FRONTIER DRIVE EXTENSION AND BRAIDED RAMPS

Springfield, Fairfax County, Virginia

Project Number: 2677-029-204, P101; UPC: 106742

Preliminary Noise Analysis Technical Report

Submitted by: WSP USA

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EXECUTIVE SUMMARY

This report for the Frontier Drive Extension and Braided Ramps project details the noise impact assessment for the Existing (2016) condition and the future design-year (2043) No-Build and Build Alternatives. All analysis was performed in accordance with current Federal Highway Administration (FHWA) regulations contained in 23 CFR 772 and Virginia Department of Transportation (VDOT) Noise Abatement Policy.

The project area is located in Springfield (Fairfax County), Virginia. The project location is shown in Figure 1-1. The proposed Build Alternative includes improvements to the existing interchange of Frontier Drive (Route 2677) and Franconia-Springfield Parkway (Route 289), changes to the access and circulation at the Franconia-Springfield Transit Center, and the extension of Frontier Drive from the Transit Center south to Loisdale Road. The ramps from the westbound Franconia-Springfield Parkway and from the Transit Center will be replaced with braided ramps.

The noise study involved monitoring of existing noise conditions and modeling of existing and future design-year noise conditions in the study area using version 2.5 of the FHWA Traffic Noise Model (TNM). The geometric modeling of the study area accounted for all relevant terrain features, buildings, and existing and proposed roadway improvements. Traffic data utilized consisted of the projected worst case loudest-hour traffic volumes. The number of predicted existing and future noise impacts are summarized by land use activity category in the table below.

Table ES-1: Noise Impact Summary

Alternative	Impact Type	Land Use and NAC Activity Category				
		Residential Exterior (B)	Recreational Exterior (C)	Institutional Interior (D)	Commercial Exterior (E)	Total
Existing	NAC	178	0	0	0	178
No-Build	NAC	217	0	0	0	217
Build	NAC	214	0	0	0	214

Noise abatement must be considered in all locations where noise impacts are predicted to occur under future build conditions. Noise abatement is evaluated to determine if the potential abatement measure satisfies VDOT criteria to be considered warranted, feasible and reasonable. The following table summarizes the total length, estimated cost and number of benefits that would be provided by proposed Noise Barrier 1. The abatement analysis findings indicate that the one proposed noise barrier is feasible and reasonable. Additionally, Table ES-2 summarizes details of Noise Barrier 2, an in-kind replacement noise wall for a section of an existing noise wall that will need to be removed because of the realignment of roadway ramps under the proposed build design.

Table ES-2: Summary of Feasible and Reasonable Noise Barriers

Barrier Location	Length (ft.)	Estimated Cost ($42/sq. ft.)	Number of Benefited Receptors		
			Impacted	Not Impacted	Total
1	2,383	$3,002,580	108	100	208
2[1]	1,125	$756,000	4	8	12

1. Replacement wall for the section of an existing noise wall that would need to be removed because of the proposed project roadway improvements. Per VDOT policy, in-kind replacement noise walls are not subject to reasonableness criteria. VDOT requires that at all receptors behind the wall, the replacement wall must provide noise reduction that meets or exceeds the performance of the existing noise wall. The number of benefited receptors represents acoustic effectiveness performance of noise wall system, which includes the existing wall sections that the replacement noise wall will tie into.

A preliminary noise evaluation was performed and a more detailed review will be completed during final design. As such, noise barriers that are found to be feasible and reasonable during the preliminary noise analysis may not be found to be feasible and reasonable during the final design noise analysis. Conversely, noise barriers that were not considered feasible and reasonable may be found to meet established criteria and be recommended for construction. If a noise barrier is determined to be feasible and reasonable in final design, the affected public will be given an opportunity to decide whether they are in favor of construction of the noise barrier.

Construction activity may cause intermittent fluctuations in noise levels. During the construction phase of the project, all reasonable measures will be taken to minimize noise impact from these activities.

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1 INTRODUCTION

The Virginia Department of Transportation (VDOT) and the Fairfax County Department of Transportation (FC DOT) have initiated preliminary engineering for the Frontier Drive Extension and Braided Ramps project in Springfield, Virginia.

The purpose of this Technical Report is to identify and assess the impact to noise-sensitive land use within the project area. This report documents the noise analysis conducted for the existing (2016) and future (2043) noise conditions in the areas adjacent to Frontier Drive Extension and Braided Ramps project area to support the Environmental Assessment (EA) being prepared by VDOT. Information in this report, described below, will support discussions presented in the EA.

- Section 1 provides an overview of the study area and purpose and need of the project;
- Section 2 describes noise terminology, regulations, noise abatement criteria, analysis methodology, and the noise prediction model;
- Section 3 describes the existing noise conditions, receptor locations, the noise monitoring program, traffic data, and model validation;
- Section 4 describes noise modeling details, predicted noise levels at all receptors, and the noise impact assessment;
- Section 5 describes noise abatement measures, including alternative measures and details on potential noise barriers;
- Section 6 describes construction noise provisions; and,
- Section 7 describes the public involvement process and provides information for local government officials.

1.1 DESCRIPTION OF THE STUDY AREA

The study area encompasses 1.2 miles of Frontier Drive and current Springfield Center Drive from Loisdale Road to just south of Spring Mall Drive and 0.7 miles of Franconia-Springfield Parkway to the east and west of Frontier Drive, as shown in Figure 1-1. Transition areas to tie into existing roadways are also included in the study area, as well as all noise sensitive land uses identified adjacent to the project study area corridor.[1]

[1] The study area for the noise analysis is 500 feet from the limits of proposed project improvements.

Frontier Drive Extension and Braided Ramps
State Project: 2677-029-204, P101; UPC: 106742

Virginia Department of Transportation

Project Improvements
500-foot Study Area
Common Noise Environment
Noise Measurement Sites

0 250 500 1,000 Feet

Frontier Drive Extension and Braided Ramps

Springfield, VA
Fairfax County

Figure 1-1
Project Location, CNEs, and Monitoring Locations

1.2 EXISTING CONDITIONS

Within the project area, Frontier Drive is a north-south minor arterial roadway that provides vehicular access to the Franconia-Springfield Transit Center and an interchange with Franconia-Springfield Parkway. South of Franconia-Springfield Parkway, Frontier Drive terminates at the Transit Center and there is no existing direct connection between Frontier Drive and Loisdale Road, which parallels I-95 to the southwest of the Transit Center. Springfield Center Drive is a private access roadway that currently begins at Loisdale Road, extends northeast and terminates approximately 500 feet south of the Transit Center access roadway.

1.3 PURPOSE AND NEED

The purpose of the proposed extension of Frontier Drive to Loisdale Road is to offer transportation network users a second route to the Franconia-Springfield Transit Center, relieve traffic levels along Spring Mall Drive, increase access to the Franconia Springfield Business Center, support economic development, and enhance interchange efficiency.

1.4 DESCRIPTION OF THE ALTERNATIVES

The No Build Alternative and one Build Alternative are under consideration and are assessed in this technical report.

1.4.1 No Build Alternative

The No Build Alternative would retain all existing roadway configurations.

1.4.2 Build Alternative

The proposed Build Alternative includes improvements to the existing interchange of Frontier Drive and Franconia-Springfield Parkway, changes to the access and circulation at the Franconia-Springfield Transit Center, and the extension of Frontier Drive from the Transit Center south to Loisdale Road. The ramps from the westbound Parkway and from the Transit Center will be replaced with braided ramps. In addition, a shared use path linking the Transit Center to Frontier Drive is planned. Current access to Frontier Drive, the Parkway, and the two existing parking structures will be maintained. A proposed roundabout at the east end of the Transit Center will connect the circulation roadways to the existing loop ramp and proposed braided ramps. A direct connection from the Transit Center to the eastbound Parkway is also provided. In addition to the roadway improvements, three new bus bays are proposed and pedestrian facilities will be upgraded.

The proposed extension of Frontier Drive from its current terminus at the Transit Center south to Loisdale Road includes new roadway, a new bridge over Long Branch, and the reconstruction of portions of the existing privately-owned Springfield Center Drive. Access to existing facilities to remain will be provided. The length of the extension is approximately 0.9 miles, including 0.5 miles of new roadway and 0.4 miles of reconstructed existing roadway.

2 METHODOLOGY

The Federal Highway Administration (FHWA) regulations for assessment and mitigation of highway traffic noise in the planning and design of federally aided highway projects are contained in Title 23 of the United States Code of Federal Regulations Part 772 (23 CFR 772). These regulations state that a "Type I" traffic noise impact analysis is required where through travel lanes or interchange ramps are added. This report details the noise impact analysis for the Frontier Drive Extension project. This noise analysis was conducted in accordance with FHWA and VDOT noise assessment regulations and guidelines.

This report presents a summary of the proposed roadway improvements under study, description of noise terminology, applicable standards and criteria, evaluation of the existing noise conditions, description of methods used to predict existing and future noise levels, prediction of future noise impacts, evaluation of potential noise abatement measures, construction noise considerations, and information for local government officials.

2.1 NOISE TERMINOLOGY

Noise is generally defined as unwanted sound that results in annoyance to listeners. Airborne sound occurs by a rapid fluctuation of air pressure. Sound pressure levels are usually measured and expressed in decibels (dB). The decibel scale is logarithmic and is expressed by the ratio of the sound pressure unit being measured to a standard reference level.

Most sounds occurring in the environment do not consist of a single frequency (or pitch), but rather include acoustic energy spread over a range of frequencies. Because the human ear does not respond to all frequencies equally, the method commonly used to quantify environmental noise and its relationship to human perception involves applying a frequency weighting system. It has been found that the A-weighted decibel scale best approximates the frequency response of the human ear.

Although the A-weighted noise level may adequately indicate the level of environmental noise at any instant in time, community noise levels vary continuously. Most environmental noise includes a combination of noise generated from sources at different distances from a listener, thereby creating a relatively steady background noise in which no particular source is identifiable. To describe the time-varying character of traffic noise, a statistical noise descriptor called the equivalent sound level, or Leq, is commonly used. The Leq is a measure of the steady, non-fluctuating sound energy that represents the same sound energy as the actual time-varying sound evaluated over the same time-period. For traffic noise assessments, the Leq level is determined over a one-hour period and is denoted as Leq(h).

2.2 REGULATIONS AND GUIDELINES

The traffic noise analysis for the Frontier Drive Extension project was completed in accordance with FHWA and VDOT traffic noise assessment regulations and guidelines. The VDOT State Noise Abatement Policy was developed to implement the requirements of 23 CFR 772 Procedures for Abatement of Highway Traffic Noise and Construction Noise (July 13, 2011), FHWA's Highway Traffic Noise Analysis and Abatement Policy and Guidance (December 2011), and the noise related requirements

of The National Environmental Policy Act of 1969. The current VDOT State Noise Abatement Policy became effective on July 13, 2011 and was updated on July 14, 2015.

2.3 NOISE ABATEMENT CRITERIA

The VDOT State Noise Abatement Policy has adopted the FHWA Noise Abatement Criteria (NAC) that have been established as part of 23 CFR 772 for determining traffic noise impacts for a variety of land uses. The NAC, listed in Table 2-1 for various activities, represent the upper limit of acceptable traffic noise conditions and a balancing of that which may be desirable with that which may be achievable. The NAC applies to areas having regular human use and where lowered noise levels are desired. They do not apply to the entire tract of land on which the activity is based, but only to that portion where the activity takes place. The NAC are given in terms of the hourly, A-weighted, equivalent sound level in decibels (dBA).

Traffic noise impacts occur if either of the following two conditions is met:

- The predicted traffic noise level (future design year) approach or exceed the NAC, as shown in Table 2-1. The VDOT State Noise Abatement Policy defines an approach level to be used when determining a traffic noise impact. The “Approach” level has been defined by VDOT as 1 dBA less than the NAC for Activity Categories A to E. For example, for a category B receptor, 66 dBA would be approach 67 dBA and would be considered an impact. If design year noise levels “approach or exceed” the NAC, then the activity is impacted and a series of abatement measures much be considered.

- The predicted traffic noise levels are substantially higher than the existing noise levels. A substantial noise increase has been defined by VDOT when the predicted (future design year) highway traffic noise levels exceed existing noise levels by 10 dBA or more for all noise-sensitive exterior activity categories. For example, if a receptor’s existing noise level is 50 dBA and the future noise level is 60 dBA, then it would be considered an impact. The noise levels of the substantial increase impact do not have to exceed the appropriate NAC. Receptors that satisfy this condition warrant consideration of highway traffic noise abatement.

If traffic noise impact is identified within the project corridor, then consideration of noise abatement measures is necessary. The final decision on whether or not to provide noise abatement along a project corridor will take into account the feasibility of the design and overall cost weighted against the benefit.

Table 2-1: FHWA Noise Abatement Criteria

Activity Category[1]	$L_{eq}(h)$[2]	Evaluation Location	Activity Description
A	57	Exterior	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose
B	67	Exterior	Residential
C	67	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	Interior	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios
E	72	Exterior	Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in 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 (without building permits)

[1] Includes undeveloped lands permitted for activity categories B, C, and E.
[2] The Leq(h) Activity Criteria values, expressed in dBA, are for impact determination only and are not design standards for noise abatement measures.

