Location: Adjacent to I-40 westbound lanes, east of the Yadkin River Bridge.

NW5 meets NCDOT noise abatement feasibility and reasonableness criteria.¹
NW5 is recommended for construction.

TNM Run: "4 NW5 r3 LTSD" / SBA: "NW5 LTSD"

Table B.3: I-40 Widening and Bridge Replacement (TIP#: I-0911A) Noise Wall 5							
NW5 Acoustical Performance Summary							
Impacts: 2				Avg. Increase @ Impacts: 2 dB(A)			
1 st -Row Receivers: 2				1 st -Row -7 dB(A): 2			
Total Benefits: 4				Total -7 dB(A): 2			
NW5 Parameters							
Terminus (West): -NW5- Sta. 10+00.00 / -L- Sta. 144+51.48 64.50' LT							
Terminus (East): -NW5- Sta. 18+40.00 / -L- Sta. 152+91.48 64.50' LT							
Length: 840 ft				Area / Benefit: 2,993 ft ²			
Area: 11,970 ft ²				Allowable Area / Benefit: 2,570 ft ²			
Receptors					Noise Wall Performance		
Rec. No.	Use	NAC	D.U.s	Address	Build	With Barrier	NLR
R-079	Res	B	1	7986 Abelia Way	61	61	0
R-080	Res	B	1	7980 Abelia Way	60	60	0
R-081	Res	B	1	7974 Abelia Way	59	59	0
R-082	Res	B	1	7966 Abelia Way	55	54	1
R-083	Res	B	1	7962 Abelia Way	56	56	0
R-084	Res	B	1	7956 Abelia Way	57	57	0
R-085	Res	B	1	3702 Peony Way	55	55	0
R-086	Res	B	1	3714 Peony Way	56	56	0
R-087	Res	B	1	3738 Peony Way	60	59	1
R-088	Res	B	1	3775 Peony Way	70	63 ²	7
R-089	Res	B	1	3763 Peony Way	68	61 ²	7
R-090	Res	B	1	3751 Peony Way	64	58 ³	6
R-091	Res	B	1	3739 Peony Way	60	55 ³	5
R-092	Res	B	1	3727 Peony Way	56	54	2
R-098	Res	B	1	7985 Abelia Way	58	58	0
NW5 Predicted Traffic Noise Level Reduction Benefits ⁴							4
Impact= <div></div> 5 to 7 dB(A) <div></div> NLR= <div></div> ≥ 7 dB(A) NLR= <div></div>							

Table B.3: I-40 Widening and Bridge Replacement (TIP#: I-0911A) Noise Wall 5

1. NW5 is recommended for construction in accordance with the Quantity Averaging provision of the 2011 Policy. The 2,993 square feet per NW5 benefit is less than two times the 2,500 square feet per benefit base quantity reasonableness criteria, and collectively the 1,759 square feet area per benefit of NW5 + NW6 + NW7 in the same Common Noise Environment (CNE) does not exceed the 2,500 square feet per benefit base quantity reasonableness criteria.
2. Reported with-barrier level includes +0.2 dB(A) adjustment to account for Parallel Barrier condition.
3. Reported with-barrier level includes +0.3 dB(A) adjustment to account for Parallel Barrier condition.
4. A receptor is considered “benefited” if the predicted Noise Level Reduction (NLR) is at least 5 dB(A).

Noise Wall 6 (NW6):

Location: Adjacent to I-40 westbound lanes, east of the Yadkin River Bridge.

NW6 meets NCDOT noise abatement feasibility and reasonableness criteria.
NW6 is recommended for construction.

TNM Run: "4 NW6 r1 LTSD" / SBA: "NW6 LTSD"

Table B.4: I-40 Widening and Bridge Replacement (TIP#: I-0911A) Noise Wall 6							
NW6 Acoustical Performance Summary							
Impacts: 35				Avg. Increase @ Impacts: 0 dB(A)			
1 st -Row Receivers: 17				1 st -Row -7 dB(A): 17			
Total Benefits: 39				Total -7 dB(A): 27			
NW6 Parameters							
Terminus (West): -NW6- Sta. 10+00.00 / -L- Sta. 139+42.30 62.65' RT							
Terminus (East): -NW6- Sta. 39+85.00 / -L- Sta. 169+12.31 127.50' RT							
Length: 2,985 ft				Area / Benefit: 1,168 ft ²			
Area: 45,540 ft ²				Allowable Area / Benefit: 2,500 ft ²			
Receptors					Noise Wall Performance		
Rec. No.	Use	NAC	D.U.s	Address	Build	With Barrier	NLR
R-021A	Res	B	1	7645 Riverview Knoll Ct	63	61	2
R-021B	Res	B	1	7641 Riverview Knoll Ct	63	62	1
R-021C	Res	B	1	7637 Riverview Knoll Ct	64	62	2
R-021D	Res	B	1	7633 Riverview Knoll Ct	66	63 ¹	3
R-022A	Res	B	1	7629 Riverview Knoll Ct	67	63 ¹	4
R-022B	Res	B	1	7625 Riverview Knoll Ct	67	62	5
R-022C	Res	B	1	7621 Riverview Knoll Ct	67	62	5
R-022D	Res	B	1	7617 Riverview Knoll Ct	67	62	5
R-023A	Res	B	1	7613 Riverview Knoll Ct	67	62	5
R-023B	Res	B	1	7609 Riverview Knoll Ct	68	62	6
R-023C	Res	B	1	7605 Riverview Knoll Ct	68	62	6
R-023D	Res	B	1	7601 Riverview Knoll Ct	69	62	7
R-024A	Res	B	1	7508 Riverview Knoll Ct	71	64 ²	7
R-024B	Res	B	1	7504 Riverview Knoll Ct	71	64 ³	7
R-024E	Res	B	1	7528 Riverview Knoll Ct	72	65 ⁴	7
R-024F	Res	B	1	7524 Riverview Knoll Ct	72	65 ⁵	7
R-025A	Res	B	1	7308 Riverview Knoll Ct	71	64 ³	7
R-025B	Res	B	1	7304 Riverview Knoll Ct	70	62 ²	8
R-025E	Res	B	1	7328 Riverview Knoll Ct	72	65 ⁵	7

Table B.4: I-40 Widening and Bridge Replacement (TIP#: I-0911A) Noise Wall 6

R-025F	Res	B	1	7324 Riverview Knoll Ct	72	63 ⁴	9
R-026A	Res	B	1	7108 Riverview Knoll Ct	69	62 ²	7
R-026B	Res	B	1	7104 Riverview Knoll Ct	68	62 ³	6
R-026E	Res	B	1	7128 Riverview Knoll Ct	71	63 ⁴	8
R-026F	Res	B	1	7124 Riverview Knoll Ct	71	64 ⁵	7
R-027B	Res	B	1	204 River Oaks Court	73	63 ⁶	10
R-027C	Res	B	1	202 River Oaks Court	75	64 ⁶	11
R-027D	Res	B	1	206 River Oaks Court	64	58	6
R-027E	Pool	C	1	River Oaks Ct Pool	72	65 ⁵	7
R-028A	Res	B	1	106 River Oaks Court	66	58	8
R-028D	Res	B	1	102 River Oaks Court	65	58	7
R-028E	Res	B	1	126 River Oaks Court	70	60	10
R-028H	Res	B	1	122 River Oaks Court	69	59	10
R-030A	Res	B	1	5000 Thoroughbred Ln Unit A	63	58	5
R-030E	Res	B	1	5000 Thoroughbred Ln Unit E	70	58	12
R-033D	Res	B	1	4000 Whirlaway Ct Unit D	66	59	7
R-033F	Res	B	1	4000 Whirlaway Ct Unit F	63	58	5
R-033G	Res	B	1	4000 Whirlaway Ct Unit G	67	58	9
R-033H	Res	B	1	4000 Whirlaway Ct Unit H	73	62	11
R-035A	Res	B	1	4001 Whirlaway Ct Unit A	65	58	7
R-035G	Res	B	1	4001 Whirlaway Ct Unit G	72	62	10
R-035H	Res	B	1	4001 Whirlaway Ct Unit H	67	59	8
R-041B	Res	B	1	3805 Westridge Farm Ln	63	58	5
R-046A	Res	B	1	3998 Westridge Meadow Cir	67	60	7
R-046B	Res	B	1	4002 Westridge Meadow Cir	65	64	1
R-046C	Res	B	1	4000 Westridge Meadow Cir	63	63	0
R-046D	Res	B	1	3996 Westridge Meadow Cir	66	60	6

NW6 Predicted Traffic Noise Level Reduction Benefits⁶ 39

Impact=  5 to 7 dB(A)  NLR=  ≥ 7 dB(A) NLR=

1. Traffic noise is predicted to impact R-021D & R-022A more than 400 feet from I-40 due to the absence of ground attenuation between these receptors and I-40. A 25-foot tall barrier would not provide a 5-decibel Noise Level Reduction (NLR) benefit to R-021D and R-022A.
2. Reported with-barrier level includes +2.0 dB(A) adjustment to account for Parallel Barrier condition.
3. Reported with-barrier level includes +2.2 dB(A) adjustment to account for Parallel Barrier condition.
4. Reported with-barrier level includes +2.7 dB(A) adjustment to account for Parallel Barrier condition.
5. Reported with-barrier level includes +3.1 dB(A) adjustment to account for Parallel Barrier condition.
6. Reported with-barrier level includes +3.0 dB(A) adjustment to account for Parallel Barrier condition.
7. A receptor is considered "benefited" if the predicted Noise Level Reduction (NLR) is at least 5 dB(A).

Noise Wall 7 (NW7):

Location: Adjacent to I-40 westbound lanes, east of the Yadkin River Bridge.

NW7 meets NCDOT noise abatement feasibility and reasonableness criteria.¹
NW7 is recommended for construction.

TNM Run: "4 NW7 r6 LTSD" / SBA: "NW7 LTSD"

Table B.5: I-40 Widening and Bridge Replacement (TIP#: I-0911A) Noise Wall 7							
NW7 Acoustical Performance Summary							
Impacts: 1				Avg. Increase @ Impacts: 3 dB(A)			
1 st -Row Receivers: 1				1 st -Row -7 dB(A): 1			
Total Benefits: 8				Total -7 dB(A): 5			
NW7 Parameters							
Terminus (West): -NW7- Sta. 10+00.00 / -L- Sta. 160+72.16 137.19' LT							
Terminus (East): -NW7- Sta. 26+50.00 / -L- Sta. 177+10.84 143.62' LT							
Length: 1,650 ft				Area / Benefit: 4,024 ft ²			
Area: 32,190 ft ²				Allowable Area / Benefit: 2,605 ft ²			
Receptors					Noise Wall Performance		
Rec. No.	Use	NAC	D.U.s	Address	Build	With Barrier	NLR
R-049C	Res	B	1	7735 Fair Oaks Drive	59	56	3
R-049	Res	B	1	7725 Fair Oaks Drive	60	55	5
R-050	Res	B	1	7715 Fair Oaks Drive	59	55	4
R-051A	Res	B	1	4264 Lake Cliff Drive	56	51	5
R-051	Res	B	1	4272 Lake Cliff Drive	60	52	8
R-052	Res	B	1	4280 Lake Cliff Drive	65	57	8
R-053	Res	B	1	4271 Lake Cliff Drive	55	51	4
R-054	Res	B	1	4279 Lake Cliff Drive	62	54	8
R-055	Res	B	1	7685 Fair Oaks Drive	70	58	12
R-056	Res	B	1	4260 Gardenspring Drive	58	51	7
R-057	Res	B	1	4267 Gardenspring Drive	57	52	5
NW7 Predicted Traffic Noise Level Reduction Benefits ²							8
Impact=					≥ 7 dB(A) NLR=		

Table B.5: I-40 Widening and Bridge Replacement (TIP#: I-0911A) Noise Wall 7

1. NW7 is recommended for construction in accordance with the Quantity Averaging provision of the 2011 Policy. The 4,024 square feet per NW7 benefit is less than two times the 2,500 square feet per benefit base quantity reasonableness criteria, and collectively the 1,759 square feet area per benefit of NW5 + NW6 + NW7 in the same Common Noise Environment (CNE) does not exceed the 2,500 square feet per benefit base quantity reasonableness criteria.
2. A receptor is considered “benefited” if the predicted Noise Level Reduction (NLR) is at least 5 dB(A).

NCDOT Noise Abatement Feasibility and Reasonableness Worksheet

I-40 Widening Bridge Replacement - NW1
TIP #: I-0911A / Davie and Forsyth Counties

PROJECT - <u>I-40 Widening & Yadkin River Bridge Replacement</u>				TIP # - <u>I-0911A</u>			
LOCATION - <u>NW1: I-40 WB, East of NC 801</u>				COUNTY(IES) - <u>Davie & Forsyth</u>			
(CIRCLE ALL THAT APPLY)							
# IMPACTS -	<u>2</u>	# BENEFITS -	<u>11</u>	NAC:	A	B	C D E F G

A. FEASIBILITY:

1 Can a 5-dB(A) reduction in noise levels be achieved for at least one impacted receptor?	<u>X</u>	YES		_____	NO
2 Does topography negatively affect the proposed abatement measure?	_____	YES		<u>X</u>	NO
3 Does the abatement measure negatively affect property access, drainage, safety and maintenance requirements?	_____	YES		<u>X</u>	NO
4 Is there control of access in the vicinity of the proposed abatement measure?	<u>X</u>	YES		_____	NO

B. REASONABLENESS:

1 Can a 7-dB(A) reduction in noise levels be achieved for at least one front row receptor?	<u>X</u>	YES		_____	NO
2 Is the unit quantity per benefited receptor of _____ ^(CIRCLE ONE) 2,075 sq.ft./cu.yd less than the maximum allowable unit quantity per benefited receptor of _____ ^(CIRCLE ONE) 2,500 sq.ft. / cu.yd?	<u>X</u>	YES		_____	NO

C. NOISE ABATEMENT DECISION:

1 Is the noise mitigation feasible?	<u>X</u>	YES		_____	NO
2 Is the noise mitigation reasonable?	<u>X</u>	YES		_____	NO
3 Is the noise mitigation likely?	<u>X</u>	YES		_____	NO
4 Have the owners' and residents' viewpoints been solicited?	_____	YES		<u>X</u>	NO
5 Is the noise mitigation recommended for construction?	<u>X</u>	YES		_____	NO

D. OPTIONAL REASONABLENESS CONSIDERATION:

1 Was optional averaging noise abatement allowance within a common noise environment used for consideration of barrier reasonableness?	_____	YES		<u>X</u>	NO
2 If the answer to D.1 is YES, the unit quantity per benefited receptor for each individual barrier within the common noise environment before averaging are:					
Bar No. _____	^(CIRCLE ONE) _____	sq.ft./cu.yd	Bar No. _____	^(CIRCLE ONE) _____	sq.ft./cu.yd
Bar No. _____	_____	sq.ft./cu.yd	Bar No. _____	_____	sq.ft./cu.yd
3 If the answer to D.1 is YES, is the unit quantity per benefited receptor for each individual barrier less than or equal to twice the maximum allowable base quantity per benefited receptor of _____ ^(CIRCLE ONE) sq.ft./cu.yd					
			YES	_____	NO

Form Completed By: <u>Joseph A. Rauseo</u>	Date: <u>December 29, 2017</u>
In Consultation With: <u>Kevin P. Hughes</u>	Date: <u>December 29, 2017</u>

**NCDOT Noise Abatement
Feasibility and Reasonableness Worksheet**
I-40 Widening and Bridge Replacement - NW3A
TIP #: I-0911A / Davie and Forsyth Counties

PROJECT - <u>I-40 Widening & Yadkin River Bridge Replacement</u>				TIP # - <u>I-0911A</u>				
LOCATION - <u>NW3A: I-40 WB, West of the Yadkin River</u>				COUNTY(IES) - <u>Davie & Forsyth</u>				
# IMPACTS - <u>2</u>	# BENEFITS - <u>0</u>	NAC: A	B	C	D	E	F	G
(CIRCLE ALL THAT APPLY)								
A. FEASIBILITY:								
1	Can a 5-dB(A) reduction in noise levels be achieved for at least one impacted receptor?			<u> </u> YES		<u>X</u> NO		
2	Does topography negatively affect the proposed abatement measure?			<u> </u> YES		<u>X</u> NO		
3	Does the abatement measure negatively affect property access, drainage, safety and maintenance requirements?			<u> </u> YES		<u>X</u> NO		
4	Is there control of access in the vicinity of the proposed abatement measure?			<u>X</u> YES		<u> </u> NO		
B. REASONABLENESS:								
1	Can a 7-dB(A) reduction in noise levels be achieved for at least one front row receptor?			<u> </u> YES		<u>X</u> NO		
2	Is the unit quantity per benefited receptor of <u>N/A</u> <small>(CIRCLE ONE)</small> sq.ft./cu.yd less than the maximum allowable unit quantity per benefited receptor of <u> </u> <small>(CIRCLE ONE)</small> YES			<u> </u> YES		<u>X</u> NO		
	<u>2,500</u> sq.ft. / <u>cu.yd.</u> ?							
C. NOISE ABATEMENT DECISION:								
1	Is the noise mitigation feasible?			<u> </u> YES		<u>X</u> NO		
2	Is the noise mitigation reasonable?			<u> </u> YES		<u>X</u> NO		
3	Is the noise mitigation likely?			<u> </u> YES		<u>X</u> NO		
4	Have the owners' and residents' viewpoints been solicited?			<u> </u> YES		<u>X</u> NO		
5	Is the noise mitigation recommended for construction?			<u> </u> YES		<u>X</u> NO		
D. OPTIONAL REASONABLENESS CONSIDERATION:								
1	Was optional averaging noise abatement allowance within a common noise environment used for consideration of barrier reasonableness?			<u> </u> YES		<u>X</u> NO		
2	If the answer to D.1 is YES, the unit quantity per benefited receptor for each individual barrier within the common noise environment before averaging are:							
	Bar No.	<u> </u>	<u> </u> sq.ft./cu.yd	Bar No.	<u> </u>	<u> </u> sq.ft./cu.yd	<small>(CIRCLE ONE)</small>	
	Bar No.	<u> </u>	<u> </u> sq.ft./cu.yd	Bar No.	<u> </u>	<u> </u> sq.ft./cu.yd	<small>(CIRCLE ONE)</small>	
3	If the answer to D.1 is YES, is the unit quantity per benefited receptor for each individual barrier less than or equal to twice the maximum allowable base quantity per benefited receptor of <u> </u> <small>(CIRCLE ONE)</small> YES			<u> </u> YES		<u> </u> NO		
Form Completed By: <u>Joseph A. Rauseo</u>				Date: <u>December 29, 2017</u>				
In Consultation With: <u>Kevin P. Hughes</u>				Date: <u>December 29, 2017</u>				

NCDOT Noise Abatement Feasibility and Reasonableness Worksheet

I-40 Widening and Bridge Replacement - NW3B

TIP #: I-0911A / Davie and Forsyth Counties

PROJECT - <u>I-40 Widening & Yadkin River Bridge Replacement</u>				TIP # - <u>I-0911A</u>			
LOCATION - <u>NW3B: I-40 EB, West of the Yadkin River</u>				COUNTY(IES) - <u>Davie & Forsyth</u>			
(CIRCLE ALL THAT APPLY)							
# IMPACTS - <u>1</u>	# BENEFITS - <u>0</u>	NAC:	A	B	C	D	E
A. FEASIBILITY:							
1	Can a 5-dB(A) reduction in noise levels be achieved for at least one impacted receptor?			<u> </u> YES		<u>X</u> NO	
2	Does topography negatively affect the proposed abatement measure?			<u> </u> YES		<u>X</u> NO	
3	Does the abatement measure negatively affect property access, drainage, safety and maintenance requirements?			<u> </u> YES		<u>X</u> NO	
4	Is there control of access in the vicinity of the proposed abatement measure?			<u>X</u> YES		<u> </u> NO	
B. REASONABLENESS:							
1	Can a 7-dB(A) reduction in noise levels be achieved for at least one front row receptor?			<u> </u> YES		<u>X</u> NO	
2	Is the unit quantity per benefited receptor of <u>N/A</u> <small>(CIRCLE ONE)</small> sq.ft./cu.yd less than the maximum allowable unit quantity per benefited receptor of <u>2,500</u> <small>(CIRCLE ONE)</small> sq.ft. / cu.yd?			<u> </u> YES		<u>X</u> NO	
C. NOISE ABATEMENT DECISION:							
1	Is the noise mitigation feasible?			<u> </u> YES		<u>X</u> NO	
2	Is the noise mitigation reasonable?			<u> </u> YES		<u>X</u> NO	
3	Is the noise mitigation likely?			<u> </u> YES		<u>X</u> NO	
4	Have the owners' and residents' viewpoints been solicited?			<u> </u> YES		<u>X</u> NO	
5	Is the noise mitigation recommended for construction?			<u> </u> YES		<u>X</u> NO	
D. OPTIONAL REASONABLENESS CONSIDERATION:							
1	Was optional averaging noise abatement allowance within a common noise environment used for consideration of barrier reasonableness?			<u> </u> YES		<u>X</u> NO	
2	If the answer to D.1 is YES, the unit quantity per benefited receptor for each individual barrier within the common noise environment before averaging are:						
	Bar No. <u> </u>	<u> </u>	<small>(CIRCLE ONE)</small> sq.ft./cu.yd	Bar No. <u> </u>	<u> </u>	<small>(CIRCLE ONE)</small> sq.ft./cu.yd	
	Bar No. <u> </u>	<u> </u>	<small>(CIRCLE ONE)</small> sq.ft./cu.yd	Bar No. <u> </u>	<u> </u>	<small>(CIRCLE ONE)</small> sq.ft./cu.yd	
3	If the answer to D.1 is YES, is the unit quantity per benefited receptor for each individual barrier less than or equal to twice the maximum allowable base quantity per benefited receptor of <u> </u> <small>(CIRCLE ONE)</small> sq.ft./cu.yd			<u> </u> YES		<u> </u> NO	
Form Completed By: <u>Joseph A. Rauseo</u>				Date: <u>December 29, 2017</u>			
In Consultation With: <u>Kevin P. Hughes</u>				Date: <u>December 29, 2017</u>			

NCDOT Noise Abatement Feasibility and Reasonableness Worksheet

I-40 Widening and Bridge Replacement - NW5
TIP #: I-0911A / Davie and Forsyth Counties

PROJECT - <u>I-40 Widening & Yadkin River Bridge Replacement</u>				TIP # - <u>I-0911A</u>			
LOCATION - <u>NW5: I-40 WB, East of the Yadkin River</u>				COUNTY(IES) - <u>Davie & Forsyth</u>			
(CIRCLE ALL THAT APPLY)							
# IMPACTS -	<u>2</u>	# BENEFITS -	<u>4</u>	NAC:	A	B	C D E F G

A. FEASIBILITY:

1 Can a 5-dB(A) reduction in noise levels be achieved for at least one impacted receptor?	<u>X</u>	YES		_____	NO
2 Does topography negatively affect the proposed abatement measure?	_____	YES		<u>X</u>	NO
3 Does the abatement measure negatively affect property access, drainage, safety and maintenance requirements?	_____	YES		<u>X</u>	NO
4 Is there control of access in the vicinity of the proposed abatement measure?	<u>X</u>	YES		_____	NO

B. REASONABLENESS:

1 Can a 7-dB(A) reduction in noise levels be achieved for at least one front row receptor?	<u>X</u>	YES		_____	NO
2 Is the unit quantity per benefited receptor of _____ ^(CIRCLE ONE) 2,993 sq.ft./cu.yd less than the maximum allowable unit quantity per benefited receptor of _____ ^(CIRCLE ONE) 2,570 sq.ft. / cu.yd?	_____	YES		<u>X</u>	NO

C. NOISE ABATEMENT DECISION:

1 Is the noise mitigation feasible?	<u>X</u>	YES		_____	NO
2 Is the noise mitigation reasonable?	<u>X</u>	YES		_____	NO
3 Is the noise mitigation likely?	<u>X</u>	YES		_____	NO
4 Have the owners' and residents' viewpoints been solicited?	_____	YES		<u>X</u>	NO
5 Is the noise mitigation recommended for construction?	<u>X</u>	YES		_____	NO

D. OPTIONAL REASONABLENESS CONSIDERATION:

1 Was optional averaging noise abatement allowance within a common noise environment used for consideration of barrier reasonableness?	<u>X</u>	YES		_____	NO
2 If the answer to D.1 is YES, the unit quantity per benefited receptor for each individual barrier within the common noise environment before averaging are:					
Bar No. <u>NW5</u>	<u>2,993</u>	^(CIRCLE ONE) <u>sq.ft./cu.yd</u>	Bar No. <u>NW6</u>	<u>1,168</u>	^(CIRCLE ONE) <u>sq.ft./cu.yd</u>
Bar No. <u>NW7</u>	<u>4,024</u>	<u>sq.ft./cu.yd</u>	Bar No. _____	_____	<u>sq.ft./cu.yd</u>
3 If the answer to D.1 is YES, is the unit quantity per benefited receptor for each individual barrier less than or equal to twice the maximum allowable base quantity per benefited receptor of _____ ^(CIRCLE ONE) 5,000 sq.ft./cu.yd <u>X</u> YES _____ NO					

Form Completed By: Joseph A. Rauseo

Date: May 8, 2018

In Consultation With: Kevin P. Hughes

Date: May 8, 2018

**NCDOT Noise Abatement
Feasibility and Reasonableness Worksheet**

I-40 Widening and Bridge Replacement - NW6

TIP #: I-0911A / Davie and Forsyth Counties

PROJECT - <u>I-40 Widening & Yadkin River Bridge Replacement</u>				TIP # - <u>I-0911A</u>			
LOCATION - <u>NW6: I-40 EB, East of the Yadkin River</u>				COUNTY(IES) - <u>Davie & Forsyth</u>			
(CIRCLE ALL THAT APPLY)							
# IMPACTS -	<u>35</u>	# BENEFITS -	<u>39</u>	NAC:	A	B	C D E F G
A. FEASIBILITY:							
1	Can a 5-dB(A) reduction in noise levels be achieved for at least one impacted receptor?					<u>X</u>	YES NO
2	Does topography negatively affect the proposed abatement measure?						YES <u>X</u> NO
3	Does the abatement measure negatively affect property access, drainage, safety and maintenance requirements?						YES <u>X</u> NO
4	Is there control of access in the vicinity of the proposed abatement measure?					<u>X</u>	YES NO
B. REASONABLENESS:							
1	Can a 7-dB(A) reduction in noise levels be achieved for at least one front row receptor?					<u>X</u>	YES NO
2	Is the unit quantity per benefited receptor of <u>1,168</u> sq.ft./cu.yd less than the maximum allowable unit quantity per benefited receptor of <u>2,500</u> sq.ft. / cu.yd?					<u>X</u>	YES NO
C. NOISE ABATEMENT DECISION:							
1	Is the noise mitigation feasible?					<u>X</u>	YES NO
2	Is the noise mitigation reasonable?					<u>X</u>	YES NO
3	Is the noise mitigation likely?					<u>X</u>	YES NO
4	Have the owners' and residents' viewpoints been solicited?						YES <u>X</u> NO
5	Is the noise mitigation recommended for construction?					<u>X</u>	YES NO
D. OPTIONAL REASONABLENESS CONSIDERATION:							
1	Was optional averaging noise abatement allowance within a common noise environment used for consideration of barrier reasonableness?						YES <u>X</u> NO
2	If the answer to D.1 is YES, the unit quantity per benefited receptor for each individual barrier within the common noise environment before averaging are:						
	Bar No.	<u> </u>	<u> </u>	(CIRCLE ONE) sq.ft./cu.yd	Bar No.	<u> </u>	(CIRCLE ONE) sq.ft./cu.yd
	Bar No.	<u> </u>	<u> </u>	sq.ft./cu.yd	Bar No.	<u> </u>	sq.ft./cu.yd
3	If the answer to D.1 is YES, is the unit quantity per benefited receptor for each individual barrier less than or equal to twice the maximum allowable base quantity per benefited receptor of <u> </u> sq.ft./cu.yd					(CIRCLE ONE) <u> </u>	YES NO
Form Completed By: <u>Joseph A. Rauseo</u>				Date: <u>December 29, 2017</u>			
In Consultation With: <u>Kevin P. Hughes</u>				Date: <u>December 29, 2017</u>			

NCDOT Noise Abatement Feasibility and Reasonableness Worksheet

I-40 Widening and Bridge Replacement - NW7

TIP #: I-0911A / Davie and Forsyth Counties

PROJECT - <u>I-40 Widening & Yadkin River Bridge Replacement</u>				TIP # - <u>I-0911A</u>			
LOCATION - <u>NW7: I-40 WB, West of SR 1101 (Harper Rd.)</u>				COUNTY(IES) - <u>Davie & Forsyth</u>			
(CIRCLE ALL THAT APPLY)							
# IMPACTS - <u>1</u>	# BENEFITS - <u>8</u>	NAC:	A	B	C	D	E
A. FEASIBILITY:							
1	Can a 5-dB(A) reduction in noise levels be achieved for at least one impacted receptor?				<u>X</u>	YES	<u> </u> NO
2	Does topography negatively affect the proposed abatement measure?				<u> </u>	YES	<u>X</u> NO
3	Does the abatement measure negatively affect property access, drainage, safety and maintenance requirements?				<u> </u>	YES	<u>X</u> NO
4	Is there control of access in the vicinity of the proposed abatement measure?				<u>X</u>	YES	<u> </u> NO
B. REASONABLENESS:							
1	Can a 7-dB(A) reduction in noise levels be achieved for at least one front row receptor?				<u>X</u>	YES	<u> </u> NO
2	Is the unit quantity per benefited receptor of <u>4,024</u> sq.ft./cu.yd. less than the maximum allowable unit quantity per benefited receptor of <u>2,605</u> sq.ft. / cu.yd.?				<u> </u>	YES	<u>X</u> NO
(CIRCLE ONE)							
C. NOISE ABATEMENT DECISION:							
1	Is the noise mitigation feasible?				<u>X</u>	YES	<u> </u> NO
2	Is the noise mitigation reasonable?				<u>X</u>	YES	<u> </u> NO
3	Is the noise mitigation likely?				<u>X</u>	YES	<u> </u> NO
4	Have the owners' and residents' viewpoints been solicited?				<u> </u>	YES	<u>X</u> NO
5	Is the noise mitigation recommended for construction?				<u>X</u>	YES	<u> </u> NO
D. OPTIONAL REASONABLENESS CONSIDERATION:							
1	Was optional averaging noise abatement allowance within a common noise environment used for consideration of barrier reasonableness?				<u>X</u>	YES	<u> </u> NO
2	If the answer to D.1 is YES, the unit quantity per benefited receptor for each individual barrier within the common noise environment before averaging are:						
	Bar No. <u>NW5</u>	<u>2,993</u> sq.ft./cu.yd.	(CIRCLE ONE)	Bar No. <u>NW6</u>	<u>1,168</u> sq.ft./cu.yd.	(CIRCLE ONE)	
	Bar No. <u>NW7</u>	<u>4,024</u> sq.ft./cu.yd.		Bar No. <u> </u>	<u> </u> sq.ft./cu.yd.		
3	If the answer to D.1 is YES, is the unit quantity per benefited receptor for each individual barrier less than or equal to twice the maximum allowable base quantity per benefited receptor of <u>5,000</u> sq.ft./cu.yd.				<u>X</u>	YES	<u> </u> NO
(CIRCLE ONE)							
Form Completed By: <u>Joseph A. Rauseo</u>				Date: <u>May 8, 2018</u>			
In Consultation With: <u>Kevin P. Hughes</u>				Date: <u>May 8, 2018</u>			

Appendix C

NOISE BARRIER DESIGN



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8/17/99

PROJECT REFERENCE NO.
1-0911A

SHEET NO.
NW1

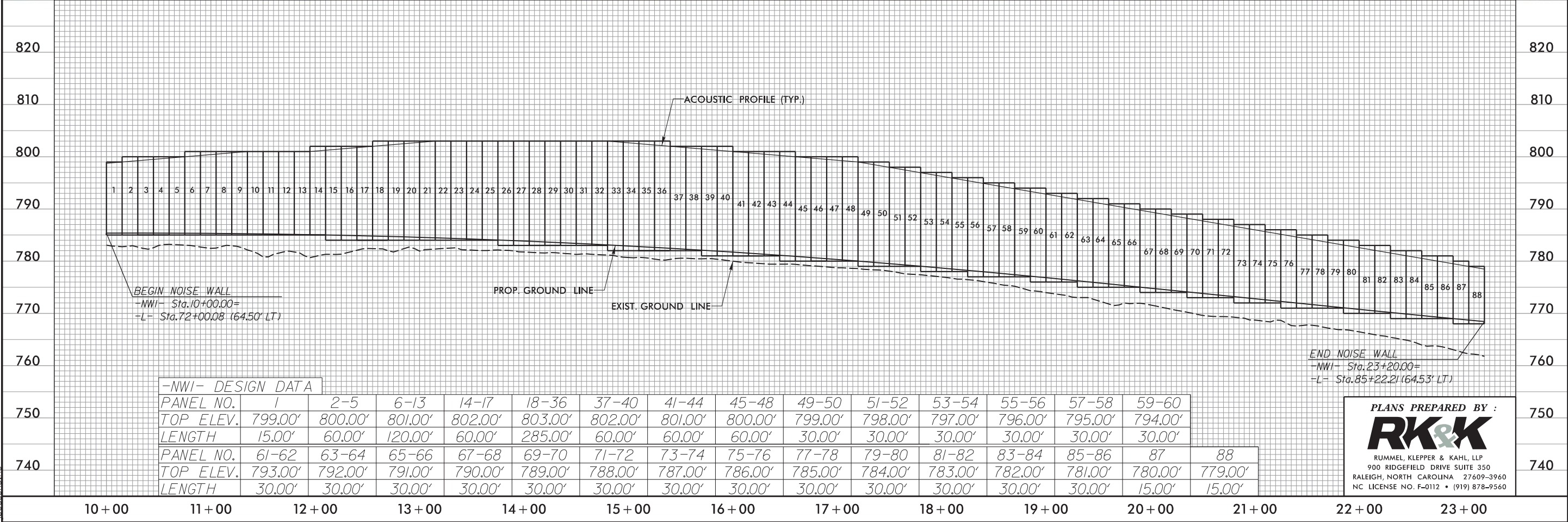
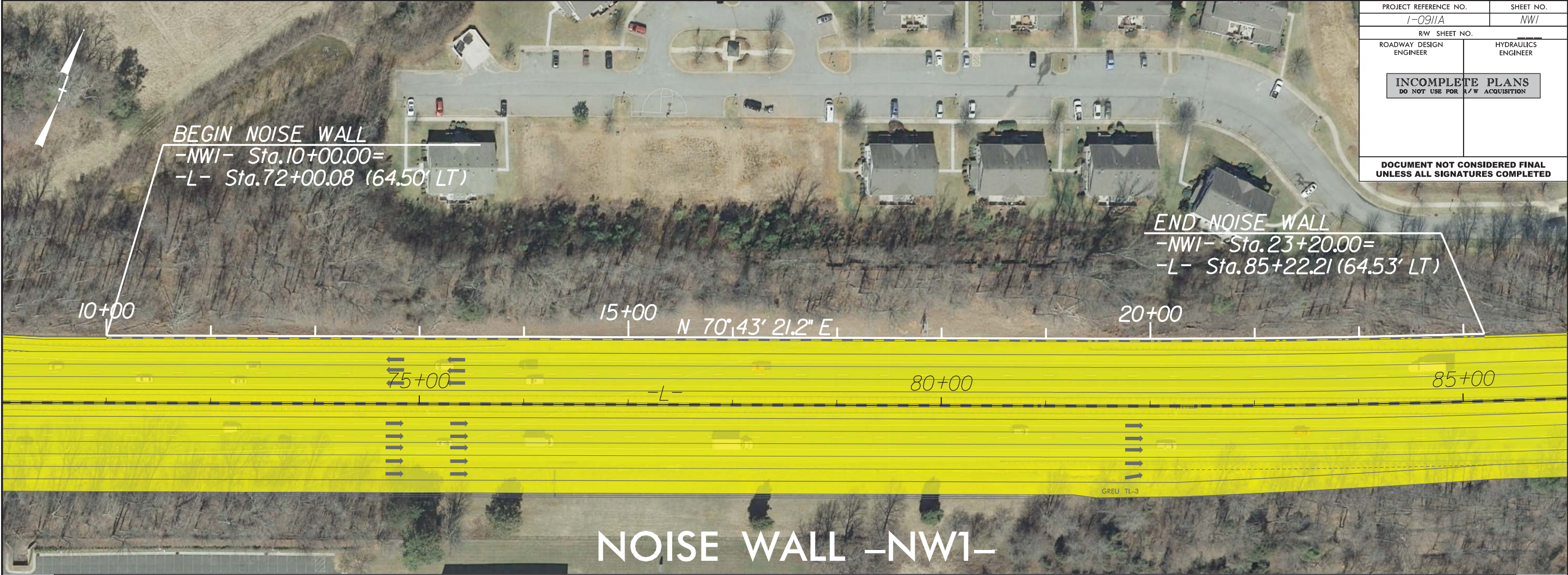
RW SHEET NO.

