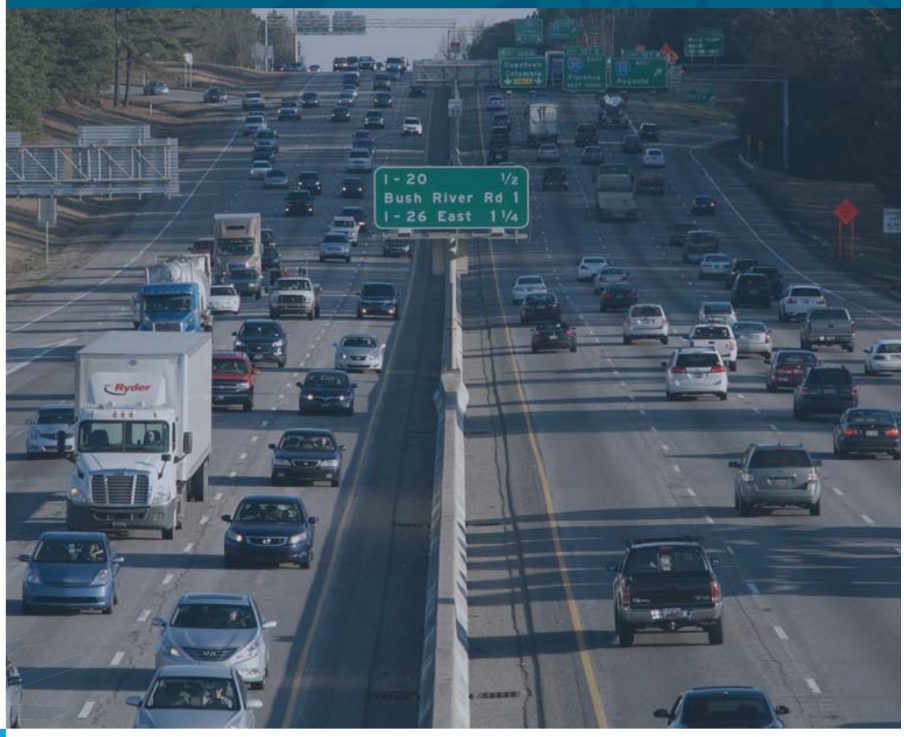
# Appendix J—Noise Technical Report

## Part 1

CAROLINA
CROSSROADS
I-20/26/126 Corridor Project




# Detailed Noise Analysis Technical Report

*Carolina Crossroads*
*I-20/26/126 Corridor Improvement Project*

SCDOT
South Carolina Department of Transportation

U.S. Department of Transportation
Federal Highway Administration

Prepared for South Carolina Department of Transportation
and the Federal Highway Administration

# Detailed Noise Analysis Technical Report

Carolina Crossroads

I-20/26/126 Corridor Improvement Project

Lexington and Richland Counties, South Carolina

FEIS May 2019

Prepared for
South Carolina Department of Transportation,
And the Federal Highway Administration

Prepared by

# Noise Technical Report

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# 1 Introduction—What is a noise study?

Traffic noise is associated with highway traffic, generally in the form of loud and/or persistent noises from vehicles. A noise study is done to determine both the existing and future predicted noise for a highway project like the proposed Carolina Crossroads I-20/26/126 Corridor Improvement Project (Carolina Crossroads). In 2015, a study was completed to assess the existing noise conditions within the project study area for the proposed Carolina Crossroads project in Lexington and Richland Counties, South Carolina.[1] The proposed project consists of roadways and bridges for improvements to the I-20/26/126 corridor in Richland and Lexington counties. To date, the project area has been defined as a mainline corridor including I-20 from Sunset Boulevard to the Broad River, I-26 from US 378 to Broad River Road, and I-126 from Colonial Life Boulevard to I-26. Figure 1.1 presents a map showing the location of the study area.

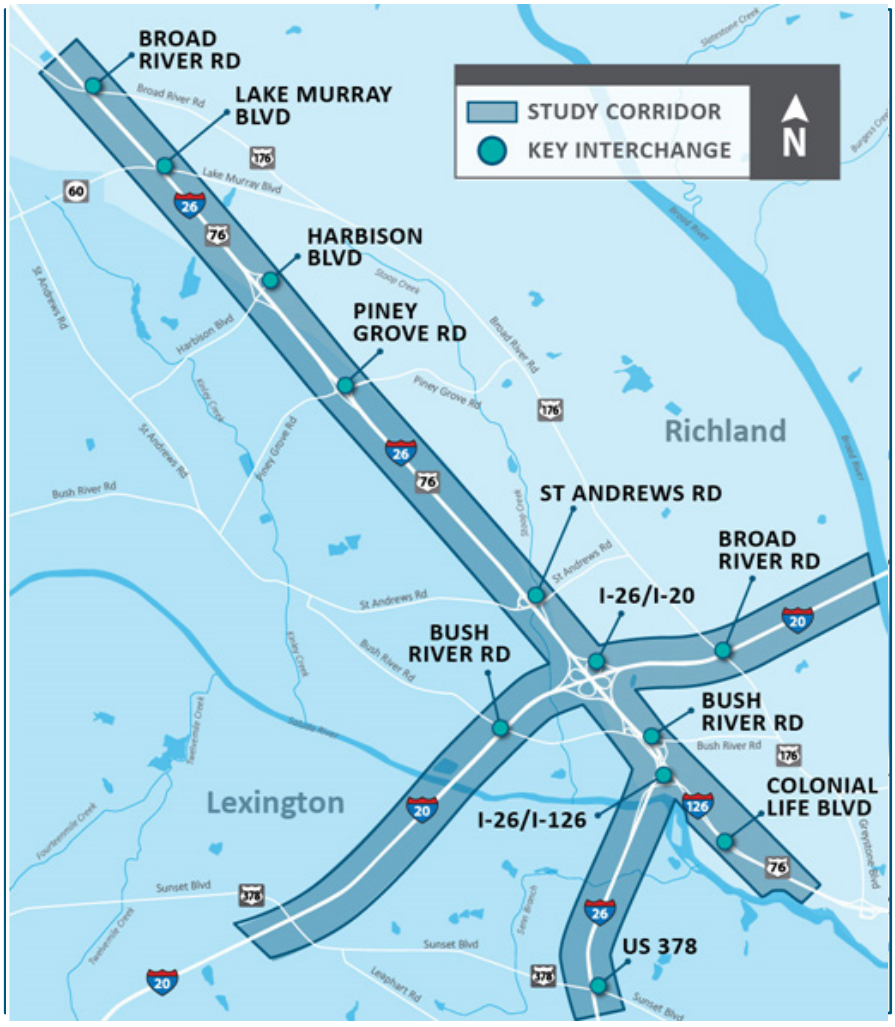



**Figure 1-1 Carolina Crossroads I-20/26/126 Corridor Improvement Project area**

The noise assessment for the I-20/I-26/I-126 project was prepared in accordance with 23 CFR §772 and SCDOT Noise Abatement Policy (September 1, 2014). SCDOT's policy states that the preliminary traffic noise analysis shall include the following for each alternative under detailed study:

- Identification of existing activities, developed lands, and undeveloped lands for which development is planned, designed and programmed, which may be affected by noise from the highway
- Measurement of existing noise levels
- Model validation

[1] Noise Data Collection Report. Carolina Crossroads I-20/26/126 Corridor Report, Lexington and Richland Counties, South Carolina. Prepared for South Carolina Department of Transportation and the Federal Highway Administration. Prepared by HDR.

- Noise model analysis of existing and future noise levels.
- Identification of traffic noise impacts
- Consideration of noise abatement

A preliminary analysis was conducted for the Reasonable Alternatives (RA1 and RA5 Modified) and included in the Carolina Crossroads I-20/26/126 Corridor Project Draft Environmental Impact Statement (DEIS). RA1 was identified as the Recommended Preferred Alternative. Having considered the written and oral comments offered by agencies and the public and further engineering considerations, the RPA in the DEIS was refined, and it is now designated as the Refined Recommended Preferred Alternative. (For further information on the design changes, please refer to Chapter 2, Alternatives). A Detailed Noise Analysis was conducted for the Refined Recommended Preferred Alternative based on the comst current design and traffic information available for the Final Environmental Impact Statement (FEIS). The Detailed Noise Analysis included the following:

- Elevations of receptors
- Elevations of existing roadway and Refined Recommended Preferred Alternative
- Roadway shoulders
- Building rows, terrain lines, and ground zones
- Identification of traffic noise impacts for Refined Recommended Preferred alternative
- Consideration of noise abatement for Refined Recommended Preferred alternative

# 2 How are noise impacts estimated?

The federal regulation that the Federal Highway Administration (FHWA) uses to assess noise impacts is 23 CFR Part 772, Procedures for Abatement of Highway Traffic Noise and Construction Noise. The South Carolina Department of Transportation (SCDOT) Traffic Noise Abatement Policy constitutes the official SCDOT noise policy and procedures for the purpose of meeting the requirements of 23 CFR Part 772 and applicable state laws. Noise-abatement criteria (NAC) are used to define the noise levels that are considered an impact (in hourly A-weighted sound-level decibels) for each land-use activity category. If future noise levels approach (within 1 dBA) or exceed the NAC, they are considered noise impacts per SCDOT policy. Noise impacts would also occur if the difference between the existing noise level and the predicted noise level under the build condition is 15 dBA $L_{eq}$ or greater. These types of impacts are typically only found on new alignment projects. Section 4.1 discusses how noise impacts are determined in more detail. The NAC are summarized in Table 2.1.

**Table 2.1 Noise-Abatement Criteria**

| Activity Category | Activity Criteria[1,2] | | Evaluation Location | Description of Activity Category |
|---|---|---|---|---|
| | $L_{eq}$ (h) | $L_{10}$(h) | | |
| **A** | 57 | 60 | 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 | 70 | Exterior | Residential |
| **C**[3] | 67 | 70 | Exterior | Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care 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 | 55 | 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 | 75 | 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. |

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

[1]Either the $L_{eq}$(h) or the $L_{10}$(h) may be used on a project (but not both)

[2]The $L_{eq}$(h) and $L_{10}$(h) Activity Criteria Values are for impact determination only, and are not design standards for noise abatement measures.

[3]Includes undeveloped lands permitted for this activity.

To ensure the model is accurate in calculating noise levels at these sensitive receivers, the model is validated by collecting field measurements with a sound level meter and counting the traffic volumes on the roads during the field data collections. If results from the TNM model are within a ±3 decibel (dB) tolerance of the measurement collected in the field, the model is considered valid to calculate noise levels for the project. For the I-20/I-26/I-126 project all of the field measurements were within tolerance of the modeled results.

# 3 What are the existing noise conditions?

On June 29, 2015, the project team measured traffic noise at locations that are representative of nearby noise-sensitive sites throughout the project study area on both sides of the roadway. These locations were reviewed and approved by SCDOT prior to the measurements occurring. Traffic noise measurements were conducted in

general conformance with the FHWA-PD-96-046 Measurement of Highway Related Noise (May 1996). The average meteorlogical conditions were reported as shown in Table 3.1 below.

**Table 3.1 Meteorological Conditions**

| Condition | Measure |
|---|---|
| **Temperature** | ≅ 77-93 ° F |
| **Humidity** | ≅ 27-76 % |
| **Wind** | ≅ 5 mph |
| **Conditions** | Clear |
| **Barometric pressure** | ≅ 30.00 |

## 3.1 What types of equipment were used?

Noise monitoring was conducted using a Larson Davis 824 Sound Level Meter (SLM) (Figure 3.1). The microphone used was a Larson Davis 2541 microphone and the calibrator was a Larson Davis CAL200.

Table 3.2 summarizes the instruments used to collect the monitoring data for this activity.

**Table 3.2 Noise Analysis Instrumentation Summary**

| Instrument | Make | Serial number | Calibration due date |
|---|---|---|---|
| **Sound level meter** | Larson Davis 824 | 2636 | 5/19/2017 |
| **Microphone** | Larson Davis 2541 | 4652 | 5/19/2017 |
| **Calibrator** | Larson Davis CAL200 | 3722 | 9/25/2015 |

## 3.2 What field methods were used?

The SLM was programmed to compute the equivalent sound level ($L_{eq}$). $L_{eq}$ is the preferred method to describe sound levels that vary over time, resulting in a single decibel value which takes into account the total sound energy over the period of time interest. $L_{eq}$ is measured in A-weighted dBA, which closely approximates the range of frequencies the human ear can hear.

The following procedures were used for noise monitoring:

- The duration of the $L_{eq}$ measurements was fifteen minutes.
- The SLM was calibrated before and after monitoring. No significant drifts were detected during the analysis.
- The microphone was mounted on a tripod five feet above the ground.
- The microphone was covered with a windscreen.
- Traffic was counted manually, classified by vehicle type, and used as input in the validation of the FHWA TNM.

- Vehicle speeds were determined in the field by driving the corridor.

## 3.3 How loud is loud?

**Figure 3.1 Larson Davis 824 sound level meter**
Source: CEQ 1970. Typical A-weighted noise levels taken with a sound-level meter and expressed as decibels on the "A" scale. The "A" scale approximates the frequency response of the human ear
Note: photo link: http://www.larsondavis.com/products/soundlevelmeters/Model824.aspx

Sound-level meters measure the actual pressure fluctuations caused by sound waves and record separate measurements for different sound frequency ranges. The decibel (dB) scale used to describe sound is a logarithmic scale that accounts for the large range of sound pressure levels (SPL) in the environment. Most sounds consist of a broad range of sound frequencies. Several frequency-weighting schemes have been used to develop composite decibel scales that approximate the way the human ear responds to sound levels. The A-weighted decibel (dBA) scale is most widely used for this purpose. Figure 3.2 presents some common outdoor and indoor noises.

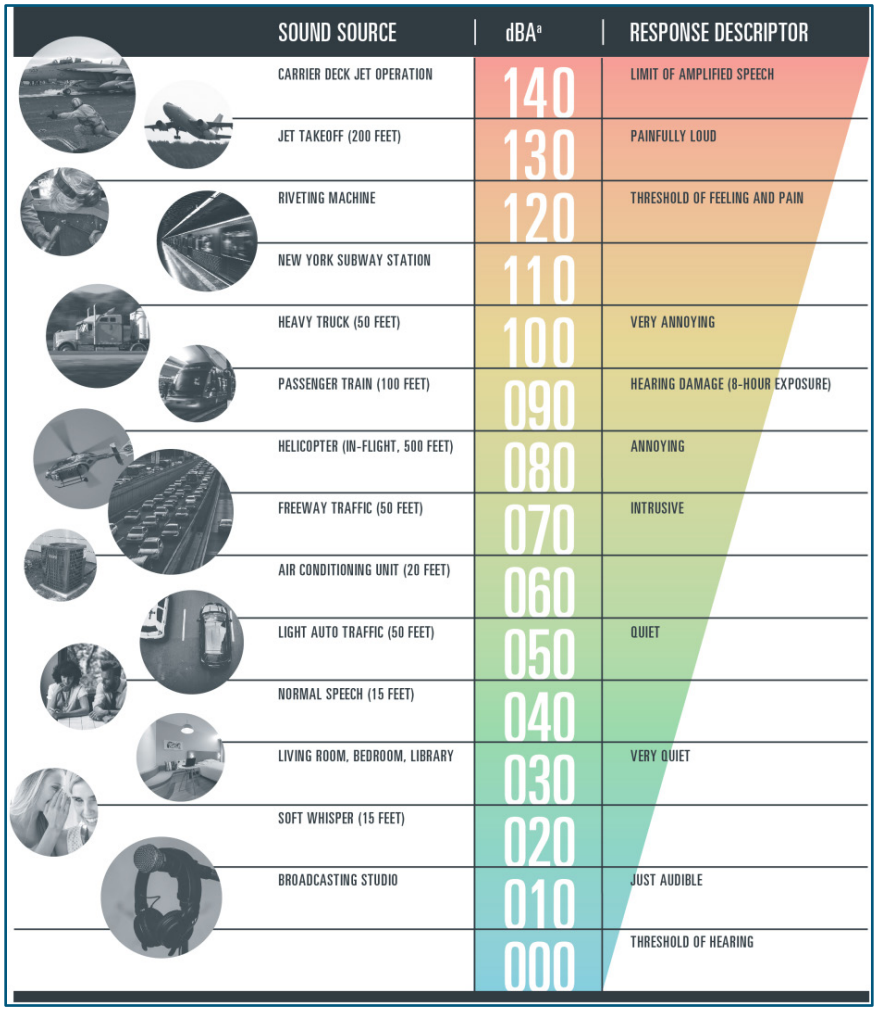



**Figure 3.2 Weighted noise levels and human response**

## 3.4 Where were noise measurements taken?

Noise measurements were taken at 11 noise validation locations spread throughout the project area. Table 3.3 describes the locations of each of the noise validation locations. Figures 3.3A - D present a detailed view of the noise validation locations.

**Table 3.3 Noise Validation Location Summary**

| Measurement location | Description |
|---|---|
| **A** | ≈ 40 feet east of Broad River Road off-ramp near Southland Log Homes |
| **B** | ≈ 122 feet east of Harbison Boulevard on-ramp near Love Chevrolet |
| **C** | ≈ 120 feet west of Piney Grove Road off-ramp near Country Walk Apartments |
| **D** | ≈ 155 feet west of Piney Grove Road on-ramp near 490 Jamil Road |
| **E** | ≈ 82 feet east of I-26 near Raintree Apartments |
| **F** | ≈ 130 feet west of I-26 near Stoney Creek Apartments |
| **G** | ≈ 100 feet east of I-126 near 164 Morninghill Drive |
| **H** | ≈ 155 feet northeast of I-126 near Three Rivers Apartments |
| **I** | ≈ 76 feet west of Sunset Boulevard off-ramp near 198 East Medical Lane |
| **J** | ≈ 198 feet southwest of Bush River Road off-ramp near Double Tree by Hilton |
| **K** | ≈ 172 feet north of I-20 near Briargate Condominiums |

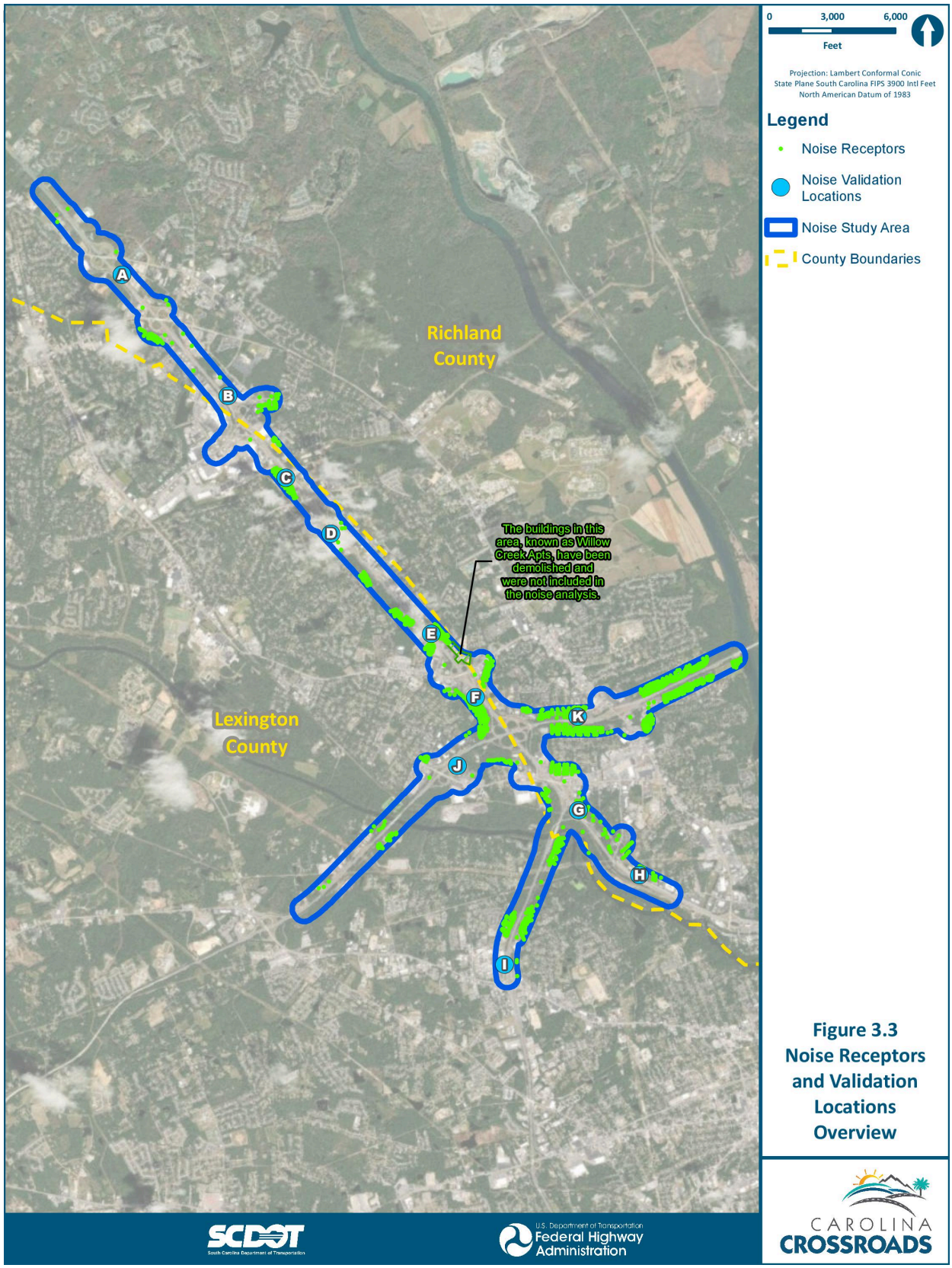
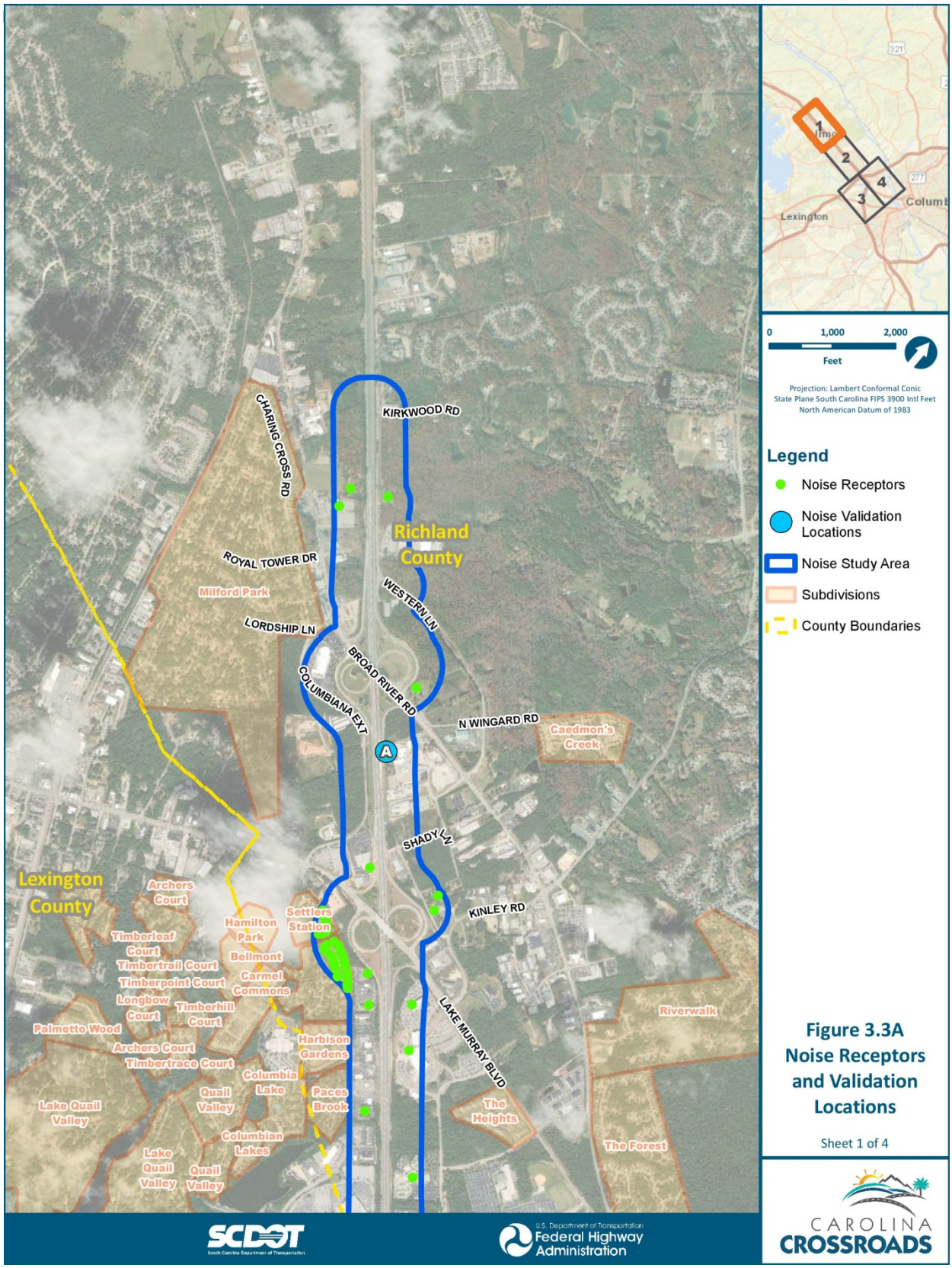



**Figure 3.3**
**Noise Receptors and Validation Locations Overview**


KIRKWOOD RD
CHARING CROSS RD
Richland County
ROYAL TOWER DR
Milford Park
WESTERN LN
LORDSHIP LN
BROAD RIVER RD
COLUMBIANA EXT
N WINGARD RD
Caedmon's Creek
A
SHADY LN
KINLEY RD
Lexington County
Archers Court
Settlers Station
Hamilton Park
Timberleaf Court
Bellmont
Timbertrail Court
Carmel Commons
Timberpoint Court
Longbow Court
Timberhill Court
Palmetto Wood
Archers Court
Timbertrace Court
Harbison Gardens
Columbia Lake
Quail Valley
Paces Brook
Lake Quail Valley
Columbian Lakes
Lake Quail Valley
Quail Valley
LAKE MURRAY BLVD
Riverwalk
The Heights
The Forest
Lexington
0
1,000
2,000
Feet
Projection: Lambert Conformal Conic
State Plane South Carolina FIPS 3900 Intl Feet
North American Datum of 1983
Legend
Noise Receptors
Noise Validation Locations
Noise Study Area
Subdivisions
County Boundaries
Figure 3.3A
Noise Receptors and Validation Locations
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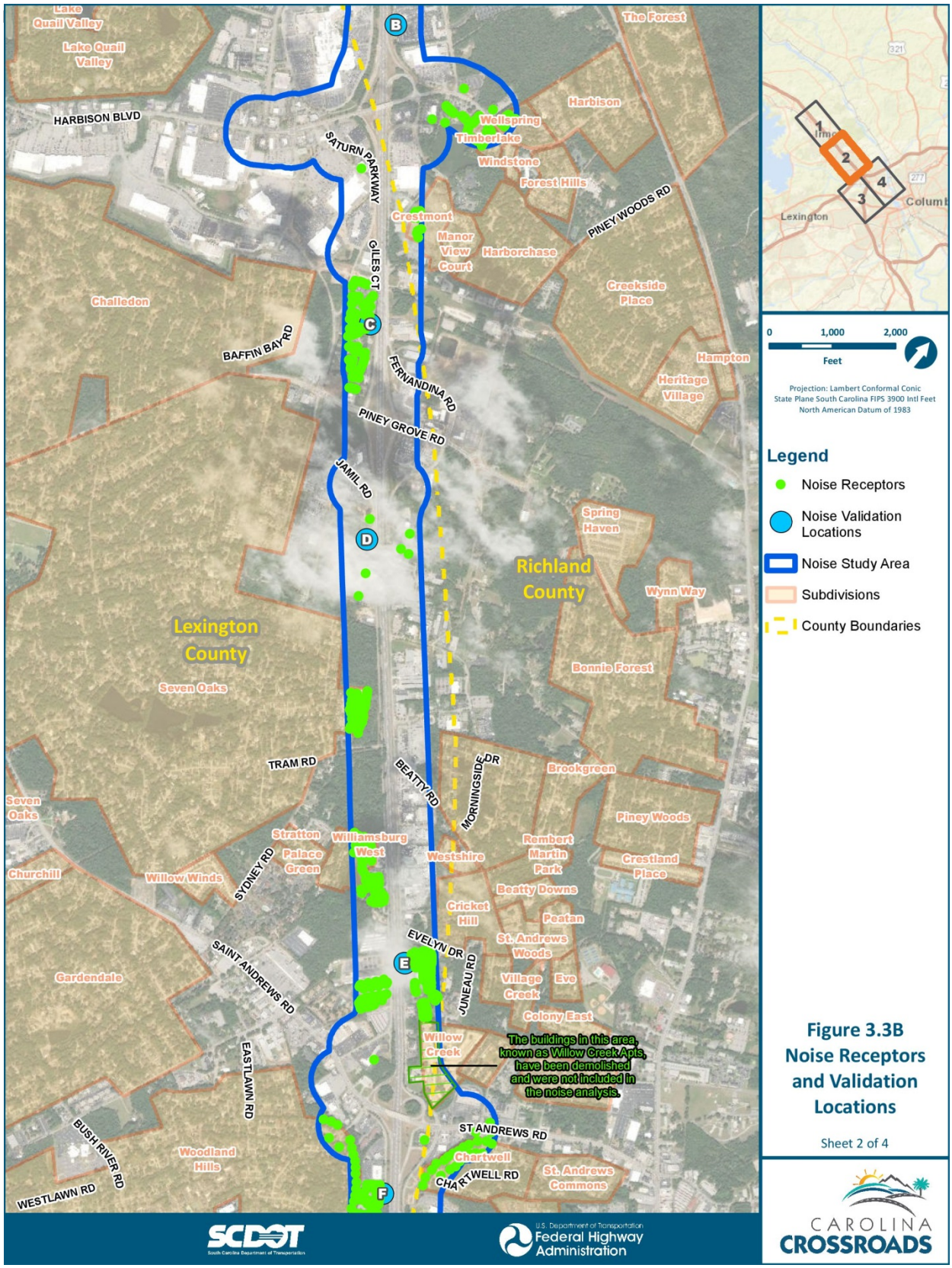
Lake Quail Valley
Lake Quail Valley
HARBISON BLVD
SATURN PARKWAY
The Forest
Harbison
Wellspring
Timberlake
Windstone
Forest Hills
PINEY WOODS RD
Crestmont
Manor View Court
Harborchase
GILES CT
Creekside Place
Challedon
BAFFIN BAY RD
FERNANDINA RD
Hampton
Heritage Village
PINEY GROVE RD
JAMIL RD
Spring Haven
Richland County
Wynn Way
Lexington County
Bonnie Forest
Seven Oaks
TRAM RD
BEATTY RD
MORNINGSIDE DR
Brookgreen
Seven Oaks
Piney Woods
Stratton
Williamsburg West
Palace Green
Westshire
Rembert Martin Park
Crestland Place
Churchill
Willow Winds
SYDNEY RD
Beatty Downs
Cricket Hill
Peatan
EVELYN DR
St. Andrews Woods
SAINT ANDREWS RD
JUNEAU RD
Gardendale
Village Creek
Eve
Colony East
Willow Creek
The buildings in this area, known as Willow Creek Apts, have been demolished and were not included in the noise analysis.
EASTLAWN RD
ST ANDREWS RD
BUSH RIVER RD
Woodland Hills
Chartwell
CHARTWELL RD
St. Andrews Commons
WESTLAWN RD
B
C
D
E
F
1
2
3
4
Lexington
0
1,000
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Feet
Projection: Lambert Conformal Conic
State Plane South Carolina FIPS 3900 Intl Feet
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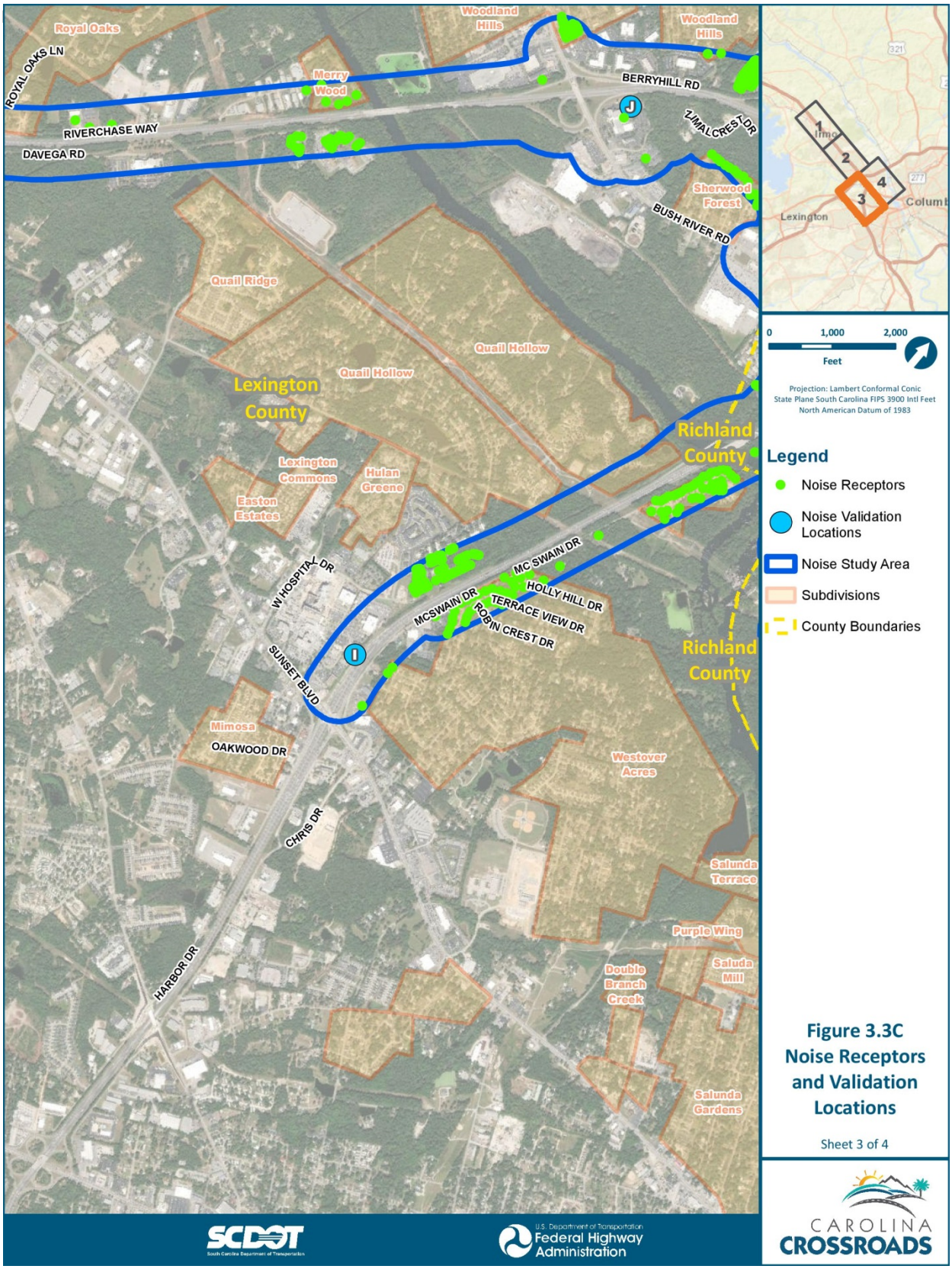
Royal Oaks
ROYAL OAKS LN
RIVERCHASE WAY
DAVEGA RD
Merry Wood
Woodland Hills
Woodland Hills
BERRYHILL RD
ZIMALCREST DR
Sherwood Forest
BUSH RIVER RD
Quail Ridge
Quail Hollow
Quail Hollow
Lexington County
Lexington Commons
Hulan Greene
Easton Estates
Richland County
MC SWAIN DR
HOLLY HILL DR
TERRACE VIEW DR
ROSIN CREST DR
MCSWAIN DR
W HOSPITAL DR
SUNSET BLVD
Richland County
Mimosa
OAKWOOD DR
Westover Acres
CHRIS DR
Salunda Terrace
Purple Wing
Saluda Mill
Double Branch Creek
HARBOR DR
Salunda Gardens
J
I
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4
Lexington
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Feet
Projection: Lambert Conformal Conic
State Plane South Carolina FIPS 3900 Intl Feet
North American Datum of 1983
Legend
Noise Receptors
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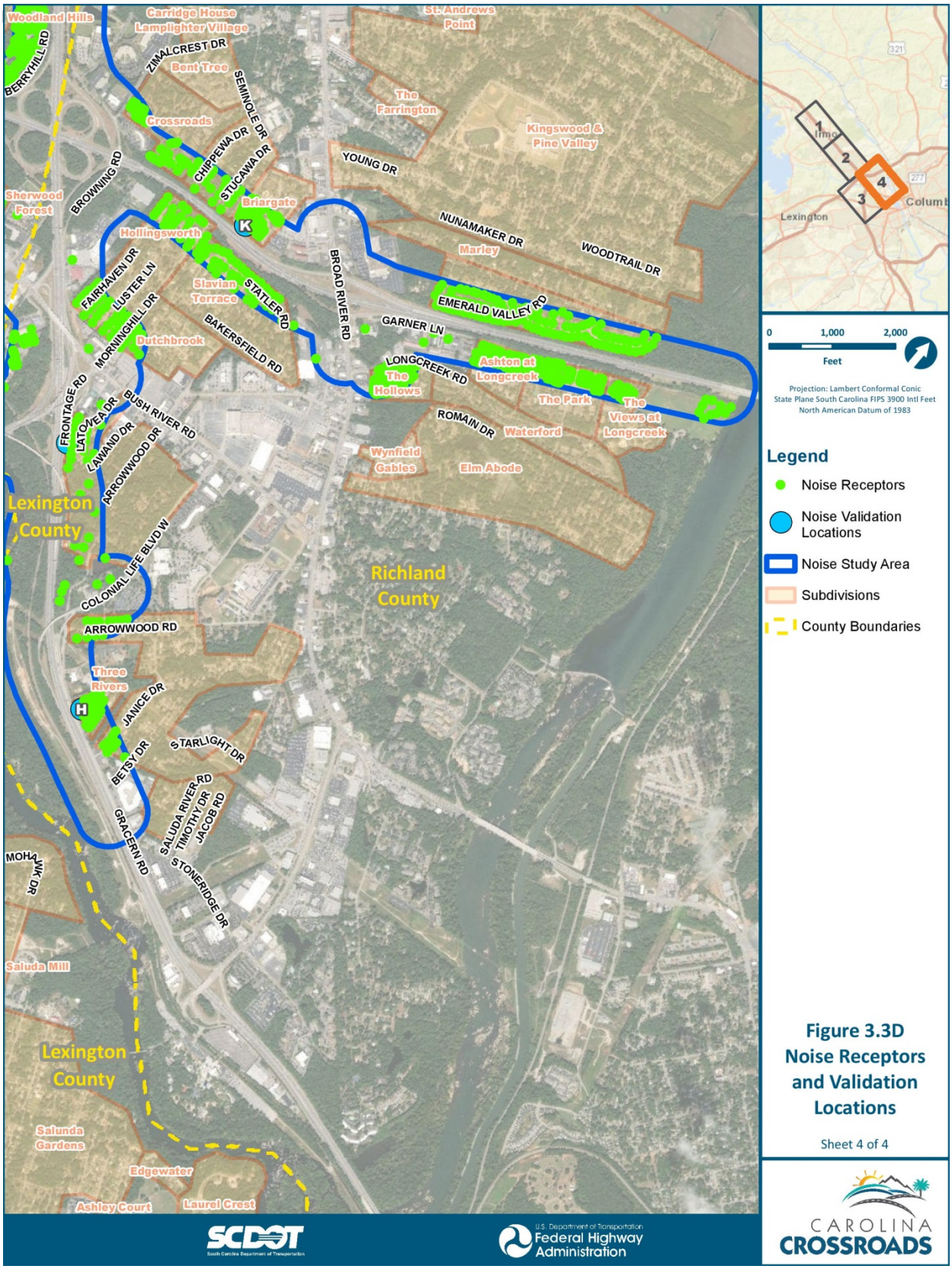
Woodland Hills
Carridge House
Lamplighter Village
St. Andrews Point
BERRYHILL RD
ZIMALCREST DR
Bent Tree
SEMINOLE DR
The Farrington
Crossroads
CHIPPEWA DR
STUCAWA DR
Kingswood & Pine Valley
YOUNG DR
Sherwood Forest
BROWNING RD
Briargate
NUNAMAKER DR
Hollingsworth
Marley
WOODTRAIL DR
BROAD RIVER RD
FAIRHAVEN DR
LUSTER LN
Slavian Terrace
STATLER RD
EMERALD VALLEY RD
MORNINGHILL DR
BAKERSFIELD RD
GARNER LN
Dutchbrook
LONGCREEK RD
Ashton at Longcreek
The Hollows
The Park
The Views at Longcreek
FRONTAGE RD
LATONEA DR
BUSH RIVER RD
ROMAIN DR
Waterford
LAWAND DR
ARROWWOOD DR
Wynfield Gables
Elm Abode
Lexington County
Richland County
COLONIAL LIFE BLVD W
ARROWWOOD RD
Three Rivers
JANICE DR
STARLIGHT DR
BETSY DR
SALUDA RIVER RD
TIMOTHY DR
JACOB RD
GRACERN RD
MOHAWK DR
STONERIDGE DR
Saluda Mill
Lexington County
Salunda Gardens
Edgewater
Ashley Court
Laurel Crest
Lexington
Columbia
0
1,000
2,000
Feet
Projection: Lambert Conformal Conic
State Plane South Carolina FIPS 3900 Intl Feet
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## 3.5 What were the results of the noise measurements?

23 CFR 772.11(d)(2) requires validation to verify the accuracy of noise models used to predict existing or future noise levels. The model is validated if existing highway traffic noise levels and predicted highway traffic noise levels are within plus or minus three decibels (dBA) of one another. If the measured and predicted highway traffic noise levels are within plus or minus 3 dBA for all the measurements at all the sites, then the model is considered valid and can be used to predict existing and future highway traffic noise levels along the entire project. The measured and predicted noise levels for each of the monitoring sites selected along the corridor are presented in Table 3.4. Each set of predicted and measured data was found to be within the acceptable plus or minus 3 dBA tolerance.

**Table 3.4 Model Validation Results**

| Measurement location | Leqh (dBA) Measured | Predicted | Difference |
|---|---|---|---|
| **A** | 72.1 | 73.0 | +0.9 |
| **B** | 71.3 | 72.0 | +0.7 |
| **C** | 69.3 | 72.2 | +2.9 |
| **D** | 68.0 | 69.3 | +1.3 |
| **E** | 74.7 | 71.9 | -2.8 |
| **F** | 69.1 | 72.0 | +2.9 |
| **G** | 67.2 | 69.4 | +2.2 |
| **H** | 62.3 | 64.2 | +1.9 |
| **I** | 67.8 | 70.8 | +3.0 |
| **J** | 65.7 | 68.1 | +2.4 |
| **K** | 65.5 | 68.4 | +2.9 |

## 3.6 What were the results of the Preliminary Analysis?

In accordance with SCDOT's *Traffic Noise Abatement Policy*, the noise analysis performed for the DEIS was considered preliminary and adhered to the requirements of the preliminary noise analysis in the *Policy*. The preliminary analysis is included as Appendix I to this report, and includes figures showing the locations of impacted receptors and investigated noise barriers.

For the preliminary analysis, the FHWA TNM version 2.5 was used to calculate existing noise levels and predict future design year noise levels. Inputs to this model include noise sensitive receiver locations, existing and future roadway alignments, and traffic volumes and posted speeds. The following was assumed for the preliminary analysis:

- Where required, multiple travel lanes were included in the TNM model;
- Peak hour traffic volumes and truck percentages;

- Ground elevations for all inputs to the model, including roadways, receptors, and barriers in the barrier analyses were assumed to be 0 feet per the preliminary noise analysis requirements in Section 3.5 of SCDOT's Traffic Noise Abatement Policy; and
- A land use survey was conducted for the project area. The corresponding NAC category from the SCDOT Traffic Noise Abatement Policy was used.

#### 3.6.1.1.1 Existing Condition

Based on this preliminary noise analysis for the existing condition, noise levels would approach or exceed the NAC established in the *SCDOT Traffic Noise Abatement Policy* for 1,605 receivers. The majority of the impacts are to NAC Category B (residences). Preliminary noise levels for the existing condition ranged from 38 to 76 dBA. Table 3.5-3 presents a summary of impacts by alternative.

**Table 3.5-1 Summary of Impacts (Preliminary Analysis)**

| Activity Category | Existing | Future No-build | Recommended Preferred Alternative (from the DEIS) |
|---|---|---|---|
| **A** | 0 | 0 | 0 |
| **B** | 1590 | 1596 | 1864 |
| **C** | 12 | 14 | 24 |
| **D** | 0 | 0 | 0 |
| **E** | 3 | 3 | 4 |
| **TOTAL** | **1605** | **1613** | **1892** |

#### 3.6.1.1.2 No-Build Alternative

Based on the preliminary noise analysis for the No-Build alternative, noise levels would approach or exceed the NAC established in the *SCDOT Traffic Noise Abatement Policy* for 1,613 receivers. The majority of the impacts are to NAC Category B (residences). Preliminary noise levels for the No-build alternative ranged from 38 to 76 dBA.

#### 3.6.1.1.3 Recommended Preferred Alternative (from the DEIS)

For the RPA, 2040 noise levels would approach or exceed the NAC established in the SCDOT Traffic Noise Abatement Policy for 1,892 receivers under the preliminary noise analysis. Relocated receivers are not included in the impact count; refer to Appendix I for additional information on relocated properties. The majority of the impacts would be to NAC Category B (residences). Preliminary noise levels for the RPA ranged from 41 to 77 dBA and are predicted to increase over existing noise levels from 0 to 6 dBA. There were no substantial increase impacts. A figure showing the impacted receptors and noise walls that were studied under the preliminary analysis can be found in Appendix I.

### 3.6.1.1.4 Preliminary Barrier Results

A summary of the results of the preliminary evaluation of feasibility and reasonableness for barriers identified under the RPA can be found in Table 3.5-4. Under the preliminary analysis, barriers that shielded a single receptor all referenced the same analysis (Barrier C). For the detailed analysis, all barriers were fully investigated.

**Table 3.5-2 Summary of Preliminary Noise Mitigation Analysis for the RPA**

| Barrier | Dimensions (length x avg. height, feet) | Cost[2] | Feasible | Reasonable | Proposed |
|---|---|---|---|---|---|
| **A** | 1,800x25 | $1,575,035 | Yes | No | No |
| **B1** | | | **See C** | | |
| **C** | 229x10 | $80,150 | Yes | No | No |
| **E1** | 1,312x15 | N/A | Yes | No | No |
| **F** | | | **See C** | | |
| **G1** | 2,604x20 | $1,823,395 | Yes | Yes | Yes |
| **H1** | 4,085x20 | $2,859,500 | Yes | No | No |
| **H2** | 845x25 | N/A | No | N/A | No |
| **I1** | 2,006x20 | $1,403,465 | Yes | No | No |
| **I2** | 6,405x20 | $4,481,400 | Yes | Yes | Yes |
| **J1** | 2,600x15 | $1,365,245 | Yes | No | No |
| **J2** | 3,210x15 | $1,685,600 | Yes | Yes | Yes |
| **K1** | 4,742x25 | $4,146,170 | Yes | Yes | Yes |
| **L1/L2** | 2,054x25 | N/A | No | N/A | No |
| **N1** | 2,200x15 | $1,155,014 | Yes | No | No |
| **N2** | | | **See C** | | |
| **O** | 2,200x15 | $1,154,930 | Yes | Yes | Yes |
| **Q1** | 5,327x20 | $3,731,665 | Yes | Yes | Yes |
| **R1** | 5,200x15 | $2,729,860 | Yes | Yes | Yes |
| **S** | 4,999x25 | $4,375,595 | Yes | Yes | Yes |
| **T1** | 4,569x25 | $3,998,225 | Yes | No | No |
| **U1** | 2,833x25 | N/A | No | N/A | No |
| **V1/V2** | 2,916x25 | N/A | Yes | No | No |

[2] Note: Cost is marked N/A if the Noise Reduction Design Goal portion of the reasonableness assessment was not met. Instances where the noise wall cost does not exactly equal to the wall area multiplied by $35/sq ft. are due to rounding that occurs during barrier dimension calculations performed by TNM.

| Barrier | Dimensions (length x avg. height, feet) | Cost[2] | Feasible | Reasonable | Proposed |
|---|---|---|---|---|---|
| W | 2,000x25 | $1,749,650 | Yes | Yes | Yes |
| X2 | 6,851x20 | $4,795,280 | Yes | No | No |
| Y1 | 3,508x25 | N/A | Yes | No | No |
| Z1 | 3,535x20 | $2,474,395 | Yes | Yes | Yes |

Based on the preliminary analysis of the RPA, of the 28 walls assessed for feasibility and reasonableness criteria, fourteen barriers were determined to be feasible but not reasonable; ten barriers were determined to be reasonable and feasible; and three barriers were determined to not be feasible (and therefore no reasonableness assessment occurred). A figure showing the locations of each of these noise barriers can be found in the Preliminary Noise Analysis, which is included as Appendix I of this report.

# 4 What are the anticipated noise impacts for the Refined Recommended Preferred Alternative?

## 4.1 How did we assess expected noise under the detailed analysis?

According to 23 CFR §772.5 (g), traffic noise impacts occur when either a) the predicted traffic noise levels approach or exceed the FHWA NAC for the applicable activity category, or b) when the predicted traffic noise levels substantially exceed the existing noise levels. SCDOT considers noise levels within 1 dBA $L_{eq}$ of the FHWA NAC as "approaching" the criteria.[3]

A 67 dBA criterion has been established for residences (NAC Category B), as well as active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, institutional, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings (NAC Category C). A 52 dBA (interior) criterion has been established for 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 that do not have an outdoor area of frequent human activity (NAC Category D). A 72 dBA criterion has been established for hotels, motels, offices, restaurants/bars, and other developed lands commercial activities (NAC Category E). Any predicted noise level that approaches or exceeds the applicable NAC is considered an impact (refer to Table 2.1).

SCDOT's Traffic Noise Abatement Policy defines a substantial increase would occur if the difference between the existing noise level and the predicted noise level under the build condition is 15 dBA $L_{eq}$ or greater.

[3] "Traffic Noise Abatement Policy", South Carolina Department of Transportation, September 1, 2014.

Noise receptors in the project area within 500 feet of the outside lane were identified through field reconnaissance and GIS parcel map information. A total of 2,772 individual noise receptors were identified in the project area. The SCDOT defines a noise receptor as a discrete or representative location of a noise sensitive area. For Category C and D receptors, equivalent dwelling units are calculated based on usage information per SCDOT's Traffic Noise Abatement Policy:

**Equivalent # Dwelling Units = #Occupants/(#People/Residence)*Usage**.

#People/Residence is based on census data for the average number of people per household in the study area, and was found to be 3. Usage is defined as the typical number of hours used per day divided by 24. The 2,772 individual receptors represented a total of 3,354 equivalent dwelling units. Usage information collected for each Category C and D receptor is given in Table 4.1.