Source: 23 CFR Part 772.

2.4 NOISE PREDICTION MODEL

All traffic noise predictions were completed using the FHWA Traffic Noise Model (TNM) version 2.5. TNM incorporates state-of-the-art sound emissions and sound propagation algorithms, based on well-established theory or on accepted international standards. The acoustical algorithms contained within TNM have been validated with respect to carefully conducted noise measurement programs, and show excellent agreement in most cases for sites with and without noise barriers. TNM uses an FHWA-approved database of vehicle noise emission levels, called reference energy mean emission levels, and its acoustical algorithms to predict traffic noise levels at the selected receptor locations.

Input data used to construct a three-dimensional model of the project study area within TNM included: project preliminary engineering design files, aerial photography, USGS topographical data[1] and project survey data.

The existing and proposed traffic noise sources are defined within TNM by inputting the various modeling elements into each model. These include: roadway alignments (horizontal and vertical geometrics), roadway widths, traffic volumes of cars, medium trucks, heavy trucks and buses, average vehicle travel speeds, pavement type, and any traffic control devices. Receptor locations, where noise level estimates will be determined, are then added to the model along with any acoustically-significant shielding features in the roadway-receptor pathways such as noise barriers, buildings, retaining walls, paved ground zones, hills and other terrain features.

[1] USGS National Elevation Dataset, https://lta.cr.usgs.gov/NED

3 EXISTING NOISE ENVIRONMENT

This section discusses existing land uses, the identification of receptors and common noise environments, review of undeveloped lands and permitted developments, monitoring of existing noise levels, validation of the traffic noise model, determination of the worst noise hour, and predicted existing noise levels.

3.1 EXISTING LAND USES

The study area includes mostly residential land use and development, as well as some recreational, institutional and exterior commercial land use.

3.1.1 Common Noise Environment (CNE) Descriptions

Table 3-1 presents a summary of the CNEs within the study area with FHWA activity categories, general location for each CNE and brief description of the noise-sensitive land uses within each CNE. More detailed descriptions of the CNEs are provided in the next section. CNE boundaries are shown in Figure 1-1 for areas with noise-sensitive land use.

Table 3-1: Common Noise Environment (CNE) Descriptions

CNE	FHWA Activity Categories[1]	Description of Land Use and Location
1	B, C	Residences at Springfield Station apartment complex, west of Frontier Drive and north of Franconia-Springfield Parkway
2	B	Single-family residences east of Frontier Drive along Melia Street
3	B	Single-family residences east of transit station and south of Franconia-Springfield Parkway along Windham Avenue
4	B	Single-family residences south of Frontier Drive extension and east of I-95
5	C, D, E	Commercial and institutional uses west of Frontier Drive extension and south of the transit station

Source: WSP, 2018

3.1.2 Receptor Identification and NAC Categorization

Land uses were identified throughout the 500-foot project improvement study area. Residential (Category B), institutional exterior (Category C), institutional interior (Category D), and commercial (Category E) land uses were identified and evaluated for potential noise impact. To fully characterize existing and future noise levels at all noise-sensitive land uses, 344 noise prediction receptors (also called “receivers” or “sites”) were included in the TNM model to represent a total of 500 noise-sensitive land uses.

The Franconia-Springfield Parkway Trail, which runs parallel to Franconia-Springfield Parkway within the project area, was confirmed to be within VDOT right-of-way and to be built for and primarily function as, a transportation facility. Thus, per VDOT policy, the Franconia-Springfield Parkway Trail was determined not to be noise-sensitive and was not included in the noise assessment.

[1] Table 3-1 provides detailed descriptions of the land uses included in the categories.

In addition, several developed lands were identified within the project area but were not modeled because there were no apparent outdoor use areas. These land uses consisted of Activity Category E (offices) and found along the Frontier Drive extension south of the Transit Station. Furthermore, Activity Category F (retail and warehousing) and G (undeveloped) properties, which are not noise-sensitive, were also identified in the project area. There are no historic properties or areas classified as either Section 106 or Section 4(f) within the project study area.

CNE 1 is located north of Franconia-Springfield Parkway, west of Frontier Drive, and south of Spring Mall Drive and it includes a multi-family residential development complex, referred to as the Residences at Springfield Station. The complex includes two 6-story buildings, seven 4-story buildings, an outdoor swimming pool and two outdoor patio areas. There are a total of 631 residential units in the complex and all units have a private outdoor balcony (Category B). The outdoor pool area is in the northern portion of the complex and the outdoor patio areas are in the eastern portion of the complex. A total of 231 TNM receptor points was modeled from the ground level up to 6-story level (55-ft above the ground) to account for all residential unit balconies with a direct view of Frontier Drive or Franconia-Springfield Parkway. Each modeled receptor represents either one or two residential units.

CNE 2 is located north of Franconia-Springfield Parkway and east of Frontier Drive and consists of single-family residences along Melia Street. Each residence has front and backyard outdoor land use at ground level (Category B). There is an existing 6 to 8-foot-tall noise wall that provides shielding from Franconia-Springfield Parkway traffic noise for the homes in this area.

CNE 3 is located south-east of the Franconia-Springfield Transit Station and the area consists of single-family residences along Windham Ave. The residences all have front and backyard outdoor land use at ground level (Category B).

CNE 4 is located south of the existing Springfield Center Drive and east of I-95 and the area consists of single-family residences along Layton Drive, Ruskin Street, and Mayo Court. The residences all have front and backyard outdoor land use at ground level (Category B).

CNE 5 is located north of the existing Springfield Center Drive and west of the CSX tracks. This area represents the Northern Virginia Community College, which has been evaluated for both exterior use at a patio area (Category C) and interior use within the building (Category D), and an undeveloped lot with an existing building permit for an office (Category E).

3.2 UNDEVELOPED LANDS AND PERMITTED DEVELOPMENTS

Highway traffic noise analyses are (and will be) performed for developed lands as well as undeveloped lands if they are considered "permitted." Undeveloped lands are deemed to be permitted when there is a definite commitment to develop land with an approved specific design of land use activities as evidenced by the issuance of at least one building permit.

In accordance with the VDOT Traffic Noise Policy, an undeveloped lot is considered to be planned, designed, and programmed if a building permit has been issued by the local authorities prior to the Date of Public Knowledge for the relevant project. VDOT considers the "Date of Public Knowledge" as the

date that the final NEPA approval is made. VDOT has no obligation to provide noise mitigation for any undeveloped land that is permitted or constructed after this date.

Fairfax County maintains an online database[1] of all building permits. The database was accessed on 12/19/2017 to investigate potential building permits on undeveloped land parcels within the noise study area. One noise-sensitive property with an existing building permit was identified. The property at 6595 Springfield Center Drive is planned for use as an office with a building permit issued on 12/4/2017. This property was included in the analysis as a noise-sensitive receptor location and is shown on Figure 4-3.

3.3 MONITORING OF EXISTING NOISE LEVELS

Noise monitoring was completed throughout the Frontier Drive Extension project noise study area consistent with FHWA and VDOT recommended procedures to: (1) document existing ambient noise levels in noise-sensitive locations in the study corridor and (2) provide a means for validation of the TNM noise prediction model. Prior to the data collection effort, VDOT reviewed and approved the proposed validation sites. Short-term noise monitoring was conducted at seven (7) sites throughout the study area on November 15th and 16th, 2017.

Four (4) of the measurement sites, labeled V-1 to V-4, were located at noise-sensitive land uses where the existing noise environment was dominated by traffic on nearby existing roadways. These sites were used to validate the TNM noise model. At each of these 4 sites, simultaneous 20-minute continuous noise measurements and traffic counts were conducted on the nearest roadways to each measurement site. Traffic counts were collected in accordance with the TNM defined vehicle classification input format.

Three (3) of the measurement sites, labeled M-1 to M-3, were at noise-sensitive land uses located adjacent to the existing rail corridor, so rail noise contributes to the existing ambient noise levels at these sites. Moreover, sites M-1 to M-3 were also relatively distant from major roadway noise sources. To establish existing noise levels from the combination of roadway, rail, and other ambient noise sources at these sites, 30-minute duration continuous noise measurements were taken at during peak commuting periods of 6 – 9 AM and 4 – 7 PM. Figure 1-1 depicts the location of the seven noise measurement sites within the project study area and each site is numbered with the “M” or “V” prefix as discussed above.

Short-term noise monitoring is not a process to determine design year noise impacts or barrier locations. Short-term noise monitoring provides a level of consistency between what is present in real-world situations and how that is represented in the computer noise model. Short-term monitoring does not need to occur within every CNE to validate the computer noise model.

The monitoring was conducted using a Larson Davis LXT (ANSI Type I, “Precision”) integrating sound level meter. The meter was equipped with a 3-inch windscreen and positioned on a tripod 5-feet above ground. In the field the accuracy of each reading was verified using a hand-held Brüel & Kjær Type 4231 sound level calibrator before and after each noise measurement. In addition, both the sound level meter and sound level meter calibrator are calibrated by an accredited laboratory each year in accordance with the National Institute of Standards and Technology traceable standards for Type I precision sound level meters.

[1] Fairfax County Land Development Database: http://ldip.fairfaxcounty.gov/

Air temperatures ranged between 31 and 63 degrees Fahrenheit and winds were light and variable with speeds of less than 10 mph during all noise measurements. There was no precipitation during measurement periods and the surfaces of all roadways were dry.

The measured noise levels are shown in Table 3-2 as equivalent sound levels (Leq). As described above, the Leq accounts for the fluctuating sound level (in A-weighted decibels or dBA) measured over a specified time period. Table 3-2 provides the site address, as well as the date, start time, and duration of each measurement.

Table 3-2: Summary of Noise Measurement Data

Site No.	Address	Date	Start Time	Duration (minutes)	Measured L_{eq} (dBA)
V-1	6600/6616 Comet Circle, Springfield	11/15/2017	12:22 PM	20	58
V-2	6509 Melia St, Springfield	11/15/2017	9:50 AM	20	57
V-3	7113/7121 Layton Dr, Springfield	11/15/2017	4:06 PM	20	51
V-4	6814 Meteor Place, Springfield	11/15/2017	11:43 AM	20	62
M-1	6706 Ruskin St, Springfield	11/16/2017	8:31 AM	30	54
M-2	6516 Windham Ave, Alexandria	11/16/2017	4:18 PM	30	63
M-3	6419 Melia St, Springfield	11/15/2017	8:23 AM	30	56

Note: Site locations are shown on map in Figure 1-1. Additional details are presented in Appendix D.
Source: WSP, 2018.

The primary noise source at sites V-1 – V-4 was from roadway traffic. Rail noise from train pass-by events was also a contributing noise source at measurement sites M-1 – M-3. Other sources of noise in the existing environment included aircraft overflights, lawn equipment, birds, insects, wind in the trees and noise generated from other human-related activities. Appendix D provides a detailed summary of the data acquired during the noise measurement survey that includes: site sketches, photographs, ambient noise measurement data with site summary results and traffic counts with hourly totals.

3.4 NOISE MODEL VALIDATION

As per FHWA and VDOT traffic noise policies, the accuracy of the noise prediction model must be verified before it can be used throughout a project study area to estimate noise levels at other receptor sites of interest. The noise model validation process compares the field measured noise levels with predicted noise levels from the FHWA TNM using the traffic count data collected during the measurement period as input to the model. The purpose of the validation process is to determine how accurate the model representation of the study area performs in reproducing the measured ambient noise environment at the time of the data collection effort. Both FHWA and VDOT consider the noise model to be validated when measured noise levels are within +/- 3 dBA of the TNM predicted noise levels of the existing conditions.

Table 3-3 presents a site-by-site comparison of measured noise versus TNM predicted noise level. The noise model validation findings indicate that the TNM predicted noise levels of the existing conditions are within 1 dBA of measured noise levels at all sites. Therefore the TNM model for this project is considered validated and can be expanded and used to estimate noise levels at other receptor sites.

Table 3-3: Noise Model Validation Results

Site No.	Location	Land Use	Measured Leq (dBA) (Traffic Only)	Predicted Leq (dBA)	Difference (decibels)
V-1	6600/6616 Comet Circle, Springfield	Multi-family residential	57.9	58.3	0.4
V-2	6509 Melia Street	Single-family residential	56.8	55.9	-0.9
V-3	7113/7121 Layton Drive	Single-family residential	51.4	50.5	-0.9
V-4	6814 Meteor Place	Single-family residential	62.2	61.1	-1.1

Note: Site locations shown on map in Figure 1-1. Detailed data presented in Appendix D.
Source: WSP, 2018

3.5 WORST NOISE HOUR DETERMINATION

As required by FHWA and VDOT, the noise analysis was performed for the loudest ("worst noise") hour of the day. Noise levels have been predicted for that hour of the day when the vehicle volume, operating speed and number of heavy trucks (vehicles with 3 or more axles) combine to produce the worst-case traffic noise exposure conditions. Additionally, as per FHWA guidance, the "worst hourly traffic noise impact" occurs at a time when truck volumes and vehicle speeds are the greatest, typically when traffic is free flowing and at or near level of service (LOS) C conditions.