ROADWAY DESIGN ENGINEER

HYDRAULICS ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

DOCUMENT NOT CONSIDERED FINAL
UNLESS ALL SIGNATURES COMPLETED



PLANS PREPARED BY :

RK&K

RUMMEL, KLEPPER & KAHL, LLP
900 RIDGEFIELD DRIVE SUITE 350
RALEIGH, NORTH CAROLINA 27609-3960
NC LICENSE NO. F-0112 • (919) 878-9560

2/28/2018 R:\Noise\0911A_RdL_psh_NW1.dgn

I-0911A NW1 DNR Noise Wall Design Table

Total L (ft)	Total A (ft ²)
1,320.00	22,830.00

Panel No.	Panel Start Station	x	y	Panel End Station	x	y	Z-bottom	Z-top	Height (ft)	Length (ft)	Area (ft ²)
1	NW1 - Sta. 10+00.00	1574753.6899	825061.8045	NW1 - Sta. 10+15.00	1574767.8489	825066.7567	785.00	799.00	14.00	15.00	210.00
2	NW1 - Sta. 10+15.00	1574767.8489	825066.7567	NW1 - Sta. 10+30.00	1574782.0078	825071.7088	785.00	800.00	15.00	15.00	225.00
3	NW1 - Sta. 10+30.00	1574782.0078	825071.7088	NW1 - Sta. 10+45.00	1574796.1668	825076.6610	785.00	800.00	15.00	15.00	225.00
4	NW1 - Sta. 10+45.00	1574796.1668	825076.6610	NW1 - Sta. 10+60.00	1574810.3257	825081.6131	785.00	800.00	15.00	15.00	225.00
5	NW1 - Sta. 10+60.00	1574810.3257	825081.6131	NW1 - Sta. 10+75.00	1574824.4847	825086.5653	785.00	800.00	15.00	15.00	225.00
6	NW1 - Sta. 10+75.00	1574824.4847	825086.5653	NW1 - Sta. 10+90.00	1574838.6437	825091.5174	785.00	801.00	16.00	15.00	240.00
7	NW1 - Sta. 10+90.00	1574838.6437	825091.5174	NW1 - Sta. 11+05.00	1574852.8026	825096.4695	785.00	801.00	16.00	15.00	240.00
8	NW1 - Sta. 11+05.00	1574852.8026	825096.4695	NW1 - Sta. 11+20.00	1574866.9616	825101.4217	785.00	801.00	16.00	15.00	240.00
9	NW1 - Sta. 11+20.00	1574866.9616	825101.4217	NW1 - Sta. 11+35.00	1574881.1206	825106.3738	785.00	801.00	16.00	15.00	240.00
10	NW1 - Sta. 11+35.00	1574881.1206	825106.3738	NW1 - Sta. 11+50.00	1574895.2795	825111.3260	785.00	801.00	16.00	15.00	240.00
11	NW1 - Sta. 11+50.00	1574895.2795	825111.3260	NW1 - Sta. 11+65.00	1574909.4385	825116.2781	785.00	801.00	16.00	15.00	240.00
12	NW1 - Sta. 11+65.00	1574909.4385	825116.2781	NW1 - Sta. 11+80.00	1574923.5975	825121.2303	785.00	801.00	16.00	15.00	240.00
13	NW1 - Sta. 11+80.00	1574923.5975	825121.2303	NW1 - Sta. 11+95.00	1574937.7564	825126.1824	785.00	801.00	16.00	15.00	240.00
14	NW1 - Sta. 11+95.00	1574937.7564	825126.1824	NW1 - Sta. 12+10.00	1574951.9154	825131.1346	785.00	802.00	17.00	15.00	255.00
15	NW1 - Sta. 12+10.00	1574951.9154	825131.1346	NW1 - Sta. 12+25.00	1574966.0744	825136.0867	784.00	802.00	18.00	15.00	270.00
16	NW1 - Sta. 12+25.00	1574966.0744	825136.0867	NW1 - Sta. 12+40.00	1574980.2333	825141.0388	784.00	802.00	18.00	15.00	270.00
17	NW1 - Sta. 12+40.00	1574980.2333	825141.0388	NW1 - Sta. 12+55.00	1574994.3923	825145.9910	784.00	802.00	18.00	15.00	270.00
18	NW1 - Sta. 12+55.00	1574994.3923	825145.9910	NW1 - Sta. 12+70.00	1575008.5512	825150.9431	784.00	803.00	19.00	15.00	285.00
19	NW1 - Sta. 12+70.00	1575008.5512	825150.9431	NW1 - Sta. 12+85.00	1575022.7102	825155.8953	784.00	803.00	19.00	15.00	285.00
20	NW1 - Sta. 12+85.00	1575022.7102	825155.8953	NW1 - Sta. 13+00.00	1575036.8692	825160.8474	784.00	803.00	19.00	15.00	285.00
21	NW1 - Sta. 13+00.00	1575036.8692	825160.8474	NW1 - Sta. 13+15.00	1575051.0281	825165.7996	784.00	803.00	19.00	15.00	285.00
22	NW1 - Sta. 13+15.00	1575051.0281	825165.7996	NW1 - Sta. 13+30.00	1575065.1871	825170.7517	784.00	803.00	19.00	15.00	285.00
23	NW1 - Sta. 13+30.00	1575065.1871	825170.7517	NW1 - Sta. 13+45.00	1575079.3461	825175.7039	784.00	803.00	19.00	15.00	285.00
24	NW1 - Sta. 13+45.00	1575079.3461	825175.7039	NW1 - Sta. 13+60.00	1575093.5050	825180.6560	784.00	803.00	19.00	15.00	285.00
25	NW1 - Sta. 13+60.00	1575093.5050	825180.6560	NW1 - Sta. 13+75.00	1575107.6640	825185.6081	784.00	803.00	19.00	15.00	285.00
26	NW1 - Sta. 13+75.00	1575107.6640	825185.6081	NW1 - Sta. 13+90.00	1575121.8230	825190.5603	783.00	803.00	20.00	15.00	300.00
27	NW1 - Sta. 13+90.00	1575121.8230	825190.5603	NW1 - Sta. 14+05.00	1575135.9819	825195.5124	783.00	803.00	20.00	15.00	300.00
28	NW1 - Sta. 14+05.00	1575135.9819	825195.5124	NW1 - Sta. 14+20.00	1575150.1409	825200.4646	783.00	803.00	20.00	15.00	300.00
29	NW1 - Sta. 14+20.00	1575150.1409	825200.4646	NW1 - Sta. 14+35.00	1575164.2998	825205.4167	783.00	803.00	20.00	15.00	300.00
30	NW1 - Sta. 14+35.00	1575164.2998	825205.4167	NW1 - Sta. 14+50.00	1575178.4588	825210.3689	783.00	803.00	20.00	15.00	300.00
31	NW1 - Sta. 14+50.00	1575178.4588	825210.3689	NW1 - Sta. 14+65.00	1575192.6178	825215.3210	783.00	803.00	20.00	15.00	300.00
32	NW1 - Sta. 14+65.00	1575192.6178	825215.3210	NW1 - Sta. 14+80.00	1575206.7767	825220.2732	783.00	803.00	20.00	15.00	300.00
33	NW1 - Sta. 14+80.00	1575206.7767	825220.2732	NW1 - Sta. 14+95.00	1575220.9357	825225.2253	782.00	803.00	21.00	15.00	315.00
34	NW1 - Sta. 14+95.00	1575220.9357	825225.2253	NW1 - Sta. 15+10.00	1575235.0947	825230.1774	782.00	803.00	21.00	15.00	315.00
35	NW1 - Sta. 15+10.00	1575235.0947	825230.1774	NW1 - Sta. 15+25.00	1575249.2536	825235.1296	782.00	803.00	21.00	15.00	315.00
36	NW1 - Sta. 15+25.00	1575249.2536	825235.1296	NW1 - Sta. 15+40.00	1575263.4126	825240.0817	782.00	803.00	21.00	15.00	315.00
37	NW1 - Sta. 15+40.00	1575263.4126	825240.0817	NW1 - Sta. 15+55.00	1575277.5716	825245.0339	782.00	802.00	20.00	15.00	300.00
38	NW1 - Sta. 15+55.00	1575277.5716	825245.0339	NW1 - Sta. 15+70.00	1575291.7305	825249.9860	782.00	802.00	20.00	15.00	300.00
39	NW1 - Sta. 15+70.00	1575291.7305	825249.9860	NW1 - Sta. 15+85.00	1575305.8895	825254.9382	781.00	802.00	21.00	15.00	315.00
40	NW1 - Sta. 15+85.00	1575305.8895	825254.9382	NW1 - Sta. 16+00.00	1575320.0485	825259.8903	781.00	802.00	21.00	15.00	315.00
41	NW1 - Sta. 16+00.00	1575320.0485	825259.8903	NW1 - Sta. 16+15.00	1575334.2074	825264.8425	781.00	801.00	20.00	15.00	300.00
42	NW1 - Sta. 16+15.00	1575334.2074	825264.8425	NW1 - Sta. 16+30.00	1575348.3664	825269.7946	781.00	801.00	20.00	15.00	300.00
43	NW1 - Sta. 16+30.00	1575348.3664	825269.7946	NW1 - Sta. 16+45.00	1575362.5253	825274.7468	781.00	801.00	20.00	15.00	300.00
44	NW1 - Sta. 16+45.00	1575362.5253	825274.7468	NW1 - Sta. 16+60.00	1575376.6843	825279.6989	780.00	801.00	21.00	15.00	315.00
45	NW1 - Sta. 16+60.00	1575376.6843	825279.6989	NW1 - Sta. 16+75.00	1575390.8433	825284.6510	780.00	800.00	20.00	15.00	300.00
46	NW1 - Sta. 16+75.00	1575390.8433	825284.6510	NW1 - Sta. 16+90.00	1575405.0022	825289.6032	780.00	800.00	20.00	15.00	300.00

I-0911A NW1 DNR Noise Wall Design Table

Total L (ft)	Total A (ft ²)
1,320.00	22,830.00

Panel No.	Panel Start Station	x	y	Panel End Station	x	y	Z-bottom	Z-top	Height (ft)	Length (ft)	Area (ft ²)
47	NW1 - Sta. 16+90.00	1575405.0022	825289.6032	NW1 - Sta. 17+05.00	1575419.1612	825294.5553	780.00	800.00	20.00	15.00	300.00
48	NW1 - Sta. 17+05.00	1575419.1612	825294.5553	NW1 - Sta. 17+20.00	1575433.3202	825299.5075	780.00	800.00	20.00	15.00	300.00
49	NW1 - Sta. 17+20.00	1575433.3202	825299.5075	NW1 - Sta. 17+35.00	1575447.4791	825304.4596	779.00	799.00	20.00	15.00	300.00
50	NW1 - Sta. 17+35.00	1575447.4791	825304.4596	NW1 - Sta. 17+50.00	1575461.6381	825309.4118	779.00	799.00	20.00	15.00	300.00
51	NW1 - Sta. 17+50.00	1575461.6381	825309.4118	NW1 - Sta. 17+65.00	1575475.7971	825314.3639	779.00	798.00	19.00	15.00	285.00
52	NW1 - Sta. 17+65.00	1575475.7971	825314.3639	NW1 - Sta. 17+80.00	1575489.9560	825319.3161	779.00	798.00	19.00	15.00	285.00
53	NW1 - Sta. 17+80.00	1575489.9560	825319.3161	NW1 - Sta. 17+95.00	1575504.1150	825324.2682	778.00	797.00	19.00	15.00	285.00
54	NW1 - Sta. 17+95.00	1575504.1150	825324.2682	NW1 - Sta. 18+10.00	1575518.2740	825329.2203	778.00	797.00	19.00	15.00	285.00
55	NW1 - Sta. 18+10.00	1575518.2740	825329.2203	NW1 - Sta. 18+25.00	1575532.4329	825334.1725	778.00	796.00	18.00	15.00	270.00
56	NW1 - Sta. 18+25.00	1575532.4329	825334.1725	NW1 - Sta. 18+40.00	1575546.5919	825339.1246	777.00	796.00	19.00	15.00	285.00
57	NW1 - Sta. 18+40.00	1575546.5919	825339.1246	NW1 - Sta. 18+55.00	1575560.7508	825344.0768	777.00	795.00	18.00	15.00	270.00
58	NW1 - Sta. 18+55.00	1575560.7508	825344.0768	NW1 - Sta. 18+70.00	1575574.9098	825349.0289	777.00	795.00	18.00	15.00	270.00
59	NW1 - Sta. 18+70.00	1575574.9098	825349.0289	NW1 - Sta. 18+85.00	1575589.0688	825353.9811	777.00	794.00	17.00	15.00	255.00
60	NW1 - Sta. 18+85.00	1575589.0688	825353.9811	NW1 - Sta. 19+00.00	1575603.2266	825358.9365	776.00	794.00	18.00	15.00	270.00
61	NW1 - Sta. 19+00.00	1575603.2266	825358.9365	NW1 - Sta. 19+15.00	1575617.3844	825363.8919	776.00	793.00	17.00	15.00	255.00
62	NW1 - Sta. 19+15.00	1575617.3844	825363.8919	NW1 - Sta. 19+30.00	1575631.5422	825368.8474	776.00	793.00	17.00	15.00	255.00
63	NW1 - Sta. 19+30.00	1575631.5422	825368.8474	NW1 - Sta. 19+45.00	1575645.7000	825373.8028	775.00	792.00	17.00	15.00	255.00
64	NW1 - Sta. 19+45.00	1575645.7000	825373.8028	NW1 - Sta. 19+60.00	1575659.8483	825378.7855	775.00	792.00	17.00	15.00	255.00
65	NW1 - Sta. 19+60.00	1575659.8483	825378.7855	NW1 - Sta. 19+75.00	1575673.9965	825383.7681	775.00	791.00	16.00	15.00	240.00
66	NW1 - Sta. 19+75.00	1575673.9965	825383.7681	NW1 - Sta. 19+90.00	1575688.1448	825388.7508	775.00	791.00	16.00	15.00	240.00
67	NW1 - Sta. 19+90.00	1575688.1448	825388.7508	NW1 - Sta. 20+05.00	1575702.2931	825393.7334	774.00	790.00	16.00	15.00	240.00
68	NW1 - Sta. 20+05.00	1575702.2931	825393.7334	NW1 - Sta. 20+20.00	1575716.4204	825398.7750	774.00	790.00	16.00	15.00	240.00
69	NW1 - Sta. 20+20.00	1575716.4204	825398.7750	NW1 - Sta. 20+35.00	1575730.5478	825403.8166	774.00	789.00	15.00	15.00	225.00
70	NW1 - Sta. 20+35.00	1575730.5478	825403.8166	NW1 - Sta. 20+50.00	1575744.6752	825408.8581	773.00	789.00	16.00	15.00	240.00
71	NW1 - Sta. 20+50.00	1575744.6752	825408.8581	NW1 - Sta. 20+65.00	1575758.8025	825413.8997	773.00	788.00	15.00	15.00	225.00
72	NW1 - Sta. 20+65.00	1575758.8025	825413.8997	NW1 - Sta. 20+80.00	1575772.9017	825419.0195	773.00	788.00	15.00	15.00	225.00
73	NW1 - Sta. 20+80.00	1575772.9017	825419.0195	NW1 - Sta. 20+95.00	1575787.0009	825424.1393	772.00	787.00	15.00	15.00	225.00
74	NW1 - Sta. 20+95.00	1575787.0009	825424.1393	NW1 - Sta. 21+10.00	1575801.1001	825429.2591	772.00	787.00	15.00	15.00	225.00
75	NW1 - Sta. 21+10.00	1575801.1001	825429.2591	NW1 - Sta. 21+25.00	1575815.1994	825434.3789	772.00	786.00	14.00	15.00	210.00
76	NW1 - Sta. 21+25.00	1575815.1994	825434.3789	NW1 - Sta. 21+40.00	1575829.2695	825439.5782	771.00	786.00	15.00	15.00	225.00
77	NW1 - Sta. 21+40.00	1575829.2695	825439.5782	NW1 - Sta. 21+55.00	1575843.3396	825444.7774	771.00	785.00	14.00	15.00	210.00
78	NW1 - Sta. 21+55.00	1575843.3396	825444.7774	NW1 - Sta. 21+70.00	1575857.4097	825449.9767	771.00	785.00	14.00	15.00	210.00
79	NW1 - Sta. 21+70.00	1575857.4097	825449.9767	NW1 - Sta. 21+85.00	1575871.4798	825455.1759	771.00	784.00	13.00	15.00	195.00
80	NW1 - Sta. 21+85.00	1575871.4798	825455.1759	NW1 - Sta. 22+00.00	1575885.5203	825460.4545	770.00	784.00	14.00	15.00	210.00
81	NW1 - Sta. 22+00.00	1575885.5203	825460.4545	NW1 - Sta. 22+15.00	1575899.5608	825465.7330	770.00	783.00	13.00	15.00	195.00
82	NW1 - Sta. 22+15.00	1575899.5608	825465.7330	NW1 - Sta. 22+30.00	1575913.6014	825471.0116	770.00	783.00	13.00	15.00	195.00
83	NW1 - Sta. 22+30.00	1575913.6014	825471.0116	NW1 - Sta. 22+45.00	1575927.6419	825476.2901	769.00	782.00	13.00	15.00	195.00
84	NW1 - Sta. 22+45.00	1575927.6419	825476.2901	NW1 - Sta. 22+60.00	1575941.6525	825481.6478	769.00	782.00	13.00	15.00	195.00
85	NW1 - Sta. 22+60.00	1575941.6525	825481.6478	NW1 - Sta. 22+75.00	1575955.6630	825487.0055	769.00	781.00	12.00	15.00	180.00
86	NW1 - Sta. 22+75.00	1575955.6630	825487.0055	NW1 - Sta. 22+90.00	1575969.6736	825492.3632	769.00	781.00	12.00	15.00	180.00
87	NW1 - Sta. 22+90.00	1575969.6736	825492.3632	NW1 - Sta. 23+05.00	1575983.6841	825497.7208	768.00	780.00	12.00	15.00	180.00
88	NW1 - Sta. 23+05.00	1575983.6841	825497.7208	NW1 - Sta. 23+20.00	1575997.6642	825503.1575	768.00	779.00	11.00	15.00	165.00

8/17/99

PROJECT REFERENCE NO.
1-0911A

SHEET NO.
NW5

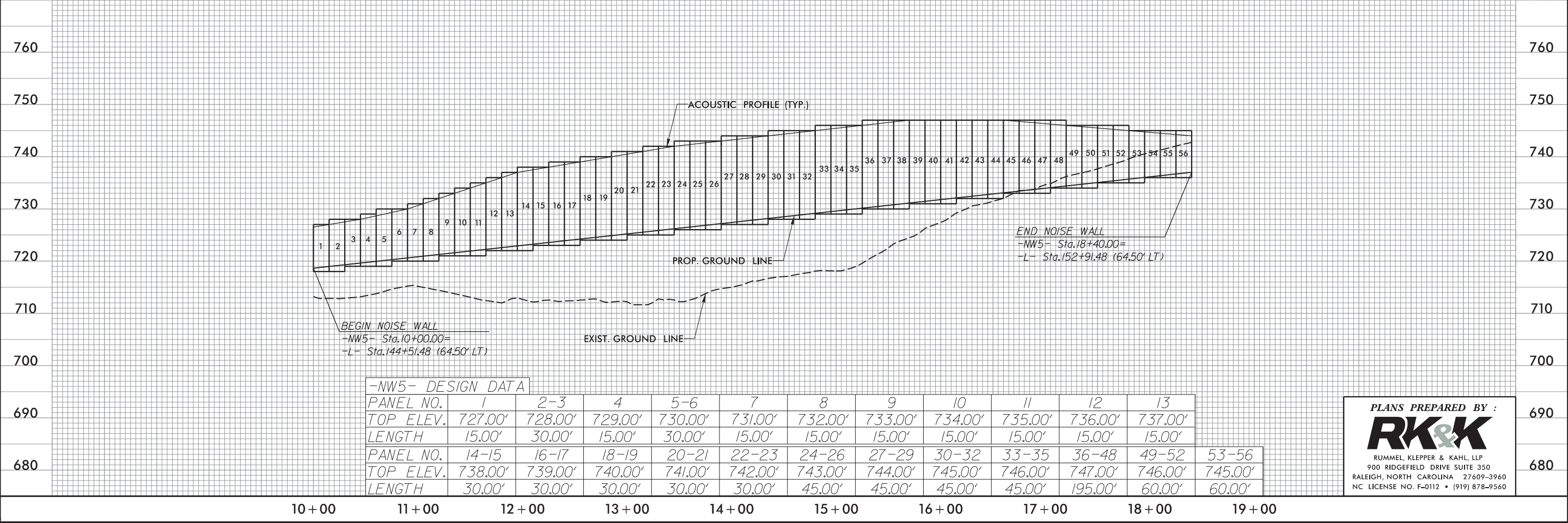
RW SHEET NO.

ROADWAY DESIGN ENGINEER

HYDRAULICS ENGINEER

INCOMPLETE PLANS
DO NOT USE FOR R/W ACQUISITION

DOCUMENT NOT CONSIDERED FINAL
UNLESS ALL SIGNATURES COMPLETED



3/19/2018 10:09:11A_RdLnsh_NW5.dgn
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PLANS PREPARED BY :

RK&K

RUMMEL, KLEPPER & KAHL, LLP
900 RIDGEFIELD DRIVE SUITE 350
RALEIGH, NORTH CAROLINA 27609-3960
NC LICENSE NO. F-0112 • (919) 878-9560

I-0911A NW5 DNR Noise Wall Design Table

Total L (ft)	Total A (ft ²)
840.00	11,970.00

Panel No.	Panel Start Station	x	y	Panel End Station	x	y	Z-bottom	Z-top	Height (ft)	Length (ft)	Area (ft ²)
1	NW5 - Sta. 10+00.00	1581186.0455	828342.5505	NW5 - Sta. 10+15.00	1581199.0516	828350.0232	718.00	727.00	9.00	15.00	135.00
2	NW5 - Sta. 10+15.00	1581199.0516	828350.0232	NW5 - Sta. 10+30.00	1581212.0577	828357.4959	718.00	728.00	10.00	15.00	150.00
3	NW5 - Sta. 10+30.00	1581212.0577	828357.4959	NW5 - Sta. 10+45.00	1581225.0639	828364.9686	719.00	728.00	9.00	15.00	135.00
4	NW5 - Sta. 10+45.00	1581225.0639	828364.9686	NW5 - Sta. 10+60.00	1581238.0700	828372.4413	719.00	729.00	10.00	15.00	150.00
5	NW5 - Sta. 10+60.00	1581238.0700	828372.4413	NW5 - Sta. 10+75.00	1581251.0761	828379.9140	719.00	730.00	11.00	15.00	165.00
6	NW5 - Sta. 10+75.00	1581251.0761	828379.9140	NW5 - Sta. 10+90.00	1581264.0822	828387.3866	720.00	730.00	10.00	15.00	150.00
7	NW5 - Sta. 10+90.00	1581264.0822	828387.3866	NW5 - Sta. 11+05.00	1581277.0883	828394.8593	720.00	731.00	11.00	15.00	165.00
8	NW5 - Sta. 11+05.00	1581277.0883	828394.8593	NW5 - Sta. 11+20.00	1581290.0944	828402.3320	720.00	732.00	12.00	15.00	180.00
9	NW5 - Sta. 11+20.00	1581290.0944	828402.3320	NW5 - Sta. 11+35.00	1581303.1005	828409.8047	721.00	733.00	12.00	15.00	180.00
10	NW5 - Sta. 11+35.00	1581303.1005	828409.8047	NW5 - Sta. 11+50.00	1581316.1067	828417.2774	721.00	734.00	13.00	15.00	195.00
11	NW5 - Sta. 11+50.00	1581316.1067	828417.2774	NW5 - Sta. 11+65.00	1581329.1128	828424.7501	721.00	735.00	14.00	15.00	210.00
12	NW5 - Sta. 11+65.00	1581329.1128	828424.7501	NW5 - Sta. 11+80.00	1581342.1189	828432.2227	722.00	736.00	14.00	15.00	210.00
13	NW5 - Sta. 11+80.00	1581342.1189	828432.2227	NW5 - Sta. 11+95.00	1581355.1250	828439.6954	722.00	737.00	15.00	15.00	225.00
14	NW5 - Sta. 11+95.00	1581355.1250	828439.6954	NW5 - Sta. 12+10.00	1581368.1311	828447.1681	722.00	738.00	16.00	15.00	240.00
15	NW5 - Sta. 12+10.00	1581368.1311	828447.1681	NW5 - Sta. 12+25.00	1581381.1372	828454.6408	723.00	738.00	15.00	15.00	225.00
16	NW5 - Sta. 12+25.00	1581381.1372	828454.6408	NW5 - Sta. 12+40.00	1581394.1433	828462.1135	723.00	739.00	16.00	15.00	240.00
17	NW5 - Sta. 12+40.00	1581394.1433	828462.1135	NW5 - Sta. 12+55.00	1581407.1494	828469.5862	723.00	739.00	16.00	15.00	240.00
18	NW5 - Sta. 12+55.00	1581407.1494	828469.5862	NW5 - Sta. 12+70.00	1581420.1556	828477.0589	724.00	740.00	16.00	15.00	240.00
19	NW5 - Sta. 12+70.00	1581420.1556	828477.0589	NW5 - Sta. 12+85.00	1581433.1617	828484.5315	724.00	740.00	16.00	15.00	240.00
20	NW5 - Sta. 12+85.00	1581433.1617	828484.5315	NW5 - Sta. 13+00.00	1581446.1678	828492.0042	724.00	741.00	17.00	15.00	255.00
21	NW5 - Sta. 13+00.00	1581446.1678	828492.0042	NW5 - Sta. 13+15.00	1581459.1739	828499.4769	725.00	741.00	16.00	15.00	240.00
22	NW5 - Sta. 13+15.00	1581459.1739	828499.4769	NW5 - Sta. 13+30.00	1581472.1800	828506.9496	725.00	742.00	17.00	15.00	255.00
23	NW5 - Sta. 13+30.00	1581472.1800	828506.9496	NW5 - Sta. 13+45.00	1581485.1861	828514.4223	725.00	742.00	17.00	15.00	255.00
24	NW5 - Sta. 13+45.00	1581485.1861	828514.4223	NW5 - Sta. 13+60.00	1581498.1922	828521.8950	726.00	743.00	17.00	15.00	255.00
25	NW5 - Sta. 13+60.00	1581498.1922	828521.8950	NW5 - Sta. 13+75.00	1581511.1984	828529.3676	726.00	743.00	17.00	15.00	255.00
26	NW5 - Sta. 13+75.00	1581511.1984	828529.3676	NW5 - Sta. 13+90.00	1581524.2045	828536.8403	726.00	743.00	17.00	15.00	255.00
27	NW5 - Sta. 13+90.00	1581524.2045	828536.8403	NW5 - Sta. 14+05.00	1581537.2106	828544.3130	727.00	744.00	17.00	15.00	255.00
28	NW5 - Sta. 14+05.00	1581537.2106	828544.3130	NW5 - Sta. 14+20.00	1581550.2167	828551.7857	727.00	744.00	17.00	15.00	255.00
29	NW5 - Sta. 14+20.00	1581550.2167	828551.7857	NW5 - Sta. 14+35.00	1581563.2228	828559.2584	727.00	744.00	17.00	15.00	255.00
30	NW5 - Sta. 14+35.00	1581563.2228	828559.2584	NW5 - Sta. 14+50.00	1581576.2289	828566.7311	728.00	745.00	17.00	15.00	255.00
31	NW5 - Sta. 14+50.00	1581576.2289	828566.7311	NW5 - Sta. 14+65.00	1581589.2350	828574.2037	728.00	745.00	17.00	15.00	255.00
32	NW5 - Sta. 14+65.00	1581589.2350	828574.2037	NW5 - Sta. 14+80.00	1581602.2412	828581.6764	728.00	745.00	17.00	15.00	255.00
33	NW5 - Sta. 14+80.00	1581602.2412	828581.6764	NW5 - Sta. 14+95.00	1581615.2473	828589.1491	729.00	746.00	17.00	15.00	255.00
34	NW5 - Sta. 14+95.00	1581615.2473	828589.1491	NW5 - Sta. 15+10.00	1581628.2534	828596.6218	729.00	746.00	17.00	15.00	255.00
35	NW5 - Sta. 15+10.00	1581628.2534	828596.6218	NW5 - Sta. 15+25.00	1581641.2595	828604.0945	729.00	746.00	17.00	15.00	255.00
36	NW5 - Sta. 15+25.00	1581641.2595	828604.0945	NW5 - Sta. 15+40.00	1581654.2656	828611.5672	730.00	747.00	17.00	15.00	255.00
37	NW5 - Sta. 15+40.00	1581654.2656	828611.5672	NW5 - Sta. 15+55.00	1581667.2717	828619.0398	730.00	747.00	17.00	15.00	255.00
38	NW5 - Sta. 15+55.00	1581667.2717	828619.0398	NW5 - Sta. 15+70.00	1581680.2778	828626.5125	730.00	747.00	17.00	15.00	255.00
39	NW5 - Sta. 15+70.00	1581680.2778	828626.5125	NW5 - Sta. 15+85.00	1581693.2840	828633.9852	731.00	747.00	16.00	15.00	240.00
40	NW5 - Sta. 15+85.00	1581693.2840	828633.9852	NW5 - Sta. 16+00.00	1581706.2901	828641.4579	731.00	747.00	16.00	15.00	240.00
41	NW5 - Sta. 16+00.00	1581706.2901	828641.4579	NW5 - Sta. 16+15.00	1581719.2962	828648.9306	731.00	747.00	16.00	15.00	240.00
42	NW5 - Sta. 16+15.00	1581719.2962	828648.9306	NW5 - Sta. 16+30.00	1581732.3023	828656.4033	732.00	747.00	15.00	15.00	225.00
43	NW5 - Sta. 16+30.00	1581732.3023	828656.4033	NW5 - Sta. 16+45.00	1581745.3084	828663.8759	732.00	747.00	15.00	15.00	225.00
44	NW5 - Sta. 16+45.00	1581745.3084	828663.8759	NW5 - Sta. 16+60.00	1581758.3145	828671.3486	732.00	747.00	15.00	15.00	225.00
45	NW5 - Sta. 16+60.00	1581758.3145	828671.3486	NW5 - Sta. 16+75.00	1581771.3206	828678.8213	733.00	747.00	14.00	15.00	210.00
46	NW5 - Sta. 16+75.00	1581771.3206	828678.8213	NW5 - Sta. 16+90.00	1581784.3267	828686.2940	733.00	747.00	14.00	15.00	210.00

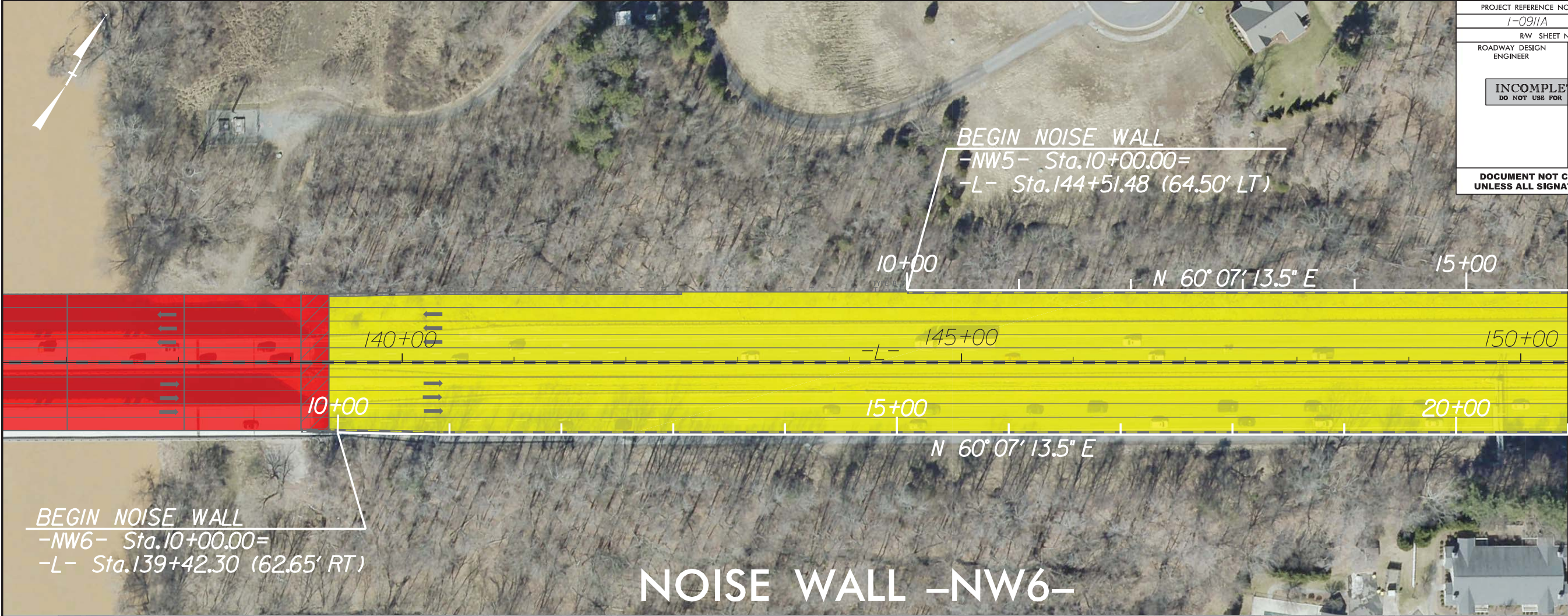
I-0911A NW5 DNR Noise Wall Design Table

Total L (ft)	Total A (ft ²)
840.00	11,970.00

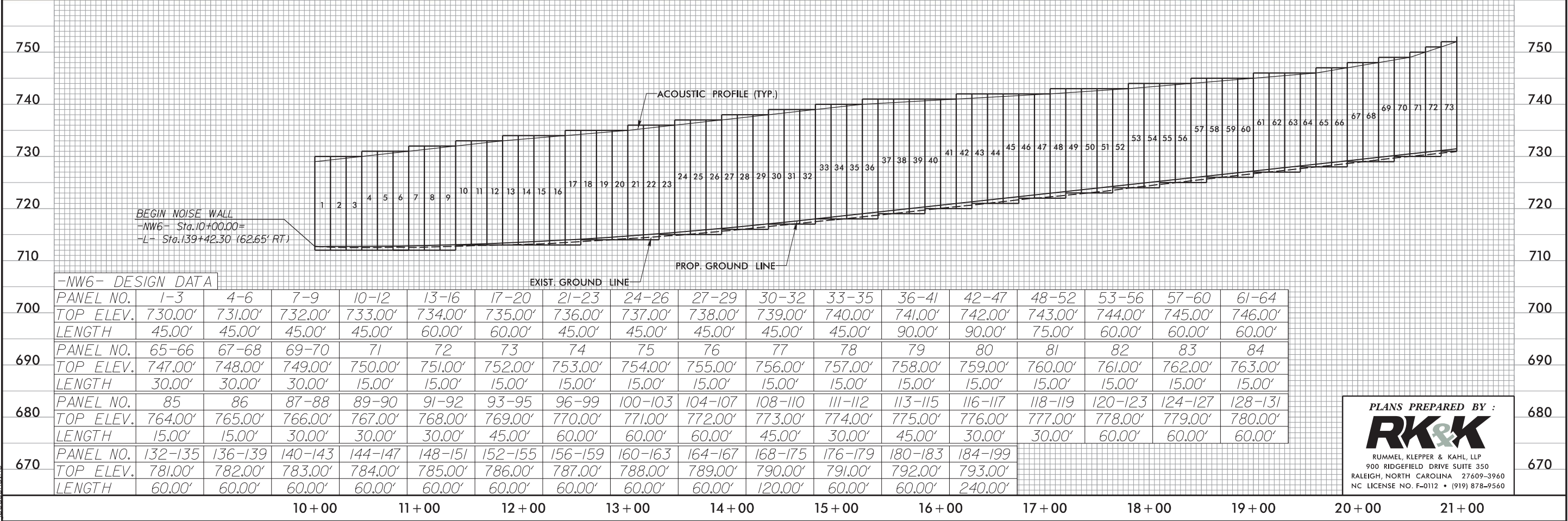
Panel No.	Panel Start Station	x	y	Panel End Station	x	y	Z-bottom	Z-top	Height (ft)	Length (ft)	Area (ft ²)
47	NW5 - Sta. 16+90.00	1581784.3267	828686.2940	NW5 - Sta. 17+05.00	1581797.3329	828693.7667	733.00	747.00	14.00	15.00	210.00
48	NW5 - Sta. 17+05.00	1581797.3329	828693.7667	NW5 - Sta. 17+20.00	1581810.3390	828701.2393	734.00	747.00	13.00	15.00	195.00
49	NW5 - Sta. 17+20.00	1581810.3390	828701.2393	NW5 - Sta. 17+35.00	1581823.3451	828708.7120	734.00	746.00	12.00	15.00	180.00
50	NW5 - Sta. 17+35.00	1581823.3451	828708.7120	NW5 - Sta. 17+50.00	1581836.3512	828716.1847	734.00	746.00	12.00	15.00	180.00
51	NW5 - Sta. 17+50.00	1581836.3512	828716.1847	NW5 - Sta. 17+65.00	1581849.3573	828723.6574	735.00	746.00	11.00	15.00	165.00
52	NW5 - Sta. 17+65.00	1581849.3573	828723.6574	NW5 - Sta. 17+80.00	1581862.3634	828731.1301	735.00	746.00	11.00	15.00	165.00
53	NW5 - Sta. 17+80.00	1581862.3634	828731.1301	NW5 - Sta. 17+95.00	1581875.3696	828738.6028	735.00	745.00	10.00	15.00	150.00
54	NW5 - Sta. 17+95.00	1581875.3696	828738.6028	NW5 - Sta. 18+10.00	1581888.3757	828746.0754	736.00	745.00	9.00	15.00	135.00
55	NW5 - Sta. 18+10.00	1581888.3757	828746.0754	NW5 - Sta. 18+25.00	1581901.3818	828753.5481	736.00	745.00	9.00	15.00	135.00
56	NW5 - Sta. 18+25.00	1581901.3818	828753.5481	NW5 - Sta. 18+40.00	1581914.3879	828761.0208	736.00	745.00	9.00	15.00	135.00

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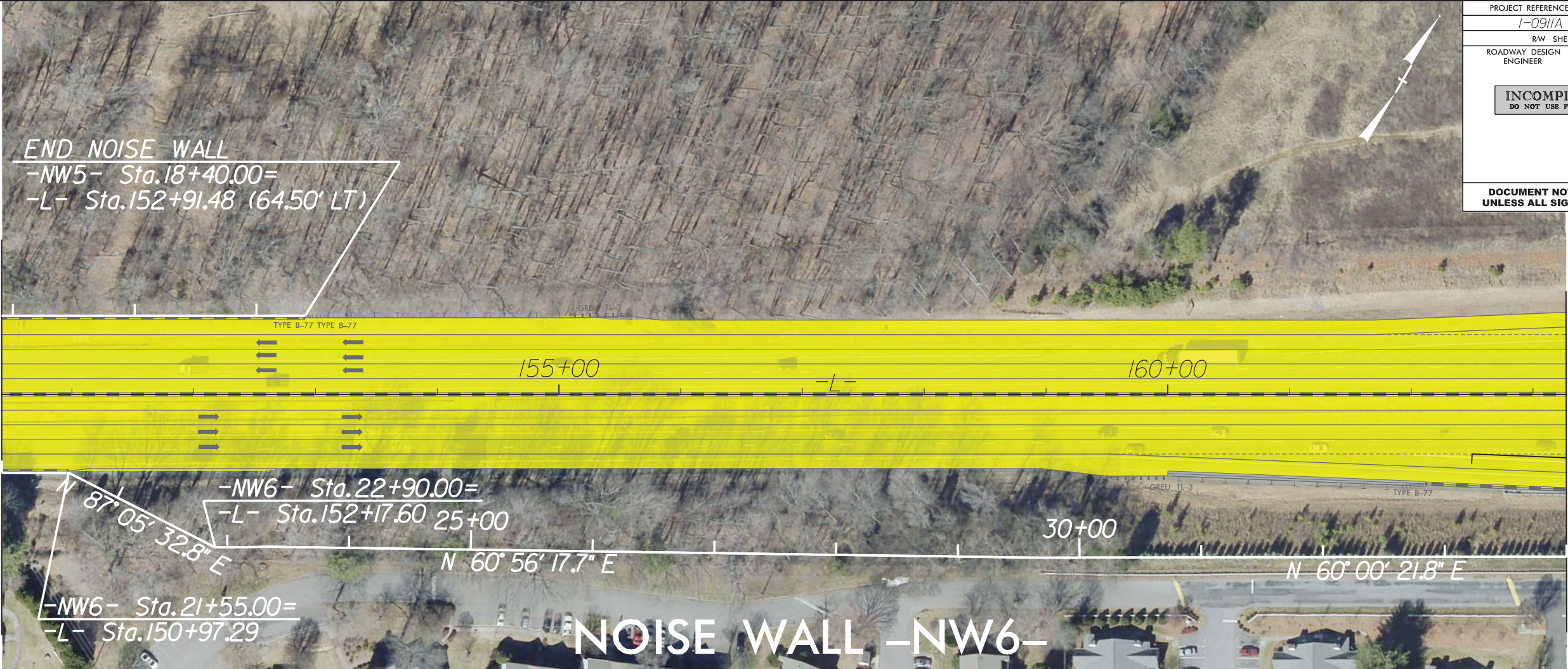
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1-0911A		NW6-1	
RW SHEET NO.			
ROADWAY DESIGN ENGINEER		HYDRAULICS ENGINEER	
INCOMPLETE PLANS DO NOT USE FOR R/W ACQUISITION			
DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED			



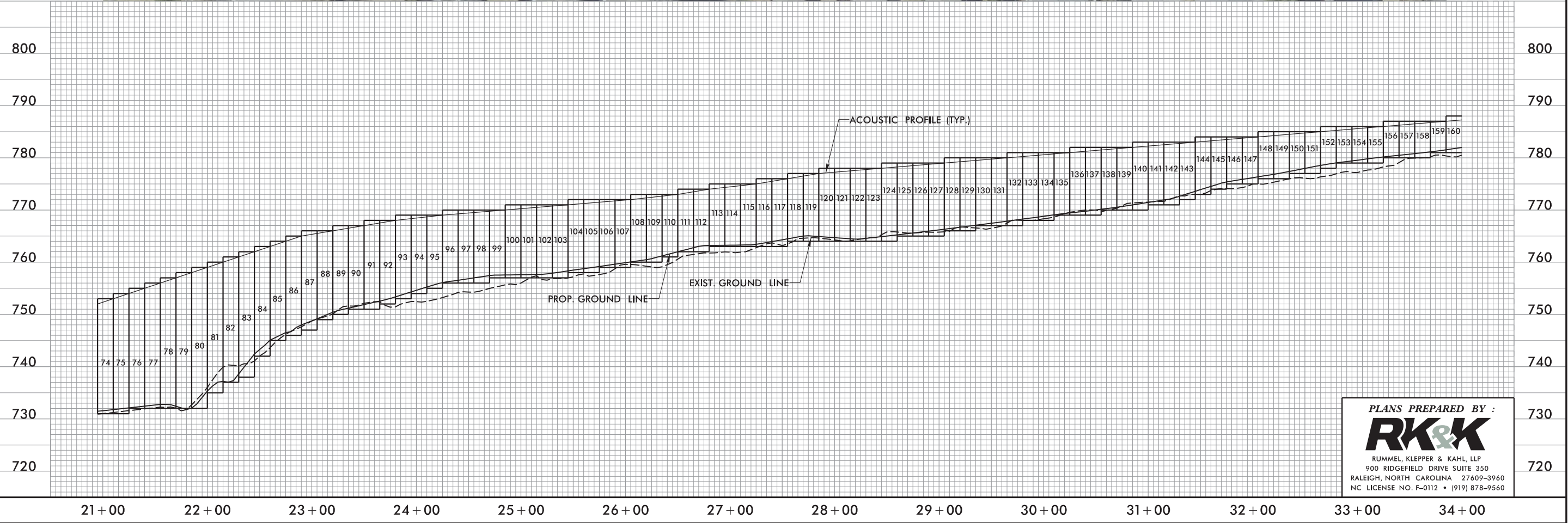
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PROJECT REFERENCE NO.		SHEET NO.	
1-0911A		NW6-2	
RW SHEET NO.			
ROADWAY DESIGN ENGINEER		HYDRAULICS ENGINEER	
INCOMPLETE PLANS DO NOT USE FOR R/W ACQUISITION			
DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED			

MATCHLINE
-NW6- STA. 21+00 SEE SHEET NW6-1



MATCHLINE -NW6- STA. 34+00
SEE SHEET NW6-3



PLANS PREPARED BY :
RK&K
RUMMEL, KLEPPER & KAHL, LLP
900 RIDGEFIELD DRIVE SUITE 350
RALEIGH, NORTH CAROLINA 27609-3960
NC LICENSE NO. F-0112 • (919) 878-9560