**Table 4.1 Usage Information for Category C and D Equivalent Dwelling Units**

| Receptor ID | Name | Average number of hours used per 24-hour day | Average number of occupants per day | Equivalent number of Dwelling Units |
|---|---|---|---|---|
| | **Category C Receptors** | | | |
| **F3** | Frankie's Fun Park Pool | 12 | 75 | 13 |
| **G39** | Country Walk Apartments Pool* | 12 | 30 | 5 |
| **H210** | Harbison Place Walking Trail* | 12 | 100 | 17 |
| **I80** | Lakewood Village Pool* | 12 | 30 | 5 |
| **I168** | St Andrews Apts Picnic Tables* | 12 | 45 | 8 |
| **J99** | Raintree Apartments Pool | 12 | 30 | 5 |
| **K36** | Stoney Creek Playground | 10 | 180 | 25 |
| **K257** | Waters at Berryhill Apartments Pool | 12 | 30 | 5 |
| **Q1** | Briargate Condos Pool | 12 | 30 | 5 |
| **S230** | Waters at Longcreek Pool* | 12 | 30 | 5 |
| **W25** | Quail Hollow Apartments Recreational Courts | 9 | 75 | 10 |
| **W26** | Quail Hollow Apartments Playground | 9 | 75 | 10 |
| **Q55** | Quail Hollow Apartments Pool | 12 | 75 | 13 |
| **X1** | Brookdale Sr Living Patio | 12 | 12 | 2 |
| **X78-X80** | Three Rivers Greenway | 6 | 171 | 15 |
| **Y030** | Columbia Zen Buddhist Priory | 2 | 10 | 1 |
| | **Category D Receptors** | | | |
| **A002** | Green Charter School of the Midlands | 8 | 270 | 30 |
| **D003** | Episcopal Church of St Simon & St Jude | 6 | 150 | 13 |
| **E029** | Cadence Acad. Preschool | 2 | 178 | 5 |
| **F001** | Palmetto Health USC Urgent Care | 11 | 45 | 7 |

| Receptor ID | Name | Average number of hours used per 24-hour day | Average number of occupants per day | Equivalent number of Dwelling Units |
|---|---|---|---|---|
| **F002** | Palmetto Health Baptist Parkridge | 24 | 59 | 20 |
| **F004** | Christus Victor Lutheran Church | 8 | 100 | 12 |
| **F005** | Grace United Methodist | 4 | 120 | 7 |
| **J305** | First Church of the Nazarene* | 6 | 150 | 13 |
| **N008** | WBAJ Radio* | 12 | 44 | 11 |
| **N009** | Seventh Day Adventist Church | 5 | 200 | 14 |
| **N010** | Columbia Adventist Academy | 8 | 56 | 7 |
| **S197** | Good Shepherd's Faith Assembly* | 6 | 150 | 13 |
| **T066** | Word of God Church | 8 | 3000 | 334 |
| *Complete usage information could not be obtained for these receptors; usage data was based on similar receptors in the area | | | | |

The Saluda Riverwalk Extension is a Section 4(f) resource currently under construction in the project study area adjacent to I-126 and I-26 (refer to Section 3.11 for further information). Based on usage information, the trail was modeled as three receptors representing five equivalent dwelling units each. The receptors were located at the beginning, middle, and end of the portion of trail within the study area. Under the Refined Recommended Preferred Alternative, no noise impacts were found for these locations.

Traffic noise modeling receptors were also placed at tees and greens on golf courses in the study area. The figures in Appendix A present closer views of these locations, including impacted and relocated receptors.. The project area was divided up into Noise Sensitive Areas (NSA) to make the noise analysis process more organized and easier to follow by laypersons and decision makers. An NSA is usually defined as a group of receptors that are geographically situated in a single, continuous geographic area, without large gaps and which might reasonably be protected by a single noise barrier. A typical NSA might encompass a residential area with a few dozen homes within a few hundred feet of the highway that extend between two interchanges. It is also common that an NSA will have fairly consistent land use (such as single family homes), but some NSAs may have mixed use areas. In this sense an NSA may consist of a single isolated noise sensitive structure, or a mile long stretch of closely spaced, uninterrupted homes alongside the project highway.

The Federal Highway Administration (FHWA) Traffic Noise Model (TNM version 2.5) was used to calculate existing noise levels and predict future design year noise levels. Inputs to this model include noise sensitive receiver locations, existing and future roadway alignments, traffic volumes and posted speeds, and features such as ground zones, terrain lines, buildings and building rows, and jersey barriers. The following was assumed:

- Where required, multiple travel lanes were included in the TNM model.
- Peak hour traffic volumes and truck percentages were provided by STV Inc.
- All requirements of the SCDOT noise policy are followed:
    - Terrain features larger than 5 feet are defined by terrain lines.

    - Building rows are included only for the first two rows of buildings.
    - Ground zones are included where there is a non-default ground type between the roadway and a receptor
    - Shoulders and medians are modeled as no-traffic roadways, or as ground zones if jersey barriers are present.
- Features including building rows, barriers, terrain lines and ground zones are included only between receptors and roadways.
- Ground elevations for all inputs to the model, including roadways, receptors, terrain lines, building rows, jersey barriers, building barriers, and barriers in the barrier analyses are defined.
- A land use survey was conducted for the project area. The corresponding Noise Abatement Criteria (NAC) category from the SCDOT Traffic Noise Abatement Policy was used.

## 4.2 Existing Condition

The existing land use consists of primarily single-family and multi-family residences (Category B) as well as some apartment pools, golf courses, and trails (Category C), interiors of medical facilities, schools, and places of worship (Category D – interior[4]) and hotel pools and restaurant patios (Category E). For the Carolina Crossroads project, noise sensitive receivers were assigned a NAC category B, C, D, or E. Based on this detailed noise analysis for the existing condition, noise levels would approach or exceed the NAC established in the *SCDOT Traffic Noise Abatement Policy* for 640 receivers. The majority of the impacts are to NAC Category B (residences). Noise levels for the existing condition ranged from 47 to 75 dBA. Table 4.2 presents a summary of impacts by alternative, while a detailed table with results for each receptor can be found in Appendix D. More detailed figures for the existing condition are in Appendix A (Figure A1, Page 1 – 27).

[4] Interior impacts are only considered if exterior impacts cannot be addressed by a feasible and reasonable abatement feature.

**Table 4.2 Summary of Impacts by Alternative**

| Activity category | Existing | Future no-build | Refined Recommended Preferred Alternative |
|---|---|---|---|
| **A** | 0 | 0 | 0 |
| **B** | 539 | 546 | 651 |
| **C** | 25 | 25 | 26 |
| **D** | 74 | 74 | 97 |
| **E** | 2 | 2 | 1 |
| **Total** | 640 | 647 | 775 |

## 4.3 No-Build Alternative

Based on this detailed noise analysis for the No-Build alternative, noise levels would approach or exceed the NAC established in the *SCDOT Traffic Noise Abatement Policy* for 647 receivers. Noise levels for the No-build Alternative ranged from 47 to 76 dBA. More detailed figures for the no-build alternative are in Appendix A (Figure A2, Page 1 – 27).

## 4.4 Refined Recommended Preferred Alternative

For the Refined Recommended Preferred Alternative, 2040 noise levels would approach or exceed the NAC established in the *SCDOT Traffic Noise Abatement Policy* for 775 receivers. Relocated receivers are not included in the impact count. The majority of the impacts would be to NAC Category B (residences). Noise levels for the Refined Recommended Preferred Alternative ranged from 48 to 78 dBA and are predicted to increase over existing noise levels from 0 to 8 dBA. There were no substantial increase impacts. Figures 4.1 and 4.1A-D highlights those receptors that are predicted to approach or exceed the NAC. More detailed figures for the Refined Recommended Preferred Alternative are in Appendix A (Figure A3, Page 1 – 27).

Exterior traffic noise was evaluated at all Activity Category D receptors. Per SCDOT's policy, interior impacts at Category D receptors should only be considered if noise barriers are not found feasible and reasonable to eliminate exterior impacts. For Activity Category D, an exterior impact is above 66 dBA, and an interior impact is above 51 dBA. Noise reductions due to the building exterior are based on the table on page 21 of SCDOT's Traffic Noise Abatement Policy, reproduced as Table 4.3 below.

**Table 4.3 Building Noise Reduction Factors**

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

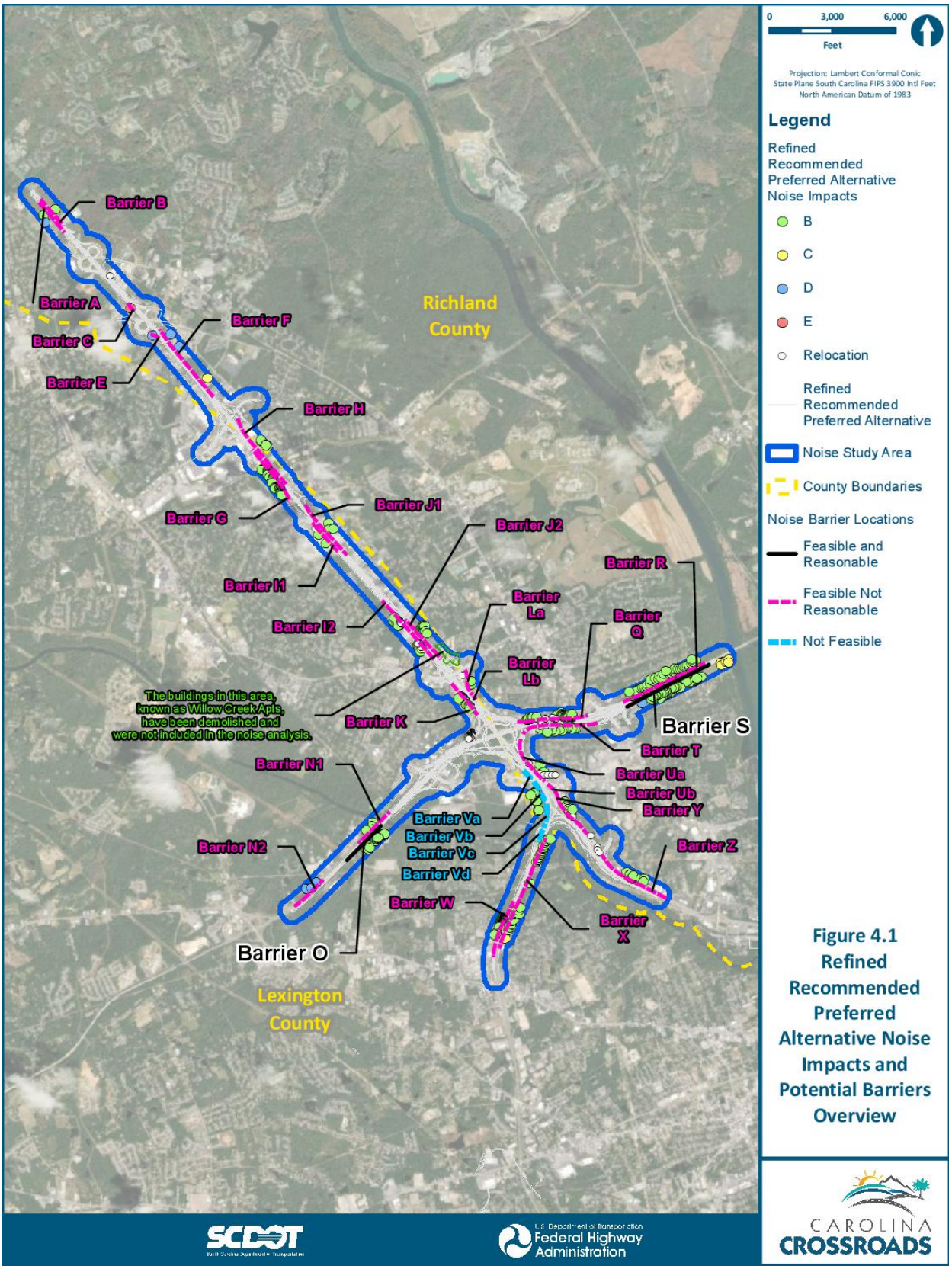
Source: SCDOT Traffic Noise Abatement Policy

Results for each impacted Category D receptor are shown in Table 4.4 below.

**Table 4.4 Assessment of Category D receptors with Exterior Impacts**

| Impacted Receptor ID | Use | Exterior SPL under Refined Recommended Preferred Alternative (dBA) | Feasible and Reasonable Barrier? | Noise Reduction due to Building Exterior (dB) | Interior SPL (dBA) | Interior Impact? |
|---|---|---|---|---|---|---|
| **A2** | School | 68.2 | No | 20 | 48.2 | No |
| **E29** | Preschool | 73.0 | No | 25 | 48.0 | No |
| **F1** | Hospital | 69.0 | No | 20 | 49.0 | No |
| **F2** | Hospital | 70.5 | No | 20 | 50.5 | No |
| **N8** | Radio Station | 71.5 | No | 25 | 46.5 | No |
| **N9** | Church | 72.0 | No | 25 | 47.0 | No |
| **N10** | School | 66.6 | No | 20 | 46.6 | No |
| **S197** | Church | 67.1 | Yes | N/A | N/A | N/A |

Of the eight Category D receptors with exterior impacts, one receptor, S197, had a feasible and reasonable barrier that eliminated the impact. When interior impacts were evaluated for the remaining receptors, none were found to be impacted. Therefore no interior mitigation is proposed for these receptors.


Barrier B
Barrier A
Barrier C
Barrier F
Barrier E
Barrier H
Barrier G
Barrier J1
Barrier J2
Barrier I1
Barrier I2
Barrier R
Barrier La
Barrier Q
Barrier Lb
The buildings in this area, known as Willow Creek Apts, have been demolished and were not included in the noise analysis.
Barrier K
Barrier S
Barrier T
Barrier N1
Barrier Ua
Barrier Ub
Barrier Y
Barrier Va
Barrier Vb
Barrier Vc
Barrier Vd
Barrier N2
Barrier Z
Barrier W
Barrier X
Barrier O
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North American Datum of 1983
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Refined Recommended Preferred Alternative
Noise Study Area
County Boundaries
Noise Barrier Locations
Feasible and Reasonable
Feasible Not Reasonable
Not Feasible
Figure 4.1 Refined Recommended Preferred Alternative Noise Impacts and Potential Barriers Overview
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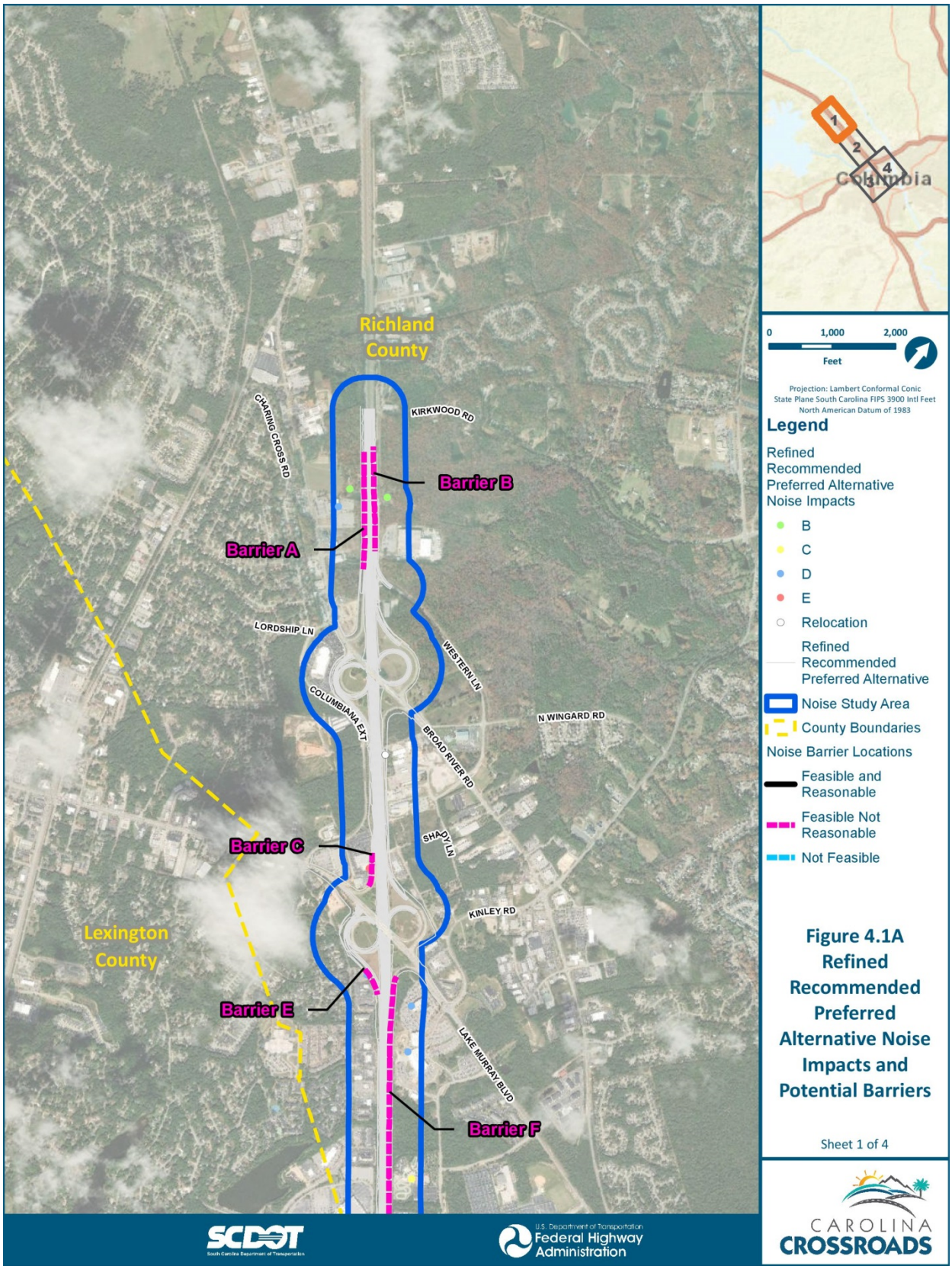
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Lexington County
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LORDSHIP LN
WESTERN LN
COLUMBIANA EXT
N WINGARD RD
BROAD RIVER RD
SHADY LN
KINLEY RD
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Noise Study Area
County Boundaries
Noise Barrier Locations
Feasible and Reasonable
Feasible Not Reasonable
Not Feasible
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Sheet 1 of 4
SCDOT
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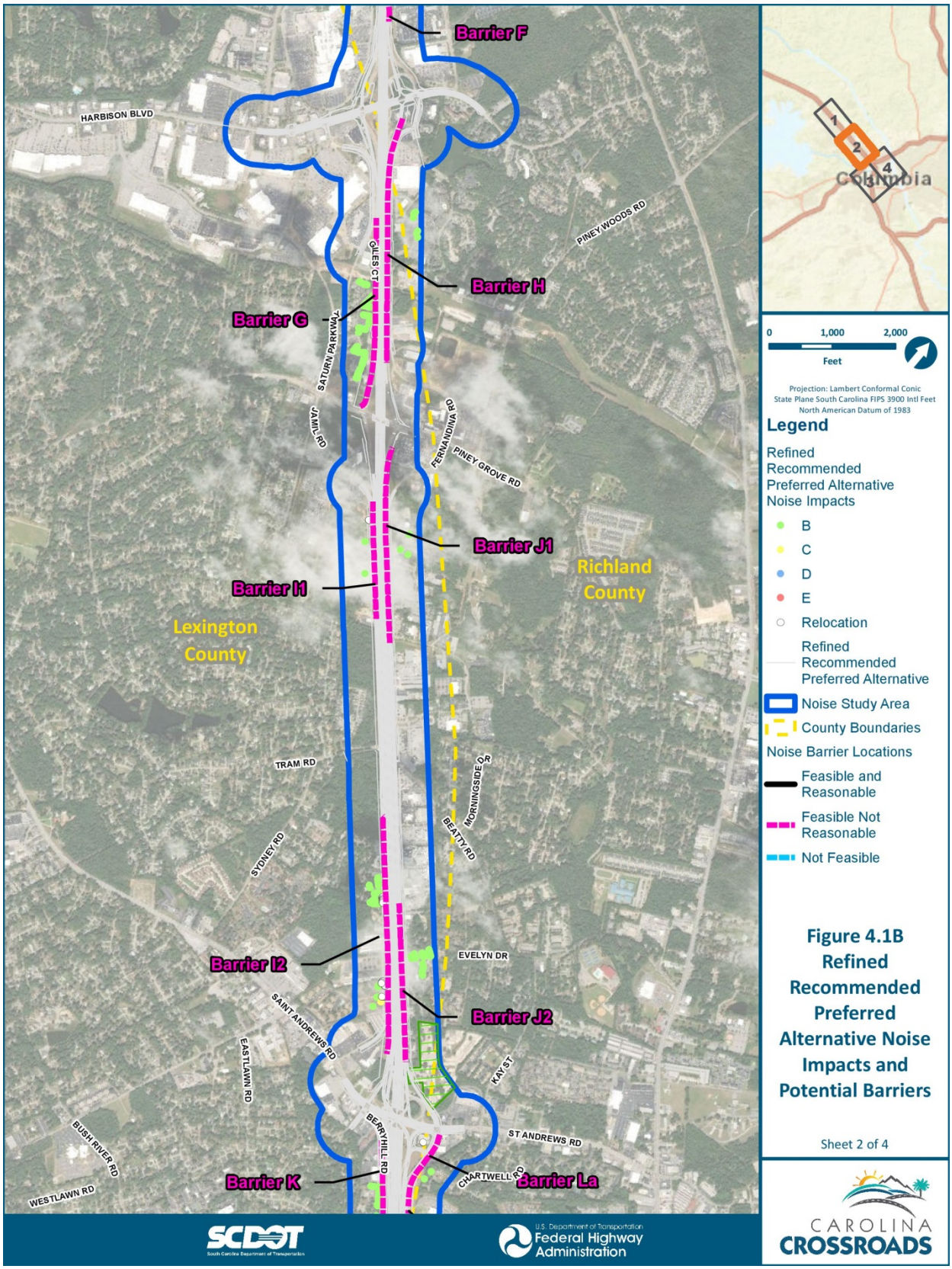
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Barrier I2
Barrier J2
Barrier K
Barrier La
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GILES CT
SATURN PARKWAY
JAMIL RD
FERNANDINA RD
PINEY GROVE RD
TRAM RD
MORNINGSIDE DR
BEATTY RD
SYDNEY RD
EVELYN DR
SAINT ANDREWS RD
EASTLAWN RD
KAY ST
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Noise Study Area
County Boundaries
Noise Barrier Locations
Feasible and Reasonable
Feasible Not Reasonable
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Sheet 2 of 4
SCDOT
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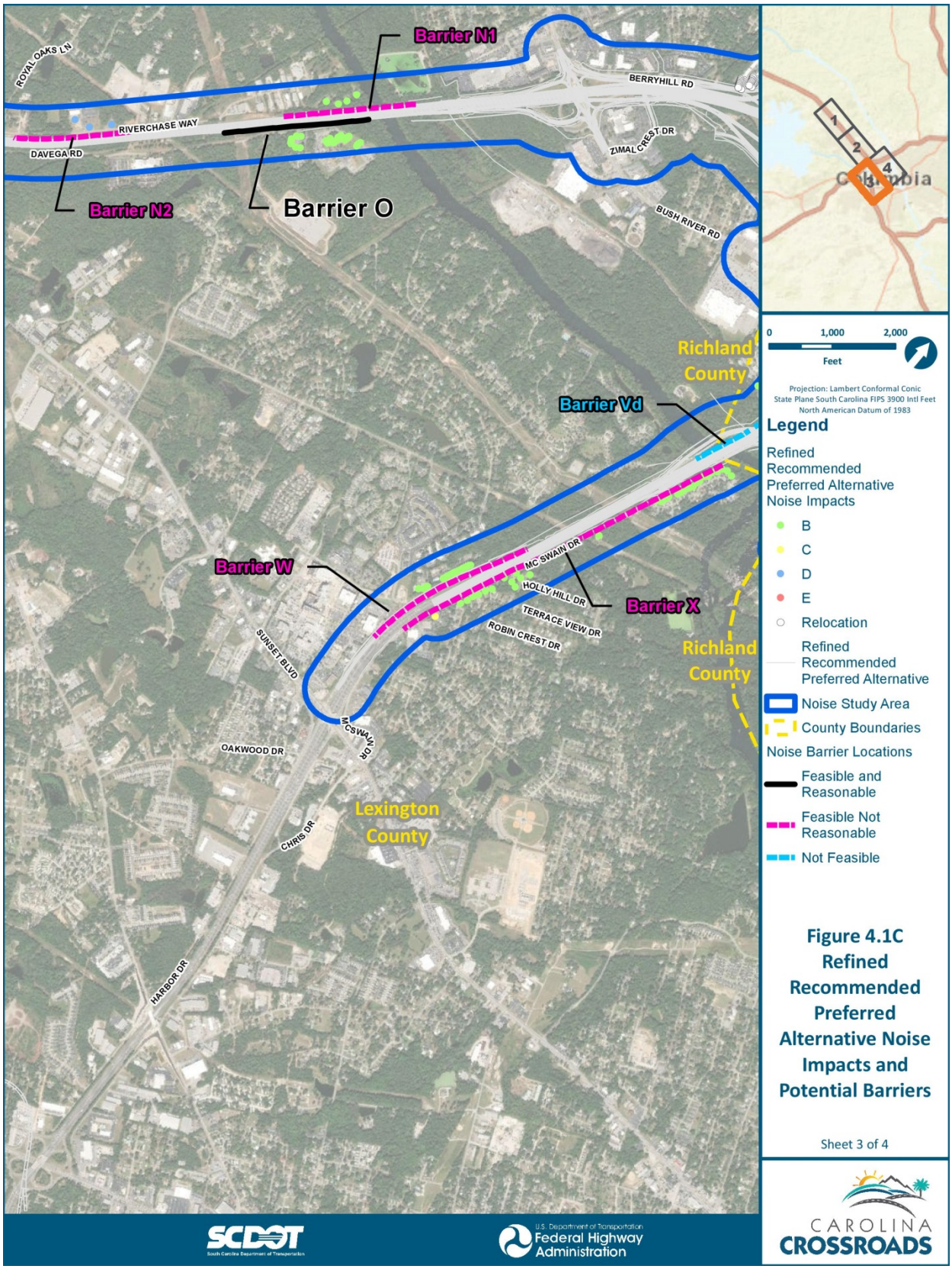
Barrier N1
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Barrier Vd
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DAVEGA RD
BERRYHILL RD
ZIMALCREST DR
BUSH RIVER RD
MC SWAIN DR
HOLLY HILL DR
TERRACE VIEW DR
ROBIN CREST DR
SUNSET BLVD
MCSWAIN DR
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County Boundaries
Noise Barrier Locations
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Sheet 3 of 4
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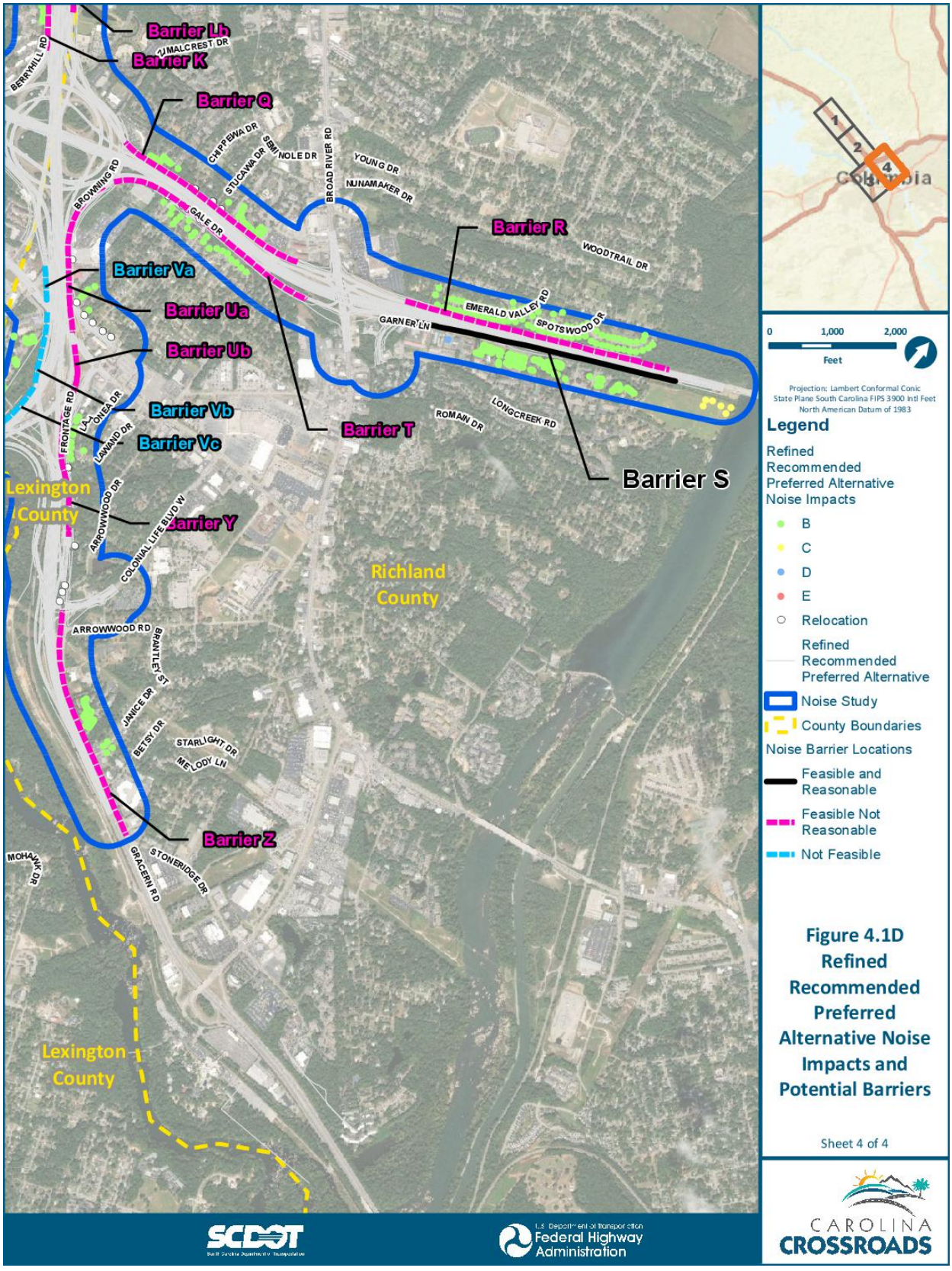
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Barrier Ua
Barrier Ub
Barrier Vb
Barrier Vc
Barrier T
Barrier S
Barrier Y
Barrier Z
Lexington County
Richland County
Lexington County
BERRYHILL RD
MALCREST DR
BROWNING RD
CHIPPEWA DR
SEMINOLE DR
STUCAWA DR
BROAD RIVER RD
YOUNG DR
NUNAMAKER DR
GALE DR
WOODTRAIL DR
EMERALD VALLEY RD
GARNER LN
SPOTSWOOD DR
ROMAIN DR
LONGCREEK RD
FRONTAGE RD
LAWAND DR
ARROWWOOD DR
COLONIAL LIFE BLVD W
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County Boundaries
Noise Barrier Locations
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Figure 4.1D Refined Recommended Preferred Alternative Noise Impacts and Potential Barriers
Sheet 4 of 4
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# 5 What happens when noise impacts occur?

Noise abatement measures must be considered for impacted receivers under the Refined Recommended Preferred Alternative.

## 5.1 What noise abatement measures were considered for the Refined Recommended Preferred Alternative?

In accordance with 23 CFR §772.13 (c) and SCDOT's Noise Abatement Policy, noise abatement measures must be considered for reducing or eliminating noise levels to impacted receivers.[5]

When considering noise abatement measures, primary consideration shall be given to exterior areas where frequent human use occurs. Since South Carolina is not part of the FHWA-approved Quiet Pavement Pilot Program, the use of quieter pavements was not considered as an abatement measure for the proposed project. In addition, the planting of vegetation or landscaping was also not considered as a potential abatement measure, since it is not an acceptable Federal-aid noise abatement measure due to the fact that only dense stands of evergreen vegetation planted 100 feet deep will reduce noise levels. The following measures were considered and evaluated as a means to reduce or eliminate the traffic noise impacts:

- Traffic management;
- Alteration of horizontal and vertical alignments;
- Acquisition of real property or interests therein (predominantly unimproved property) to serve as a buffer zone to preempt development;
- Noise insulation of public use or nonprofit institutional structures; and,
- Noise barriers.

Table 5.1 outlines the different types of noise abatement measures considered and whether they were eliminated from consideration or carried forward. Of the possible noise abatement measures considered for the proposed project, only noise barriers were carried forward for consideration due to the constraints listed in Table 5.1 for the other options, primarily because the preliminary design was modified to minimize impacts to the greatest extent to the natural and human environment. The acquisition of additional right-of-way to alter the alignment or create a buffer zone would result in an increase in impacts.

[5] "Traffic Noise Abatement Policy", South Carolina Department of Transportation, September 1, 2014.

**Table 5.1 Mitigation Types Considered for Noise Impacts**

| Mitigation type | Status |
|---|---|
| **Traffic management** | Eliminated. Measures such as exclusive lane designations and signing for prohibition of certain vehicle type would prevent the project from serving its intended purpose, such as moving people, goods and services. |
| **Alteration of horizontal and vertical alignments** | Eliminated. Alignment modifications as a means of noise abatement may result in disruptive relocations for this project and may affect other natural resources. |
| **Acquisition of real property or interests therein (predominantly unimproved property)** | Eliminated. The taking of adequate property to create an effective buffer zone would most likely involve taking the impacted receivers and would require purchasing additional right-of-way. Additionally, receivers that are farther from the road are likely not impacted. |
| **Noise insulation of public use or nonprofit institutional structures** | Eliminated. No interiors of public use or nonprofit institutional structures would be impacted by the proposed project. |
| **Noise barriers** | Carried forward for further consideration. |

## 5.2 How were noise barriers assessed for mitigation?

The use of structural barriers (freestanding walls) was considered for impacted receivers. There are feasibility and reasonableness criteria that must be met for construction of noise walls. Noise walls are assessed under the feasibility criteria first, and if all conditions are met are then considered for reasonableness. There are two feasibility criteria. Per SCDOT policy acoustic feasibility means that a noise reduction of at least 5 dBA must be achieved for 75% of impacted receivers. There are also seven engineering and design considerations that must be achieved to meet the engineering feasibility criteria. These considerations include topography, safety, drainage, utilities, maintenance, access, and wall height.

Based on the location and concentration of impacted receivers in the build condition, 26 locations within the project area were considered for noise walls and assessed for adherence to feasibility criteria. Of these, a total of 25 barriers met both the acoustic and engineering feasibility requirements and were assessed for reasonableness. As with feasibility, there are several reasonableness criteria that must be met. These include:

- Noise Reduction Design Goal – It is SCDOT's policy that a noise reduction of at least 8 dBA must be achieved for 80% of those receivers determined to be in the first two building rows and considered benefited.

- Cost Effectiveness – The allowable cost of the abatement is based on $35.00 per square foot. This allowable cost is based on the cost effectiveness criteria found in SCDOT's Traffic Noise Abatement Policy. This construction cost will be divided by the number of benefited receivers. If the cost per benefited receiver is less than $30,000 then the barrier is determined to be cost effective.
- Property Owners and Residents – SCDOT will solicit the viewpoints of all of the benefited receivers and document a decision on either desiring or not desiring the noise abatement measure. A noise wall will be constructed unless a majority (greater than 50% of the benefited receivers) of votes not desiring noise abatement is received (p.24 of policy). This third criterion is only considered if the noise wall meets the first two criteria.

The three mandatory reasonable factors must collectively be achieved in order for a noise abatement measure to be deemed reasonable. Failure to achieve any one of the reasonable factors will result in the noise abatement measure being deemed not reasonable. Completion of a "Feasibility and Reasonableness Worksheet" is required for each barrier evaluated (refer to Appendix B). Figure 5.1 summarizes the reasonability and feasibility criteria used to assess traffic noise mitigation measures.

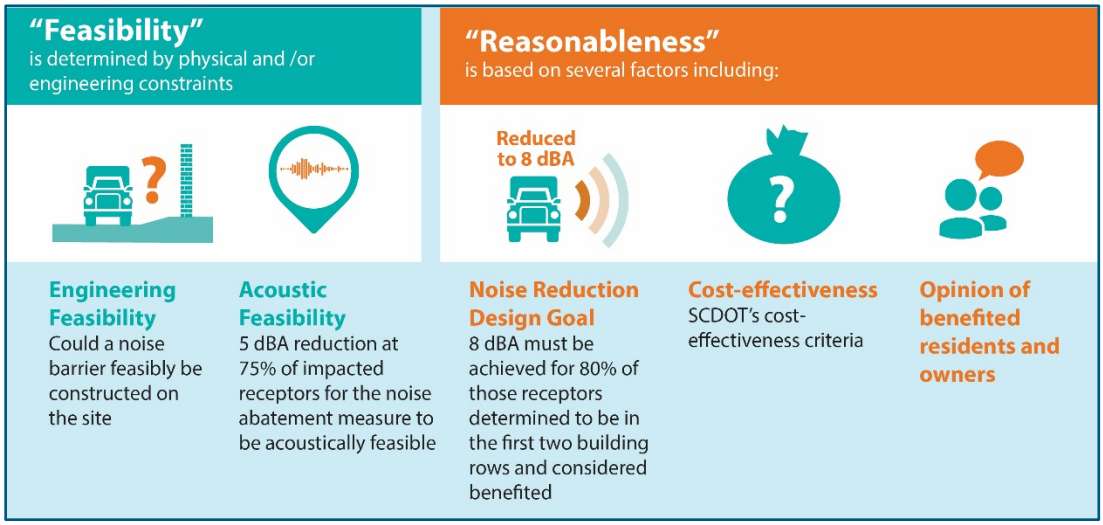


**Figure 5.1 Reasonableness and Feasibility Criteria**

## 5.3 What were the results of the feasibility and reasonableness considerations?

### 5.3.1.1 Refined Recommended Preferred Alternative

This section discusses the evaluations of feasibility and reasonableness performed on the barriers that could potentially mitigate projected traffic noise impacts. Numerous barriers were evaluated as described below. Following are the results of the evaluation of feasibility and reasonableness for barriers identified under the Refined Recommended Preferred Alternative.

#### 5.3.1.1.1 Barrier A – Impacted Receivers A1 and A2[6]

Barrier A is a 1,860 feet long noise wall whose height varies between 19 and 20 feet.

Feasibility:

*Acoustic Feasibility:* SCDOT noise policy states that a noise reduction of at least 5 dBA must be achieved for 75 percent of the impacted receivers. This was achieved for 31 of the 31 impacted receivers (100%). This meets the SCDOT allowable percentage (75%) per impacted receiver.

*Engineering Feasibility:* No known issues at this time.

Reasonableness:

*Noise Reduction Design Goal:* SCDOT noise policy states that a noise reduction of at least 8 dBA must be achieved for 80 percent of the benefited receivers in the first two building rows. Of the 31 benefited receivers in the first two rows, there were 31 that achieved the 8 dBA reduction (100%). This meets the SCDOT allowable percentage (80%) of the benefited receivers.

*Cost Effectiveness:* The analyzed feature was deemed not to be reasonable, because the estimated cost per benefited receiver was more than the SCDOT allowable cost ($30,000) per benefited receiver ($1,274,665 / 31 benefited receivers = $41,118).

Conclusion: Based on the above results of the detailed analysis, this abatement feature is feasible but not reasonable, and is not proposed as part of this project.

#### 5.3.1.1.2 Barrier B – Impacted Receiver B1.

Barrier B is a 1,659 feet long noise wall whose height is 20 feet.

Feasibility:

*Acoustic Feasibility:* SCDOT noise policy states that a noise reduction of at least 5 dBA must be achieved for 75 percent of the impacted receivers. This was achieved for the one impacted receiver (100%). This meets the SCDOT allowable percentage (75%) per impacted receiver.

*Engineering Feasibility:* No known issues at this time.

Reasonableness:

*Noise Reduction Design Goal:* SCDOT noise policy states that a noise reduction of at least 8 dBA must be achieved for 80 percent of the benefited receivers in the first two building rows. The one benefited receiver in the first two rows did achieve the 8 dBA reduction (100%). This meets the SCDOT allowable percentage (80%) of the benefited receivers.

[6] Receptor A2 represents a school with 30 equivalent dwelling units.

*Cost Effectiveness:* The analyzed feature was deemed to be not reasonable, because the estimated cost per benefited receiver was more than the SCDOT allowable cost ($30,000) per benefited receiver ($1,161,265 / one benefited receiver = $1,161,265).

Conclusion: Based on the above results of the detailed analysis, this abatement feature is feasible but not reasonable, and is not proposed as part of this project.

#### 5.3.1.1.3 Barrier C – Impacted Receiver C1

Barrier C is a 539 feet long noise wall whose height is 15 feet.

Feasibility:

*Acoustic Feasibility:* SCDOT noise policy states that a noise reduction of at least 5 dBA must be achieved for 75 percent of the impacted receivers. This was achieved for the one impacted receiver (100%). This meets the SCDOT allowable percentage (75%) per impacted receiver.

*Engineering Feasibility:* No known issues at this time.

Reasonableness:

*Noise Reduction Design Goal:* SCDOT noise policy states that a noise reduction of at least 8 dBA must be achieved for 80 percent of the benefited receivers in the first two building rows. The one benefited receiver in the first two rows did achieve the 8 dBA reduction (100%). This meets the SCDOT allowable percentage (80%) of the benefited receivers.

*Cost Effectiveness:* The analyzed feature was deemed to be not reasonable, because the estimated cost per benefited receiver was more than the SCDOT allowable cost ($30,000) per benefited receiver ($283,080 / one benefited receiver = $283,080).

Conclusion: Based on the above results of the detailed analysis, this abatement feature is feasible but not reasonable, and is not proposed as part of this project.

#### 5.3.1.1.4 Barrier E – Impacted Receiver E29[7]

Barrier E is a 480 feet long noise wall whose height is 19 feet.

Feasibility:

*Acoustic Feasibility:* SCDOT noise policy states that a noise reduction of at least 5 dBA must be achieved for 75 percent of the impacted receivers. This was achieved for five of the five impacted receivers (100%). This meets the SCDOT allowable percentage (75%) per impacted receiver.

*Engineering Feasibility:* No known issues at this time.

[7] Receptor E29 represents a preschool with five equivalent dwelling units.

Reasonableness:

*Noise Reduction Design Goal:* SCDOT noise policy states that a noise reduction of at least 8 dBA must be achieved for 80 percent of the benefited receivers in the first two building rows. Of the five benefited receivers in the first two rows, there were five that achieved the 8 dBA reduction (100%). This meets the SCDOT allowable percentage (80%) of the benefited receivers.

*Cost Effectiveness:* The analyzed feature was deemed to be not reasonable, because the estimated cost per benefited receiver was more than the SCDOT allowable cost ($30,000) per benefited receiver ($319,060 / five benefited receivers = $63,812).

Conclusion: Based on the above results of the detailed analysis, this abatement feature is feasible but not reasonable, and is not proposed as part of this project.

#### 5.3.1.1.5 Barrier F – Impacted Receivers F1-F3[8]

Barrier F is a 4,080 feet long noise wall whose height varies between 16 and 19 feet.

Feasibility:

*Acoustic Feasibility:* SCDOT noise policy states that a noise reduction of at least 5 dBA must be achieved for 75 percent of the impacted receivers. This was achieved for 40 of the 40 impacted receivers (100%). This meets the SCDOT allowable percentage (75%) per impacted receiver.

*Engineering Feasibility:* No known issues at this time.

Reasonableness:

*Noise Reduction Design Goal:* SCDOT noise policy states that a noise reduction of at least 8 dBA must be achieved for 80 percent of the benefited receivers in the first two building rows. Of the 40 benefited receivers in the first two rows, there were 40 that achieved the 8 dBA reduction (100%). This meets the SCDOT allowable percentage (80%) of the benefited receivers.

*Cost Effectiveness:* The analyzed feature was deemed to be not reasonable, because the estimated cost per benefited receiver was more than the SCDOT allowable cost ($30,000) per benefited receiver ($2,673,020 / 40 benefited receivers = $66,826).

Conclusion: Based on the above results of the detailed analysis, this abatement feature is feasible but not reasonable, and is not proposed as part of this project.

[8] Receptors F1 and F2 represent medical facilities with 7 and 20 equivalent dwelling units respectively, and F3 represents an amusement park with 13 equivalent dwelling units.

#### 5.3.1.1.6 Barrier G – Impacted Receivers G10, G12, G18-G20, G22, G43, G45-G57, G66, G69-G72, G74-G75, G80-G81, G84-G85, G88, G91-G92, G96, G98, G101-G102, G104-G105, G108, G110-G111, G113-G114, G117-G118, G123, G125, G127, G131, G137, G141-G142, G144-G151, G153, G156-G159, G161-G162, G164-G165, G168

Barrier G is a 3,071 feet long noise wall whose height is 25 feet.

Feasibility:

*Acoustic Feasibility:* SCDOT noise policy states that a noise reduction of at least 5 dBA must be achieved for 75 percent of the impacted receivers. This was achieved for 72 of the 72 impacted receivers (100%). This meets the SCDOT allowable percentage (75%) per impacted receiver. A total of 140 receivers including impacted and non-impacted achieved at least 5 dBA of noise reduction.

*Engineering Feasibility:* No known issues at this time.

Reasonableness:

*Noise Reduction Design Goal:* SCDOT noise policy states that a noise reduction of at least 8 dBA must be achieved for 80 percent of the benefited receivers in the first two building rows. Of the 132 benefited receivers in the first two rows, there were 90 that achieved the 8 dBA reduction (68%). This does not meet the SCDOT allowable percentage (80%) of the benefited receivers.

*Cost Effectiveness:* The cost effectiveness analysis is not applicable since the noise reduction design goal was not met.

Conclusion: Based on the above results of the detailed analysis, this abatement feature is feasible but not reasonable, and is not proposed as part of this project.

#### 5.3.1.1.7 Barrier H – Impacted Receivers H95-H97, H271-H272, H275, H286-H287

Barrier H is a 3,900 feet long noise wall whose height is 25 feet.

Feasibility:

*Acoustic Feasibility:* SCDOT noise policy states that a noise reduction of at least 5 dBA must be achieved for 75 percent of the impacted receivers. This was achieved for eight of the eight impacted receivers (100%). This meets the SCDOT allowable percentage (75%) per impacted receiver. A total of 35 receivers including impacted and non-impacted achieved at least 5 dBA of noise reduction.

*Engineering Feasibility:* No known issues at this time.

Reasonableness:

*Noise Reduction Design Goal:* SCDOT noise policy states that a noise reduction of at least 8 dBA must be achieved for 80 percent of the benefited receivers in the first two building rows. Of the 35 benefited

receivers in the first two rows, there were 9 that achieved the 8 dBA reduction (26%). This does not meet the SCDOT allowable percentage (80%) of the benefited receivers.

*Cost Effectiveness:* The cost effectiveness analysis is not applicable since the noise reduction design goal was not met.

Conclusion: Based on the above results of the detailed analysis, this abatement feature is feasible but not reasonable, and is not proposed as part of this project.

#### 5.3.1.1.8 Barrier I1 – Impacted Receivers I16, I17

Barrier I1 is a 1,860 feet long noise wall whose height is 25 feet.

Feasibility:

*Acoustic Feasibility:* SCDOT noise policy states that a noise reduction of at least 5 dBA must be achieved for 75 percent of the impacted receivers. This was achieved for two of the two impacted receivers (100%). This meets the SCDOT allowable percentage (75%) per impacted receiver. A total of three receivers including impacted and non-impacted achieved at least 5 dBA of noise reduction.

*Engineering Feasibility:* No known issues at this time.

Reasonableness:

*Noise Reduction Design Goal:* SCDOT noise policy states that a noise reduction of at least 8 dBA must be achieved for 80 percent of the benefited receivers in the first two building rows. Of the three benefited receivers in the first two rows, none achieved the 8 dBA reduction (0%). This does not meet the SCDOT allowable percentage (80%) of the benefited receivers.

*Cost Effectiveness:* The cost effectiveness analysis is not applicable since the noise reduction design goal was not met.

Conclusion: Based on the above results of the detailed analysis, this abatement feature is feasible but not reasonable, and is not proposed as part of this project.

#### 5.3.1.1.9 Barrier I2 – Impacted Receivers I81, I83-I92, I94, I96-I97, I99-I107, I109, I112, I129-I132, I153, I155, I158, I160, I162, I168[9]

Barrier I2 is a 3,777 feet long noise wall whose height is 25 feet.

Feasibility:

*Acoustic Feasibility:* SCDOT noise policy states that a noise reduction of at least 5 dBA must be achieved for 75 percent of the impacted receivers. This was achieved for 39 of the 39 impacted receivers (100%). This meets

[9] Receptor I168 represents a picnic area with 8 equivalent dwelling units.

the SCDOT allowable percentage (75%) per impacted receiver. A total of 121 receivers including impacted and non-impacted achieved at least 5 dBA of noise reduction.

*Engineering Feasibility:* No known issues at this time.

Reasonableness:

*Noise Reduction Design Goal:* SCDOT noise policy states that at least 8 dBA must be achieved for 80 percent of the benefited receivers in the first two building rows. Of the 92 benefited receivers in the first two rows, there were 54 that achieved the 8 dBA reduction (59%). This does not meet the SCDOT allowable percentage (80%) of the benefited receivers.

*Cost Effectiveness:* The cost effectiveness analysis is not applicable since the noise reduction design goal was not met.

Conclusion: Based on the above results of the detailed analysis, this abatement feature is feasible but not reasonable, and is not proposed as part of this project.

#### 5.3.1.1.10 Barrier J1 – Impacted Recievers J31-J33

Barrier J1 is a 3,114 feet long noise wall whose height is 25 feet.

Feasibility:

*Acoustic Feasibility:* SCDOT noise policy states that a noise reduction of at least 5 dBA must be achieved for 75 percent of the impacted receivers. This was achieved for three of the three impacted receivers (100%). This meets the SCDOT allowable percentage (75%) per impacted receiver.

*Engineering Feasibility:* No known issues at this time.

Reasonableness:

*Noise Reduction Design Goal:* SCDOT noise policy states that a noise reduction of at least 8 dBA must be achieved for 80 percent of the benefited receivers in the first two building rows. Of the three benefited receivers in the first two rows, there were two that achieved the 8 dBA reduction (67%). This does not meet the SCDOT allowable percentage (80%) of the benefited receivers.

*Cost Effectiveness:* The cost effectiveness analysis is not applicable since the noise reduction design goal was not met.

Conclusion: Based on the above results of the detailed analysis, this abatement feature is feasible but not reasonable, and is not proposed as part of this project.