A detailed traffic analysis was completed for the project and described in an Interchange Modification Report (IMR) that was conditionally approved by VDOT in October 2017. The noise analysis utilized traffic forecasts in accordance with the VDOT Environmental Traffic Data (ENTRADA) spreadsheet format. The ENTRADA output data included hourly volumes, posted and operating travel speeds and projected LOS for Franconia-Springfield Parkway mainline and ramps, Frontier Drive, and Springfield Center Drive over a 24-hour weekday time-period.

The ENTRADA data were reviewed to identify the hour with the highest overall traffic volumes and free flowing (LOS C or higher) traffic conditions. Therefore, based on this approach, the PM peak hour of 5:00 – 6:00 PM was determined as the worst case (loudest) traffic hour for use in the noise analysis. After determining the worst noise hour, traffic volumes for Loisdale Road and the Franconia-Springfield Transit Station access roads were estimated based on PM peak hour traffic forecasts.

The traffic analysis also utilized vehicle classification data derived from tube counts. The data allowed for determining the percentage of buses, medium trucks, and heavy trucks for Franconia-Springfield Parkway mainline and ramps and Frontier Drive. Furthermore, the vehicle speeds used in the TNM modeling was the higher of either the ENTRADA operating speeds or the posted speed. The traffic input data used for the noise analysis is included in Appendix C.

3.6 EXISTING NOISE LEVELS

3.6.1 Predicted

Using the worst hour traffic data, the TNM model was used to predict Existing 2016 traffic noise levels at all receptor locations identified within the study area limits. The TNM model of the existing conditions included the existing 6 to 8-foot-high noise barrier along westbound Franconia-Springfield Parkway near CNE 2. Under future build conditions, this existing noise wall is physically impacted by this project and a replacement noise wall is evaluated in Section 5.2.3. The predicted existing noise levels are presented and discussed in Section 4.2.

3.6.2 Measured

As discussed in Section 3.3, noise monitoring was completed during peak hour periods at sites M-1, M-2, and M-3 to provide representative peak hour ambient existing noise levels in the areas of CNEs 5, 4, and 2, respectively. These areas are either relatively distant from major traffic noise sources or close enough to the rail corridor that rail noise contributes to the existing noise environment. Therefore, as per VDOT policy and direction, the purpose of this monitoring was to establish existing noise levels using field measurements because TNM estimates noise solely from vehicular traffic and may not accurately represent the existing conditions in these communities exposed to rail noise. The measured existing noise levels are shown in Appendix D at the relevant receptor locations. The measured existing noise levels were also used to evaluate whether future Build condition noise levels would cause a substantial increase above existing noise levels.

4 FUTURE NOISE ENVIRONMENT

4.1 PREDICTION METHODS

4.1.1 Traffic Noise

Future traffic noise levels were predicted for design year 2043 using the FHWA TNM model described in Section 2.4. TNM models of future No-Build and Build conditions were developed to account for future traffic volumes and roadway design changes. Under future build design conditions a section of the existing noise wall near CNE 2 would be physically impacted by the proposed roadway improvements so it was removed from the Build condition TNM model.

All noise-sensitive land uses potentially affected by the project are near roads for which traffic forecasts were projected as part of the IMR. As described in Section 3.5 traffic forecasts used for the noise impact assessment was for the 5:00 – 6:00 PM period which was determined to generate the worst case loudest traffic noise exposure at each noise sensitive receptor site. A summary of the traffic data used in the noise modeling is shown in Appendix C.

4.1.2 Rail Noise

Rail noise from the Washington Metro Area Transit Authority (WMATA) Blue Line Metrorail trains, Virginia Railway Express (VRE) Fredericksburg Line commuter trains, Amtrak regional trains, and CSX freight rail activities contribute to the overall noise levels at receptors near the rail corridor in CNEs 2, 3, 4 and 5. As per VDOT policy, at receptor locations influenced by non-traffic noise sources such as transit and rail activities, the total noise level resulting from the combination of all noise sources must be determined and used for the noise impact assessment. Therefore, future rail noise levels were predicted.

The schedule for CSX freight activities is not published and there were no CSX freight passbys observed from 5:00 – 6:00 PM during the field review, so freight trains were not included in the rail noise predictions. Published schedules for WMATA, VRE, and Amtrak service were reviewed to identify the number of trains passing through the project corridor during the 5:00 – 6:00 PM hour. It was determined that there are 15 WMATA train passbys, 2 VRE train passbys, and no Amtrak train passbys during this time-period.

Using this data, future worst-hour Leq(h) rail noise levels were estimated using procedures from the 2006 Federal Transit Administration (FTA) Transit Noise and Vibration Impact Assessment manual. The predictions account for the type of train, number of cars and number of locomotives, type of track, travel speed and distance from the tracks to the nearest receptor in each of the CNEs exposed to rail noise. Detailed rail noise calculations are included in Appendix F.

4.2 PREDICTED NOISE LEVELS

Traffic noise levels were predicted for the Existing 2016 and the design-year 2043 No-Build and Build conditions. All noise levels were predicted for the worst noise hour and are expressed in Leq(h) dBA.

Table 4-1 provides a summary of ranges of the predicted sound levels at the receptors within each CNE. Table E-1 in Appendix E shows the predicted sound levels at each receptor location. The receptor IDs are displayed in Figure 1-1.

Table 4-1: Ranges of Predicted Worst Hour Noise Levels by CNE

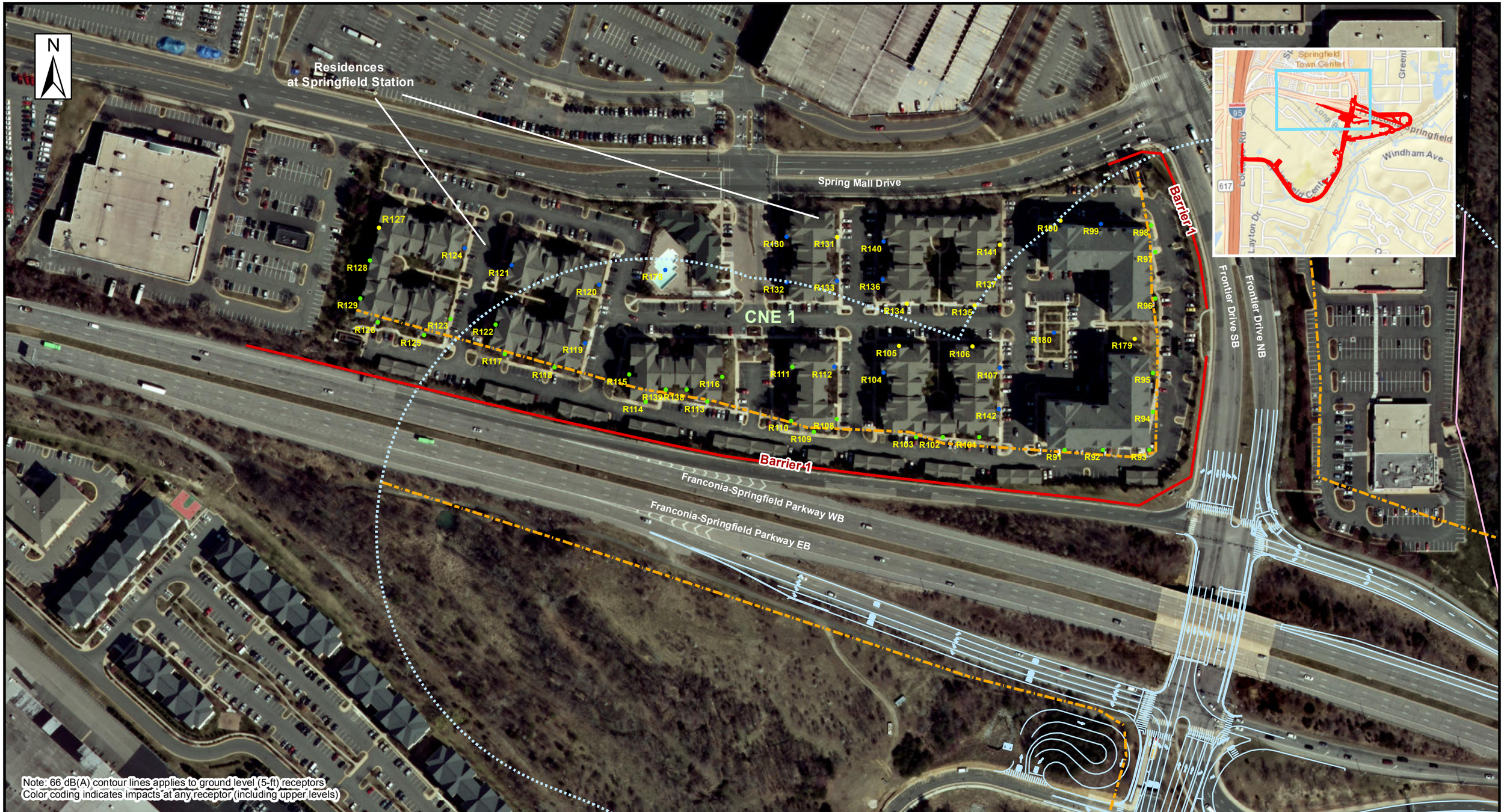
CNE ID	Area Land Use and Description	Ranges of Predicted Leq(h) Noise Levels in dBA		
		Existing	No Build	Build
1	Residences at Springfield Station apartment complex, west of Frontier Drive and north of Franconia-Springfield Parkway	48 - 72	49-73	49-72
2	Single-family residences east of Frontier Drive along Melia Street	53 - 63	54 - 64	55 - 66
3	Single-family residences east of transit center and south of Franconia-Springfield Parkway along Windham Avenue	62 - 64	62 - 64	63 - 64
4	Single-family residences south of Frontier Drive extension and east of I-95	44 - 65	46 - 67	46 - 67
5	Commercial and institutional uses west of Frontier Drive extension and south of the transit center	45 - 55	48 - 57	47 - 57

Figures 4-1, 4-2 and 4-3 show the impacted and benefited receptors for the Build Alternative in graphical form. For impacted receptors, predicted 2043 Build noise levels would approach or exceed the NAC for the associated land use category. The impact and abatement condition for each receptor is identified using a color code system. A green receptor dot indicates an impacted and benefited receptor, a red dot is an impacted but not benefited receptor, a blue dot is non-impacted but benefited site and a yellow dot indicates a non-impacted non-benefited receptor. The actual TNM estimated noise level at each receptor is detailed in Table E-1. The abatement analysis findings are discussed in detail in Section 5. Lastly, under future Build conditions no receptors were projected to experience a substantial noise level increase of 10 dBA or more over Existing noise levels.

Overall, throughout the project study area the predicted exterior noise levels range from 44 to 72 dBA for the 2016 Existing condition, 46 to 73 dBA under future 2043 No-Build traffic conditions, and 46 to 72 dBA with the 2043 Build design. On average, No-Build noise levels are predicted to be slightly higher than Existing noise levels due to higher future traffic volume forecasts. In general, projected Build Alternative noise levels are slightly higher than Existing noise levels. However, in some areas Build condition noise levels are expected to increase by as much as 6 dBA or decrease by as much as 3 dBA, relative to Existing noise levels.

The increase in future Build noise levels relative to Existing is primarily due to higher future traffic volumes, roadways shifting nearer to receptor locations in CNEs 2 and 5 and the new Frontier Drive roadway extension section in CNE 5. The realignment of the Franconia-Springfield ramps south of CNE 2 will also impact the existing noise wall along westbound Franconia-Springfield Parkway and requires a section of it to be removed from the TNM Build model of this area. As a result, receptors in this area are predicted to experience an increase in future noise levels. An in-kind replacement noise wall (Barrier 2), which is not subject to reasonableness criteria, has been proposed as part of the project and is discussed in Section 5.2.3.

The predicted decrease in future Build noise levels relative to Existing in a few areas is due to several elements of the project highway design. The proposed 4’-6” tall concrete barriers adjacent to sections of the eastbound Frontier Drive roadway shoulder in CNE 4 would provide additional shielding from traffic noise for some first-row below roadway grade receptors along Layton Drive.