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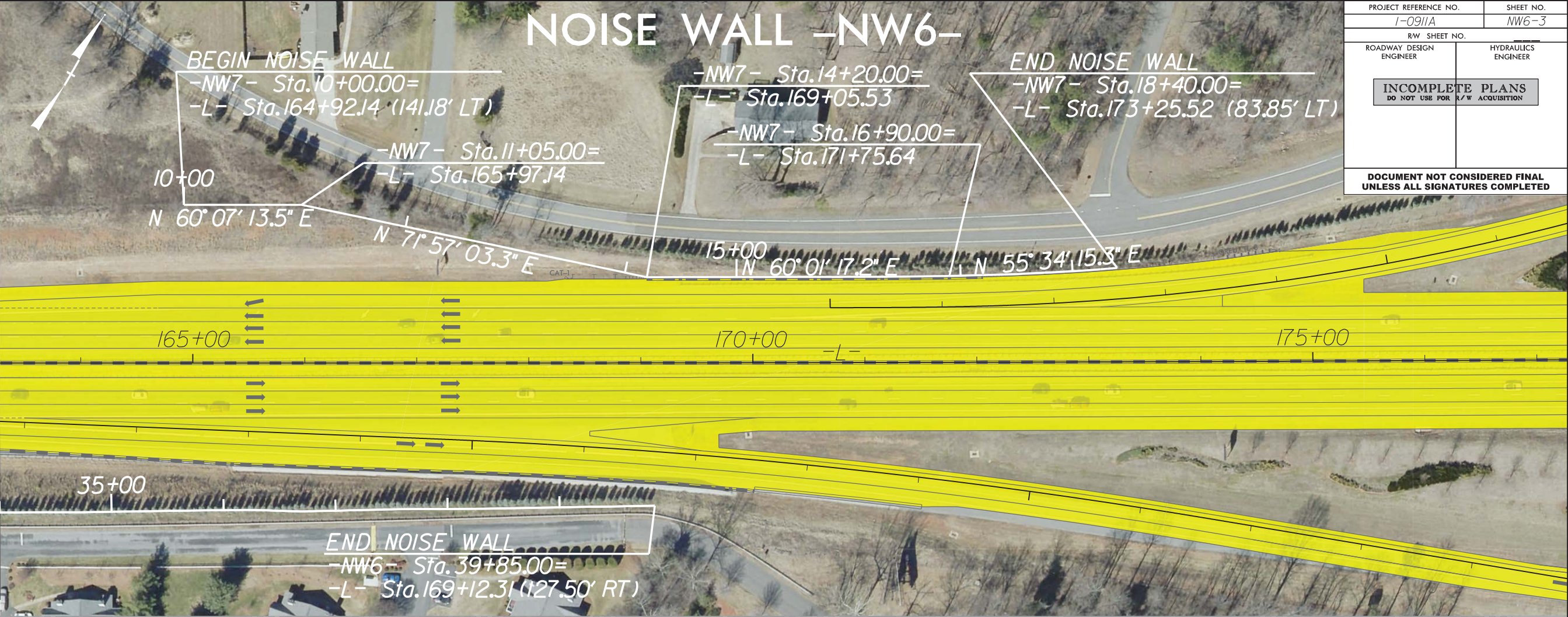
8/17/99

NOISE WALL -NW6-

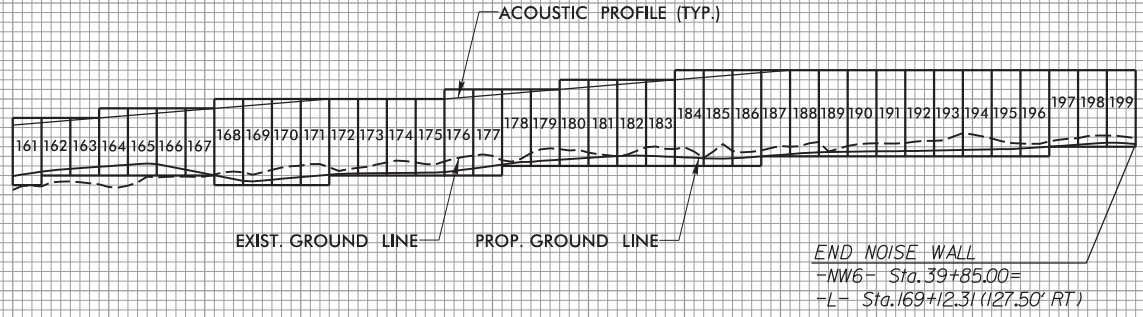
PROJECT REFERENCE NO.	SHEET NO.
1-0911A	NW6-3
RW SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
INCOMPLETE PLANS DO NOT USE FOR R/W ACQUISITION	
DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED	

MATCHLINE
-NW6- STA. 34+00 SEE SHEET NW6-2

BEGIN NOISE WALL
-NW7- Sta. 10+00.00=
-L- Sta. 164+92.14 (141.18' LT)
10+00
N 60° 07' 13.5" E
-NW7- Sta. 11+05.00=
-L- Sta. 165+97.14
N 71° 57' 03.3" E
15+00
N 60° 01' 17.2" E
-NW7- Sta. 14+20.00=
-L- Sta. 169+05.53
-NW7- Sta. 16+90.00=
-L- Sta. 171+75.64
END NOISE WALL
-NW7- Sta. 18+40.00=
-L- Sta. 173+25.52 (83.85' LT)
N 55° 34' 15.3" E



820
810
800
790
780
770
760
750
740



820
810
800
790
780
770
760
750
740

34+00 35+00 36+00 37+00 38+00 39+00 40+00

PLANS PREPARED BY :
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RUMMEL, KLEPPER & KAHL, LLP
900 RIDGEFIELD DRIVE SUITE 350
RALEIGH, NORTH CAROLINA 27609-3960
NC LICENSE NO. F-0112 • (919) 878-9560

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I-0911A NW6 DNR Noise Wall Design Table

Total L (ft)	Total A (ft ²)
2,985.00	45,540.00

Panel No.	Panel Start Station	x	y	Panel End Station	x	y	Z-bottom	Z-top	Height (ft)	Length (ft)	Area (ft ²)
1	NW6 - Sta. 10+00.00	1580807.8958	827978.6378	NW6 - Sta. 10+15.00	1580821.0525	827985.8420	712.00	730.00	18.00	15.00	270.00
2	NW6 - Sta. 10+15.00	1580821.0525	827985.8420	NW6 - Sta. 10+30.00	1580834.2092	827993.0463	712.00	730.00	18.00	15.00	270.00
3	NW6 - Sta. 10+30.00	1580834.2092	827993.0463	NW6 - Sta. 10+45.00	1580847.3659	828000.2505	712.00	730.00	18.00	15.00	270.00
4	NW6 - Sta. 10+45.00	1580847.3659	828000.2505	NW6 - Sta. 10+60.00	1580860.5226	828007.4547	712.00	731.00	19.00	15.00	285.00
5	NW6 - Sta. 10+60.00	1580860.5226	828007.4547	NW6 - Sta. 10+75.00	1580873.6794	828014.6589	712.00	731.00	19.00	15.00	285.00
6	NW6 - Sta. 10+75.00	1580873.6794	828014.6589	NW6 - Sta. 10+90.00	1580886.8361	828021.8631	712.00	731.00	19.00	15.00	285.00
7	NW6 - Sta. 10+90.00	1580886.8361	828021.8631	NW6 - Sta. 11+05.00	1580899.8422	828029.3358	712.00	732.00	20.00	15.00	300.00
8	NW6 - Sta. 11+05.00	1580899.8422	828029.3358	NW6 - Sta. 11+20.00	1580912.8483	828036.8085	712.00	732.00	20.00	15.00	300.00
9	NW6 - Sta. 11+20.00	1580912.8483	828036.8085	NW6 - Sta. 11+35.00	1580925.8544	828044.2812	712.00	732.00	20.00	15.00	300.00
10	NW6 - Sta. 11+35.00	1580925.8544	828044.2812	NW6 - Sta. 11+50.00	1580938.8605	828051.7538	713.00	733.00	20.00	15.00	300.00
11	NW6 - Sta. 11+50.00	1580938.8605	828051.7538	NW6 - Sta. 11+65.00	1580951.8667	828059.2265	713.00	733.00	20.00	15.00	300.00
12	NW6 - Sta. 11+65.00	1580951.8667	828059.2265	NW6 - Sta. 11+80.00	1580964.8728	828066.6992	713.00	733.00	20.00	15.00	300.00
13	NW6 - Sta. 11+80.00	1580964.8728	828066.6992	NW6 - Sta. 11+95.00	1580977.8789	828074.1719	713.00	734.00	21.00	15.00	315.00
14	NW6 - Sta. 11+95.00	1580977.8789	828074.1719	NW6 - Sta. 12+10.00	1580990.8850	828081.6446	713.00	734.00	21.00	15.00	315.00
15	NW6 - Sta. 12+10.00	1580990.8850	828081.6446	NW6 - Sta. 12+25.00	1581003.8911	828089.1173	713.00	734.00	21.00	15.00	315.00
16	NW6 - Sta. 12+25.00	1581003.8911	828089.1173	NW6 - Sta. 12+40.00	1581016.8972	828096.5899	713.00	734.00	21.00	15.00	315.00
17	NW6 - Sta. 12+40.00	1581016.8972	828096.5899	NW6 - Sta. 12+55.00	1581029.9033	828104.0626	713.00	735.00	22.00	15.00	330.00
18	NW6 - Sta. 12+55.00	1581029.9033	828104.0626	NW6 - Sta. 12+70.00	1581042.9095	828111.5353	714.00	735.00	21.00	15.00	315.00
19	NW6 - Sta. 12+70.00	1581042.9095	828111.5353	NW6 - Sta. 12+85.00	1581055.9156	828119.0080	714.00	735.00	21.00	15.00	315.00
20	NW6 - Sta. 12+85.00	1581055.9156	828119.0080	NW6 - Sta. 13+00.00	1581068.9217	828126.4807	714.00	735.00	21.00	15.00	315.00
21	NW6 - Sta. 13+00.00	1581068.9217	828126.4807	NW6 - Sta. 13+15.00	1581081.9278	828133.9534	714.00	736.00	22.00	15.00	330.00
22	NW6 - Sta. 13+15.00	1581081.9278	828133.9534	NW6 - Sta. 13+30.00	1581094.9339	828141.4260	714.00	736.00	22.00	15.00	330.00
23	NW6 - Sta. 13+30.00	1581094.9339	828141.4260	NW6 - Sta. 13+45.00	1581107.9400	828148.8987	715.00	736.00	21.00	15.00	315.00
24	NW6 - Sta. 13+45.00	1581107.9400	828148.8987	NW6 - Sta. 13+60.00	1581120.9461	828156.3714	715.00	737.00	22.00	15.00	330.00
25	NW6 - Sta. 13+60.00	1581120.9461	828156.3714	NW6 - Sta. 13+75.00	1581133.9523	828163.8441	715.00	737.00	22.00	15.00	330.00
26	NW6 - Sta. 13+75.00	1581133.9523	828163.8441	NW6 - Sta. 13+90.00	1581146.9584	828171.3168	715.00	737.00	22.00	15.00	330.00
27	NW6 - Sta. 13+90.00	1581146.9584	828171.3168	NW6 - Sta. 14+05.00	1581159.9645	828178.7895	716.00	738.00	22.00	15.00	330.00
28	NW6 - Sta. 14+05.00	1581159.9645	828178.7895	NW6 - Sta. 14+20.00	1581172.9706	828186.2621	716.00	738.00	22.00	15.00	330.00
29	NW6 - Sta. 14+20.00	1581172.9706	828186.2621	NW6 - Sta. 14+35.00	1581185.9767	828193.7348	716.00	738.00	22.00	15.00	330.00
30	NW6 - Sta. 14+35.00	1581185.9767	828193.7348	NW6 - Sta. 14+50.00	1581198.9828	828201.2075	717.00	739.00	22.00	15.00	330.00
31	NW6 - Sta. 14+50.00	1581198.9828	828201.2075	NW6 - Sta. 14+65.00	1581211.9889	828208.6802	717.00	739.00	22.00	15.00	330.00
32	NW6 - Sta. 14+65.00	1581211.9889	828208.6802	NW6 - Sta. 14+80.00	1581224.9951	828216.1529	717.00	739.00	22.00	15.00	330.00
33	NW6 - Sta. 14+80.00	1581224.9951	828216.1529	NW6 - Sta. 14+95.00	1581238.0012	828223.6256	718.00	740.00	22.00	15.00	330.00
34	NW6 - Sta. 14+95.00	1581238.0012	828223.6256	NW6 - Sta. 15+10.00	1581251.0073	828231.0982	718.00	740.00	22.00	15.00	330.00
35	NW6 - Sta. 15+10.00	1581251.0073	828231.0982	NW6 - Sta. 15+25.00	1581264.0134	828238.5709	718.00	740.00	22.00	15.00	330.00
36	NW6 - Sta. 15+25.00	1581264.0134	828238.5709	NW6 - Sta. 15+40.00	1581277.0195	828246.0436	718.00	741.00	23.00	15.00	345.00
37	NW6 - Sta. 15+40.00	1581277.0195	828246.0436	NW6 - Sta. 15+55.00	1581290.0256	828253.5163	719.00	741.00	22.00	15.00	330.00
38	NW6 - Sta. 15+55.00	1581290.0256	828253.5163	NW6 - Sta. 15+70.00	1581303.0317	828260.9890	719.00	741.00	22.00	15.00	330.00
39	NW6 - Sta. 15+70.00	1581303.0317	828260.9890	NW6 - Sta. 15+85.00	1581316.0379	828268.4617	719.00	741.00	22.00	15.00	330.00
40	NW6 - Sta. 15+85.00	1581316.0379	828268.4617	NW6 - Sta. 16+00.00	1581329.0440	828275.9343	720.00	741.00	21.00	15.00	315.00
41	NW6 - Sta. 16+00.00	1581329.0440	828275.9343	NW6 - Sta. 16+15.00	1581342.0501	828283.4070	720.00	741.00	21.00	15.00	315.00
42	NW6 - Sta. 16+15.00	1581342.0501	828283.4070	NW6 - Sta. 16+30.00	1581355.0562	828290.8797	720.00	742.00	22.00	15.00	330.00
43	NW6 - Sta. 16+30.00	1581355.0562	828290.8797	NW6 - Sta. 16+45.00	1581368.0623	828298.3524	721.00	742.00	21.00	15.00	315.00
44	NW6 - Sta. 16+45.00	1581368.0623	828298.3524	NW6 - Sta. 16+60.00	1581381.0684	828305.8251	721.00	742.00	21.00	15.00	315.00
45	NW6 - Sta. 16+60.00	1581381.0684	828305.8251	NW6 - Sta. 16+75.00	1581394.0745	828313.2978	721.00	742.00	21.00	15.00	315.00
46	NW6 - Sta. 16+75.00	1581394.0745	828313.2978	NW6 - Sta. 16+90.00	1581407.0806	828320.7705	722.00	742.00	20.00	15.00	300.00

I-0911A NW6 DNR Noise Wall Design Table

Total L (ft)	Total A (ft ²)
2,985.00	45,540.00

Panel No.	Panel Start Station	x	y	Panel End Station	x	y	Z-bottom	Z-top	Height (ft)	Length (ft)	Area (ft ²)
47	NW6 - Sta. 16+90.00	1581407.0806	828320.7705	NW6 - Sta. 17+05.00	1581420.0868	828328.2431	722.00	742.00	20.00	15.00	300.00
48	NW6 - Sta. 17+05.00	1581420.0868	828328.2431	NW6 - Sta. 17+20.00	1581433.0929	828335.7158	722.00	743.00	21.00	15.00	315.00
49	NW6 - Sta. 17+20.00	1581433.0929	828335.7158	NW6 - Sta. 17+35.00	1581446.0990	828343.1885	723.00	743.00	20.00	15.00	300.00
50	NW6 - Sta. 17+35.00	1581446.0990	828343.1885	NW6 - Sta. 17+50.00	1581459.1051	828350.6612	723.00	743.00	20.00	15.00	300.00
51	NW6 - Sta. 17+50.00	1581459.1051	828350.6612	NW6 - Sta. 17+65.00	1581472.1112	828358.1339	723.00	743.00	20.00	15.00	300.00
52	NW6 - Sta. 17+65.00	1581472.1112	828358.1339	NW6 - Sta. 17+80.00	1581485.1173	828365.6066	724.00	743.00	19.00	15.00	285.00
53	NW6 - Sta. 17+80.00	1581485.1173	828365.6066	NW6 - Sta. 17+95.00	1581498.1234	828373.0792	724.00	744.00	20.00	15.00	300.00
54	NW6 - Sta. 17+95.00	1581498.1234	828373.0792	NW6 - Sta. 18+10.00	1581511.1296	828380.5519	724.00	744.00	20.00	15.00	300.00
55	NW6 - Sta. 18+10.00	1581511.1296	828380.5519	NW6 - Sta. 18+25.00	1581524.1357	828388.0246	725.00	744.00	19.00	15.00	285.00
56	NW6 - Sta. 18+25.00	1581524.1357	828388.0246	NW6 - Sta. 18+40.00	1581537.1418	828395.4973	725.00	744.00	19.00	15.00	285.00
57	NW6 - Sta. 18+40.00	1581537.1418	828395.4973	NW6 - Sta. 18+55.00	1581550.1479	828402.9700	725.00	745.00	20.00	15.00	300.00
58	NW6 - Sta. 18+55.00	1581550.1479	828402.9700	NW6 - Sta. 18+70.00	1581563.1540	828410.4427	726.00	745.00	19.00	15.00	285.00
59	NW6 - Sta. 18+70.00	1581563.1540	828410.4427	NW6 - Sta. 18+85.00	1581576.1601	828417.9153	726.00	745.00	19.00	15.00	285.00
60	NW6 - Sta. 18+85.00	1581576.1601	828417.9153	NW6 - Sta. 19+00.00	1581589.1662	828425.3880	726.00	745.00	19.00	15.00	285.00
61	NW6 - Sta. 19+00.00	1581589.1662	828425.3880	NW6 - Sta. 19+15.00	1581602.1724	828432.8607	727.00	746.00	19.00	15.00	285.00
62	NW6 - Sta. 19+15.00	1581602.1724	828432.8607	NW6 - Sta. 19+30.00	1581615.1785	828440.3334	727.00	746.00	19.00	15.00	285.00
63	NW6 - Sta. 19+30.00	1581615.1785	828440.3334	NW6 - Sta. 19+45.00	1581628.1846	828447.8061	727.00	746.00	19.00	15.00	285.00
64	NW6 - Sta. 19+45.00	1581628.1846	828447.8061	NW6 - Sta. 19+60.00	1581641.1907	828455.2788	728.00	746.00	18.00	15.00	270.00
65	NW6 - Sta. 19+60.00	1581641.1907	828455.2788	NW6 - Sta. 19+75.00	1581654.1968	828462.7514	728.00	747.00	19.00	15.00	285.00
66	NW6 - Sta. 19+75.00	1581654.1968	828462.7514	NW6 - Sta. 19+90.00	1581667.2029	828470.2241	728.00	747.00	19.00	15.00	285.00
67	NW6 - Sta. 19+90.00	1581667.2029	828470.2241	NW6 - Sta. 20+05.00	1581680.2090	828477.6968	729.00	748.00	19.00	15.00	285.00
68	NW6 - Sta. 20+05.00	1581680.2090	828477.6968	NW6 - Sta. 20+20.00	1581693.2152	828485.1695	729.00	748.00	19.00	15.00	285.00
69	NW6 - Sta. 20+20.00	1581693.2152	828485.1695	NW6 - Sta. 20+35.00	1581706.2213	828492.6422	729.00	749.00	20.00	15.00	300.00
70	NW6 - Sta. 20+35.00	1581706.2213	828492.6422	NW6 - Sta. 20+50.00	1581719.2274	828500.1149	730.00	749.00	19.00	15.00	285.00
71	NW6 - Sta. 20+50.00	1581719.2274	828500.1149	NW6 - Sta. 20+65.00	1581732.2335	828507.5875	730.00	750.00	20.00	15.00	300.00
72	NW6 - Sta. 20+65.00	1581732.2335	828507.5875	NW6 - Sta. 20+80.00	1581745.2396	828515.0602	730.00	751.00	21.00	15.00	315.00
73	NW6 - Sta. 20+80.00	1581745.2396	828515.0602	NW6 - Sta. 20+95.00	1581758.2457	828522.5329	731.00	752.00	21.00	15.00	315.00
74	NW6 - Sta. 20+95.00	1581758.2457	828522.5329	NW6 - Sta. 21+10.00	1581771.2518	828530.0056	731.00	753.00	22.00	15.00	330.00
75	NW6 - Sta. 21+10.00	1581771.2518	828530.0056	NW6 - Sta. 21+25.00	1581784.2579	828537.4783	731.00	754.00	23.00	15.00	345.00
76	NW6 - Sta. 21+25.00	1581784.2579	828537.4783	NW6 - Sta. 21+40.00	1581797.2641	828544.9510	732.00	755.00	23.00	15.00	345.00
77	NW6 - Sta. 21+40.00	1581797.2641	828544.9510	NW6 - Sta. 21+55.00	1581810.2702	828552.4236	732.00	756.00	24.00	15.00	360.00
78	NW6 - Sta. 21+55.00	1581810.2702	828552.4236	NW6 - Sta. 21+70.00	1581825.2509	828553.1845	732.00	757.00	25.00	15.00	375.00
79	NW6 - Sta. 21+70.00	1581825.2509	828553.1845	NW6 - Sta. 21+85.00	1581840.2316	828553.9454	732.00	758.00	26.00	15.00	390.00
80	NW6 - Sta. 21+85.00	1581840.2316	828553.9454	NW6 - Sta. 22+00.00	1581855.2122	828554.7063	732.00	759.00	27.00	15.00	405.00
81	NW6 - Sta. 22+00.00	1581855.2122	828554.7063	NW6 - Sta. 22+15.00	1581870.1929	828555.4671	735.00	760.00	25.00	15.00	375.00
82	NW6 - Sta. 22+15.00	1581870.1929	828555.4671	NW6 - Sta. 22+30.00	1581885.1736	828556.2280	737.00	761.00	24.00	15.00	360.00
83	NW6 - Sta. 22+30.00	1581885.1736	828556.2280	NW6 - Sta. 22+45.00	1581900.1543	828556.9889	738.00	762.00	24.00	15.00	360.00
84	NW6 - Sta. 22+45.00	1581900.1543	828556.9889	NW6 - Sta. 22+60.00	1581915.1350	828557.7498	742.00	763.00	21.00	15.00	315.00
85	NW6 - Sta. 22+60.00	1581915.1350	828557.7498	NW6 - Sta. 22+75.00	1581930.1157	828558.5106	745.00	764.00	19.00	15.00	285.00
86	NW6 - Sta. 22+75.00	1581930.1157	828558.5106	NW6 - Sta. 22+90.00	1581945.0964	828559.2715	746.00	765.00	19.00	15.00	285.00
87	NW6 - Sta. 22+90.00	1581945.0964	828559.2715	NW6 - Sta. 23+05.00	1581958.0170	828566.8911	747.00	766.00	19.00	15.00	285.00
88	NW6 - Sta. 23+05.00	1581958.0170	828566.8911	NW6 - Sta. 23+20.00	1581970.9376	828574.5106	749.00	766.00	17.00	15.00	255.00
89	NW6 - Sta. 23+20.00	1581970.9376	828574.5106	NW6 - Sta. 23+35.00	1581983.8582	828582.1302	750.00	767.00	17.00	15.00	255.00
90	NW6 - Sta. 23+35.00	1581983.8582	828582.1302	NW6 - Sta. 23+50.00	1581996.9697	828589.4165	751.00	767.00	16.00	15.00	240.00
91	NW6 - Sta. 23+50.00	1581996.9697	828589.4165	NW6 - Sta. 23+65.00	1582010.0811	828596.7027	751.00	768.00	17.00	15.00	255.00
92	NW6 - Sta. 23+65.00	1582010.0811	828596.7027	NW6 - Sta. 23+80.00	1582023.1926	828603.9890	752.00	768.00	16.00	15.00	240.00

I-0911A NW6 DNR Noise Wall Design Table

Total L (ft)	Total A (ft ²)
2,985.00	45,540.00

Panel No.	Panel Start Station	x	y	Panel End Station	x	y	Z-bottom	Z-top	Height (ft)	Length (ft)	Area (ft ²)
93	NW6 - Sta. 23+80.00	1582023.1926	828603.9890	NW6 - Sta. 23+95.00	1582036.3040	828611.2753	753.00	769.00	16.00	15.00	240.00
94	NW6 - Sta. 23+95.00	1582036.3040	828611.2753	NW6 - Sta. 24+10.00	1582049.4155	828618.5616	754.00	769.00	15.00	15.00	225.00
95	NW6 - Sta. 24+10.00	1582049.4155	828618.5616	NW6 - Sta. 24+25.00	1582062.5269	828625.8478	755.00	769.00	14.00	15.00	210.00
96	NW6 - Sta. 24+25.00	1582062.5269	828625.8478	NW6 - Sta. 24+40.00	1582075.6384	828633.1341	756.00	770.00	14.00	15.00	210.00
97	NW6 - Sta. 24+40.00	1582075.6384	828633.1341	NW6 - Sta. 24+55.00	1582088.7498	828640.4204	756.00	770.00	14.00	15.00	210.00
98	NW6 - Sta. 24+55.00	1582088.7498	828640.4204	NW6 - Sta. 24+70.00	1582101.8613	828647.7067	756.00	770.00	14.00	15.00	210.00
99	NW6 - Sta. 24+70.00	1582101.8613	828647.7067	NW6 - Sta. 24+85.00	1582114.9727	828654.9930	757.00	770.00	13.00	15.00	195.00
100	NW6 - Sta. 24+85.00	1582114.9727	828654.9930	NW6 - Sta. 25+00.00	1582128.0842	828662.2792	757.00	771.00	14.00	15.00	210.00
101	NW6 - Sta. 25+00.00	1582128.0842	828662.2792	NW6 - Sta. 25+15.00	1582141.1956	828669.5655	757.00	771.00	14.00	15.00	210.00
102	NW6 - Sta. 25+15.00	1582141.1956	828669.5655	NW6 - Sta. 25+30.00	1582154.3071	828676.8518	757.00	771.00	14.00	15.00	210.00
103	NW6 - Sta. 25+30.00	1582154.3071	828676.8518	NW6 - Sta. 25+45.00	1582167.4186	828684.1381	757.00	771.00	14.00	15.00	210.00
104	NW6 - Sta. 25+45.00	1582167.4186	828684.1381	NW6 - Sta. 25+60.00	1582180.5300	828691.4243	758.00	772.00	14.00	15.00	210.00
105	NW6 - Sta. 25+60.00	1582180.5300	828691.4243	NW6 - Sta. 25+75.00	1582193.6415	828698.7106	758.00	772.00	14.00	15.00	210.00
106	NW6 - Sta. 25+75.00	1582193.6415	828698.7106	NW6 - Sta. 25+90.00	1582206.7529	828705.9969	759.00	772.00	13.00	15.00	195.00
107	NW6 - Sta. 25+90.00	1582206.7529	828705.9969	NW6 - Sta. 26+05.00	1582219.8644	828713.2832	759.00	772.00	13.00	15.00	195.00
108	NW6 - Sta. 26+05.00	1582219.8644	828713.2832	NW6 - Sta. 26+20.00	1582232.9758	828720.5695	760.00	773.00	13.00	15.00	195.00
109	NW6 - Sta. 26+20.00	1582232.9758	828720.5695	NW6 - Sta. 26+35.00	1582246.0873	828727.8557	760.00	773.00	13.00	15.00	195.00
110	NW6 - Sta. 26+35.00	1582246.0873	828727.8557	NW6 - Sta. 26+50.00	1582259.1987	828735.1420	761.00	773.00	12.00	15.00	180.00
111	NW6 - Sta. 26+50.00	1582259.1987	828735.1420	NW6 - Sta. 26+65.00	1582272.3102	828742.4283	762.00	774.00	12.00	15.00	180.00
112	NW6 - Sta. 26+65.00	1582272.3102	828742.4283	NW6 - Sta. 26+80.00	1582285.4216	828749.7146	762.00	774.00	12.00	15.00	180.00
113	NW6 - Sta. 26+80.00	1582285.4216	828749.7146	NW6 - Sta. 26+95.00	1582298.5331	828757.0008	763.00	775.00	12.00	15.00	180.00
114	NW6 - Sta. 26+95.00	1582298.5331	828757.0008	NW6 - Sta. 27+10.00	1582311.6445	828764.2871	763.00	775.00	12.00	15.00	180.00
115	NW6 - Sta. 27+10.00	1582311.6445	828764.2871	NW6 - Sta. 27+25.00	1582324.7560	828771.5734	763.00	775.00	12.00	15.00	180.00
116	NW6 - Sta. 27+25.00	1582324.7560	828771.5734	NW6 - Sta. 27+40.00	1582337.8674	828778.8597	763.00	776.00	13.00	15.00	195.00
117	NW6 - Sta. 27+40.00	1582337.8674	828778.8597	NW6 - Sta. 27+55.00	1582350.9789	828786.1460	763.00	776.00	13.00	15.00	195.00
118	NW6 - Sta. 27+55.00	1582350.9789	828786.1460	NW6 - Sta. 27+70.00	1582364.0903	828793.4322	764.00	777.00	13.00	15.00	195.00
119	NW6 - Sta. 27+70.00	1582364.0903	828793.4322	NW6 - Sta. 27+85.00	1582377.2018	828800.7185	764.00	777.00	13.00	15.00	195.00
120	NW6 - Sta. 27+85.00	1582377.2018	828800.7185	NW6 - Sta. 28+00.00	1582390.3132	828808.0048	764.00	778.00	14.00	15.00	210.00
121	NW6 - Sta. 28+00.00	1582390.3132	828808.0048	NW6 - Sta. 28+15.00	1582403.4247	828815.2911	764.00	778.00	14.00	15.00	210.00
122	NW6 - Sta. 28+15.00	1582403.4247	828815.2911	NW6 - Sta. 28+30.00	1582416.5361	828822.5773	764.00	778.00	14.00	15.00	210.00
123	NW6 - Sta. 28+30.00	1582416.5361	828822.5773	NW6 - Sta. 28+45.00	1582429.6476	828829.8636	764.00	778.00	14.00	15.00	210.00
124	NW6 - Sta. 28+45.00	1582429.6476	828829.8636	NW6 - Sta. 28+60.00	1582442.7590	828837.1499	764.00	779.00	15.00	15.00	225.00
125	NW6 - Sta. 28+60.00	1582442.7590	828837.1499	NW6 - Sta. 28+75.00	1582455.8705	828844.4362	765.00	779.00	14.00	15.00	210.00
126	NW6 - Sta. 28+75.00	1582455.8705	828844.4362	NW6 - Sta. 28+90.00	1582468.9819	828851.7225	765.00	779.00	14.00	15.00	210.00
127	NW6 - Sta. 28+90.00	1582468.9819	828851.7225	NW6 - Sta. 29+05.00	1582482.0934	828859.0087	765.00	779.00	14.00	15.00	210.00
128	NW6 - Sta. 29+05.00	1582482.0934	828859.0087	NW6 - Sta. 29+20.00	1582495.2048	828866.2950	766.00	780.00	14.00	15.00	210.00
129	NW6 - Sta. 29+20.00	1582495.2048	828866.2950	NW6 - Sta. 29+35.00	1582508.3163	828873.5813	766.00	780.00	14.00	15.00	210.00
130	NW6 - Sta. 29+35.00	1582508.3163	828873.5813	NW6 - Sta. 29+50.00	1582521.4277	828880.8676	767.00	780.00	13.00	15.00	195.00
131	NW6 - Sta. 29+50.00	1582521.4277	828880.8676	NW6 - Sta. 29+65.00	1582534.5392	828888.1539	767.00	780.00	13.00	15.00	195.00
132	NW6 - Sta. 29+65.00	1582534.5392	828888.1539	NW6 - Sta. 29+80.00	1582547.5304	828895.6525	767.00	781.00	14.00	15.00	210.00
133	NW6 - Sta. 29+80.00	1582547.5304	828895.6525	NW6 - Sta. 29+95.00	1582560.5215	828903.1511	768.00	781.00	13.00	15.00	195.00
134	NW6 - Sta. 29+95.00	1582560.5215	828903.1511	NW6 - Sta. 30+10.00	1582573.5127	828910.6497	768.00	781.00	13.00	15.00	195.00
135	NW6 - Sta. 30+10.00	1582573.5127	828910.6497	NW6 - Sta. 30+25.00	1582586.5039	828918.1484	769.00	781.00	12.00	15.00	180.00
136	NW6 - Sta. 30+25.00	1582586.5039	828918.1484	NW6 - Sta. 30+40.00	1582599.4950	828925.6470	769.00	782.00	13.00	15.00	195.00
137	NW6 - Sta. 30+40.00	1582599.4950	828925.6470	NW6 - Sta. 30+55.00	1582612.4862	828933.1456	769.00	782.00	13.00	15.00	195.00
138	NW6 - Sta. 30+55.00	1582612.4862	828933.1456	NW6 - Sta. 30+70.00	1582625.4774	828940.6443	770.00	782.00	12.00	15.00	180.00

I-0911A NW6 DNR Noise Wall Design Table

Total L (ft)	Total A (ft ²)
2,985.00	45,540.00

Panel No.	Panel Start Station	x	y	Panel End Station	x	y	Z-bottom	Z-top	Height (ft)	Length (ft)	Area (ft ²)
139	NW6 - Sta. 30+70.00	1582625.4774	828940.6443	NW6 - Sta. 30+85.00	1582638.4686	828948.1429	770.00	782.00	12.00	15.00	180.00
140	NW6 - Sta. 30+85.00	1582638.4686	828948.1429	NW6 - Sta. 31+00.00	1582651.4597	828955.6415	770.00	783.00	13.00	15.00	195.00
141	NW6 - Sta. 31+00.00	1582651.4597	828955.6415	NW6 - Sta. 31+15.00	1582664.4509	828963.1401	771.00	783.00	12.00	15.00	180.00
142	NW6 - Sta. 31+15.00	1582664.4509	828963.1401	NW6 - Sta. 31+30.00	1582677.4421	828970.6388	771.00	783.00	12.00	15.00	180.00
143	NW6 - Sta. 31+30.00	1582677.4421	828970.6388	NW6 - Sta. 31+45.00	1582690.4333	828978.1374	772.00	783.00	11.00	15.00	165.00
144	NW6 - Sta. 31+45.00	1582690.4333	828978.1374	NW6 - Sta. 31+60.00	1582703.4244	828985.6360	773.00	784.00	11.00	15.00	165.00
145	NW6 - Sta. 31+60.00	1582703.4244	828985.6360	NW6 - Sta. 31+75.00	1582716.4156	828993.1347	774.00	784.00	10.00	15.00	150.00
146	NW6 - Sta. 31+75.00	1582716.4156	828993.1347	NW6 - Sta. 31+90.00	1582729.4068	829000.6333	775.00	784.00	9.00	15.00	135.00
147	NW6 - Sta. 31+90.00	1582729.4068	829000.6333	NW6 - Sta. 32+05.00	1582742.3979	829008.1319	775.00	784.00	9.00	15.00	135.00
148	NW6 - Sta. 32+05.00	1582742.3979	829008.1319	NW6 - Sta. 32+20.00	1582755.3891	829015.6306	776.00	785.00	9.00	15.00	135.00
149	NW6 - Sta. 32+20.00	1582755.3891	829015.6306	NW6 - Sta. 32+35.00	1582768.3803	829023.1292	776.00	785.00	9.00	15.00	135.00
150	NW6 - Sta. 32+35.00	1582768.3803	829023.1292	NW6 - Sta. 32+50.00	1582781.3715	829030.6278	777.00	785.00	8.00	15.00	120.00
151	NW6 - Sta. 32+50.00	1582781.3715	829030.6278	NW6 - Sta. 32+65.00	1582794.3626	829038.1264	777.00	785.00	8.00	15.00	120.00
152	NW6 - Sta. 32+65.00	1582794.3626	829038.1264	NW6 - Sta. 32+80.00	1582807.3538	829045.6251	778.00	786.00	8.00	15.00	120.00
153	NW6 - Sta. 32+80.00	1582807.3538	829045.6251	NW6 - Sta. 32+95.00	1582820.3450	829053.1237	779.00	786.00	7.00	15.00	105.00
154	NW6 - Sta. 32+95.00	1582820.3450	829053.1237	NW6 - Sta. 33+10.00	1582833.3361	829060.6223	779.00	786.00	7.00	15.00	105.00
155	NW6 - Sta. 33+10.00	1582833.3361	829060.6223	NW6 - Sta. 33+25.00	1582846.3273	829068.1210	779.00	786.00	7.00	15.00	105.00
156	NW6 - Sta. 33+25.00	1582846.3273	829068.1210	NW6 - Sta. 33+40.00	1582859.3185	829075.6196	780.00	787.00	7.00	15.00	105.00
157	NW6 - Sta. 33+40.00	1582859.3185	829075.6196	NW6 - Sta. 33+55.00	1582872.3097	829083.1182	780.00	787.00	7.00	15.00	105.00
158	NW6 - Sta. 33+55.00	1582872.3097	829083.1182	NW6 - Sta. 33+70.00	1582885.3008	829090.6168	780.00	787.00	7.00	15.00	105.00
159	NW6 - Sta. 33+70.00	1582885.3008	829090.6168	NW6 - Sta. 33+85.00	1582898.2920	829098.1155	781.00	787.00	6.00	15.00	90.00
160	NW6 - Sta. 33+85.00	1582898.2920	829098.1155	NW6 - Sta. 34+00.00	1582911.2832	829105.6141	781.00	788.00	7.00	15.00	105.00
161	NW6 - Sta. 34+00.00	1582911.2832	829105.6141	NW6 - Sta. 34+15.00	1582924.2744	829113.1127	781.00	788.00	7.00	15.00	105.00
162	NW6 - Sta. 34+15.00	1582924.2744	829113.1127	NW6 - Sta. 34+30.00	1582937.2655	829120.6114	782.00	788.00	6.00	15.00	90.00
163	NW6 - Sta. 34+30.00	1582937.2655	829120.6114	NW6 - Sta. 34+45.00	1582950.2567	829128.1100	782.00	788.00	6.00	15.00	90.00
164	NW6 - Sta. 34+45.00	1582950.2567	829128.1100	NW6 - Sta. 34+60.00	1582963.2479	829135.6086	782.00	789.00	7.00	15.00	105.00
165	NW6 - Sta. 34+60.00	1582963.2479	829135.6086	NW6 - Sta. 34+75.00	1582976.2390	829143.1073	783.00	789.00	6.00	15.00	90.00
166	NW6 - Sta. 34+75.00	1582976.2390	829143.1073	NW6 - Sta. 34+90.00	1582989.1261	829150.7835	782.00	789.00	7.00	15.00	105.00
167	NW6 - Sta. 34+90.00	1582989.1261	829150.7835	NW6 - Sta. 35+05.00	1583002.0131	829158.4597	782.00	789.00	7.00	15.00	105.00
168	NW6 - Sta. 35+05.00	1583002.0131	829158.4597	NW6 - Sta. 35+20.00	1583014.9001	829166.1360	781.00	790.00	9.00	15.00	135.00
169	NW6 - Sta. 35+20.00	1583014.9001	829166.1360	NW6 - Sta. 35+35.00	1583027.7871	829173.8122	781.00	790.00	9.00	15.00	135.00
170	NW6 - Sta. 35+35.00	1583027.7871	829173.8122	NW6 - Sta. 35+50.00	1583040.6742	829181.4884	781.00	790.00	9.00	15.00	135.00
171	NW6 - Sta. 35+50.00	1583040.6742	829181.4884	NW6 - Sta. 35+65.00	1583053.5612	829189.1647	781.00	790.00	9.00	15.00	135.00
172	NW6 - Sta. 35+65.00	1583053.5612	829189.1647	NW6 - Sta. 35+80.00	1583066.4873	829196.7749	782.00	790.00	8.00	15.00	120.00
173	NW6 - Sta. 35+80.00	1583066.4873	829196.7749	NW6 - Sta. 35+95.00	1583079.4134	829204.3851	782.00	790.00	8.00	15.00	120.00
174	NW6 - Sta. 35+95.00	1583079.4134	829204.3851	NW6 - Sta. 36+10.00	1583092.3396	829211.9953	782.00	790.00	8.00	15.00	120.00
175	NW6 - Sta. 36+10.00	1583092.3396	829211.9953	NW6 - Sta. 36+25.00	1583105.2657	829219.6055	782.00	790.00	8.00	15.00	120.00
176	NW6 - Sta. 36+25.00	1583105.2657	829219.6055	NW6 - Sta. 36+40.00	1583118.4973	829226.6713	782.00	791.00	9.00	15.00	135.00
177	NW6 - Sta. 36+40.00	1583118.4973	829226.6713	NW6 - Sta. 36+55.00	1583131.7289	829233.7370	782.00	791.00	9.00	15.00	135.00
178	NW6 - Sta. 36+55.00	1583131.7289	829233.7370	NW6 - Sta. 36+70.00	1583144.9605	829240.8028	783.00	791.00	8.00	15.00	120.00
179	NW6 - Sta. 36+70.00	1583144.9605	829240.8028	NW6 - Sta. 36+85.00	1583157.7863	829248.5809	783.00	791.00	8.00	15.00	120.00
180	NW6 - Sta. 36+85.00	1583157.7863	829248.5809	NW6 - Sta. 37+00.00	1583170.6121	829256.3590	783.00	792.00	9.00	15.00	135.00
181	NW6 - Sta. 37+00.00	1583170.6121	829256.3590	NW6 - Sta. 37+15.00	1583183.4379	829264.1371	783.00	792.00	9.00	15.00	135.00
182	NW6 - Sta. 37+15.00	1583183.4379	829264.1371	NW6 - Sta. 37+30.00	1583196.2637	829271.9151	784.00	792.00	8.00	15.00	120.00
183	NW6 - Sta. 37+30.00	1583196.2637	829271.9151	NW6 - Sta. 37+45.00	1583209.0895	829279.6932	783.00	792.00	9.00	15.00	135.00
184	NW6 - Sta. 37+45.00	1583209.0895	829279.6932	NW6 - Sta. 37+60.00	1583221.9153	829287.4713	783.00	793.00	10.00	15.00	150.00