#### 5.3.1.1.11 Barrier J2 – Impacted Receivers J44-J45, J48-J49, J54, J68, J71, J76, J78, J82, J85, J88, J90, J94, J96, J101-J102, J108, J110-J111, J119, J125, J141, J154, J166

Barrier J2 is a 2,520 feet long noise wall whose height is 25 feet.

Feasibility:

*Acoustic Feasibility:* SCDOT noise policy states that a noise reduction of at least 5 dBA must be achieved for 75 percent of the impacted receivers. This was achieved for 25 of the 25 impacted receivers (100%). This meets the SCDOT allowable percentage (75%) per impacted receiver. A total of 168 receivers including impacted and non-impacted achieved at least 5 dBA of noise reduction.

*Engineering Feasibility:* No known issues at this time.

Reasonableness:

*Noise Reduction Design Goal:* SCDOT noise policy states that a noise reduction of at least 8 dBA must be achieved for 80 percent of the benefited receivers in the first two building rows. Of the 100 benefited receivers in the first two rows, there were three that achieved the 8 dBA reduction (3%). This does not meet the SCDOT allowable percentage (80%) of the benefited receivers.

*Cost Effectiveness:* The cost effectiveness analysis is not applicable since the noise reduction design goal was not met.

Conclusion: Based on the above results of the detailed analysis, this abatement feature is feasible but not reasonable, and is not proposed as part of this project.

#### 5.3.1.1.12 Barrier K – Impacted Receivers K132, K139, K150, K152, K158, K161, K164, K167, K170-K171, K173, K175, K180, K182, K187-K188, K192, K196, K211, K214, K252, K269, K275, K283, K287

Barrier K is a 1,937 feet long noise wall whose height is 25 feet.

Feasibility:

*Acoustic Feasibility:* SCDOT noise policy states that a noise reduction of at least 5 dBA must be achieved for 75 percent of the impacted receivers. This was achieved for 25 of the 25 impacted receivers (100%). This meets the SCDOT allowable percentage (75%) per impacted receiver. A total of 77 receivers (including impacted and non-impacted) achieved at least 5 dBA of noise reduction.

*Engineering Feasibility:* No known issues at this time.

Reasonableness:

*Noise Reduction Design Goal:* SCDOT noise policy states that a noise reduction of at least 8 dBA must be achieved for 80 percent of the benefited receivers in the first two building rows. There were 23 of the 77 benefited receivers in the first two rows that achieved the 8 dBA reduction (30%). This does not meet the SCDOT allowable percentage (80%) of the benefited receivers.

*Cost Effectiveness:* The cost effectiveness analysis is not applicable since the noise reduction design goal was not met.

Conclusion: Based on the above results of the detailed analysis, this abatement feature is feasible but not reasonable, and is not proposed as part of this project.

#### 5.3.1.1.13 Barrier La/Lb – Impacted Receivers L53-L54

Barrier La/Lb is a 1,501 feet long noise wall whose height is 25 feet.

Feasibility:

*Acoustic Feasibility:* SCDOT noise policy states that a noise reduction of at least 5 dBA must be achieved for 75 percent of the impacted receivers. This was achieved for two of the two impacted receivers (100%). This meets the SCDOT allowable percentage (75%) of impacted receivers. A total of eight receivers (including impacted and non-impacted) achieved at least 5 dBA of noise reduction.

*Engineering Feasibility:* No known issues at this time.

Reasonableness:

*Noise Reduction Design Goal:* SCDOT noise policy states that a noise reduction of at least 8 dBA must be achieved for 80 percent of the benefited receivers in the first two building rows. Of the eight benefited receivers in the first two rows, there was one that achieved the 8 dBA reduction (13%). This does not meet the SCDOT allowable percentage (80%) of the benefited receivers.

*Cost Effectiveness:* The cost effectiveness analysis is not applicable since the noise reduction design goal was not met.

Conclusion: Based on the above results of the detailed analysis, this abatement feature is feasible but not reasonable, and is not proposed as part of this project.

#### 5.3.1.1.14 Barrier N1 – Impacted Receivers N1, N4-N6

Barrier N1 is a 2,100 feet long noise wall whose height is 25 feet.

Feasibility:

*Acoustic Feasibility:* SCDOT noise policy states that a noise reduction of at least 5 dBA must be achieved for 75 percent of the impacted receivers. This was achieved for four of the four impacted receivers (100%). This meets the SCDOT allowable percentage (75%) per impacted receiver. A total of six receivers (including impacted and non-impacted) achieved at least 5 dBA of noise reduction.

*Engineering Feasibility:* No known issues at this time.

Reasonableness:

*Noise Reduction Design Goal:* SCDOT noise policy states that at a noise reduction of least 8 dBA must be achieved for 80 percent of the benefited receivers in the first two building rows. Of the six benefited

receivers in the first two rows, there were four that achieved the 8 dBA reduction (67%). This does not meet the SCDOT allowable percentage (80%) of the benefited receivers.

*Cost Effectiveness:* The cost effectiveness analysis is not applicable since the noise reduction design goal was not met.

Conclusion: Based on the above results of the detailed analysis, this abatement feature is feasible but not reasonable, and is not proposed as part of this project.

#### 5.3.1.1.15 Barrier N2 – Impacted Receivers N8-N10[10]

Barrier N2 is a 1,860 feet long noise wall whose height varies between 16 and 18 feet, with an average height of 17.1 feet.

Feasibility:

*Acoustic Feasibility:* SCDOT noise policy states that a noise reduction of at least 5 dBA must be achieved for 75 percent of the impacted receivers. This was achieved for 22 of the 22 impacted receivers (100%). This meets the SCDOT allowable percentage (75%) of impacted receivers.

*Engineering Feasibility:* No known issues at this time.

Reasonableness:

*Noise Reduction Design Goal:* SCDOT noise policy states that at a noise reduction of least 8 dBA must be achieved for 80 percent of the benefited receivers in the first two building rows. Of the 22 benefited receivers in the first two rows, there were 22 that achieved the 8 dBA reduction (100%). This meets the SCDOT allowable percentage (80%) of the benefited receivers.

*Cost Effectiveness:* The analyzed feature was deemed to be not reasonable, because the estimated cost per benefited receiver is greater than the SCDOT allowable cost ($30,000) per benefited receiver ($1,110,865 / 22 benefited receivers = $50,494).

Conclusion: Based on the above results of the detailed analysis, this abatement feature is feasible but not reasonable, and is not proposed as part of this project. 18 ballots were returned in support of the abatement measure, and no ballots were returned in opposition to the abatement measure. Because

#### 5.3.1.1.16 Barrier O – Impacted Receivers O1-O8, O10-O12, O14-O15, O18, O22-O27, O29-O30, O32, O34-O54

Barrier O is a 2,301 feet long noise wall whose height varies between 11 and 18 feet, with an average height of 15.4 feet.

[10] Receptor N9 represents a church with 14 equivalent dwelling units. Receptor N10 represents a school with 7 equivalent dwelling units.

Feasibility:

*Acoustic Feasibility:* SCDOT noise policy states that a noise reduction of at least 5 dBA must be achieved for 75 percent of the impacted receivers. This was achieved for 37 of the 44 impacted receivers (84%). This meets the SCDOT allowable percentage (75%) of impacted receivers. A total of 47 receivers (including impacted and non-impacted) achieved at least 5 dBA of noise reduction.

*Engineering Feasibility:* In addition to acoustical feasibility, the SCDOT noise policy includes consideration of engineering factors as part of the feasibility evaluation of a noise abatement measure. There are no engineering constraints in the vicinity of the proposed abatement feature that could impede constructability and lead to increased cost.

Reasonableness:

*Noise Reduction Design Goal:* SCDOT noise policy states that at a noise reduction of least 8 dBA must be achieved for 80 percent of the benefited receivers in the first two building rows. Of the 47 benefited receivers in the first two rows, there were 39 that achieved the 8 dBA reduction (83%). This meets the SCDOT allowable percentage (80%) of the benefited receivers.

*Cost Effectiveness:* The analyzed feature was deemed to be reasonable, because the estimated cost per benefited receiver is less than the SCDOT allowable cost ($30,000) per benefited receiver ($1,269,660 / 47 benefited receivers = $27,014). There are no unusual features in the vicinity of the proposed abatement feature that would impede constructability and lead to increased cost.

*Viewpoints of the property owners and residents of the benefited receivers:* Ballots were sent to the 47 residents of benefited receptors, as well as to the property owners of those 47 receptors, for a total of 94 possible votes. Sixteen ballots were returned by residents in support of the abatement measure and two by owners representing a total of 47 benefited receivers for a total of 63 votes in favor (67%). Of the 16 resident ballots, three votes were returned after the voting period ended. No ballots (0%) were returned in opposition to the abatement measure. Because fewer than 50% of benefited receivers expressed opposition to the measure, the measure is considered reasonable.

Conclusion: Based on the above results of the detailed analysis, this abatement feature is feasible and reasonable.

#### 5.3.1.1.17 Barrier Q – Impacted Receivers Q64-Q67, Q69, Q71-Q72, Q74, Q79, Q83-Q85, Q89, Q91, Q93, Q95, Q106, Q125, Q128, Q130-Q133, Q135, Q142, Q144, Q147, Q150, Q154, Q157, Q160, Q165, Q170, Q180-Q194

Barrier Q is a 3,360 feet long noise wall whose height is 25 feet.

Feasibility:

*Acoustic Feasibility:* SCDOT noise policy states that a noise reduction of at least 5 dBA must be achieved for 75 percent of the impacted receivers. This was achieved for 48 of the 48 impacted receivers (100%). This meets

the SCDOT allowable percentage (75%) of impacted receivers. A total of 159 receivers (including impacted and non-impacted) achieved at least 5 dBA of noise reduction.

*Engineering Feasibility:* No known issues at this time.

Reasonableness:

*Noise Reduction Design Goal:* SCDOT noise policy states that at a noise reduction of least 8 dBA must be achieved for 80 percent of the benefited receivers in the first two building rows. Of the 144 benefited receivers in the first two rows, there were 88 that achieved the 8 dBA reduction (61%). This does not meet the SCDOT allowable percentage (80%) of the benefited receivers.

*Cost Effectiveness:* The cost effectiveness analysis is not applicable since the noise reduction design goal was not met.

Conclusion: Based on the above results of the detailed analysis, this abatement feature is feasible but not reasonable, and is not proposed as part of this project.

#### 5.3.1.1.18 Barrier R – Impacted Receivers R1, R3-R4, R6-R7, R9-R10, R12-R14, R16-R17, R19-R20, R22-R23, R25-R26, R28-R29, R31-R32, R34-R56, R58-R67, R69, R71-R91, R93

Barrier R is a 4,320 feet long noise wall whose height varies between 11 and 22 feet, with an average height of 17.2 feet.

Feasibility:

*Acoustic Feasibility:* SCDOT noise policy states that a noise reduction of at least 5 dBA must be achieved for 75 percent of the impacted receivers. This was achieved for 74 of the 78 impacted receivers (95%). This meets the SCDOT allowable percentage (75%) of impacted receivers. A total of 87 receivers (including impacted and non-impacted) achieved at least 5 dBA of noise reduction.

*Engineering Feasibility:* No known issues at this time.

Reasonableness:

*Noise Reduction Design Goal:* SCDOT noise policy states that at a noise reduction of least 8 dBA must be achieved for 80 percent of the benefited receivers in the first two building rows. Of the 71 benefited receivers in the first two rows, there were 57 that achieved the 8 dBA reduction (80%). This meets the SCDOT allowable percentage (80%) of the benefited receivers.

*Cost Effectiveness:* The analyzed feature was deemed to be not reasonable, because the estimated cost per benefited receiver is greater than the SCDOT allowable cost ($30,000) per benefited receiver ($2,843,120 / 87 benefited receivers = $32,680).

Conclusion: Based on the above results of the detailed analysis, this abatement feature is feasible but not reasonable, and is not proposed as part of this project.

#### 5.3.1.1.19 Barrier S – Impacted Receivers S197-S199, S201-S203, S206-S207, S211-S213, S216, S219, S211-S222, S226-S228, S231, S233, S235, S237, S239, S243-S244, S246-S249, S251-S254, S256-S257, S261, S263, S265, S267-S268, S270, S272, S275, S279-S282, S284, S286, S288, S291, S293-S294, S297, S299, S303-S304, S306, S308, S311-S312, S314-S315, S319, S323-S324, S326, S329, S335, S337, S340-S341, S344-S345, S349, S353, S357, S360-S364, S368, S370, S372, S375, S377, S379-S381, S385, S389, S399, S427, S439, S441, S444-S445, S448-S449, S451, S459, S467-S470, S477, S481, S486, S488-S489, S491, S493, S495-S497, S499-S518, S535-S542, S548-S550[11]

Barrier S is a 5,160 feet long noise wall whose height is 25 feet.

Feasibility:

*Acoustic Feasibility:* SCDOT noise policy states that a noise reduction of at least 5 dBA must be achieved for 75 percent of the impacted receivers. This was achieved for 153 of the 159 impacted receivers (96%). This meets the SCDOT allowable percentage (75%) of impacted receivers. A total of 344 receivers (including impacted and non-impacted) achieved at least 5 dBA of noise reduction.

*Engineering Feasibility:* In addition to acoustical feasibility, the SCDOT noise policy includes consideration of engineering factors as part of the feasibility evaluation of a noise abatement measure. There are no engineering constraints in the vicinity of the proposed abatement feature that could impede constructability and lead to increased cost.

Reasonableness:

*Noise Reduction Design Goal:* SCDOT noise policy states that at a noise reduction of least 8 dBA must be achieved for 80 percent of the benefited receivers in the first two building rows. Of the 310 benefited receivers in the first two rows, there were 273 that achieved the 8 dBA reduction (88%). This meets the SCDOT allowable percentage (80%) of the benefited receivers.

*Cost Effectiveness:* The analyzed feature was deemed to be reasonable, because the estimated cost per benefited receiver is less than the SCDOT allowable cost ($30,000) per benefited receiver ($3,832,430 / 344 benefited receivers = $11,141). There are no unusual features in the vicinity of the proposed abatement feature that would impede constructability and lead to increased cost.

*Viewpoints of the property owners and residents of the benefited receivers:* Ballots were sent to the 295 residents of benefited receptors, a church with 13 equivalent receivers, and property owners representing 255 of the benefited receivers, for a total of 563 possible votes. 24 ballots were returned in support of the abatement measure by residents and owners representing single receivers, and one ballot in support was returned by a property owner that represents 110 benefited receivers, for a total of 134 votes in support of the abatement measure (24%). A total of four ballots (<1%) were returned in opposition to the abatement measure,

[11] Receptor S197 represents a church with 13 equivalent dwelling units.

including four residents and owners representing single recievers. Of the 24 resident ballots in favor of the wall, one was returned after the voting period had ended. Because fewer than 50% of benefited receivers expressed opposition to the measure, the measure is considered reasonable.

Conclusion: Based on the above results of the detailed analysis, this abatement feature is feasible and reasonable.

#### 5.3.1.1.20 Barrier T – Impacted Receivers T18, T20-T21, T24-T26, T28-T29, T32, T34, T36-T37, T40-T41, T43, T45, T47-T48, T50, T52

Barrier T is a 3,660 feet long noise wall whose height is 25 feet.

Feasibility:

*Acoustic Feasibility:* SCDOT noise policy states that a noise reduction of at least 5 dBA must be achieved for 75 percent of the impacted receivers. This was achieved for 20 of the 20 impacted receivers (100%). This meets the SCDOT allowable percentage (75%) per impacted receiver. A total of 39 receivers (including impacted and non-impacted) achieved at least 5 dBA of noise reduction.

*Engineering Feasibility:* No known issues at this time.

Reasonableness:

*Noise Reduction Design Goal:* SCDOT noise policy states that a noise reduction of at least 8 dBA must be achieved for 80 percent of the benefited receivers in the first two building rows. Of the 28 benefited receivers in the first two rows, there were 13 that achieved the 8 dBA reduction (46%). This does not meet the SCDOT allowable percentage (80%) of the benefited receivers.

*Cost Effectiveness:* The cost effectiveness analysis is not applicable since the noise reduction design goal was not met.

Conclusion: Based on the above results of the detailed analysis, this abatement feature is feasible but not reasonable, and is not proposed as part of this project.

#### 5.3.1.1.21 Barrier Ua/Ub – Impacted Receivers U17-U20, U24

Barrier Ua/Ub is a 3,201 feet long noise wall whose height is 25 feet. It is separated into two segments to avoid conflicts with a bridge in the area.

Feasibility:

*Acoustic Feasibility:* SCDOT noise policy states that a noise reduction of at least 5 dBA must be achieved for 75 percent of the impacted receivers. This was achieved for 4 of the 5 impacted receivers (80%). This meets the SCDOT allowable percentage (75%) per impacted receiver. A total of 5 receivers (including impacted and non-impacted) achieved at least 5 dBA of noise reduction.

*Engineering Feasibility:* No known issues at this time.

Reasonableness:

*Noise Reduction Design Goal:* SCDOT noise policy states that a noise reduction of at least 8 dBA must be achieved for 80 percent of the benefited receivers in the first two building rows. Of the five benefited receivers in the first two rows, there were none that achieved the 8 dBA reduction (0%). This does not meet the SCDOT allowable percentage (80%) of the benefited receivers.

*Cost Effectiveness:* The cost effectiveness analysis is not applicable since the noise reduction design goal was not met.

Conclusion: Based on the above results of the detailed analysis, this abatement feature is feasible but not reasonable, and is not proposed as part of this project.

#### 5.3.1.1.22 Barrier Va/b/c/d – Impacted Receivers V12-V15, V33, V37, V39-V40, V42-V45, V47-V48, V51-V54

Barrier Va/b/c/d is a 3,573 feet long noise wall whose height is 25 feet. It is separated into four segments to avoid conflicts with ramps and bridges in the area.

Feasibility:

*Acoustic Feasibility:* SCDOT noise policy states that a noise reduction of at least 5 dBA must be achieved for 75 percent of the impacted receivers. This was achieved for five of the 21 impacted receivers (24%). This does not meet the SCDOT allowable percentage (75%) per impacted receiver. A total of 26 receivers (including impacted and non-impacted) achieved at least 5 dBA of noise reduction.

*Engineering Feasibility:* No known issues at this time.

Conclusion: Based on the above results of the detailed analysis, this abatement feature is not feasible, and is not proposed as part of this project. Per SCDOT policy, reasonableness was not evaluated because the feature was found to be not feasible.

#### 5.3.1.1.23 Barrier W – Impacted Receivers W46, W51, W53-W54, W57, W59, W61-W62, W65, W67-W68, W71-W76, W78-W80, W82, W84-W86, W88-W89, W91

Barrier W is a 2,822 feet long noise wall whose height is 25 feet.

Feasibility:

*Acoustic Feasibility:* SCDOT noise policy states that a noise reduction of at least 5 dBA must be achieved for 75 percent of the impacted receivers. This was achieved for 27 of the 27 impacted receivers (100%). This meets the SCDOT allowable percentage (75%) per impacted receiver. A total of 73 receivers (including impacted and non-impacted) achieved 5 dBA of noise reduction.

*Engineering Feasibility:* No known issues at this time.

Reasonableness:

*Noise Reduction Design Goal:* SCDOT noise policy states that a noise reduction of at least 8 dBA must be achieved for 80 percent of the benefited receivers in the first two building rows. Of the 67 benefited receivers in the first two rows, there were 45 that achieved the 8 dBA reduction (67%). This does not meet the SCDOT allowable percentage (80%) of the benefited receivers.

*Cost Effectiveness:* The cost effectiveness analysis is not applicable since the noise reduction design goal was not met.

Conclusion: Based on the above results of the detailed analysis, this abatement feature is feasible but not reasonable, and is not proposed as part of this project.

#### 5.3.1.1.24 Barrier X – Impacted Receivers X1, X8, X11-X12, X14, X17, X21, X23, X27-X28, X31-X32, X35, X39-X40, X42-X44, X47-X48, X50-X51, X53-X56, X59-X60, X62, X65, X69, X73[12]

Barrier X is a 5,697 feet long noise wall whose height is 25 feet.

Feasibility:

*Acoustic Feasibility:* SCDOT noise policy states that a noise reduction of at least 5 dBA must be achieved for 75 percent of the impacted receivers. This was achieved for 25 of the 33 impacted receivers (76%). This meets the SCDOT allowable percentage (75%) per impacted receiver. A total of 30 receivers (including impacted and non-impacted) achieved 5 dBA of noise reduction.

*Engineering Feasibility:* No known issues at this time.

Reasonableness:

*Noise Reduction Design Goal:* SCDOT noise policy states that a noise reduction of at least 8 dBA must be achieved for 80 percent of the benefited receivers in the first two building rows. Of the 29 benefited receivers in the first two rows, there were 14 that achieved the 8 dBA reduction (48%). This does not meet the SCDOT allowable percentage (80%) of the benefited receivers.

*Cost Effectiveness:* The cost effectiveness analysis is not applicable since the noise reduction design goal was not met.

Conclusion: Based on the above results of the detailed analysis, this abatement feature is feasible but not reasonable, and is not proposed as part of this project.

#### 5.3.1.1.25 Barrier Y – Impacted Receivers Y1-Y4, Y6, Y8, Y11, Y13, Y15

Barrier Y is a 2,760 feet long noise wall whose height is 25 feet.

Feasibility:

[12] Receiver X1 represents a retirement home patio with 2 equivalent dwelling units.

*Acoustic Feasibility:* SCDOT noise policy states that a noise reduction of at least 5 dBA must be achieved for 75 percent of the impacted receivers. This was achieved for nine of the nine impacted receivers (100%). This meets the SCDOT allowable percentage (75%) per impacted receiver. A total of 17 receivers (including impacted and non-impacted) achieved 5 dBA of noise reduction.

*Engineering Feasibility:* No known issues at this time.

Reasonableness:

*Noise Reduction Design Goal:* SCDOT noise policy states that at a noise reduction of least 8 dBA must be achieved for 80 percent of the benefited receivers in the first two building rows. Of the 16 benefited receivers in the first two rows, there were 9 that achieved the 8 dBA reduction (56%). This does not meet the SCDOT allowable percentage (80%) of the benefited receivers.

*Cost Effectiveness:* The cost effectiveness analysis is not applicable since the noise reduction design goal was not met.

Conclusion: Based on the above results of the detailed analysis, this abatement feature is feasible but not reasonable, and is not proposed as part of this project.

#### 5.3.1.1.26 Barrier Z – Impacted Receivers Z12-Z14, Z16, Z18, Z20, Z28, Z48, Z50, Z52, Z62, Z80, Z82, Z84-Z91, Z93, Z109, Z111-Z119, Z150-Z155, Z166, Z171-Z181, Z184-Z185

Barrier Z is a 3,769 feet long noise wall whose height varies from 15 to 25 feet, with an average height of 20.1 feet.

Feasibility:

*Acoustic Feasibility:* SCDOT noise policy states that a noise reduction of at least 5 dBA must be achieved for 75 percent of the impacted receivers. This was achieved for 52 of the 52 impacted receivers (100%). This meets the SCDOT allowable percentage (75%) per impacted receiver. A total of 152 receivers (including impacted and non-impacted) achieved 5 dBA of noise reduction.

*Engineering Feasibility:* In addition to acoustical feasibility, the SCDOT noise policy includes consideration of engineering factors as part of the feasibility evaluation of a noise abatement measure. There are engineering constraints including an existing retaining wall, frontage road and utilities in the vicinity of the proposed abatement feature that could impede constructability and lead to increased cost. These constraints were evaluated in further detail under cost effectiveness as part of the reasonableness criteria.

Reasonableness:

*Noise Reduction Design Goal:* SCDOT noise policy states that a noise reduction of at least 8 dBA must be achieved for 80 percent of the benefited receivers in the first two building rows. There were 119 of the 145 benefited receivers in the first two rows that achieved the 8 dBA reduction (82%). This meets the SCDOT allowable percentage (80%) of the benefited receivers.

*Cost Effectiveness:* As a result of the engineering constraints noted in the vicinity of Barrier Z during the feasibility evaluation, the impact to cost resulting from constructing the proposed barrier in relation to the existing retaining wall and other existing features was evaluated. It is undesirable, due to structural and geotechnical stability considerations, to construct the proposed noise barrier on top of the existing retaining wall. Therefore, the proposed barrier was evaluated to be constructed on the frontage road side of the existing retaining wall. In order to avoid conflict with the retaining wall foundation and accommodate the noise barrier in this location, relocation of the frontage road, a sanitary sewer line, and a sanitary sewer pump station would be necessary. In addition, the frontage road relocation and placement of additional safety barrier would result in additional retaining walls and significant access issues at existing driveway locations. All of these constraints result in an estimated additional cost of $4.25 million dollars bringing the total cost for inclusion of a noise barrier at this location to $7,028,030.

The analyzed feature was deemed to be not reasonable, because the estimated cost per benefited receiver is greater than the SCDOT allowable cost ($30,000) per benefited receiver ($7,028,030 / 152 benefited receivers = $46,237). The presence of an existing retaining wall that would conflict with the proposed barrier alignment, including but not limited to utilites and access, led to additional costs beyond the base $35 per square foot that needed to be considered in order to address issues with the stability of the wall and existing frontage road.

Conclusion: Based on the above results of the detailed analysis, this abatement feature is feasible but not reasonable.

#### 5.3.1.1.27 Mitigation Summary

Based on the detailed noise analysis of the Refined Recommended Preferred Alternative, 23 barriers were determined to be feasible but not reasonable; two barriers were determined to be feasible and reasonable; and one barrier was determined to not be feasible (and therefore no reasonableness assessment occurred). Appendix B contains the worksheets for these determinations. A summary of the barrier analysis is presented in Table 5.2. The location of the proposed noise walls is shown on Figure A3 in Appendix A.

**Table 5.2 Summary of Detailed Noise Mitigation Analysis, Refined Recommended Preferred Alternative**

| Barrier | Dimensions (length x avg. height, feet) | Cost[13] | Feasible | Reasonable | Proposed |
|---|---|---|---|---|---|
| A | 1,860 x 19.4 | $1,274,665 | Yes | No | No |
| B | 1,659 x 20 | $1,161,265 | Yes | No | No |
| C | 539 x 15 | $283,080 | Yes | No | No |
| E | 480 x 19 | $319,060 | Yes | No | No |
| F | 4,080 x 18.6 | $2,673,020 | Yes | No | No |
| G | 3,071 x 25 | N/A | Yes | No | No |

[13] Note: Cost is marked N/A if the Noise Reduction Design Goal portion of the reasonableness assessment was not met. Instances where the noise wall cost does not exactly equal to the wall area multiplied by $35/sq ft. are due to rounding that occurs during barrier dimension calculations performed by TNM.

| Barrier | Dimensions (length x avg. height, feet) | Cost[13] | Feasible | Reasonable | Proposed |
|---|---|---|---|---|---|
| H | 3,900 x 25 | N/A | Yes | No | No |
| I1 | 1,860 x 25 | N/A | Yes | No | No |
| I2 | 3,777 x 25 | N/A | Yes | No | No |
| J1 | 3,114 x 25 | N/A | Yes | No | No |
| J2 | 2,520 x 25 | N/A | Yes | No | No |
| K | 1,937 x 25 | N/A | Yes | No | No |
| La/Lb | 1,501 x 25 | N/A | Yes | No | No |
| N1 | 2,100 x 25 | N/A | Yes | No | No |
| N2 | 1,860 x 17.1 | $1,110,865 | Yes | No | No |
| O | 2,301 x 15.4 | $1,269,660 | Yes | Yes | Yes |
| Q | 3,360 x 25 | N/A | Yes | No | No |
| R | 4,320 x 17.2 | $2,843,120 | Yes | No | No |
| S | 4,380 x 25 | $3,832,430 | Yes | Yes | Yes |
| T | 3,660 x 25 | N/A | Yes | No | No |
| U | 3,201 x 25 | N/A | Yes | No | No |
| Va/b/c/d | 3,573 x 25 | N/A | No | N/A | No |
| W | 2,822 x 25 | N/A | Yes | No | No |
| X | 5,697 x 25 | N/A | Yes | No | No |
| Y | 2,760 x 25 | N/A | Yes | No | No |
| Z | 3,769 x 20.1 | $7,028,030 | Yes | No | No |

In the preliminary noise analysis, ten barriers were identified as feasible and reasonable, while only two were identified as feasible and reasonable in the detailed noise analysis. The additions to the model required for the detailed study, such as inclusion of elevation for roadways and receptors and inclusion of buildings and shoulder barriers, generally resulted in reduction in build year noise levels compared to the preliminary analysis. Because of this, it was more difficult for the investigated barriers to meet the required noise reduction design goals for the acoustical reasonableness criterion. Additional costs related to constructablilty were also investigated during the detailed analysis, leading to at least one barrier being unable to meet the cost reasonableness criterion.

Appendix D contains a summary of the predicted traffic noise levels for each receptor analyzed.

# 6 Will there be noise during construction?

Temporary increases in noise levels would occur during the time period that construction takes place. Noise levels due to construction, although temporary, can impact areas adjacent to the project. The major noise sources from construction would be the heavy equipment operated at the site. However, other construction site noise sources would include hand tools and trucks supplying and removing materials.

Typical noise levels generated by different types of construction equipment are presented in Appendix C. Construction operations are typically broken down into several phases including clearing and grubbing, earthwork, erection, paving and finishing. Although these phases can overlap, each has their own noise characteristics and objective.

SCDOT's "2007 Standard Specifications for Highway Construction" includes various references to construction noise, including Sections 107.6-paragraph 3, 606.3.1.6.3-paragraph 1, 607.3.1.6.3-paragraph 1, 607.3.2.6.3-paragraph 1, and 702.4.15-paragraph 3. The SCDOT specifications cited above are generalized for nuisance noise avoidance. Detailed specifications that will be incorporated as environmental commitments in the environmental document and plan notes consist of the following:

- Construction equipment powered by an internal combustion engine shall be equipped with a properly maintained muffler.
- Air compressors shall meet current USEPA noise emission exhaust standards.
- Air powered equipment shall be fitted with pneumatic exhaust silencers.
- Stationary equipment powered by an internal combustion engine shall not be operated within 150 feet of noise sensitive areas without portable noise barriers placed between the equipment and noise sensitive sites. Noise sensitive sites include residential buildings, motels, hotels, schools, churches, hospitals, nursing homes, libraries and public recreation areas.
- Portable noise barriers shall be constructed of plywood or tongue and groove boards with a noise absorbent treatment on the interior surface (facing the equipment).
- Powered construction equipment shall not be operated during the traditional evening and/or sleeping hours within 150 feet of a noise sensitive site, to be decided either by local ordinances and/or agreement with the SCDOT.

# 7 Coordination with local officials

SCDOT has no authority over local land use planning and development. SCDOT can only encourage local officials and developers to consider highway traffic noise in the planning, zoning and development of property near existing and proposed highway corridors. The lack of consideration of highway traffic noise in land use planning at the local level has added to the highway traffic noise problem which will continue to grow as development continues adjacent to major highways long after these highways were proposed and/or constructed.

In order to help local officials and developers consider highway traffic noise in the vicinity of a proposed Type I project, SCDOT will inform them of the predicted future noise levels and the required distance from such projects needed to ensure that noise levels remain below the NAC for each type of land use in accordance with 23 CFR §772.17. The contour distances to the 66 and 71 dBA sound levels are shown in Table 7.1. Please note that the values in the table do not represent predicted levels at every location at a particular distance back from the roadway. Sound levels will vary with changes in terrain and will be affected by the shielding of objects such as buildings and tree zones. These locations were chosen in areas where there is potential for future

development. SCDOT will provide this information to Richland and Lexington counties, as well as the Towns and Cities with jurisdiction over planning and development adjacent to the project.

**Table 7.1 Contour Distances (dBA) for Land Use Planning – Refined Recommended Preferred Alternative**

| Project area (noise sensitive area – NSA) | Worst-case approximate distance from edge of pavement (feet) | |
|---|---|---|
| | Category B & C (residential, outdoor recreation facilities, churches, schools, hospitals, etc.) NAC Limit 66 dBA | Category E (hotels, motels, offices, restaurants/bars, and other developments/activities not included in the other NAC's) NAC Limit 71 dBA |
| **NSA B** | 330 | 170 |
| **NSA C** | 360 | 220 |
| **NSA F** | 440 | 240 |
| **NSA I** | 140 | Within ROW |
| **NSA J** | 170 | 100 |
| **NSA O** | Within ROW | Within ROW |
| **NSA P** | 200 | 80 |
| **NSA R** | 280 | 40 |
| **NSA V** | Within ROW | Within ROW |
| **NSA W** | 230 | Within ROW |
| **NSA X** | 300 | 160 |

Source: HDR Engineering, January 2019

# 8 Was the public involved?

Through a call for volunteers at project information and public input meetings, the project team identified neighborhood contacts to serve on a Noise Advisory Board (NAB). The purpose of the NAB is to involve representatives from each subdivision/community within the project study area. NAB members, who represented a variety of non-governmental and civic organizations, were invited to participate in meetings designed to provide the project team with specific feedback related to noise concerns. NAB representatives were requested to share information with the community at-large.

At the onset of the project, it was determined that members of the NAB were volunteers from subdivisions and neighborhoods that fall within the noise study area boundary. This boundary is a 500-foot buffer outside of the project study area boundary and consists of 49 identified subdivisions and neighborhoods. During the Community Kickoff and Public Input meetings, a station was set up to explain the NAB and its purpose. If a person was interested in serving on the NAB, he or she could express their interest by leaving their name and contact information on the sign-in sheet that was located at the station. Between the two meetings, 17 individuals expressed an interest in being part of this advisory board. Of the 17 individuals, nine live within, or just outside of, the noise study area boundary. Those nine individuals are primarily located near to the I-20/26 interchange. The other eight were members of the public that lived slightly farther outside of the noise study area, but expressed interest in noise concerns after attending the meetings.

In order to identify additional potential board members for greater geographic coverage within the noise study area, information was drawn from the public involvement database to determine active participants in the project. Active participants were identified as having attended the Community Kickoff Meeting, Public Input Meeting, and/or submitted a comment via online, email, in-person comment form, or hotline voicemail. Approximately 230 individuals were identified, with an approximately 54 of them being located within or just outside of the noise study area boundary.

Following the identification of potential members, a letter/postcard was distributed with information regarding the NAB, the anticipated commitment, and a request for an alternative candidate if they were uninterested. Social media outlets were used to solicit participation as well. Content was posted on Facebook, Twitter and Instagram requesting that interested parties contact the project hotline or project email with their information and interest in volunteering on the NAB.

An initial NAB meeting was held on March 15, 2016 to review the proposed project, the goals and objectives of the NAB, and to provide greater understanding of the noise evaluation process. Meeting materials and minutes from the initial NAB meeting were provided prior to and after, respectively, the NAB meeting. It is important to note, NAB participants were made aware during outreach and meetings that the function of the NAB is not to vote on a noise abatement, rather to inform the analysis process. SCDOT follows its Traffic Noise Abatement Policy on every project to determine impacts, and whether abatement is warranted or not. The next NAB meeting was held on January 24, 2019 to review the findings of the detailed noise analysis prior to the issuance of the FEIS. An update on the noise analysis and potential locations of noise barriers was sent out via email to property owners and residents of benefited receptors and posted to the project website on February 5, 2019.

Additionally, it should be noted that questions and comments about the environmental process, and specifically potential noise impacts, led the project team to post a video describing the noise analysis process. This video may be accessed at http://www.scdotcarolinacrossroads.com/ under “Project Resources”.

# 9 Summary

Based on the future traffic conditions, noise impacts within the refined study area are anticipated for the Refined Recommended Preferred Alternative. The majority of impacted receivers consisted of NAC B (residential) properties. The detailed analysis showed that consideration of noise abatement was warranted in some locations, as discussed in Section 5 and shown on the figures in Appendix A.

# 10 References

South Carolina Department of Transportation, *Traffic Noise Abatement Policy*, Issued: August 2014, Effective: September 1, 2014.

U.S. Department of Transportation, Federal Highway Administration. Measurement of Highway-Related Noise. FHWA Report Number FHWA-PD-96-046. May 1996.

U.S. Department of Transportation, Federal Highway Administration. FHWA Traffic Noise Model: User's Guide. FHWA Report Number FHWA-PD-96-009. January, 1998.

U.S. Department of Transportation, Federal Highway Administration. FHWA Traffic Noise Model: User's Guide (Version 2.5 Addendum). April 2004.

U.S. National Archives and Records Administration, Office of the Federal Register. Title 23, Code of Federal Regulations, Part 772. Procedures for Abatement of Highway Traffic Noise and Construction Noise.

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# Appendix A—Figures

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**Figure A1**
**Existing Conditions**
**Noise Analysis Details**

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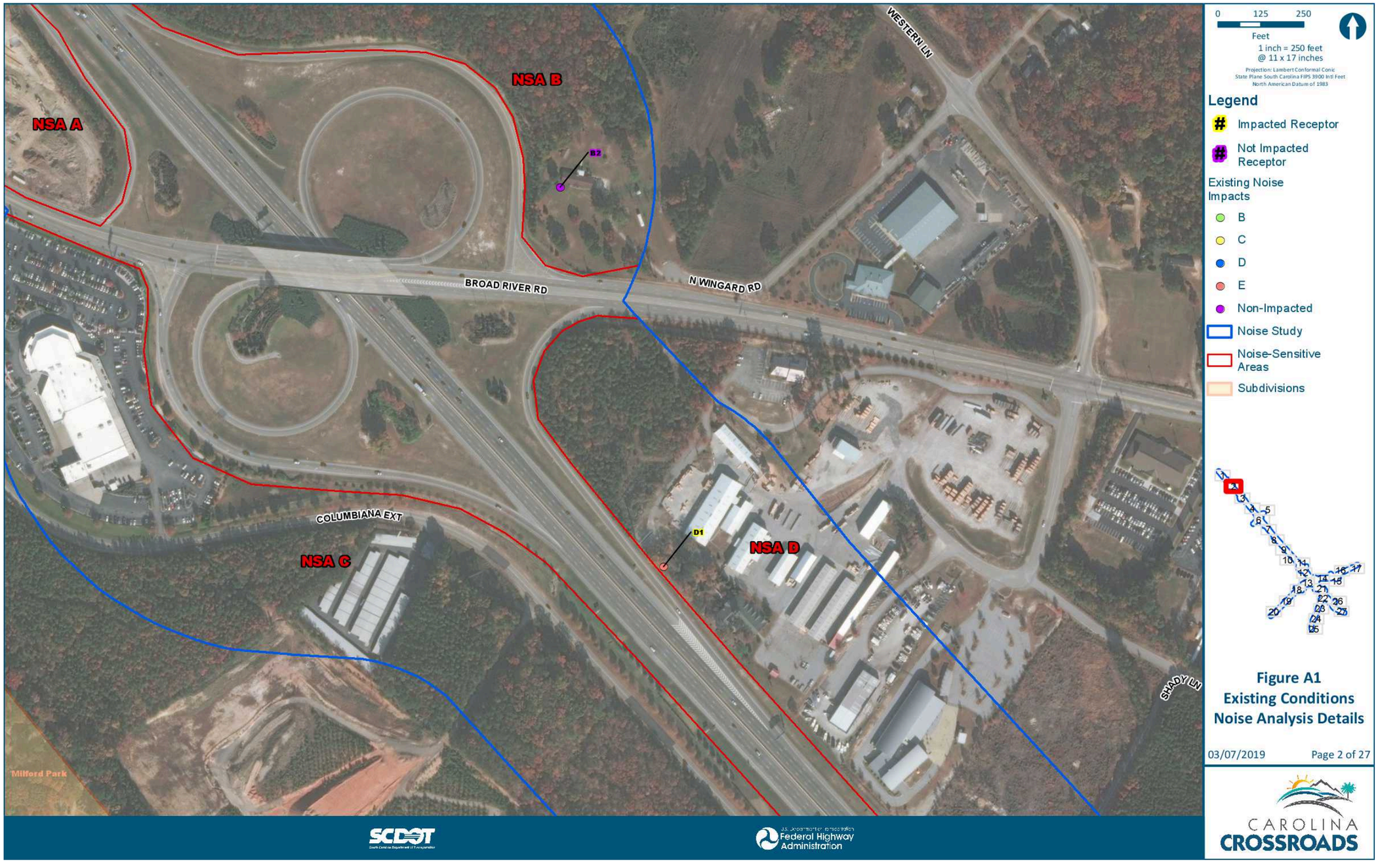


**Figure A1**
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**Figure A1**
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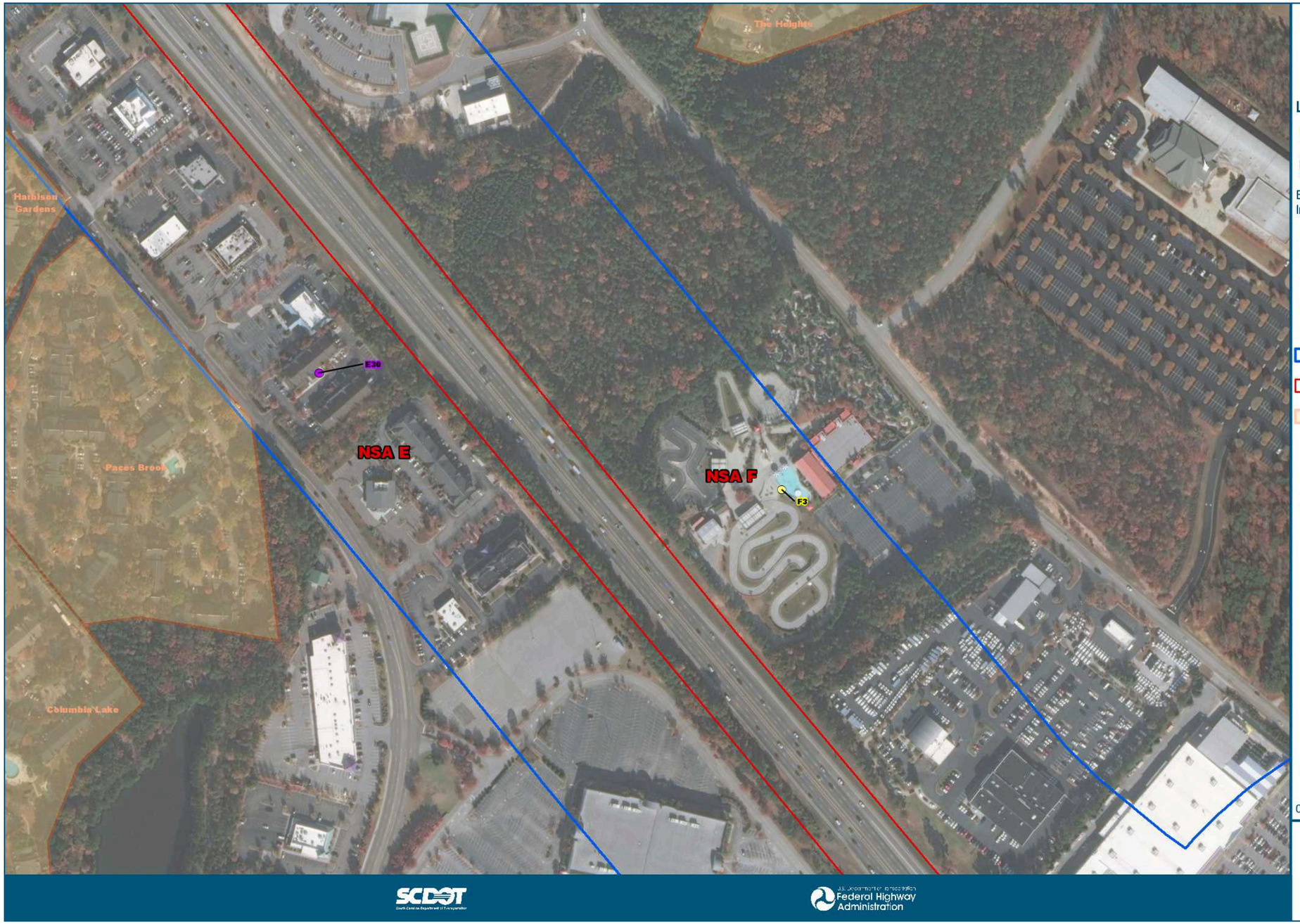


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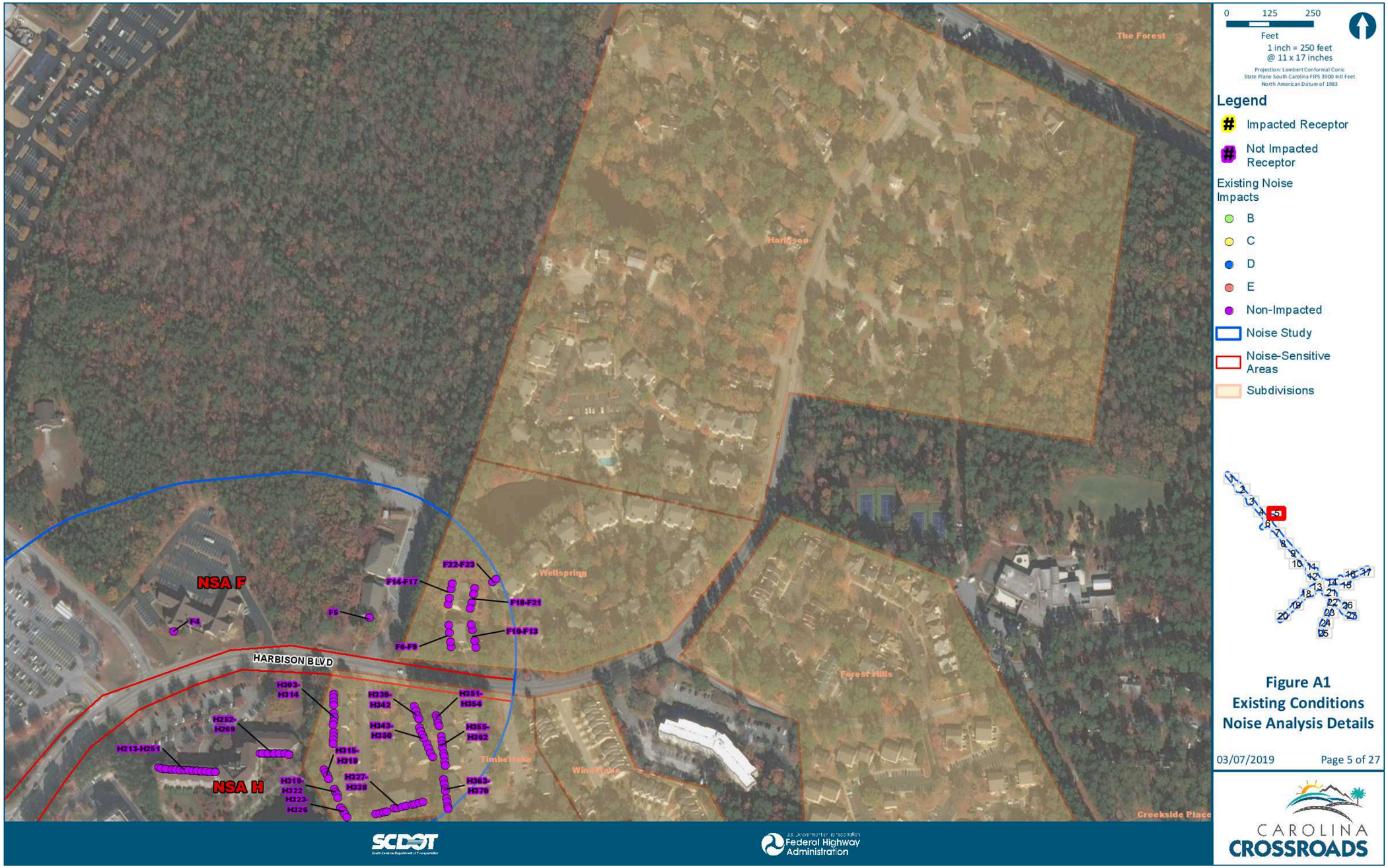


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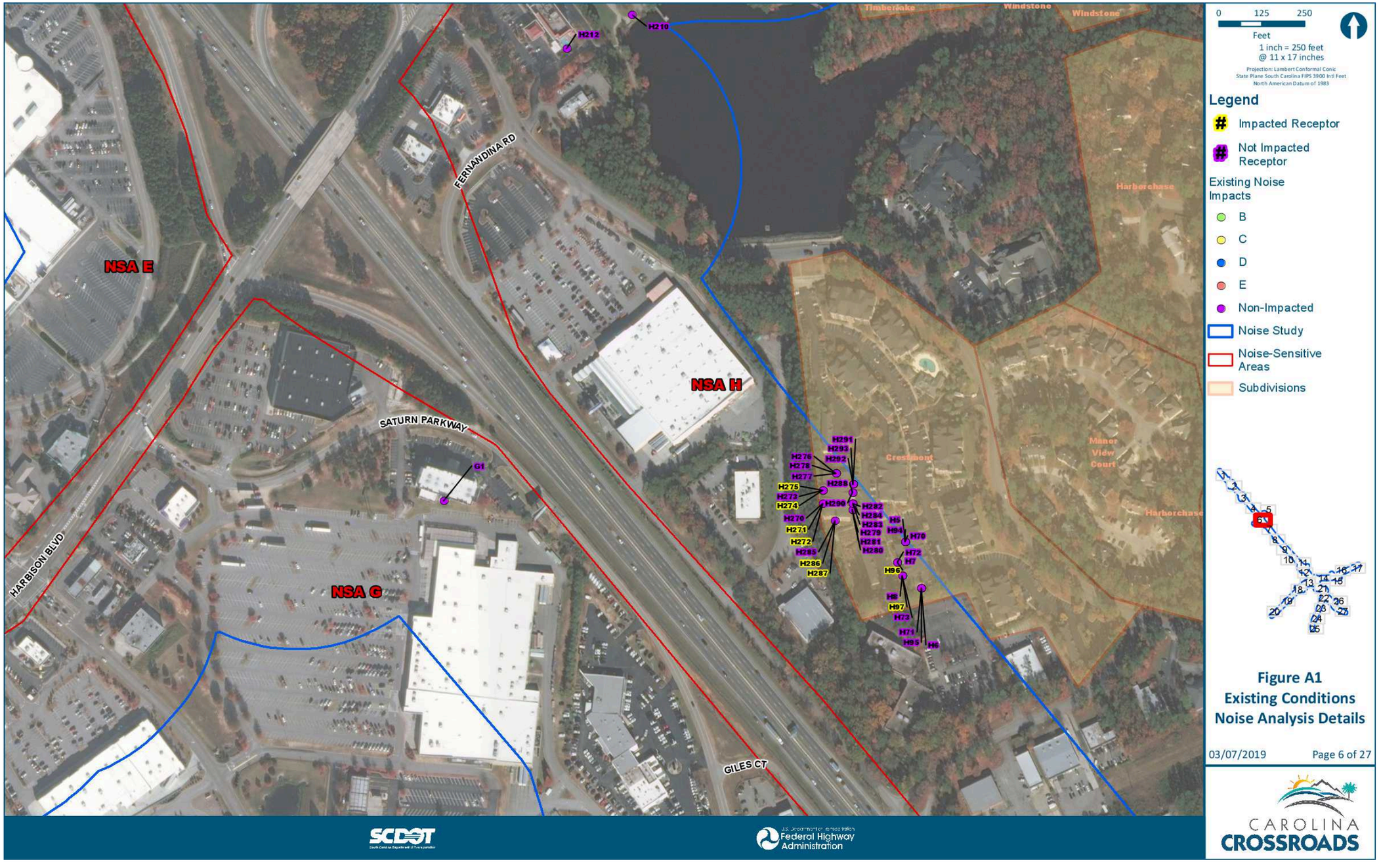