Frontier Drive Extension and Braided Ramps
State Project: 2677-029-204, P101; UPC: 106742

Virginia Department of Transportation

- Project Improvements
- Existing Noise Wall
- Permitted Commercial Development
- 66 dB(A) Contour
- 500-foot Study Area

Noise Receptors

- Impacted & Benefited
- Impacted & Not Benefited
- Not Impacted & Benefited
- Not Impacted & Not Benefited

Evaluated Noise Barriers

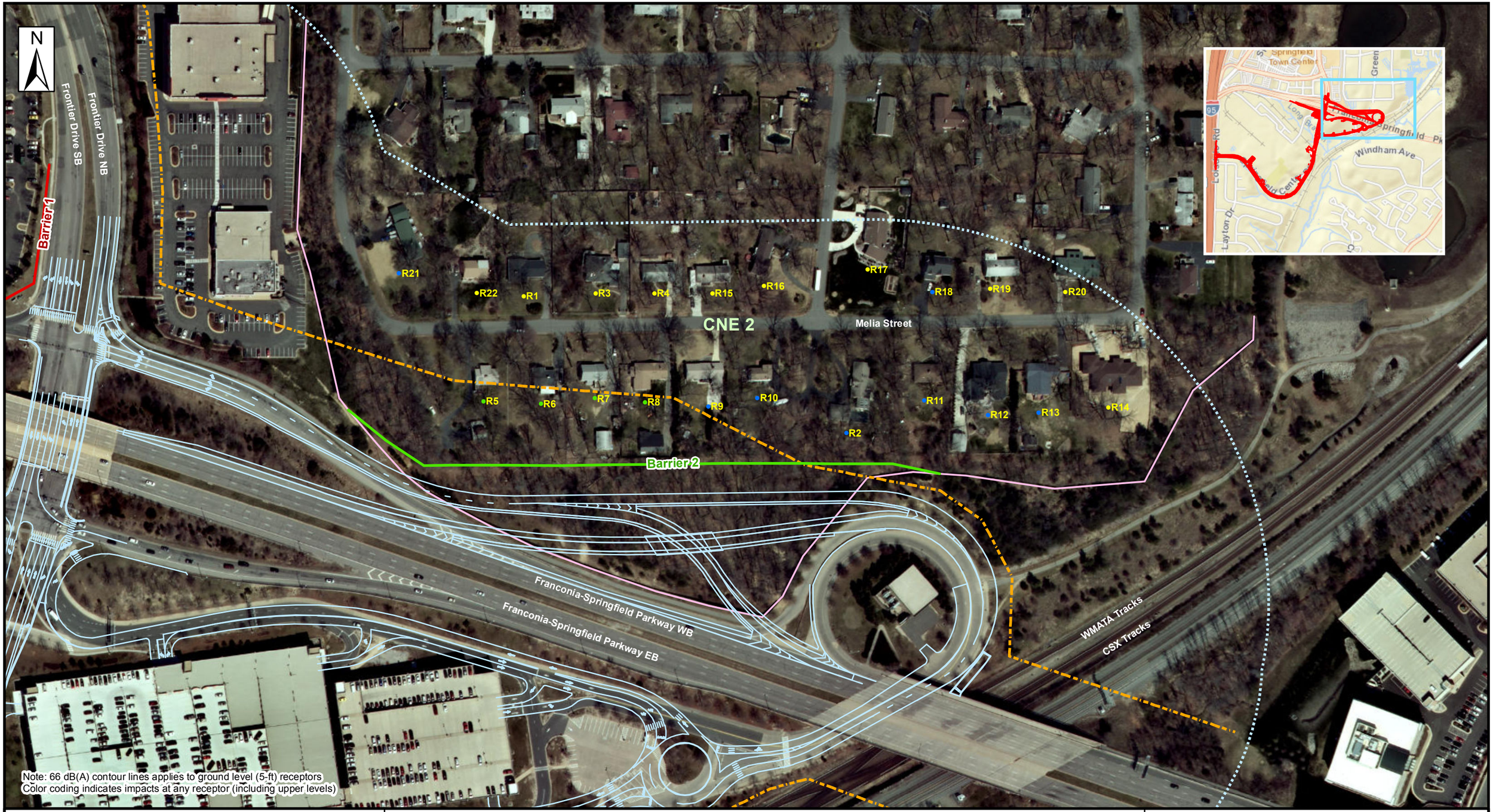
- Feasible and Reasonable
- Not Feasible

0 75 150 300 Feet

Frontier Drive Extension and Braided Ramps

Springfield, VA
Fairfax County

Figure 4-1
Northwest Noise Receptors and Modeling Results



Frontier Drive Extension and Braided Ramps
State Project: 2677-029-204, P101; UPC: 106742

Virginia Department of Transportation

Project Improvements
Existing Noise Wall
In-Kind Replacement Barrier
66 dB(A) Contour
500-foot Study Area

Noise Receptors
Impacted & Benefited
Impacted & Not Benefited
Not Impacted & Benefited
Not Impacted & Not Benefited

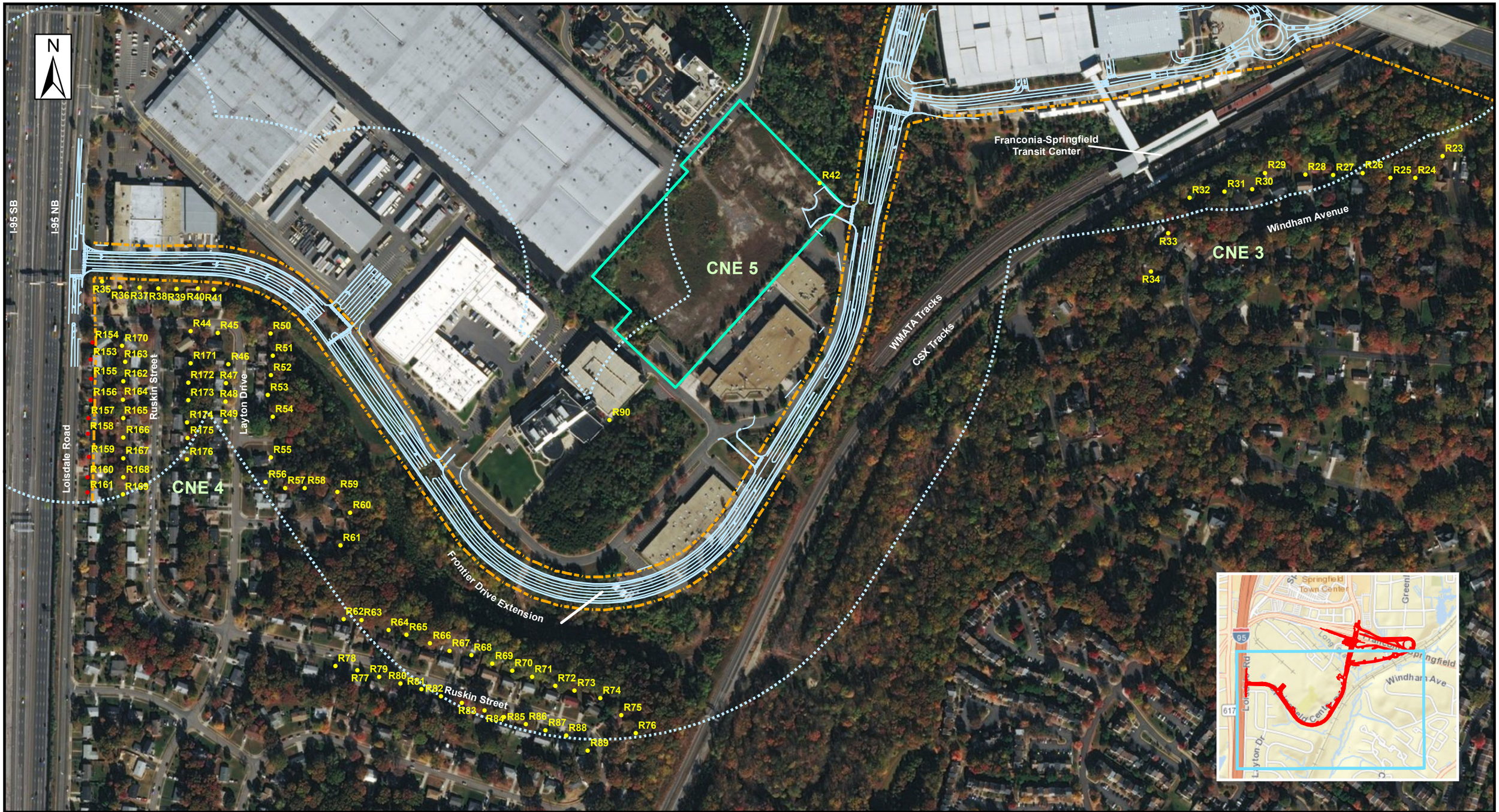
Evaluated Noise Barriers
Feasible and Reasonable
Not Feasible

0 75 150 300 Feet

Frontier Drive Extension and Braided Ramps

Springfield, VA
Fairfax County

Figure 4-2
Northeast Noise Receptors and Modeling Results



Frontier Drive Extension and Braided Ramps
State Project: 2677-029-204, P101; UPC: 106742

Virginia Department of Transportation

Project Improvements
Existing Noise Wall
Permitted Commercial Development
66 dB(A) Contour
500-foot Study Area

Noise Receptors
- Impacted & Benefited
- Impacted & Not Benefited
- Not Impacted & Benefited
- Not Impacted & Not Benefited

Evaluated Noise Barriers
- Feasible and Reasonable
- Not Feasible

0 125 250 500 Feet

Frontier Drive Extension and Braided Ramps

Springfield, VA
Fairfax County

Figure 4-3
South Noise Receptors and Modeling Results

4.3 NOISE IMPACT ASSESSMENT

Potential noise impacts due to the Frontier Drive Extension Project were assessed per FHWA and VDOT policy requirements as described in Section 2.

Figures 4-1, 4-2, and 4-3 show the locations of individual receptors where noise impacts are predicted to occur in the Build Alternative. Figure 1-1 also includes a 66 dBA noise contour, which represents the approximate extent of unabated Build condition noise impacts at ground floor receptors in residential (Category B) and recreational (Category C) areas.

Table 4-2 presents a summary of the predicted noise impact for the 2016 Existing and 2043 No Build and Build alternatives. The impacts are summarized for the entire study area and separated by NAC activity land use categories. All identified impacts are due to noise levels that are predicted to approach or exceed the NAC impact thresholds. No impacts due to substantial increases in existing noise levels were identified in this study.

Table 4-2: Noise Impact Summary

Alternative	Impact Type	Land Use and NAC Activity Category				
		Residential Exterior (B)	Recreational Exterior (C)	Institutional Interior (D)	Commercial Exterior (E)	Total
Existing	NAC	178	0	0	0	178
No-Build	NAC	217	0	0	0	217
Build	NAC	214	0	0	0	214

Source: WSP, 2018

Residential impacts are predicted to occur under all three conditions. The future No-Build condition has the most NAC impacts, with a total of 217. The Build condition has 214 impacts. The reduction in total number of impacts for the Build Condition is due to minor changes in the predicted Build noise levels at receptors that only slightly exceeded the NAC under the No-Build condition. Impacted receptors under Existing, No-Build, and Build Conditions consist of all residential dwellings. A total of 214 impacted receptors are predicted for the Build Alternative, all consisting of residential dwellings (Category B).

Table 4-3 summarizes the residential and recreational noise impacts by CNE. The color-coding of the receptors and the noise contour shown in Figures 4-1, 4-2 and 4-3 for the Build Alternative provides a visual depiction of where noise impacts are predicted to occur.

Table 4-3: Noise Impacts by Common Noise Environment

CNE ID	Area Land Use and Description	Residential Dwelling Units Impacted by Noise			Recreational Receptors Impacted by Noise		
		Existing	No-Build	Build	Existing	No-Build	Build
1	Residences at Springfield Station apartment complex, west of Frontier Drive and north of Franconia-Springfield Parkway	178	207	201	0	0	0
2	Single-family residences east of Frontier Drive along Melia Street	0	0	4	0	0	0
3	Single-family residences east of transit station and south of Franconia-Springfield Parkway along Windham Avenue	0	0	0	0	0	0
4	Single-family residences south of Frontier Drive extension and east of I-95	0	10	9	0	0	0
5	Commercial and institutional uses west of Frontier Drive extension and south of the transit station	0	0	0	0	0	0
	Total	178	217	214	0	0	0

Source: WSP, 2018

No noise impacts are projected within CNEs 3 and 5. Predicted noise impacts within each of the other CNEs are discussed below:

- CNE 1 – Impacted receptors include ground and upper-level (up to 6th story) private outdoor balconies for the buildings within the Residences at Springfield Station apartment complex.
- CNE 2 – Impacted receptors include single-family residences along Melia Street. The proposed roadway alignment would require removal of a section of the existing noise wall in this area and the Build condition impacts are due to the additional noise exposure from a gap in the noise wall.
- CNE 4 – Impacted receptors include single-family residences along Loisdale Road.

Noise abatement has been considered for all impacted receptor locations and these findings are discussed in Section 5.

4.3.1 Total Noise Levels

As discussed in Section 4.1.2, receptors within the study area near the rail corridor are exposed to a combination of both rail and traffic noise. VDOT policy requires that the total noise level resulting from the combination of all noise sources must be evaluated and considered in the noise impact assessment. Noise levels from rail activities have been estimated and added to the predicted traffic noise levels to calculate the total noise level at each receptor site located within 500 feet of the rail tracks. The predicted rail noise levels and resulting total noise levels are shown in Table E-2 of Appendix E. The impact assessment completed using the total noise levels determined that no additional impacts are caused by the addition of rail noise. Therefore, the traffic-only noise impact assessment presented in Section 4.3 accurately represents all potential noise impacts from the combination of both roadway traffic and rail sources in the project area.

5 NOISE ABATEMENT DETERMINATION

Noise abatement determination is a three-phased approach. **Phase 1** of the process is to determine if consideration of highway traffic noise abatement is warranted for the affected communities. Because predicted noise levels for the future 2043 Build design condition either approach or exceed the NAC, per VDOT's State Noise Abatement Policy, noise abatement considerations are warranted for the impacted areas described in Section 4.3. **Phases 2 and 3** of the noise abatement determination process involve evaluating the feasibility and reasonableness of the noise abatement measures being considered. Following the completion of all three phases, a determination can be made regarding whether each noise abatement measure is feasible and reasonable.