I-0911A NW6 DNR Noise Wall Design Table

Total L (ft)	Total A (ft ²)
2,985.00	45,540.00

Panel No.	Panel Start Station	x	y	Panel End Station	x	y	Z-bottom	Z-top	Height (ft)	Length (ft)	Area (ft ²)
185	NW6 - Sta. 37+60.00	1583221.9153	829287.4713	NW6 - Sta. 37+75.00	1583234.9001	829294.9810	783.00	793.00	10.00	15.00	150.00
186	NW6 - Sta. 37+75.00	1583234.9001	829294.9810	NW6 - Sta. 37+90.00	1583247.8849	829302.4906	783.00	793.00	10.00	15.00	150.00
187	NW6 - Sta. 37+90.00	1583247.8849	829302.4906	NW6 - Sta. 38+05.00	1583260.8697	829310.0003	784.00	793.00	9.00	15.00	135.00
188	NW6 - Sta. 38+05.00	1583260.8697	829310.0003	NW6 - Sta. 38+20.00	1583273.8545	829317.5099	784.00	793.00	9.00	15.00	135.00
189	NW6 - Sta. 38+20.00	1583273.8545	829317.5099	NW6 - Sta. 38+35.00	1583286.7298	829325.2059	784.00	793.00	9.00	15.00	135.00
190	NW6 - Sta. 38+35.00	1583286.7298	829325.2059	NW6 - Sta. 38+50.00	1583299.6050	829332.9019	784.00	793.00	9.00	15.00	135.00
191	NW6 - Sta. 38+50.00	1583299.6050	829332.9019	NW6 - Sta. 38+65.00	1583312.4802	829340.5979	784.00	793.00	9.00	15.00	135.00
192	NW6 - Sta. 38+65.00	1583312.4802	829340.5979	NW6 - Sta. 38+80.00	1583325.3555	829348.2939	784.00	793.00	9.00	15.00	135.00
193	NW6 - Sta. 38+80.00	1583325.3555	829348.2939	NW6 - Sta. 38+95.00	1583338.2307	829355.9898	784.00	793.00	9.00	15.00	135.00
194	NW6 - Sta. 38+95.00	1583338.2307	829355.9898	NW6 - Sta. 39+10.00	1583351.1060	829363.6858	784.00	793.00	9.00	15.00	135.00
195	NW6 - Sta. 39+10.00	1583351.1060	829363.6858	NW6 - Sta. 39+25.00	1583363.9812	829371.3818	784.00	793.00	9.00	15.00	135.00
196	NW6 - Sta. 39+25.00	1583363.9812	829371.3818	NW6 - Sta. 39+40.00	1583376.8565	829379.0778	784.00	793.00	9.00	15.00	135.00
197	NW6 - Sta. 39+40.00	1583376.8565	829379.0778	NW6 - Sta. 39+55.00	1583389.7317	829386.7738	785.00	793.00	8.00	15.00	120.00
198	NW6 - Sta. 39+55.00	1583389.7317	829386.7738	NW6 - Sta. 39+70.00	1583402.6069	829394.4698	785.00	793.00	8.00	15.00	120.00
199	NW6 - Sta. 39+70.00	1583402.6069	829394.4698	NW6 - Sta. 39+85.00	1583415.4822	829402.1657	785.00	793.00	8.00	15.00	120.00

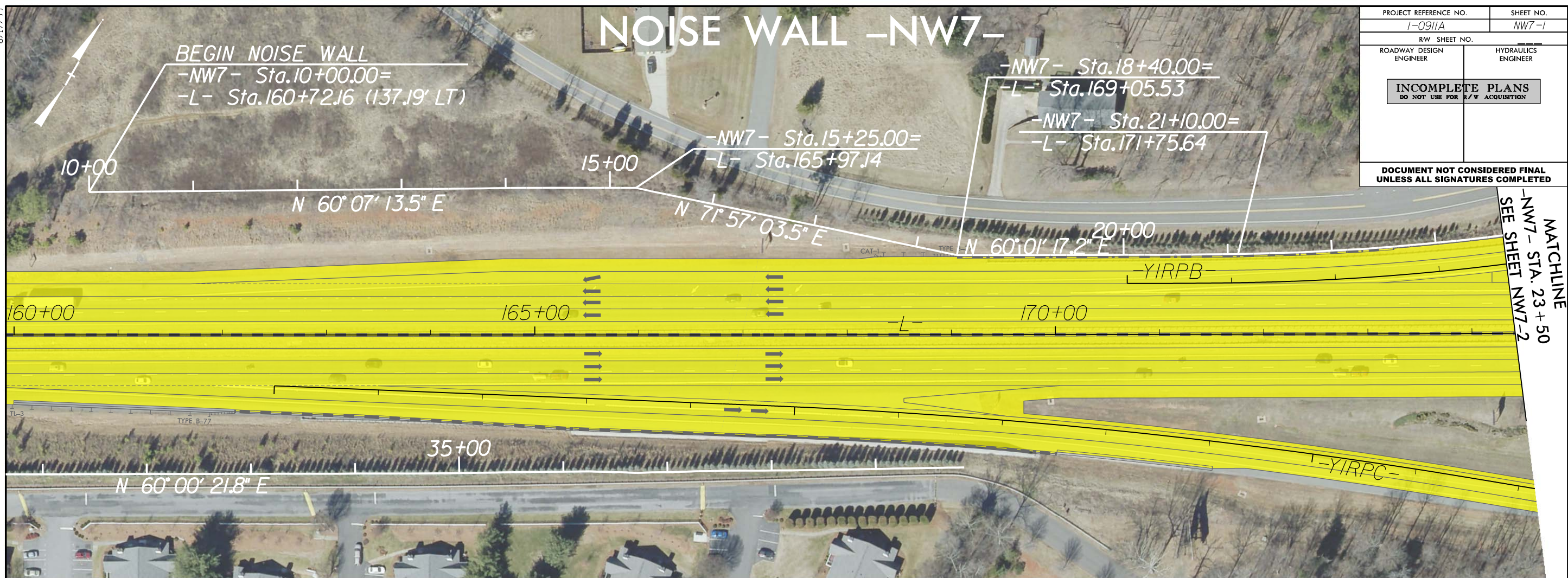
8/17/99

NOISE WALL -NW7-

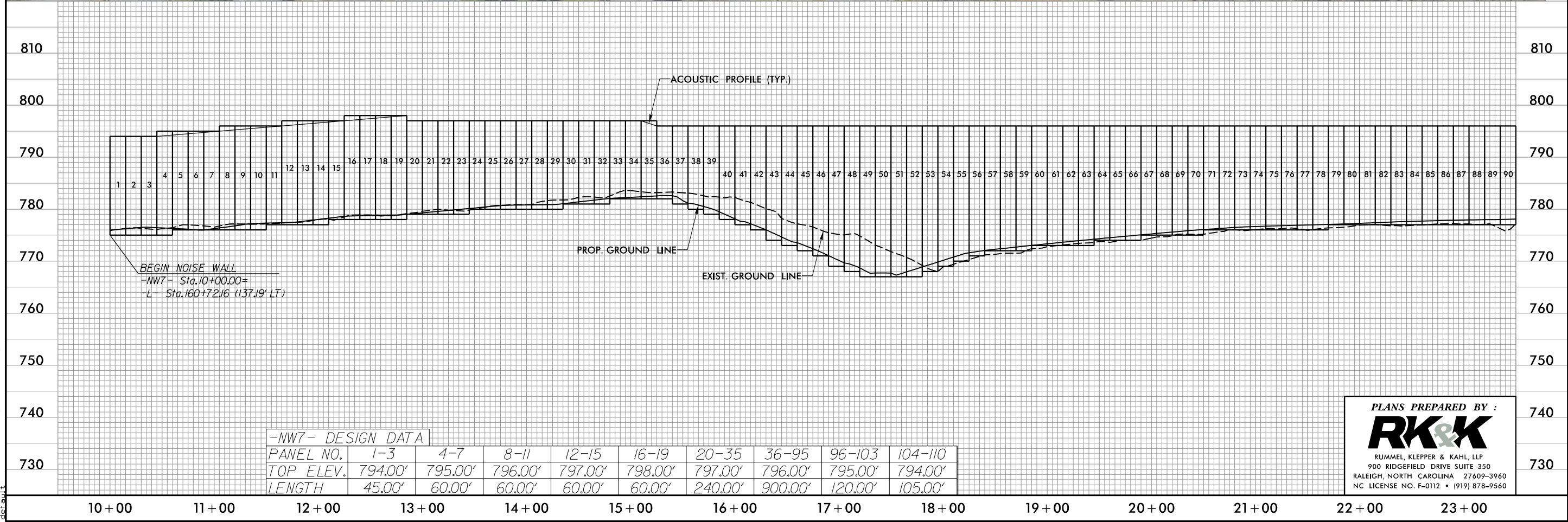
BEGIN NOISE WALL
-NW7- Sta.10+00.00=
-L- Sta.160+72.16 (137.19' LT)

-NW7- Sta.18+40.00=
-L- Sta.169+05.53
-NW7- Sta.21+10.00=
-L- Sta.171+75.64

-NW7- Sta.15+25.00=
-L- Sta.165+97.14



PROJECT REFERENCE NO.		SHEET NO.	
I-0911A		NW7-1	
RW SHEET NO.			
ROADWAY DESIGN ENGINEER		HYDRAULICS ENGINEER	
INCOMPLETE PLANS DO NOT USE FOR R/W ACQUISITION			
DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED			



PLANS PREPARED BY :

RK&K

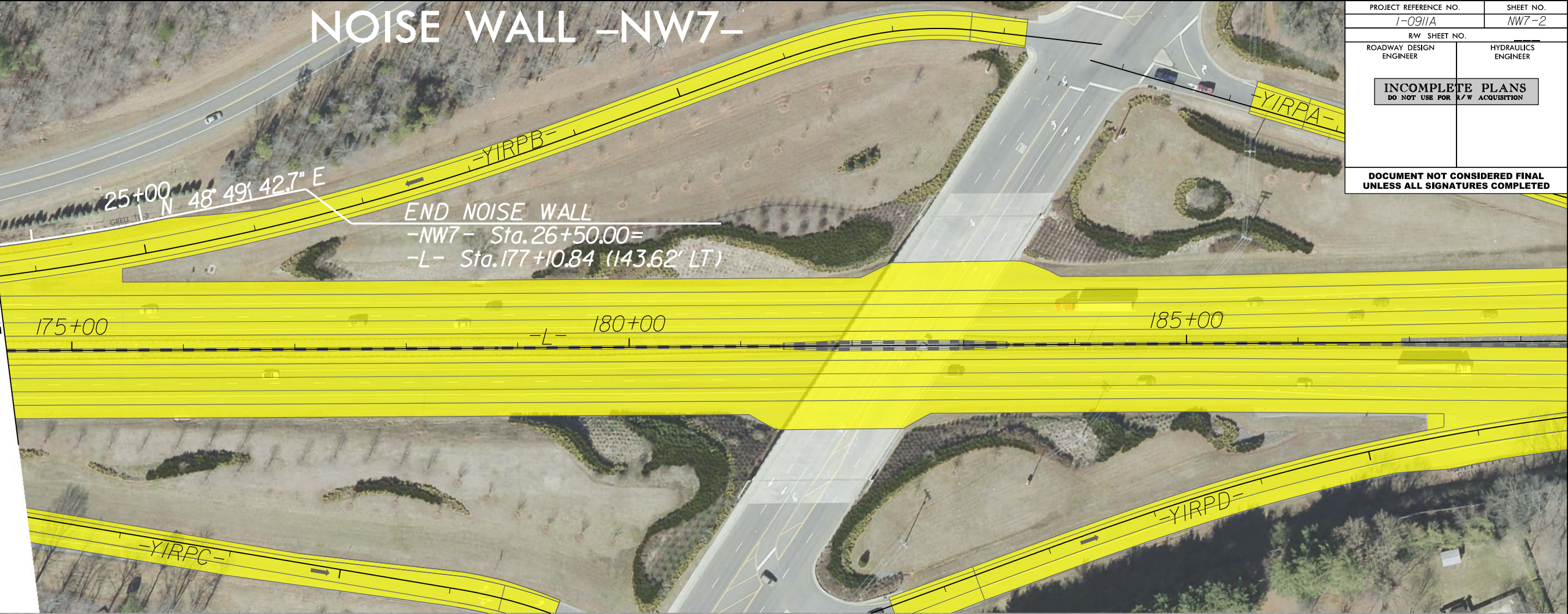
RUMMEL, KLEPPER & KAHL, LLP
900 RIDGEFIELD DRIVE SUITE 350
RALEIGH, NORTH CAROLINA 27609-3960
NC LICENSE NO. F-0112 • (919) 878-9560

5/7/2018
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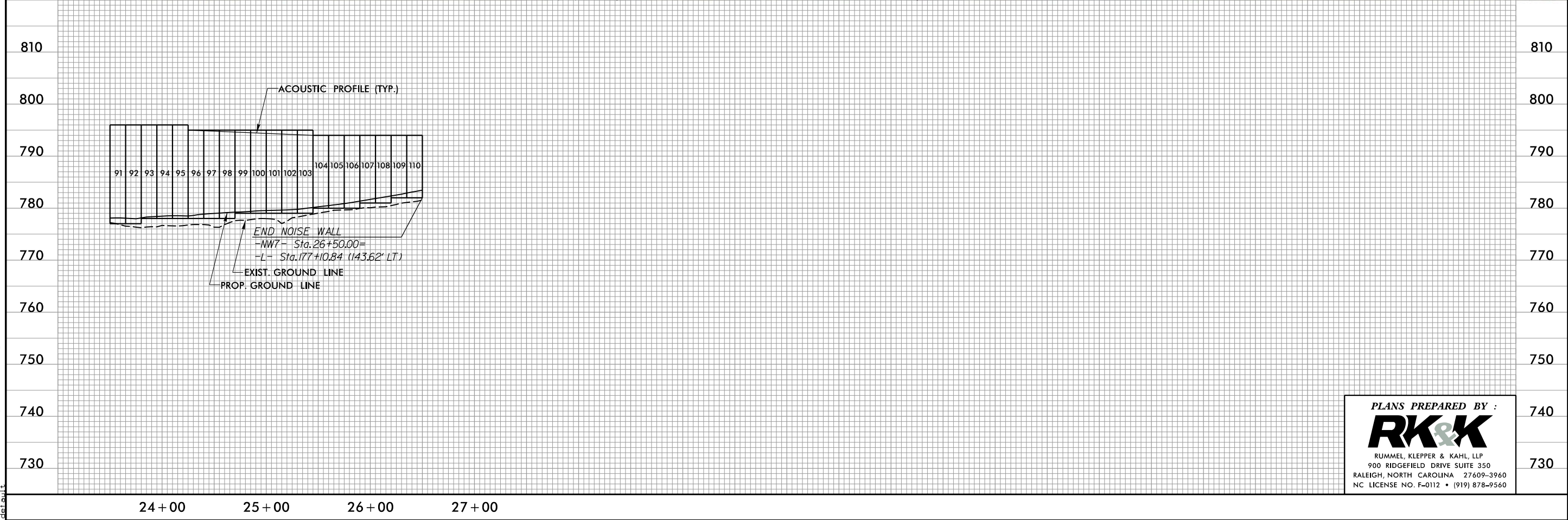
8/17/99

MATCHLINE
-NW7- STA. 23+50
SEE SHEET NW7-1

NOISE WALL -NW7-



PROJECT REFERENCE NO.	SHEET NO.
I-0911A	NW7-2
RW SHEET NO.	
ROADWAY DESIGN ENGINEER	HYDRAULICS ENGINEER
INCOMPLETE PLANS DO NOT USE FOR R/W ACQUISITION	
DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED	



PLANS PREPARED BY :
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900 RIDGEFIELD DRIVE SUITE 350
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NC LICENSE NO. F-0112 • (919) 878-9560

5/7/2018
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I-0911A NW7 DNR Noise Wall Design Table

Total L (ft)	Total A (ft ²)
1,650.00	32,190.00

Panel No.	Panel Start Station	x	y	Panel End Station	x	y	Z-bottom	Z-top	Height (ft)	Length (ft)	Area (ft ²)
1	NW7 - Sta. 10+00.00	1582555.0760	829212.9665	NW7 - Sta. 10+15.00	1582568.0106	829220.5624	775.00	794.00	19.00	15.00	285.00
2	NW7 - Sta. 10+15.00	1582568.0106	829220.5624	NW7 - Sta. 10+30.00	1582580.9451	829228.1582	775.00	794.00	19.00	15.00	285.00
3	NW7 - Sta. 10+30.00	1582580.9451	829228.1582	NW7 - Sta. 10+45.00	1582593.8797	829235.7541	775.00	794.00	19.00	15.00	285.00
4	NW7 - Sta. 10+45.00	1582593.8797	829235.7541	NW7 - Sta. 10+60.00	1582606.8142	829243.3499	775.00	795.00	20.00	15.00	300.00
5	NW7 - Sta. 10+60.00	1582606.8142	829243.3499	NW7 - Sta. 10+75.00	1582619.7488	829250.9458	776.00	795.00	19.00	15.00	285.00
6	NW7 - Sta. 10+75.00	1582619.7488	829250.9458	NW7 - Sta. 10+90.00	1582632.6834	829258.5416	776.00	795.00	19.00	15.00	285.00
7	NW7 - Sta. 10+90.00	1582632.6834	829258.5416	NW7 - Sta. 11+05.00	1582645.6179	829266.1375	776.00	795.00	19.00	15.00	285.00
8	NW7 - Sta. 11+05.00	1582645.6179	829266.1375	NW7 - Sta. 11+20.00	1582658.5525	829273.7333	776.00	796.00	20.00	15.00	300.00
9	NW7 - Sta. 11+20.00	1582658.5525	829273.7333	NW7 - Sta. 11+35.00	1582671.4871	829281.3292	776.00	796.00	20.00	15.00	300.00
10	NW7 - Sta. 11+35.00	1582671.4871	829281.3292	NW7 - Sta. 11+50.00	1582684.4217	829288.9250	776.00	796.00	20.00	15.00	300.00
11	NW7 - Sta. 11+50.00	1582684.4217	829288.9250	NW7 - Sta. 11+65.00	1582697.3562	829296.5209	777.00	796.00	19.00	15.00	285.00
12	NW7 - Sta. 11+65.00	1582697.3562	829296.5209	NW7 - Sta. 11+80.00	1582710.2908	829304.1167	777.00	797.00	20.00	15.00	300.00
13	NW7 - Sta. 11+80.00	1582710.2908	829304.1167	NW7 - Sta. 11+95.00	1582723.2254	829311.7126	777.00	797.00	20.00	15.00	300.00
14	NW7 - Sta. 11+95.00	1582723.2254	829311.7126	NW7 - Sta. 12+10.00	1582736.1599	829319.3084	777.00	797.00	20.00	15.00	300.00
15	NW7 - Sta. 12+10.00	1582736.1599	829319.3084	NW7 - Sta. 12+25.00	1582749.0945	829326.9043	778.00	797.00	19.00	15.00	285.00
16	NW7 - Sta. 12+25.00	1582749.0945	829326.9043	NW7 - Sta. 12+40.00	1582762.0290	829334.5001	778.00	798.00	20.00	15.00	300.00
17	NW7 - Sta. 12+40.00	1582762.0290	829334.5001	NW7 - Sta. 12+55.00	1582774.9636	829342.0960	778.00	798.00	20.00	15.00	300.00
18	NW7 - Sta. 12+55.00	1582774.9636	829342.0960	NW7 - Sta. 12+70.00	1582787.8982	829349.6919	778.00	798.00	20.00	15.00	300.00
19	NW7 - Sta. 12+70.00	1582787.8982	829349.6919	NW7 - Sta. 12+85.00	1582800.8327	829357.2877	778.00	798.00	20.00	15.00	300.00
20	NW7 - Sta. 12+85.00	1582800.8327	829357.2877	NW7 - Sta. 13+00.00	1582813.7673	829364.8836	779.00	797.00	18.00	15.00	270.00
21	NW7 - Sta. 13+00.00	1582813.7673	829364.8836	NW7 - Sta. 13+15.00	1582826.7019	829372.4795	779.00	797.00	18.00	15.00	270.00
22	NW7 - Sta. 13+15.00	1582826.7019	829372.4795	NW7 - Sta. 13+30.00	1582839.6365	829380.0753	779.00	797.00	18.00	15.00	270.00
23	NW7 - Sta. 13+30.00	1582839.6365	829380.0753	NW7 - Sta. 13+45.00	1582852.5710	829387.6712	779.00	797.00	18.00	15.00	270.00
24	NW7 - Sta. 13+45.00	1582852.5710	829387.6712	NW7 - Sta. 13+60.00	1582865.5056	829395.2670	780.00	797.00	17.00	15.00	255.00
25	NW7 - Sta. 13+60.00	1582865.5056	829395.2670	NW7 - Sta. 13+75.00	1582878.4402	829402.8629	780.00	797.00	17.00	15.00	255.00
26	NW7 - Sta. 13+75.00	1582878.4402	829402.8629	NW7 - Sta. 13+90.00	1582891.3747	829410.4587	780.00	797.00	17.00	15.00	255.00
27	NW7 - Sta. 13+90.00	1582891.3747	829410.4587	NW7 - Sta. 14+05.00	1582904.3093	829418.0546	780.00	797.00	17.00	15.00	255.00
28	NW7 - Sta. 14+05.00	1582904.3093	829418.0546	NW7 - Sta. 14+20.00	1582917.2438	829425.6504	780.00	797.00	17.00	15.00	255.00
29	NW7 - Sta. 14+20.00	1582917.2438	829425.6504	NW7 - Sta. 14+35.00	1582930.2499	829433.1232	780.00	797.00	17.00	15.00	255.00
30	NW7 - Sta. 14+35.00	1582930.2499	829433.1232	NW7 - Sta. 14+50.00	1582943.2560	829440.5959	781.00	797.00	16.00	15.00	240.00
31	NW7 - Sta. 14+50.00	1582943.2560	829440.5959	NW7 - Sta. 14+65.00	1582956.2621	829448.0685	781.00	797.00	16.00	15.00	240.00
32	NW7 - Sta. 14+65.00	1582956.2621	829448.0685	NW7 - Sta. 14+80.00	1582969.2682	829455.5412	781.00	797.00	16.00	15.00	240.00
33	NW7 - Sta. 14+80.00	1582969.2682	829455.5412	NW7 - Sta. 14+95.00	1582982.2743	829463.0139	782.00	797.00	15.00	15.00	225.00
34	NW7 - Sta. 14+95.00	1582982.2743	829463.0139	NW7 - Sta. 15+10.00	1582995.2804	829470.4866	782.00	797.00	15.00	15.00	225.00
35	NW7 - Sta. 15+10.00	1582995.2804	829470.4866	NW7 - Sta. 15+25.00	1583008.2866	829477.9593	782.00	797.00	15.00	15.00	225.00
36	NW7 - Sta. 15+25.00	1583008.2866	829477.9593	NW7 - Sta. 15+40.00	1583022.5484	829482.6067	782.00	796.00	14.00	15.00	210.00
37	NW7 - Sta. 15+40.00	1583022.5484	829482.6067	NW7 - Sta. 15+55.00	1583036.8103	829487.2542	781.00	796.00	15.00	15.00	225.00
38	NW7 - Sta. 15+55.00	1583036.8103	829487.2542	NW7 - Sta. 15+70.00	1583051.0722	829491.9017	780.00	796.00	16.00	15.00	240.00
39	NW7 - Sta. 15+70.00	1583051.0722	829491.9017	NW7 - Sta. 15+85.00	1583065.3341	829496.5492	779.00	796.00	17.00	15.00	255.00
40	NW7 - Sta. 15+85.00	1583065.3341	829496.5492	NW7 - Sta. 16+00.00	1583079.5959	829501.1966	778.00	796.00	18.00	15.00	270.00
41	NW7 - Sta. 16+00.00	1583079.5959	829501.1966	NW7 - Sta. 16+15.00	1583093.8578	829505.8441	777.00	796.00	19.00	15.00	285.00
42	NW7 - Sta. 16+15.00	1583093.8578	829505.8441	NW7 - Sta. 16+30.00	1583108.1197	829510.4916	776.00	796.00	20.00	15.00	300.00
43	NW7 - Sta. 16+30.00	1583108.1197	829510.4916	NW7 - Sta. 16+45.00	1583122.3815	829515.1390	774.00	796.00	22.00	15.00	330.00
44	NW7 - Sta. 16+45.00	1583122.3815	829515.1390	NW7 - Sta. 16+60.00	1583136.6434	829519.7865	773.00	796.00	23.00	15.00	345.00
45	NW7 - Sta. 16+60.00	1583136.6434	829519.7865	NW7 - Sta. 16+75.00	1583150.9053	829524.4340	772.00	796.00	24.00	15.00	360.00
46	NW7 - Sta. 16+75.00	1583150.9053	829524.4340	NW7 - Sta. 16+90.00	1583165.1672	829529.0815	771.00	796.00	25.00	15.00	375.00

I-0911A NW7 DNR Noise Wall Design Table

Total L (ft)	Total A (ft ²)
1,650.00	32,190.00

Panel No.	Panel Start Station	x	y	Panel End Station	x	y	Z-bottom	Z-top	Height (ft)	Length (ft)	Area (ft ²)
47	NW7 - Sta. 16+90.00	1583165.1672	829529.0815	NW7 - Sta. 17+05.00	1583179.4290	829533.7289	769.00	796.00	27.00	15.00	405.00
48	NW7 - Sta. 17+05.00	1583179.4290	829533.7289	NW7 - Sta. 17+20.00	1583193.6909	829538.3764	768.00	796.00	28.00	15.00	420.00
49	NW7 - Sta. 17+20.00	1583193.6909	829538.3764	NW7 - Sta. 17+35.00	1583207.9528	829543.0239	767.00	796.00	29.00	15.00	435.00
50	NW7 - Sta. 17+35.00	1583207.9528	829543.0239	NW7 - Sta. 17+50.00	1583222.2147	829547.6713	767.00	796.00	29.00	15.00	435.00
51	NW7 - Sta. 17+50.00	1583222.2147	829547.6713	NW7 - Sta. 17+65.00	1583236.4765	829552.3188	767.00	796.00	29.00	15.00	435.00
52	NW7 - Sta. 17+65.00	1583236.4765	829552.3188	NW7 - Sta. 17+80.00	1583250.7384	829556.9663	767.00	796.00	29.00	15.00	435.00
53	NW7 - Sta. 17+80.00	1583250.7384	829556.9663	NW7 - Sta. 17+95.00	1583265.0003	829561.6138	768.00	796.00	28.00	15.00	420.00
54	NW7 - Sta. 17+95.00	1583265.0003	829561.6138	NW7 - Sta. 18+10.00	1583279.2621	829566.2612	769.00	796.00	27.00	15.00	405.00
55	NW7 - Sta. 18+10.00	1583279.2621	829566.2612	NW7 - Sta. 18+25.00	1583293.5240	829570.9087	770.00	796.00	26.00	15.00	390.00
56	NW7 - Sta. 18+25.00	1583293.5240	829570.9087	NW7 - Sta. 18+40.00	1583307.7859	829575.5562	771.00	796.00	25.00	15.00	375.00
57	NW7 - Sta. 18+40.00	1583307.7859	829575.5562	NW7 - Sta. 18+55.00	1583320.7834	829583.0437	772.00	796.00	24.00	15.00	360.00
58	NW7 - Sta. 18+55.00	1583320.7834	829583.0437	NW7 - Sta. 18+70.00	1583333.7810	829590.5313	772.00	796.00	24.00	15.00	360.00
59	NW7 - Sta. 18+70.00	1583333.7810	829590.5313	NW7 - Sta. 18+85.00	1583346.7767	829598.0221	772.00	796.00	24.00	15.00	360.00
60	NW7 - Sta. 18+85.00	1583346.7767	829598.0221	NW7 - Sta. 19+00.00	1583359.7724	829605.5129	773.00	796.00	23.00	15.00	345.00
61	NW7 - Sta. 19+00.00	1583359.7724	829605.5129	NW7 - Sta. 19+15.00	1583372.7681	829613.0037	773.00	796.00	23.00	15.00	345.00
62	NW7 - Sta. 19+15.00	1583372.7681	829613.0037	NW7 - Sta. 19+30.00	1583385.7638	829620.4945	773.00	796.00	23.00	15.00	345.00
63	NW7 - Sta. 19+30.00	1583385.7638	829620.4945	NW7 - Sta. 19+45.00	1583398.7569	829627.9896	773.00	796.00	23.00	15.00	345.00
64	NW7 - Sta. 19+45.00	1583398.7569	829627.9896	NW7 - Sta. 19+60.00	1583411.7501	829635.4848	774.00	796.00	22.00	15.00	330.00
65	NW7 - Sta. 19+60.00	1583411.7501	829635.4848	NW7 - Sta. 19+75.00	1583424.7433	829642.9799	774.00	796.00	22.00	15.00	330.00
66	NW7 - Sta. 19+75.00	1583424.7433	829642.9799	NW7 - Sta. 19+90.00	1583437.7365	829650.4750	774.00	796.00	22.00	15.00	330.00
67	NW7 - Sta. 19+90.00	1583437.7365	829650.4750	NW7 - Sta. 20+05.00	1583450.7216	829657.9842	775.00	796.00	21.00	15.00	315.00
68	NW7 - Sta. 20+05.00	1583450.7216	829657.9842	NW7 - Sta. 20+20.00	1583463.7067	829665.4933	775.00	796.00	21.00	15.00	315.00
69	NW7 - Sta. 20+20.00	1583463.7067	829665.4933	NW7 - Sta. 20+35.00	1583476.6918	829673.0025	775.00	796.00	21.00	15.00	315.00
70	NW7 - Sta. 20+35.00	1583476.6918	829673.0025	NW7 - Sta. 20+50.00	1583489.6769	829680.5116	775.00	796.00	21.00	15.00	315.00
71	NW7 - Sta. 20+50.00	1583489.6769	829680.5116	NW7 - Sta. 20+65.00	1583502.6029	829688.1221	776.00	796.00	20.00	15.00	300.00
72	NW7 - Sta. 20+65.00	1583502.6029	829688.1221	NW7 - Sta. 20+80.00	1583515.5289	829695.7325	776.00	796.00	20.00	15.00	300.00
73	NW7 - Sta. 20+80.00	1583515.5289	829695.7325	NW7 - Sta. 20+95.00	1583528.4549	829703.3429	776.00	796.00	20.00	15.00	300.00
74	NW7 - Sta. 20+95.00	1583528.4549	829703.3429	NW7 - Sta. 21+10.00	1583541.3809	829710.9534	776.00	796.00	20.00	15.00	300.00
75	NW7 - Sta. 21+10.00	1583541.3809	829710.9534	NW7 - Sta. 21+25.00	1583554.1714	829718.7894	776.00	796.00	20.00	15.00	300.00
76	NW7 - Sta. 21+25.00	1583554.1714	829718.7894	NW7 - Sta. 21+40.00	1583566.9619	829726.6254	776.00	796.00	20.00	15.00	300.00
77	NW7 - Sta. 21+40.00	1583566.9619	829726.6254	NW7 - Sta. 21+55.00	1583579.7524	829734.4614	776.00	796.00	20.00	15.00	300.00
78	NW7 - Sta. 21+55.00	1583579.7524	829734.4614	NW7 - Sta. 21+70.00	1583592.5429	829742.2974	776.00	796.00	20.00	15.00	300.00
79	NW7 - Sta. 21+70.00	1583592.5429	829742.2974	NW7 - Sta. 21+85.00	1583605.1330	829750.4515	777.00	796.00	19.00	15.00	285.00
80	NW7 - Sta. 21+85.00	1583605.1330	829750.4515	NW7 - Sta. 22+00.00	1583617.7231	829758.6056	777.00	796.00	19.00	15.00	285.00
81	NW7 - Sta. 22+00.00	1583617.7231	829758.6056	NW7 - Sta. 22+15.00	1583630.3132	829766.7597	777.00	796.00	19.00	15.00	285.00
82	NW7 - Sta. 22+15.00	1583630.3132	829766.7597	NW7 - Sta. 22+30.00	1583642.9033	829774.9137	777.00	796.00	19.00	15.00	285.00
83	NW7 - Sta. 22+30.00	1583642.9033	829774.9137	NW7 - Sta. 22+45.00	1583655.2757	829783.3945	777.00	796.00	19.00	15.00	285.00
84	NW7 - Sta. 22+45.00	1583655.2757	829783.3945	NW7 - Sta. 22+60.00	1583667.6481	829791.8753	777.00	796.00	19.00	15.00	285.00
85	NW7 - Sta. 22+60.00	1583667.6481	829791.8753	NW7 - Sta. 22+75.00	1583679.9648	829800.4369	777.00	796.00	19.00	15.00	285.00
86	NW7 - Sta. 22+75.00	1583679.9648	829800.4369	NW7 - Sta. 22+90.00	1583692.2814	829808.9985	777.00	796.00	19.00	15.00	285.00
87	NW7 - Sta. 22+90.00	1583692.2814	829808.9985	NW7 - Sta. 23+05.00	1583704.4850	829817.7205	777.00	796.00	19.00	15.00	285.00
88	NW7 - Sta. 23+05.00	1583704.4850	829817.7205	NW7 - Sta. 23+20.00	1583716.6885	829826.4425	777.00	796.00	19.00	15.00	285.00
89	NW7 - Sta. 23+20.00	1583716.6885	829826.4425	NW7 - Sta. 23+35.00	1583728.7769	829835.3235	777.00	796.00	19.00	15.00	285.00
90	NW7 - Sta. 23+35.00	1583728.7769	829835.3235	NW7 - Sta. 23+50.00	1583740.8652	829844.2045	777.00	796.00	19.00	15.00	285.00
91	NW7 - Sta. 23+50.00	1583740.8652	829844.2045	NW7 - Sta. 23+65.00	1583752.8363	829853.2429	777.00	796.00	19.00	15.00	285.00
92	NW7 - Sta. 23+65.00	1583752.8363	829853.2429	NW7 - Sta. 23+80.00	1583764.8073	829862.2813	777.00	796.00	19.00	15.00	285.00

I-0911A NW7 DNR Noise Wall Design Table

Total L (ft)	Total A (ft ²)
1,650.00	32,190.00

Panel No.	Panel Start Station	x	y	Panel End Station	x	y	Z-bottom	Z-top	Height (ft)	Length (ft)	Area (ft ²)
93	NW7 - Sta. 23+80.00	1583764.8073	829862.2813	NW7 - Sta. 23+95.00	1583776.6591	829871.4756	778.00	796.00	18.00	15.00	270.00
94	NW7 - Sta. 23+95.00	1583776.6591	829871.4756	NW7 - Sta. 24+10.00	1583788.5109	829880.6699	778.00	796.00	18.00	15.00	270.00
95	NW7 - Sta. 24+10.00	1583788.5109	829880.6699	NW7 - Sta. 24+25.00	1583800.2414	829890.0186	778.00	796.00	18.00	15.00	270.00
96	NW7 - Sta. 24+25.00	1583800.2414	829890.0186	NW7 - Sta. 24+40.00	1583811.9718	829899.3672	778.00	795.00	17.00	15.00	255.00
97	NW7 - Sta. 24+40.00	1583811.9718	829899.3672	NW7 - Sta. 24+55.00	1583823.5789	829908.8686	778.00	795.00	17.00	15.00	255.00
98	NW7 - Sta. 24+55.00	1583823.5789	829908.8686	NW7 - Sta. 24+70.00	1583835.1859	829918.3699	778.00	795.00	17.00	15.00	255.00
99	NW7 - Sta. 24+70.00	1583835.1859	829918.3699	NW7 - Sta. 24+85.00	1583846.4704	829928.2528	779.00	795.00	16.00	15.00	240.00
100	NW7 - Sta. 24+85.00	1583846.4704	829928.2528	NW7 - Sta. 25+00.00	1583857.7548	829938.1357	779.00	795.00	16.00	15.00	240.00
101	NW7 - Sta. 25+00.00	1583857.7548	829938.1357	NW7 - Sta. 25+15.00	1583869.0461	829948.0103	779.00	795.00	16.00	15.00	240.00
102	NW7 - Sta. 25+15.00	1583869.0461	829948.0103	NW7 - Sta. 25+30.00	1583880.3373	829957.8849	779.00	795.00	16.00	15.00	240.00
103	NW7 - Sta. 25+30.00	1583880.3373	829957.8849	NW7 - Sta. 25+45.00	1583891.6286	829967.7595	779.00	795.00	16.00	15.00	240.00
104	NW7 - Sta. 25+45.00	1583891.6286	829967.7595	NW7 - Sta. 25+60.00	1583902.9198	829977.6341	780.00	794.00	14.00	15.00	210.00
105	NW7 - Sta. 25+60.00	1583902.9198	829977.6341	NW7 - Sta. 25+75.00	1583914.2111	829987.5087	780.00	794.00	14.00	15.00	210.00
106	NW7 - Sta. 25+75.00	1583914.2111	829987.5087	NW7 - Sta. 25+90.00	1583925.5023	829997.3833	780.00	794.00	14.00	15.00	210.00
107	NW7 - Sta. 25+90.00	1583925.5023	829997.3833	NW7 - Sta. 26+05.00	1583936.7936	830007.2579	781.00	794.00	13.00	15.00	195.00
108	NW7 - Sta. 26+05.00	1583936.7936	830007.2579	NW7 - Sta. 26+20.00	1583948.0848	830017.1325	781.00	794.00	13.00	15.00	195.00
109	NW7 - Sta. 26+20.00	1583948.0848	830017.1325	NW7 - Sta. 26+35.00	1583959.3761	830027.0071	782.00	794.00	12.00	15.00	180.00
110	NW7 - Sta. 26+35.00	1583959.3761	830027.0071	NW7 - Sta. 26+50.00	1583970.6673	830036.8817	782.00	794.00	12.00	15.00	180.00

Appendix D

FIELD DATA SHEETS

NOISE METER CALIBRATION
CERTIFICATES

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NOISE MONITORING FIELD DATA SHEET

PROJECT INFORMATION:

Project Name:	I-40 WIDENING / YADKIN RIV. BR	Date:	11/14/2017
TIP# / County:	I 0911A / FORSYTH & DAVIE	NSA / Setup:	1
Description:	WIDEN I-40 4- to 6-LANES	Time Start:	08:25
Consultant:	RKJ	Time Stop:	08:45

MONITORING SUMMARY:

Meter:	1	2	3	4	Meter:	1	2	3	4
Make:	DL-1	DL-2	DL-2		LAeq	59.9	64.2	59.7	
S/N:	#1	#2	#3		LAmx				
Cal Spec:	114 dB @ 1 kHz				LA10				
Cal Offset:	N/A	N/A	N/A		LA90				

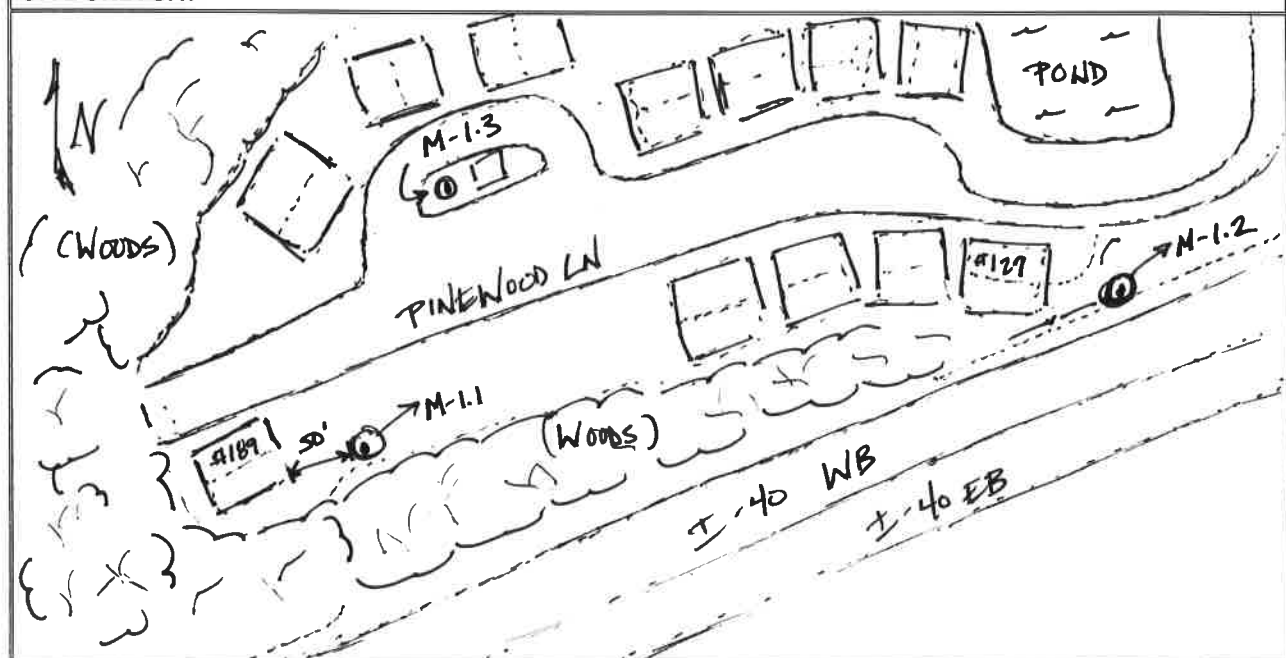
TRAFFIC COUNT DATA:

Paved Width:		38' x 2		# Lanes:	4	Spd.Limit:	65	Obs.Spd.:	EB 63.2 WB 58.6
Lanes:	Dir:	Field Traffic Counts:			Time:	Hourly Traffic Counts:			
		A	MT	HT		A	MT	HT	
2	EB	620	28	38	0:20	1860	84	114	
2	WB	340	32	32	0:20	1020	96	96	

WEATHER / ENVIRONMENTAL SUMMARY: #4

Temp:		Time/Event:	
Wind Vel:		Time/Event:	
Wind Dir:		Time/Event:	
Other:		Time/Event:	

SITE SKETCH:



#1 S/N BLH040011 #2 B1J030015 #3 B1H030023
#4 SEE REPORT

NOISE MONITORING FIELD DATA SHEET

PROJECT INFORMATION:

Project Name:	I-40 WIDENING / YADEID RIVER BRIDGE	Date:	11/14/2017
TIP# / County:	I-0911A / FORSYTH & DAVID	NSA / Setup:	2
Description:	WIDEN I-40 4 TO 6 LANES	Time Start:	9:20
Consultant:	RK & K	Time Stop:	9:40

MONITORING SUMMARY:

Meter:	1	2	3	4	Meter:	1	2	3	4
Make:	DL-1	DL-2	DL-3		LAeq	68.2	63.5	62.5	
S/N:	*1	*2	*3		LAmx				
Cal Spec:	114 dB @ 1 kHz				LA10				
Cal Offset:	N/A	N/A	N/A		LA90				

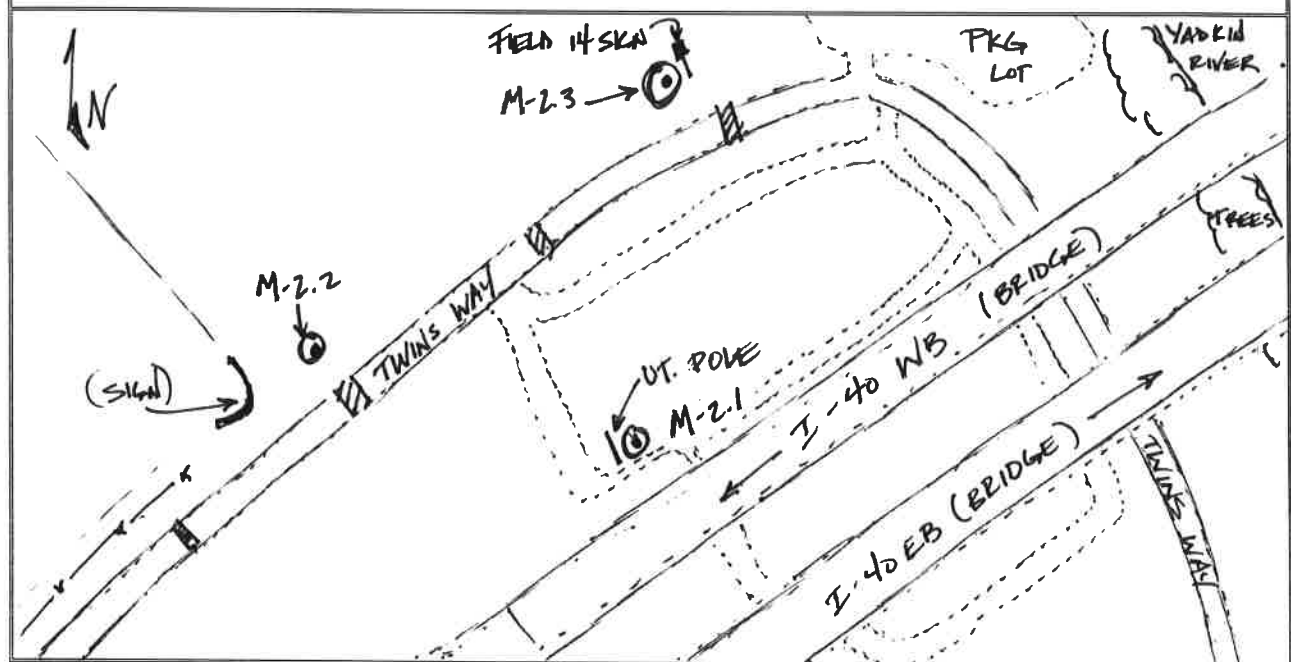
TRAFFIC COUNT DATA:

Paved Width:		38' x 2		# Lanes:	4	Spd. Limit:	65	Obs. Spd.:	EB 61.2 WB 60.7
Lanes:	Dir:	Field Traffic Counts:			Time:	Hourly Traffic Counts:			
		A	MT	HT		A	MT	HT	
2	EB	484	31	52	0:20	1452	93	156	
2	WB	341	18	50	0:20	1023	54	150	

WEATHER / ENVIRONMENTAL SUMMARY:

Temp:		Time/Event:	
Wind Vel:		Time/Event:	
Wind Dir:		Time/Event:	
Other:		Time/Event:	

SITE SKETCH:



*1 S/N BLH 040011

*2 S/N B15030015

*3 B1H 030023

*4 SEE REPORT

NOISE MONITORING FIELD DATA SHEET

PROJECT INFORMATION:

Project Name:	I-40 WIDENING / YADKIN RIVER BRIDGE	Date:	11/14/2017
TIP# / County:	I-0911A / FORSYTH & DAVID	NSA / Setup:	3
Description:	WIDEN I-40 4 TO 6 LANES	Time Start:	10:20
Consultant:	RK & K	Time Stop:	10:40

MONITORING SUMMARY:

Meter:	1	2	3	4	Meter:	1	2	3	4
Make:	DL-1	DL-2	DL-2		LAeq	66.5	63.4	59.1	
S/N:	*1	*2	*3		LAmx				
Cal Spec:	114 dB @ 1 kHz				LA10				
Cal Offset:	N/A	N/A	N/A		LA90				

TRAFFIC COUNT DATA:

Paved Width:		38' x 2	# Lanes:	4	Spd.Limit:	65	Obs.Spd.:	EB 57.8 WB 51.9
Lanes:	Dir:	Field Traffic Counts:			Time:	Hourly Traffic Counts:		
		A	MT	HT		A	MT	HT
2	EB	440	28	43	0:20	1320	84	129
2	WB	419	31	54	0:20	1257	93	162

WEATHER / ENVIRONMENTAL SUMMARY: *5

Temp:		Time/Event:	
Wind Vel:		Time/Event:	
Wind Dir:		Time/Event:	
Other:		Time/Event:	

SITE SKETCH:



*1 S/N BLH040011

*2 S/N BJS030015

*3 S/N BJS030023

*4 AVG CPDS < TRAVEL OBSERVED

*5 SEE REPORT

NOISE MONITORING FIELD DATA SHEET

PROJECT INFORMATION:

Project Name:	I-40 WIDENING / YADKIN RIV. BRIDGE	Date:	11/14/2017
TIP# / County:	I-0911A / FORSYTH & DAVIE	NSA / Setup:	4
Description:	WIDEN I-40 4- TO 6- LANES	Time Start:	10:50
Consultant:	RK & K	Time Stop:	11:10

MONITORING SUMMARY:

Meter:	1	2	3	4	Meter:	1	2	3	4
Make:	DL-1	DL-2	DL-2		L _{Aeq}	64.8	68.5	57.5	
S/N:	K ¹	K ²	K ³		L _{Amax}				
Cal Spec:	114 dB @ 1 kHz				L _{A10}				
Cal Offset:	N/A	N/A	N/A		L _{A90}				

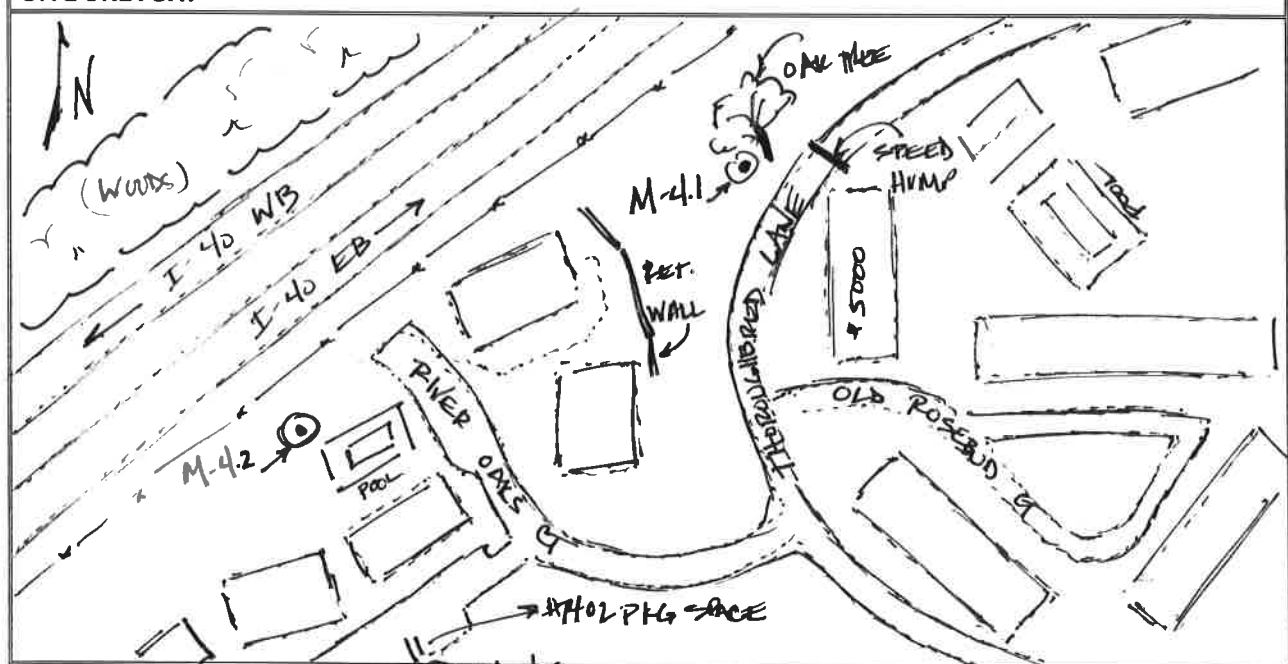
TRAFFIC COUNT DATA:

Paved Width:		38' x 2		# Lanes:	4	Spd. Limit:	65	Obs. Spd.:	EB: 54.3 WB: 57.0	
Lanes:	Dir:	Field Traffic Counts:			Time:	Hourly Traffic Counts:				
		A	MT	HT		A	MT	HT		
2	EB	410	27	63	0:20	1230	81	189		
2	WB	400	24	58	0:20	1200	72	174		

WEATHER / ENVIRONMENTAL SUMMARY: K⁵

Temp:		Time/Event:	
Wind Vel:		Time/Event:	
Wind Dir:		Time/Event:	
Other:		Time/Event:	

SITE SKETCH:



K¹ S/N BLH040011

K² S/N BJS030015

K³ S/N BIH030023

K⁴ OBS SPEEDS < TRAVEL OBSERVED

K⁵ SEE REPORT

NOISE MONITORING FIELD DATA SHEET

PROJECT INFORMATION:

Project Name:	I-40 WIDENING / YADEKIN RIVER BR	Date:	11/14/2017
TIP# / County:	I-0911A / FORSYTH & DADE	NSA / Setup:	6
Description:	WIDEN I-40 4- TO 6 LANES	Time Start:	11:45
Consultant:	RK & K	Time Stop:	12:05

MONITORING SUMMARY:

Meter:	1	2	3	4	Meter:	1	2	3	4
Make:	DL-1	DL-2	DL-2		L _{Aeq}	67.0	63.6	67.5	
S/N:	K ¹	K ²	K ³		L _{Amax}				
Cal Spec:	114 dB @ 1 kHz				L _{A10}				
Cal Offset:	N/A	N/A	N/A		L _{A90}				

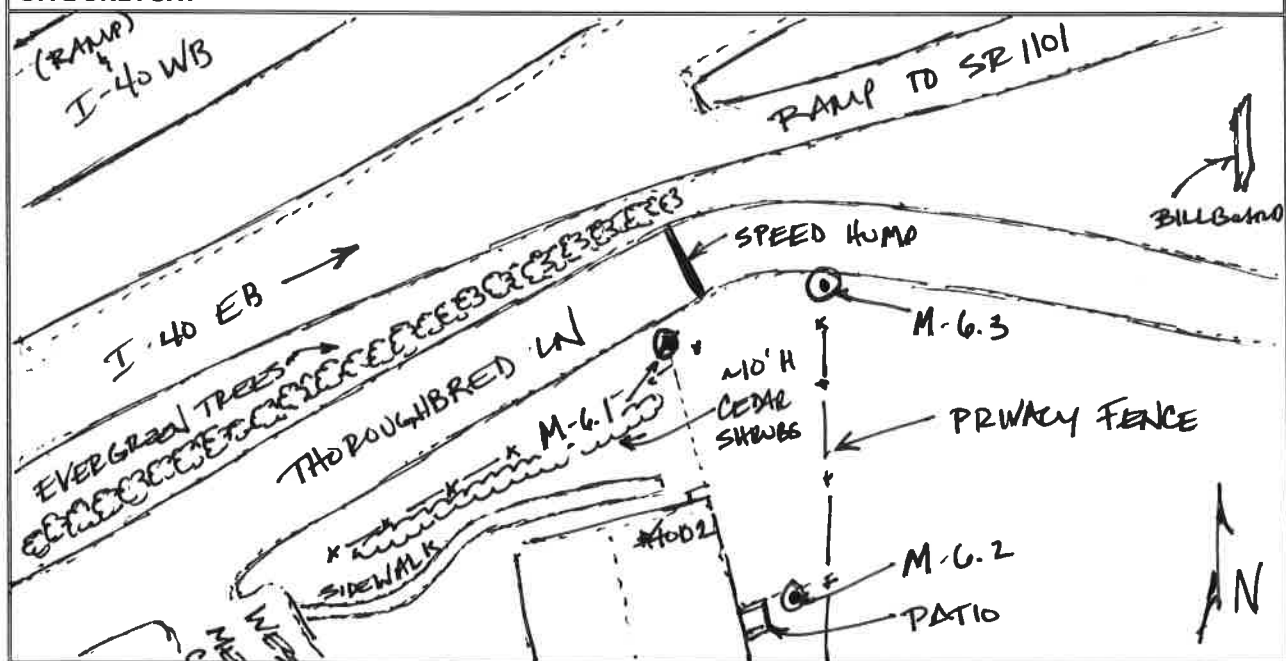
TRAFFIC COUNT DATA:

→ PLUS 2 RAMP, PAVED WIDTH VARIES EB SB.1								
Paved Width:	38' x 2	# Lanes:	4	Spd. Limit:	65	Obs. Spd.:	WB 62.9	
Lanes:	Dir:	Field Traffic Counts:			Time:	Hourly Traffic Counts:		
		A	MT	HT		A	MT	HT
2	EB	411	18	39	0:20	1233	54	117
2	WB	400	24	63	0:20	1200	72	189

WEATHER / ENVIRONMENTAL SUMMARY: K⁴

Temp:		Time/Event:	
Wind Vel:		Time/Event:	
Wind Dir:		Time/Event:	
Other:		Time/Event:	

SITE SKETCH:



K¹ S/N BLH040011 K² S/N BJS 030015
 K³ S/N BIA 030023 K⁴ SEE REPORT

NOISE MONITORING FIELD DATA SHEET

PROJECT INFORMATION:

Project Name:	I-40 WIDENING / VANDER RIVER RR.	Date:	11/14/2017
TIP# / County:	0911A / FORSYTH & DAVIE	NSA / Setup:	7
Description:	WIDEN I-40 4- TO 6-LANES	Time Start:	13:30
Consultant:	RK & K	Time Stop:	13:50

MONITORING SUMMARY:

Meter:	1	2	3	4	Meter:	1	2	3	4
Make:	DL-1	DL-2	DL-2		L _{Aeq}	62.4	57.0	51.3	
S/N:	A ¹	A ²	A ³		L _{Amax}				
Cal Spec:	114 dB @ 1 kHz				L _{A10}				
Cal Offset:	N/A	N/A	N/A		L _{A90}				

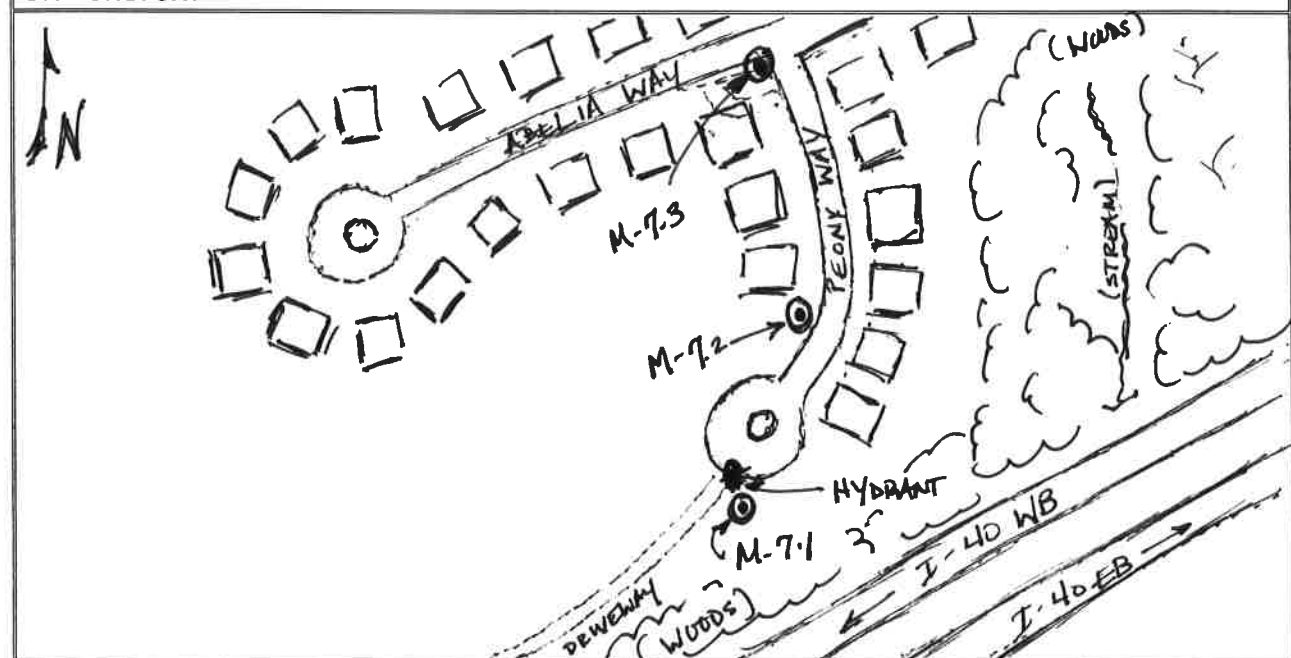
TRAFFIC COUNT DATA:

Paved Width:		38' x 2	# Lanes:	4	Spd. Limit:	65	Obs. Spd.: NB: 56.7	
Lanes:	Dir:	Field Traffic Counts:			Time:	Hourly Traffic Counts:		
		A	MT	HT		A	MT	HT
2	EB	452	12	39	0:20	1356	36	117
2	WB	440	30	48	0:20	1320	90	144

WEATHER / ENVIRONMENTAL SUMMARY: K⁵

Temp:		Time/Event:	
Wind Vel:		Time/Event:	
Wind Dir:		Time/Event:	
Other:		Time/Event:	

SITE SKETCH:



K¹ S/N BHH040011

K² S/N BHS030015

K³ S/N BHS030023

K⁴ AVG SPDs < TRAVEL SPEEDS OBSERVED

K⁵ SEE REPORT

NOISE MONITORING FIELD DATA SHEET

PROJECT INFORMATION:

Project Name:	I-40 WIDENING / VADEIN PK. BR.	Date:	11/14/2017
TIP# / County:	I-0911A / FORSYTH & DAVIE	NSA / Setup:	8
Description:	WIDEN I-40 4 LANES TO 6-LANES	Time Start:	14:05
Consultant:	RK & K	Time Stop:	14:25

MONITORING SUMMARY:

Meter:	1	2	3	4	Meter:	1	2	3	4
Make:	DL-1	DL-2	DL-2		L _{Aeq}	66.2	57.7	51.3	
S/N:	K ¹	K ²	K ³		L _{Amax}				
Cal Spec:	114 dB @ 1 kHz				L _{A10}				
Cal Offset:	N/A	N/A	N/A		L _{A90}				

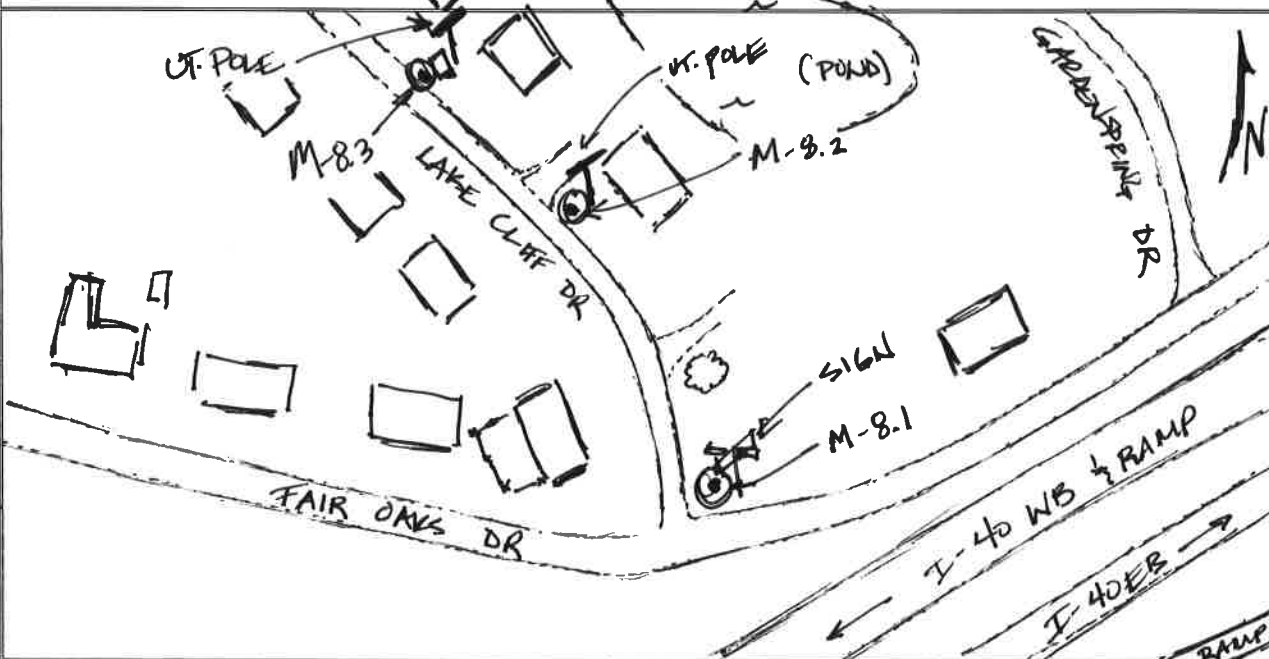
TRAFFIC COUNT DATA:

Paved Width:		~50' R2		# Lanes:	4 ^A	Spd. Limit:	65	Obs. Spd.:	EB: 58.8 WB: 58.8
Lanes:	Dir:	Field Traffic Counts:			Time:	Hourly Traffic Counts:			
		A	MT	HT		A	MT	HT	
2	EB	475	22	68	0:20	1425	66	204	
2	WB	470	29	45	0:20	1410	87	135	

WEATHER / ENVIRONMENTAL SUMMARY: ^{K⁵}

Temp:		Time/Event:	
Wind Vel:		Time/Event:	
Wind Dir:		Time/Event:	
Other:		Time/Event:	

SITE SKETCH:



K¹ S/N BLH040011 K² S/N BII030015 K³ BII030023

K⁴ G.P. LANES + EB RAMP

K⁵ SEE REPORT

NOISE MONITORING FIELD DATA SHEET

PROJECT INFORMATION:

Project Name:	I-40 WIDENING / YARDEN RIVER BR.	Date:	11/14/2017
TIP# / County:	E-0911A / FORSYTH & DAVIE	NSA / Setup:	9
Description:	WIDEN I-40 4- TO 6- LANES	Time Start:	14:45
Consultant:	RK & K	Time Stop:	15:05

MONITORING SUMMARY:

Meter:	1	2	3	4	Meter:	1	2	3	4
Make:	DL1	DL-2	DL-2		LAeq	64.0	61.7	59.7	
S/N:	K ¹	K ²	K ³		L _{Amax}				
Cal Spec:	114 dB @ 1 kHz				L _{A10}				
Cal Offset:	N/A	N/A	N/A		L _{A90}				

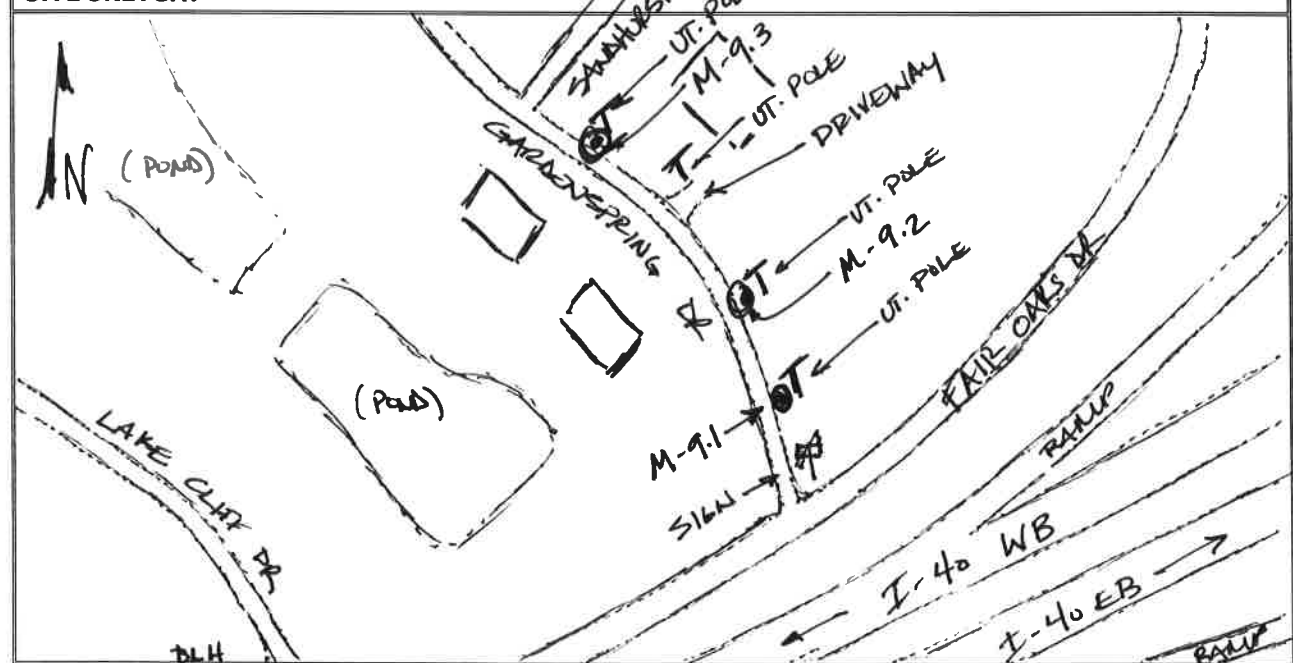
TRAFFIC COUNT DATA:

Paved Width:		38' x 2	# Lanes:	2- RAMP	Spd. Limit:	65	Obs. Spd.: N/B:	
Lanes:	Dir:	Field Traffic Counts:			Time:	Hourly Traffic Counts:		
		A	MT	HT		A	MT	HT
2	EB	445	21	40	0:20	1335	63	120
2	NB	498	18	59	0:20	1494	54	177

WEATHER / ENVIRONMENTAL SUMMARY:

Temp:		Time/Event:	
Wind Vel:		Time/Event:	
Wind Dir:		Time/Event:	
Other:		Time/Event:	

SITE SKETCH:



K¹ S/N 040011

K² S/N BJS 030015

K³ S/N BJS 030023

K⁴ 4 G.P. LANES + 1-LN WB & 1-LN EB RAMP K⁵ SEE REPORT

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Calibration Certificate No. S8003245

Instrument: Sound Level Meter
Model: SoundPro SE_DL1
Manufacturer: Quest
Serial number: BLH040011
Tested with: Microphone 4936 s/n 2614662
Preamplifier n/a s/n 0308 1833
Type (class): 1
Customer: BK&K
Tel/Fax: 919-653-7349 /

Date Calibrated: 8/16/2017 **Cal Due:** 8/16/2018

Status:	Received	Sent
In tolerance:	X	X
Out of tolerance:		
See comments:		
Contains non-accredited tests: <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No		
Calibration service: <input type="checkbox"/> Basic <input checked="" type="checkbox"/> Standard		
Address: 900 RIDGEFIELD DR STE 350 RALEIGH, NC 27609		

Tested in accordance with the following procedures and standards:
Calibration of Sound Level Meters, Scantek Inc., Rev. 6/22/2012
SLM & Dosimeters – Acoustical Tests, Scantek Inc., Rev. 7/6/2011

Instrumentation used for calibration: Nor-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence	Cal. Due
				Cal. Lab / Accreditation	
483B-Norsonic	SME Cal Unit	31079	June 22, 2017	Norsonic SA	June 22, 2018
DS-360-SRS	Function Generator	123268	June 22, 2017	SRS	June 22, 2018
34401A-Agilent Technologies	Digital Voltmeter	MY53003818	July 14, 2017	Agilent Provider #93107	July 14, 2018
SD700-Extech	Meteo Station	Q769118	June 22, 2017	INNOCAL	June 22, 2018
PC Program 1019 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
1251-Norsonic	Calibrator	34103	July 18, 2017	Scantek, Inc./ NVLAP	July 18, 2018

Instrumentation and test results are traceable to SI (International System of Units) through standards maintained by NIST (USA) and NPL (UK).

Environmental conditions:

Temperature (°C)	Barometric pressure (kPa)	Relative Humidity (%)
23.0	101.00	40.0

Calibrated by:	Steven Boertmann	Authorized signatory:	Dale Taylor
Signature	STEVEN BOERTMANN	Signature	DALE TAYLOR
Date	8-16-17	Date	8-16-17

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Document stored C:\Nor1504\Slm\2014\QsproSE1_BLH040011_M1.doc

Page 1 of 2

Results summary: Device complies with following clauses of mentioned specifications:

1 CLAUSES FROM IEC/ANSI STANDARDS REFERENCED IN PROCEDURES:	RESULT ^{2,3}	EXPANDED UNCERTAINTY (coverage factor 2) [dB]
INDICATION AT THE CALIBRATION CHECK FREQUENCY - ANSI S1.4 CLAUSE 3.2	Passed	0.20.15
FREQUENCY WEIGHTINGS: A NETWORK - IEC 61672-3 ED.1 CLAUSE 12	Passed	0.2
FREQUENCY WEIGHTINGS: C NETWORK - IEC 61672-3 ED.1 CLAUSE 12	Passed	0.2
FREQUENCY WEIGHTINGS: Z NETWORK - IEC 61672-3 ED.1 CLAUSE 12	Passed	0.2
FREQUENCY AND TIME WEIGHTINGS AT 1 KHZ IEC 61672-3 ED.1 CLAUSE 13	Passed	0.2
LEVEL LINEARITY ON THE REFERENCE LEVEL RANGE - IEC 61672-3 ED.1 CLAUSE 14	Passed	0.3
LEVEL LINEARITY INCLUDING THE LEVEL RANGE CONTROL - IEC 61672-3 ED.1 CLAUSE 15	Passed	0.3
TONEBURST RESPONSE - IEC 61672-3 ED.1 CLAUSE 16	Passed	0.3
PEAK C SOUND LEVEL - IEC 61672-3 ED.1 CLAUSE 17	Passed	0.35
FILTER TEST 1/OCTAVE: FLAT FREQUENCY RESPONSE - IEC 61260, CLAUSE 4.10 & #5.9	Passed	0.25
FILTER TEST 1/3OCTAVE: FLAT FREQUENCY RESPONSE - IEC 61260, CLAUSE 4.10 & #5.9	Passed	0.25

¹ The results of this calibration apply only to the instrument type with serial number identified in this report.

² Parameters are certified at actual environmental conditions.

³

Comments: The instrument was tested and met all specifications found in the referenced procedures.

Note: The instrument was tested for the parameters listed in the table above, using the test methods described in the listed standards. All tests were performed around the reference conditions. The test results were compared with the manufacturer's or with the standard's specifications, whichever are larger. Compliance with any standard cannot be claimed based solely on the periodic tests.

Tests made with the following attachments to the instrument:

Microphone: Brüel & Kjær 4936 s/n 2614662 for acoustical test
Preamplifier: Quest n/a s/n 0308 1833 for all tests
Other: line adaptor ADP005 (18pF) for electrical tests and 1448 (18pF) for noise test
Accompanying acoustical calibrator: Quest QC-10 s/n QIJ070197
Windscreen: none

Place of Calibration: Premier Safety

46410 Continental Dr.
Chesterfield, MI 48047

Ph/Fax: 586-840-3220/ -3221
www.premier-safety.com

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Document stored C:\Nor1504\Slm\2014\QSPROSE1_BLH040011_M1.doc

Page 2 of 2

SoundPro SE_DL1 s/n: BLH040011 ID:

Date: 8/16/2017 By: SB

Due: 8/16/2018



Calibration Certificate No. S8003245

Instrument: Microphone
Model: 4936
Manufacturer: Brüel & Kjær
Serial number: 2614662

Composed of:

Customer: BK&K
Tel/Fax: 919-653-7349/

Date Calibrated: 8/16/2017 **Cal Due:** 8/16/2018

Status:	Received	Sent
In tolerance:	X	X
Out of tolerance:		
See comments:		

Contains non-accredited tests: ☐ Yes ☒ No

Address: 900 RIDGEFIELD DR STE 350
RALEIGH, NC 27609

Tested in accordance with the following procedures and standards:

Calibration of Measurement Microphones, Scantek, Inc., Rev. 11/30/2010

Instrumentation used for calibration: N-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence	Cal. Due
				Cal. Lab / Accreditation	
483B-Norsonic	SME Cal Unit	31079	June 22, 2017	Norsonic SA	June 22, 2018
DS-360-SRS	Function Generator	123268	June 22, 2017	SRS	June 22, 2018
34401A-Agilent Technologies	Digital Voltmeter	MY53003818	July 14, 2017	Agilent Provider #93107	July 14, 2018
SD700-Extech	Meteo Station	Q769118	June 22, 2017	INNOCAL	June 22, 2018
PC Program 1017 Norsonic	Calibration software	v.6.1T	Validated November, 2014	Scantek, Inc.	-
1253-Norsonic	Calibrator	32018	July 18, 2017	Scantek, Inc./ NVLAP	July 18, 2018
NN1203-Norsonic	Preamplifier	138531	July 18, 2017	Norsonic SA	July 18, 2018
40AU-GRAS	Microphone	81111	July 18, 2017	Scantek, Inc./ NVLAP	July 18, 2018

Instrumentation and test results are traceable to SI - BIPM through standards maintained by NPL (UK) and NIST (USA)

Calibrated by:	Steven Boertmann	Authorized signatory:	Dale Taylor
Signature	STEVEN BOERTMANN	Signature	DALE TAYLOR
Date	8-16-17	Date	8-16-17

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Document stored as: C:\Nor1504\Mic\2014\B&K4936_2614662_M2.doc

Page 1 of 2

Results summary: Device was tested and complies with following clauses of mentioned specifications:

CLAUSES / METHODS ¹ FROM PROCEDURES		MET ^{2,3}	NOT MET	NOT TESTED	MEASUREMENT EXPANDED UNCERTAINTY (coverage factor 2)
Open circuit sensitivity (insert voltage method, 250 Hz)		X			See below
Frequency response	Actuator response	X			63 – 200Hz: 0.3 dB 200 – 8000 Hz: 0.2 dB 8 – 10 kHz: 0.5 dB 10 – 20 kHz: 0.7 dB 20 – 50 kHz: 0.9 dB 50 – 100 kHz: 1.2 dB
	FF/Diffuse field responses	X			63 – 200Hz: 0.3 dB 200 – 4000 Hz: 0.2 dB 4 – 10 kHz: 0.6 dB 10 – 20 kHz: 0.9 dB 20 – 50 kHz: 2.2 dB 50 – 100 kHz: 4.4 dB
	Scantek, Inc. acoustical method			X	31.5 – 125 Hz: 0.16 dB 250, 1000 Hz: 0.12 dB 2 – 8 kHz: 0.8 dB 12.5 – 16 kHz: 2.4 dB

¹ The results of this calibration apply only to the instrument type with serial number identified in this report.

² Parameters are certified at actual environmental conditions.

³

Note: The free field/diffuse field characteristics were calculated based on the measured actuator response and adjustment coefficients as provided by the manufacturer. The uncertainties reported for these characteristics may include assumed uncertainty components for the adjustment coefficients.

Comments: The instrument was tested and met all specifications found in the referenced procedures.

Environmental conditions:

Temperature (°C)	Barometric pressure (kPa)	Relative Humidity (%)
23.0	101.00	40.0

Main measured parameters:

Tone frequency (Hz)	Measured ⁴ Open circuit sensitivity (dB re 1V/Pa)	Sensitivity (mV/Pa)
250	-27.72 ± 0.14	41.13

⁴ The reported expanded uncertainty is calculated with a coverage factor k=2The reported expanded uncertainty is calculated with a coverage factor k=2.00

Tests made with following attachments to instrument and auxiliary devices:

Protection grid mounted for sensitivity measurements

Actuator type: G.R.A.S. RA0014

Place of Calibration: Premier Safety

46410 Continental Dr.
Chesterfield, MI 48047

Ph/Fax: 586-840-3220/ -3221
www.premier-safety.com

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This Calibration Certificate or Test Report shall not be used to claim product certification, approval or endorsement by NIST, or any agency of the federal government.

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Page 2 of 2

4936 s/n: 2614662 ID:
Date: 8/16/2017 By: SB
Due: 8/16/2018



Calibration Certificate

S8003245

Instrument: **Acoustical Calibrator**
Model: **QC-10**
Manufacturer: **Quest**
Serial number: **QIJ070197**
Class (IEC 60942): **1**
Barometer type:
Barometer s/n:

Date Calibrated: **8/16/2017** *Cal Due:* **8/16/2018**
Status:

Received	Sent
X	X

In tolerance:

X	X
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Out of tolerance:

--	--

See comments:

--	--

Contains non-accredited tests: **Yes X No**

Customer: **RK&K**
Tel/Fax: **919-653-7349 /**

Address: **900 RIDGEFIELD DR STE 350**
RALEIGH, NC 27609

Tested in accordance with the following procedures and standards:

Calibration of Noise Dosimeters, Sound Meters, and Calibrators., Rev. Chf 04

Instrumentation used for calibration: Nor-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence	Cal. Due
				Cal. Lab / Accreditation	
483B-Norsonic	SME Cal Unit	31079	June 22, 2017	Norsonic SA	June 22, 2018
DS-360-SRS	Function Generator	123268	June 22, 2017	SRS	June 22, 2018
34401A-Agilent Technologies	Digital Voltmeter	MY53003818	July 14, 2017	Agilent Provider #93107	July 14, 2018
SD700-Extech	Meteo Station	Q769118	June 22, 2017	INNOCAL	June 22, 2018
140-Norsonic	Real Time Analyzer	1405966	June 22, 2017	Norsonic SA	June 22, 2018
PC Program 1018 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
40AG-GRAS	Microphone	173539	July 18, 2017	Scantek, Inc. / NVLAP	July 18, 2018
NN1203-Norsonic	Preamplifier	138531	July 18, 2017	Norsonic SA	July 18, 2018

Instrumentation and test results are traceable to SI (International System of Units) through standards maintained by NIST (USA) and NPL (UK)

Calibrated by:	Steven Boertmann	Authorized signatory:	Dale Taylor
Signature	STEVEN BOERTMANN	Signature	DALE TAYLOR
Date	8-16-17	Date	8-16-17

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This Calibration Certificate or Test Reports shall not be used to claim product certification, approval or endorsement by NVLAP, NIST, or any agency of the federal government.