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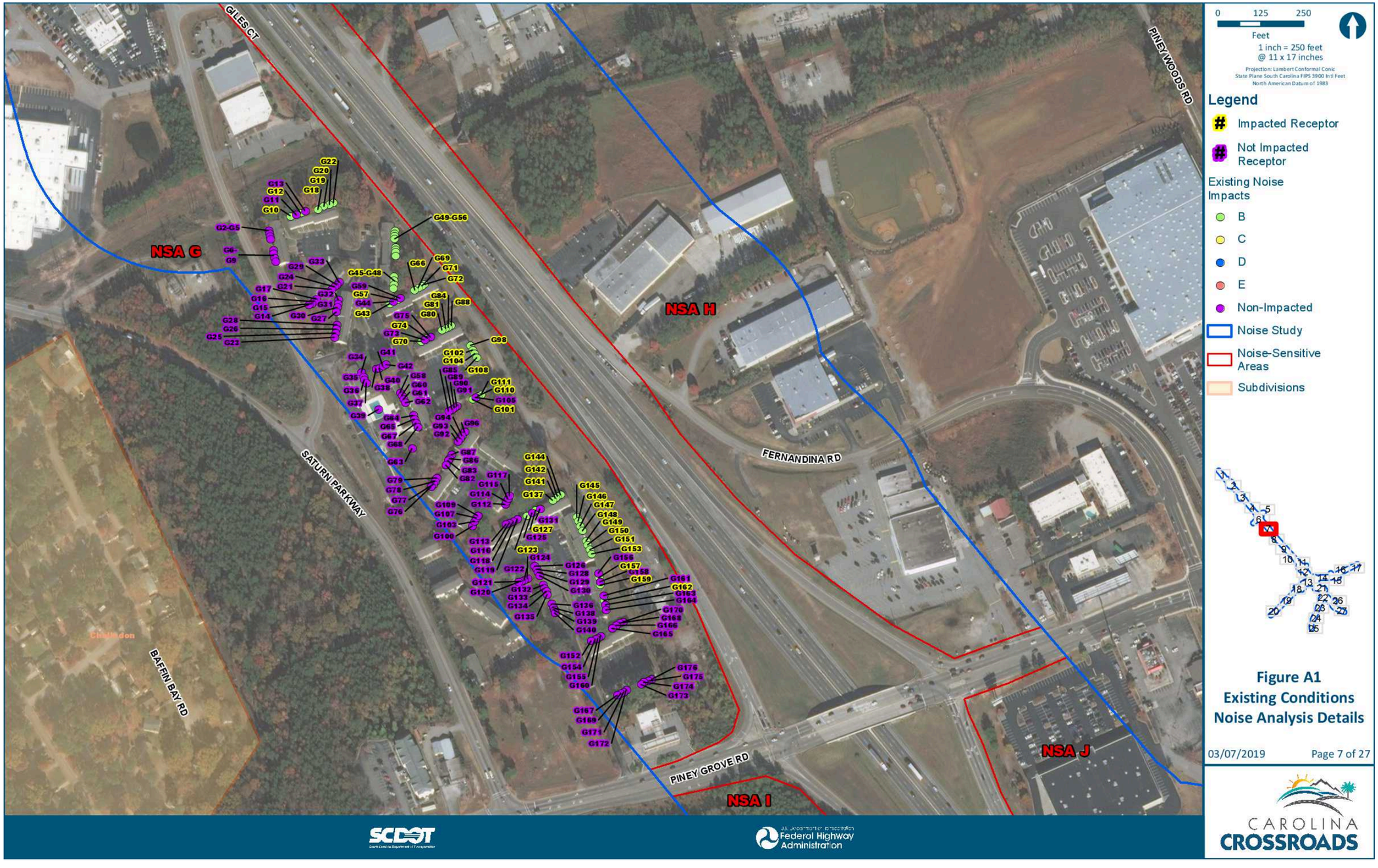


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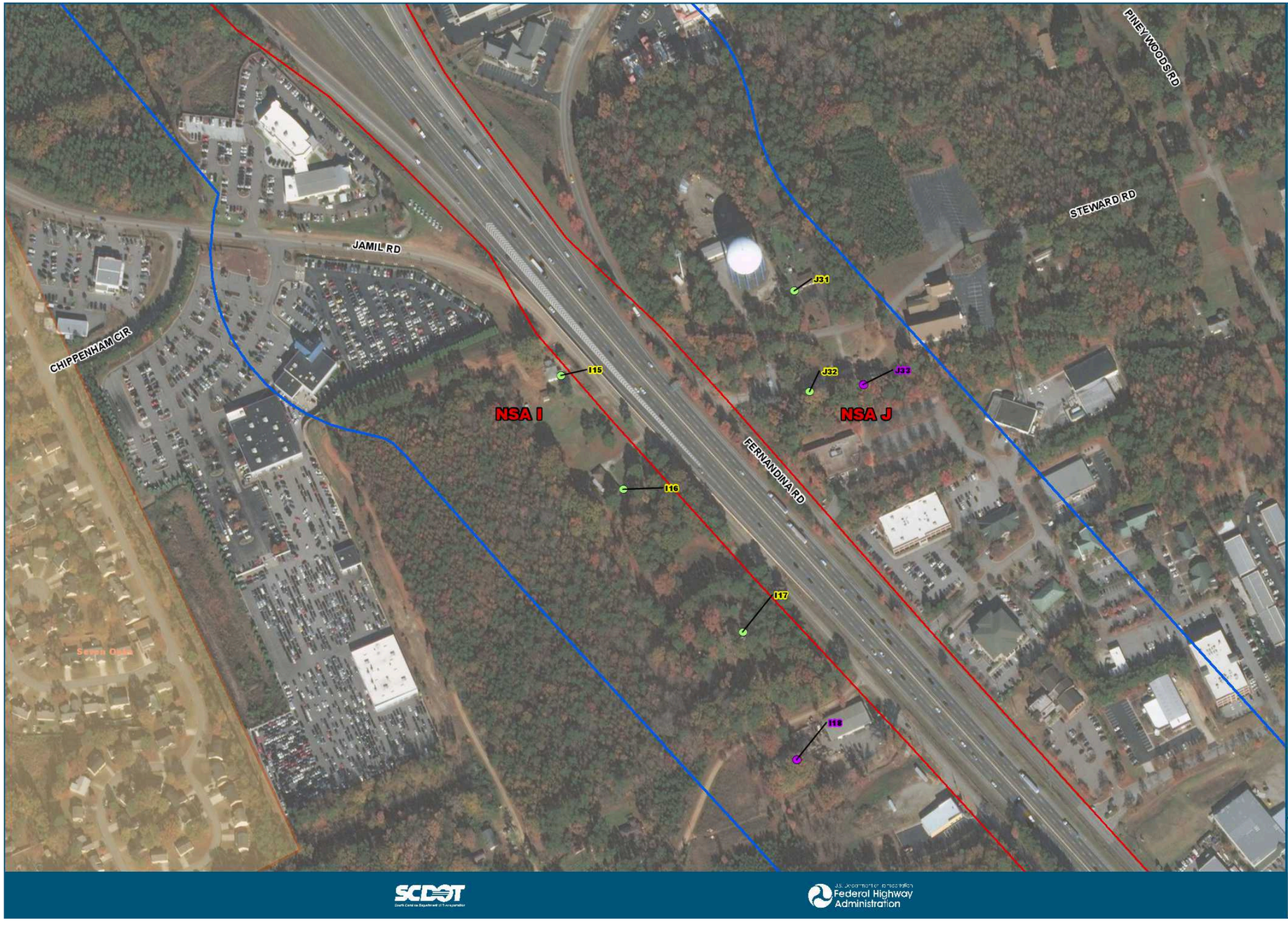


0 125 250
Feet
1 inch = 250 feet
@ 11 x 17 inches

Projection: Lambert Conformal Conic
State Plane South Carolina FIPS 3900 Intl Feet
North American Datum of 1983

**Legend**

- Impacted Receptor
- Not Impacted Receptor

Existing Noise Impacts

- B
- C
- D
- E
- Non-Impacted

- Noise Study
- Noise-Sensitive Areas
- Subdivisions

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**Existing Conditions Noise Analysis Details**

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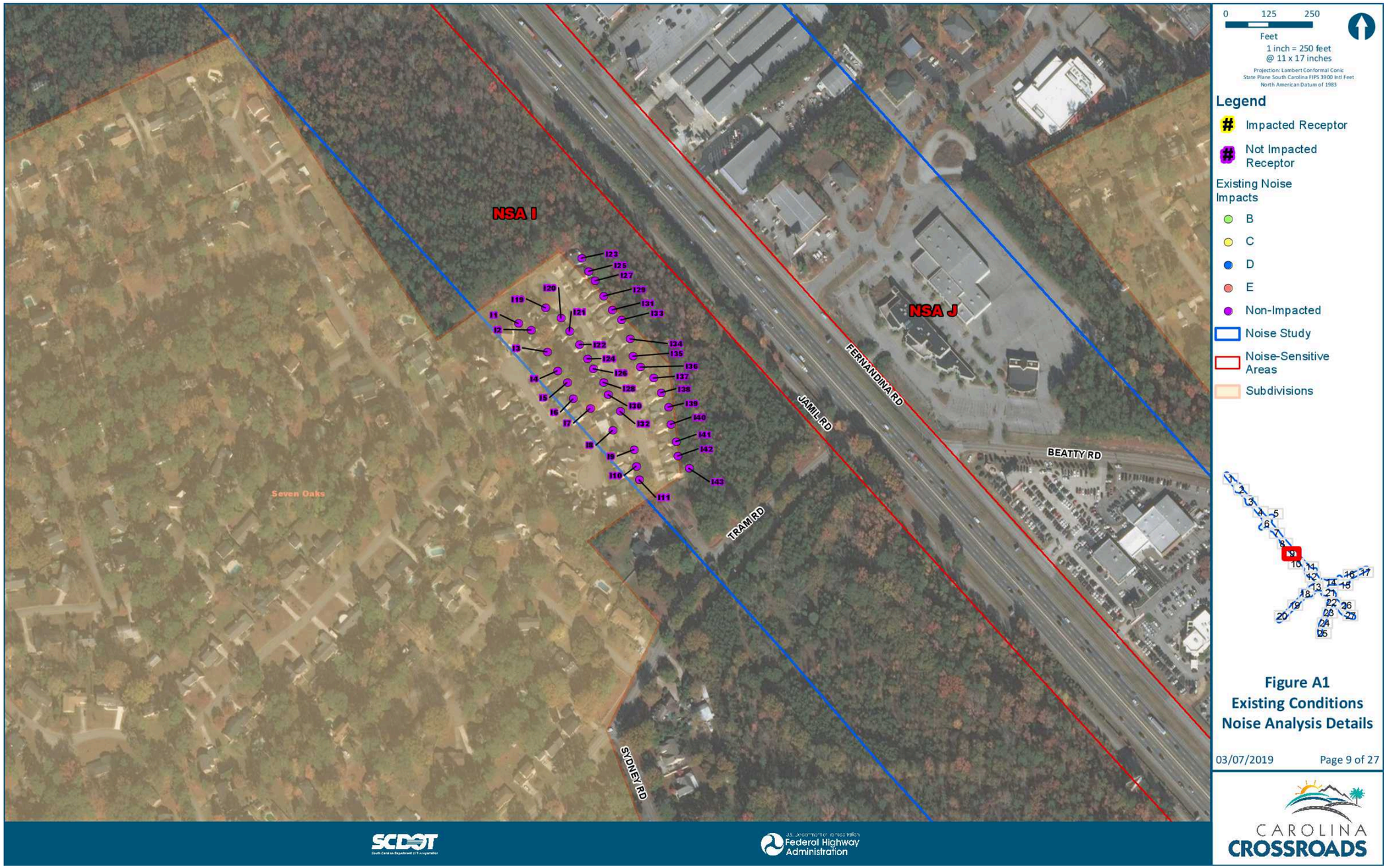


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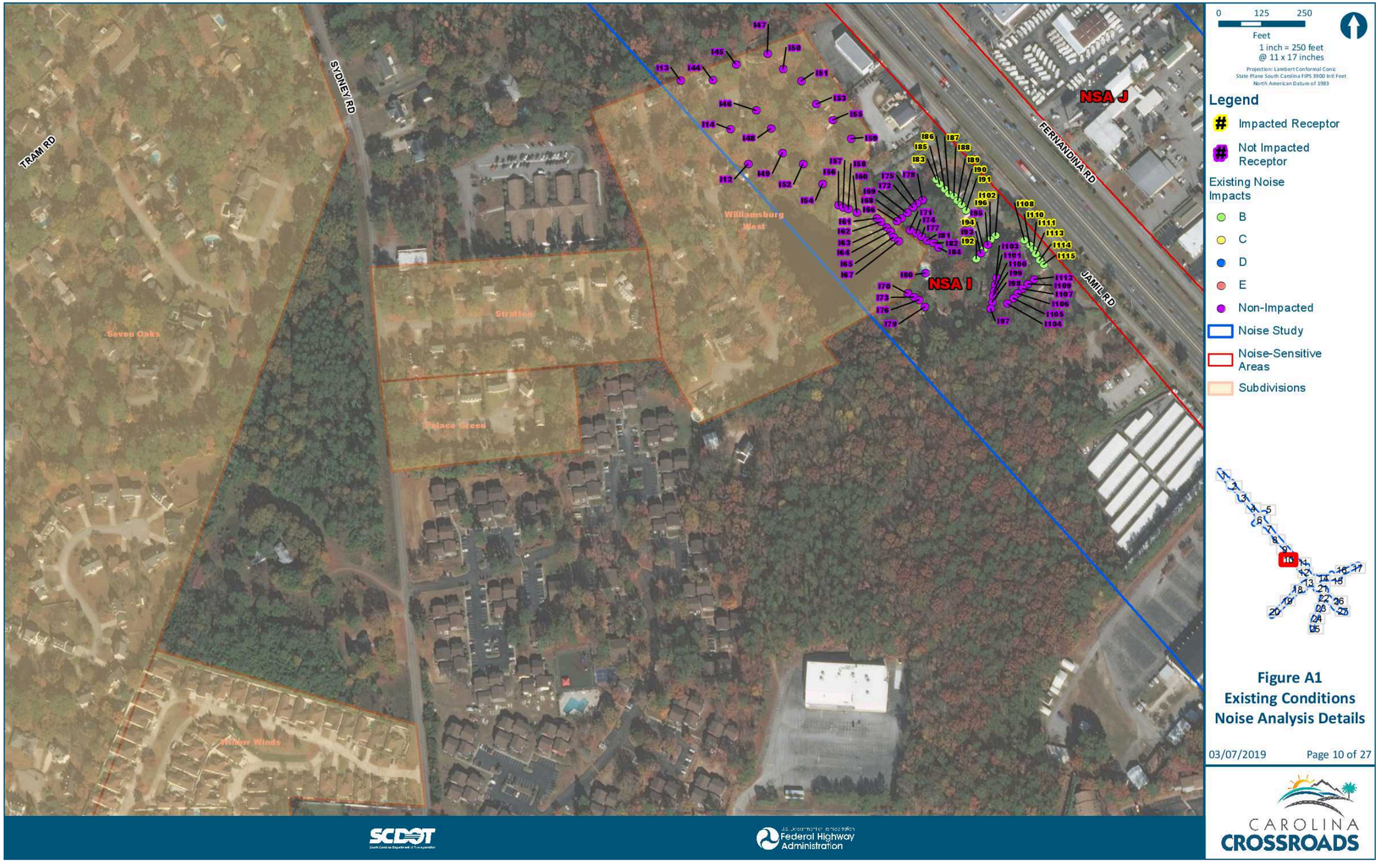
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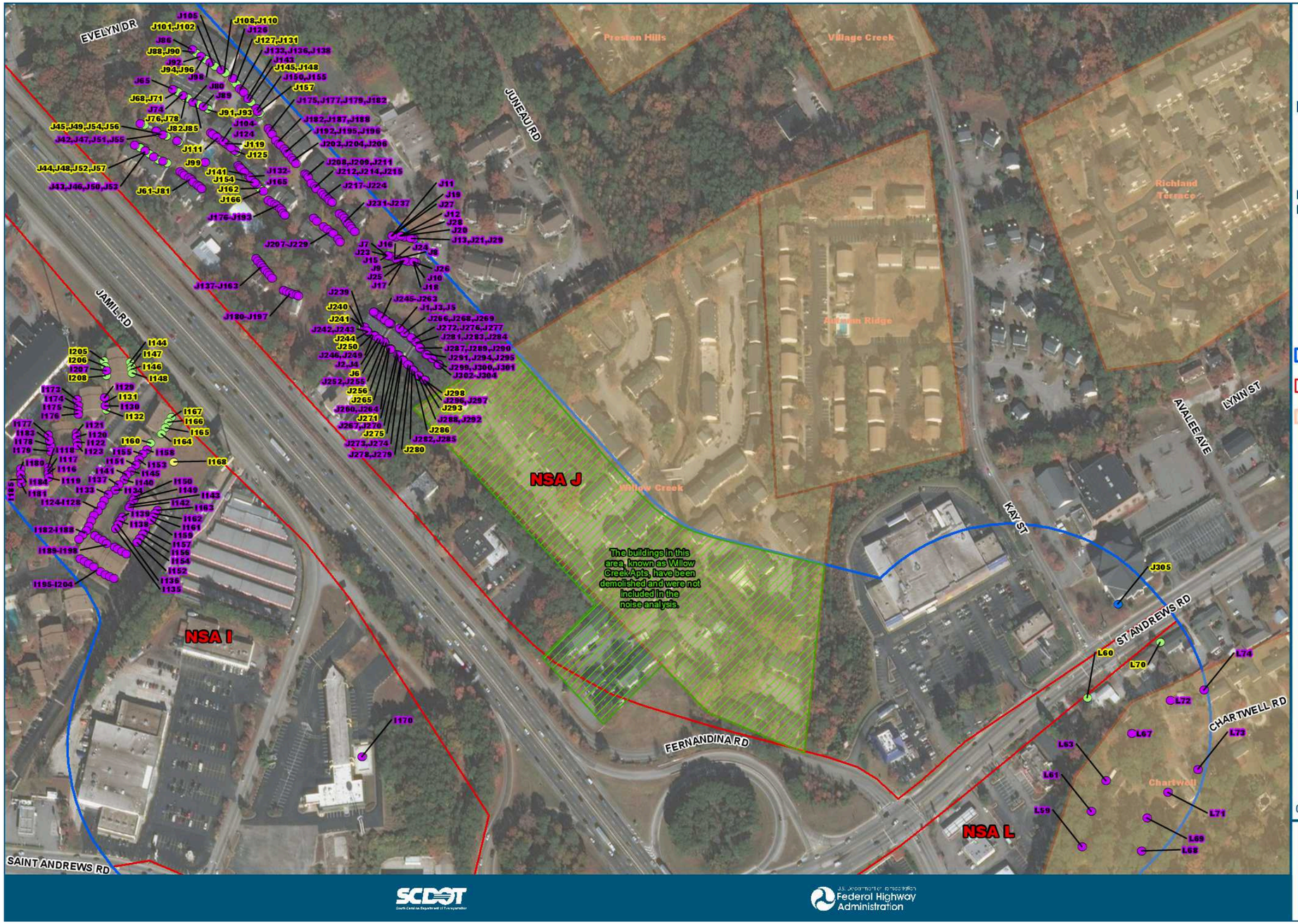


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**Legend**

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- Not Impacted Receptor

Existing Noise Impacts

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- Subdivisions

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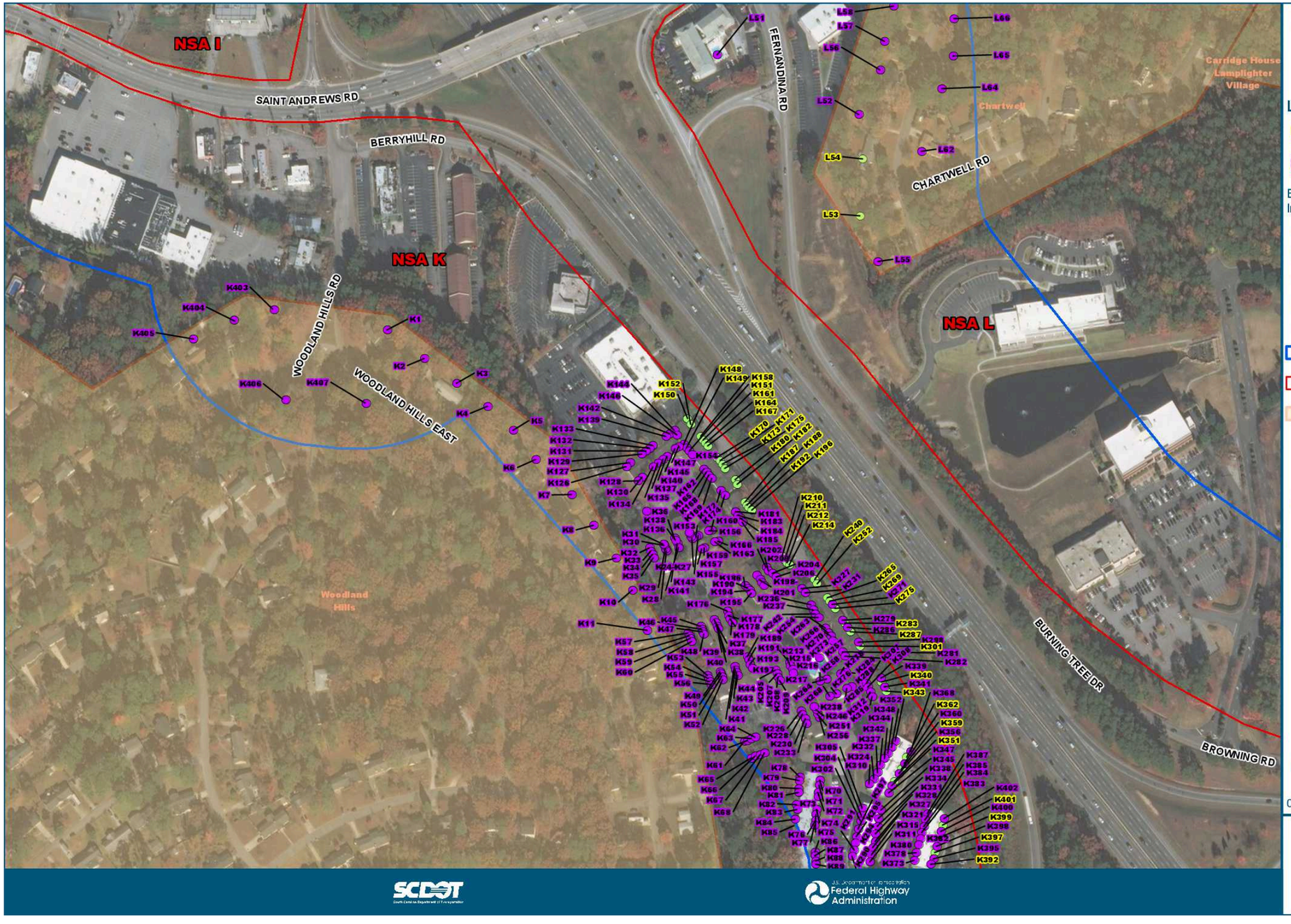


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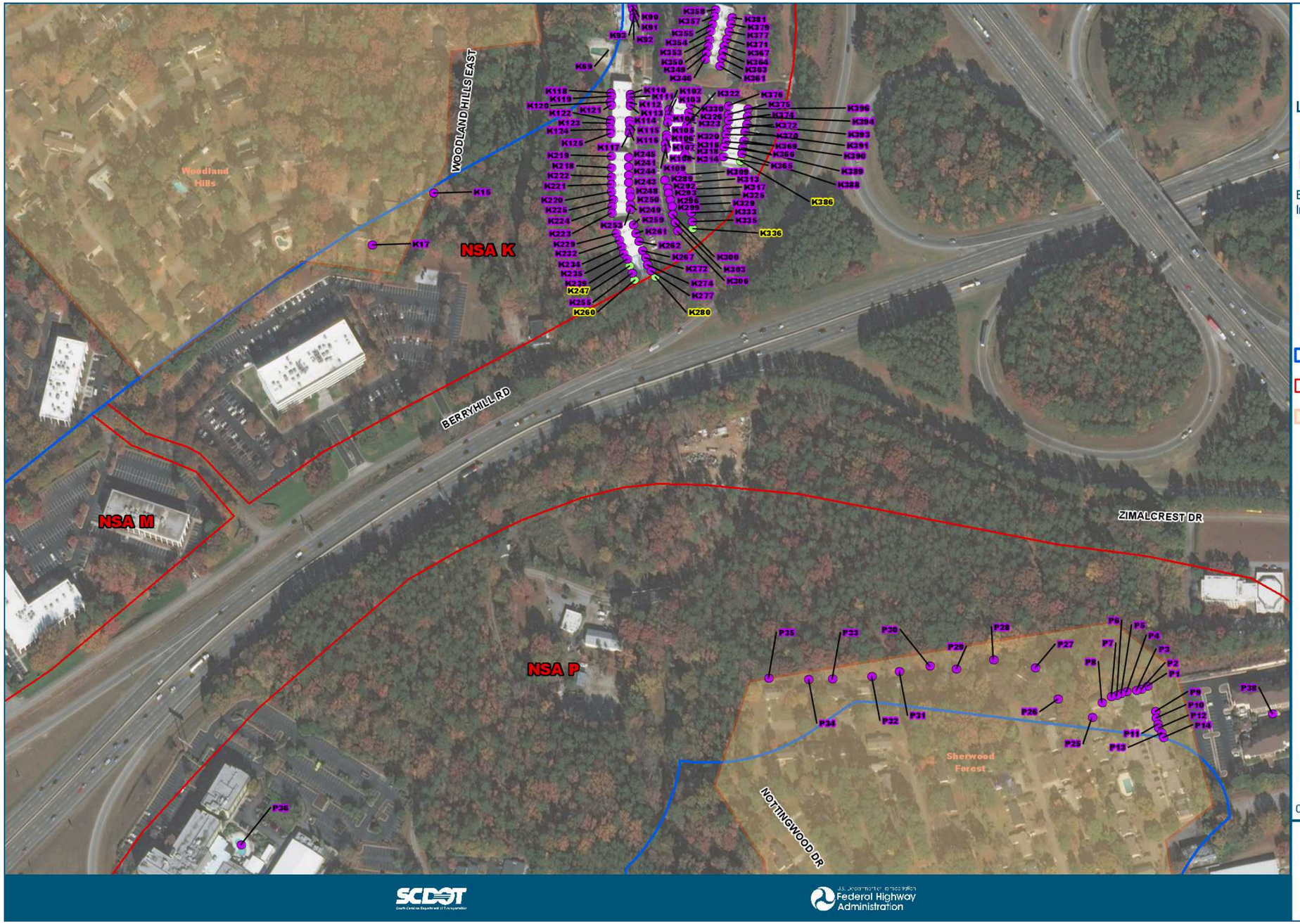


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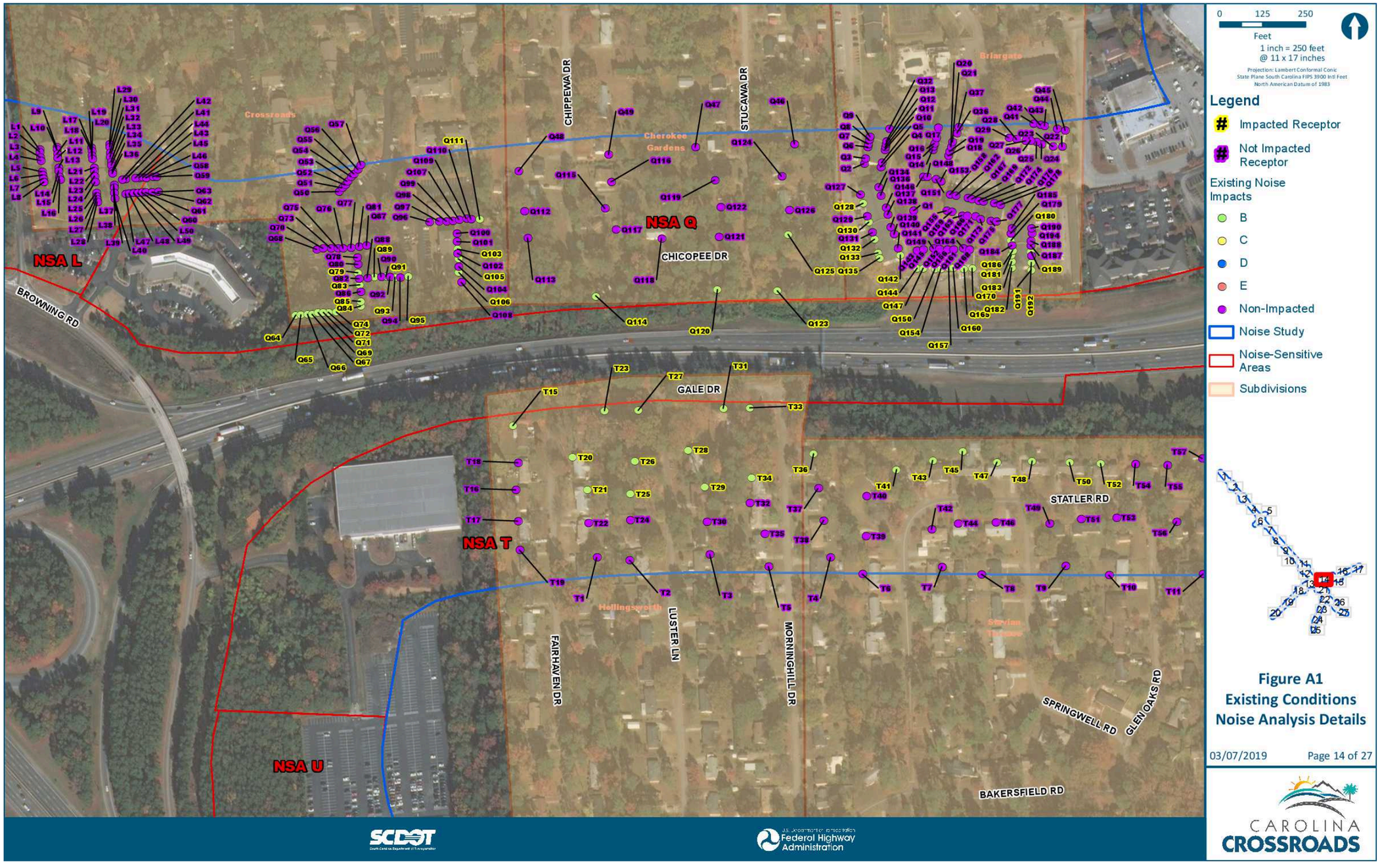


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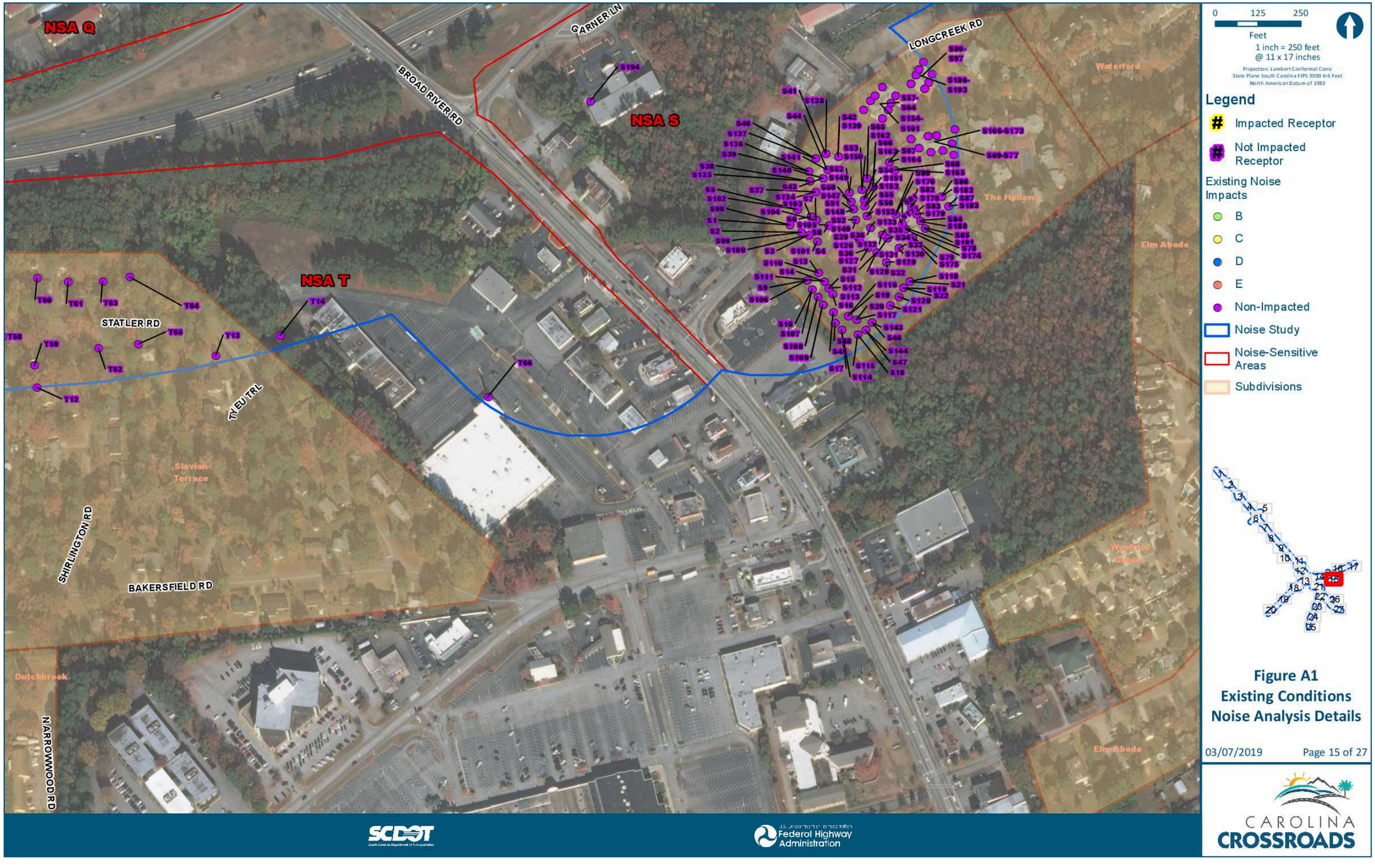


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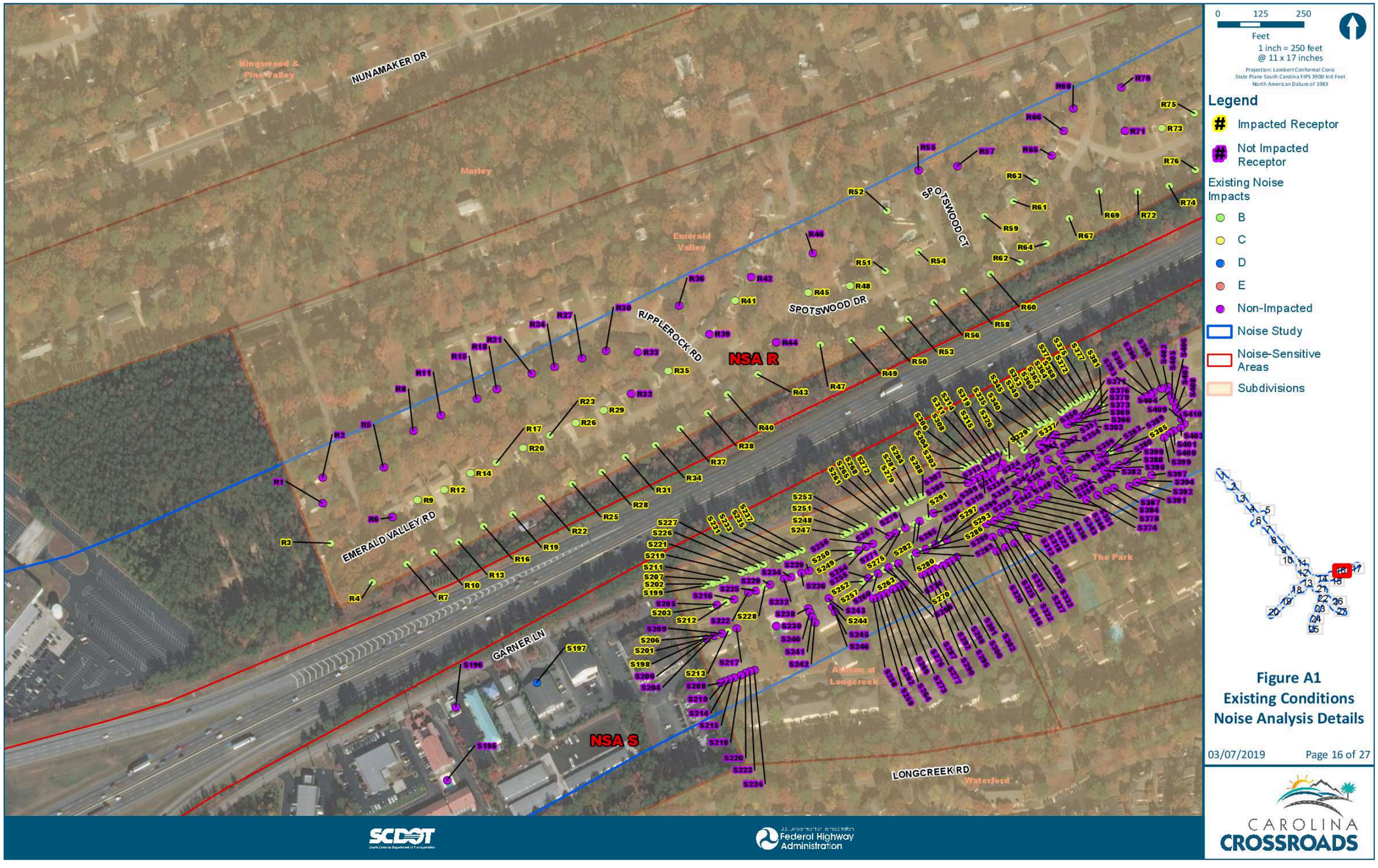
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Emerald Valley
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GARNER LN
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LONGCREEK RD
Waterford
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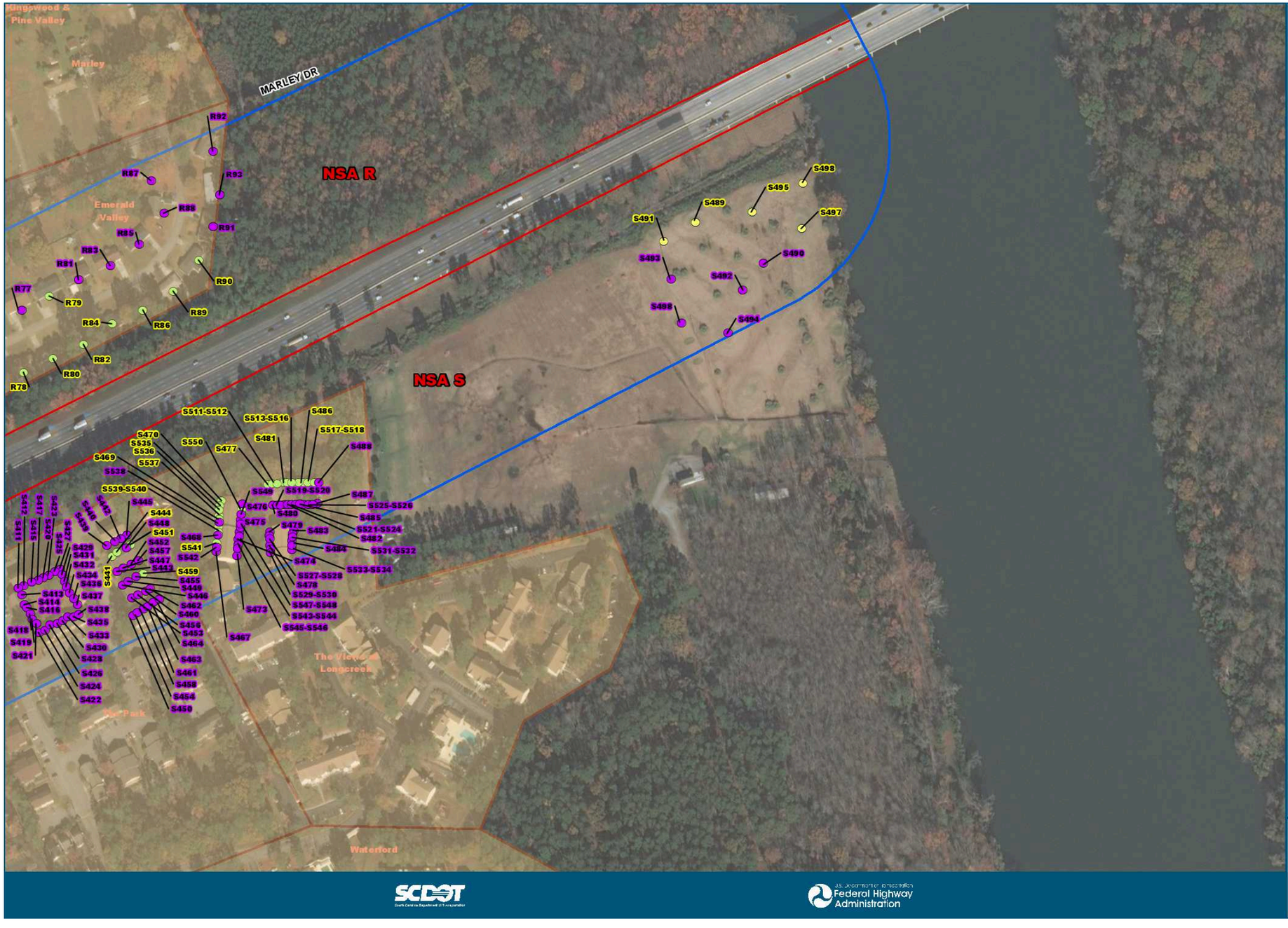


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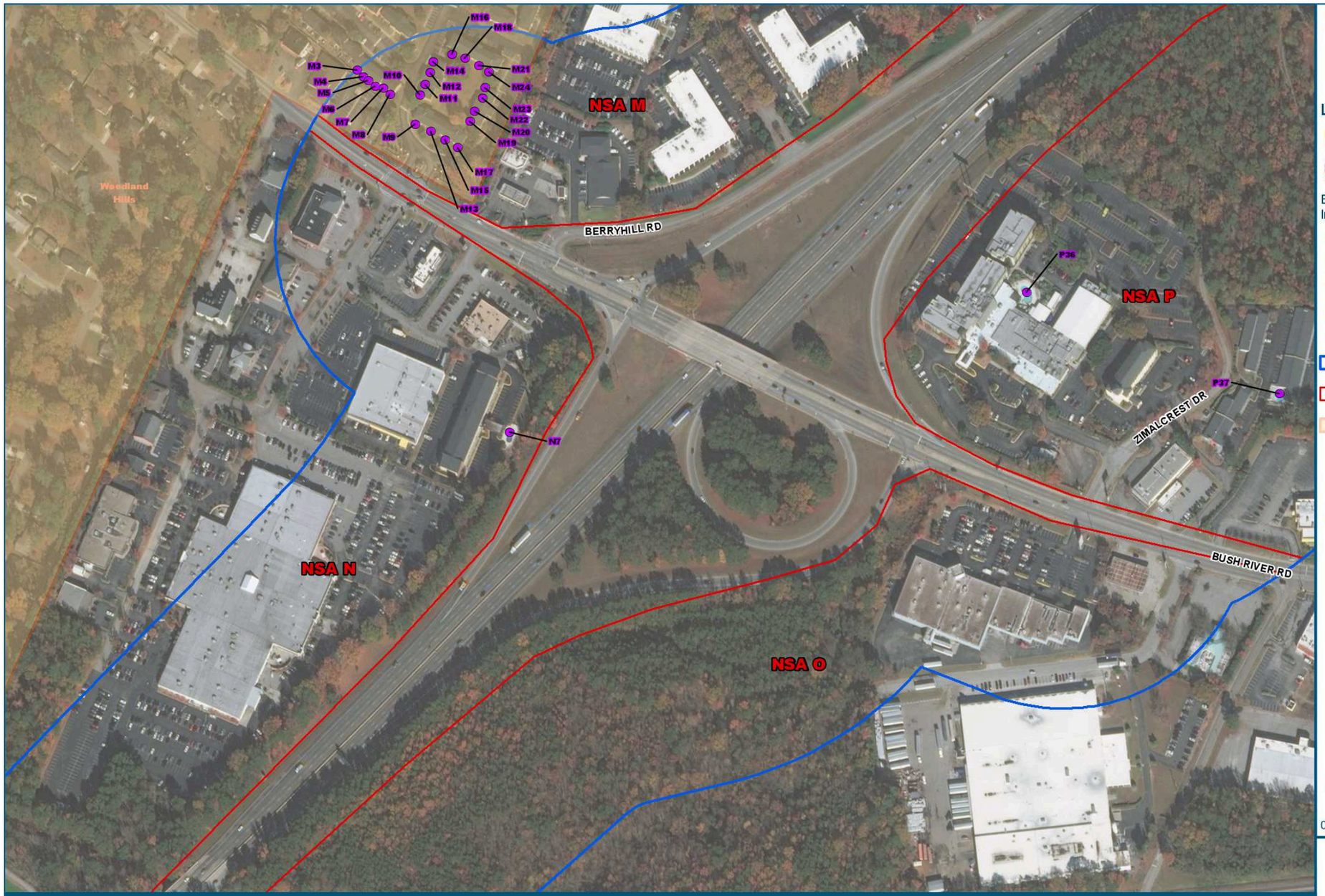


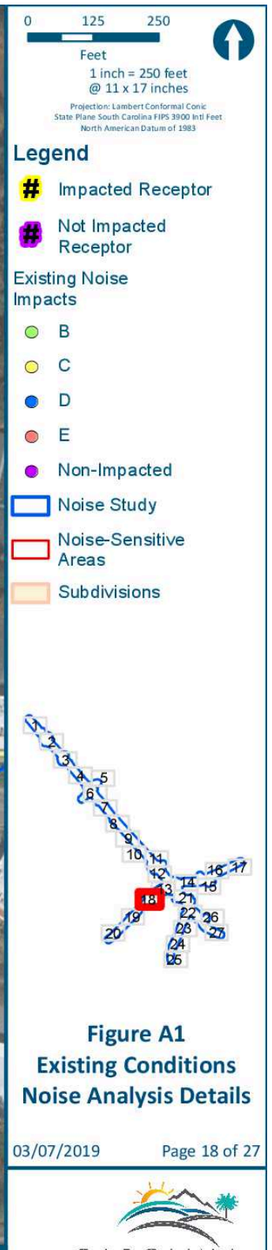




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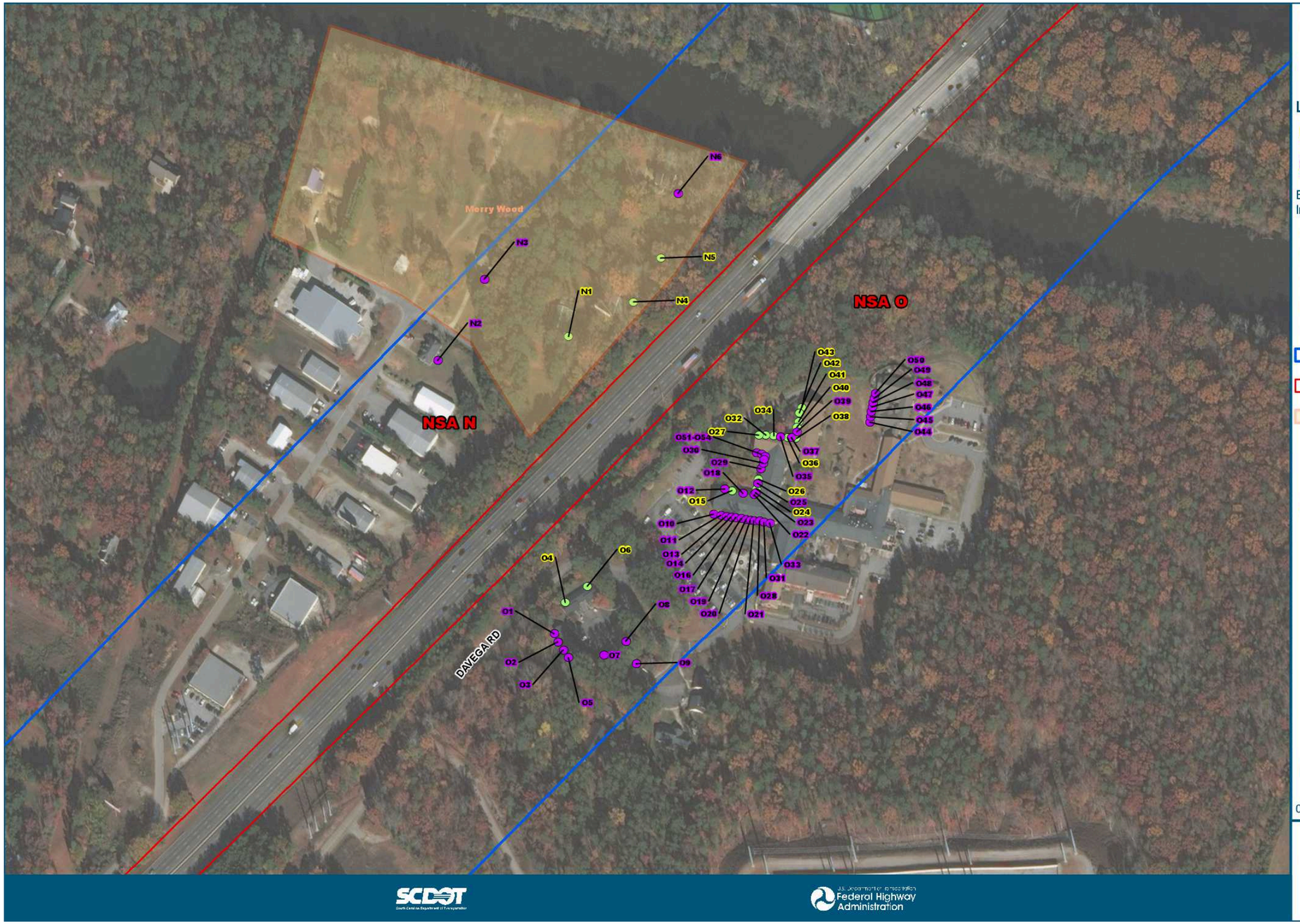


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**Existing Conditions**
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**Figure A1**
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**Noise Analysis Details**