5.1 ALTERNATIVE ABATEMENT MEASURES

VDOT guidelines recommend a variety of mitigation measures that should be considered in response to transportation-related noise impacts. While noise barriers and/or earth berms are generally the most effective form of noise mitigation, additional mitigation measures exist that have the potential to provide considerable noise reductions under certain circumstances. Mitigation measures considered for this project include:

- Traffic management;
- Alignment modifications;
- Acoustical insulation of public use and non-profit facilities,
- Buffer lands;
- Construction of earth berms, and
- Construction of noise barriers.

Additionally, the Noise Policy Code of Virginia (HB 2577, as amended by HB 2025) states: Requires that whenever the Commonwealth Transportation Board or the Department plan for or undertake any highway construction or improvement project and such project includes or may include the requirement for the mitigation of traffic noise impacts, first consideration should be given to the use of noise reducing design and low noise pavement materials and techniques in lieu of construction of noise walls or sound barriers. Vegetative screening, such as the planting of appropriate conifers, in such a design would be utilized to act as a visual screen if visual screening is required. Consideration would be given to these measures during the final design stage, where feasible. The response form from project management team has been included.

Traffic management measures normally considered for noise abatement include reduced vehicle travel speeds and truck movement restrictions on specific roadways. However, for this project reduced travel speeds would not be an effective noise mitigation measure alone because a substantial decrease in speed is necessary to provide a significant noise reduction. Typically, a 10-mph reduction in speed will result in only a 2 dBA decrease in noise level, which would not effectively eliminate noise impacts at most receptor sites. Restricting truck usage on Frontier Drive and Franconia-Springfield Parkway would not be

practical because one of the purposes of these facilities is to accommodate regional truck traffic movements. Moreover, the diversion of truck traffic to other roadways would increase noise levels in residential areas.

A significant alteration of the horizontal alignment of the Frontier Drive Extension project would be necessary to make such a measure effective in reducing noise exposure, since a doubling of distance to the highway is usually needed to cause a 3-decibel reduction in noise levels. However, such shifts would create undesirable impacts by increasing right-of-way acquisitions and relocations. Furthermore, alteration of the vertical alignment would not be feasible because the proposed project improvements are designed to tie into the existing roadway system.

Acoustical Insulation of public-use and non-profit facilities applies only to public and institutional use buildings. Because no public use or institutional structures are anticipated to have interior noise levels exceeding FHWA's interior NAC, this noise abatement option is not warranted.

The purchase of property for the creation of a "buffer zone" to reduce noise impacts is only considered for predominantly unimproved properties because the amount of property required for this option to be effective would create significant additional impacts and extra costs (e.g., in terms of residential displacements), which were determined to outweigh the benefits of land acquisition.

Berms are an alternative to noise walls where there is sufficient land and fill available for them. However, berms are note feasible for Frontier Drive Extension because they would greatly increase the cost and the footprint of the project by substantially increasing the amount of right of way land required to construct the berms in the communities with predicted noise impacts.

5.2 NOISE BARRIERS

None of the alternate abatement measures discussed in Section 5.1 are feasible and therefore the only remaining abatement measure for consideration is the construction of noise barriers, which can be an effective way to reduce noise levels at areas of outdoor activity. The acoustic effectiveness of a proposed noise barrier depends on the distance and elevation difference between roadway and receptor and the available placement location for a barrier.

As a general practice, noise barriers are most acoustically effective in reducing traffic noise when located at a relatively high point between the roadway and the receptor such that it breaks the line-of-sight to the greatest degree possible. In roadway fill conditions, where the highway is above the natural grade, noise barriers are typically most effective when placed on the edge of the roadway shoulder or on top of the fill slope. In roadway cut conditions, where the roadway is located below the natural grade, barriers are typically most effective when placed at the top of the cut slope. Engineering and safety issues have the potential to alter these typical barrier locations.

To be constructed, noise barriers must satisfy VDOT's feasibility and reasonableness criteria.

5.2.1 Feasibility

All receptors that meet the warranted criterion must progress to the "feasible" phase. **Phase 2** of the noise abatement criteria requires that both of the following acoustical and engineering conditions be considered:

1. At least a 5 dBA highway traffic noise reduction at impacted receptors. Per 23 CFR 772, FHWA requires the highway agency to determine the number of impacted receptors required to achieve at least 5 dBA of reduction. VDOT requires that fifty percent (50%) or more of the impacted receptors experience 5 dBA or more of insertion loss to be feasible; and,

2. The determination that it is possible to design and construct the noise abatement measure. The factors related to the design and construction include: safety, barrier height, topography, drainage, utilities, and maintenance of the abatement measure, maintenance access to adjacent properties, and general access to adjacent properties (i.e. arterial widening projects).

The noise abatement measure is said to be feasible if it meets both criteria.

5.2.2 Reasonableness

All receptors that meet the feasibility criterion must progress to the "reasonableness" phase. **Phase 3** of the noise abatement criteria requires that all of the following conditions be considered.

Noise Reduction Design Goals

The design goal is a reasonableness factor indicating a specific reduction in noise levels that VDOT uses to identify that a noise abatement measure effectively reduces noise. The design goal establishes a criterion, selected by VDOT, which noise abatement must achieve. VDOT's noise reduction design goal is defined as 7 dBA of insertion loss for at least one impacted receptor, meaning that at least one impacted receptor is predicted to achieve a 7 dBA or greater noise reduction with the proposed barrier in place. The design goal is not the same as acoustic feasibility, which defines the minimum level of effectiveness for a noise abatement measure. Acoustic feasibility indicates that the noise abatement measure can, at a minimum, achieve a discernible reduction in noise levels.

Noise reduction is measured by comparing the future design year build condition pre- and post-barrier noise levels. This difference between unabated and abated noise levels is known as "insertion loss" (IL). It is important to optimize the noise barrier design to achieve the most effective noise barrier in terms of both noise reduction (insertion losses) and cost. Although at least a 5 dBA reduction is required to meet the feasibility criteria, the following tiered noise barrier abatement goals are used to govern barrier design and optimization.

- Reduction of future highway traffic noise by 7 dBA at one (1) or more of the impacted receptor sites (required criterion).

- Reduction of future highway traffic noise levels to the low-60-decibel range when practical (desirable).

- Reduction of future highway traffic noise levels to existing noise levels when practical (desirable).

Cost-Effectiveness

Typically, the limiting factor related to barrier reasonableness is the cost effectiveness value, where the total surface area of the barrier is divided by the number of benefited receptors receiving at least a 5 dBA reduction in noise level. VDOT's approved cost is based on a maximum square footage of abatement per benefited receptor, a value of 1,600 square feet per benefited receptor.

Where multi-family housing includes balconies at elevations that exceed a 30-ft high barrier or the topography causes receptor to be above the elevation of a 30-ft barrier, these receptors are not assessed for barrier benefits and are not included in the computation of the barrier's reasonableness.

For non-residential properties, such as parks and public use facilities, a special calculation is performed to quantify the type and duration of activity and compare to the cost effectiveness criterion. The determination is based on cost, severity of impact (both in terms of noise levels and the size of the impacted area and the activity it contains), and amount of noise reduction.

The Viewpoints of Benefited Receptors

VDOT shall solicit the viewpoints of all benefited receptors through certified mailings and obtain enough responses to document a decision as to whether or not there is a desire for the proposed noise abatement measure. Fifty percent (50%) or more of the respondents shall be required to favor the noise abatement measure in determining reasonableness. Community views in and of themselves are not sufficient for a barrier to be found reasonable if one or both of the other two reasonableness criteria are not satisfied.

5.2.3 Evaluated Noise Barriers

Details of the evaluated barriers are included in Table 5-1 and described in text following the table. Each of the evaluated noise barriers are depicted in Figure 4-1 or Figure 4-2 as a solid line. The color of the line indicates whether it would be feasible and reasonable (red), not feasible (dark blue), or a replacement noise wall (green). Appendix H presents the preliminary Warranted, Feasible and Reasonable Worksheets for all barriers. Detailed barrier analysis results tables showing insertion loss for each receptor are included in Appendix G.

A noise barrier was considered for the impacted first-row residences along Loisdale Road represented by receptors R153 – R161. However, these receptors all have driveways with direct access to Loisdale Road. For a noise barrier to be acoustically effective it needs to be relatively continuous with minimal gaps, therefore, it was determined that a noise barrier would not be feasible in this area because a continuous noise barrier would restrict property access.

Table 5-1: Details of Potential Noise Barriers

Barrier ID	Barrier Data						Total Number of Impacted Receptors[1]	Impacted and Benefited Receptors	Non-Impacted and Benefited Receptors	Total Benefited Receptors	Percent Impacted Receptors Benefited	Barrier Surface Area per Benefited Receptor (SF/BR)[2]	Barrier Status[3]
	Noise Reduction (dBA)		Length (ft.)	Height (ft.)	Surface Area (sq. ft.)	Cost at $42/sq. ft.							
	Range	Avg.											
1	1 - 18	9	2,383	30	71,490	$3,002,580	108 (201)	108	100	208	100%	344	F & R
2[4]	2 – 9	5	1,125	16	18,000	$756,000	4	4	8	12	100%	N/A[4]	RW

Source: WSP, 2018

Notes:

1. For Barrier 1, the total number of impacted receptors first lists those below the point of intersection with a 30-ft tall noise barrier that are eligible to be counted as benefited. The second number shown in parentheses is the total number of impacted receptors behind the noise barrier, regardless of elevation.
2. Where the ratio of Surface Area to Benefiting Receptors (SF/BR) is found to exceed VDOT's maximum of 1,600, a proposed noise barrier would not be considered cost-reasonable
3. Barrier Status: F & R – Feasible and Reasonable; F & NR – Feasible and Not Reasonable; NF – Not Feasible; RW – Replacement Wall.
4. In-kind replacement wall for the section of an existing noise wall that would need to be removed because of the proposed project roadway improvements. Per VDOT policy, in-kind replacement noise walls are not subject to reasonableness criteria. At all receptors behind the existing noise wall, the in-kind replacement wall was found to provide noise reduction that meets or exceeds the performance of the existing noise wall. Predicted noise reduction and number of benefited receptors represents performance of the noise wall system, which includes the existing wall sections that replacement wall will tie into.

Barrier 1 is a potential two-barrier design system for CNE 1. The first barrier section begins along the south side of Spring Mall Drive just west of the Frontier Drive Intersection and then extends south along the west side of Frontier Drive and ends at a 90-ft gap to allow pedestrian access to the Springfield Station apartment complex. The second barrier section would then continue south to the Franconia-Springfield Parkway WB on-ramp and west along the north side of the Franconia-Springfield Parkway WB shoulder. The impacted receptors in CNE 1 include the Residences at Springfield Station apartment complex. There are 631 units in the complex and all units have a private outdoor balcony. Per VDOT policy, only first, second and third-story receptors (up to an elevation of 30 feet above ground) have been included in the barrier analysis. This includes 154 receptors representing 248 residential units and 3 outdoor common use areas. Barrier 1 is shown in Figure 4-1.

Barrier 1 would benefit all 108 of the impacted receptors in this area. At a height of 30 feet, Barrier 1 would be 2,383 feet in length and consist of a total area of 71,490 square feet. The barrier would satisfy VDOT's 7 dBA noise reduction design goal at 96 receptors. The estimated surface area per benefited receptor is 344 SF/BR and therefore Barrier 1 would be feasible and reasonable.

An alternative design option for Barrier 1 was also considered and evaluated. The alternative Barrier 1 design would be a two-barrier system that is slightly shorter in length and 8 feet shorter in height than Barrier 1. The barrier would be 2,282 feet in length, with a height of 22 feet, and a total area of 50,204 square feet. The barrier would benefit 82 of 108 (76%) impacted receptors, provide 7 dBA noise reduction for 62 receptors, and have a surface area per benefited receptor of 299 SF/BR. This barrier design has not been presented as the recommended design in this report because the 30-foot tall barrier benefits more impacted receptor locations. However, this alternate noise barrier design would also be feasible and reasonable and could be considered as an option during the project final design.

Barrier 2 has been evaluated for CNE 2, located north of the proposed Franconia-Springfield Parkway WB off-ramps and east of Frontier Drive. The wall would be an in-kind replacement for a section of the existing noise wall that would need to be removed due to the proposed ramp alignments. The Barrier 2 replacement wall section would be 1,125 feet in length, 16 feet in height and have a total area of 18,000 square feet. When evaluated along with the existing noise wall sections that it would tie into, a total of 12 receptors would be benefited by the Barrier 2 noise wall system.

With the in-kind barrier replacement in place, there are no impacts predicted in the future build design year. Per VDOT policy, an in-kind replacement noise wall is not subject to reasonableness criteria and at a minimum it must provide the same level of protection (noise reduction) as the existing noise wall. At all receptors behind the wall, Barrier 2 would provide noise reduction that meets or exceeds the performance of the existing noise wall.