Document stored as: C:\Nor1504\Cal\2014\Questc10-old_QIJ070197_M1.doc

Results summary: Device was tested and complies with following clauses of mentioned specifications:

CLAUSES ¹ FROM STANDARDS REFERENCED IN PROCEDURES:	MET ²	NOT MET	COMMENTS
Manufacturer specifications			
Manufacturer specifications: Sound pressure level	X		
Manufacturer specifications: Frequency	X		
Manufacturer specifications: Total harmonic distortion	X		
Current standards			
ANSI S1.40:2006 B.3 / IEC 60942: 2003 B.2 - Preliminary inspection	X		Unit older than the standard
ANSI S1.40:2006 B.4.4 / IEC 60942: 2003 B.3.4 - Sound pressure level	X		Unit older than the standard
ANSI S1.40:2006 A.5.4 / IEC 60942: 2003 A.4.4 - Sound pressure level stability	-	-	Unit older than the standard
ANSI S1.40:2006 B.4.5 / IEC 60942: 2003 B.3.5 - Frequency	X		Unit older than the standard
ANSI S1.40:2006 B.4.6 / IEC 60942: 2003 B.3.6 - Total harmonic distortion	X		Unit older than the standard
Older standards (obsolete)			
IEC 60942: 1997 B.2 - Preliminary inspection	X		
IEC 60942: 1997 B.3.3 - Sound pressure level	X		
IEC 60942: 1997 B.3.4 - Sound pressure level stability	X		
IEC 60942: 1997 B.3.5 - Frequency	X		
IEC 60942: 1997 B.3.6 - Total harmonic distortion	X		
ANSI S1.40: 1984 (R1997) 4.4.2 Sound pressure level in the coupler	X		Not applicable
ANSI S1.40: 1984 (R1997) 4.4 Frequency sound in the coupler	X		Not applicable
ANSI S1.40: 1984 (R1997) 4.10 Total harmonic distortion	X		Not applicable

¹ The results of this calibration apply only to the instrument type with serial number identified in this report.

²

Main measured parameters ³:

Measured ⁴ /Acceptable ⁵ Tone frequency (Hz):	Measured ⁴ /Acceptable ⁵ Total Harmonic Distortion (%):	Measured ⁴ /Acceptable Level ⁵ (dB):
996.10 ± 1.0/1000.0 ± 10.0	0.00 ± 0.10/ < 3	114.14 ± 0.02/114.0 ± 0.4

³ The stated level is valid at reference conditions.

⁴ The above expanded uncertainties for frequency and distortion are calculated with a coverage factor k=2; for level k=4.53

⁵ Acceptable parameters values are from the current standards

Barometer indication	Nominal indication

Environmental conditions:

Temperature (°C)	Barometric pressure (kPa)	Relative Humidity (%)
23.0 ± 1.0	101.00 ± 0.001	40.0 ± 2.0

Tests made with following attachments to instrument:

Calibrator ½" Adaptor Type:
Other:

Adjustments: NO ADJUSTMENTS NEEDED

Comments: The instrument was tested and met all specifications found in the referenced procedures.

Note: The instrument was tested for the parameters listed in the table above, using the test methods described in the listed standards. All tests were performed around the reference conditions. The test results were compared with the manufacturer's or with the standard's specifications, whichever are larger.
Compliance with any standard cannot be claimed based solely on the periodic tests.

Place of Calibration: Premier Safety

46410 Continental Dr.
Chesterfield, MI 48047

Ph/Fax: 586-840-3220/ -3221
www.premier-safety.com

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This Calibration Certificate or Test Reports shall not be used to claim product certification, approval or endorsement by NVLAP, NIST, or any agency of the federal government.
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Calibration Certificate No. S8003245

Instrument: Sound Level Meter
Model: SoundPro SE_DL2
Manufacturer: Quest
Serial number: BIJ030015
Tested with: Microphone QE7052 s/n 38299
 Preamplifier n/a s/n 0311 5576
Type (class): 2
Customer: RK&K
Tel/Fax: 919-653-7349 /

Date Calibrated: 8/17/2017 **Cal Due:** 8/17/2018

Status:	Received	Sent
In tolerance:	X	X
Out of tolerance:		
See comments:		
Contains non-accredited tests: __ Yes <u>X</u> No		
Calibration service: __ Basic <u>X</u> Standard		
Address: 900 RIDGEFIELD DR STE 350 RALEIGH, NC 27609		

Tested in accordance with the following procedures and standards:

Calibration of Sound Level Meters, Scantek Inc., Rev. 6/22/2012
 SLM & Dosimeters – Acoustical Tests, Scantek Inc., Rev. 7/6/2011

Instrumentation used for calibration: Nor-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence	Cal. Due
				Cal. Lab / Accreditation	
483B-Norsonic	SME Cal Unit	31079	June 22, 2017	Norsonic SA	June 22, 2018
DS-360-SRS	Function Generator	123268	June 22, 2017	SRS	June 22, 2018
34401A-Agilent Technologies	Digital Voltmeter	MY53003818	July 14, 2017	Agilent Provider #93107	July 14, 2018
SD700-Extech	Meteo Station	Q769118	June 22, 2017	INNOCAL	June 22, 2018
PC Program 1019 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	
1251-Norsonic	Calibrator	34103	July 18, 2017	Scantek, Inc./ NVLAP	July 18, 2018

Instrumentation and test results are traceable to SI (International System of Units) through standards maintained by NIST (USA) and NPL (UK).

Environmental conditions:

Temperature (°C)	Barometric pressure (kPa)	Relative Humidity (%)
23.0	101.00	43.0

Calibrated by:	Steven Boertmann	Authorized signatory:	Dale Taylor
Signature	STEVEN BOERTMAN	N	DALE TAYLOR
Date	8-17-17	Date	8-17-17

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Results summary: Device complies with following clauses of mentioned specifications:

CLAUSES ¹ FROM IEC/ANSI STANDARDS REFERENCED IN PROCEDURES:	RESULT ^{2,3}	EXPANDED UNCERTAINTY (coverage factor 2) [dB]
INDICATION AT THE CALIBRATION CHECK FREQUENCY - ANSI S1.4 CLAUSE 3.2	Passed	0.20.15
FREQUENCY WEIGHTINGS: A NETWORK - IEC 61672-3 ED.1 CLAUSE 12	Passed	0.2
FREQUENCY WEIGHTINGS: C NETWORK - IEC 61672-3 ED.1 CLAUSE 12	Passed	0.2
FREQUENCY WEIGHTINGS: Z NETWORK - IEC 61672-3 ED.1 CLAUSE 12	Passed	0.2
FREQUENCY AND TIME WEIGHTINGS AT 1 KHZ IEC 61672-3 ED.1 CLAUSE 13	Passed	0.2
LEVEL LINEARITY ON THE REFERENCE LEVEL RANGE - IEC 61672-3 ED.1 CLAUSE 14	Passed	0.3
LEVEL LINEARITY INCLUDING THE LEVEL RANGE CONTROL - IEC 61672-3 ED.1 CLAUSE 15	Passed	0.3
TONEBURST RESPONSE - IEC 61672-3 ED.1 CLAUSE 16	Passed	0.3
PEAK C SOUND LEVEL - IEC 61672-3 ED.1 CLAUSE 17	Passed	0.35
FILTER TEST 1/1OCTAVE: FLAT FREQUENCY RESPONSE - IEC 61260, CLAUSE 4.10 & #5.9	Passed	0.25
FILTER TEST 1/3OCTAVE: FLAT FREQUENCY RESPONSE - IEC 61260, CLAUSE 4.10 & #5.9	Passed	0.25

¹ The results of this calibration apply only to the instrument type with serial number identified in this report.

² Parameters are certified at actual environmental conditions.

³

Comments: The instrument was tested and met all specifications found in the referenced procedures.

Note: The instrument was tested for the parameters listed in the table above, using the test methods described in the listed standards. All tests were performed around the reference conditions. The test results were compared with the manufacturer's or with the standard's specifications, whichever are larger.
Compliance with any standard cannot be claimed based solely on the periodic tests.

Tests made with the following attachments to the instrument:

Microphone: Quest QE7052 s/n 38299 for acoustical test
Preamplifier: Quest n/a s/n 0311 5576 for all tests
Other: line adaptor ADP005 (18pF) for electrical tests and 1448 (18pF) for noise test
Accompanying acoustical calibrator: Quest QC-20 s/n QOJ080004
Windscreen: none

Measured Data: in Test Report # of ... pages.

Place of Calibration: Premier Safety

46410 Continental Dr.
Chesterfield, MI 48047

Ph/Fax: 586-840-3220/ -3221
www.premier_safety.com

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SoundPro SE_DL2 s/n: BIJ030015 ID:

Date: 8/17/2017 By: SB

Due: 8/17/2018



Calibration Certificate No. S8003245

Instrument: **Microphone**
Model: **QE7052**
Manufacturer: **Quest**
Serial number: **38299**

Composed of:

Customer: **RK&K**
Tel/Fax: **919-653-7349/**

Date Calibrated: **8/17/2017** Cal Due: **8/17/2018**

Status:	Received	Sent
In tolerance:	X	X
Out of tolerance:		
See comments:		

Contains non-accredited tests: ☐ Yes ☒ No

Address: **900 RIDGEFIELD DR STE 350**
RALEIGH, NC 27609

Tested in accordance with the following procedures and standards:

Calibration of Measurement Microphones, Scantek, Inc., Rev. 11/30/2010

Instrumentation used for calibration: N-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence	Cal. Due
				Cal. Lab / Accreditation	
483B-Norsonic	SME Cal Unit	31079	June 22, 2017	Norsonic SA	June 22, 2018
DS-360-SRS	Function Generator	123268	June 22, 2017	SRS	June 22, 2018
34401A-Agilent Technologies	Digital Voltmeter	MY53003818	July 14, 2017	Agilent Provider #93107	July 14, 2018
SD700-Extech	Meteo Station	Q769118	June 22, 2017	INNOCAL	June 22, 2018
PC Program 1017 Norsonic	Calibration software	v.6.1T	Validated November, 2014	Scantek, Inc.	-
1253-Norsonic	Calibrator	32018	July 18, 2017	Scantek, Inc./ NVLAP	July 18, 2018
NN1203-Norsonic	Preamplifier	138531	July 18, 2017	Norsonic SA	July 18, 2018
40AU-GRAS	Microphone	81111	July 18, 2017	Scantek, Inc./ NVLAP	July 18, 2018

Instrumentation and test results are traceable to SI - BIPM through standards maintained by NPL (UK) and NIST (USA)

Calibrated by:	Steven Boertmann	Authorized signatory:	Dale Taylor
Signature	STEVEN BOERTMANN	Signature	DALE TAYLOR
Date	8-17-17	Date	8-17-17

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Document stored as: C:\Nor1504\Mic\2014\QST7052_38299_M1.doc

Page 1 of 2

Results summary: Device was tested and complies with following clauses of mentioned specifications:

CLAUSES / METHODS ¹ FROM PROCEDURES		MET ^{2,3}	NOT MET	NOT TESTED	MEASUREMENT EXPANDED UNCERTAINTY (coverage factor 2)
Open circuit sensitivity (insert voltage method, 250 Hz)		X			See below
Frequency response	Actuator response	X			63 – 200Hz: 0.3 dB 200 – 8000 Hz: 0.2 dB 8 – 10 kHz: 0.5 dB 10 – 20 kHz: 0.7 dB 20 – 50 kHz: 0.9 dB 50 – 100 kHz: 1.2 dB
	FF/Diffuse field responses	X			63 – 200Hz: 0.3 dB 200 – 4000 Hz: 0.2 dB 4 – 10 kHz: 0.6 dB 10 – 20 kHz: 0.9 dB 20 – 50 kHz: 2.2 dB 50 – 100 kHz: 4.4 dB
	Scantek, Inc. acoustical method			X	31.5 – 125 Hz: 0.16 dB 250, 1000 Hz: 0.12 dB 2 – 8 kHz: 0.8 dB 12.5 – 16 kHz: 2.4 dB

¹ The results of this calibration apply only to the instrument type with serial number identified in this report.

² Parameters are certified at actual environmental conditions.

³

Note: The free field/diffuse field characteristics were calculated based on the measured actuator response and adjustment coefficients as provided by the manufacturer. The uncertainties reported for these characteristics may include assumed uncertainty components for the adjustment coefficients.

Comments: The instrument was tested and met all specifications found in the referenced procedures.

Environmental conditions:

Temperature (°C)	Barometric pressure (kPa)	Relative Humidity (%)
23.0	101.00	43.0

Main measured parameters:

Tone frequency (Hz)	Measured ⁴ Open circuit sensitivity (dB re 1V/Pa)	Sensitivity (mV/Pa)
250	-30.41 ± 0.14	30.18

⁴ The reported expanded uncertainty is calculated with a coverage factor k=2The reported expanded uncertainty is calculated with a coverage factor k=2.00

Tests made with following attachments to instrument and auxiliary devices:

Protection grid mounted for sensitivity measurements
Actuator type: G.R.A.S. RA0014

Place of Calibration: Premier Safety

46410 Continental Dr.
Chesterfield, MI 48047

Ph/Fax: 586-840-3220/ -3221
www.premier-safety.com

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Page 2 of 2

QE7052 s/n: 38299 ID:
Date: 8/17/2017 By: SB
Due: 8/17/2018



Calibration Certificate

S8003245

Instrument: Acoustical Calibrator
Model: QC-20
Manufacturer: Quest
Serial number: QOJ080004
Class (IEC 60942): 1
Barometer type:
Barometer s/n:

Date Calibrated: 8/17/2017 **Cal Due:** 8/17/2018

Status:	Received	Sent
In tolerance:	X	X
Out of tolerance:		
See comments:		
Contains non-accredited tests:	___ Yes <u>X</u> No	

Customer: RK&K
Tel/Fax: 919-653-7349 /

Address: 900 RIDGEFIELD DR STE 350
RALEIGH, NC 27609

Tested in accordance with the following procedures and standards:
Calibration of Noise Dosimeters, Sound Meters, and Calibrators., Rev. Chf 04

Instrumentation used for calibration: Nor-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence	Cal. Due
				Cal. Lab / Accreditation	
483B-Norsonic	SME Cal Unit	31079	June 22, 2017	Norsonic SA	June 22, 2018
DS-360-SRS	Function Generator	123268	June 22, 2017	SRS	June 22, 2018
34401A-Agilent Technologies	Digital Voltmeter	MY53003818	July 14, 2017	Agilent Provider #93107	July 14, 2018
SD700-Extech	Meteo Station	Q769118	June 22, 2017	INNOCAL	June 22, 2018
140-Norsonic	Real Time Analyzer	1405966	June 22, 2017	Norsonic SA	June 22, 2018
PC Program 1018 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
40AG-GRAS	Microphone	173539	July 18, 2017	Scantek, Inc. / NVLAP	July 18, 2018
NN1203-Norsonic	Preamplifier	138531	July 18, 2017	Norsonic SA	July 18, 2018

Instrumentation and test results are traceable to SI (International System of Units) through standards maintained by NIST (USA) and NPL (UK)

Calibrated by:	Steven Boertmann	Authorized signatory:	Dale Taylor
Signature	STEVEN BOERTMANN	Signature	DALE TAYLOR
Date	8-17-17	Date	8-17-17

Results summary: Device was tested and complies with following clauses of mentioned specifications:

CLAUSES ¹ FROM STANDARDS REFERENCED IN PROCEDURES:	MET ²	NOT MET	COMMENTS
Manufacturer specifications			
Manufacturer specifications: Sound pressure level	X		
Manufacturer specifications: Frequency	X		
Manufacturer specifications: Total harmonic distortion	X		
Current standards			
ANSI S1.40:2006 B.3 / IEC 60942: 2003 B.2 - Preliminary inspection	X		Unit older than the standard
ANSI S1.40:2006 B.4.4 / IEC 60942: 2003 B.3.4 - Sound pressure level	X		Unit older than the standard
ANSI S1.40:2006 A.5.4 / IEC 60942: 2003 A.4.4 - Sound pressure level stability	-	-	Unit older than the standard
ANSI S1.40:2006 B.4.5 / IEC 60942: 2003 B.3.5 - Frequency	X		Unit older than the standard
ANSI S1.40:2006 B.4.6 / IEC 60942: 2003 B.3.6 - Total harmonic distortion	X		Unit older than the standard
Older standards (obsolete)			
IEC 60942: 1997 B.2 - Preliminary inspection	X		
IEC 60942: 1997 B.3.3 - Sound pressure level	X		
IEC 60942: 1997 B.3.4 - Sound pressure level stability	X		
IEC 60942: 1997 B.3.5 - Frequency	X		
IEC 60942: 1997 B.3.6 - Total harmonic distortion	X		
ANSI S1.40: 1984 (R1997) 4.4.2 Sound pressure level in the coupler	X		Not applicable
ANSI S1.40: 1984 (R1997) 4.4 Frequency sound in the coupler	X		Not applicable
ANSI S1.40: 1984 (R1997) 4.10 Total harmonic distortion	X		Not applicable

¹ The results of this calibration apply only to the instrument type with serial number identified in this report.

²

Main measured parameters ³:

Measured ⁴ /Acceptable ⁵ Tone frequency (Hz):	Measured ⁴ /Acceptable ⁵ Total Harmonic Distortion (%):	Measured ⁴ /Acceptable Level ⁵ (dB):
1002.67 ± 1.0/1000.0 ± 10.0	0.00 ± 0.10/ < 3	113.91 ± 0.00/114.0 ± 0.4

³ The stated level is valid at reference conditions.

⁴ The above expanded uncertainties for frequency and distortion are calculated with a coverage factor k=2; for level k=4.53

⁵ Acceptable parameters values are from the current standards

Barometer indication	Nominal indication

Environmental conditions:

Temperature (°C)	Barometric pressure (kPa)	Relative Humidity (%)
23.0 ± 1.0	101.00 ± 0.001	43.0 ± 2.0

Tests made with following attachments to instrument:

Calibrator ½" Adaptor Type:
Other:

Adjustments: NO ADJUSTMENTS NEEDED

Comments: The instrument was tested and met all specifications found in the referenced procedures.

Note: The instrument was tested for the parameters listed in the table above, using the test methods described in the listed standards. All tests were performed around the reference conditions. The test results were compared with the manufacturer's or with the standard's specifications, whichever are larger.
Compliance with any standard cannot be claimed based solely on the periodic tests.

Place of Calibration: Premier Safety

46410 Continental Dr.
Chesterfield, MI 48047

Ph/Fax: 586-840-3220/ -3221
www.premier-safety.com

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Page 2 of 2



Calibration Certificate No. S8003245

Instrument: Sound Level Meter
Model: SoundPro SE_DL2
Manufacturer: Quest
Serial number: BIH030023
Tested with: Microphone QE7052 s/n 31715
 Preamplifier n/a s/n 0508 2028
Type (class): 2
Customer: RK&K
Tel/Fax: 919-653-7349 /

Date Calibrated: 8/16/2017 **Cal Due:** 8/16/2018
Status:

Received	Sent
X	X

In tolerance:

X	X
---	---

Out of tolerance:

--	--

See comments:

--	--

Contains non-accredited tests: ☐ Yes ☒ No
Calibration service: ☐ Basic ☒ Standard
Address: 900 RIDGEFIELD DR STE 350
 RALEIGH, NC 27609

Tested in accordance with the following procedures and standards:
 Calibration of Sound Level Meters, Scantek Inc., Rev. 6/22/2012
 SLM & Dosimeters – Acoustical Tests, Scantek Inc., Rev. 7/6/2011

Instrumentation used for calibration: Nor-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence	Cal. Due
				Cal. Lab / Accreditation	
483B-Norsonic	SME Cal Unit	31079	June 22, 2017	Norsonic SA	June 22, 2018
DS-360-SRS	Function Generator	123268	June 22, 2017	SRS	June 22, 2018
34401A-Agilent Technologies	Digital Voltmeter	MY53003818	July 14, 2017	Agilent Provider #93107	July 14, 2018
SD700-Extech	Meteo Station	Q769118	June 22, 2017	INNOCAL	June 22, 2018
PC Program 1019 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
1251-Norsonic	Calibrator	34103	July 18, 2017	Scantek, Inc./ NVLAP	July 18, 2018

Instrumentation and test results are traceable to SI (International System of Units) through standards maintained by NIST (USA) and NPL (UK).

Environmental conditions:

Temperature (°C)	Barometric pressure (kPa)	Relative Humidity (%)
23.0	101.00	40.0

Calibrated by:	Steven Boertmann	Authorized signatory:	Dale Taylor
Signature	STEVEN BOERTMANN	Signature	DALE TAYLOR
Date	8-16-17	Date	8-16-17

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Results summary: Device complies with following clauses of mentioned specifications:

1 CLAUSES FROM IEC/ANSI STANDARDS REFERENCED IN PROCEDURES:	RESULT ^{2,3}	EXPANDED UNCERTAINTY (coverage factor 2) [dB]
INDICATION AT THE CALIBRATION CHECK FREQUENCY - ANSI S1.4 CLAUSE 3.2	Passed	0.20.15
FREQUENCY WEIGHTINGS: A NETWORK - IEC 61672-3 ED.1 CLAUSE 12	Passed	0.2
FREQUENCY WEIGHTINGS: C NETWORK - IEC 61672-3 ED.1 CLAUSE 12	Passed	0.2
FREQUENCY WEIGHTINGS: Z NETWORK - IEC 61672-3 ED.1 CLAUSE 12	Passed	0.2
FREQUENCY AND TIME WEIGHTINGS AT 1 KHZ IEC 61672-3 ED.1 CLAUSE 13	Passed	0.2
LEVEL LINEARITY ON THE REFERENCE LEVEL RANGE - IEC 61672-3 ED.1 CLAUSE 14	Passed	0.3
LEVEL LINEARITY INCLUDING THE LEVEL RANGE CONTROL - IEC 61672-3 ED.1 CLAUSE 15	Passed	0.3
TONEBURST RESPONSE - IEC 61672-3 ED.1 CLAUSE 16	Passed	0.3
PEAK C SOUND LEVEL - IEC 61672-3 ED.1 CLAUSE 17	Passed	0.35
FILTER TEST 1/OCTAVE: FLAT FREQUENCY RESPONSE - IEC 61260, CLAUSE 4.10 & #5.9	Passed	0.25
FILTER TEST 1/3OCTAVE: FLAT FREQUENCY RESPONSE - IEC 61260, CLAUSE 4.10 & #5.9	Passed	0.25

¹ The results of this calibration apply only to the instrument type with serial number identified in this report.

² Parameters are certified at actual environmental conditions.

³

Comments: The instrument was tested and met all specifications found in the referenced procedures.

Note: The instrument was tested for the parameters listed in the table above, using the test methods described in the listed standards. All tests were performed around the reference conditions. The test results were compared with the manufacturer's or with the standard's specifications, whichever are larger.
Compliance with any standard cannot be claimed based solely on the periodic tests.

Tests made with the following attachments to the instrument:

Microphone: Quest QE7052 s/n 31715 for acoustical test
Preamplifier: Quest n/a s/n 0508 2028 for all tests
Other: line adaptor ADP005 (18pF) for electrical tests and 1448 (18pF) for noise test
Accompanying acoustical calibrator: Quest QC-10 s/n QIL020010
Windscreen: none

Measured Data: in Test Report # of ... pages.

Place of Calibration: Premier Safety
46410 Continental Dr.
Chesterfield, MI 48047

Ph/Fax: 586-840-3220/ -3221
www.premier-safety.com

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Document stored C:\Nor1504\Slm\2014\QSPROSE2_BIH030023_M1.doc

Page 2 of 2

SoundPro SE_DL2 s/n: BIH030023 ID:
Date: 8/16/2017 By: SB
Due: 8/16/2018



Calibration Certificate No. S8003245

Instrument: Microphone
Model: QE7052
Manufacturer: Quest
Serial number: 31715

Composed of:

Customer: RK&K
Tel/Fax: 919-653-7349/

Date Calibrated: 8/16/2017 **Cal Due:** 8/16/2018

Status:	Received	Sent
In tolerance:	X	X
Out of tolerance:		
See comments:		

Contains non-accredited tests: ☐ Yes ☒ No

Address: 900 RIDGEFIELD DR STE 350
RALEIGH, NC 27609

Tested in accordance with the following procedures and standards:

Calibration of Measurement Microphones, Scantek, Inc., Rev. 11/30/2010

Instrumentation used for calibration: N-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence	Cal. Due
				Cal. Lab / Accreditation	
483B-Norsonic	SME Cal Unit	31079	June 22, 2017	Norsonic SA	June 22, 2018
DS-360-SRS	Function Generator	123268	June 22, 2017	SRS	June 22, 2018
34401A-Agilent Technologies	Digital Voltmeter	MY53003818	July 14, 2017	Agilent Provider #93107	July 14, 2018
SD700-Extech	Meteo Station	Q769118	June 22, 2017	INNOCAL	June 22, 2018
PC Program 1017 Norsonic	Calibration software	v.6.1T	Validated November, 2014	Scantek, Inc.	-
1253-Norsonic	Calibrator	32018	July 18, 2017	Scantek, Inc./ NVLAP	July 18, 2018
NN1203-Norsonic	Preamplifier	138531	July 18, 2017	Norsonic SA	July 18, 2018
40AU-GRAS	Microphone	81111	July 18, 2017	Scantek, Inc./ NVLAP	July 18, 2018

Instrumentation and test results are traceable to SI - BIPM through standards maintained by NPL (UK) and NIST (USA)

Calibrated by:	Steven Boertmann	Authorized signatory:	Dale Taylor
Signature	STEVEN BOERTMANN	Signature	DALE TAYLOR
Date	8-16-17	Date	8-16-17

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Page 1 of 2

Results summary: Device was tested and complies with following clauses of mentioned specifications:

CLAUSES / METHODS ¹ FROM PROCEDURES		MET ^{2,3}	NOT MET	NOT TESTED	MEASUREMENT EXPANDED UNCERTAINTY (coverage factor 2)
Open circuit sensitivity (insert voltage method, 250 Hz)		X			See below
Frequency response	Actuator response	X			63 – 200Hz: 0.3 dB 200 – 8000 Hz: 0.2 dB 8 – 10 kHz: 0.5 dB 10 – 20 kHz: 0.7 dB 20 – 50 kHz: 0.9 dB 50 – 100 kHz: 1.2 dB
	FF/Diffuse field responses	X			63 – 200Hz: 0.3 dB 200 – 4000 Hz: 0.2 dB 4 – 10 kHz: 0.6 dB 10 – 20 kHz: 0.9 dB 20 – 50 kHz: 2.2 dB 50 – 100 kHz: 4.4 dB
	Scantek, Inc. acoustical method			X	31.5 – 125 Hz: 0.16 dB 250, 1000 Hz: 0.12 dB 2 – 8 kHz: 0.8 dB 12.5 – 16 kHz: 2.4 dB

¹ The results of this calibration apply only to the instrument type with serial number identified in this report.

² Parameters are certified at actual environmental conditions.

³

Note: The free field/diffuse field characteristics were calculated based on the measured actuator response and adjustment coefficients as provided by the manufacturer. The uncertainties reported for these characteristics may include assumed uncertainty components for the adjustment coefficients.

Comments: The instrument was tested and met all specifications found in the referenced procedures.

Environmental conditions:

Temperature (°C)	Barometric pressure (kPa)	Relative Humidity (%)
23.0	101.00	40.0

Main measured parameters:

Tone frequency (Hz)	Measured ⁴ Open circuit sensitivity (dB re 1V/Pa)	Sensitivity (mV/Pa)
250	-27.21 ± 0.14	43.60

⁴ The reported expanded uncertainty is calculated with a coverage factor k=2The reported expanded uncertainty is calculated with a coverage factor k=2.00

Tests made with following attachments to instrument and auxiliary devices:

Protection grid mounted for sensitivity measurements
Actuator type: G.R.A.S. RA0014

Place of Calibration: Premier Safety

46410 Continental Dr.
Chesterfield, MI 48047

Ph/Fax: 586-840-3220/ -3221
www.premier-safety.com

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Page 2 of 2

QE7052 s/n: 31715 ID:
Date: 8/16/2017 By: SB
Due: 8/16/2018



Calibration Certificate

S8003245

Instrument: **Acoustical Calibrator**
Model: **QC-10**
Manufacturer: **Quest**
Serial number: **QIL020010**
Class (IEC 60942): **1**
Barometer type:
Barometer s/n:

Date Calibrated: **8/16/2017** *Cal Due:* **8/16/2018**
Status:

Received	Sent
X	X

In tolerance:
Out of tolerance:
See comments:
Contains non-accredited tests: **Yes** **No**

Customer: **RK&K**
Tel/Fax: **919-653-7349 /**

Address: **900 RIDGEFIELD DR STE 350**
RALEIGH, NC 27609

Tested in accordance with the following procedures and standards:

Calibration of Noise Dosimeters, Sound Meters, and Calibrators., Rev. Chf 04

Instrumentation used for calibration: Nor-1504 Norsonic Test System:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence	Cal. Due
				Cal. Lab / Accreditation	
483B-Norsonic	SME Cal Unit	31079	June 22, 2017	Norsonic SA	June 22, 2018
DS-360-SRS	Function Generator	123268	June 22, 2017	SRS	June 22, 2018
34401A-Agilent Technologies	Digital Voltmeter	MY53003818	July 14, 2017	Agilent Provider #93107	July 14, 2018
SD700-Extech	Meteo Station	Q769118	June 22, 2017	INNOCAL	June 22, 2018
140-Norsonic	Real Time Analyzer	1405966	June 22, 2017	Norsonic SA	June 22, 2018
PC Program 1018 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
40AG-GRAS	Microphone	173539	July 18, 2017	Scantek, Inc. / NVLAP	July 18, 2018
NN1203-Norsonic	Preamplifier	138531	July 18, 2017	Norsonic SA	July 18, 2018

Instrumentation and test results are traceable to SI (International System of Units) through standards maintained by NIST (USA) and NPL (UK)

Calibrated by:	Steven Boertmann	Authorized signatory:	Dale Taylor
Signature	STEVEN BOERTMANN	Signature	DALE TAYLOR
Date	8-16-17	Date	8-16-17

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Results summary: Device was tested and complies with following clauses of mentioned specifications:

CLAUSES ¹ FROM STANDARDS REFERENCED IN PROCEDURES:	MET ²	NOT MET	COMMENTS
Manufacturer specifications			
Manufacturer specifications: Sound pressure level	X		
Manufacturer specifications: Frequency	X		
Manufacturer specifications: Total harmonic distortion	X		
Current standards			
ANSI S1.40:2006 B.3 / IEC 60942: 2003 B.2 - Preliminary inspection	X		Unit older than the standard
ANSI S1.40:2006 B.4.4 / IEC 60942: 2003 B.3.4 - Sound pressure level	X		Unit older than the standard
ANSI S1.40:2006 A.5.4 / IEC 60942: 2003 A.4.4 - Sound pressure level stability	-	-	Unit older than the standard
ANSI S1.40:2006 B.4.5 / IEC 60942: 2003 B.3.5 - Frequency	X		Unit older than the standard
ANSI S1.40:2006 B.4.6 / IEC 60942: 2003 B.3.6 - Total harmonic distortion	X		Unit older than the standard
Older standards (obsolete)			
IEC 60942: 1997 B.2 - Preliminary inspection	X		
IEC 60942: 1997 B.3.3 - Sound pressure level	X		
IEC 60942: 1997 B.3.4 - Sound pressure level stability	X		
IEC 60942: 1997 B.3.5 - Frequency	X		
IEC 60942: 1997 B.3.6 - Total harmonic distortion	X		
ANSI S1.40: 1984 (R1997) 4.4.2 Sound pressure level in the coupler	X		Not applicable
ANSI S1.40: 1984 (R1997) 4.4 Frequency sound in the coupler	X		Not applicable
ANSI S1.40: 1984 (R1997) 4.10 Total harmonic distortion	X		Not applicable

¹ The results of this calibration apply only to the instrument type with serial number identified in this report.

²

Main measured parameters ³:

Measured ⁴ /Acceptable ⁵ Tone frequency (Hz):	Measured ⁴ /Acceptable ⁵ Total Harmonic Distortion (%):	Measured ⁴ /Acceptable Level ⁵ (dB):
1002.85 ± 1.0/1000.0 ± 10.0	0.00 ± 0.10/ < 3	114.13 ± 0.00/114.0 ± 0.4

³ The stated level is valid at reference conditions.

⁴ The above expanded uncertainties for frequency and distortion are calculated with a coverage factor k=2; for level k=2.00

⁵ Acceptable parameters values are from the current standards

Barometer indication	Nominal indication

Environmental conditions:

Temperature (°C)	Barometric pressure (kPa)	Relative Humidity (%)
23.0 ± 1.0	101.00 ± 0.001	40.0 ± 2.0

Tests made with following attachments to instrument:

Calibrator ½" Adaptor Type:
Other:

Adjustments: NO ADJUSTMENTS NEEDED

Comments: The instrument was tested and met all specifications found in the referenced procedures.

Note: The instrument was tested for the parameters listed in the table above, using the test methods described in the listed standards. All tests were performed around the reference conditions. The test results were compared with the manufacturer's or with the standard's specifications, whichever are larger.

Compliance with any standard cannot be claimed based solely on the periodic tests.

Place of Calibration: Premier Safety

46410 Continental Dr.
Chesterfield, MI 48047

Ph/Fax: 586-840-3220/ -3221
www.premier-safety.com

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Appendix E

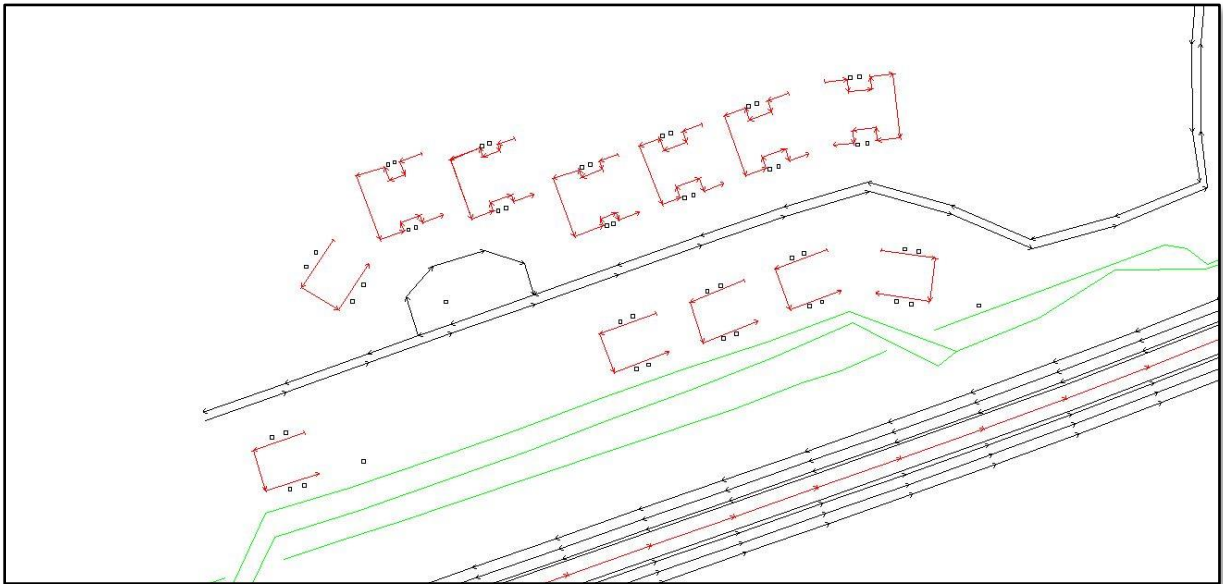
TRAFFIC NOISE MODELS

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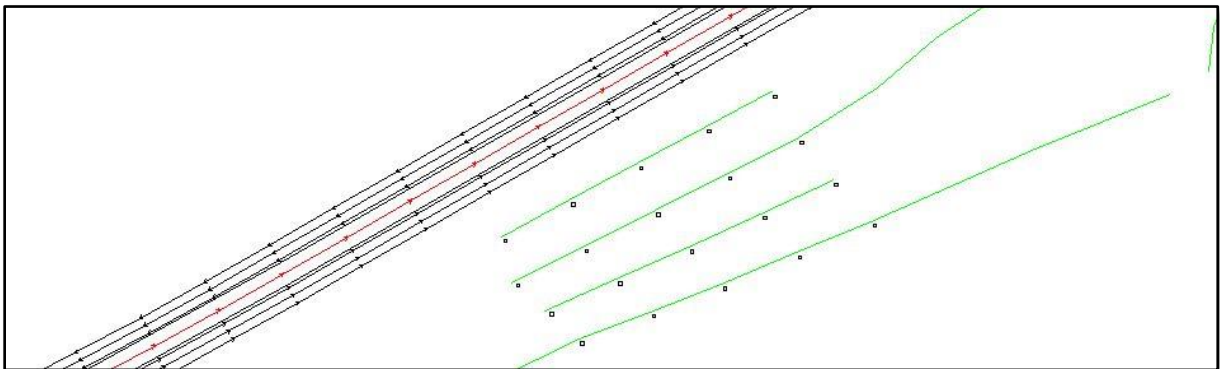
Within the TNM model, roadway elements, terrain lines, barriers, tree zones, building rows, and ground zones are used to represent the existing and build-condition topography of the project and noise study areas. With the exception of ground zones, each of these elements defines the horizontal (x, y) and vertical (z) coordinates for the model. The discrete point locations at which TNM calculates traffic noise levels are modeled as receptors. The horizontal and vertical coordinates define a point for each modeled receptor; however, TNM does not interpolate ground elevations between receptors as it does between terrain lines, roads, tree zones, barriers, and building rows.

To increase efficiency in TNM calculations (decreasing TNM model “run-times”), traffic noise models are reduced in size to one smaller TNM model per each NSA. A single project-wide existing condition, or “baseline”, TNM model is created to ensure that all modeled elements are identical in each of the smaller NSA models. The Design Year 2040 build-condition TNM models for the nine NSAs are shown in the images below.