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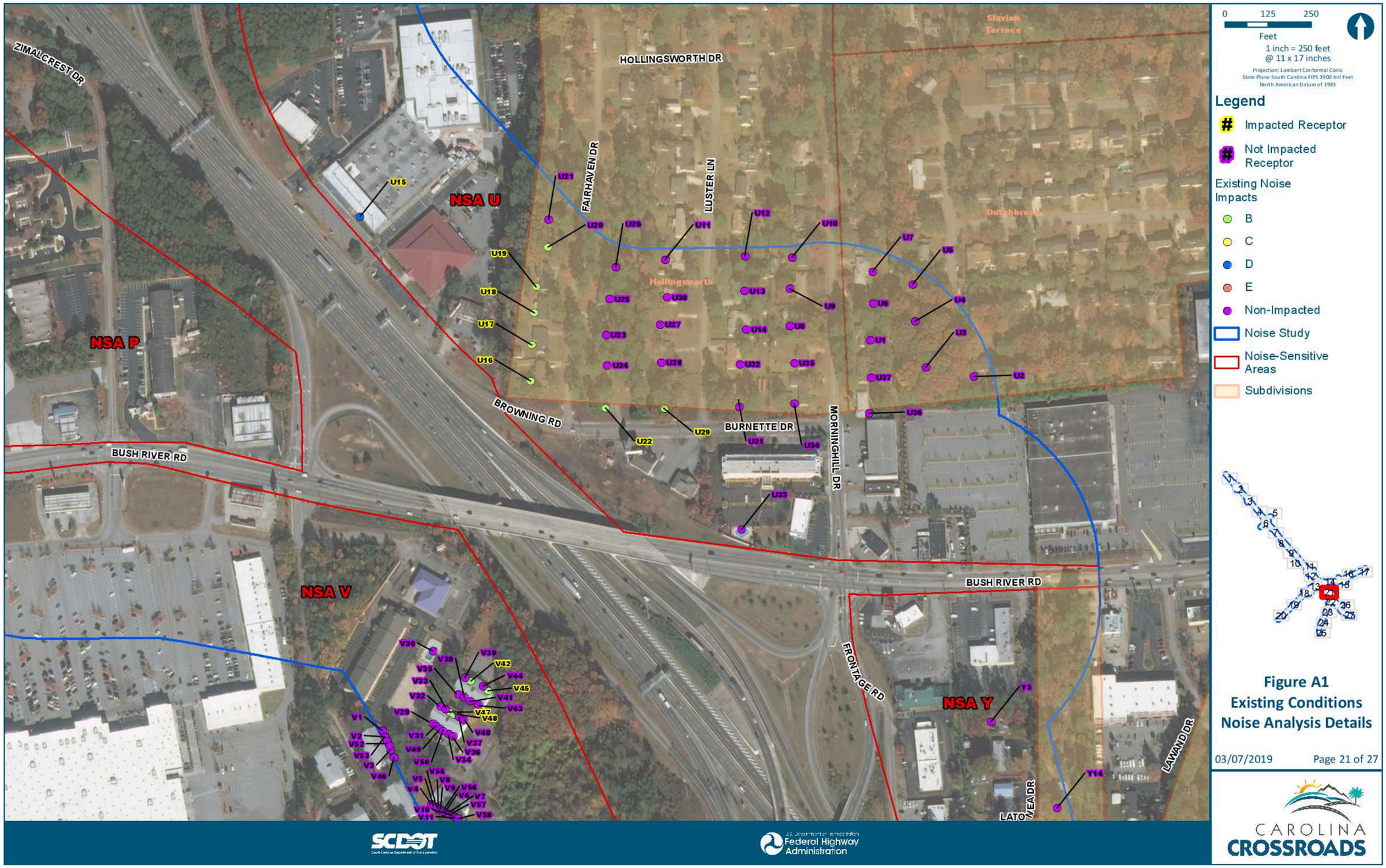


**Figure A1**
**Existing Conditions**
**Noise Analysis Details**

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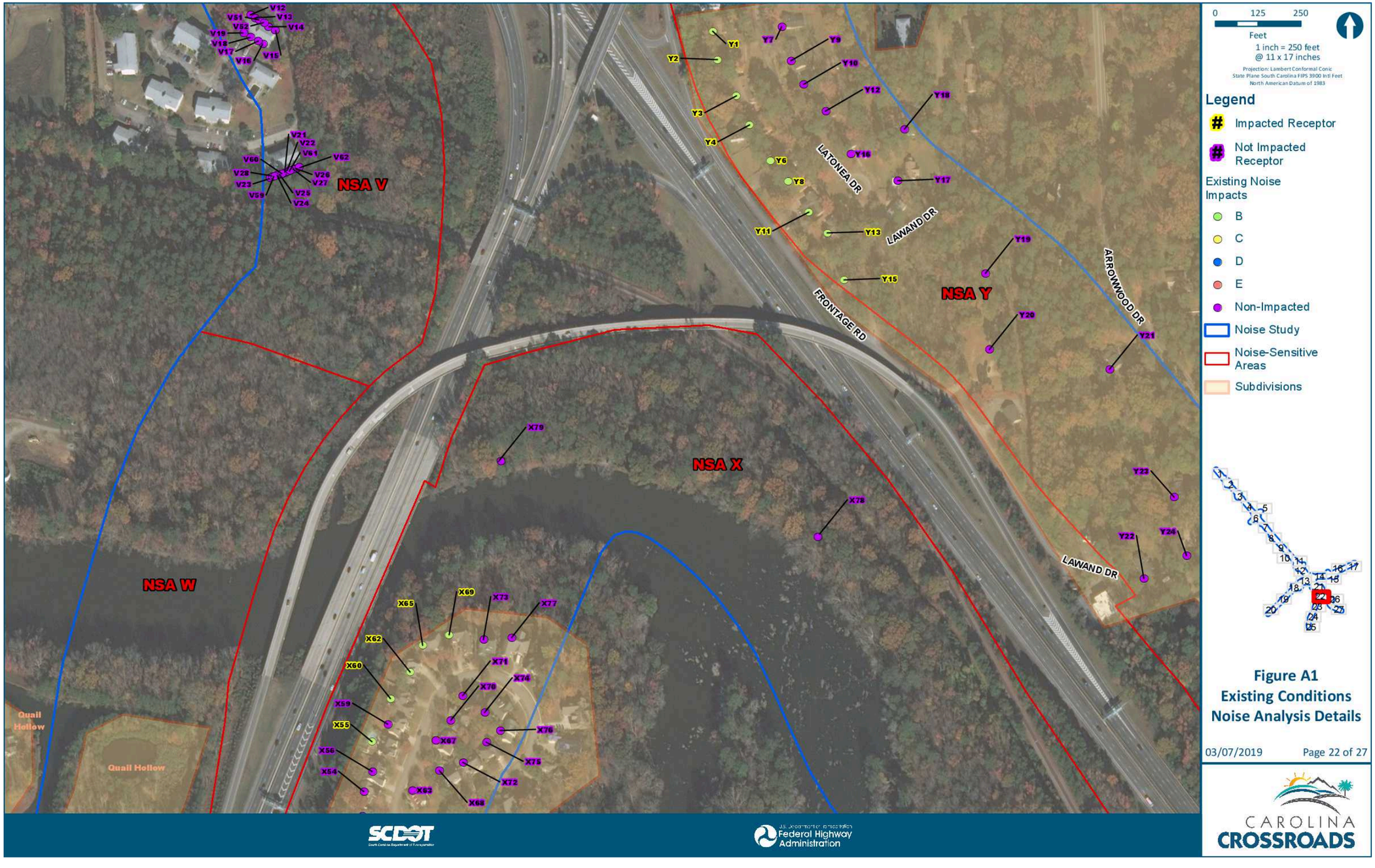


**Figure A1**
**Existing Conditions Noise Analysis Details**

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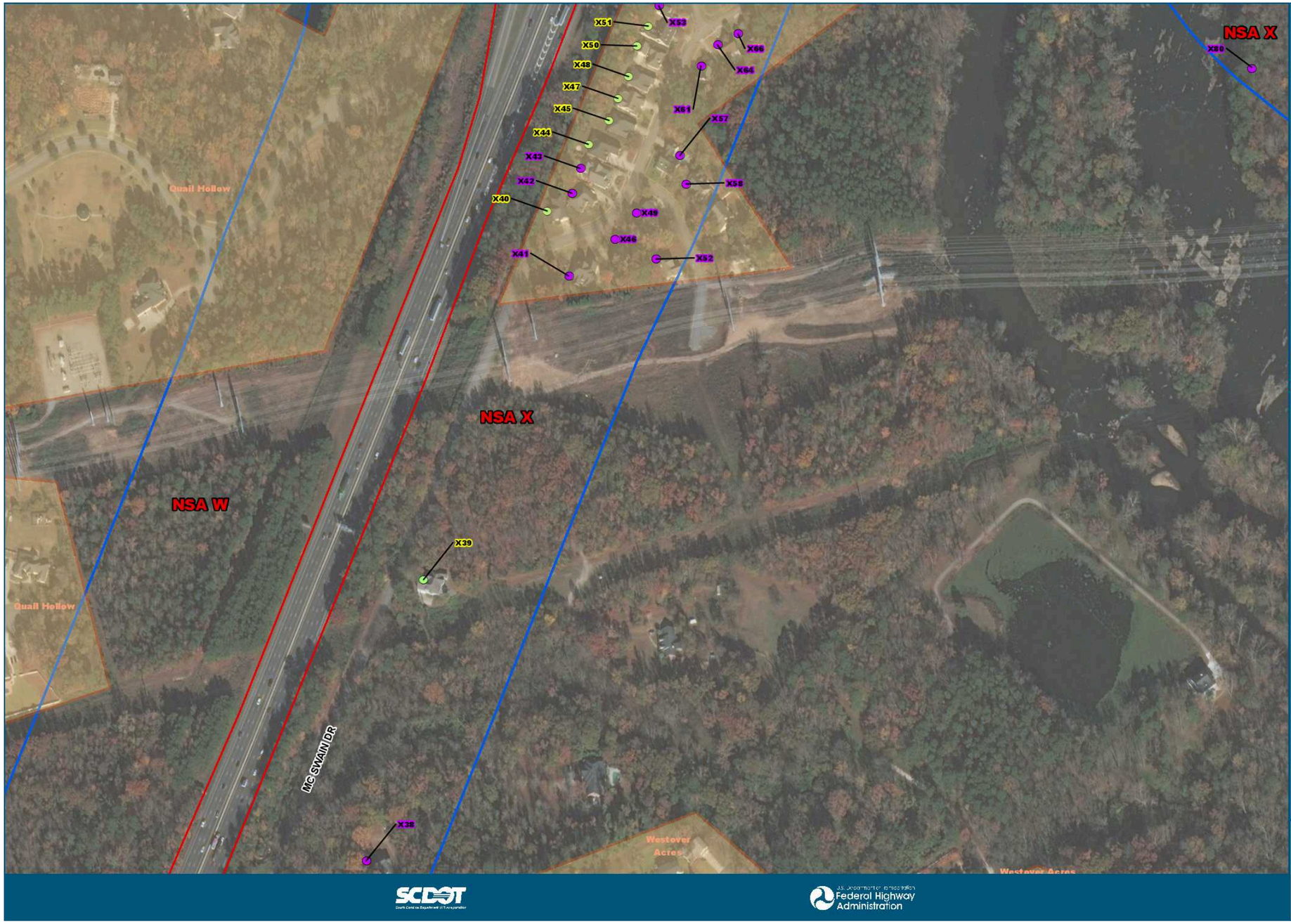


**Figure A1**
**Existing Conditions**
**Noise Analysis Details**

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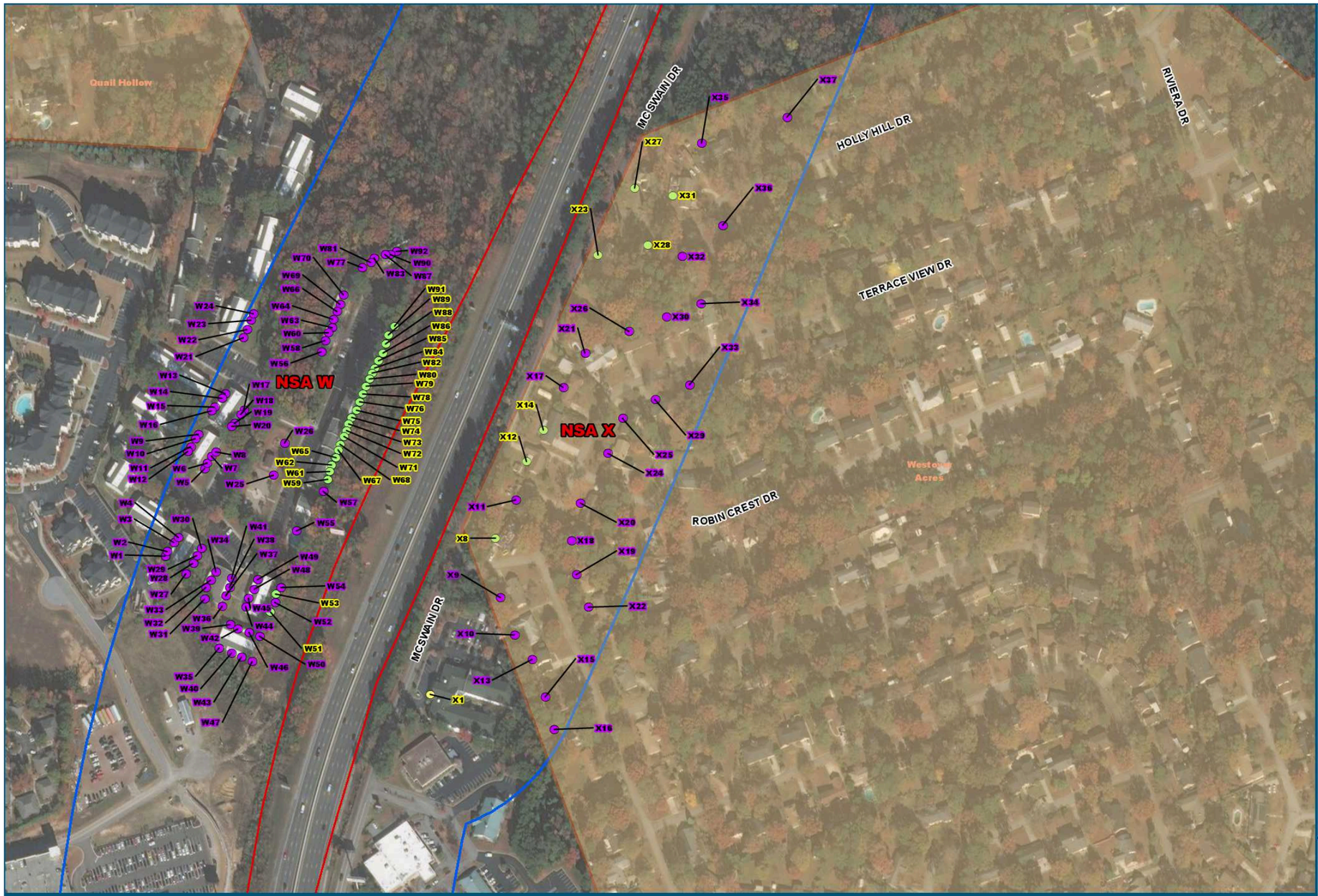


**Figure A1**
**Existing Conditions**
**Noise Analysis Details**

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**Figure A1**
**Existing Conditions**
**Noise Analysis Details**

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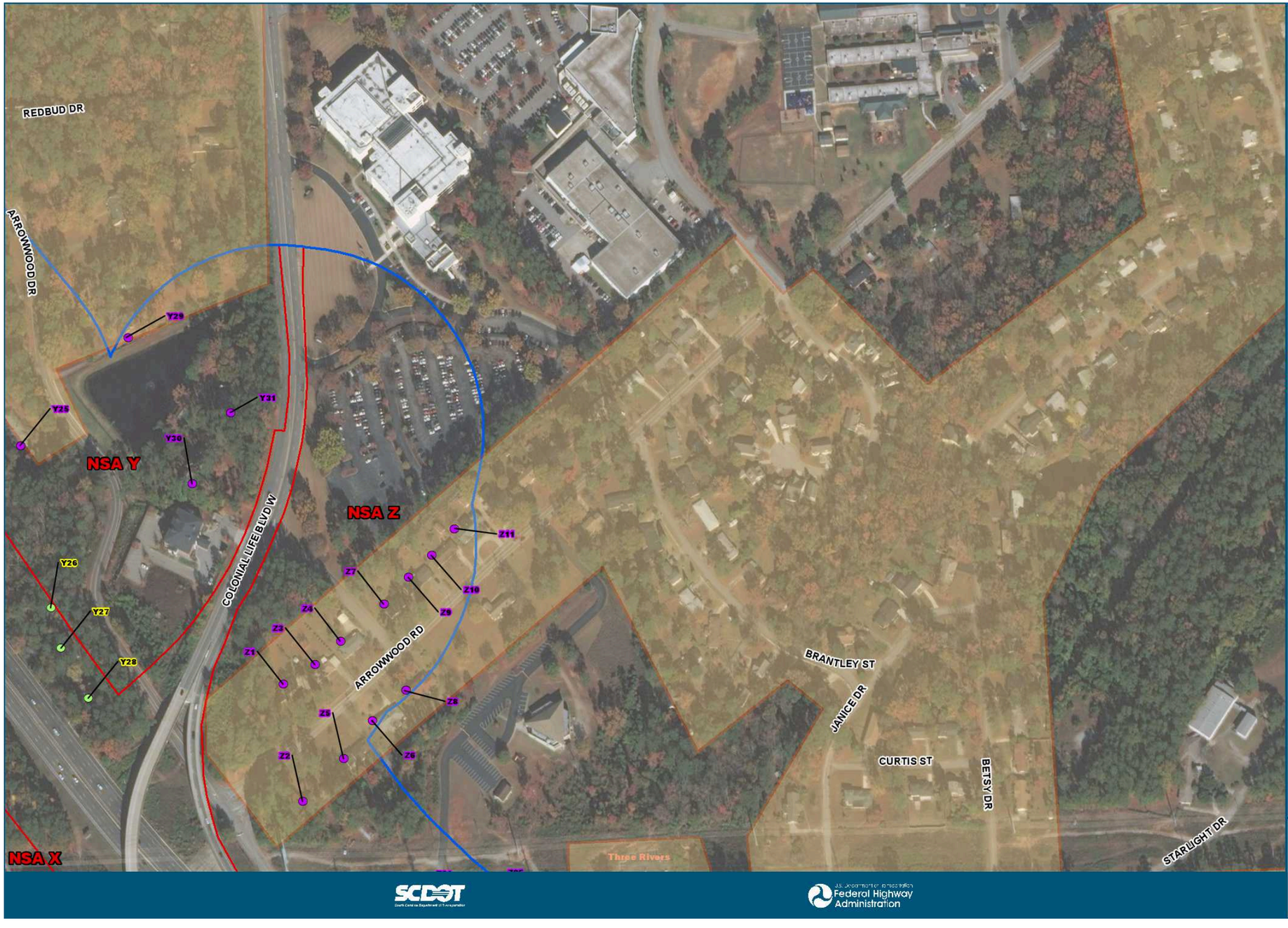


**Figure A1**
**Existing Conditions Noise Analysis Details**

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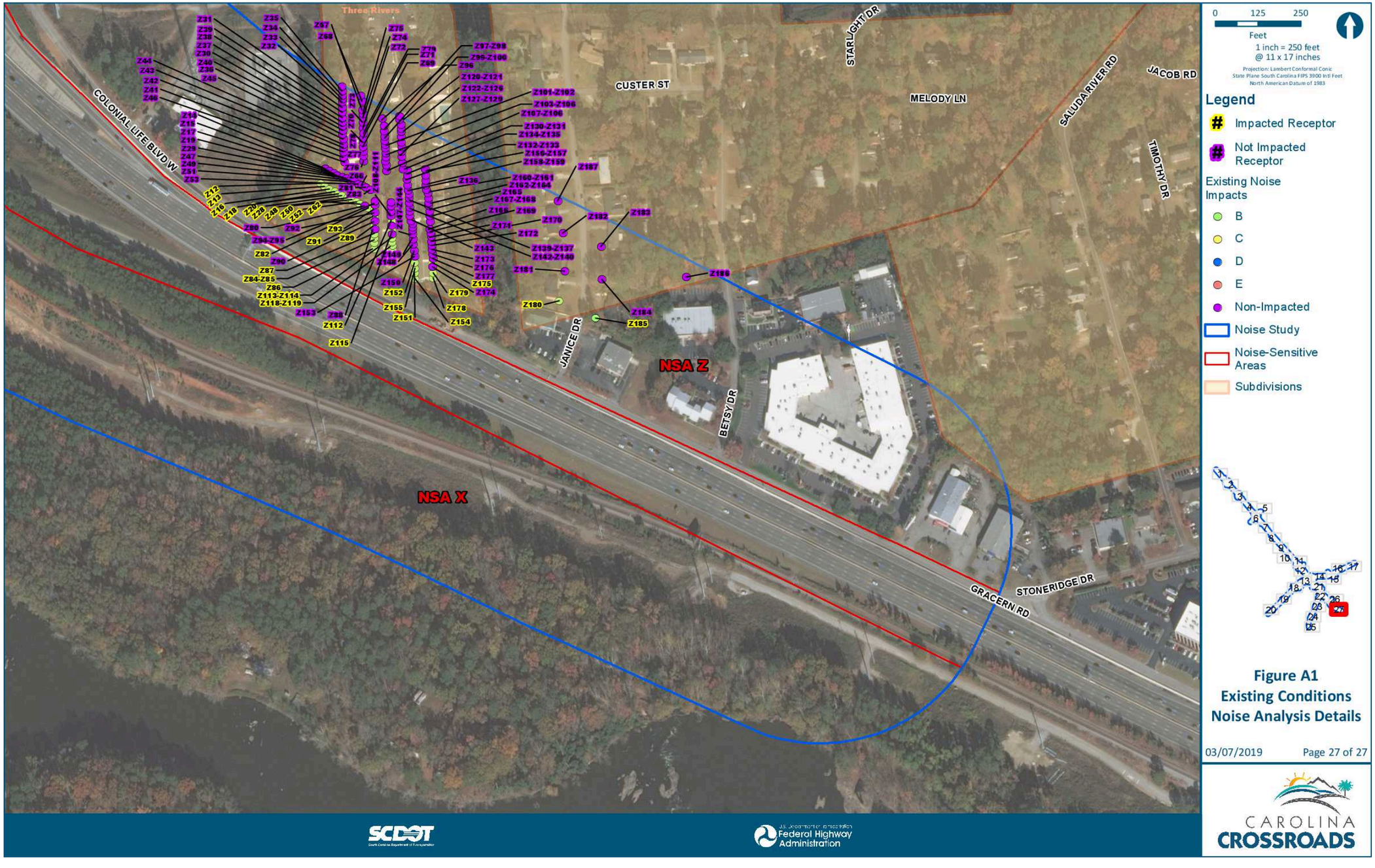
Three Rivers
COLONIAL LIFE BLVD W
CUSTER ST
STARLIGHT DR
MELODY LN
SALUDA RIVER RD
JACOB RD
TIMOTHY DR
JANICE DR
BETSY DR
GRACERN RD
STONERIDGE DR
NSA Z
NSA X
Z31 Z39 Z38 Z37 Z30 Z40 Z36 Z45 Z44 Z43 Z42 Z41 Z46
Z35 Z34 Z33 Z32
Z67 Z68
Z75 Z74 Z72 Z73 Z76 Z77 Z78 Z66 Z81 Z83 Z108 Z109-Z111
Z79 Z71 Z69
Z97-Z98 Z99-Z100 Z96 Z120-Z121 Z122-Z126 Z127-Z129
Z101-Z102 Z103-Z106 Z107-Z106 Z130-Z131 Z134-Z135 Z132-Z133 Z156-Z157 Z158-Z159
Z14 Z15 Z17 Z19 Z29 Z47 Z49 Z51 Z53
Z42 Z43 Z16 Z18 Z20 Z28 Z48 Z50 Z52 Z54
Z80 Z92 Z93 Z94-Z95 Z91 Z89 Z82 Z90 Z87 Z84-Z85 Z86 Z112-Z114 Z118-Z119 Z153 Z88 Z112 Z115
Z148 Z149 Z150 Z152 Z155 Z151
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Z187 Z170 Z182 Z183 Z129-Z137 Z142-Z140 Z181 Z180 Z186 Z184 Z185
0 125 250
Feet
1 inch = 250 feet
@ 11 x 17 inches
Projection: Lambert Conformal Conic
State Plane South Carolina FIPS 3900 Intl Feet
North American Datum of 1983
Legend
Impacted Receptor
Not Impacted Receptor
Existing Noise Impacts
B
C
D
E
Non-Impacted
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**Figure A2**
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**Noise Analysis Details**

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**Figure A2**
**No-Build**
**Noise Analysis Details**

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**Figure A2**
**No-Build**
**Noise Analysis Details**

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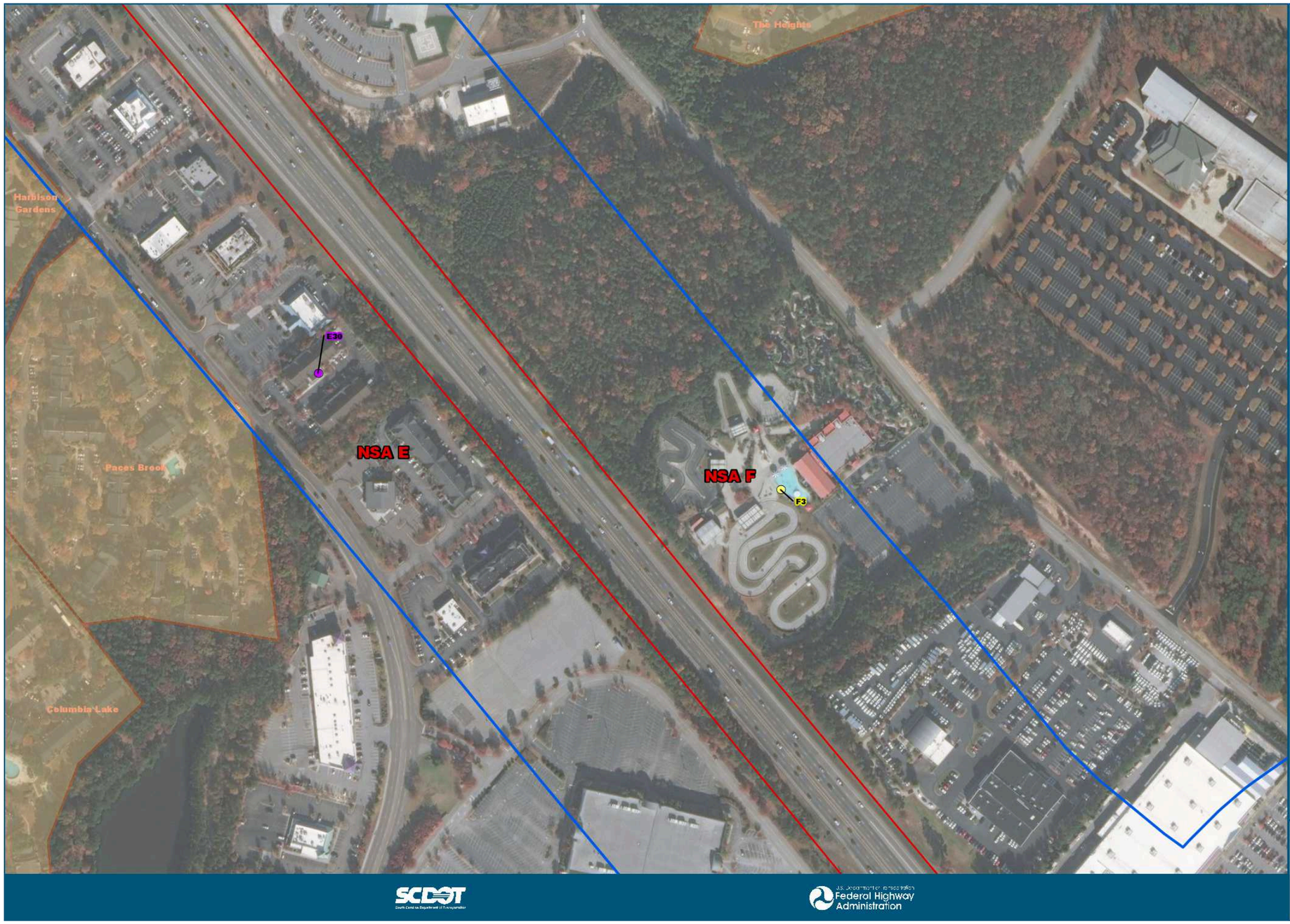


**Figure A2**
**No-Build**
**Noise Analysis Details**

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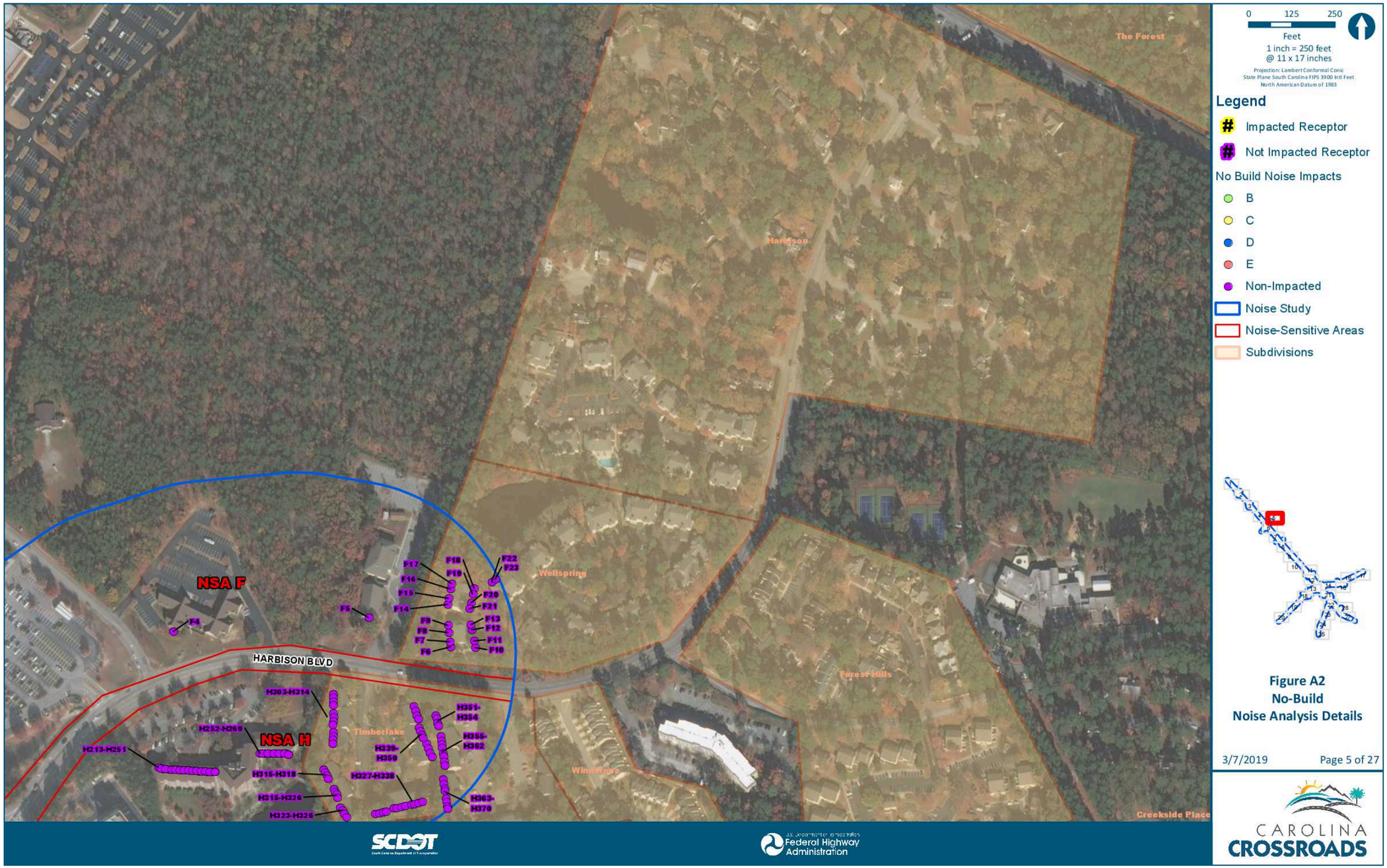


Figure A2
No-Build
Noise Analysis Details

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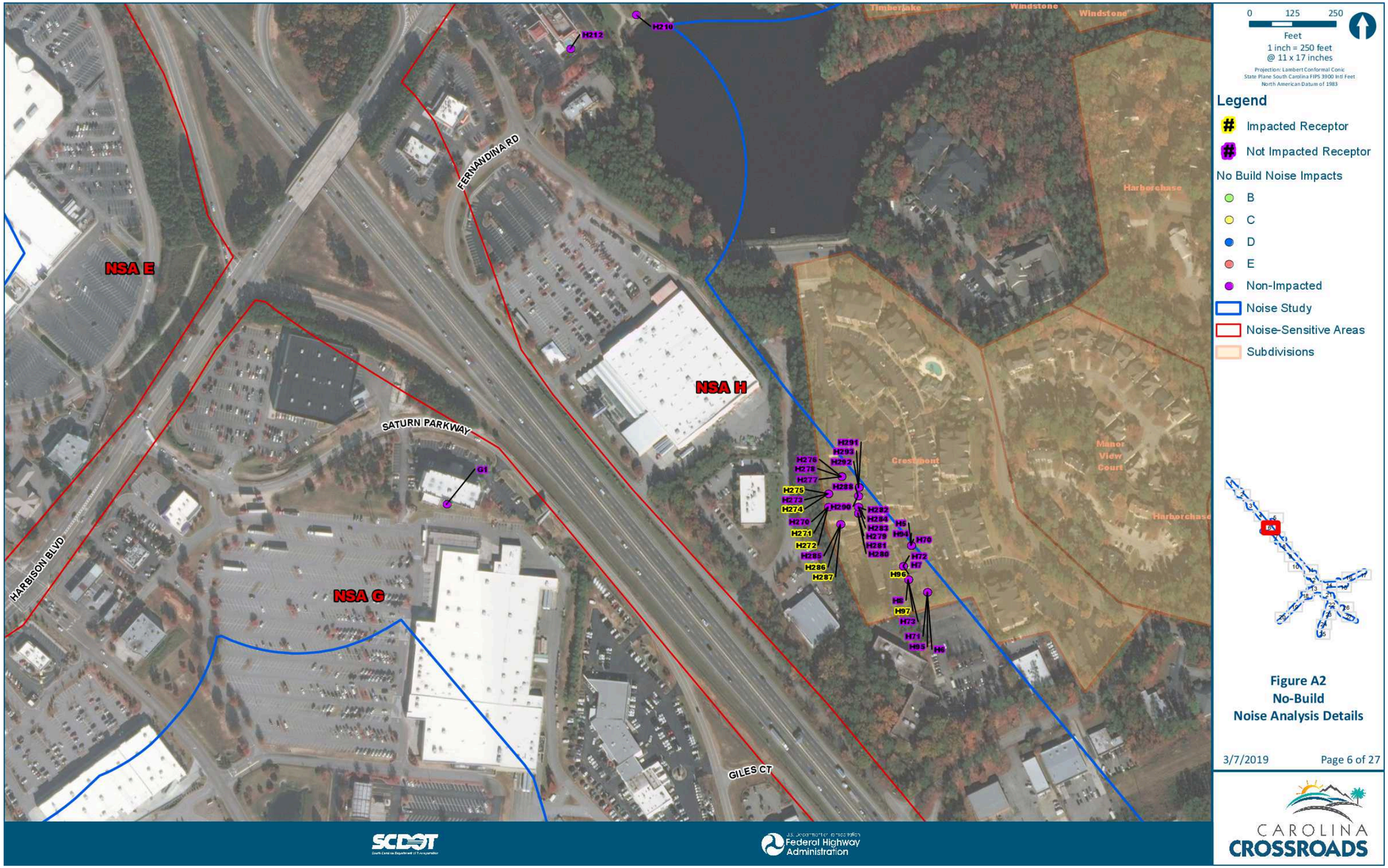




**Figure A2**
**No-Build**
**Noise Analysis Details**

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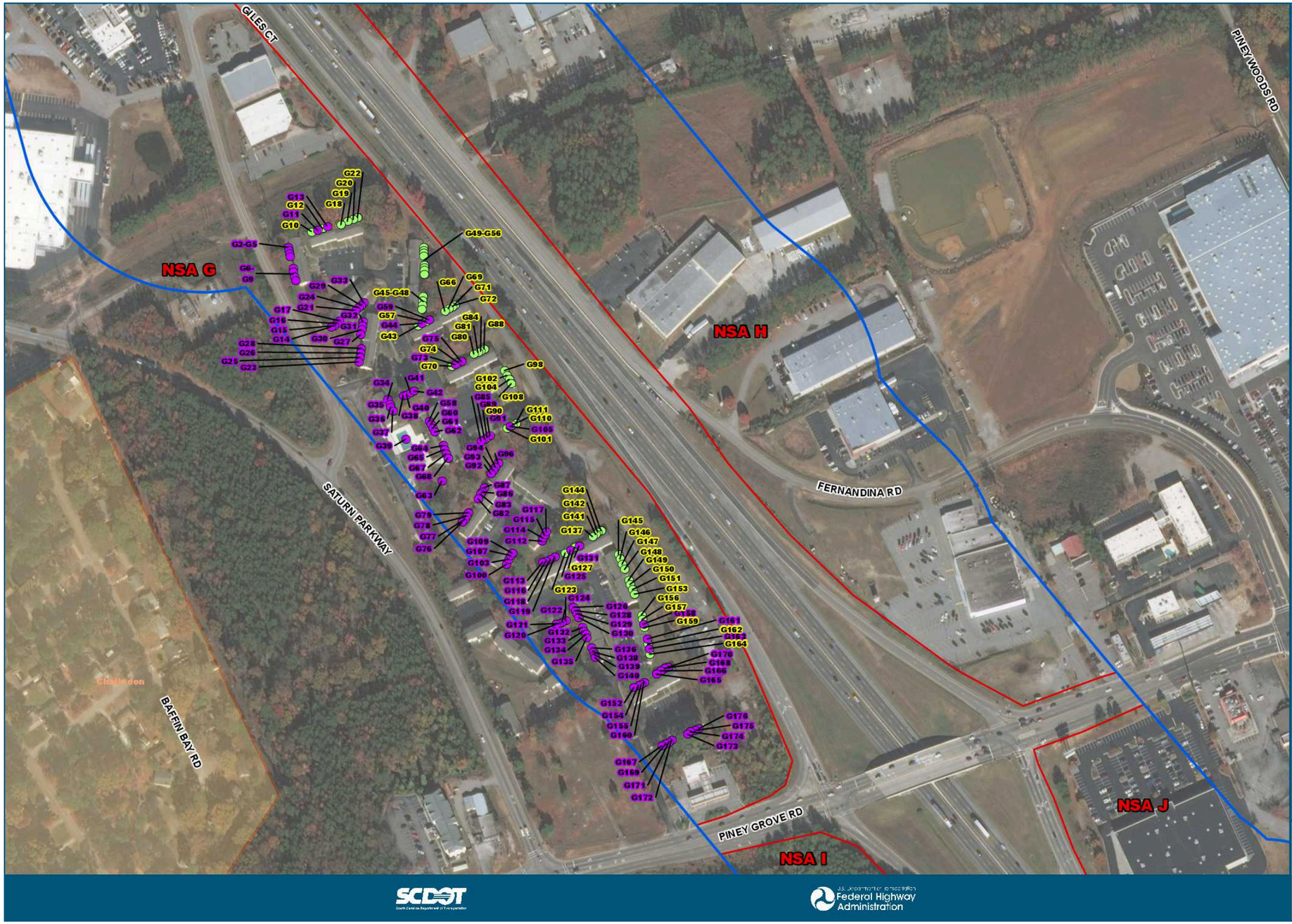


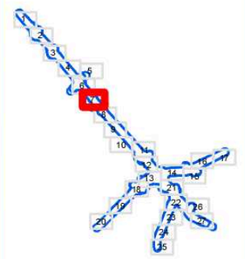

**Figure A2**
**No-Build**
**Noise Analysis Details**

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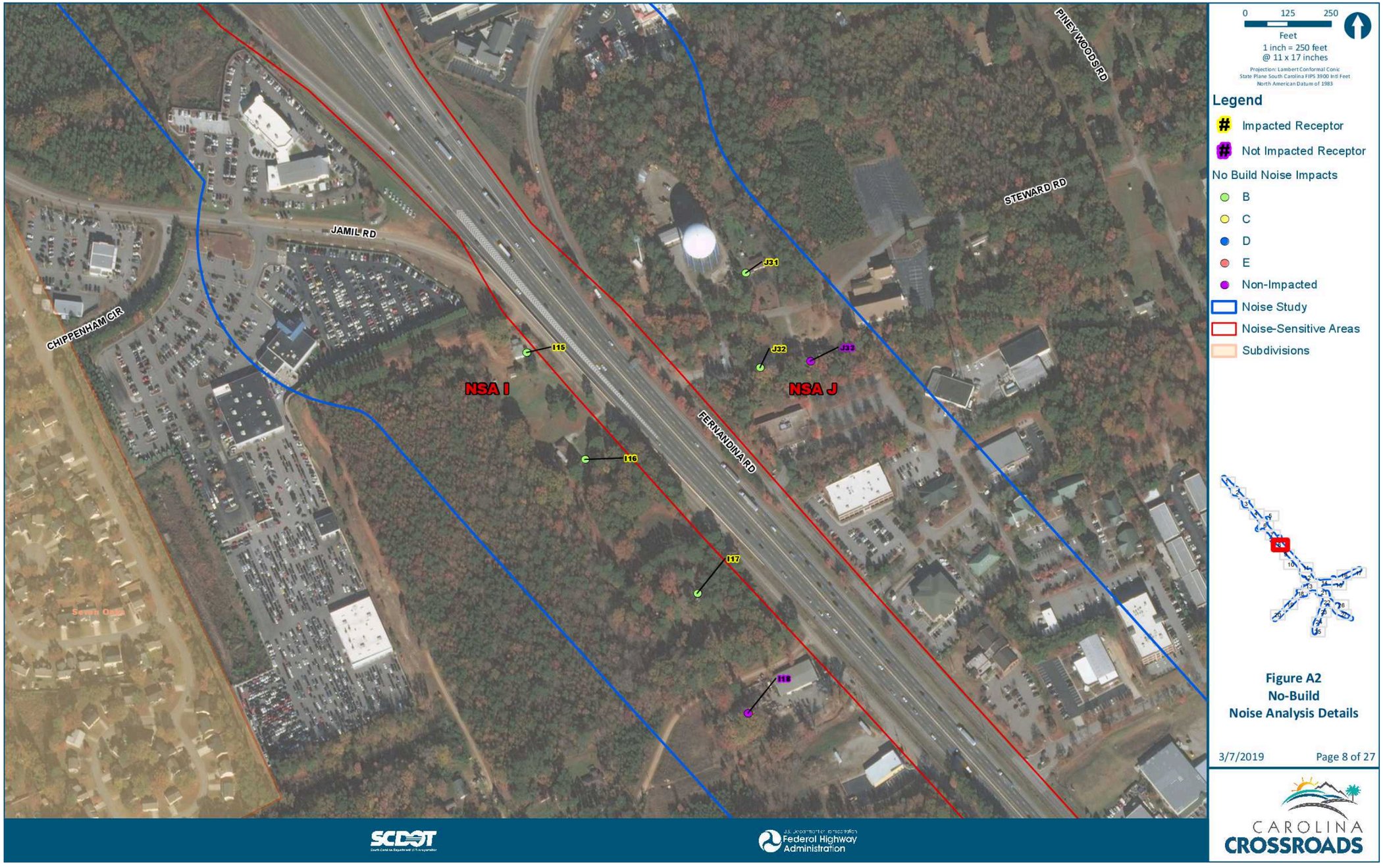




**Figure A2**
**No-Build**
**Noise Analysis Details**

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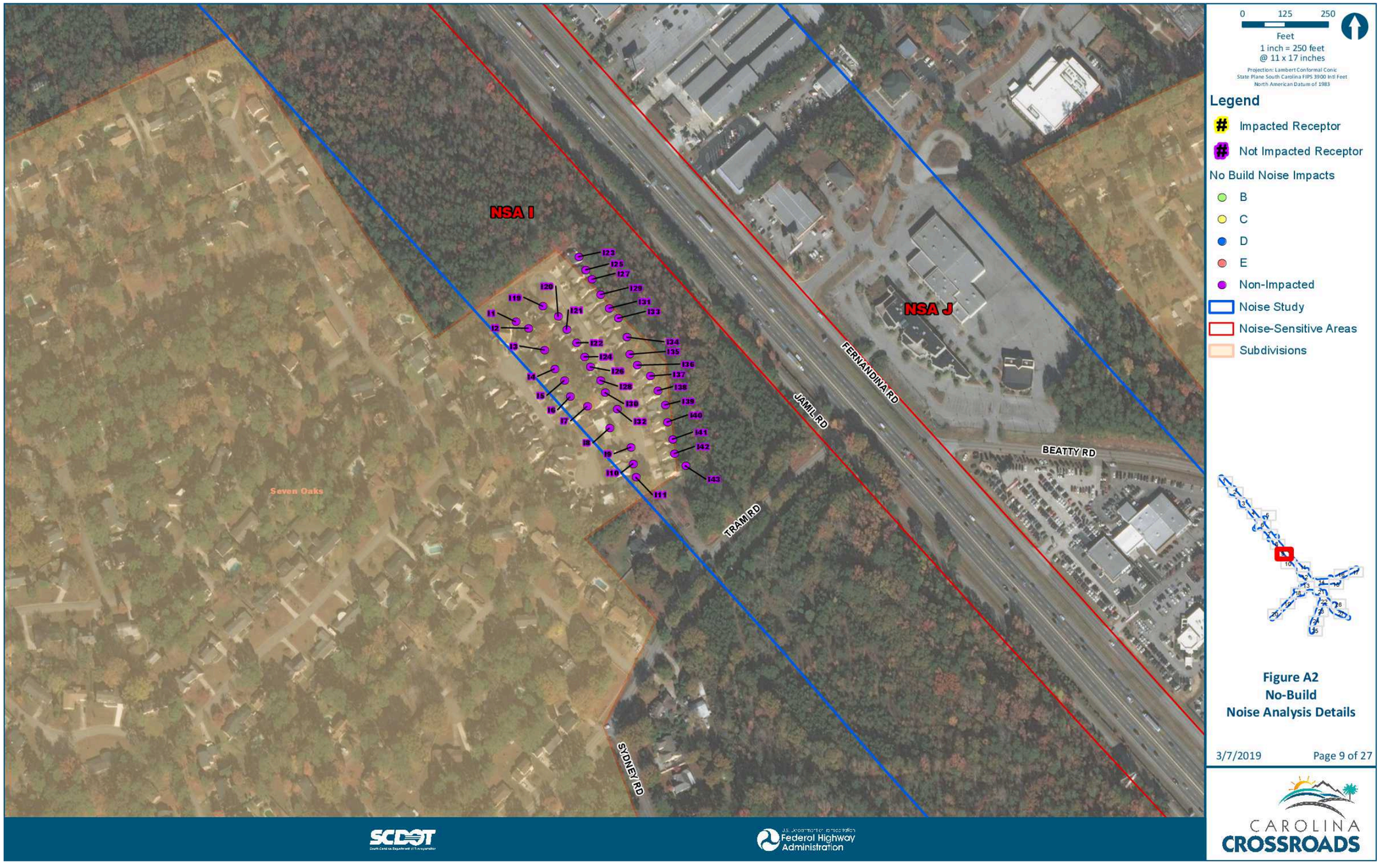


**Figure A2**
**No-Build**
**Noise Analysis Details**

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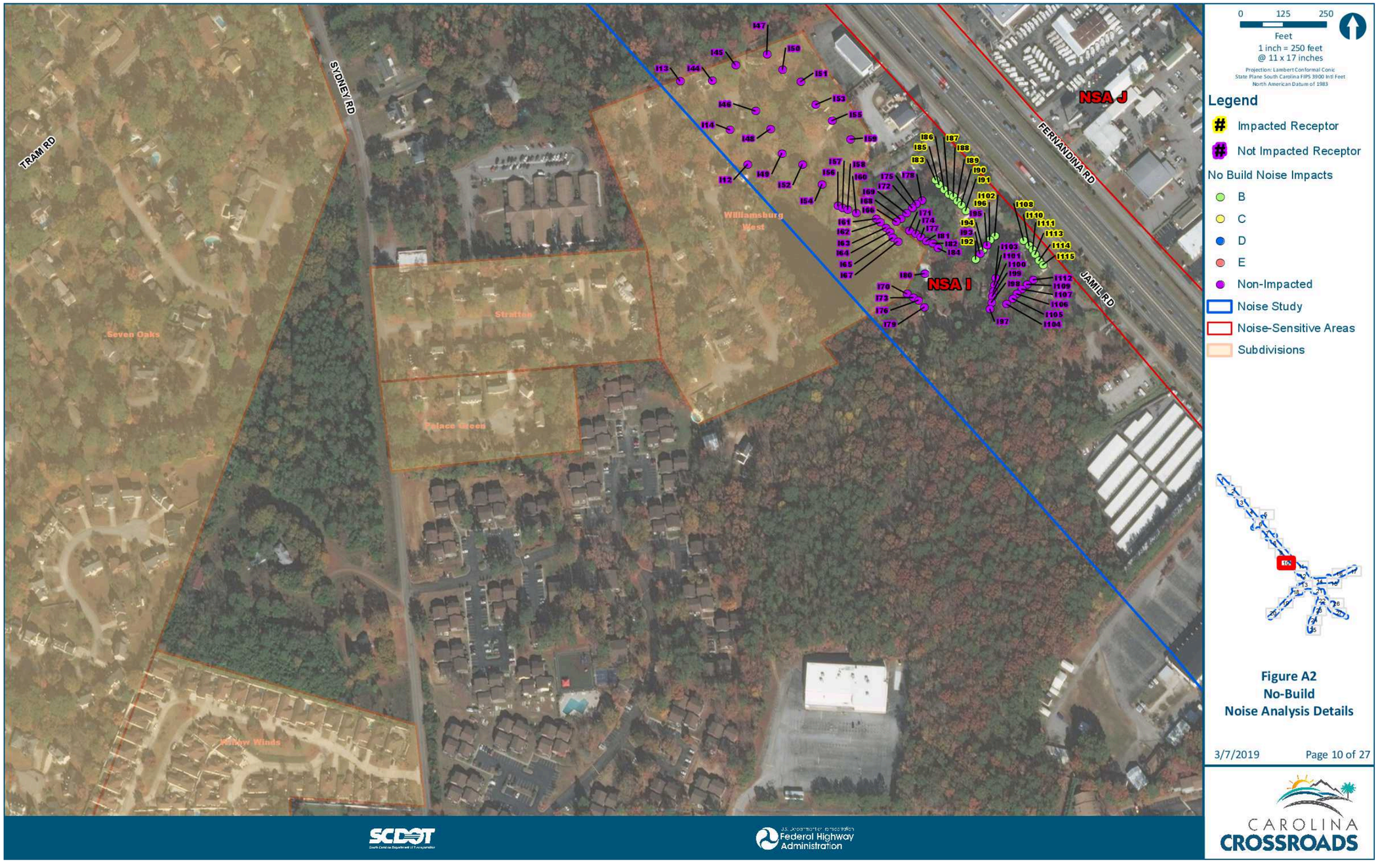