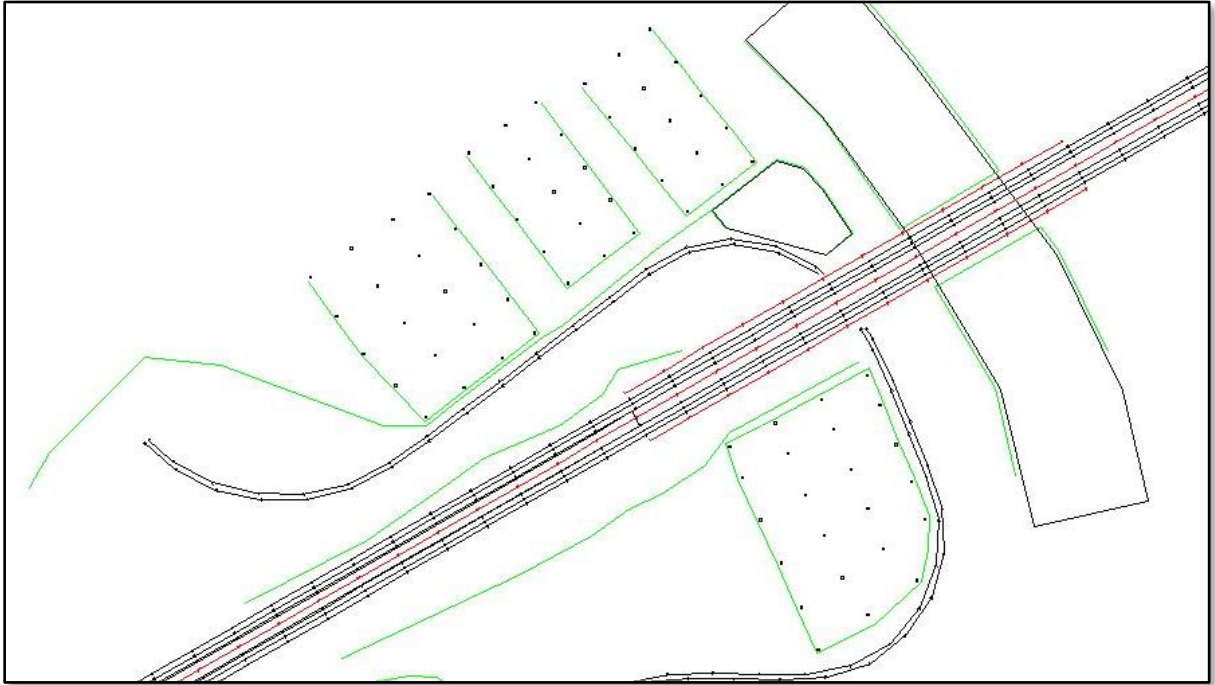
NSA 1 – Pinewood Lane: *(Not to Scale)*



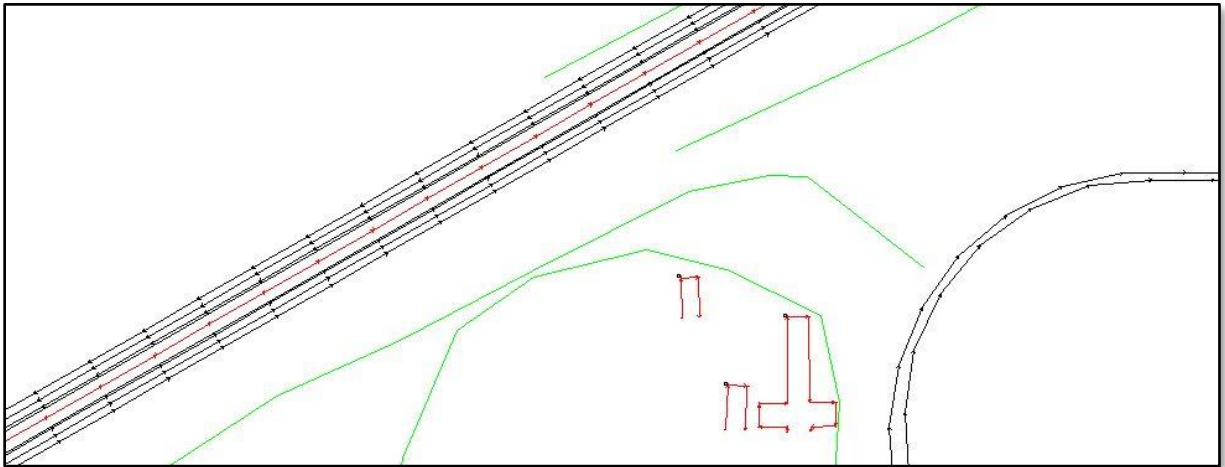
NSA 2 – Medical Drive, Kinderton Way: *(Not to Scale. Noise Contour Modeling Only)*



NSA 3 – BB&T Sports Park: *(Not to Scale)*



NSA 4 – Church of the Good Shepherd, WinMock at Kinderton: *(Not to Scale)*



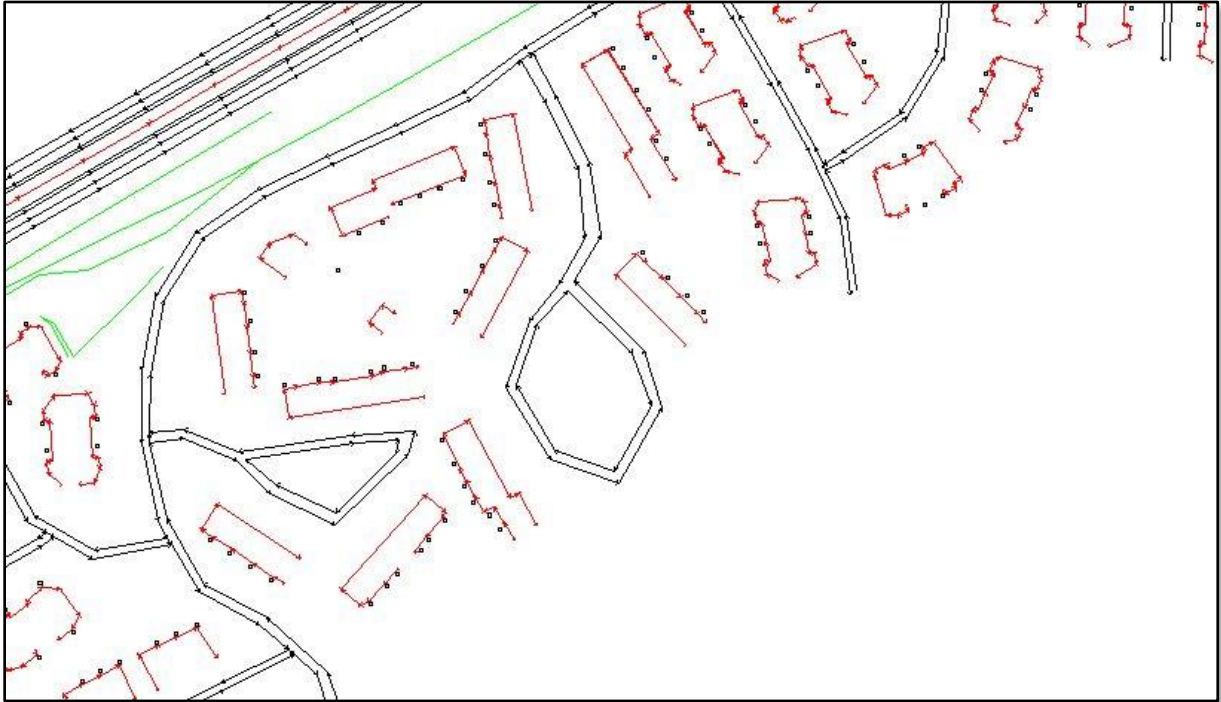
NSA 5 – Abelia Way, Peony Way, Verbena Way: *(Not to Scale)*



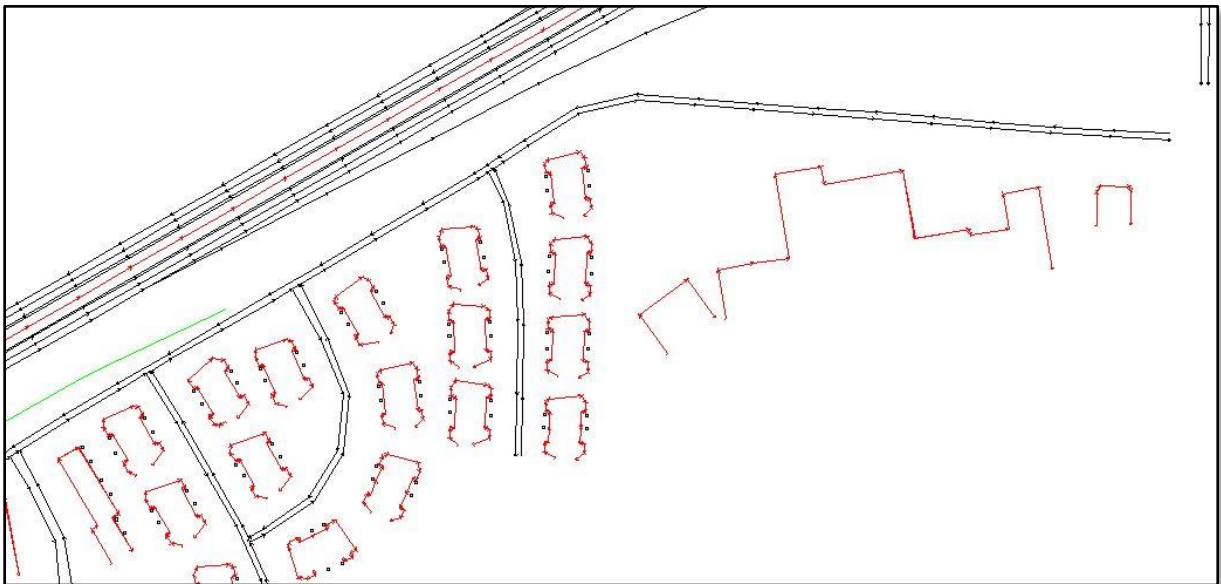
NSA 6 – Riverview Knoll Court, River Oaks Court: *(Not to Scale)*



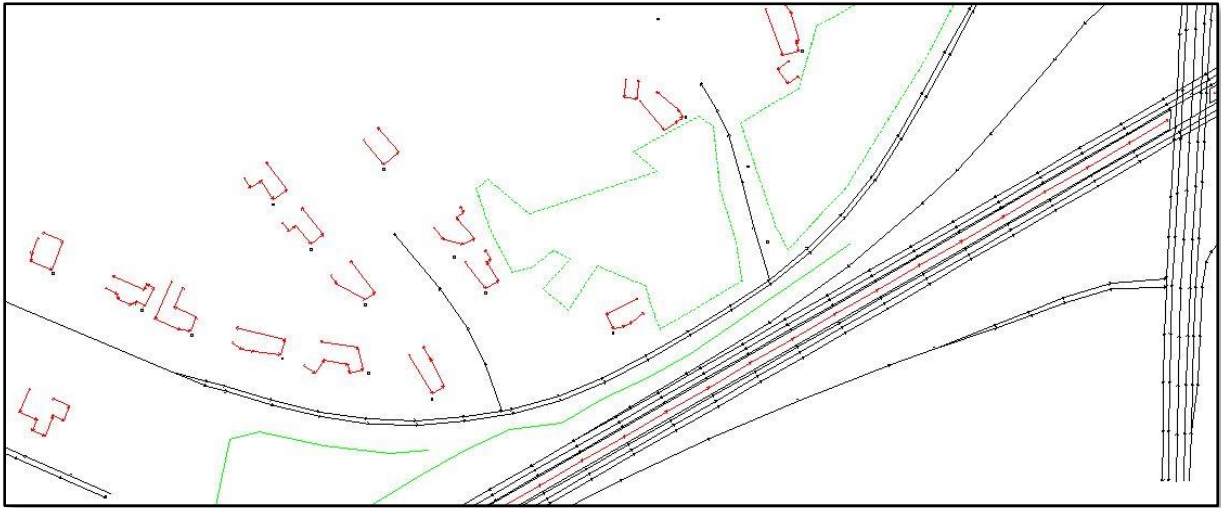
NSA 6 – Thoroughbred Lane, Old Rosebud Court, Whirlaway Court: *(Not to Scale)*



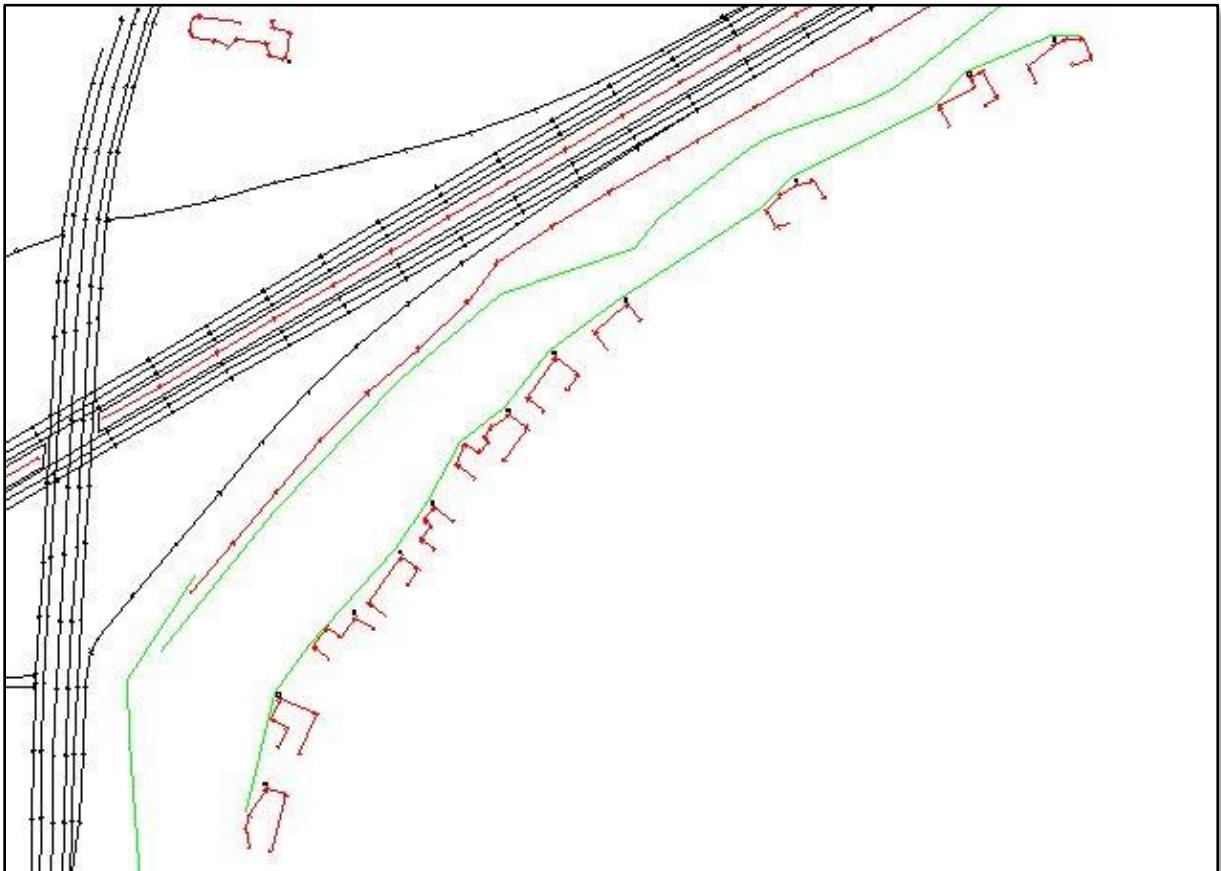
NSA 6 – Westridge Meadow Circle, Westridge Farm Lane: *(Not to Scale)*



NSA 7 – Whitehorse Drive, Fair Oaks Drive, Lake Cliff Drive, Gardenspring Drive:
(Not to Scale)



NSA 8, NSA 9 – Hickory Grove A.M.E. Zion Church, Rollingwood Drive: *(Not to Scale)*



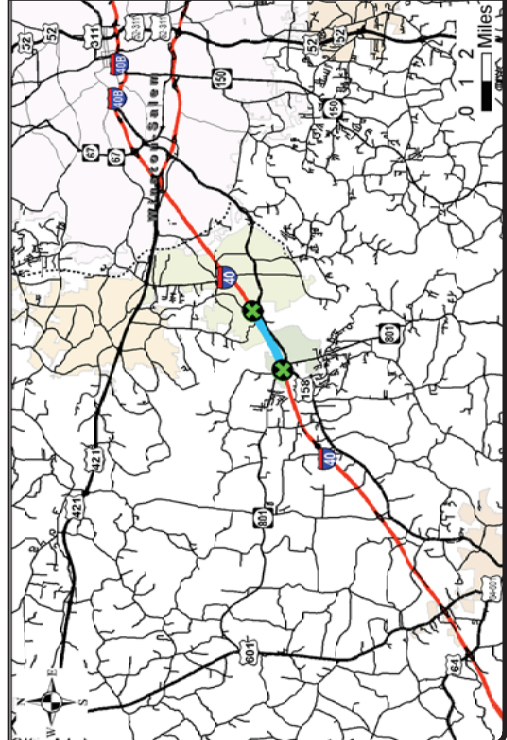
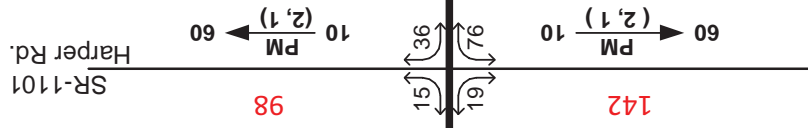
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Appendix F

TRAFFIC DATA

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2016 – No Build & Build

AVERAGE ANNUAL
DAILY TRAFFIC

SHEET 1 OF 2

LEGEND

####	No. of Vehicles Per Day in 100s
1-	Less than 50 vpd
X	Movement Prohibited
	$K \xrightarrow{\text{PM}} D$
K	Design Hour Factor (%)
PM	PM Peak Period
D	Peak Hour Directional Split (%)
→	Indicates Direction of D
(d, t)	Duals, TT-STs (%)

TIP: I-0911A

WBS: 34147.1.2

COUNTY: Davie & Forsyth **DIVISION:** 9

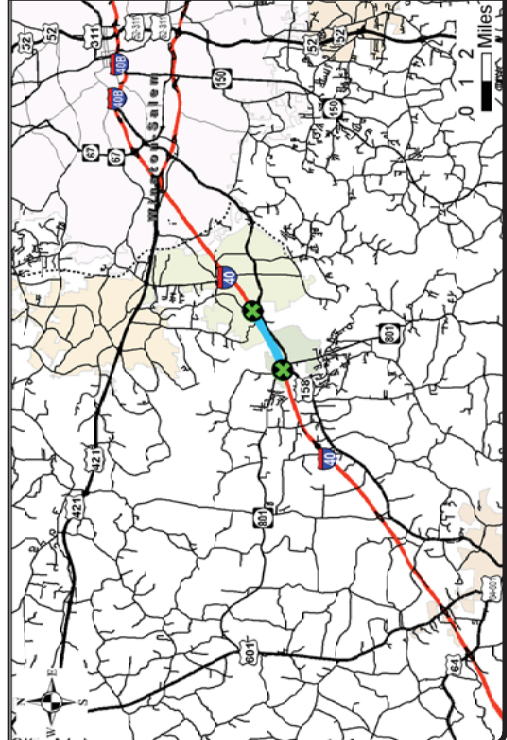
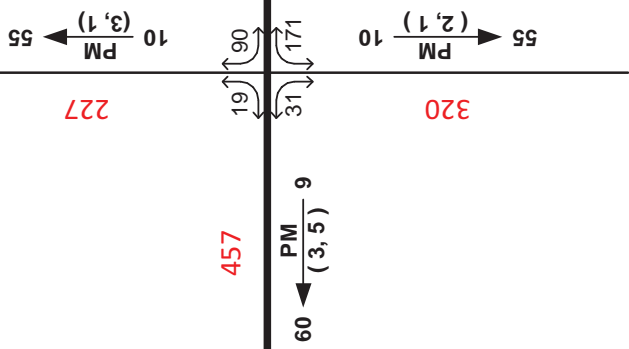
DATE: 1/9/2017

Forecaster: Michael Orr

Prepared by: Aarsalan Sabouri

LOCATION: I 40 at NC 801 & SR 1101

PROJECT: I 40 widening from NC 801 to SR 1101



2040 – No Build & Build

LEGEND

- ### No. of Vehicles Per Day in 100s
- 1- Less than 50 vpd
- X Movement Prohibited
- K $\frac{PM}{(d, t)} \rightarrow D$ Design Hour Factor (%)
- PM PM Peak Period
- D Peak Hour Directional Split (%)
- \rightarrow Indicates Direction of D
- (d, t) Duals, TT-STs (%)

AVERAGE ANNUAL
DAILY TRAFFIC

SHEET 2 OF 2

TIP: I-0911A	WBS: 34147.1.2
COUNTY: Davie & Forsyth	DIVISION: 9
DATE: 1/9/2017	
Forecaster: Michael Orr	
Prepared by: Arsalan Sabouri	
LOCATION: I 40 at NC 801 & SR 1101	
PROJECT: I 40 widening from NC 801 to SR 1101	

Appendix G

PERMITTED PROPERTY REVIEW

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After the Date of Public Knowledge, the federal and state governments are no longer responsible for providing noise abatement measures for new development within the noise impact area of the proposed highway project. It is the responsibility of local governments and private landowners to ensure that noise-compatible designs are used for development permitted after the Date of Public Knowledge.

The Date of Public Knowledge for the I-40 widening and bridge replacement project (TIP#: I-0911A) is the June 30, 2014 Finding of Noise Significant Impact (FONSI). Refer to the descriptions for NSA 5 and NSA 7 below for information regarding properties near the project that were permitted after the June 30, 2014 Date of Public Knowledge, which are not eligible for noise abatement consideration, and were not included in this Design Noise Report.

Additionally, NCDOT Policy stipulates that acoustically significant structures should be modeled as individual barriers. Care was taken when positioning TNM receptors to represent exterior human use areas that are located behind buildings that totally shield the exterior use from the highway (refer to Appendix E). Refer to the descriptions for NSA 1 and NSA 6 below for information regarding appropriate positioning of TNM receptors representing residences for which exterior use areas are ground level patios or second-story balconies.

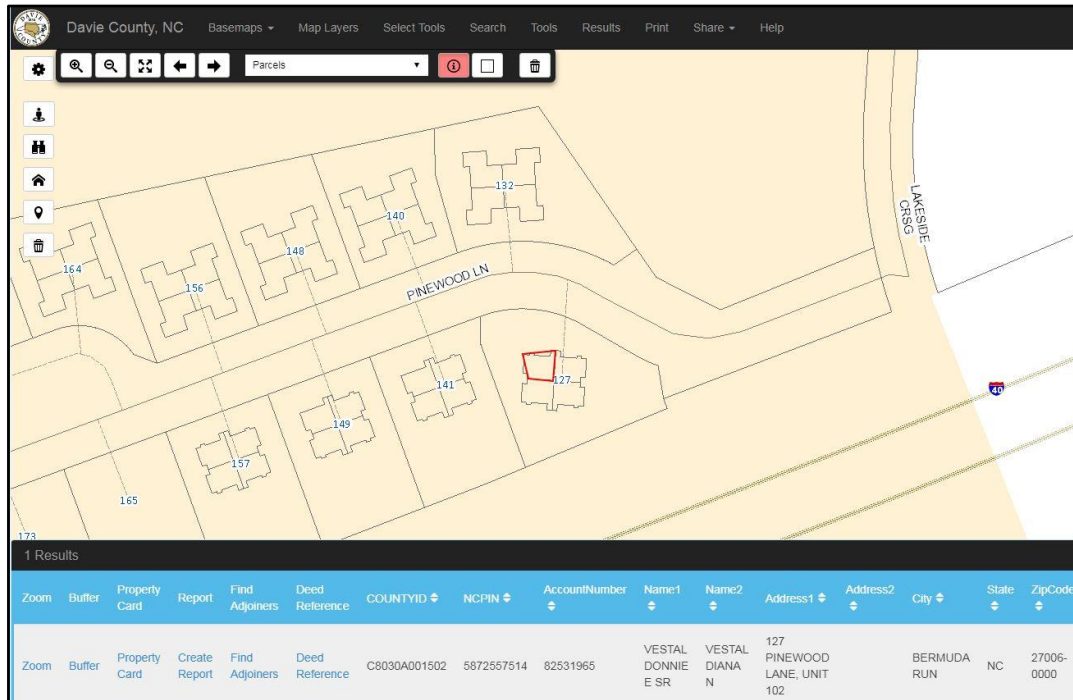
NSA 1 (*Pinewood Lane*):

NSA 1 consists of 48 individually deeded condominium residences on Pinewood Lane, adjacent to I-40 westbound just east of NC 801. All residences in NSA 1 were permitted prior to the June 30, 2014 Date of Public Knowledge.

The 48 residences in NSA 1 are arranged in 12 buildings, each with a cluster of four two-story townhouse-style condominiums. Each residential property includes a ground-level patio; however, does not include any of the common ground outside of the building and patio boundary (refer to the following images).

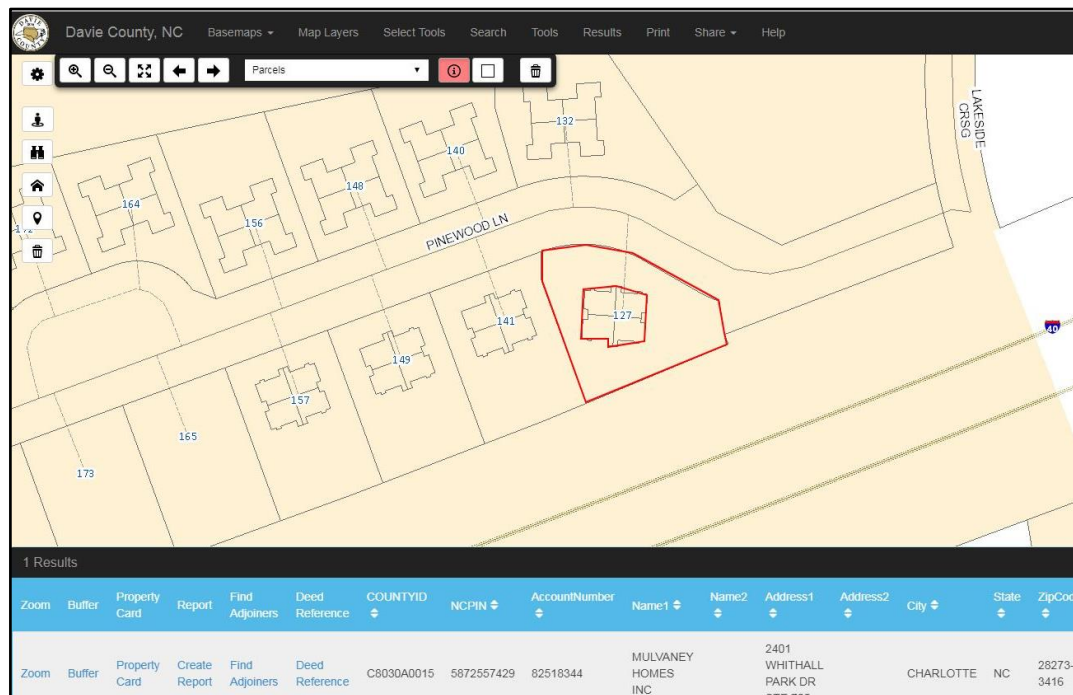
Receptors in NSA 1 were modeled at the location of each residential patio to assess traffic noise levels for each exterior area of frequent human use as accurately as possible (refer to Appendix E). As indicated by the following images, the building structures shield approximately half of the residential patios from I-40 traffic noise (refer to Appendix A). In addition to not over-predicting traffic noise impacts, accurate modeling of shielded receptors serves to not over-predict traffic sound barrier performance (refer to Appendix B).

Typical NSA 1 Residential Property Boundary (127 Pinewood Lane, Unit 102):



Source: Davie County North Carolina GIS Mapping (http://maps2.roktech.net/davieNC_gm4/#)

Typical NSA 1 Common Grounds Boundary (Development-Owned):



Source: Davie County North Carolina GIS Mapping (http://maps2.roktech.net/davieNC_gm4/#)

NSA 2: (Medical Drive, Kinderton Way)

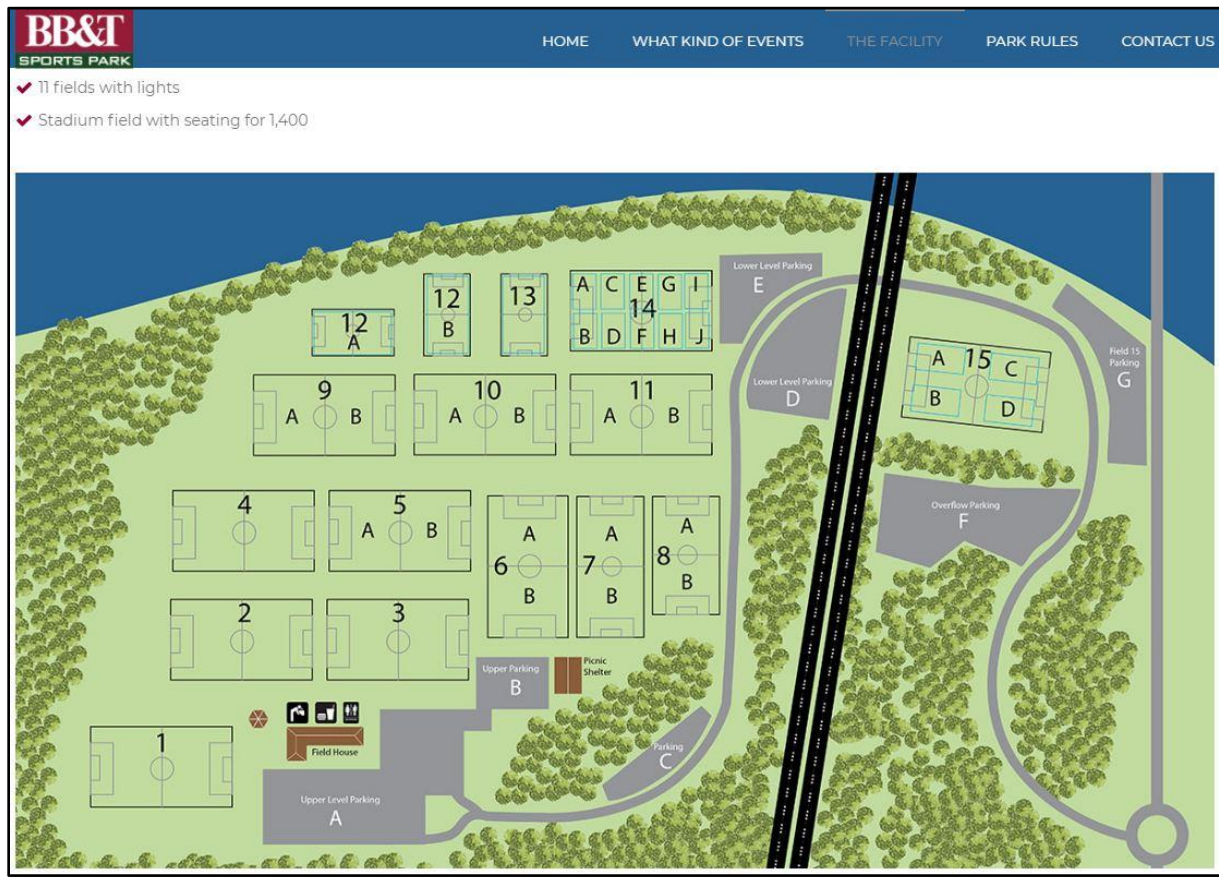
NSA 2 consists of commercial properties adjacent to I-40 eastbound, from east of NC 801 to west of the traffic circle near the eastern terminus of E Kinderton Way. There are no qualifying noise-sensitive receptors in NSA 2. Contours correlating to the distances from the I-40 centerline at which 66 dB(A) and 71 dB(A) traffic noise levels might occur in the vicinity of NSA 2 were predicted to assist with future land use development planning.

NSA 3: (BB&T Sports Park – Twin City Youth Soccer Association)

NSA 3 consists of the athletic (soccer) fields north and south of I-40, west of the Yadkin River. The athletic fields in NSA 3 were permitted prior to the June 30, 2014 Date of Public Knowledge.

Four representative receptor locations were modeled to assess loudest-hour traffic noise impacts, and arrays of receptors in grid patterns were modeled to evaluate potential noise wall performance at fields 8, 11, 14, and 15 (refer to the image below, and Appendix E).

BB&T Sport Park Site Map (Note: North is Approximately Oriented to Page Left)



Source: NC Youth Soccer® (<http://bbtsportspark.com/the-facility/>)

NSA 4: (*Church of the Good Shepherd, WinMock at Kinderton*)

NSA 4 consists of the Church of the Good Shepherd, and WinMock at Kinderton indoor event facility adjacent to I-40 eastbound east of E Kinderton Way and west of Twins Way. These receptors were permitted prior to the June 30, 2014 Date of Public Knowledge.

There are no discernible qualifying exterior areas of frequent human use in NSA 4. In accordance with the Manual, receptors in NSA 4 were modeled at the location outside of each of the three modeled building structures closest to the dominant traffic noise source (I-40) to assess interior traffic noise levels (refer to Appendix E).

NSA 5: (*Abelia Way, Peony Way, Verbena Way*)

NSA 5 is adjacent to I-40 westbound east of the Yadkin River. NSA 5 consists of the single-family detached residences on Abelia Way, Peony Way, and Verbena Way. Receptors were modeled for the 36 residences in NSA 5 that were permitted prior to the June 30, 2014 Date of Public Knowledge. Receptors were not modeled for the residences at 7944 Abelia Way and 3765 Verbena Way that were permitted after June 30, 2014 (refer to Appendix E).

Post-Dating NSA 5 Residence – 7944 Abelia Way:

Building Location Address		Building Description	
7944 Abelia WAY		SINGLE-FAMILY	
Bldg Type	RESIDENTIAL	Year Built	2015
Units	0	Effective Year	2017
Living Area (SQFT)	1922	Additions	7
Number of Stories	1.00	Remodeled	0
Style	CONVENTIONAL	Interior Adj.	FIREPLACE LC (2.00)

Source: Forsyth County North Carolina GIS Data (<http://tellus.co.forsyth.nc.us/lrcpwa/BuildingDetails...>)

Post-Dating NSA 5 Residence – 3765 Verbena Way:

Building Location Address		Building Description	
7944 Abelia WAY		SINGLE-FAMILY	
Bldg Type	RESIDENTIAL	Year Built	2015
Units	0	Effective Year	2017
Living Area (SQFT)	1922	Additions	7
Number of Stories	1.00	Remodeled	0
Style	CONVENTIONAL	Interior Adj.	FIREPLACE LC (2.00)

Source: Forsyth County North Carolina GIS Data (<http://tellus.co.forsyth.nc.us/lrcpwa/BuildingDetails...>)

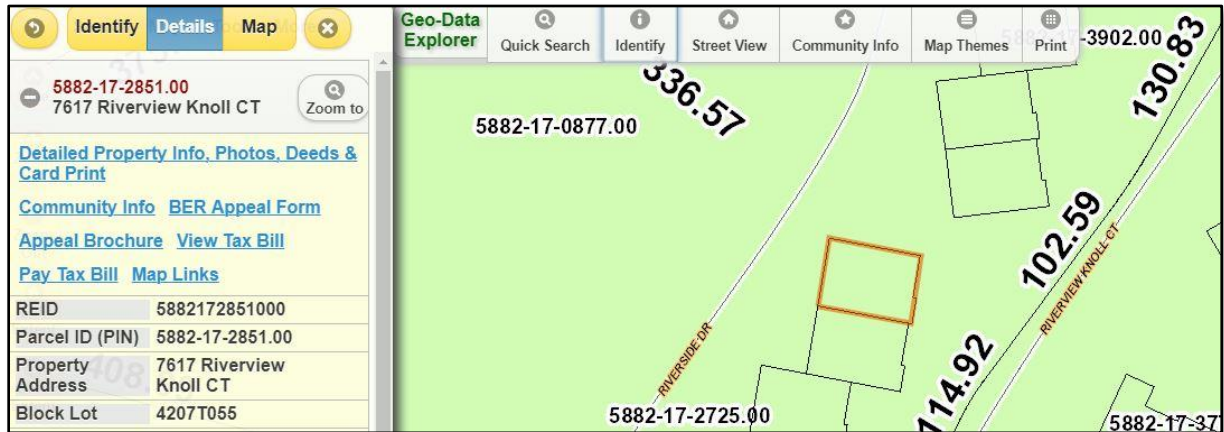
NSA 6: (*Riverview Knoll Court, Thoroughbred Lane, et al.*)

NSA 6 is adjacent to I-40 eastbound from east of the Yadkin River to west of SR 1101 (Harper Road). NSA 6 consists of two swimming pools and 265 individually deeded condominium residences on Riverview Knoll Court, Riverside Court, Riverside Drive, River Oaks Court, Old Rosebud Court, Thoroughbred Lane, Whirlaway Court, Westridge Meadow Circle, and Westridge Farm Lane. All residences in NSA 6 were permitted prior to the June 30, 2014 Date of Public Knowledge.

The residences in NSA 6 are arranged in 48 buildings consisting of two-story townhouses, single-level condominium residences in one-story structures, or single-level condominium residences in two-story structures. Each residential property includes a ground-level patio or second-story balcony; however, does not include any of the common ground outside of the building and patio/balcony boundary (refer to the following images).

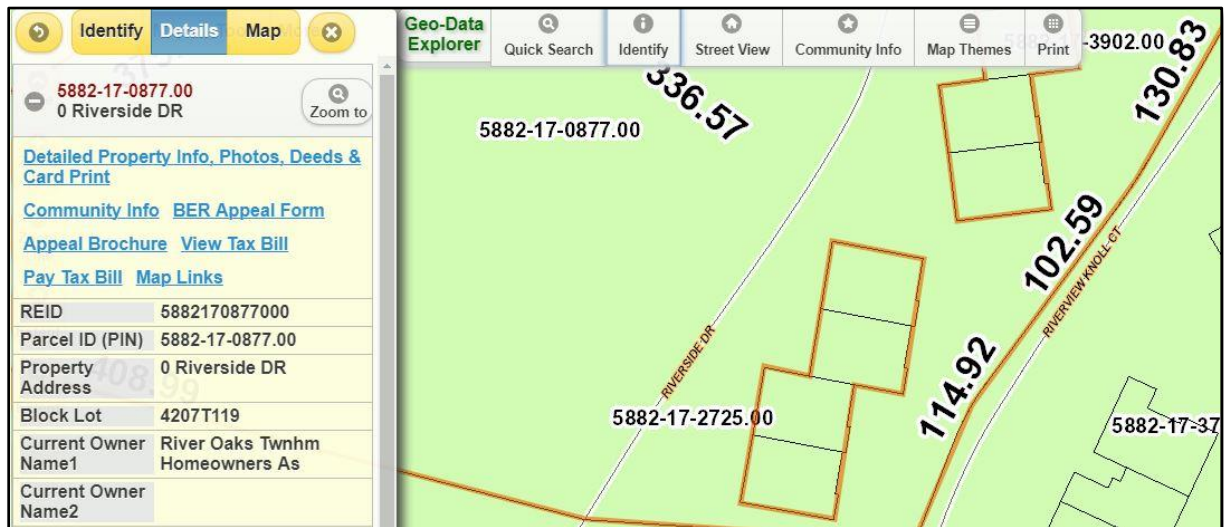
Receptors in NSA 6 were modeled at the location of each residential patio or balcony to assess traffic noise levels for each exterior area of frequent human use as accurately as possible (refer to Appendix E). As indicated by the following images, the building structures shield many of the residential patios and balconies from I-40 traffic noise (refer to Appendix A). In addition to not over-predicting traffic noise impacts, accurate modeling of shielded receptors serves to not over-predict traffic sound barrier performance (refer to Appendix B).