**Figure A2**
**No-Build**
**Noise Analysis Details**

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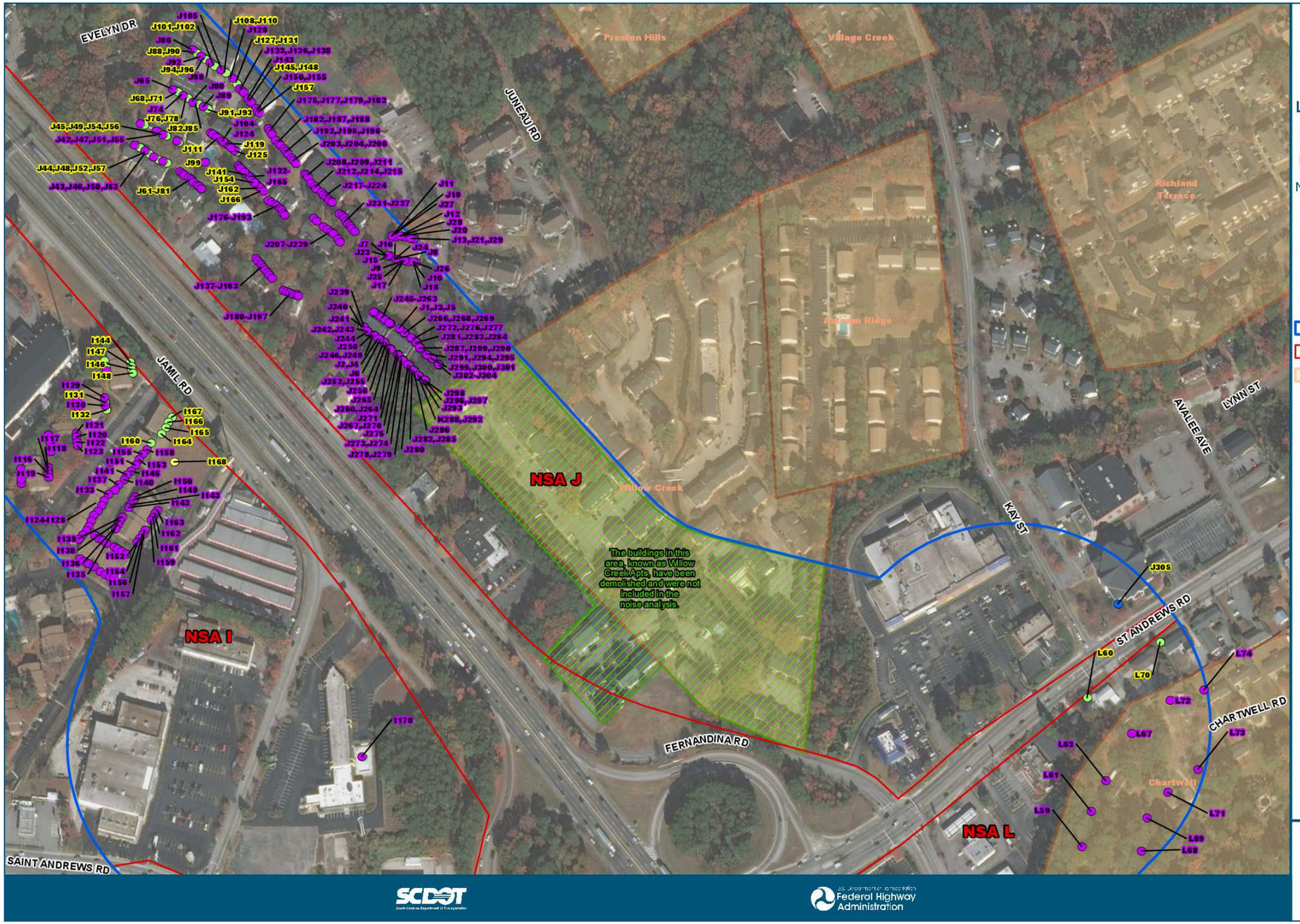


**Figure A2**
**No-Build**
**Noise Analysis Details**

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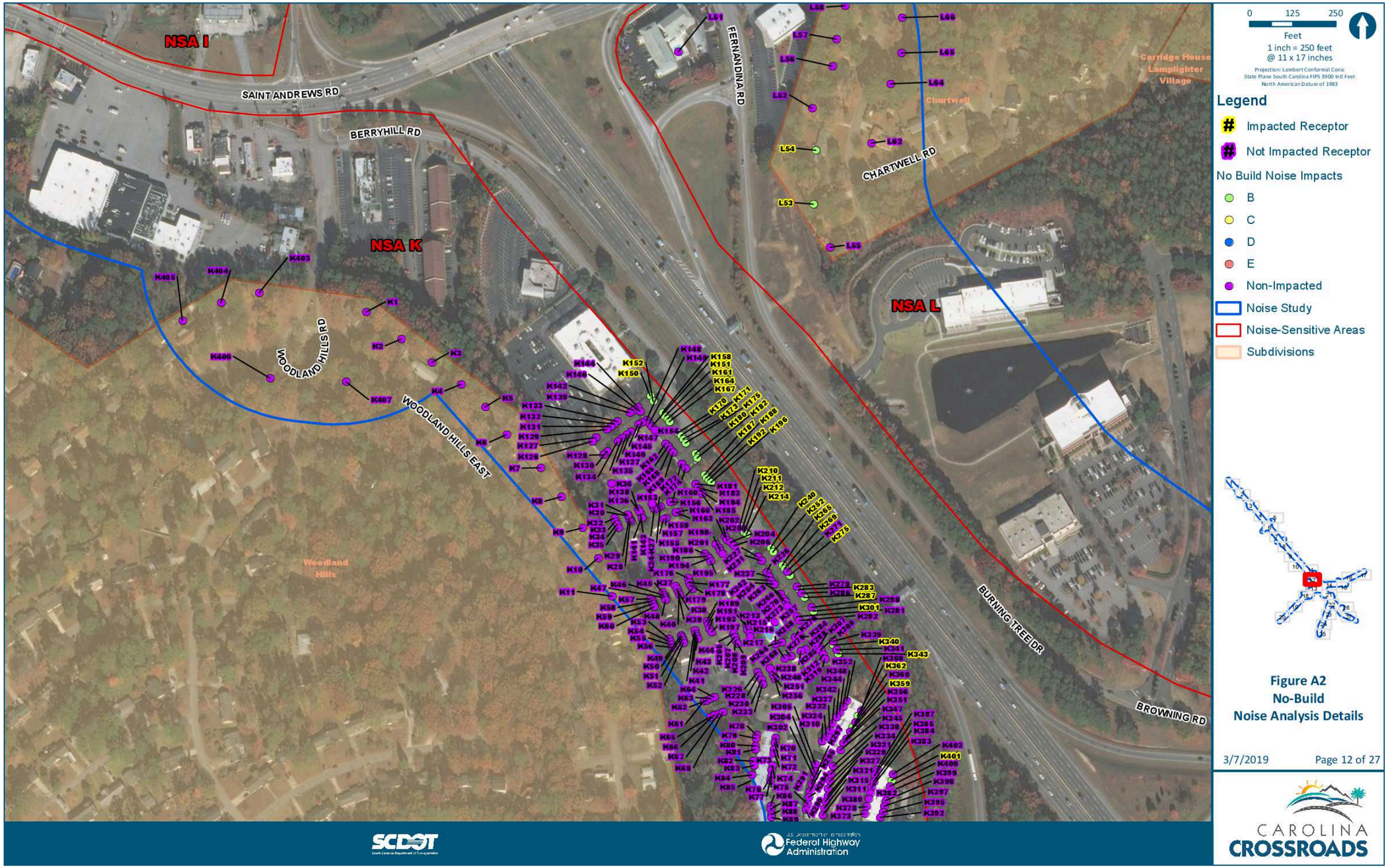


**Figure A2**
**No-Build**
**Noise Analysis Details**

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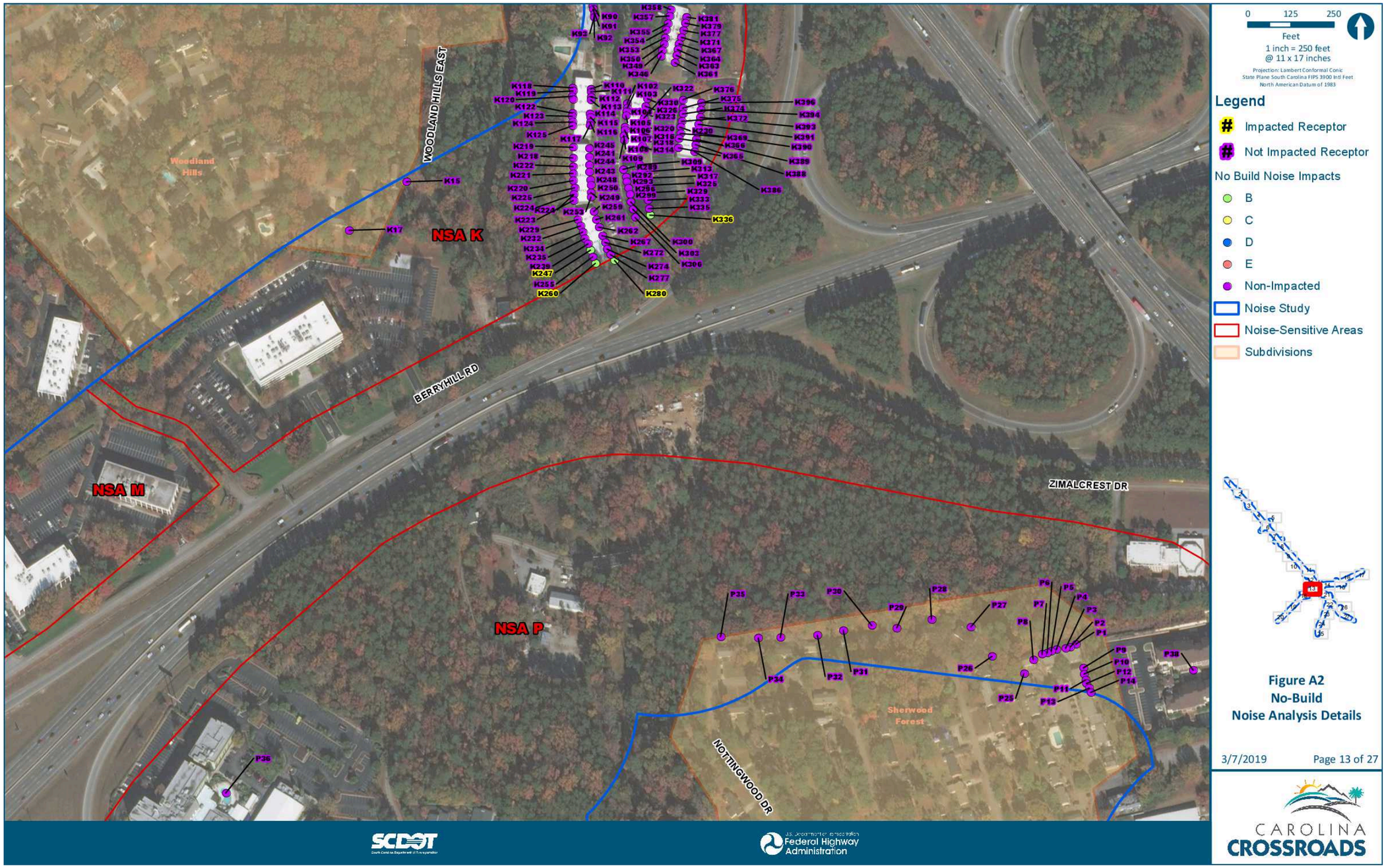


**Figure A2**
**No-Build**
**Noise Analysis Details**

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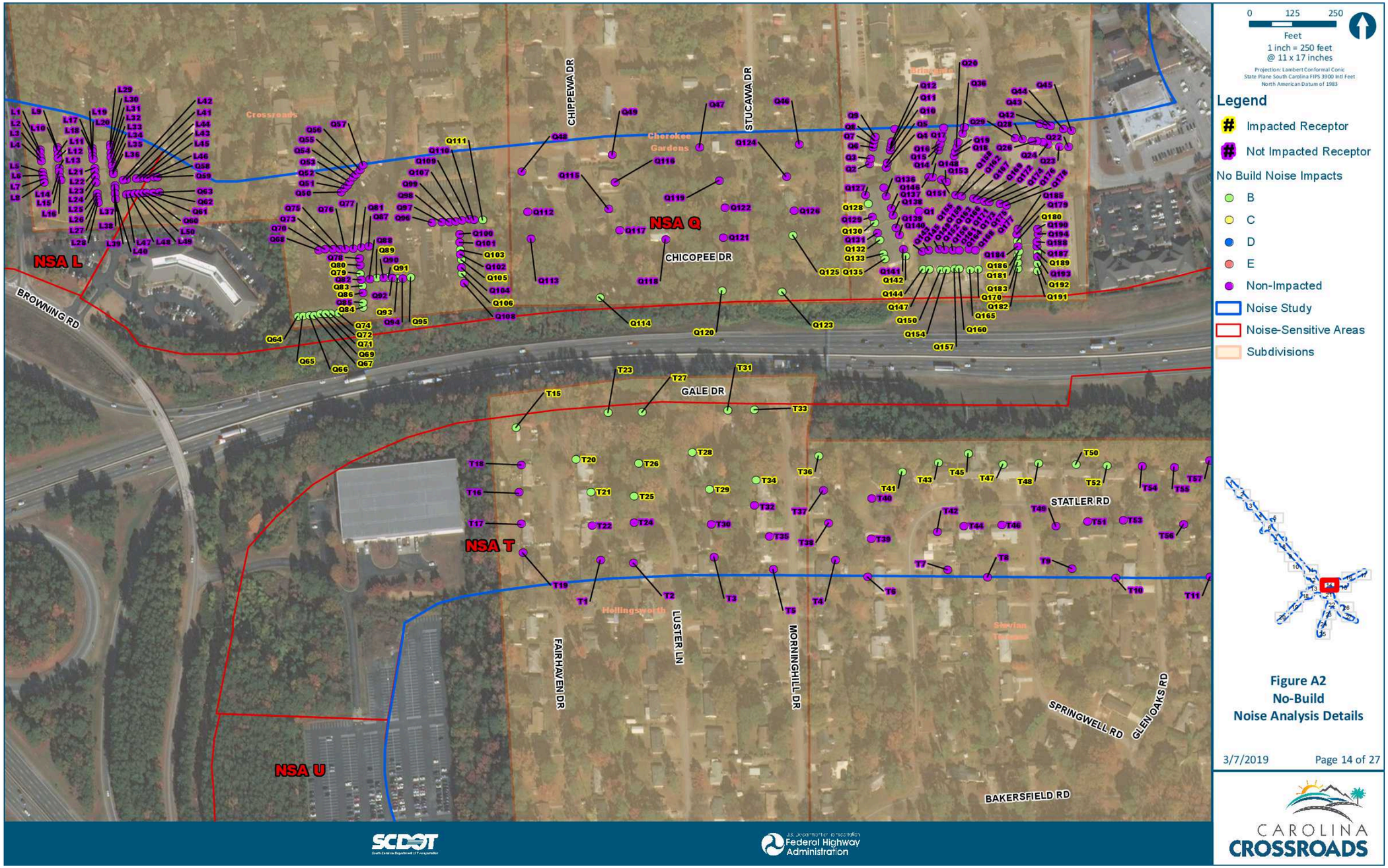


**Figure A2**
**No-Build**
**Noise Analysis Details**

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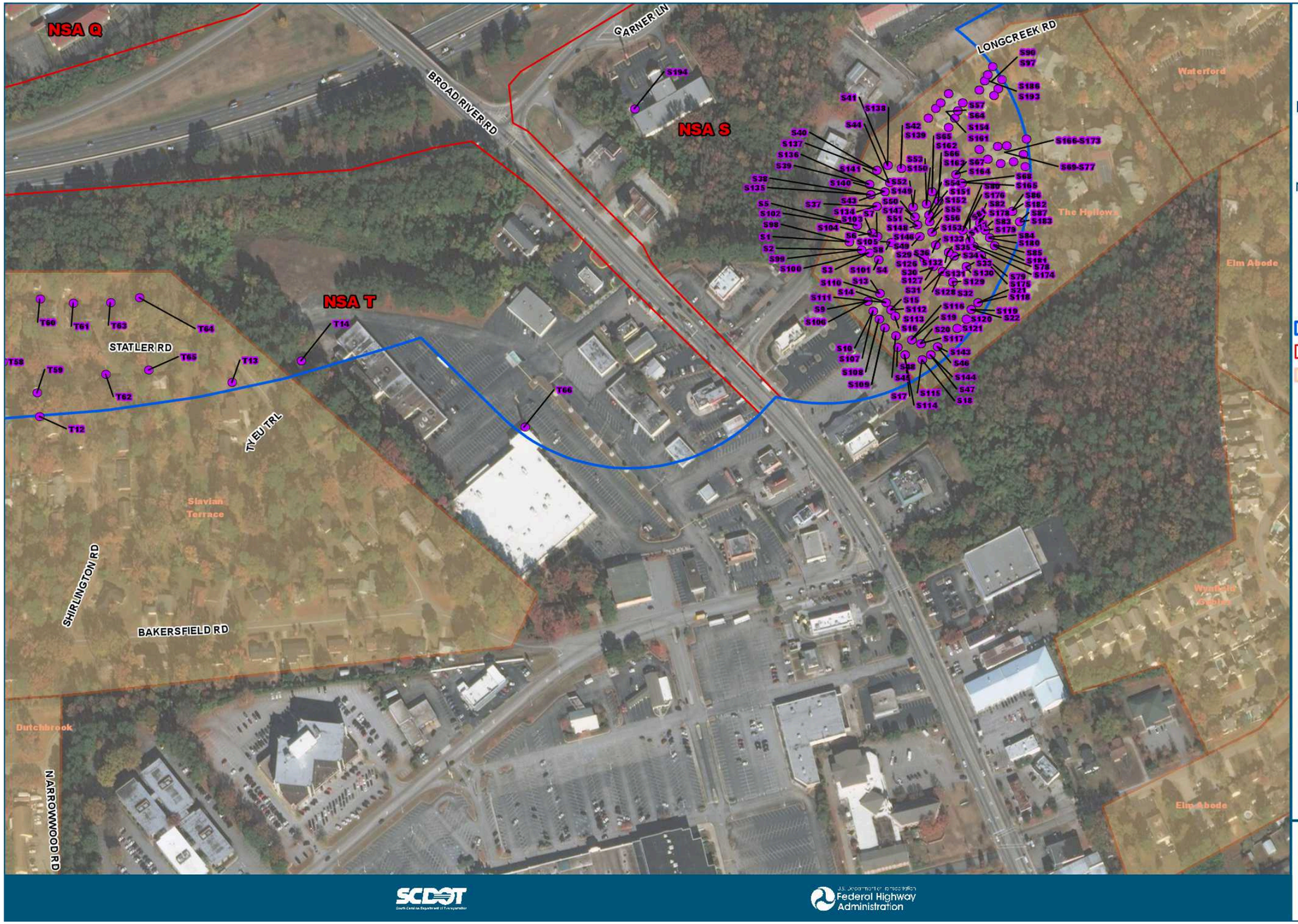


**Figure A2**
**No-Build**
**Noise Analysis Details**

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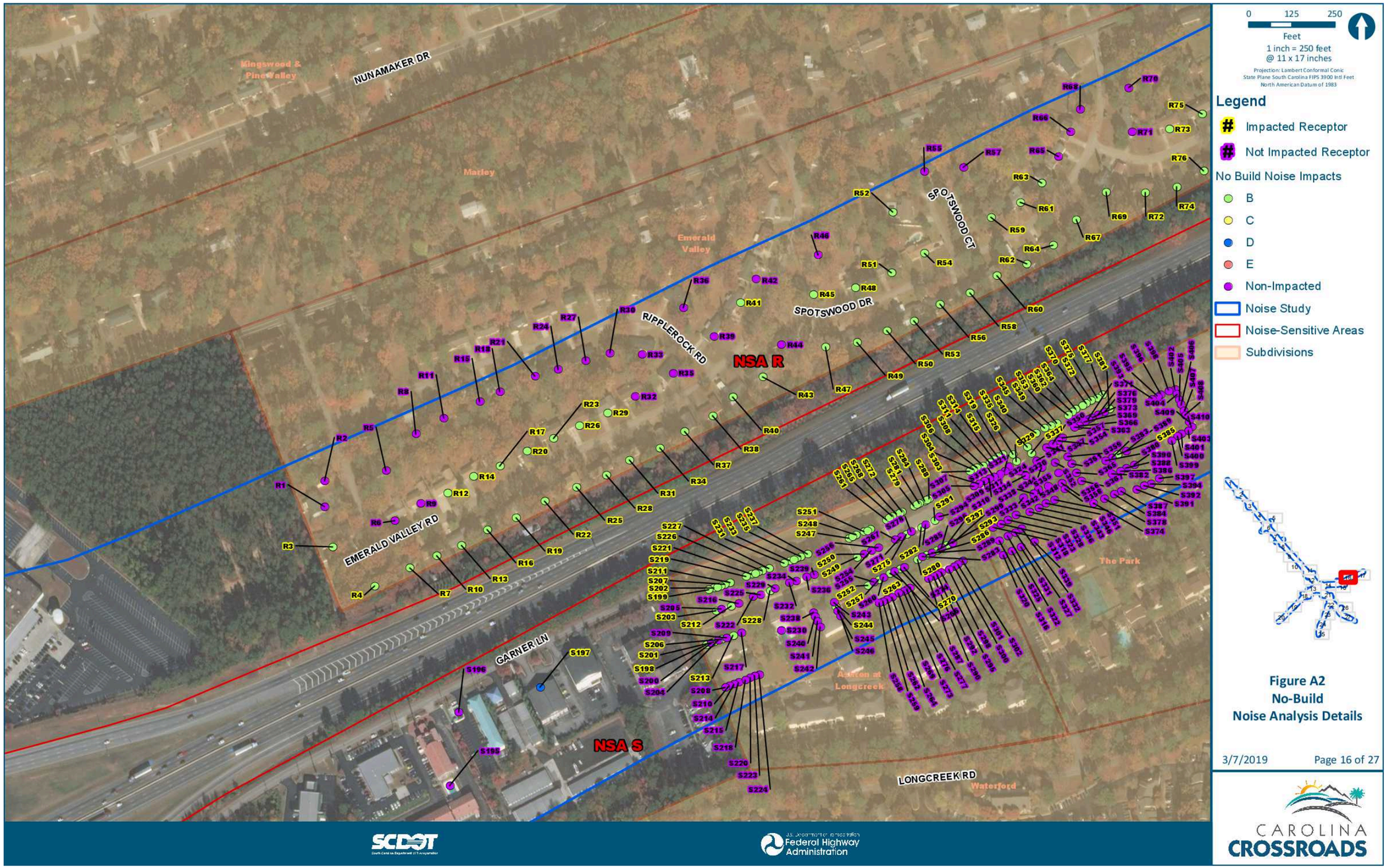


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**Noise Analysis Details**

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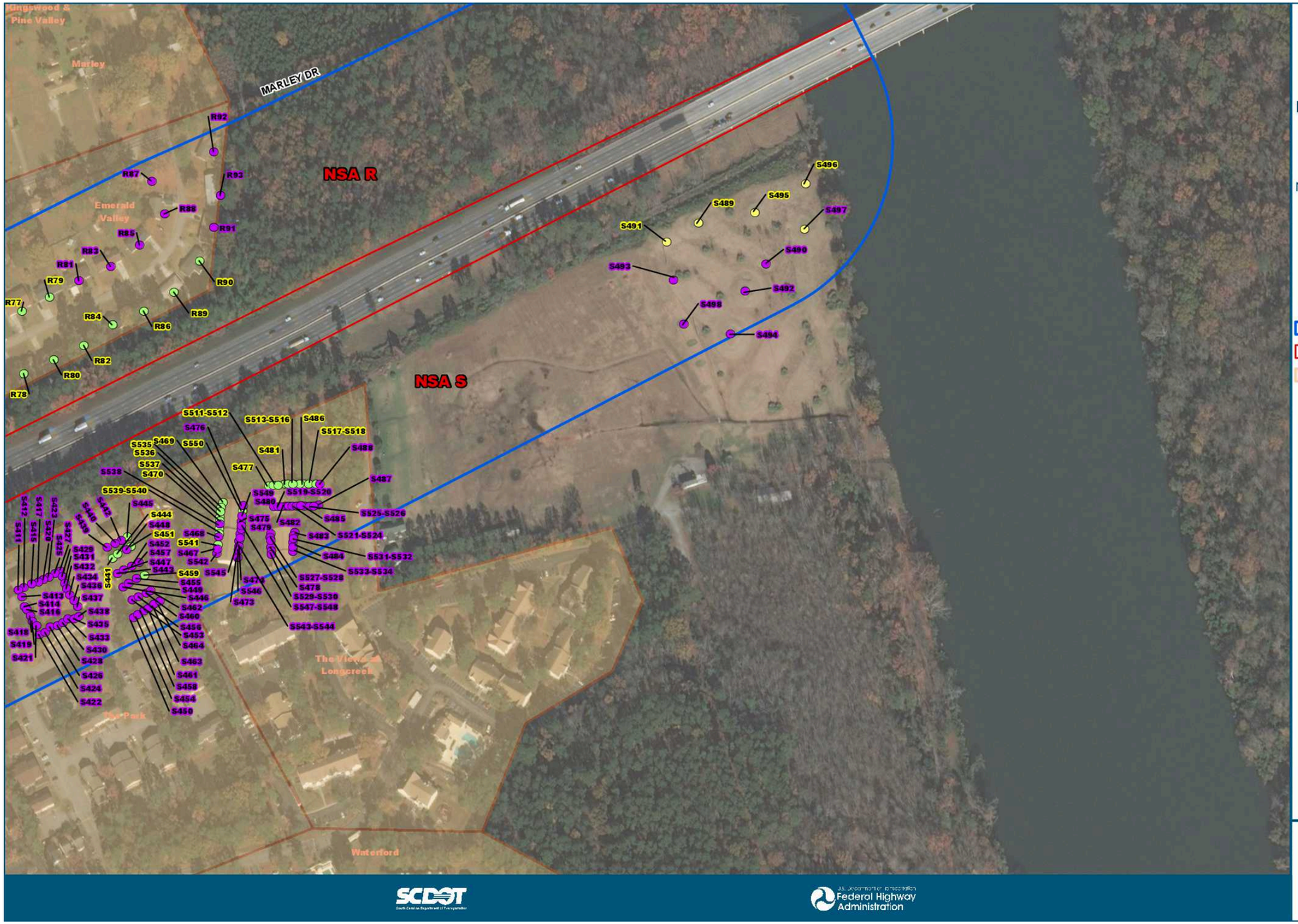


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**Noise Analysis Details**

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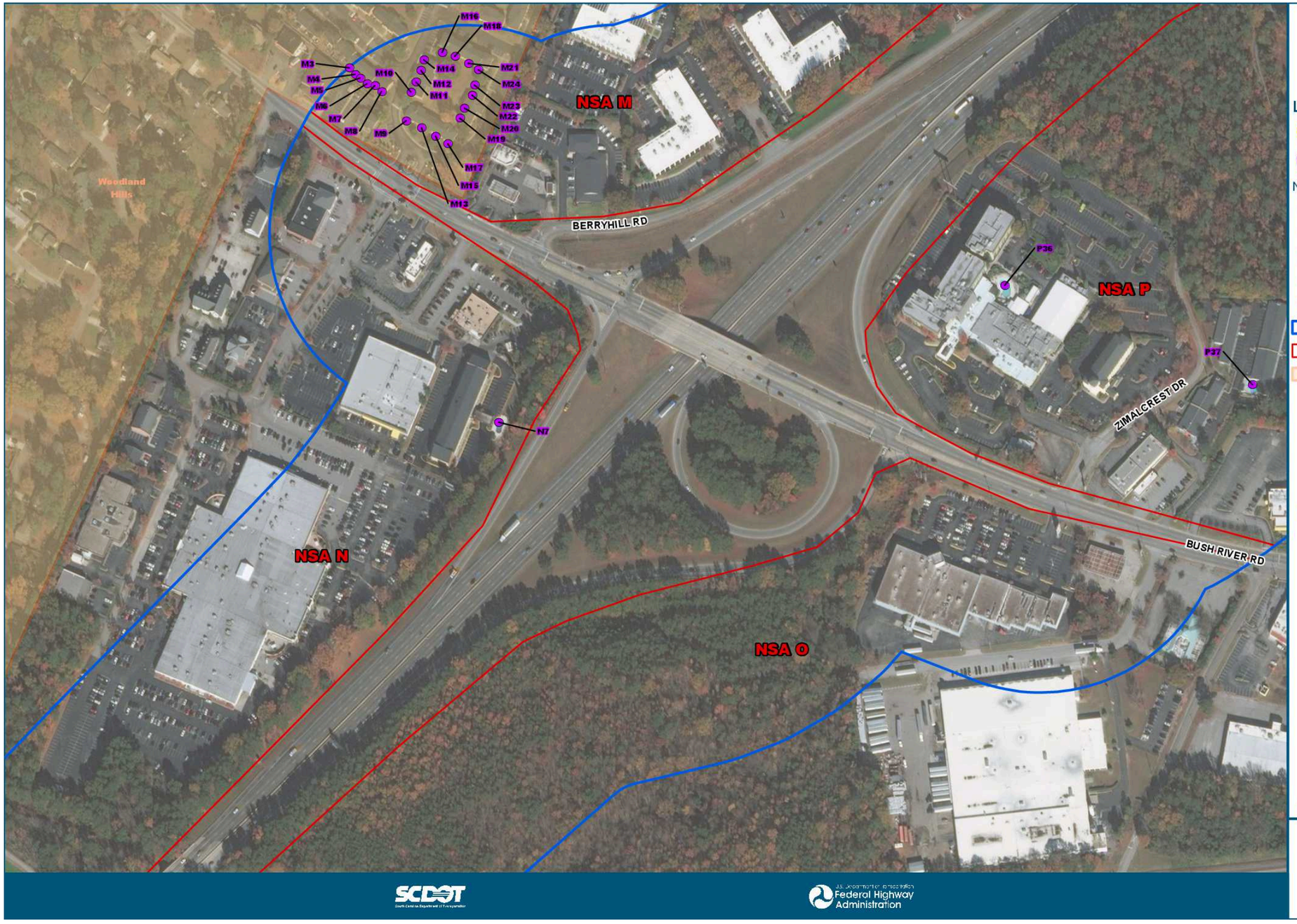


**Figure A2**
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**Noise Analysis Details**

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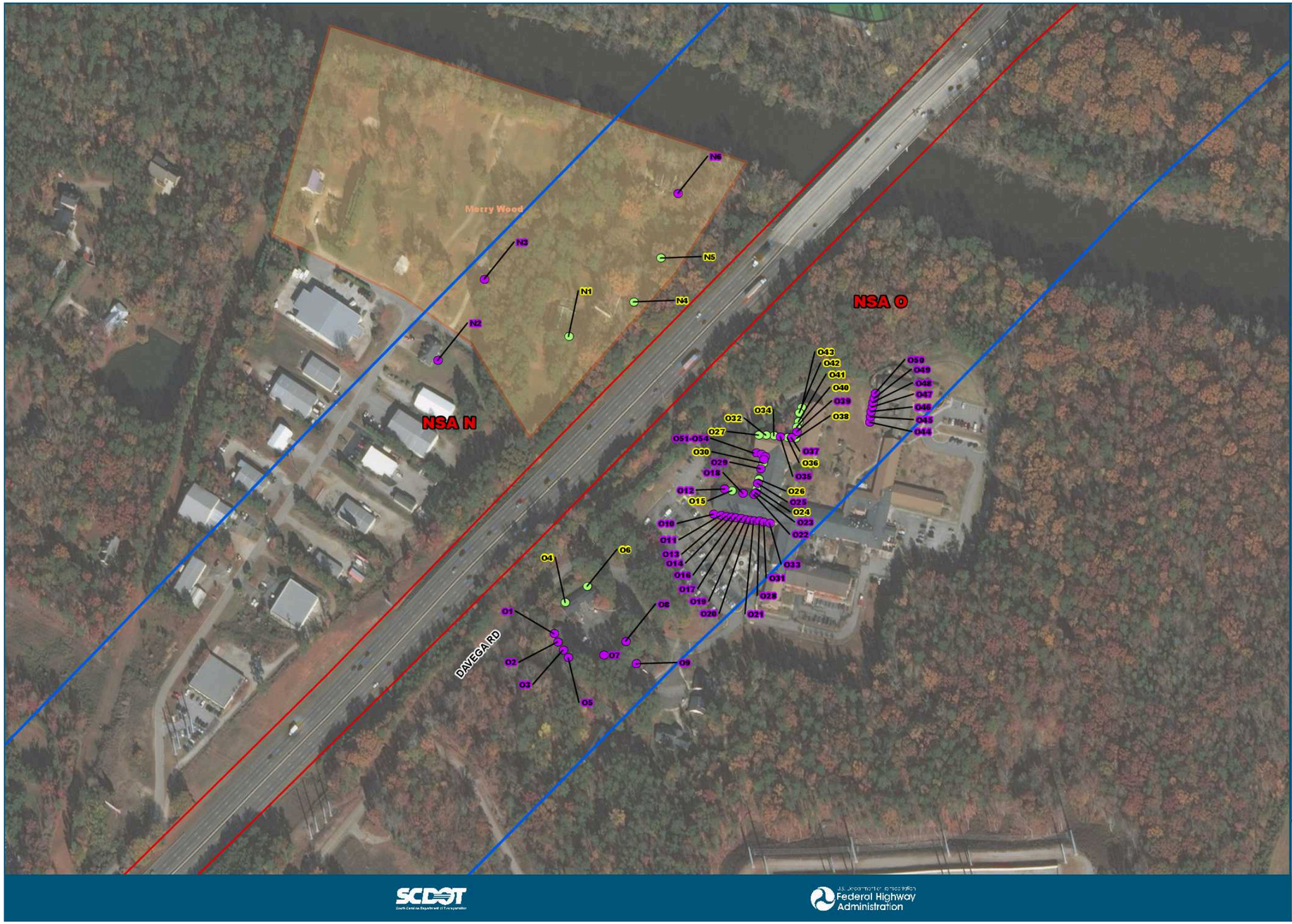





**Figure A2**
**No-Build**
**Noise Analysis Details**

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**Figure A2**
**No-Build**
**Noise Analysis Details**

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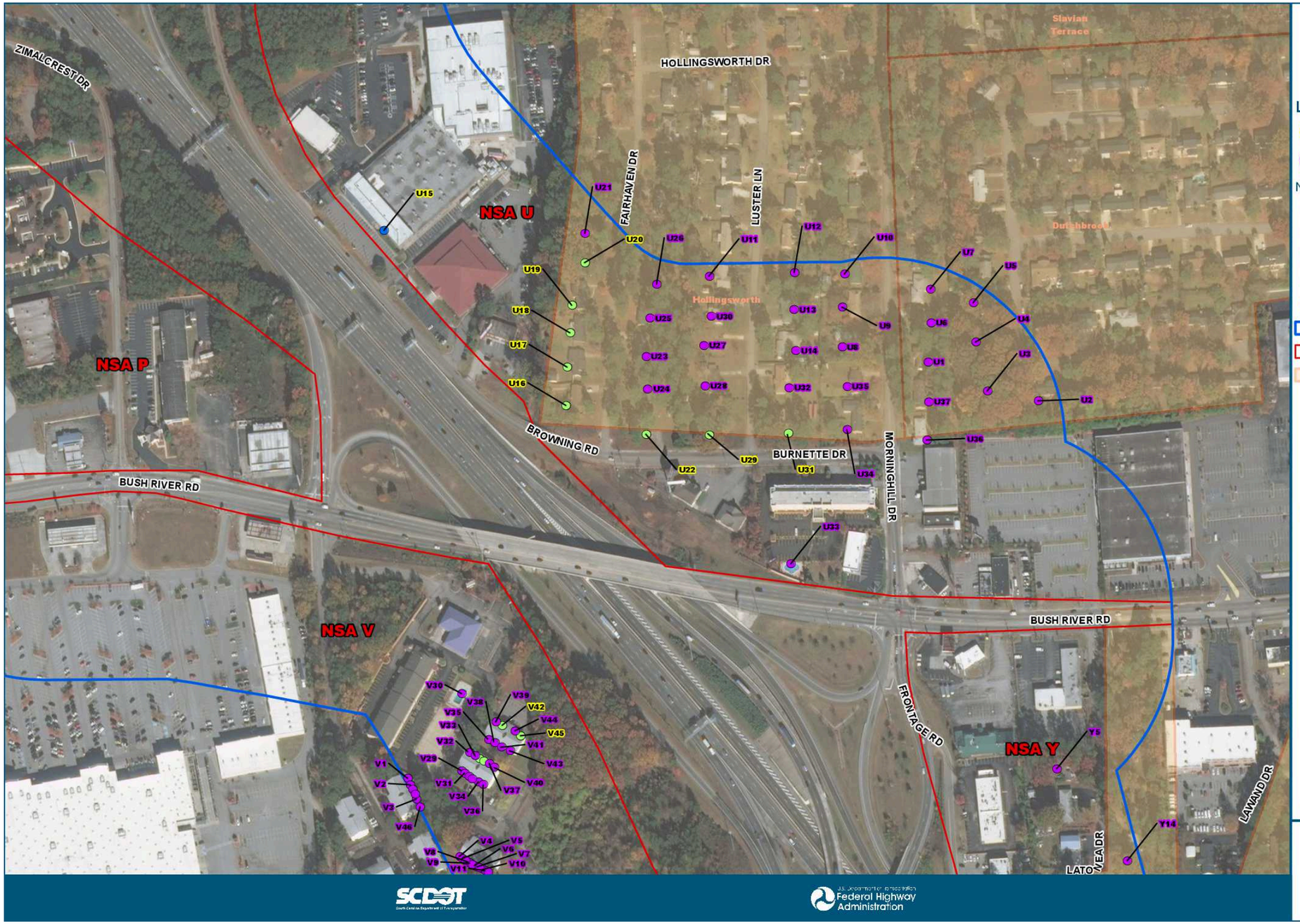


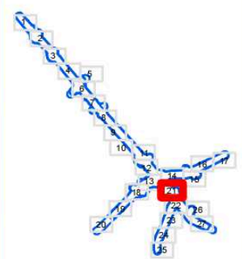

**Figure A2**
**No-Build**
**Noise Analysis Details**

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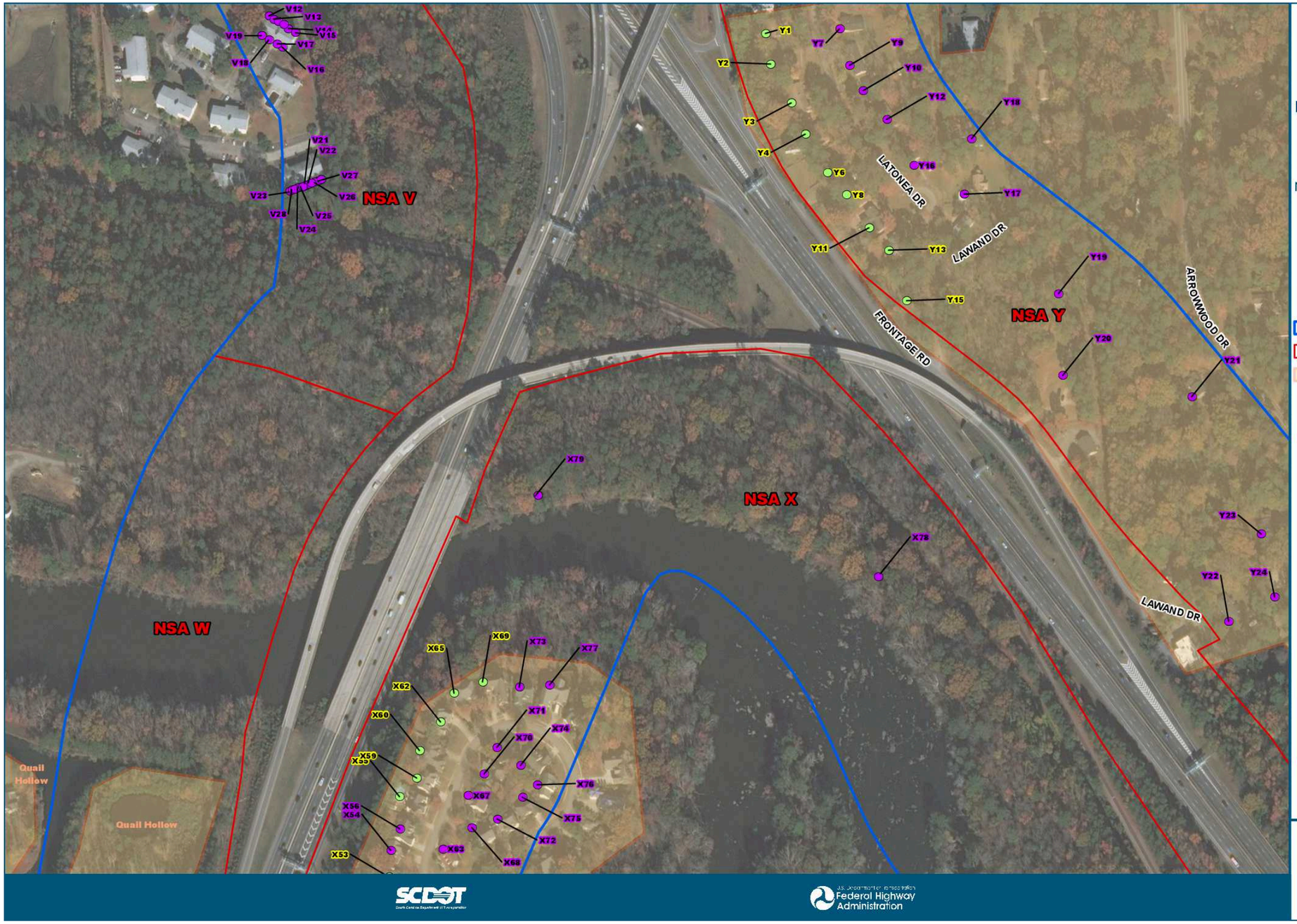


**Figure A2**
**No-Build**
**Noise Analysis Details**

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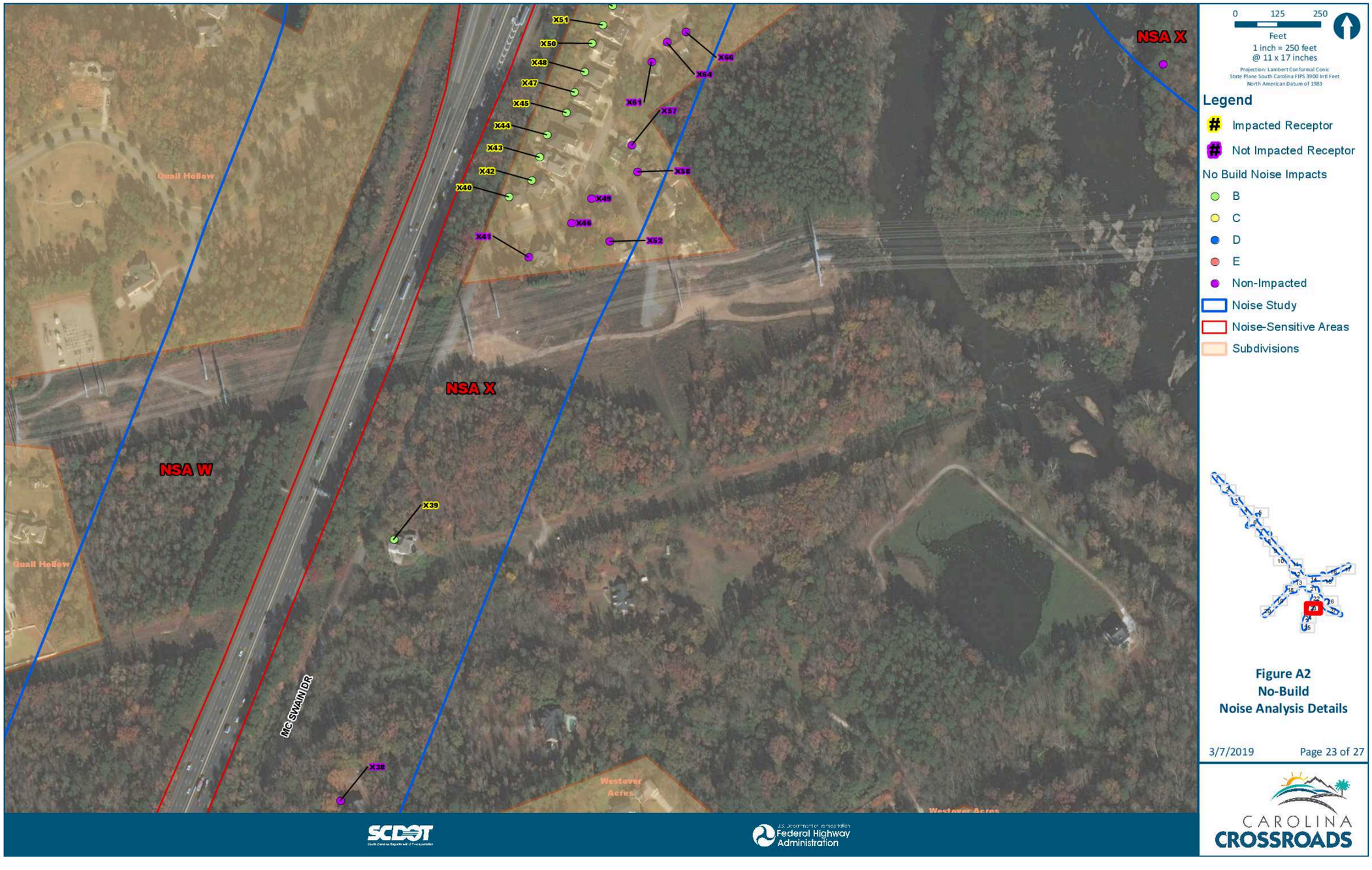




**Figure A2**
**No-Build**
**Noise Analysis Details**

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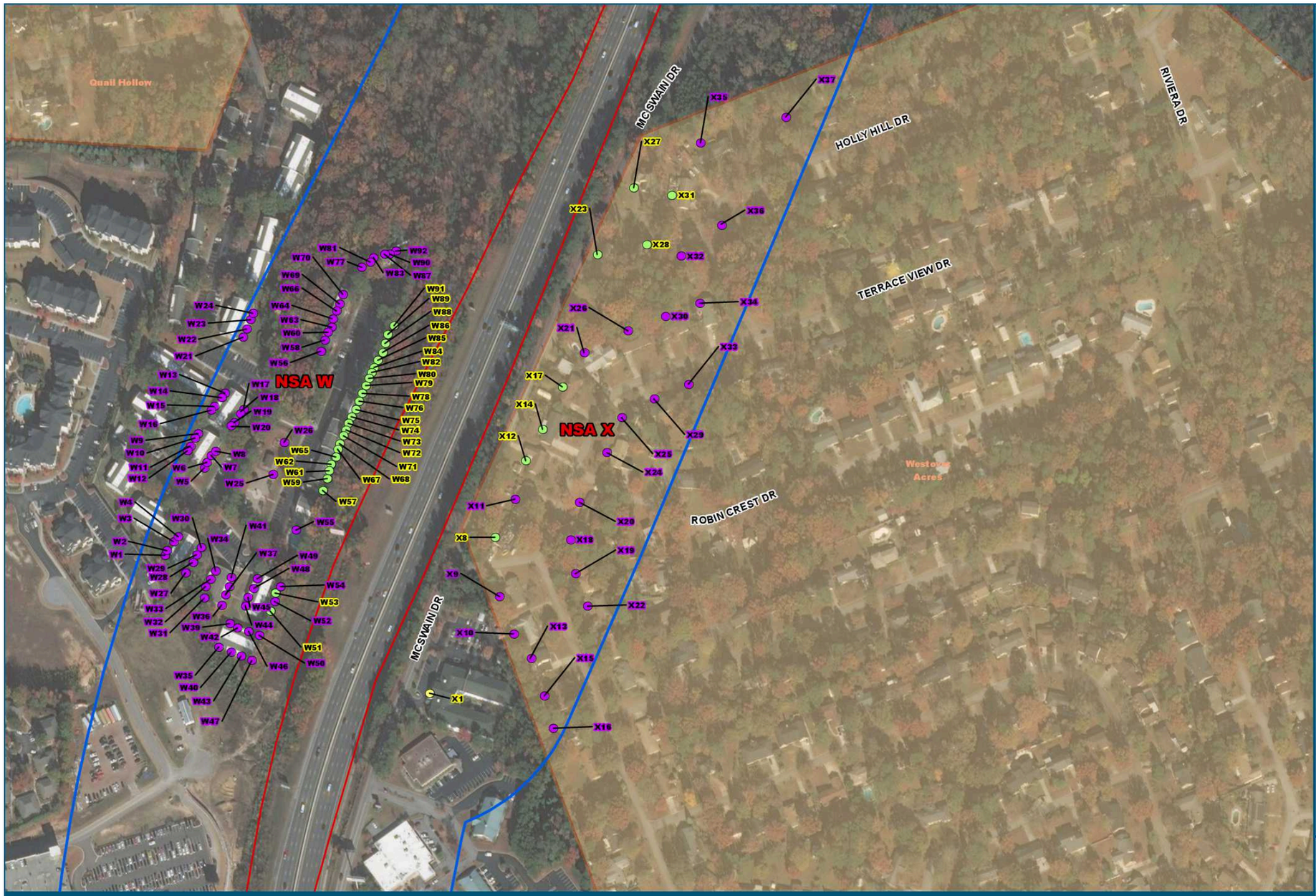


**Figure A2**
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**Noise Analysis Details**

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**Figure A2**
**No-Build**
**Noise Analysis Details**

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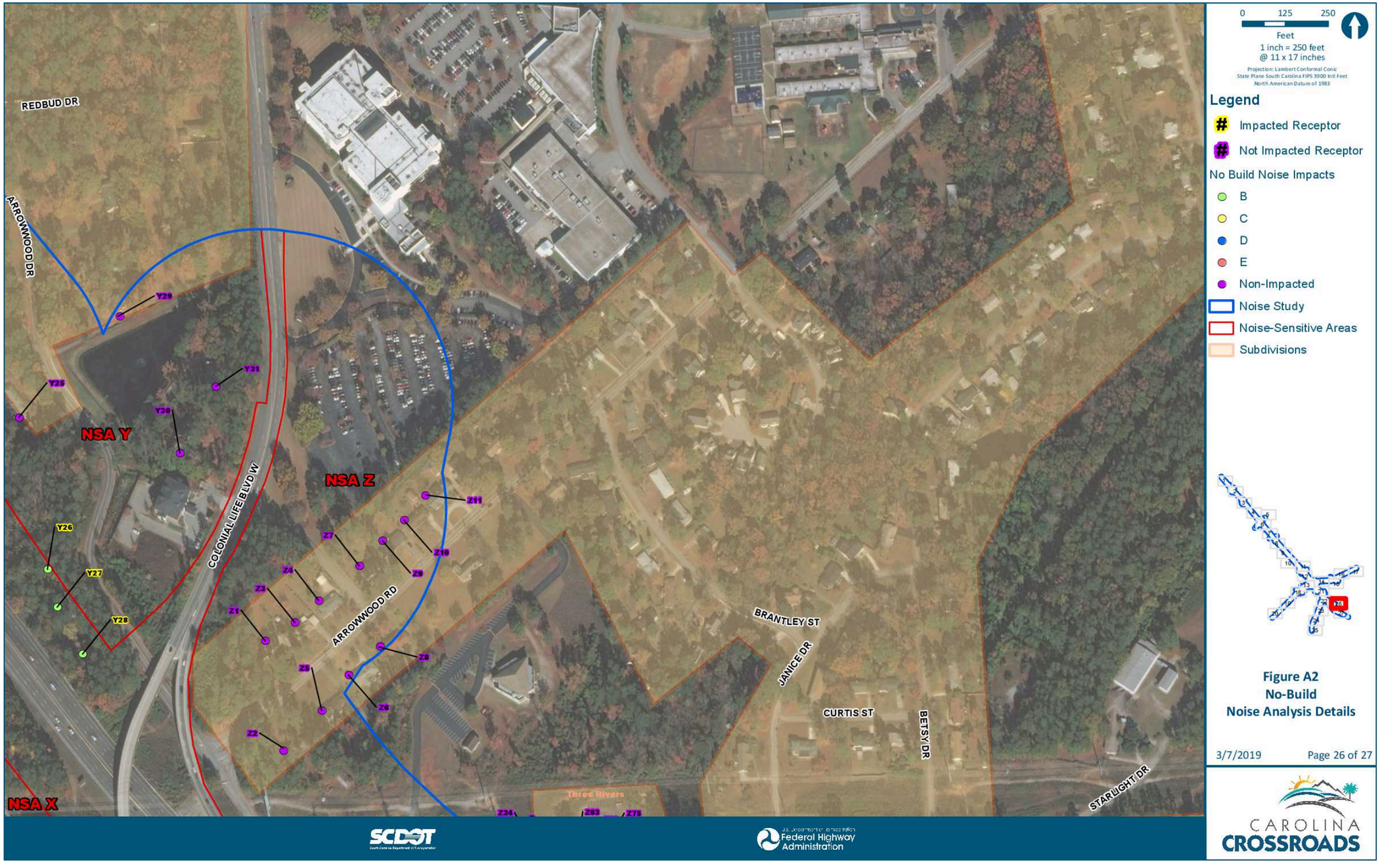




**Figure A2**
**No-Build**
**Noise Analysis Details**

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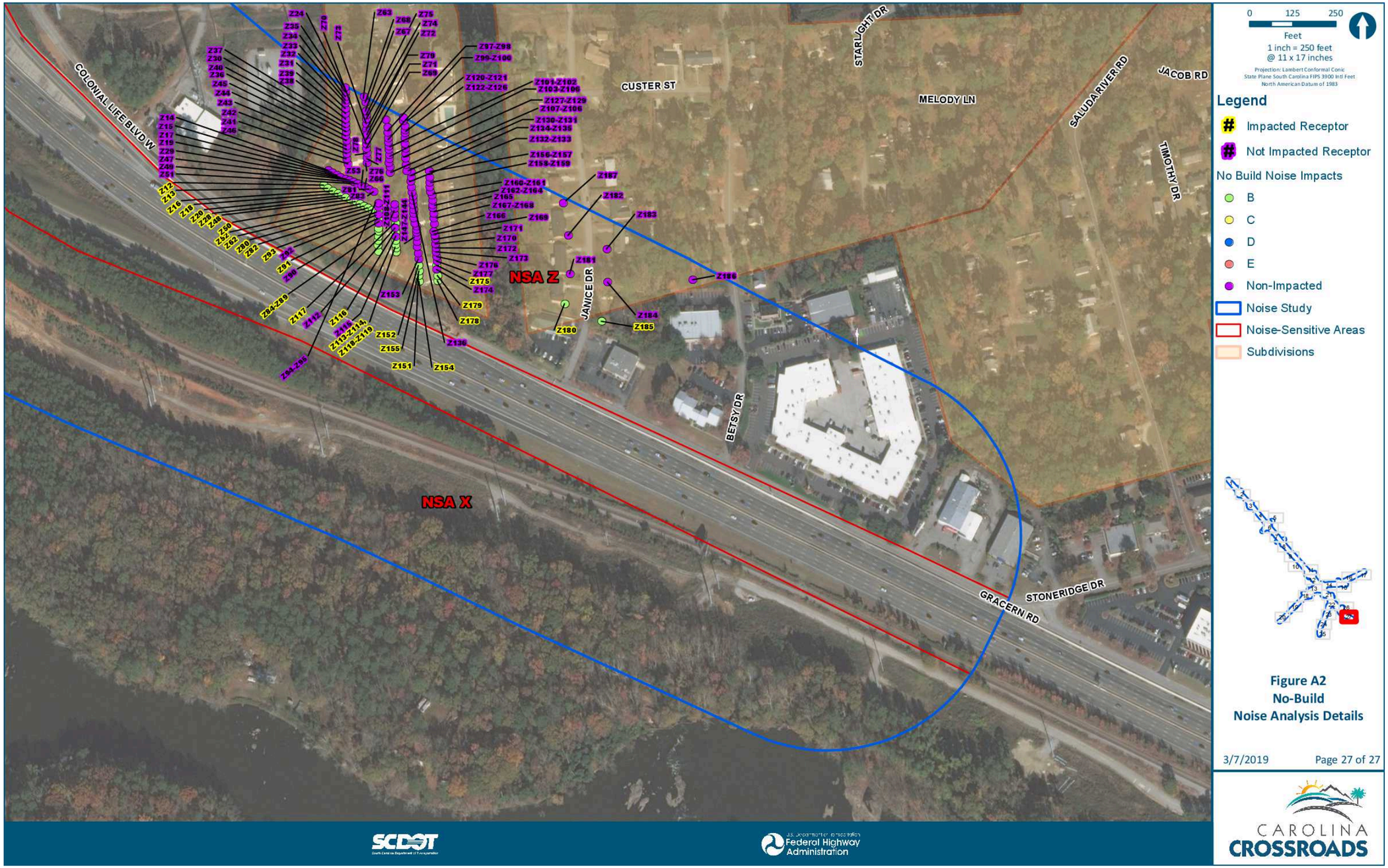


**Figure A2**
**No-Build**
**Noise Analysis Details**

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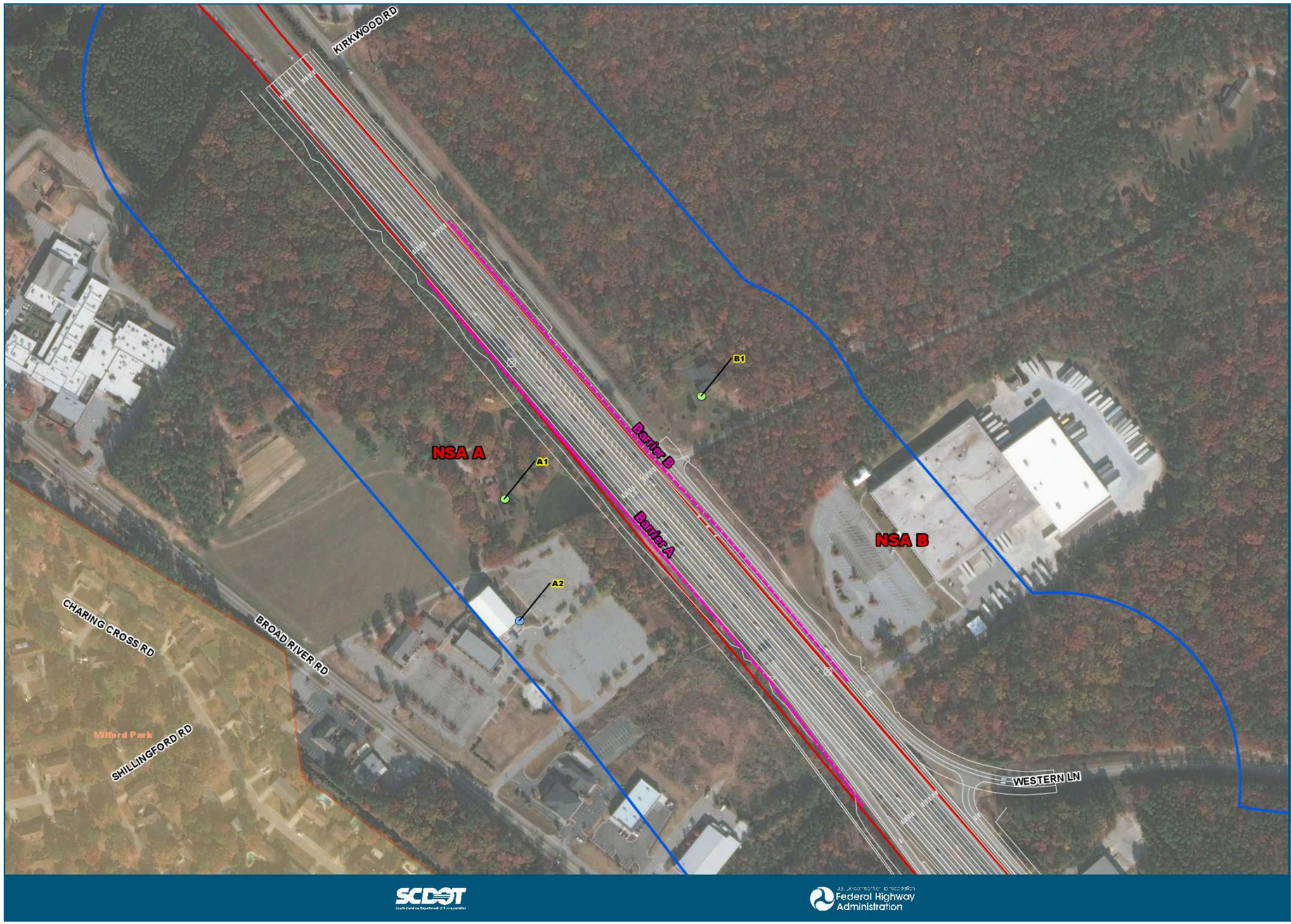


0 125 250

Feet

1 inch = 250 feet
@ 11 x 17 inches

Projection: Lambert Conformal Conic
State Plane South Carolina FIPS 3900 Intl Feet
North American Datum of 1983

**Legend**

- Impacted Receptor
- Not Impacted Receptor
- Relocation

Refined Preferred Alternative Noise Impacts

- B
- C
- D
- E
- Non-Impacted
- Relocation

- Refined Recommended Preferred Alternative
- Noise Study Area
- Noise-Sensitive Areas
- Subdivisions

Noise Barrier Locations

- Feasible and Reasonable
- Feasible Not Reasonable
- Not Feasible

**Figure A3**
**Refined Recommended Preferred Alternative Noise Analysis Details**

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CAROLINA CROSSROADS

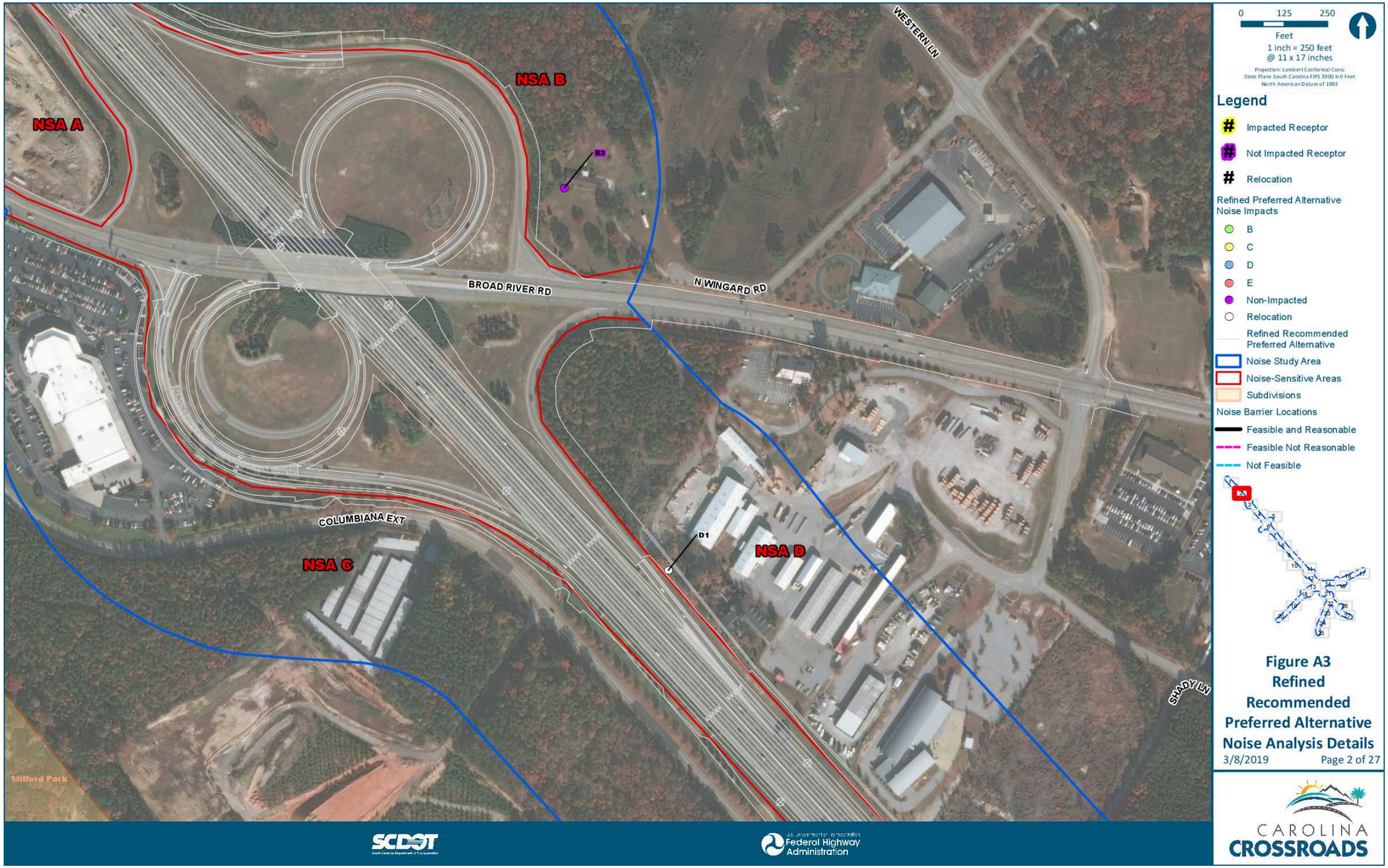


**Figure A3**
**Refined Recommended Preferred Alternative Noise Analysis Details**
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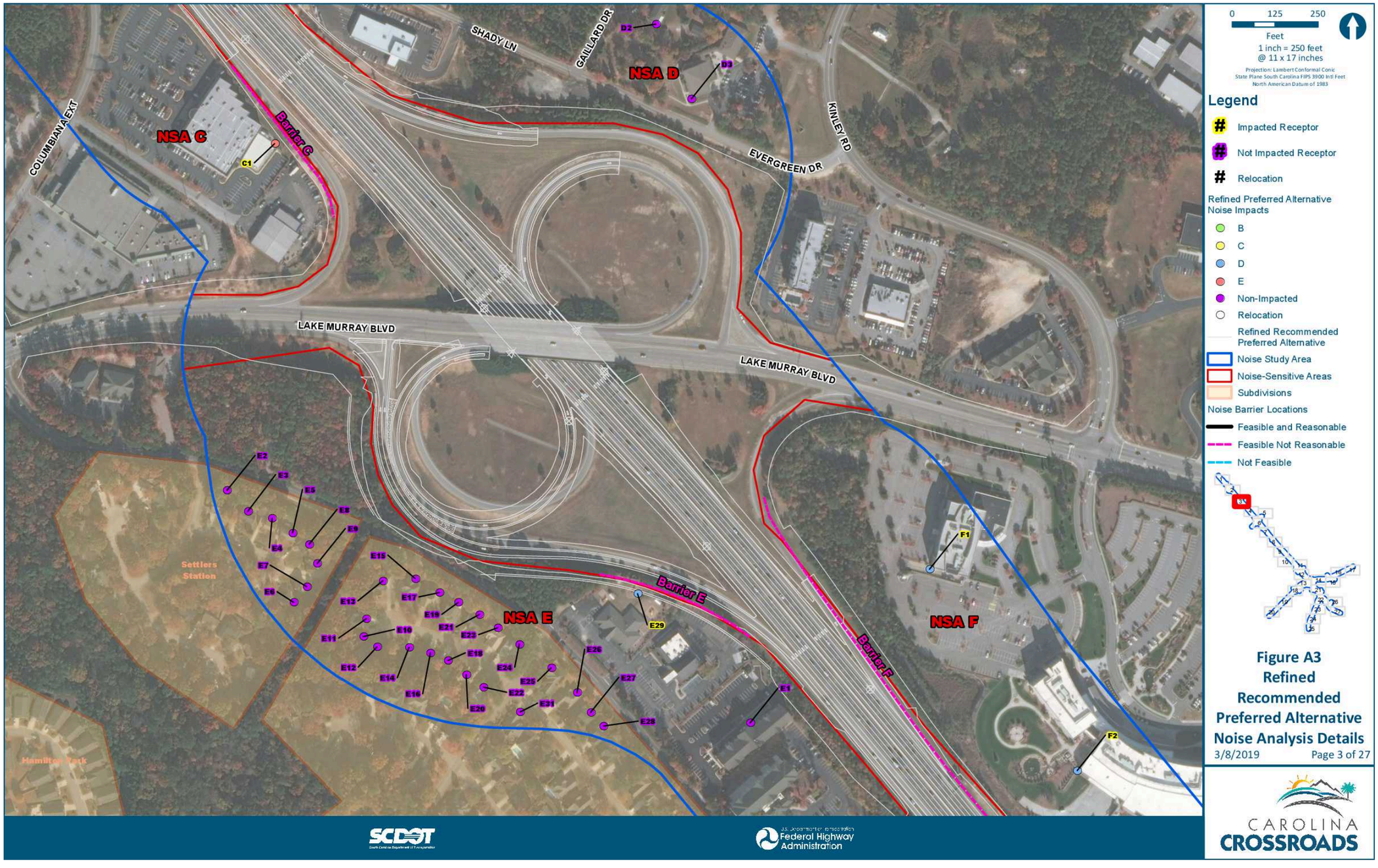


**Figure A3**
**Refined Recommended Preferred Alternative Noise Analysis Details**
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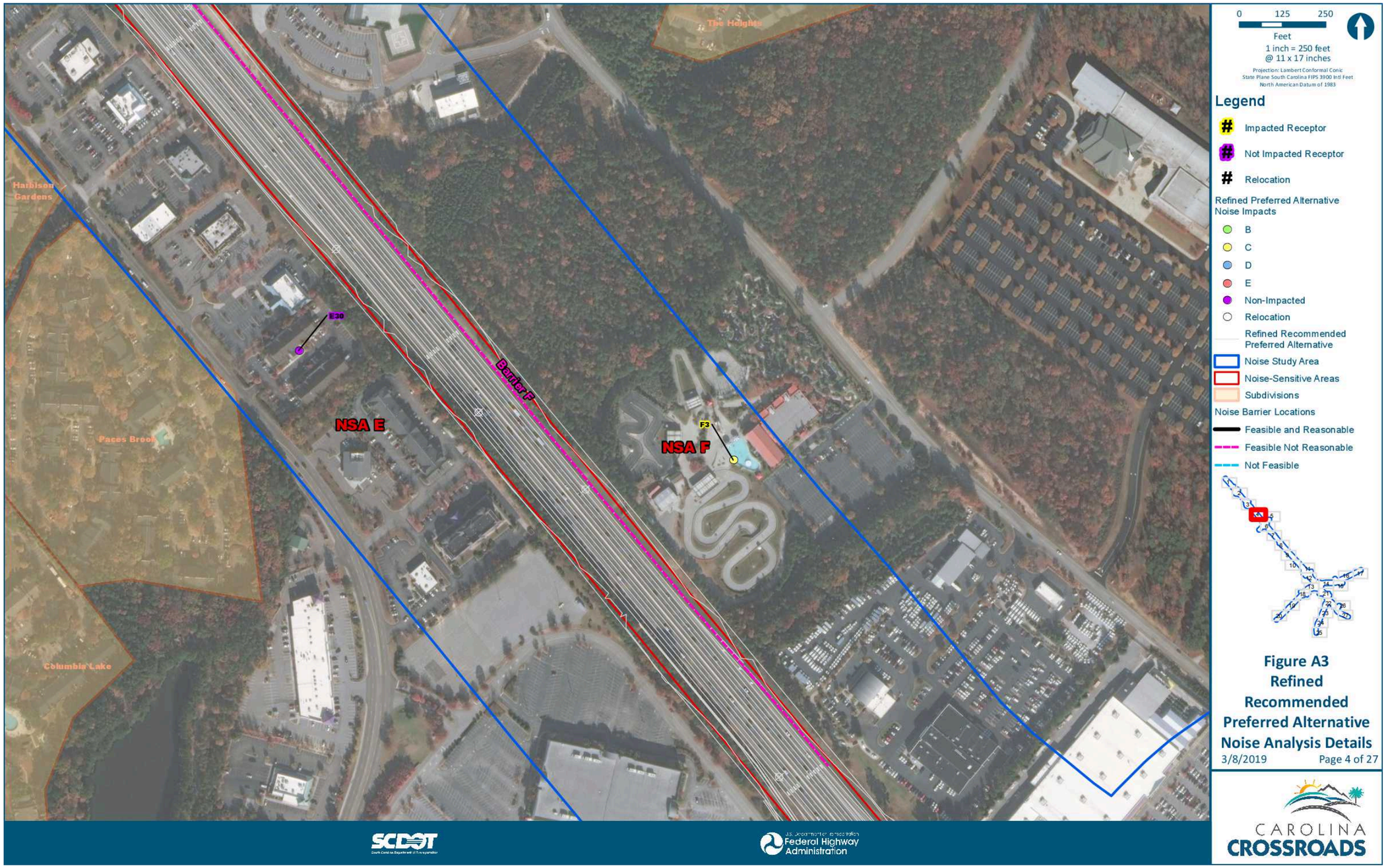


**Figure A3**
**Refined Recommended Preferred Alternative Noise Analysis Details**
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**Figure A3**
**Refined Recommended Preferred Alternative Noise Analysis Details**
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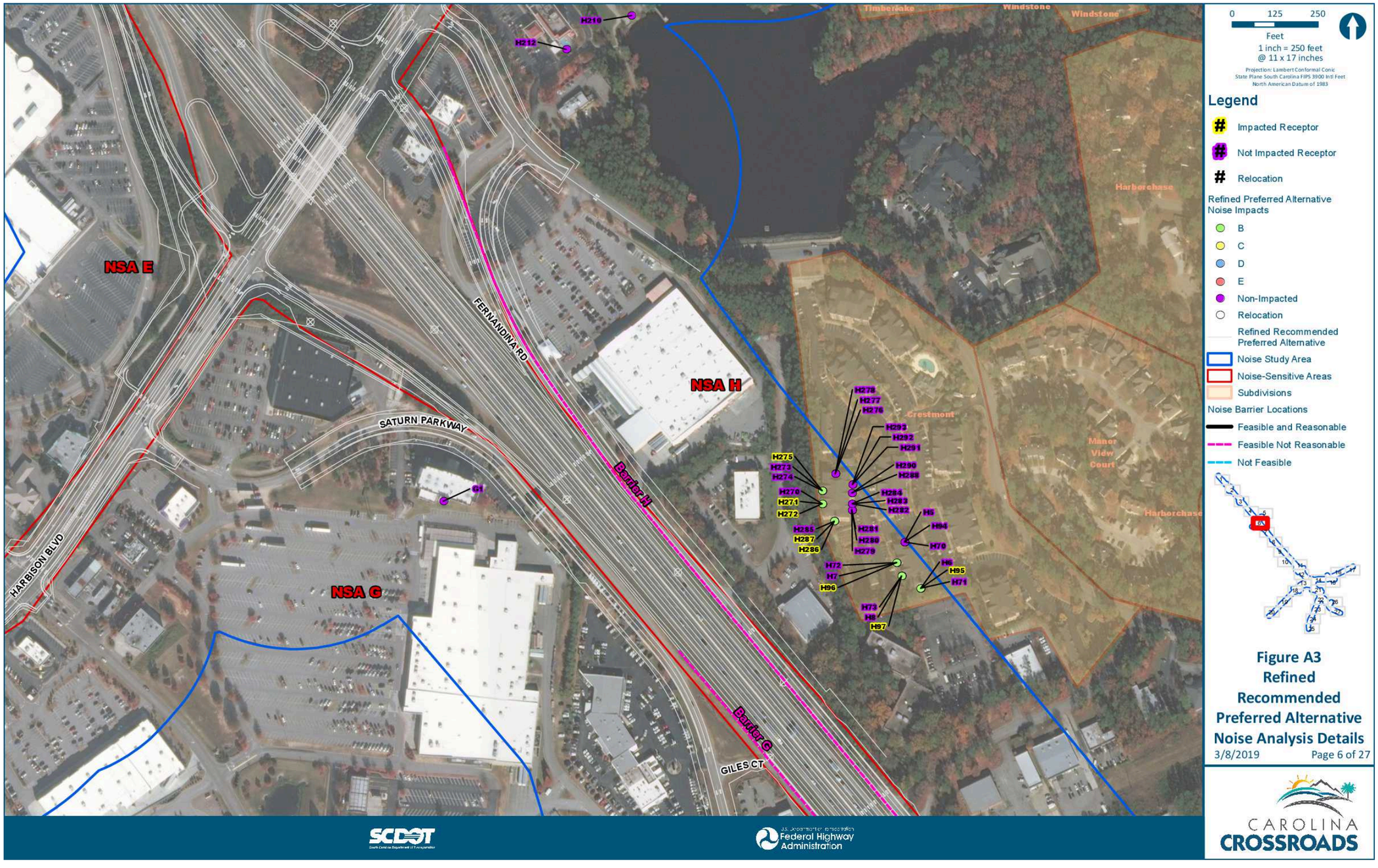


**Figure A3**
**Refined Recommended Preferred Alternative Noise Analysis Details**
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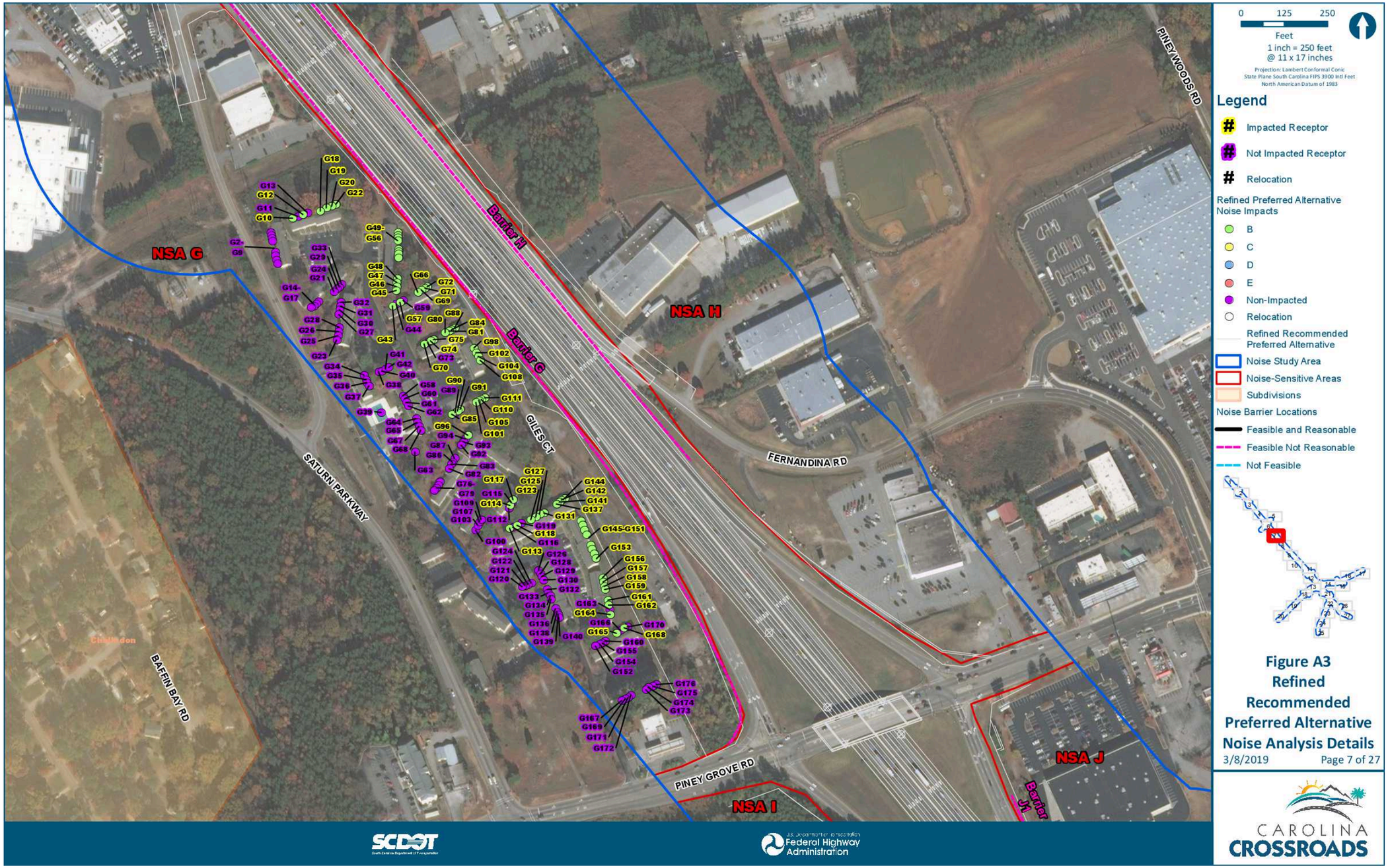


**Figure A3**
**Refined Recommended Preferred Alternative Noise Analysis Details**
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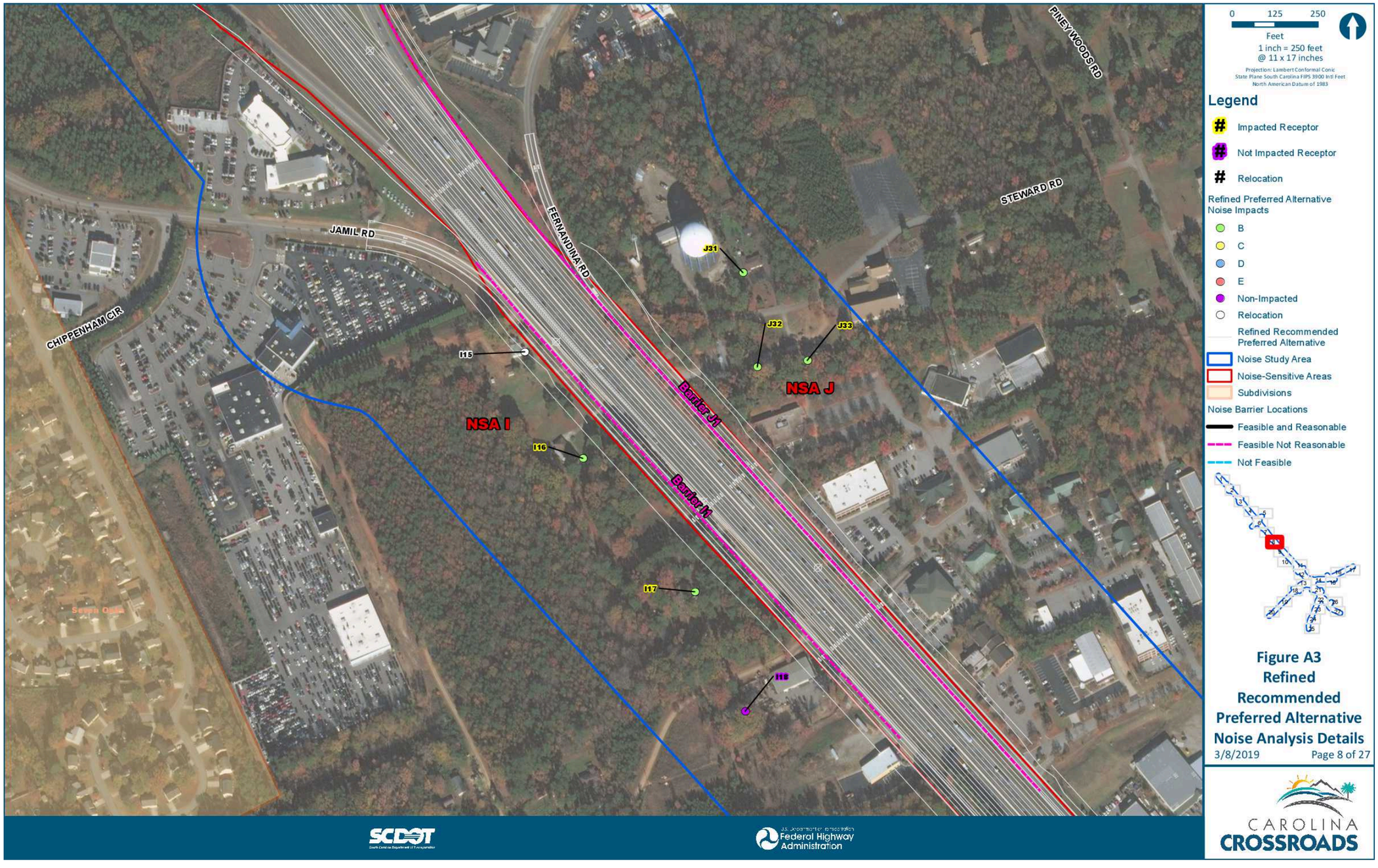


**Figure A3 Refined Recommended Preferred Alternative Noise Analysis Details**

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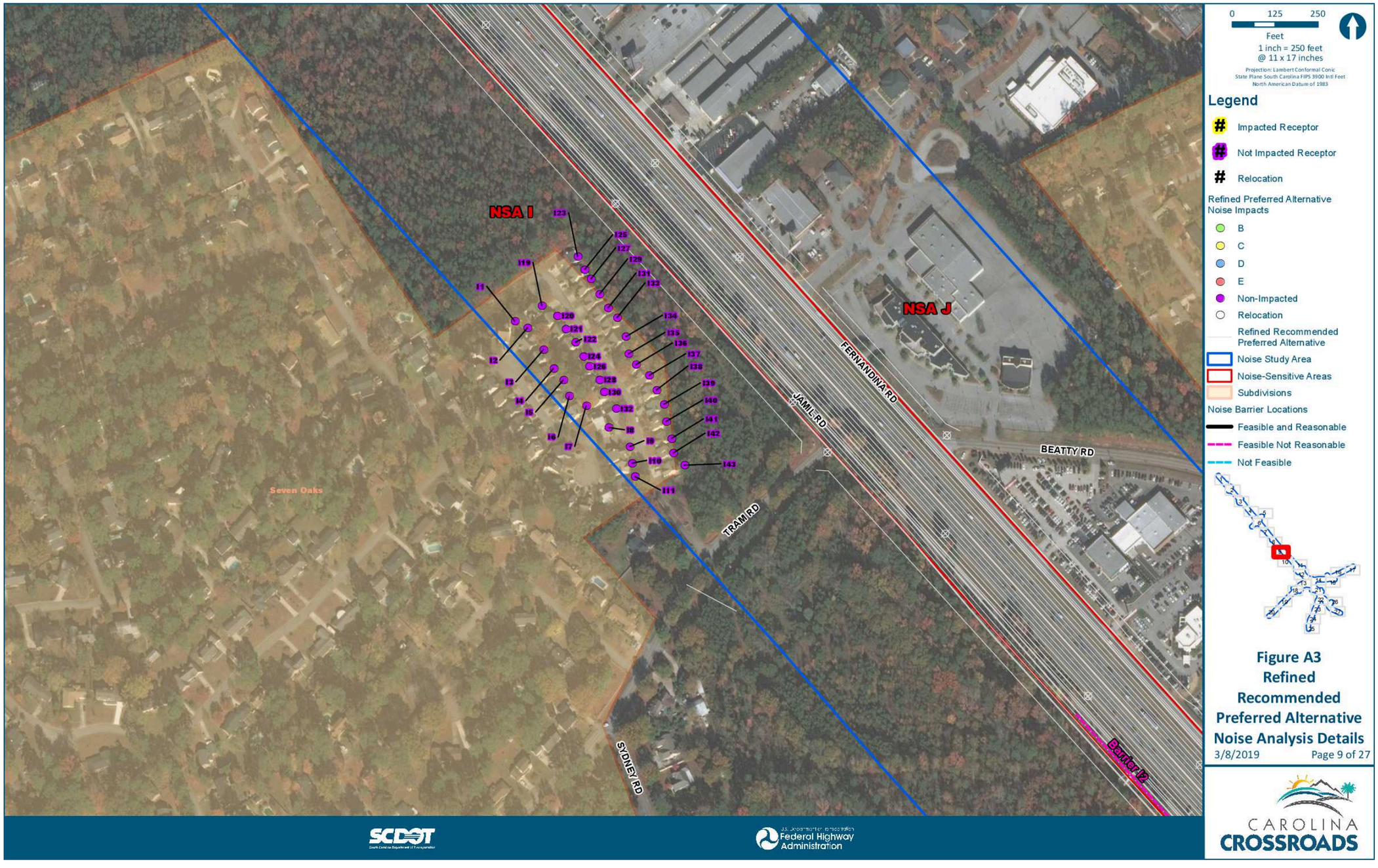


**Figure A3**
**Refined Recommended Preferred Alternative Noise Analysis Details**
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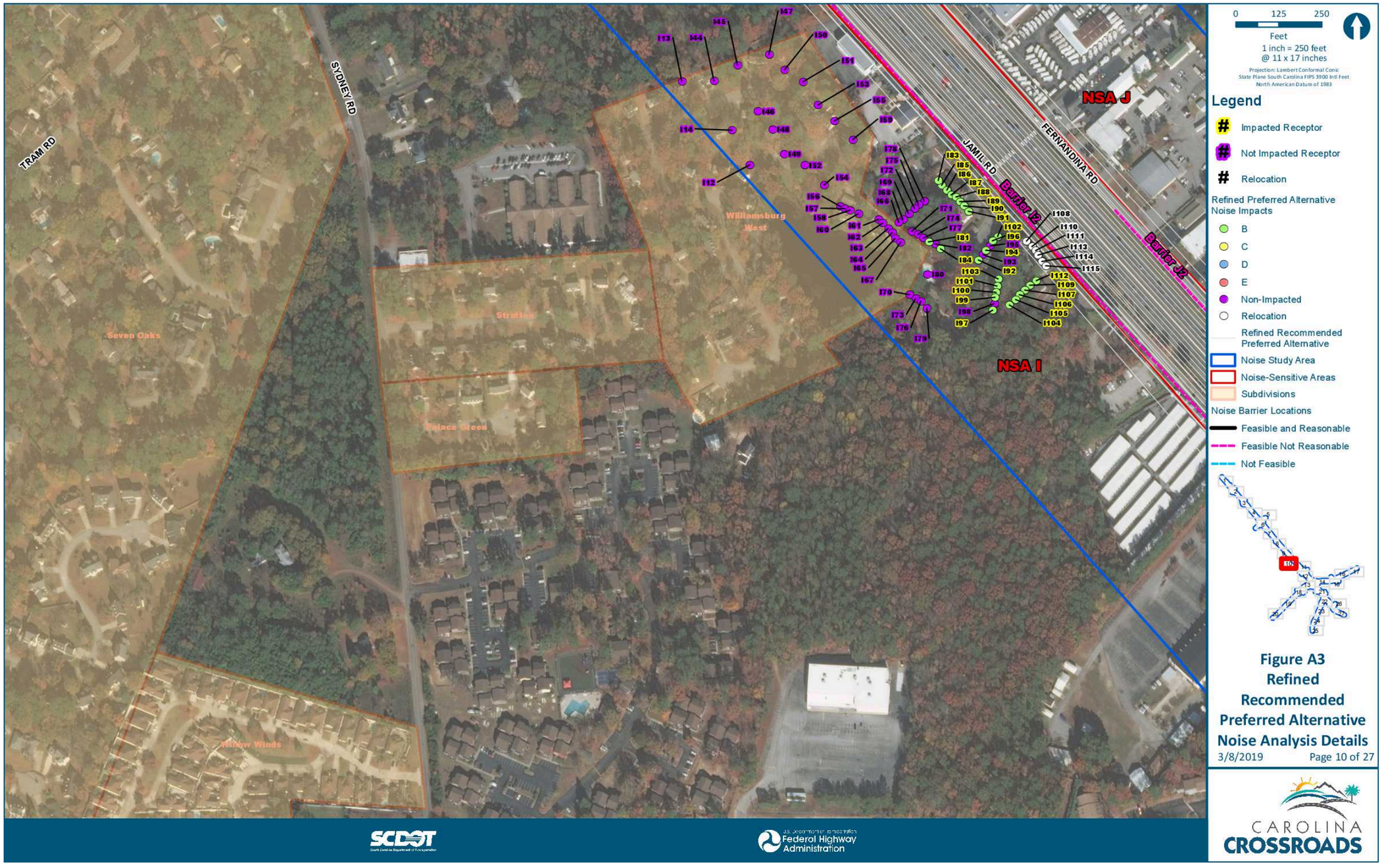


**Figure A3**
**Refined Recommended Preferred Alternative Noise Analysis Details**
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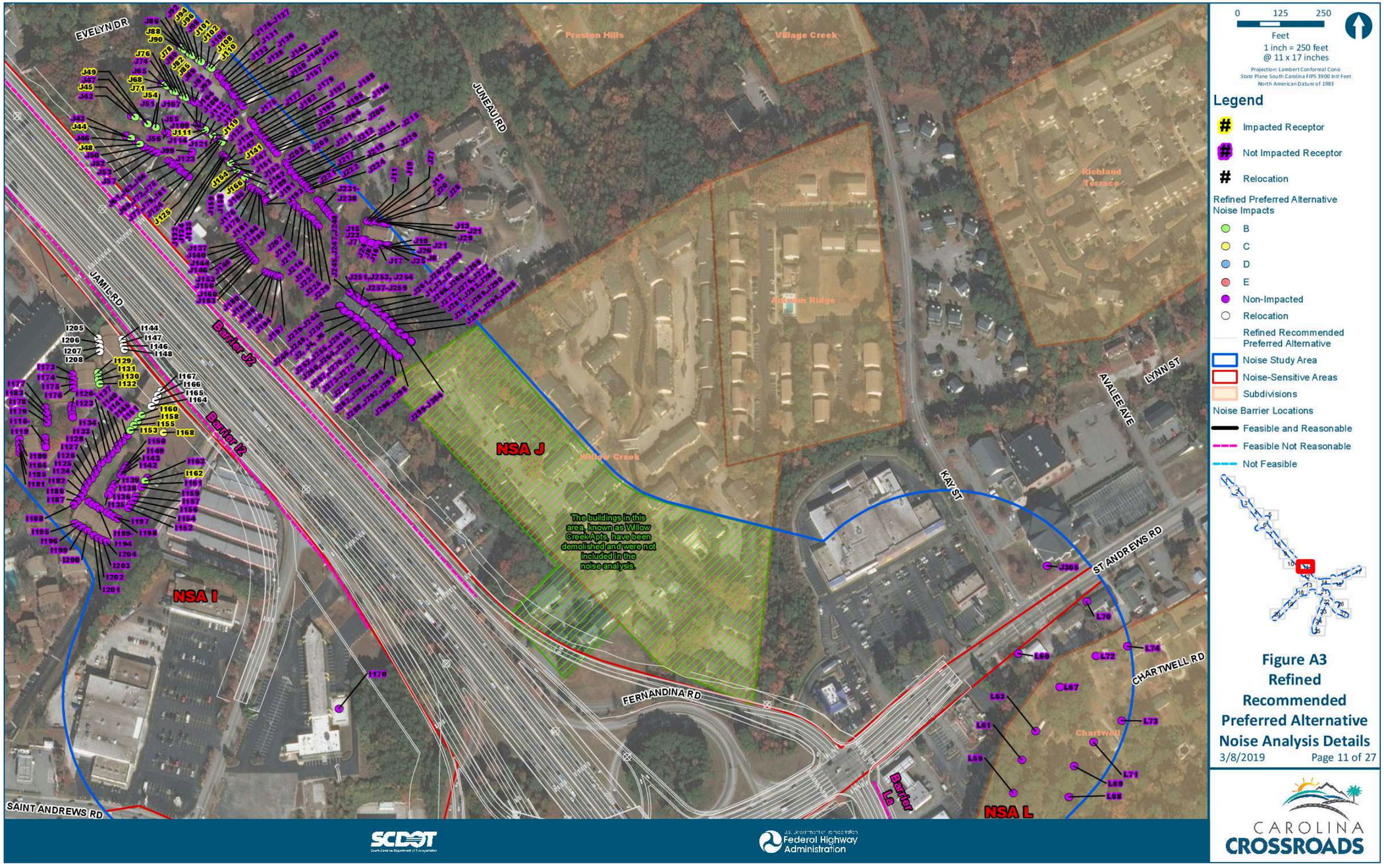


**Figure A3**
**Refined Recommended Preferred Alternative Noise Analysis Details**
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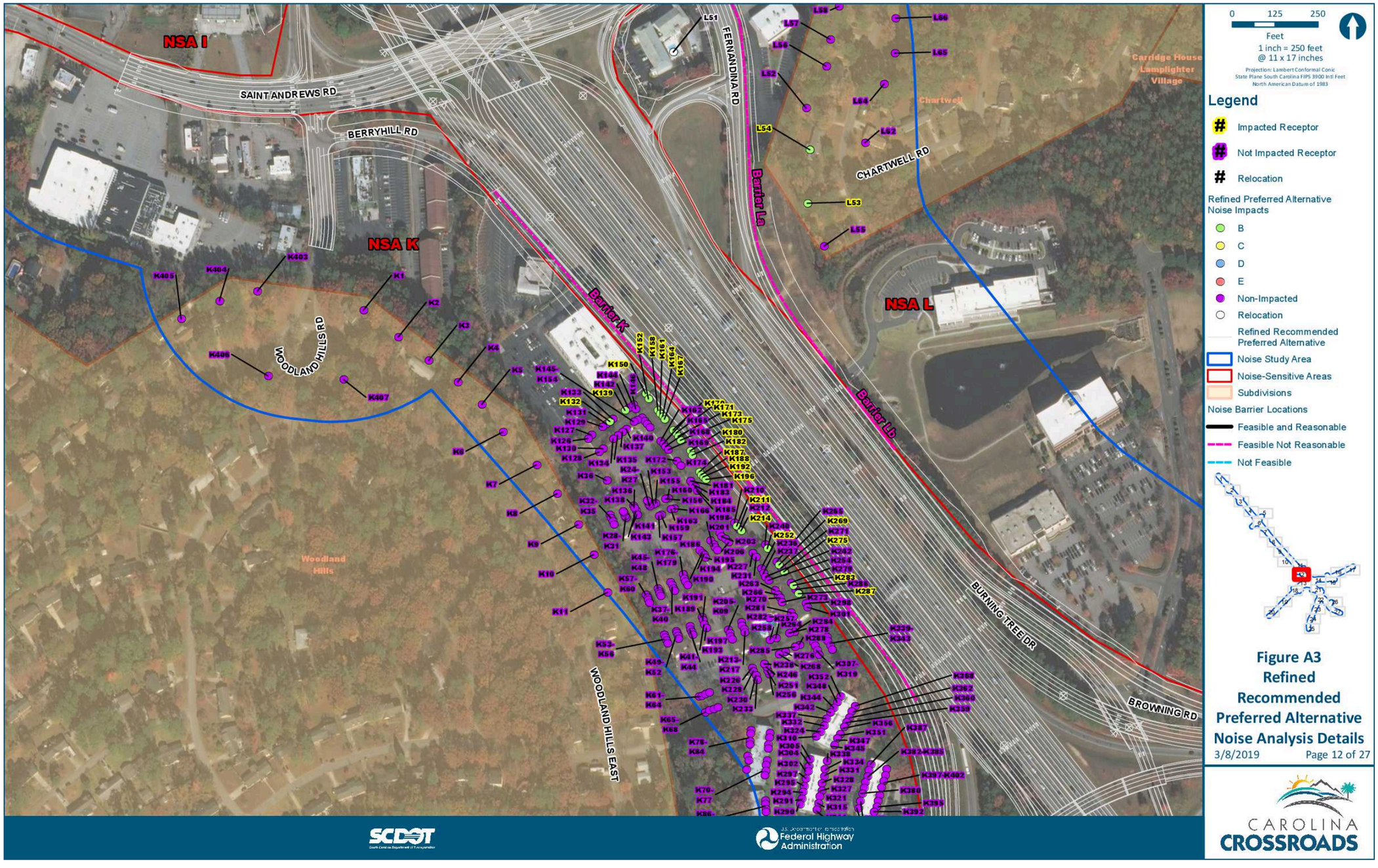