Typical NSA 6 Residential Property Boundary (7617 Riverview Knoll Court):



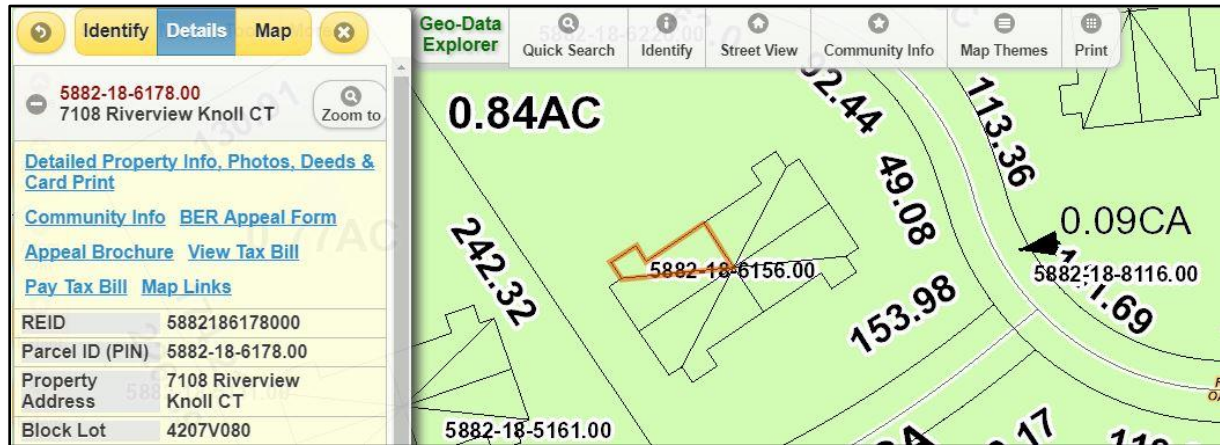
Source: Forsyth County North Carolina GIS Mapping (<http://maps.co.forsyth.nc.us/forsythjs/>)

Typical NSA 6 Common Grounds Boundary (Development-Owned):



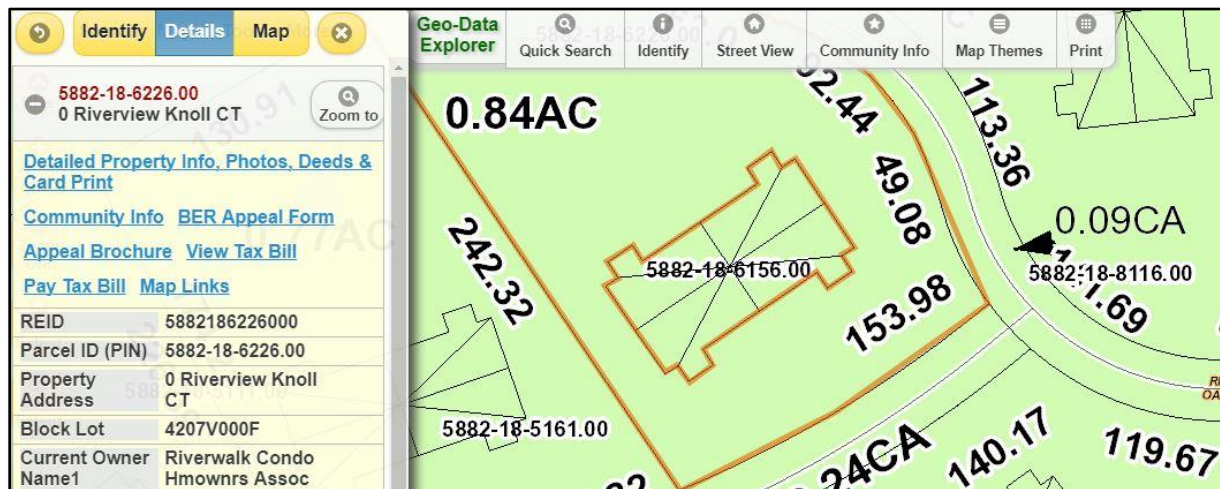
Source: Forsyth County North Carolina GIS Mapping (<http://maps.co.forsyth.nc.us/forsythjs/>)

Typical NSA 6 Residential Property Boundary (7108 Riverview Knoll Court):



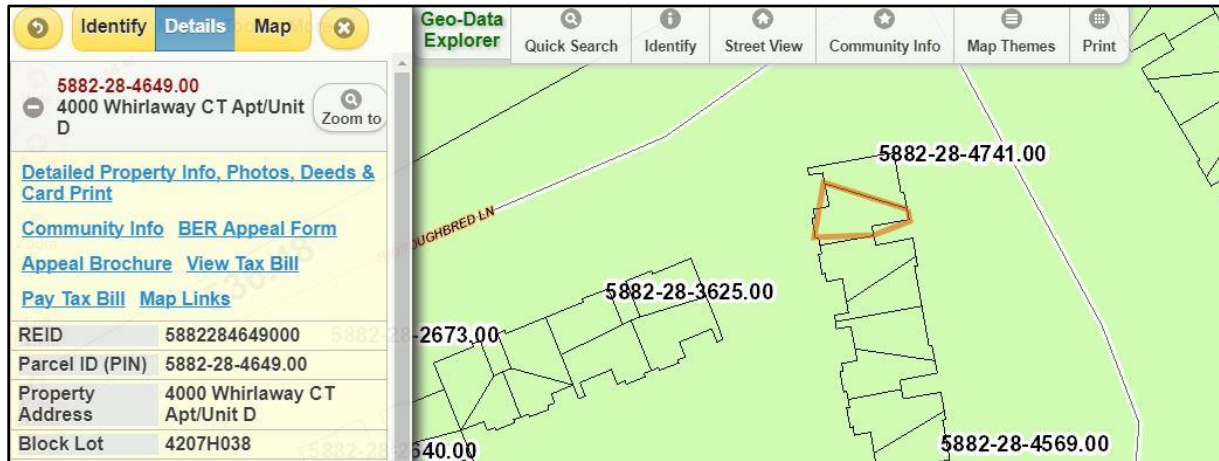
Source: Forsyth County North Carolina GIS Mapping (<http://maps.co.forsyth.nc.us/forsythjs/>)

Typical NSA 6 Common Grounds Boundary (Development-Owned):



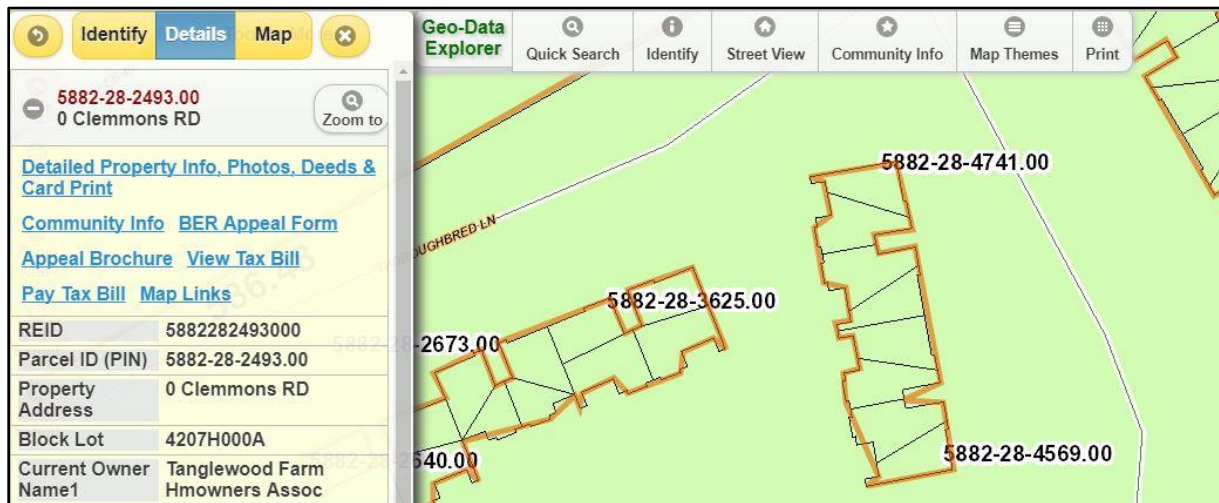
Source: Forsyth County North Carolina GIS Mapping (<http://maps.co.forsyth.nc.us/forsythjs/>)

Typical NSA 6 Residential Property Boundary (4000 Whirlaway Court, Unit D):



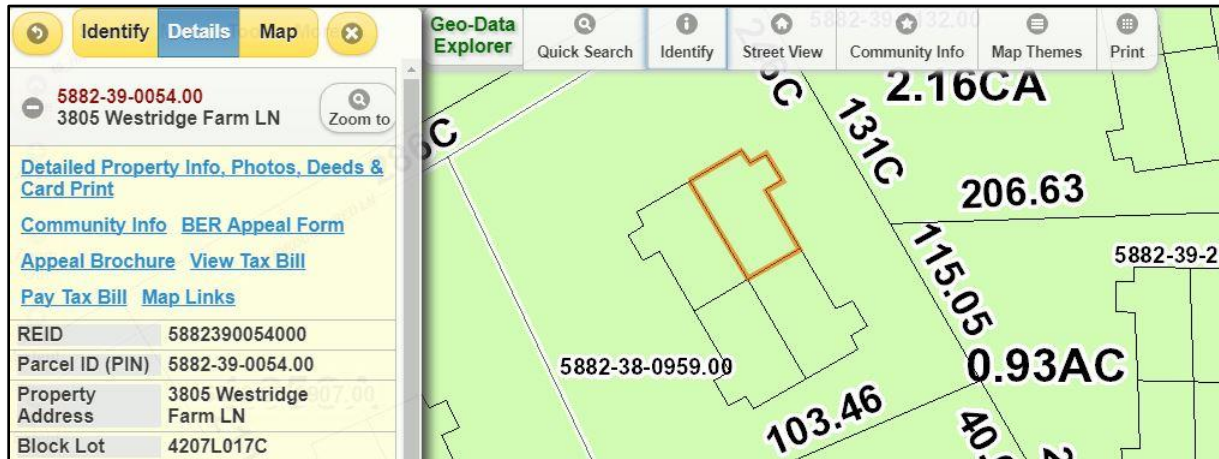
Source: Forsyth County North Carolina GIS Mapping (<http://maps.co.forsyth.nc.us/forsythjs/>)

Typical NSA 6 Common Grounds Boundary (Development-Owned):



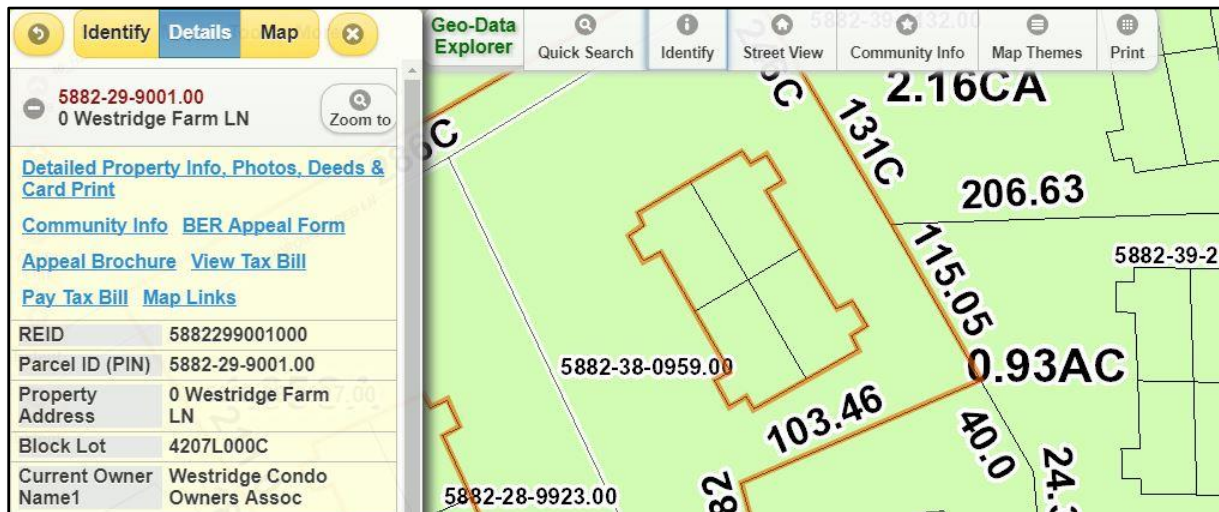
Source: Forsyth County North Carolina GIS Mapping (<http://maps.co.forsyth.nc.us/forsythjs/>)

Typical NSA 6 Residential Property Boundary (3805 Westridge Farm Lane):



Source: Forsyth County North Carolina GIS Mapping (<http://maps.co.forsyth.nc.us/forsythjs/>)

Typical NSA 6 Common Grounds Boundary (Development-Owned):



Source: Forsyth County North Carolina GIS Mapping (<http://maps.co.forsyth.nc.us/forsythjs/>)

NSA 7: (*Whitehorse Drive, Fair Oaks Drive, Lake Cliff Drive, Gardenspring Drive*)

NSA 7 is adjacent to I-40 westbound from east of Verbena Way to west of SR 1101 (Harper Road). NSA 7 consists of 15 single-family detached residences on Whitehorse Drive, Fair Oaks Drive, Lake Cliff Drive, and Gardenspring Drive. All residences in NSA 7 were permitted prior to the June 30, 2014 Date of Public Knowledge.

NSA 8: (*Hickory Grove A.M.E. Zion Church*)

NSA 8 consists of the Hickory Grove A.M.E. Zion Church adjacent to I-40 westbound east of SR 1101 (Harper Road). This place of worship was permitted prior to the June 30, 2014 Date of Public Knowledge.

There are no discernible qualifying exterior areas of frequent human use in NSA 8. In accordance with the Manual, the receptor in NSA 8 was modeled at the location outside of the modeled building structure closest to the dominant traffic noise source to assess interior traffic noise levels (refer to Appendix E).

NSA 9: (*Rollingwood Drive*)

NSA 9 is adjacent to I-40 eastbound from east of SR 1101 (Harper Road) to the eastern project limits. NSA 9 consists of 11 single-family detached residences on Rollingwood Drive. All residences in NSA 9 were permitted prior to the June 30, 2014 Date of Public Knowledge.

NSA 9 also includes an existing traffic sound barrier (noise wall) that was constructed prior to the I-40 widening and bridge replacement project (TIP#: I-0911A). Using best available survey, GIS, ground-level imagery, and field inspection data, the existing NSA 9 noise wall was included in TNM modeling for existing, Design Year 2040 no-build, and Design Year 2040 build conditions (refer to Appendix E).

NSA 9 Existing Noise Wall Adjacent to I-40 Eastbound, East of SR 1101 (Harper Road):



Appendix H

PROJECT NOISE ABATEMENT DESIGN COMPARATIVE REVIEW

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The I-40 widening and bridge replacement project (TIP#: I-0911A) final design roadway horizontal alignment and vertical profile have been modified from the project design presented by NCDOT (NCDOT Design) to the Design-Build Team (DBT) during the project procurement process.

Due to project schedule constraints, an assessment of traffic noise impacts and noise abatement consistent with applicable 2011 NCDOT Traffic Noise Abatement Policy (Policy) based on NCDOT Design was not completed and documented in an accepted Design Noise Report prior to project award.

The purpose of this Appendix is to confirm that the project final design has not diminished the mitigation of predicted traffic noise impacts that would have been required for the NCDOT Design.

The procedure for predicting NCDOT Design traffic noise levels was to replace project final design with the NCDOT Design in the design year 2040 build-condition TNM models. Except for TNM model elements representing the NCDOT Design, all other TNM model elements are identical to the TNM models used to predict impacts and assess abatement measures for project final design.




Finally, the noise wall parameters presented in this Appendix represent the above-grade acoustical profile areas. The areas of noise walls recommended for construction are greater than the acoustical profile areas documented in this Appendix because the level tops of noise wall panels will be constructed above the acoustical profile, and the level bottoms of constructed noise wall panels will be embedded below grade.

Noise Wall 1 (NW1):

Location: Adjacent to I-40 westbound lanes, east of NC 801.

NCDOT Design TNM Run: "4 NW1 DOTdsn" / SBA: "NW1 DOTdsn Input"

Table H.1: I-40 Widening and Bridge Replacement (TIP#: I-0911A) Noise Wall 1							
NCDOT Design NW1 Acoustical Performance Summary (Final Design Performance)							
Impacts: 2 (2)				Avg. Increase @ Impacts: 1 dBA (0 dBA)			
1 st -Row Receivers: 10				1 st -Row -7 dB(A): 2 (2)			
Total Benefits: 12 (11)				Total -7 dB(A): 3 (3)			
NCDOT Design NW1 Parameters (Final Design Parameters)							
Length: 1,440 ft (1,320 ft)				Area / Benefit: 1,624 ft ² (1,962 ft ²)			
Area: 19,494 ft ² (21,585 ft ²)				Allowable Area / Bene.: 2,535 ft ² (2,500 ft ²)			
Receptors					Noise Wall Performance		
Rec. No.	Use	NAC	D.U.s	Address	Build	With Barrier	NLR
R-008A	Res	B	1	189 Pinewood Ln #104	62	58	4
R-008D	Res	B	1	189 Pinewood Ln #103	62	58	4
R-009A	Res	B	1	178 Pinewood Ln #101	65	58	7
R-009D	Res	B	1	178 Pinewood Ln #102	64	58	6
R-010A	Res	B	1	172 Pinewood Ln #101	63	58	5
R-010D	Res	B	1	172 Pinewood Ln #102	63	58	5
R-011A	Res	B	1	164 Pinewood Ln #101	63	58	5
R-011D	Res	B	1	164 Pinewood Ln #102	63	58	5
R-012A	Res	B	1	156 Pinewood Ln #101	63	58	5
R-012D	Res	B	1	156 Pinewood Ln #102	63	58	5
R-013A	Res	B	1	148 Pinewood Ln #101	62	60	2
R-013D	Res	B	1	148 Pinewood Ln #102	62	60	2
R-014A	Res	B	1	140 Pinewood Ln #101	63	60	3
R-014D	Res	B	1	140 Pinewood Ln #102	63	61	2
R-015A	Res	B	1	132 Pinewood Ln #101	64	62	2
R-015D	Res	B	1	132 Pinewood Ln #102	65	62	3
R-016A	Res	B	1	157 Pinewood Ln #104	62	58	4
R-016D	Res	B	1	157 Pinewood Ln #103	62	58	4
R-017A	Res	B	1	149 Pinewood Ln #104	62	58	4
R-017D	Res	B	1	149 Pinewood Ln #103	62	58	4
R-018A	Res	B	1	141 Pinewood Ln #104	64	59	5
R-018D	Res	B	1	141 Pinewood Ln #103	64	59	5
R-019A	Res	B	1	127 Pinewood Ln #104	68	60	8
R-019D	Res	B	1	127 Pinewood Ln #103	68	61	7

Table H.1: I-40 Widening and Bridge Replacement (TIP#: I-0911A) Noise Wall 1	
NCDOT Design NW1 Predicted Traffic Noise Level Reduction Benefits ¹	
Impact= 	5 to 7 dB(A) NLR=  ≥ 7 dB(A) NLR= 
1. A receptor is considered “benefited” if the predicted Noise Level Reduction (NLR) is at least 5 dB(A).	

Noise Wall 5 (NW5):

Location: Adjacent to I-40 westbound lanes, east of the Yadkin River Bridge.

NCDOT Design TNM Run: “4 NW5-7 DOTdsn” / SBA: “NW5&NW7 DOTdsn Opt1”




Table H.2: I-40 Widening and Bridge Replacement (TIP#: I-0911A) Noise Wall 5							
NCDOT Design NW5 Acoustical Performance Summary (Final Design Performance)							
Impacts: 2 (2)				Avg. Increase @ Impacts: 2 dBA (2 dBA)			
1 st -Row Receivers: 2				1 st -Row -7 dB(A): 2 (2)			
Total Benefits: 4 (4)				Total -7 dB(A): 2 (2)			
NCDOT Design NW5 Parameters (Final Design Parameters)							
Length: 750 ft (840 ft)				Area / Benefit: 2,583 ft ² (2,555 ft ²)			
Area: 10,331 ft ² (10,220 ft ²)				Allowable Area / Bene.: 2,570 ft ² (2,570 ft ²)			
Receptors					Noise Wall Performance		
Rec. No.	Use	NAC	D.U.s	Address	Build	With Barrier	NLR
R-079	Res	B	1	7986 Abelia Way	61	61	0
R-080	Res	B	1	7980 Abelia Way	60	60	0
R-081	Res	B	1	7974 Abelia Way	59	58	1
R-082	Res	B	1	7966 Abelia Way	56	56	0
R-083	Res	B	1	7962 Abelia Way	58	57	1
R-084	Res	B	1	7956 Abelia Way	58	58	0
R-085	Res	B	1	3702 Peony Way	56	57	0
R-086	Res	B	1	3714 Peony Way	56	56	0
R-087	Res	B	1	3738 Peony Way	60	59	1
R-088	Res	B	1	3775 Peony Way	70	63	7
R-089	Res	B	1	3763 Peony Way	68	61	7
R-090	Res	B	1	3751 Peony Way	64	59	5
R-091	Res	B	1	3739 Peony Way	60	55	5
R-092	Res	B	1	3727 Peony Way	55	52	3
R-098	Res	B	1	7985 Abelia Way	56	55	1
NCDOT Design NW5 Predicted Traffic Noise Level Reduction Benefits ²							4
Impact= <div></div> 5 to 7 dB(A) <div></div> NLR= <div></div> ≥7 dB(A) NLR= <div></div>							
<p>1. NW5 would have been recommended for construction in accordance with the Quantity Averaging provision of the 2011 Policy. The 2,583 square feet per NW5 benefit would have been less than two times the 2,500 square feet per benefit base quantity reasonableness criteria, and collectively the 1,350 square feet area per benefit of NW5 + NW6 + NW7 in the same Common Noise Environment (CNE) would not have exceeded the 2,500 square feet per benefit base quantity reasonableness criteria.</p> <p>2. A receptor is considered “benefited” if the predicted Noise Level Reduction (NLR) is at least 5 dB(A).</p>							

Noise Wall 6 (NW6):

Location: Adjacent to I-40 westbound lanes, east of the Yadkin River Bridge.

NCDOT Design TNM Run: "4 NW6 DOTdsn" / SBA: "NW6DOT DSN Opt1"

Table H.3: I-40 Widening and Bridge Replacement (TIP#: I-0911A) Noise Wall 6							
NCDOT Design NW6 Acoustical Performance Summary <i>(Final Design Performance)</i>							
Impacts: 37 <i>(35)</i>				Avg. Increase @ Impacts: 1 dBA <i>(0 dBA)</i>			
1 st -Row Receivers: 17				1 st -Row -7 dB(A): 17 <i>(17)</i>			
Total Benefits: 38 <i>(39)</i>				Total -7 dB(A): 29 <i>(27)</i>			
NCDOT Design NW6 Parameters <i>(Final Design Parameters)</i>							
Length: 2,985 ft <i>(2,985 ft)</i>				Area / Benefit: 1,009 ft ² <i>(1,002 ft²)</i>			
Area: 38,355 ft ² <i>(39,061 ft²)</i>				Allowable Area / Bene.: 2,535 ft ² <i>(2,500 ft²)</i>			
Receptors					Noise Wall Performance		
Rec. No.	Use	NAC	D.U.s	Address	Build	With Barrier	NLR
R-021A	Res	B	1	7645 Riverview Knoll Ct	64	62	2
R-021B	Res	B	1	7641 Riverview Knoll Ct	64	62	2
R-021C	Res	B	1	7637 Riverview Knoll Ct	65	63	2
R-021D	Res	B	1	7633 Riverview Knoll Ct	66	63	3
R-022A	Res	B	1	7629 Riverview Knoll Ct	68	63	5
R-022B	Res	B	1	7625 Riverview Knoll Ct	67	63	4
R-022C	Res	B	1	7621 Riverview Knoll Ct	68	63	5
R-022D	Res	B	1	7617 Riverview Knoll Ct	67	62	5
R-023A	Res	B	1	7613 Riverview Knoll Ct	67	62	5
R-023B	Res	B	1	7609 Riverview Knoll Ct	68	62	6
R-023C	Res	B	1	7605 Riverview Knoll Ct	68	62	6
R-023D	Res	B	1	7601 Riverview Knoll Ct	69	62	7
R-024A	Res	B	1	7508 Riverview Knoll Ct	71	62	9
R-024B	Res	B	1	7504 Riverview Knoll Ct	71	62	9
R-024E	Res	B	1	7528 Riverview Knoll Ct	73	64	9
R-024F	Res	B	1	7524 Riverview Knoll Ct	73	63	10
R-025A	Res	B	1	7308 Riverview Knoll Ct	71	62	9
R-025B	Res	B	1	7304 Riverview Knoll Ct	71	60	11
R-025E	Res	B	1	7328 Riverview Knoll Ct	73	63	10
R-025F	Res	B	1	7324 Riverview Knoll Ct	72	62	10
R-026A	Res	B	1	7108 Riverview Knoll Ct	69	61	8
R-026B	Res	B	1	7104 Riverview Knoll Ct	68	60	8
R-026E	Res	B	1	7128 Riverview Knoll Ct	72	62	10
R-026F	Res	B	1	7124 Riverview Knoll Ct	72	62	10

Receptor	Use	Building Type	Distance (ft)	Property Address	2025 L _{dn} (dBA)	2025 L _{dn} (dBA) - NLR	2025 L _{dn} (dBA) - NLR
R-027B	Res	B	1	204 River Oaks Court	74	61	13
R-027C	Res	B	1	202 River Oaks Court	76	62	14
R-027D	Res	B	1	206 River Oaks Court	64	59	5
R-027E	Res	B	1	River Oaks Ct Pool	73	61	12
R-028A	Res	B	1	106 River Oaks Court	66	59	7
R-028D	Res	B	1	102 River Oaks Court	66	58	8
R-028E	Res	B	1	126 River Oaks Court	70	61	9
R-028H	Res	B	1	122 River Oaks Court	69	60	9
R-030A	Res	B	1	5000 Thoroughbred Ln Unit A	63	58	5
R-030E	Res	B	1	5000 Thoroughbred Ln Unit E	69	60	9
R-033D	Res	B	1	4000 Whirlaway Ct Unit D	67	60	7
R-033F	Res	B	1	4000 Whirlaway Ct Unit F	62	58	4
R-033G	Res	B	1	4000 Whirlaway Ct Unit G	67	58	9
R-033H	Res	B	1	4000 Whirlaway Ct Unit H	73	63	10
R-035A	Res	B	1	4001 Whirlaway Ct Unit A	66	59	7
R-035G	Res	B	1	4001 Whirlaway Ct Unit G	72	63	9
R-035H	Res	B	1	4001 Whirlaway Ct Unit H	67	60	7
R-041B	Res	B	1	3805 Westridge Farm Ln	64	58	6
R-046A	Res	B	1	3998 Westridge Meadow Cir	68	60	8
R-046B	Res	B	1	4002 Westridge Meadow Cir	65	65	0
R-046C	Res	B	1	4000 Westridge Meadow Cir	64	63	1
R-046D	Res	B	1	3996 Westridge Meadow Cir	66	59	7
NCDOT Design NW6 Predicted Traffic Noise Level Reduction Benefits⁶							38
Impact=  5 to 7 dB(A)  ≥ 7 dB(A) NLR= 							
1. Traffic noise is predicted to impact R-021D & R-022A more than 400 feet from I-40 due to the absence of ground attenuation between these receptors and I-40. A 25-foot tall barrier would not provide a 5-decibel Noise Level Reduction (NLR) benefit to R-021D and R-022A. 2. A receptor is considered “benefited” if the predicted Noise Level Reduction (NLR) is at least 5 dB(A).							

Noise Wall 7 (NW7):

Location: Adjacent to I-40 westbound lanes, east of the Yadkin River Bridge.

NCDOT Design TNM Run: "4 NW7 DOTdsn r1" / SBA: "NW7 DOTdsn Opt1"

Table H.4: I-40 Widening and Bridge Replacement (TIP#: I-0911A) Noise Wall 7							
NCDOT Design NW7 Acoustical Performance Summary (Final Design Performance)							
Impacts: 1 (1)				Avg. Increase @ Impacts: 2 dBA (3 dBA)			
1 st -Row Receivers: 1				1 st -Row -7 dB(A): 1 (1)			
Total Benefits: 4 (8)				Total -7 dB(A): 1 (5)			
NCDOT Design NW7 Parameters (Final Design Parameters)							
Length: 913 ft (1,650 ft)				Area / Benefit: 3,353 ft ² (4,024 ft ²)			
Area: 13,411 ft ² (32,190 ft ²)				Allowable Area / Bene: 2,570 ft ² (2,605 ft ²)			
Receptors					Noise Wall Performance		
Rec. No.	Use	NAC	D.U.s	Address	Build	With Barrier	NLR
R-049C	Res	B	1	7735 Fair Oaks Drive	59	59	0
R-049	Res	B	1	7725 Fair Oaks Drive	61	60	1
R-050	Res	B	1	7715 Fair Oaks Drive	60	58	2
R-051A	Res	B	1	4264 Lake Cliff Drive	56	53	3
R-051	Res	B	1	4272 Lake Cliff Drive	60	55	5
R-052	Res	B	1	4280 Lake Cliff Drive	65	60	5
R-054	Res	B	1	4279 Lake Cliff Drive	61	56	5
R-055	Res	B	1	7685 Fair Oaks Drive	69	60	9
R-056	Res	B	1	4260 Gardenspring Drive	58	57	1
R-057	Res	B	1	4267 Gardenspring Drive	57	57	0
NCDOT Design NW7 Predicted Traffic Noise Level Reduction Benefits ²							4
Impact=					≥7 dB(A) NLR=		
1. Per the NCDOT Design, NW7 would have been recommended for construction in accordance with the Quantity Averaging provision of the 2011 Policy. The 3,353 square feet per NW7 benefit would have been less than two times the 2,500 square feet per benefit base quantity reasonableness criteria, and collectively the 1,350 square feet area per benefit of NW5 + NW6 + NW7 in the same Common Noise Environment (CNE) would not have exceeded the 2,500 square feet per benefit base quantity reasonableness criteria.							
2. A receptor is considered “benefited” if the predicted Noise Level Reduction (NLR) is at least 5 dB(A).							

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Appendix I

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION TRAFFIC NOISE ABATEMENT POLICY



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**NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION
TRAFFIC NOISE ABATEMENT POLICY**



Effective Date: July 13, 2011

Noise Policy Committee:

Jay Bennett, PE.....Roadway Design Unit
Drew Joyner, PE.....Human Environment Unit
Daniel Keel, PE.....NCDOT Operations
Mike Mills, PE.....NCDOT Division 7
Gregory A. Smith, PE.....Human Environment Unit

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Missy Dickens Pair, PE.....Project Development &
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Ed Lewis.....Human Environment Unit
Joe Rauseo.....Human Environment Unit
Tracy Roberts, AICP.....North Carolina Turnpike Authority
Steve Walker.....Human Environment Unit

Sponsors:

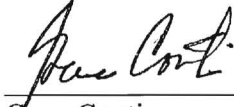
Rob Ayers.....Federal Highway Administration
Felix Davila, PE.....Federal Highway Administration
Mike Fox.....Board of Transportation
Nina Szlosberg-Landis.....Board of Transportation

APPROVED BY:


3/9/2011
Date of Approval


John F. Sullivan, III, PE
Division Administrator
Federal Highway Administration

2/28/2011
Date of Approval


Gene Conti
Secretary of Transportation

2/22/11
Date of Approval


Robert A. Collier, Jr.
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INTRODUCTION

This document contains the North Carolina Department of Transportation (hereinafter NCDOT) policy on highway traffic noise and construction noise and describes the implementation of the requirements of the Federal Highway Administration (hereinafter FHWA) Noise Standard at 23 Code of Federal Regulations (CFR) Part 772 as they relate to federal and state funded highway construction in North Carolina. This policy was developed by the NCDOT and reviewed and approved by the FHWA.

The North Carolina Department of Transportation Traffic Noise Analysis and Abatement Guidance Manual and 23 CFR 772 are intended to be companion documents to this policy.

PURPOSE

This policy describes the NCDOT process that is used in determining traffic noise impacts and abatement measures and the equitable and cost-effective expenditure of public funds for traffic noise abatement. Where the FHWA has given highway agencies flexibility in implementing the 23 CFR 772 standards, this policy describes the NCDOT approach to implementation.

APPLICABILITY

This policy applies to all "Type I" federal, state or federal-aid highway projects in the State of North Carolina, including federal projects that are administered by local public agencies. NCDOT does not participate in nor fund Type II (retrofit) projects along existing state transportation facilities. Noise analyses are not required for Type III projects. Each of these project types are defined below. This policy shall be applied uniformly and consistently to all Type I federal projects throughout the state.

Type I Project

- (a) The construction of a highway on new location; or,
- (b) The physical alteration of an existing highway where there is either:
 - (i) Substantial Horizontal Alteration. A project that halves the distance between the traffic noise source and the closest receptor between the existing condition to the future build condition; or,
 - (ii) Substantial Vertical Alteration. A project that removes shielding, therefore exposing the line-of-sight between the receptor and the traffic noise source. This is done by either altering the vertical alignment of the highway or by altering the topography between the highway traffic noise source and the receptor; or,
- (c) The addition of a through-traffic lane(s). This includes the addition of a through-traffic lane that functions as a HOV lane, High-Occupancy Toll (HOT) lane, bus lane, or truck climbing lane; or,

- (d) The addition of an auxiliary lane, except for when the auxiliary lane is a turn lane; or,
- (e) The addition or relocation of interchange lanes or ramps added to a quadrant to complete an existing partial interchange; or,
- (f) Restriping existing pavement for the purpose of adding a through-traffic lane or an auxiliary lane; or,
- (g) The addition of a new or substantial alteration of a weigh station, rest stop, ride-share lot or toll plaza.
- (h) If a project is determined to be a Type I project under this definition then the entire project area as defined in the environmental document is a Type I project.

Type II Project.

A Federal or Federal-aid highway project for noise abatement on an existing highway. For a Type II project to be eligible for Federal-aid funding, the highway agency must develop and implement a Type II program in accordance with section 772.7(e).

Type III Project

A Federal or Federal-aid highway project that does not meet the classifications of a Type I or Type II project. Type III projects do not require a noise analysis.

The highway traffic noise prediction requirements, noise analyses, noise abatement criteria, and requirements for informing local officials in 23 CFR 772 and this policy constitute the noise standards mandated by 23 U.S.C. 109(1). All highway projects which are developed in conformance with this policy shall be deemed to be in accordance with the FHWA noise standards.

Projects let for construction on or after July 13, 2011 shall be reviewed under the criteria of this policy; however, the original date of public knowledge shall remain unchanged.

DATE OF PUBLIC KNOWLEDGE

The Date of Public Knowledge of the location and potential noise impacts of a proposed highway project is the approval date of the final environmental document, e.g., Categorical Exclusion (CE), State or Federal Finding of No Significant Impact (FONSI) or State or Federal Record of Decision (ROD).

After this date, the federal and state governments are no longer responsible for providing noise abatement measures for new development within the noise impact area of the proposed highway project. It is the responsibility of local governments and private landowners to ensure that noise-compatible designs are used for development permitted after the Date of Public Knowledge.

This policy applies only to developed land and to undeveloped land for which development is permitted before the project Date of Public Knowledge. The criteria (trigger date) for determining when undeveloped land is permitted for development is the approval date of a building permit for an individual lot or site.

TRAFFIC NOISE PREDICTION

All traffic noise analyses performed by or for NCDOT must utilize the most current version of the FHWA Traffic Noise Model (TNM®) or any other model determined by the FHWA to be consistent with the methodology of the TNM® model, pursuant to 23 CFR 772.9.

Average pavement type shall be used in the FHWA TNM® for future noise level prediction.

Noise contour lines may be used for project alternative screening or for land use planning, but shall not be used for determining highway traffic noise impacts.

Traffic characteristics that would yield the loudest hourly equivalent traffic noise levels for the design year shall be used in predicting noise levels and assessing noise impacts.

Traffic noise prediction must adhere to all methodologies detailed in the NCDOT Traffic Noise Analysis and Abatement Guidance Manual.

NOISE IMPACT DETERMINATION

Traffic noise abatement for NCDOT highway projects is warranted and must be considered when traffic noise impacts are created by either of the following two conditions:

- (a) The predicted traffic noise levels for the Design Year approach (reach one decibel less than) or exceed the Noise Abatement Criteria (NAC) contained in 23 CFR 772 and in Table 1, found on page 4 of this policy, OR
- (b) The predicted traffic noise levels for the Design Year substantially exceed existing noise levels as defined in Table 2, found on page 5 of this policy.

A receptor is a discrete or representative location of a noise sensitive area(s) for any of the land uses listed in Table 1. For multifamily dwellings, each residence shall be counted as one receptor when determining impacted and benefited receptors.

Primary consideration shall be given to exterior areas where frequent human use occurs in the determination of traffic noise impacts.

A traffic noise analysis shall be completed for each project alternative under detailed study and for each Activity Category listed in Table 1 that is present in the study area.

Table 1			
Noise Abatement Criteria			
Hourly Equivalent A-Weighted Sound Level (decibels (dB(A)))			
Activity Category	Activity Criteria ¹ Leq(h) ²	Evaluation Location	Activity Description
A	57	Exterior	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B ³	67	Exterior	Residential
C ³	67	Exterior	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, daycare centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings
D	52	Interior	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios
E ³	72	Exterior	Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in A-D or F
F	--	--	Agriculture, airports, bus yards, emergency services, industrial, logging maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing
G	--	--	Undeveloped lands that are not permitted

¹ The Leq(h) Activity Criteria values are for impact determination only, and are not design standards for noise abatement measures.

² The equivalent steady-state sound level which in a stated period of time contains the same acoustic energy as the time-varying sound level during the same time period, with Leq(h) being the hourly value of Leq.

³ Includes undeveloped lands permitted for this activity category.

Table 2	
Substantial Noise Level Increase	
Hourly Equivalent A-Weighted Sound Level (decibels (dB(A)))	
Existing Noise Level ¹ (Leq(h))	Predicted Design Year Noise Level Increase ² (Leq(h))
50 or less	15 or more
51	14 or more
52	13 or more
53	12 or more
54	11 or more
55 or more	10 or more

¹ Loudest hourly equivalent noise level from the combination of natural and mechanical sources and human activity usually present in a particular area.

² Predicted hourly equivalent Design Year traffic noise level minus existing noise level.

ANALYSIS OF NOISE ABATEMENT MEASURES

When traffic noise impacts are identified and noise abatement is warranted, noise abatement measures shall be considered and evaluated for feasibility and reasonableness. All of the following conditions must be met in order for noise abatement to be justified and incorporated into project design, as applicable. Failure to achieve any single element of feasibility or reasonableness will result in the noise abatement measure being deemed not feasible or not reasonable, whichever applies.

Feasibility

The combination of acoustical and engineering factors considered in the evaluation of a noise abatement measure.

- (a) Any receptor that receives a minimum noise level reduction of five dB(A) due to noise abatement measures shall be considered a benefited receptor. Noise reduction of five dB(A) must be achieved for at least one impacted receptor.
- (b) Engineering feasibility of the noise abatement measure(s) shall consider adverse impacts created by or upon property access, drainage, topography, utilities, safety, and maintenance requirements.

Reasonableness

The combination of social, economic, and environmental factors considered in the evaluation of a noise abatement measure.

- (a) Viewpoints of the property owners and residents of all benefited receptors shall be solicited. One owner ballot and one resident ballot shall be solicited for each benefited receptor. Points per ballot shall be distributed in the following weighted manner:
 - 3 points/ballot for benefited front row property owners
 - 1 point/ballot for all other benefited property owners
 - 1 point/ballot vote for all residents

Consideration of the noise abatement measure will continue unless a simple majority of all distributed points are returned that indicates the balloted voters do not want the abatement measure.

- (b) The maximum allowable base quantity of noise walls and/or earthen berms per benefited receptor shall not exceed 2,500 ft² and 7,000 yd³, respectively. Additionally, an incremental increase of 35 ft² for noise walls and 100 yd³ for earthen berms shall be added to the base quantity per the average increase in dB(A) between existing and predicted exterior noise levels of all impacted receptors within each noise sensitive area, which is defined as a group of receptors that are exposed to similar noise sources. A base dollar value of \$37,500 plus an incremental increase of \$525 (as defined above) shall be used to determine reasonableness of buffer zones and noise insulation.
- (c) A noise reduction design goal of at least 7 dB(A) must be evaluated for all front row receptors. At least one benefited front row receptor must achieve the noise reduction design goal of 7 dB(A) to indicate the noise abatement measure effectively reduces traffic noise.

Other Considerations

Prior to CE approval or issuance of a FONSI or ROD, NCDOT shall identify in environmental documents:

- (a) Noise abatement measures that are feasible and reasonable,
- (b) Noise impacts for which no abatement appears to be feasible and reasonable;
- (c) Locations where noise impacts will occur, where noise abatement is feasible and reasonable, and the locations that have no feasible and reasonable abatement.
- (d) Whether it is “likely” or “unlikely” that noise abatement measures will be installed for each noise sensitive area identified. “Likely” does not mean a firm commitment. The final decision on the installation of the abatement measures shall be made upon

completion of the project design, the public involvement process, concurrence with the NCDOT Policy, and FHWA approval.

Acceptable Noise Abatement Measures

The following noise abatement measures may be considered for incorporation into a project to reduce traffic noise impacts.

- (a) Construction of noise barriers
- (b) Traffic management measures
- (c) Alteration of horizontal and vertical alignments
- (d) Establishment of buffer zones
- (e) Noise insulation of Activity Category D land use facilities listed in Table 1 on Page 4 of this policy.

Third Party Participation

- (a) Third party funding of noise abatement measures cannot be used to make up the difference between the reasonable base quantity allowance and the actual quantity of noise abatement. Third party funding is allowed only by public entities, and can only be used to pay for additional features such as landscaping and aesthetic treatments for noise barriers that meet cost-effectiveness criteria.
- (b) Traditional highway construction resources pay for required noise abatement measures. Should a local government request that materials be used that are more costly than those proposed by NCDOT, the requesting entity must assume 100% of the actual additional construction cost.
- (c) If a local government insists on the provision of a noise abatement measure deemed not reasonable by NCDOT, an abatement measure may be installed provided the local government assumes 100% of the costs and obtains an encroachment permit from NCDOT to perform the work. These costs include, but are not limited to, preliminary engineering, actual construction and maintenance. In addition, local governments must ensure that NCDOT's material, design and construction specifications are met. The local government must also assume 100% of the liability associated with the measure and hold harmless the NCDOT.
- (d) For (b) and (c) above, the settlement agreement shall be signed before third party noise abatement design begins and payment shall be made to NCDOT before project construction begins.

Quantity Averaging

NCDOT will utilize abatement measure quantity averaging among all noise sensitive areas within the same Activity Category in Table 1 that are exposed to a common noise environment, i.e., similar noise sources and levels, traffic volumes, traffic mix, speed and topographic features, if:

- (a) No single common noise environment exceeds two times the base quantity reasonableness criteria (e.g., two times 2,500 square feet, or two times 7,000 cubic yards); and,
- (b) Collectively, all common noise environments being averaged do not exceed the base quantity reasonableness criteria.

PUBLIC INVOLVEMENT

Communication with the community regarding noise impacts and possible noise abatement shall occur at the start of the noise study process and continue throughout the development of the project. NCDOT will communicate with citizens to present information on the nature of highway traffic noise and discuss the effects of noise abatement measures in attenuating traffic noise and the types of noise abatement measures that may be considered. The concerns of the community shall be a major consideration in reaching a decision on the abatement measures to be provided.

COORDINATION WITH LOCAL OFFICIALS

NCDOT will provide all traffic noise analyses to local government officials within whose jurisdiction a highway project is proposed as early in the project planning process as possible to protect future development from becoming incompatible with traffic noise levels. Specifically, environmental documents and design noise reports will contain information identifying areas that may be impacted by traffic noise, predicted noise level contour information, the best estimation of future noise levels for developed and undeveloped lands or properties in the immediate vicinity of the project and other appropriate design information. If requested, NCDOT will assist local officials with coordination and distribution of this information to residents, property owners and developers. NCDOT will provide assistance to local jurisdictions in the development of local noise controls, when requested. NCDOT will advocate the planning, design and construction of noise-compatible development and encourage its practice among planners, building officials, developers and others.

All noise-sensitive areas and any known noise abatement measures will be presented and discussed at the Design Public Hearing and Design Public Meetings.

CONSTRUCTION NOISE

To minimize the impacts of construction noise on the public, NCDOT shall:

- (a) Identify land uses or activities that may be affected by noise from construction of the project.
- (b) Determine the measures that are needed in the plans and specifications to minimize or eliminate adverse construction noise impacts to the community. This determination shall consider the benefits achieved and the overall adverse social, economic, and environmental effects and costs of the abatement measures.
- (c) Consider construction techniques and scheduling to reduce construction noise impacts to nearby receptors and incorporate the needed abatement measures in the project plans and specifications.

FEDERAL PARTICIPATION

The costs of noise abatement measures may be included in federal-aid participating project costs with the federal share being the same as that for the system on which the project is located when:

- (a) Traffic noise impacts have been identified; and
- (b) Abatement measures have been determined to be feasible and reasonable pursuant to 23 CFR 772 and this policy.

REVIEW OF POLICY

This policy shall be reviewed by the NCDOT Board of Transportation at least every five years.