**Figure A3**
**Refined Recommended Preferred Alternative Noise Analysis Details**
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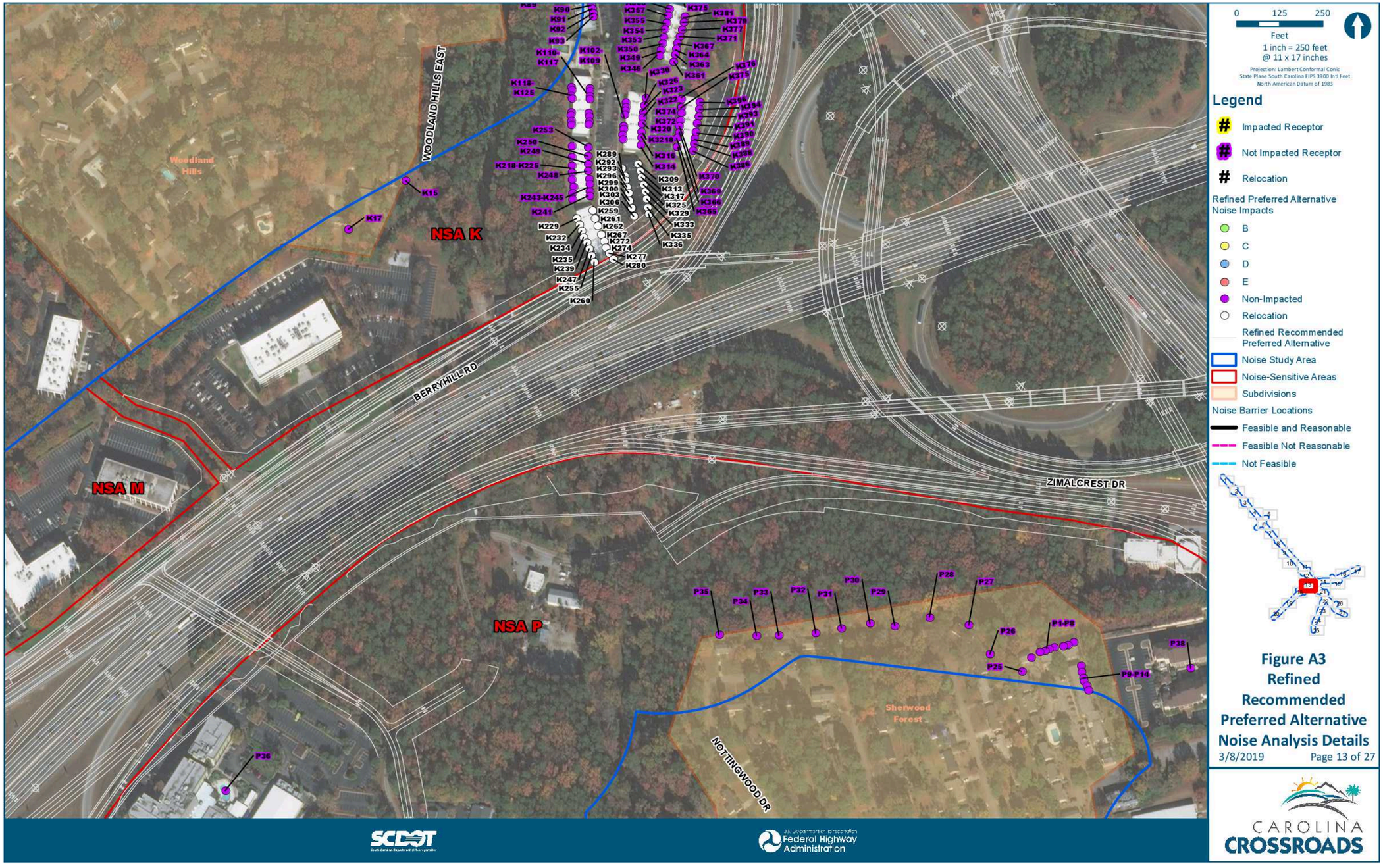


**Figure A3**
**Refined Recommended Preferred Alternative Noise Analysis Details**
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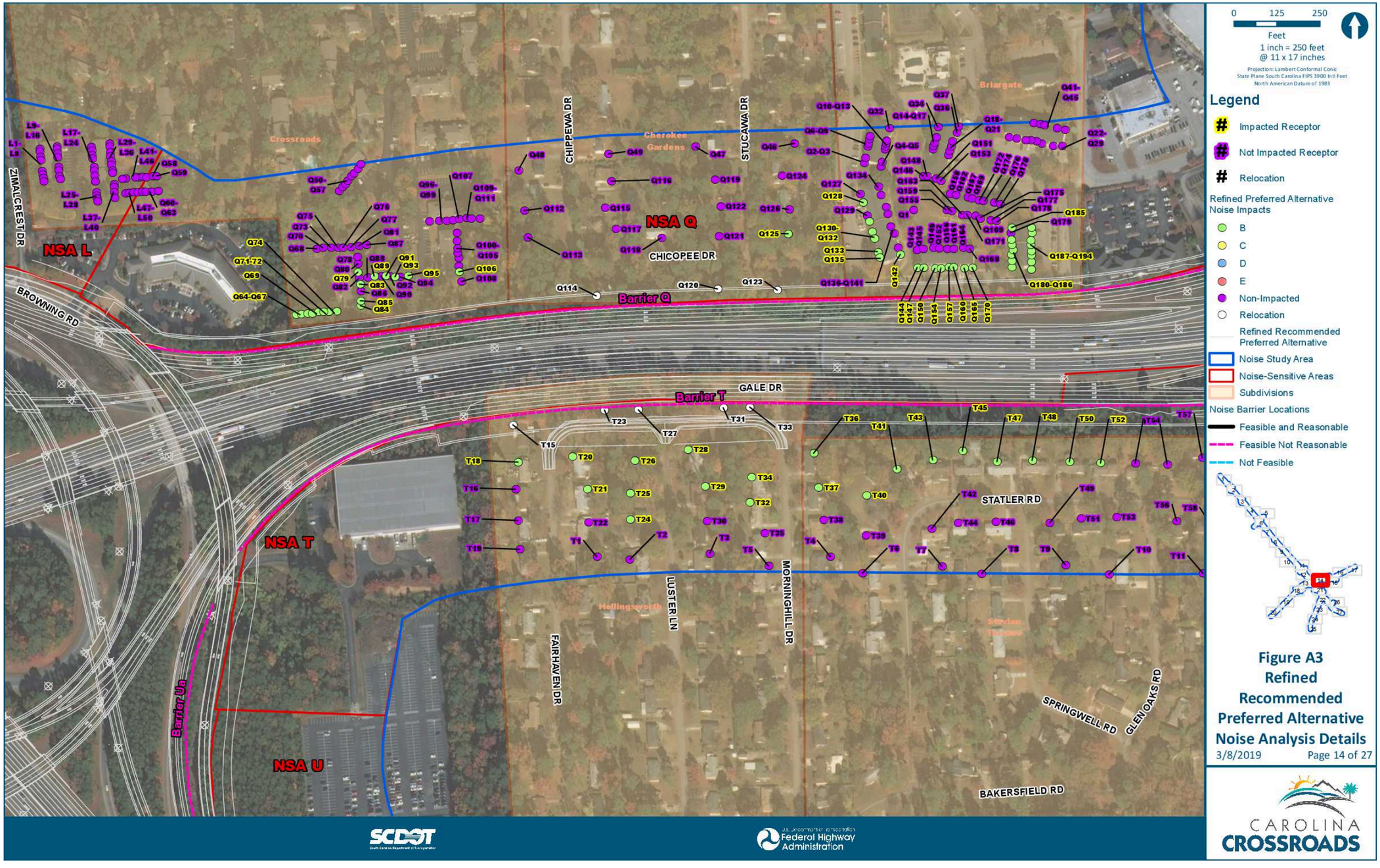


**Figure A3**
**Refined Recommended Preferred Alternative Noise Analysis Details**
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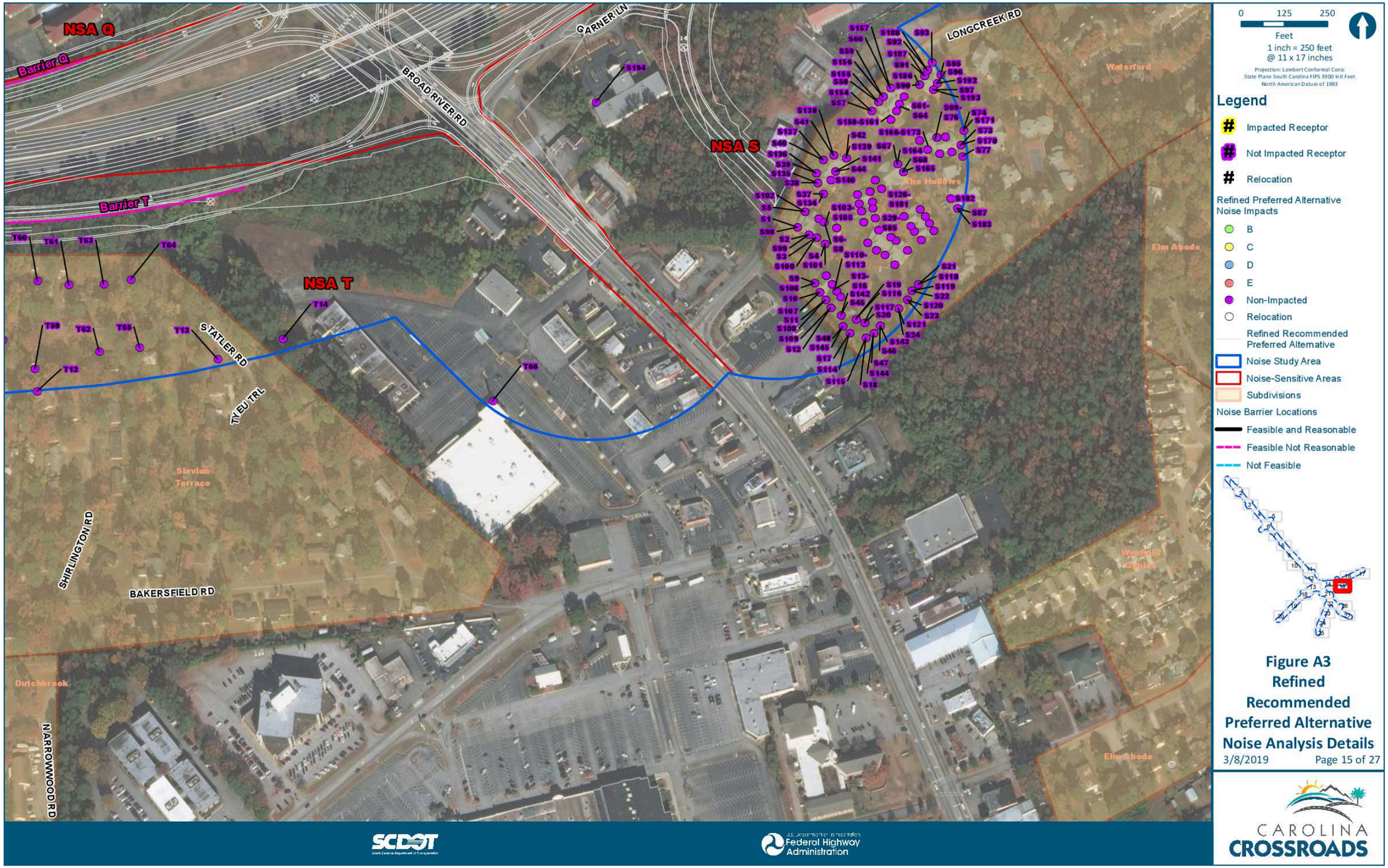


**Figure A3**
**Refined Recommended Preferred Alternative Noise Analysis Details**
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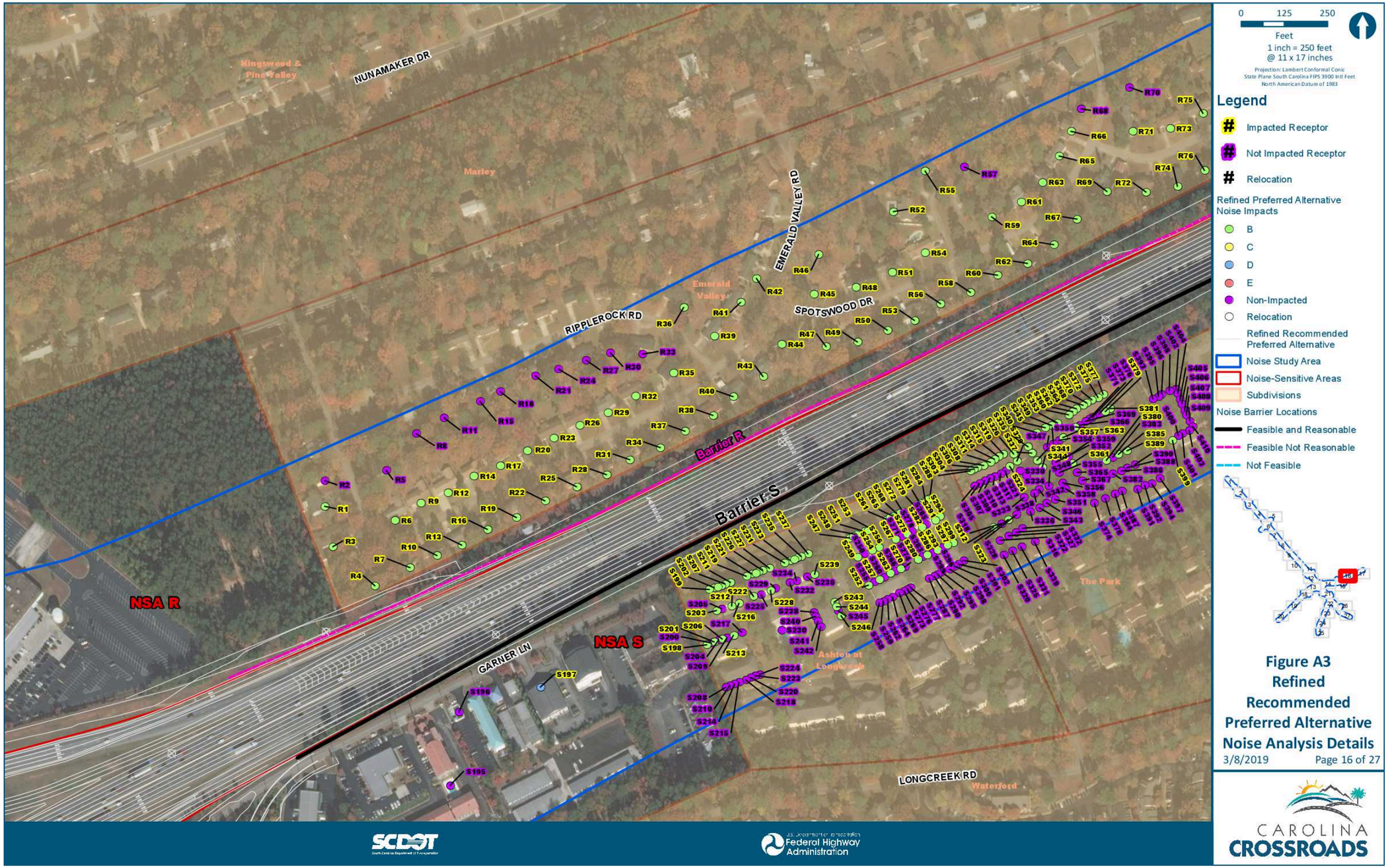


**Figure A3**
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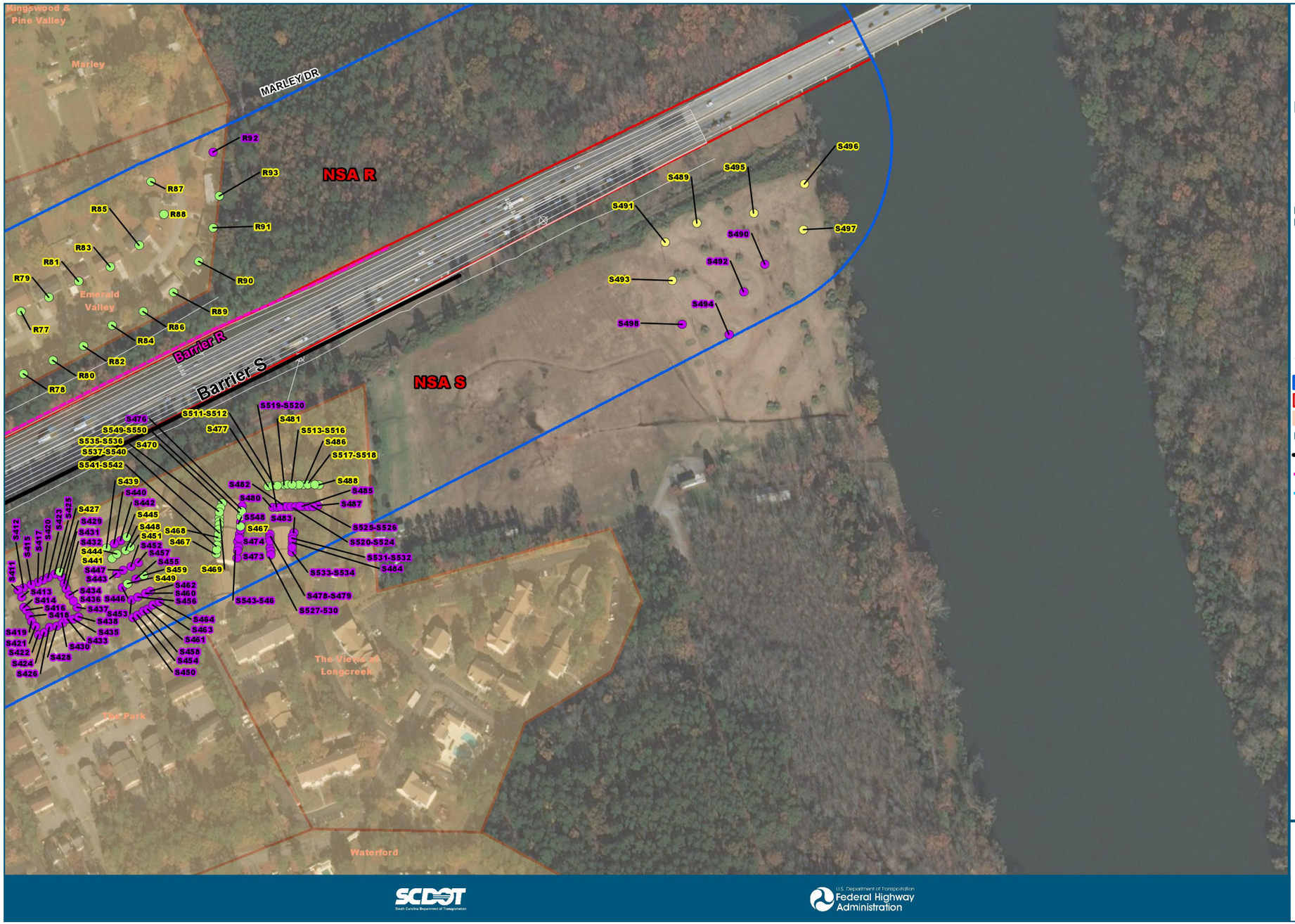


**Figure A3**
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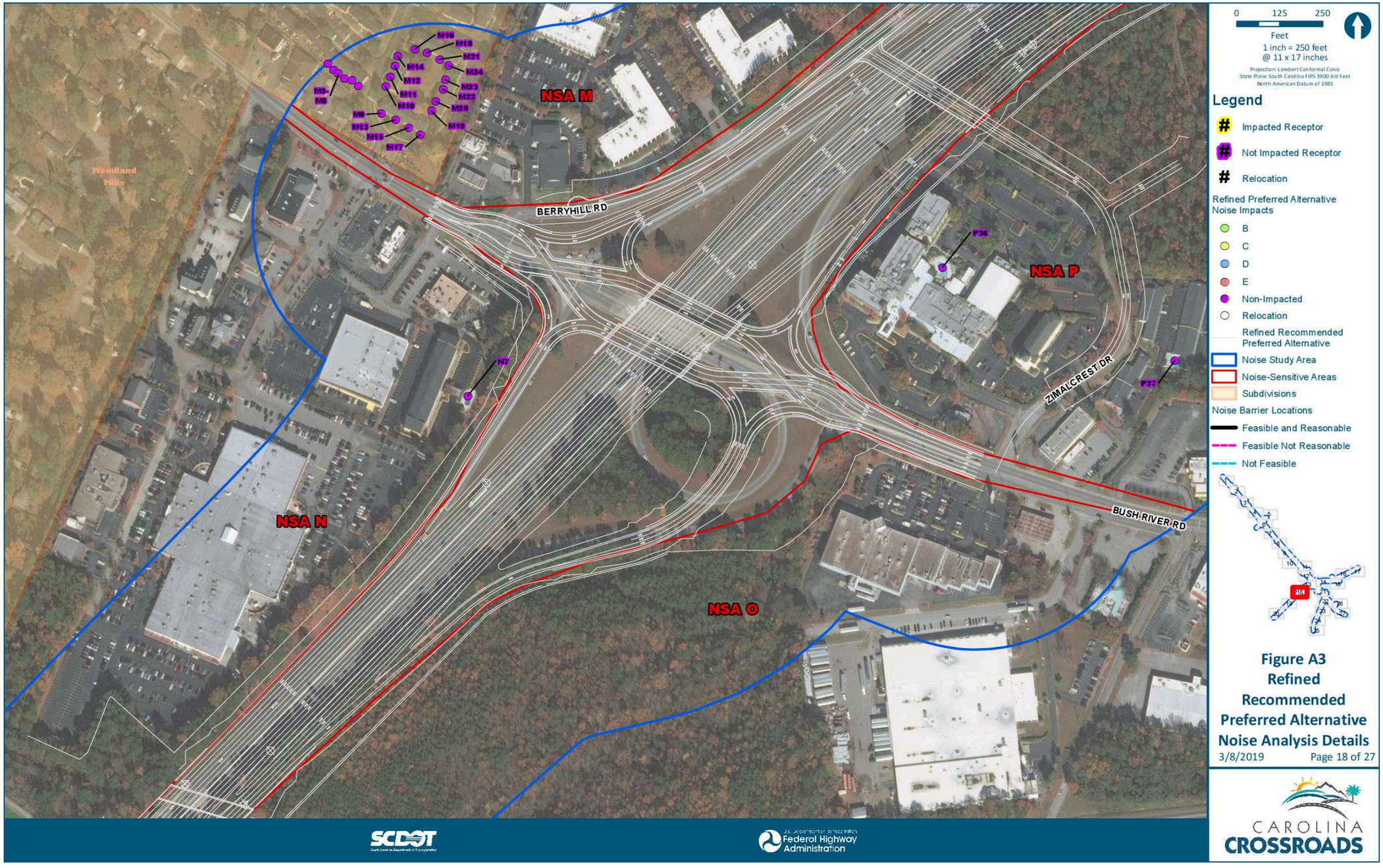


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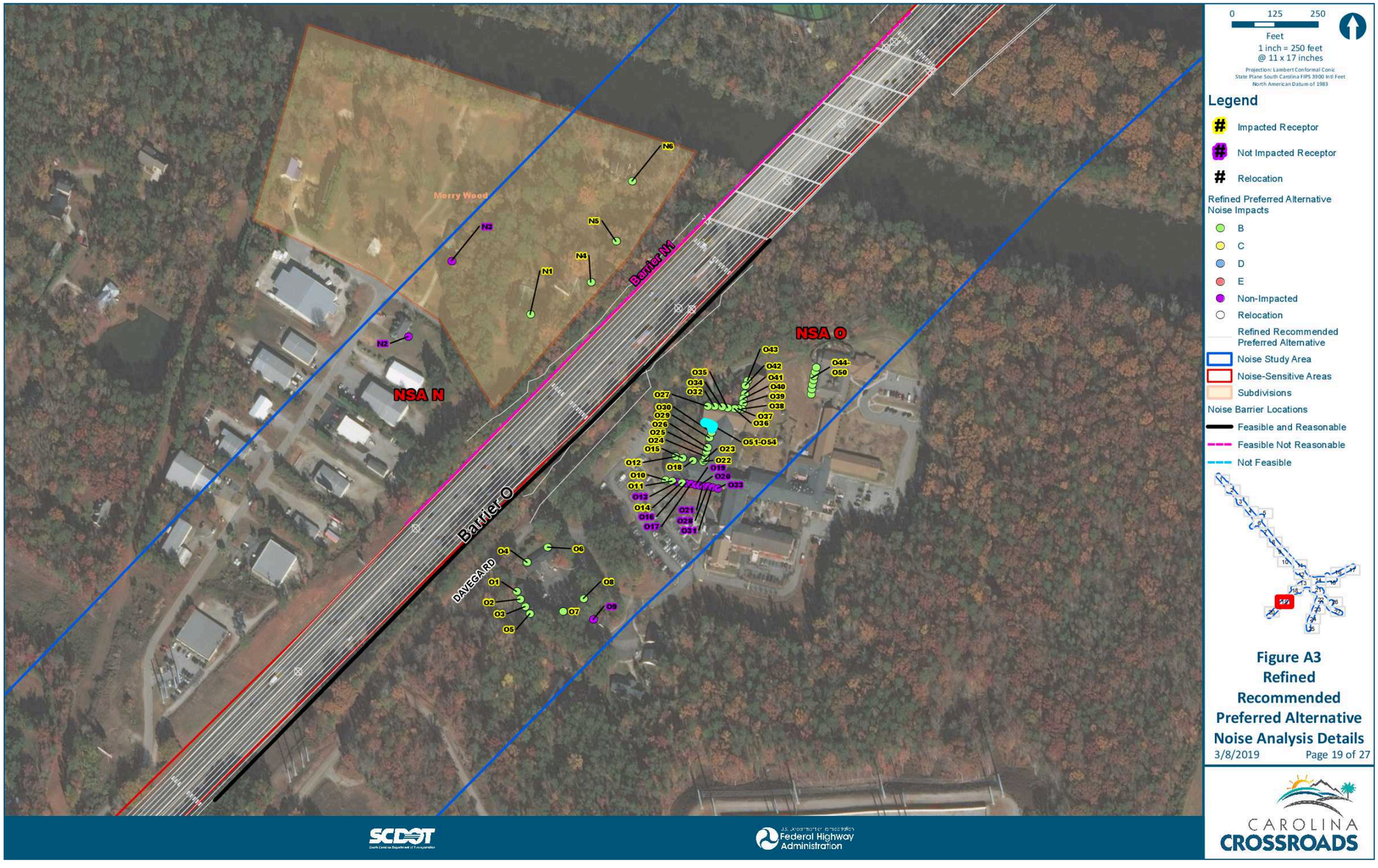


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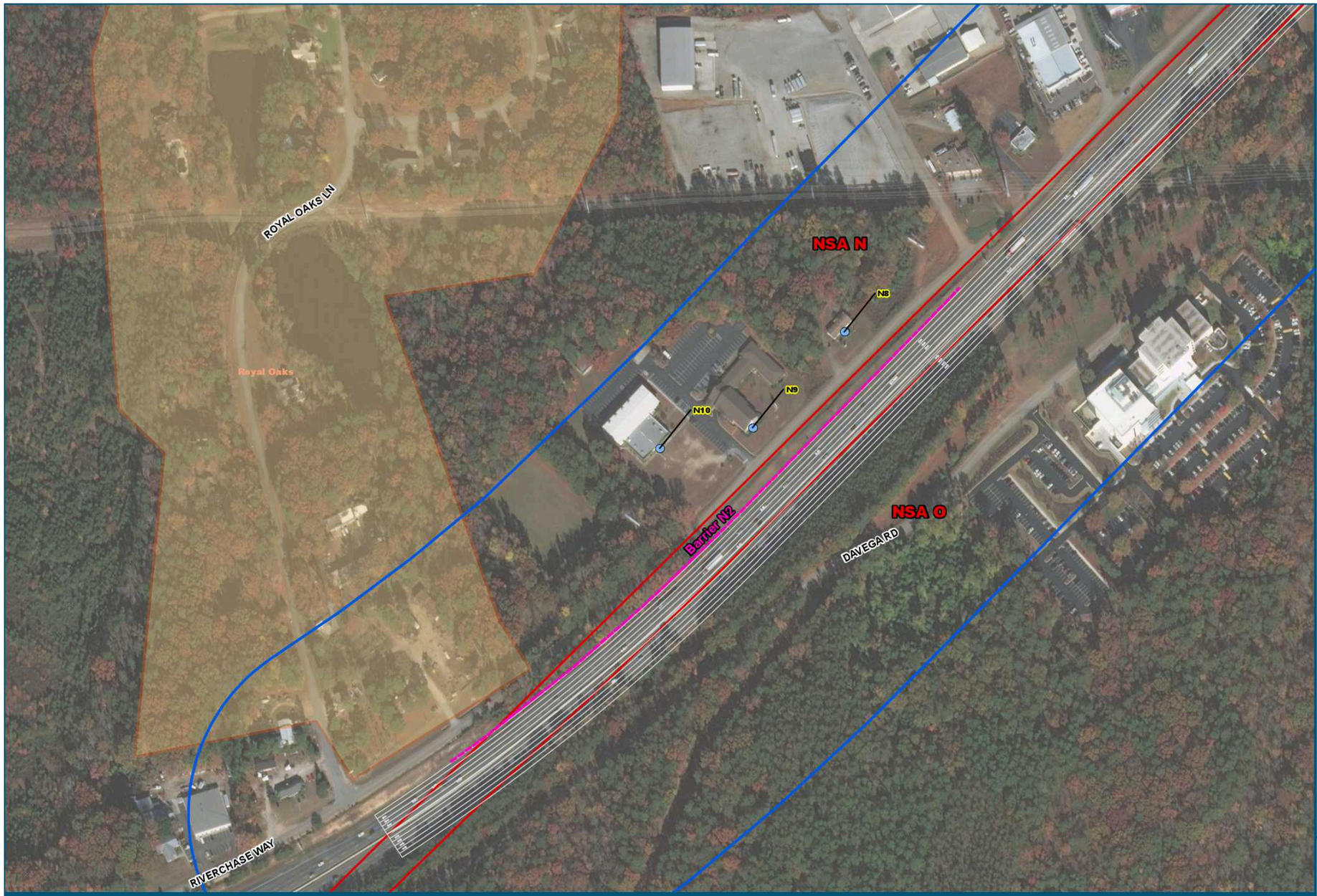


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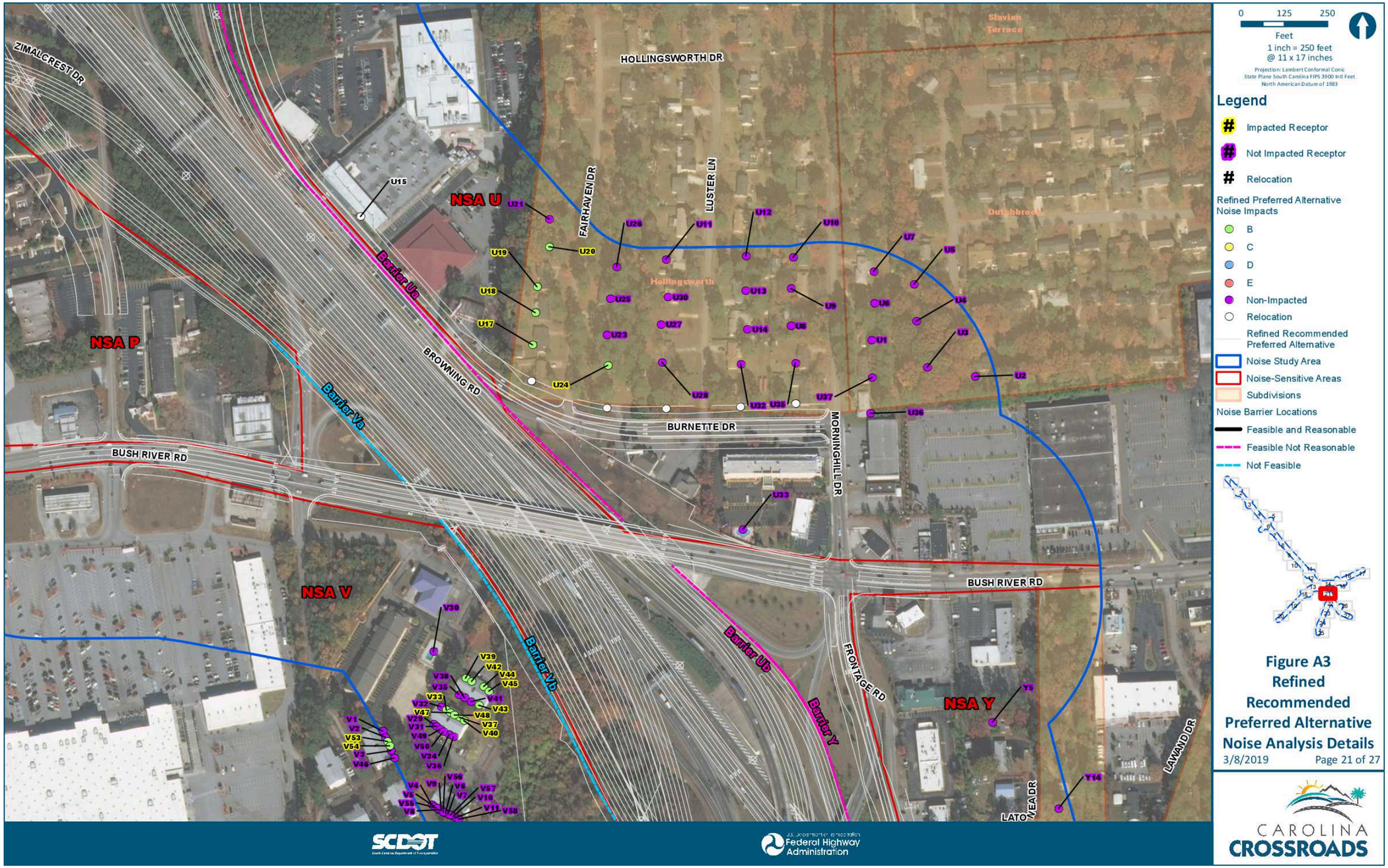


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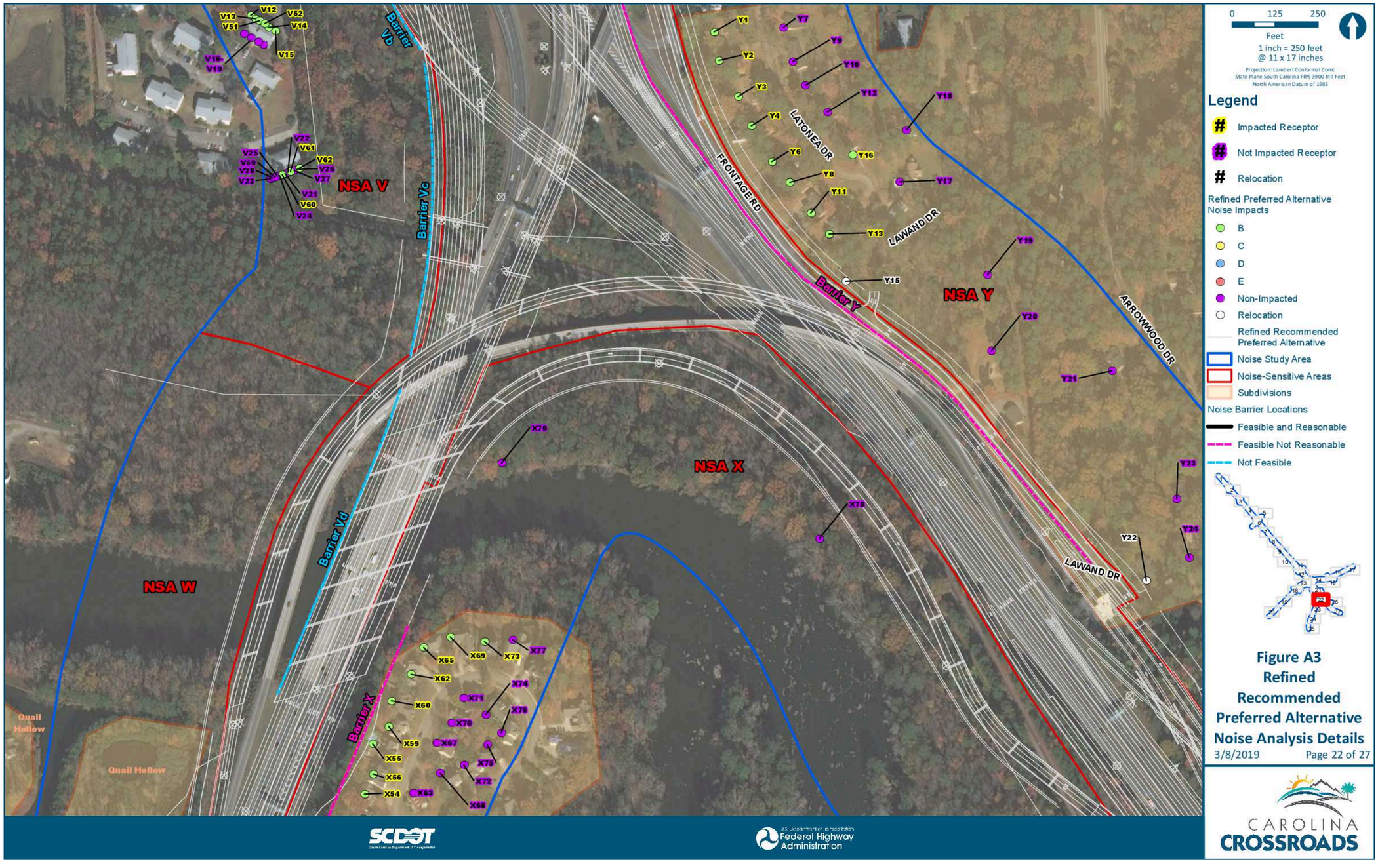


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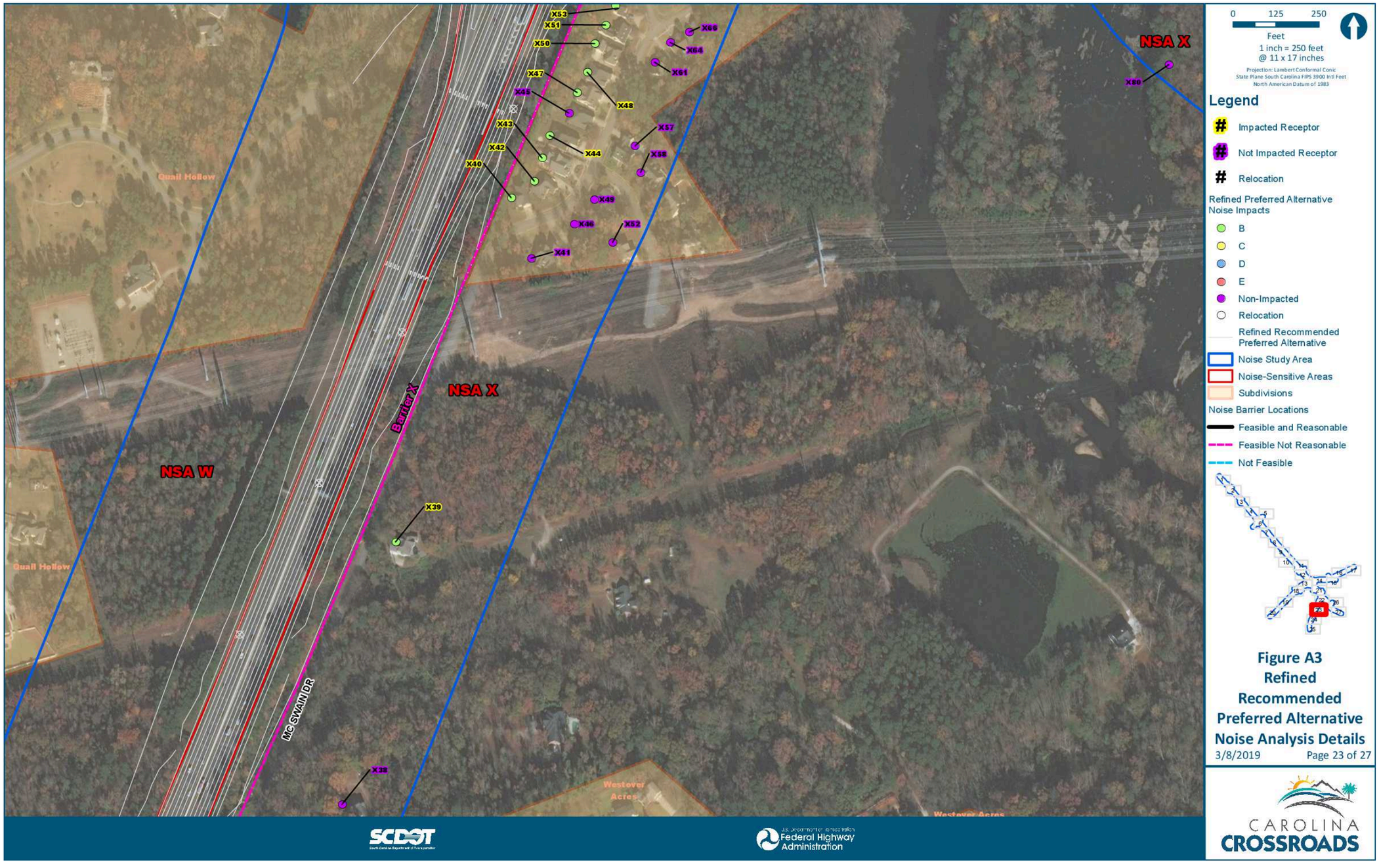


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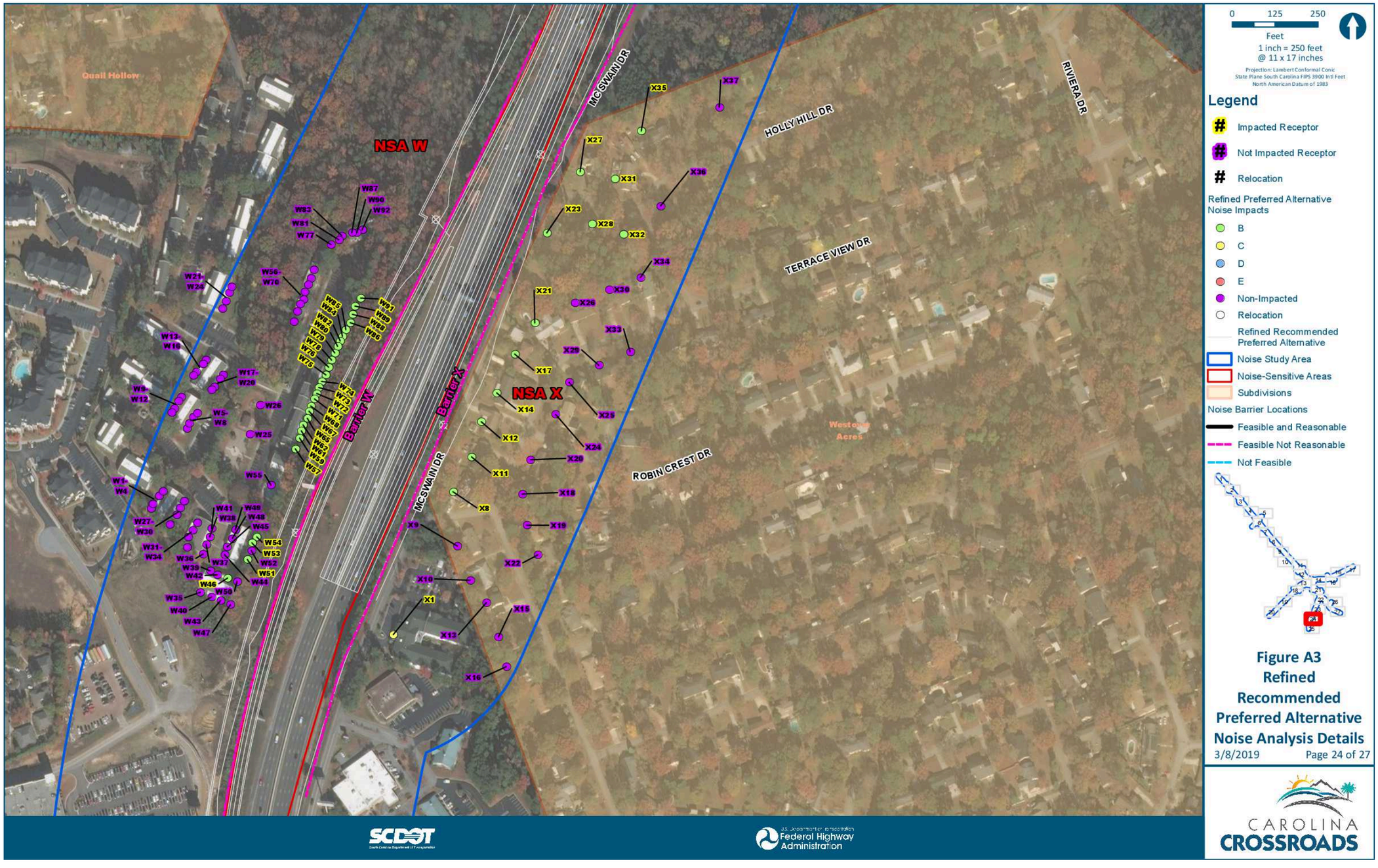


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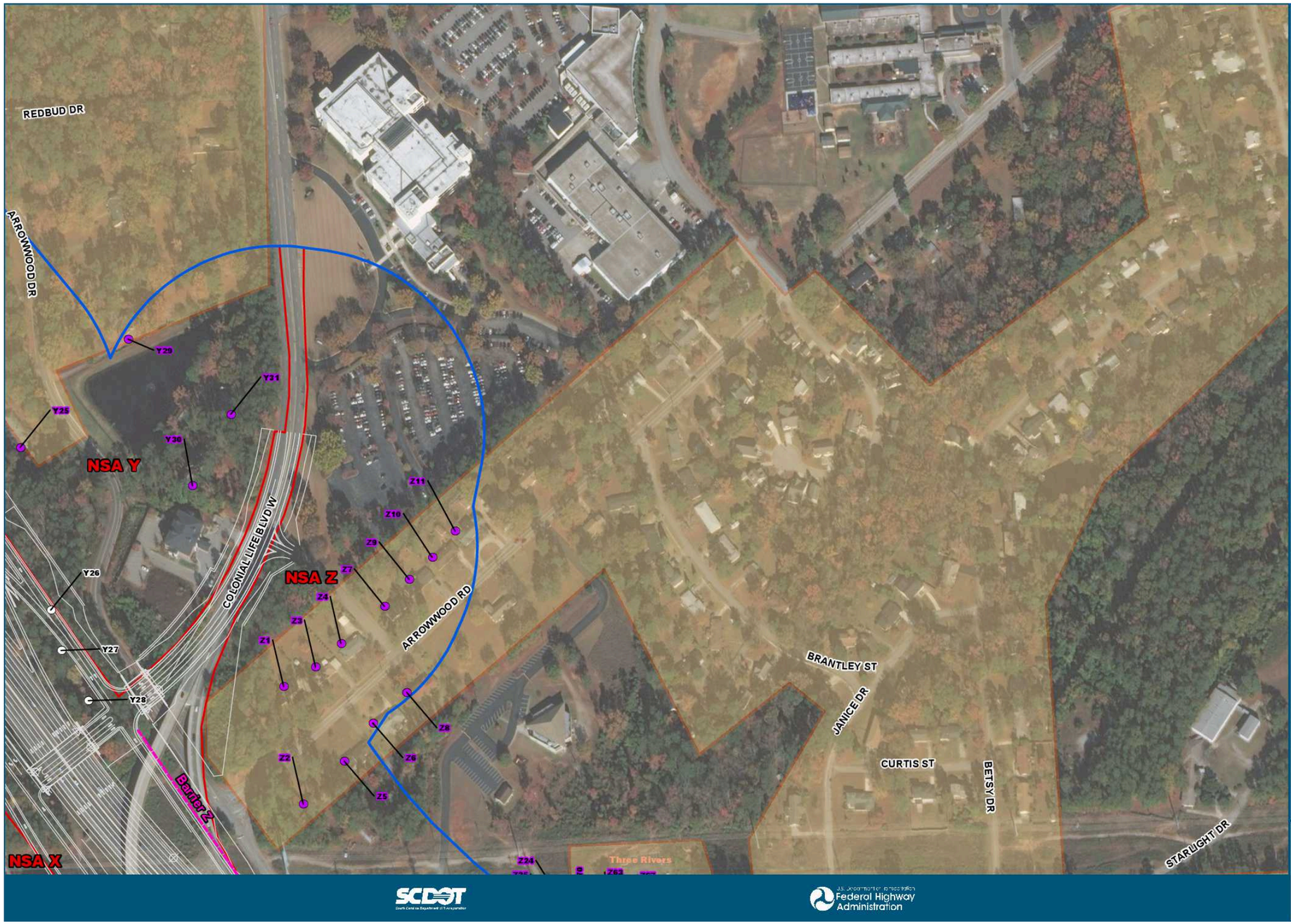



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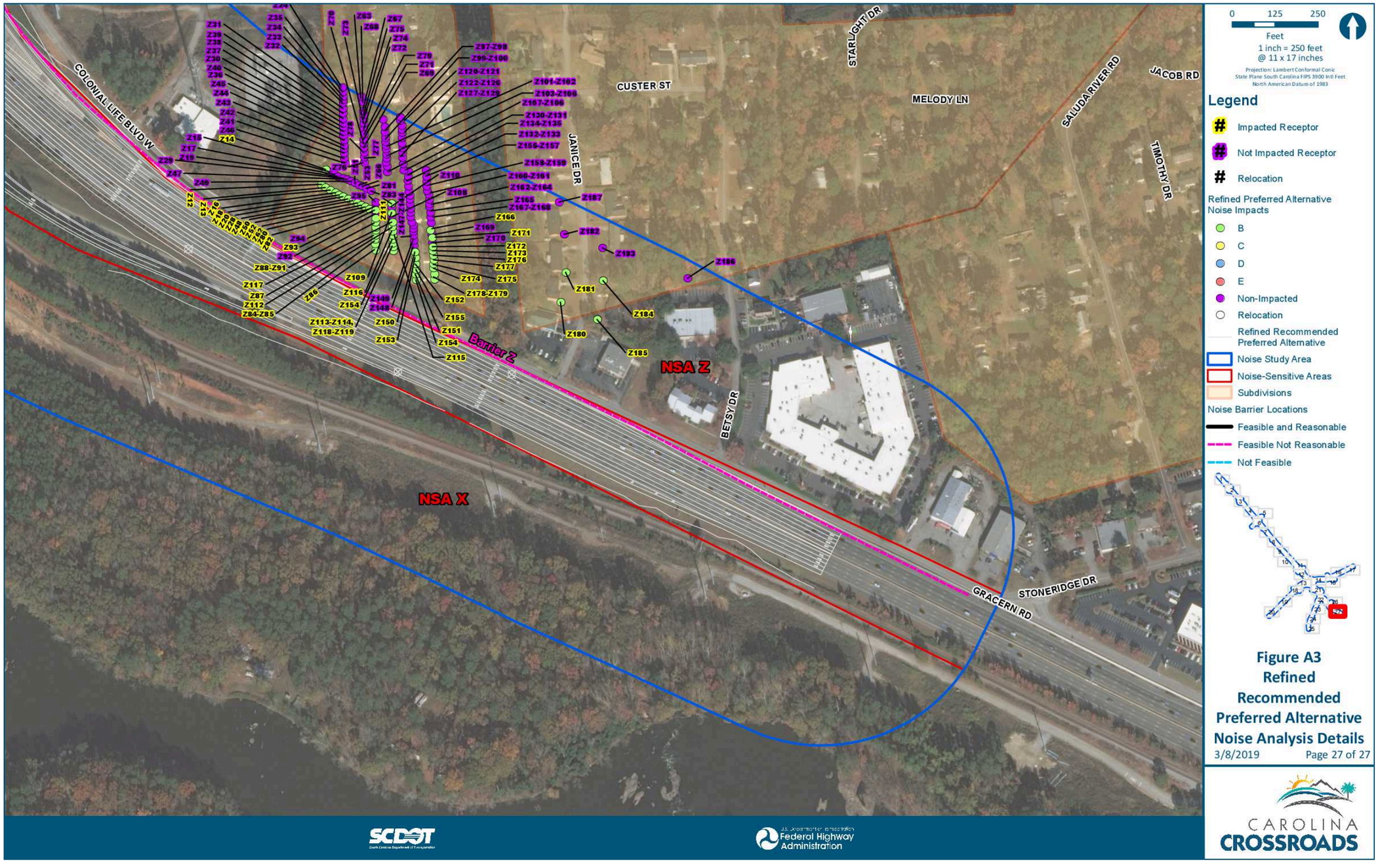


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