6 CONSTRUCTION NOISE

VDOT is also concerned with noise generated during the construction phase of the proposed project. While the degree of construction noise impact will vary, it is directly related to the types and number of equipment used and the proximity to the noise-sensitive land uses within the project area. Land uses that are sensitive to traffic noise are also potentially sensitive to construction noise. Any construction noise impacts that do occur as a result of roadway construction measures are anticipated to be temporary in nature and will cease upon completion of the project construction phase. A method of controlling construction noise is to establish the maximum level of noise that construction operations can generate. In view of this, VDOT has developed and FHWA has approved a specification that establishes construction noise limits. This specification can be found in VDOT's 2016 Road and Bridge Specifications, Section 107.16(b.3), "Noise". The contractor will be required to conform to this specification to reduce the impact of construction noise on the surrounding community.

7 PUBLIC INVOLVEMENT PROCESS

7.1 NOISE-COMPATIBLE LAND-USE PLANNING

FHWA and VDOT policies require that VDOT provides certain information to local officials within whose jurisdiction the highway project is located, to minimize future traffic noise impacts of Type I projects on currently undeveloped lands. (Type I projects involve highway improvements with noise analysis.) This information must include details on noise-compatible land-use planning and noise impact zones in undeveloped land in the highway project corridor. These details are provided below and shown on the graphics in Figures 4-1, 4-2, and 4-3. Additional information about VDOT's noise abatement program has also been included in this section.

Section 12.1 and 12.2 of VDOT's 2015 Highway Traffic Noise Impact Analysis Guidance Manual outline VDOT's approach to communication with local officials, and provide information and resources on highway noise and noise-compatible land-use planning. VDOT's intention is to assist local officials in planning the uses of undeveloped land adjacent to highways to minimize the potential impacts of highway traffic noise.

Entering the Quiet Zone is a brochure that provides general information and examples to elected officials, planners, developers, and the general public about the problem of traffic noise and effective responses to it. A link to this brochure on FHWA's website is provided:

http://www.fhwa.dot.gov/environment/noise/noise_compatible_planning/federal_approach/land_use/qz00.cfm

A wide variety of administrative strategies may be used to minimize or eliminate potential highway noise impacts, thereby preventing the need or desire for costly noise abatement structures such as noise barriers in future years. There are five broad categories of such strategies:

- Zoning,
- Other legal restrictions (subdivision control, building codes, health codes),
- Municipal ownership or control of the land,
- Financial incentives for compatible development, and
- Educational and advisory services.

The Audible Landscape: A Manual for Highway and Land Use is a very well-written and comprehensive guide addressing these noise-compatible land use planning strategies, with significant detailed information. This document is available through FHWA's Website, at

http://www.fhwa.dot.gov/environment/noise/noise_compatible_planning/federal_approach/audiblelandscape/al00.cfm

Noise Impact Zones in Undeveloped Land along the Study Corridor

Also required under the revised 2011 FHWA and VDOT noise policies is information on the noise impact zones adjacent to project roadways in undeveloped lands. To determine these zones, noise levels are computed at various distances from the edge of the project roadways in each of the undeveloped areas of the project study area. Then, the distances from the edge of the roadway to the Noise Abatement Criteria sound levels are determined through interpolation. Distances vary in the project corridor due to changes in traffic volumes or terrain features. Noise sensitive sites within these zones should be considered impacted if no barrier is present to reduce sound levels. The graphics in Figures 4-1, 4-2, and 4-3 show the predicted 66 dBA contours for the project, where noise impact would occur for exterior first-floor residential and recreational land uses.

VDOT's Noise Abatement Program

Information on VDOT's noise program is available on VDOT's website, at: http://www.virginiadot.org/projects/pr-noise-walls-about.asp. The site provides information on VDOT's noise program and policies, noise walls, and a downloadable noise wall brochure.

7.2 VOTING PROCEDURES

For noise barriers determined to be feasible and reasonable, the affected public that will be benefited by the proposed mitigation will be given an opportunity to decide whether they are in favor of construction of the noise barrier. A final determination as to the construction of barriers will be made after the design public hearing process. Before final decisions and approvals can be made to construct a noise barrier, a final design noise analysis will be performed. For barriers that are determined to be feasible and reasonable, input from the owners and residents of those receptor units that will be benefited by the proposed mitigation may vote by completing and returning the citizen survey that they receive in the mail. The initial citizen survey is sent out as certified mail so the disposition of the letters can be tracked. Of the votes tallied, 50% or more must be in favor of a proposed noise barrier for that barrier to be considered further. Upon completion of the citizen survey, the VDOT Noise Abatement staff will make recommendations to the Chief Engineer for approval. Approved barriers will be incorporated into the road project plans. A technical memorandum of the results of the public survey will be prepared and submitted to the FHWA.

Appendix A – List of References

List of References

23 CFR, Chapter 1, Subchapter H, Part 772, *Procedures for Abatement of Highway Traffic Noise and Construction Noise*, July 2011.

Highway Traffic Noise: Analysis and Abatement Guidance, U.S. Department of Transportation, Federal Highway Administration, December 2011.

Highway Traffic Noise Impact Analysis Guidance Manual, Virginia Department of Transportation, July 2015.

State Noise Abatement Policy, Commonwealth of Virginia, July 2014.

Transit Noise and Vibration Impact Assessment, Federal Transit Administration, (FTA-VA-90-1003-06), May 2006.

Appendix B – List of Preparers

The project noise study was completed by WSP USA. Staff involved in the noise study included:

- Arthur Morrone – Project Manager and QA review
- Jacob Poling – Noise measurement and analysis
- Brian Isoldi – Noise measurement and analysis

Appendix C – Traffic Data Used for Noise Analysis

Roadway	Direction	Segment	Worst-Hour Volume (vph)			Speed (mph)	Vehicle Mix (%)				
			Existing 2016	No-Build 2043	Build 2043		Auto	Med. Truck	Heavy Truck	Bus	Moto
F-S Pkwy	EB	East of Frontier	2,192	2,472	2,399	55	92	4	3	1	0
F-S Pkwy	EB	West of Frontier	1,735	1,936	2,014	55	94	3	1	1	0
F-S Pkwy	WB	East of Frontier	2,477	2,794	2,712	50	95	4	0	1	0
F-S Pkwy	WB	West of Frontier	2,688	2,999	3,120	50	97	2	1	1	0
F-S Pkwy	EB	Off-ramp to Frontier	403	457	512	50	93	3	1	3	0
F-S Pkwy	EB	On-ramp from Frontier	1,210	1,407	1,407	45	96	3	1	1	0
F-S Pkwy	WB	Off-ramp to Frontier	915	1,110	1,480	45	95	4	1	1	0
F-S Pkwy	WB	On-ramp from Frontier	999	1,142	818	45	95	4	0	1	0
F-S Pkwy	WB	On-ramp from Transit Station	144	144	827	30	94	3	1	1	0
F-S Pkwy	WB	Off-ramp to Transit Station	122	122	67	30	91	6	0	4	0
Frontier Dr	NB	North of F-S Pkwy	1,038	1,942	1,928	35	95	4	1	1	0
Frontier Dr	NB	South of F-S Pkwy to Transit Station	582	582	674	35	96	3	1	1	0
Frontier Dr	SB	North of F-S Pkwy	1,129	2,110	2,095	35	95	4	0	1	0
Frontier Dr	SB	South of F-S Pkwy to Transit Station	191	191	221	35	93	3	1	3	0
Springfield Center Dr (Frontier Drive in Build)	NB/EB	South of Transit Station	61	398	325	35	99	1	0	0	0
Springfield Center Dr (Frontier Drive in Build)	SB/WB	South of Transit Station	20	130	106	35	99	1	0	0	0
Loisdale Rd	NB	North of Springfield Cr	442	1,088	689	35	95	3	1	1	0
Loisdale Rd	NB	South of Springfield Cr	392	597	589	35	95	3	1	1	0
Loisdale Rd	SB	North of Springfield Cr	985	1,566	1,465	35	95	3	1	1	0
Loisdale Rd	SB	South of Springfield Cr	959	1,536	1,513	35	95	3	1	1	0
Ramp 3	WB	Transit Station to Frontier	N/A	N/A	453	30	94	3	1	1	0
Transit Station Access Rd	EB	Frontier to RAB	N/A	N/A	526	35	94	3	1	1	0
Ring Rd	WB	Roundabout to F-S Pkwy EB on ramp	N/A	N/A	147	35	94	3	1	1	0

Appendix D - Noise Monitoring Data

Site V-1: 6600/6616 Comet Circle

Traffic Counts - 20 Minutes		
Road:	**Frontier Dr SB**	**Frontier Dr NB**
Speed:	25 mph	25 mph
Auto:	349	383
Med Truck:	8	5
Hvy Truck:	3	1
Bus:	5	10
Moto:	1	0
Traffic Counts - 1 Hour		
Auto:	1047	1149
Med Truck:	24	15
Hvy Truck:	9	3
Bus:	15	30
Moto:	3	0

PROJECT: Frontier Drive

MEAS SITE: V-1: Springfield Station Apts

DATE: 11/15/17 **STAFF:** Poling / Isoldi

MEAS NO	1		
START TIME	12:27		
END TIME	12:42		
INSTRUMENT	LD LXT		
BATTERY	65%		
LEQ	57.9		
CAL CHECK	94.01	/	/

TRAFFIC

ROADWAY	Frontier Dr SB (near)		
VEH SPEED	20-30 mph		
AUTO	349		
MT	8		
HT	3		
BUS	5		
MOTO	1		
ROADWAY	Frontier Dr NB (far)		
VEH SPEED	20-30 mph		
AUTO	383		
MT	5		
HT	1		
BUS	10		
MOTO	0		
ROADWAY			
VEH SPEED			
AUTO			
MT			
HT			
BUS			
MOTO			

WEATHER

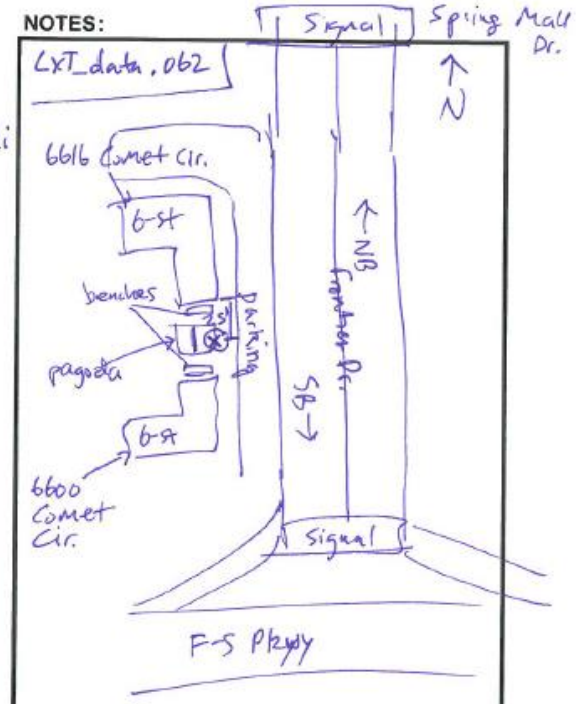
GENERAL	clear, sunny
TEMP	52°F
% RH	53%
WIND	light/mild
ROAD COND.	dry

INSTRUMENTS:

LD LXT
BK 4230

Lat: 38.770781
Long: -77.171547

NOTES:



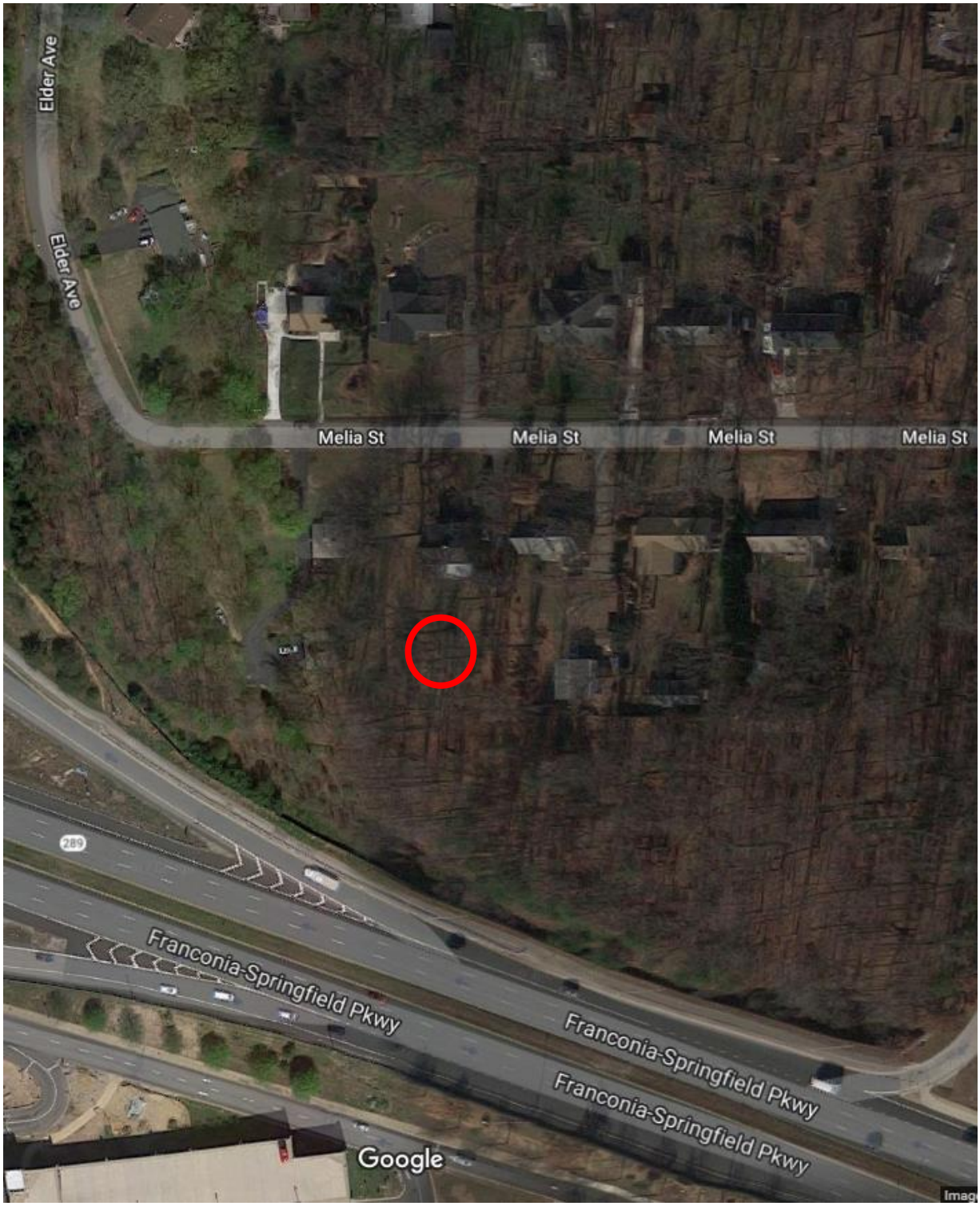
meter 5-ft above ground, ground ~ 4-ft above road grade

- occasional queing at light (SB) up to measurement location
- all vehicles are traveling ~ 20-30 mph between sig. intersections

Audible noise sources:
traffic from ~~F-5 Pkwy~~ Frontier Dr, wind in trees, distant construction

Events:
12:30 distant banging noise

Site V-2: 6509 Melia St



Traffic Counts - 20 Minutes				
Road:	**Franconia Springfield Pkwy WB mainline**	**Franconia Springfield Pkwy WB off-ramp**	**Franconia Springfield Pkwy EB mainline**	**Franconia Springfield Pkwy EB on-ramp**
Speed:	50 mph	40 mph	50 mph	accel up to 50 mph
Auto:	204	204	230	154
Med Truck:	4	2	8	6
Hvy Truck:	1	0	1	0
Bus:	4	9	5	3
Moto:	0	0	0	0
Traffic Counts - 1 Hour				
Auto:	612	612	691	461
Med Truck:	12	6	25	17
Hvy Truck:	3	0	2	1
Bus:	12	27	14	10
Moto:	0	0	0	0

PROJECT: Frontier Drive

MEAS SITE: V-2: 6509 Melia St.

DATE: 11/15/17 **STAFF:** Poling/Isoldi

MEAS NO	1		
START TIME	09:~~46~~50		
END TIME	10:10		
INSTRUMENT	LD LxT		
BATTERY	66%		
LEQ	56.8		
CAL CHECK	94.01	/	/

TRAFFIC

ROADWAY	F-5 Pkwy WB (near)		
VEH SPEED	~~total~~ ML	Ramp 45-55 mph	
AUTO	204	204	
MT	4	2	
HT	1	0	
BUS	4	9	
MOTO	0	0	
ROADWAY	F-5 Pkwy EB (far)		
VEH SPEED	Total	45-55 mph	
AUTO	384	EB on-ramp traffic ~40% of total	
MT	14		
HT	1		
BUS	8		
MOTO	0		
ROADWAY			
VEH SPEED			
AUTO			
MT			
HT			
BUS			
MOTO			

WEATHER

GENERAL	clear, sunny
TEMP	35°F
% RH	75%
WIND	calm/light
ROAD COND.	dry

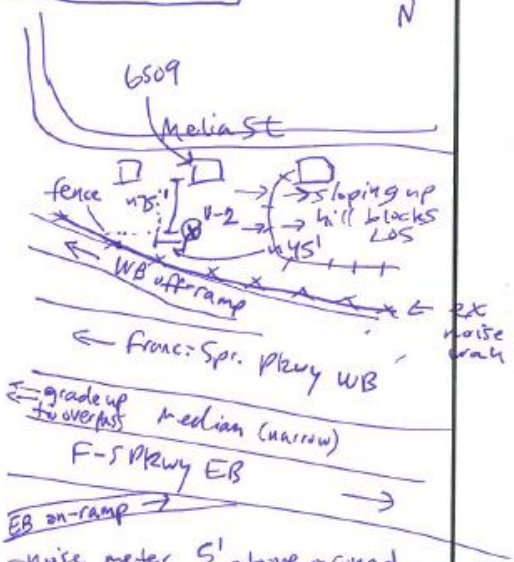
INSTRUMENTS:

LD LxT
BK 4230

Long: -77.16801
Lat: 39.76905

NOTES:

LxT_Data.055



- noise meter 5' above ground, ground ~ 8' below road grade

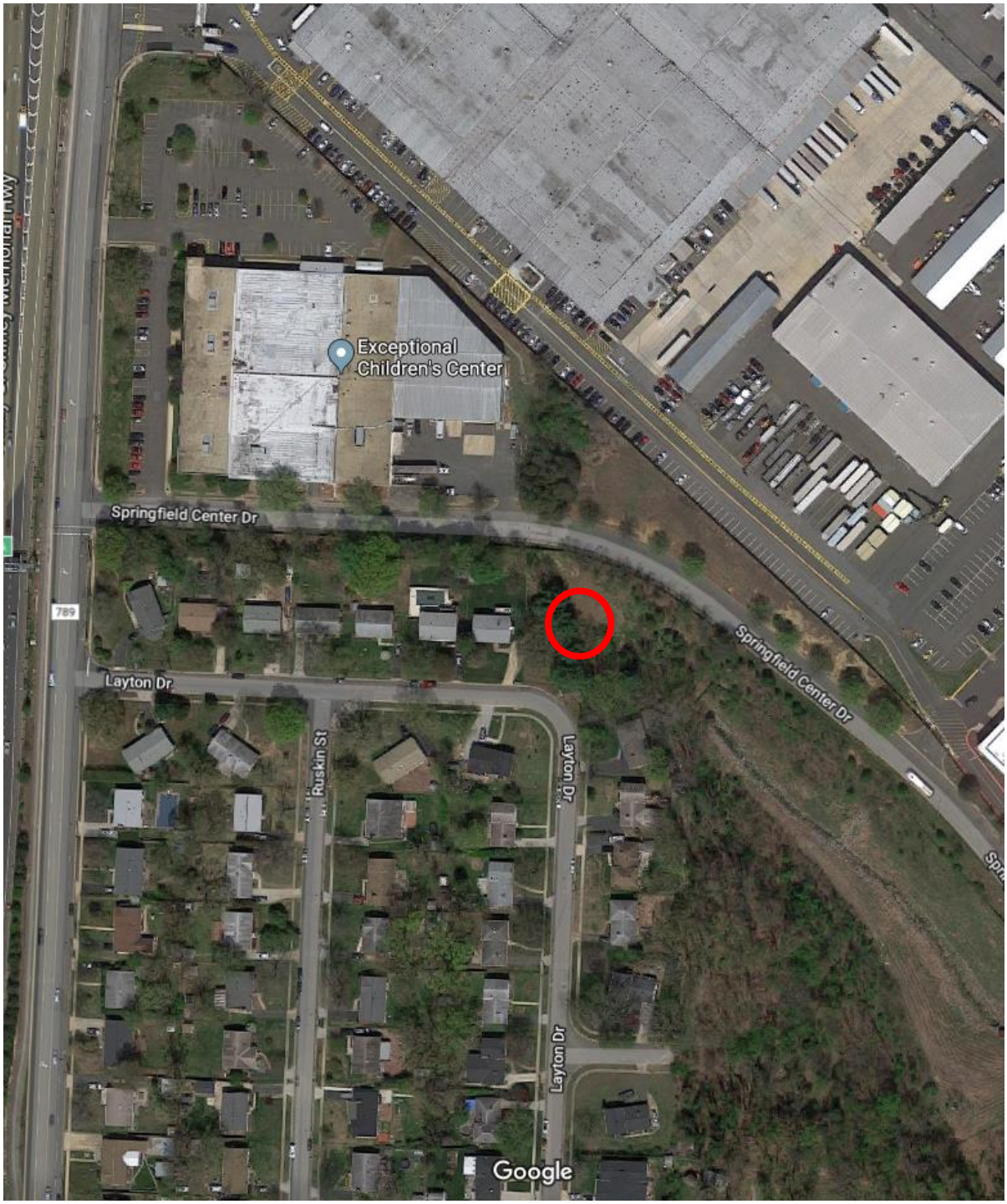
F-5 Pkwy posted speed = 50 mph
F-5 Pkwy WB off-ramp veh. speed ~ 40 mph @ meas. point

Noise sources: traffic from F-5 Pkwy, train horn, wind in trees, aircraft overpass

Events:
9:57: plane
10:07 train horn

Main / ramp

Site V-3: Between 7113 and 7121 Layton Dr



Traffic Counts - 20 Minutes		
Road:	**Springfield Center Dr EB**	**Springfield Center Dr WB**
Speed:	30 mph	30 mph
Auto:	15	47
Med Truck:	0	1
Hvy Truck:	0	0
Bus:	0	0
Moto:	0	0
Traffic Counts - 1 Hour		
Auto:	45	141
Med Truck:	0	3
Hvy Truck:	0	0
Bus:	0	0
Moto:	0	0

PROJECT: Frontier Drive

MEAS SITE: V-3: Btwn 7113 Layton + 7121 Layton

DATE: 11/15/17 **STAFF:** Poling / Jsoldi

MEAS NO	1		
START TIME	16:06		
END TIME	16:26		
INSTRUMENT	LD LxT		
BATTERY	66%		
LEQ	51.4		
CAL CHECK	94.01	/	/

TRAFFIC

ROADWAY	Springfield Center Dr EB		
VEH SPEED	30 mph		
AUTO	15		
MT	0		
HT	0		
BUS	0		
MOTO	0		
ROADWAY	Springfield Center Dr WB		
VEH SPEED	30 mph		
AUTO	47		
MT	1		
HT	0		
BUS	0		
MOTO	0		
ROADWAY	Layton Dr		
VEH SPEED	20-30 mph		
AUTO	11		
MT			
HT			
BUS	1		
MOTO			

WEATHER

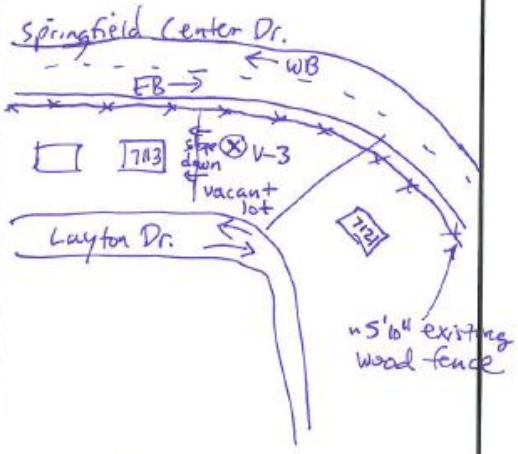
GENERAL	overcast
TEMP	54°F
% RH	53%
WIND	calm / mild
ROAD COND.	dry

INSTRUMENTS:

LD LxT
BK 12230
Lat: 38.764861°
Long: -77.180354°

NOTES:

LxT_Data.063

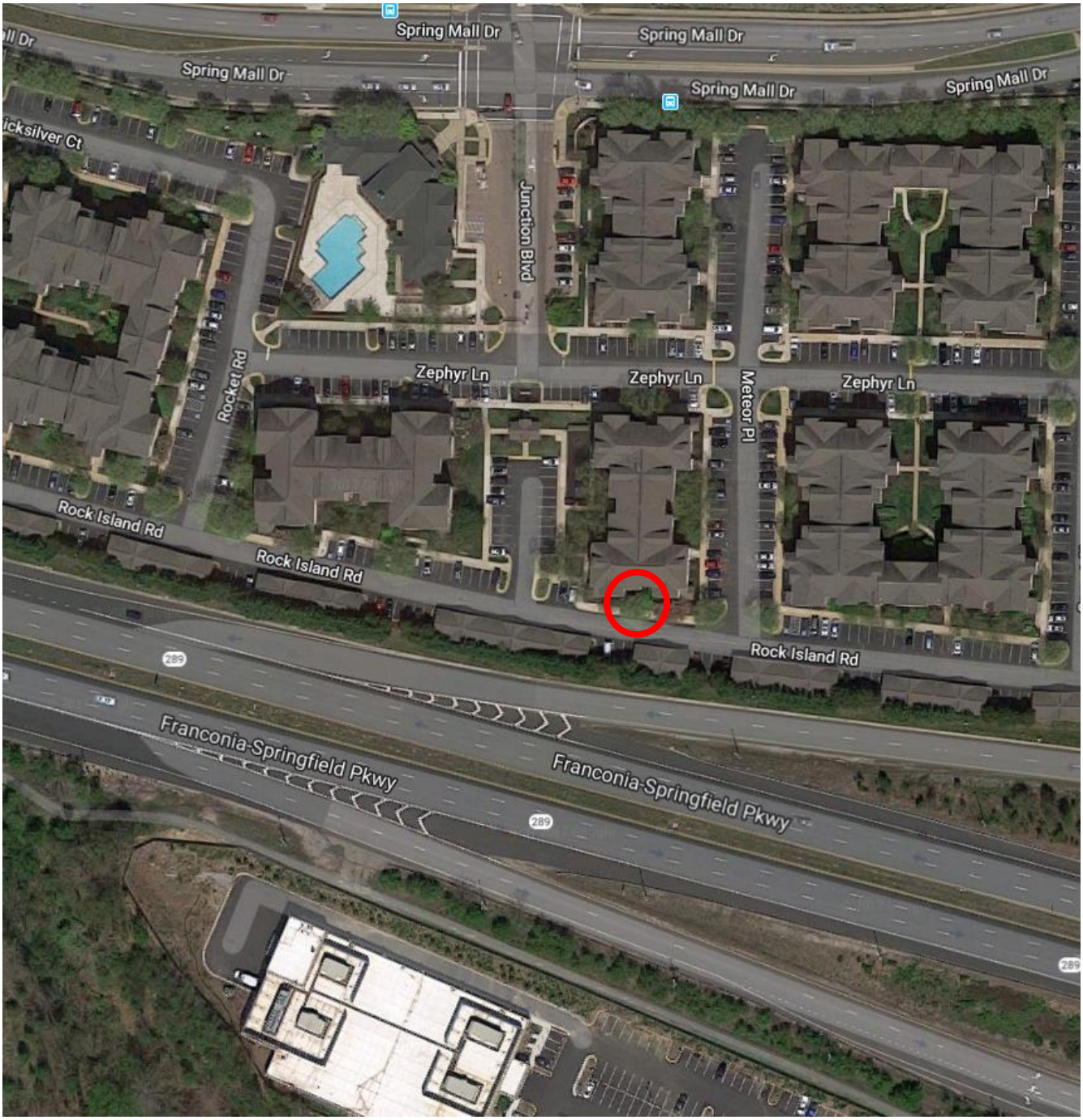


- meter 5-ft above ground, ground ~at grade w/ Spr. Center Dr.
- level during vehicle passby not notably higher than ambient (~+1dB)
- existing wood fence blocks almost all visibility to road, ~8-ft gap near meas site

Audible noise sources:
traffic along Springfield Center Dr, distant traffic, birds, wind in trees, local traffic on Layton Dr., distant lawn blowers, aircraft overpass

Events:
16:11 school bus squeal / idle

Site V-4: 6814 Meteor Place



Traffic Counts - 20 Minutes			
Road:	**Franconia Springfield Pkwy WB mainline**	**Franconia Springfield Pkwy WB on-ramp**	**Franconia Springfield Pkwy EB mainline**
Speed:	50 mph	Accel up to 50 mph	50 mph
Auto:	212	106	283
Med Truck:	2	2	6
Hvy Truck:	4	0	0
Bus:	2	1	3
Moto:	0	0	0
Traffic Counts - 1 Hour			
Auto:	636	318	849
Med Truck:	6	6	18
Hvy Truck:	12	0	0
Bus:	6	3	9
Moto:	0	0	0

PROJECT: Frontier Drive

MEAS SITE: V-4: 6814 Meteor Place

DATE: 11/15/17 **STAFF:** Poling/Isoldi

MEAS NO	1		
START TIME	11:43		
END TIME	12:03		
INSTRUMENT	LD LxT		
BATTERY	66%		
LEQ	62.2		
CAL CHECK	94.01	/	/

TRAFFIC

ROADWAY	Franconia Springfield Pkwy WB (near)		
VEH SPEED	ML	Ramp	ML = 45-55 mph; ramp = 40 mph @ meas pt
AUTO	212	106	
MT	2	2	
HT	4	0	
BUS	2	1	
MOTO	0	0	
ROADWAY	F-S pkwy WB (far)		
VEH SPEED	45-55 mph		
AUTO	283		
MT	6		
HT	0		
BUS	3		
MOTO	0		
ROADWAY			
VEH SPEED			
AUTO			
MT			
HT			
BUS			
MOTO			

WEATHER

GENERAL	clear, sunny
TEMP	40°F
% RH	70%
WIND	calm
ROAD COND.	dry

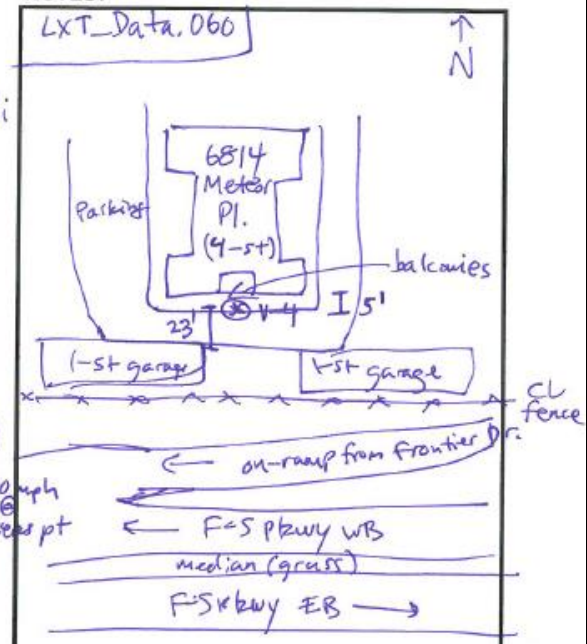
INSTRUMENTS:

LD LxT
BK 4230

Lat: 38.770105°
Long: -77.173646°

NOTES:

LXT_Data.060



meter 5' above ground, ground at grade w/ ramp / 2-3 ft below WB mainline

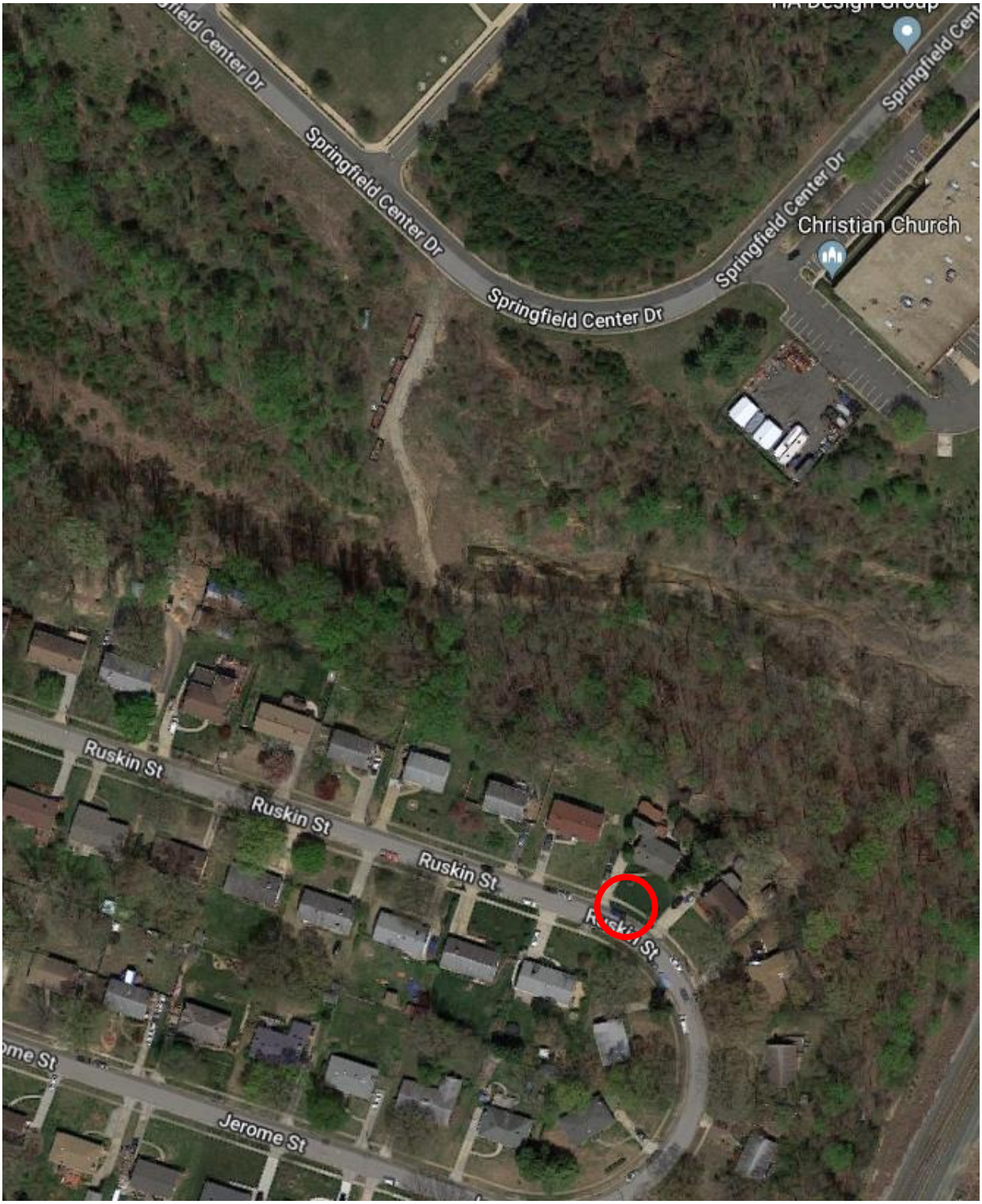
WB on-ramp vehicles accelerating up to mainline speed

50 mph posted speed on F-S Pkwy

Audible noise sources:
traffic on F-S Pkwy, occasional local vehicle traffic, distant tool, distant train horn, distant construction

Events:
11:52 : train horn
11:53 "
11:58 van passby (local)
11:59 "

Site M-1: 6706 Ruskin St



PROJECT: Frontier Drive

MEAS SITE: M-1: 6706 Ruskin St (ambient)

DATE: 11/15/17 **STAFF:** Poling/Isoldi

MEAS NO	1		
START TIME	08:31		
END TIME	09:01		
INSTRUMENT	LD LxT		
BATTERY	66%		
LEQ	53.9		
CAL CHECK	94.01	/	/

TRAFFIC

ROADWAY			
VEH SPEED			
AUTO			
MT			
HT			
BUS			
MOTO			
ROADWAY			
VEH SPEED			
AUTO			
MT			
HT			
BUS			
MOTO			
ROADWAY			
VEH SPEED			
AUTO			
MT			
HT			
BUS			
MOTO			

WEATHER

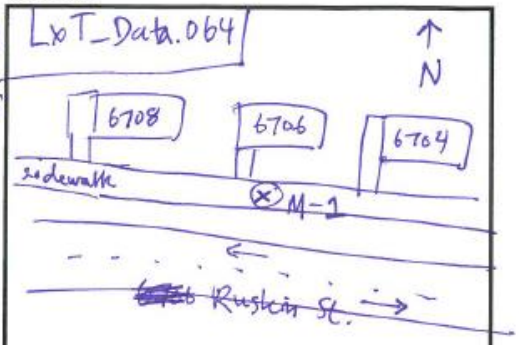
GENERAL	clear, sunny
TEMP	40°F
% RH	91%
WIND	calm/mild
ROAD COND.	dry

INSTRUMENTS:

LD LxT
BK 2230
Lat: 38.76054°
Long: -77.175954°

NOTES:

LxT_Data.064



Meter located 5-ft above ground

Audible noise sources: aircraft overpass, distant siren, distant traffic, birds, wind in trees, local traffic along Ruskin St., train passbys

Trains:

Commuter: [redacted] 11
Freight: [redacted] 1

Site M-2: 6516 Windham Ave

PROJECT: Frontier Drive

MEAS SITE: M-2 : 6516 Windham Ave

DATE: 11/16/17 **STAFF:** Poling / Isoldi

MEAS NO	1		
START TIME	16:18		
END TIME	16:48		
INSTRUMENT	LD LXT		
BATTERY	63%		
LEQ	63.1		
CAL CHECK	94.01	/	/

TRAFFIC

ROADWAY			
VEH SPEED			
AUTO			
MT			
HT			
BUS			
MOTO			
ROADWAY			
VEH SPEED			
AUTO			
MT			
HT			
BUS			
MOTO			
ROADWAY			
VEH SPEED			
AUTO			
MT			
HT			
BUS			
MOTO			

WEATHER

GENERAL	clear, sunny
TEMP	63°F
% RH	33%
WIND	mild
ROAD COND.	dry

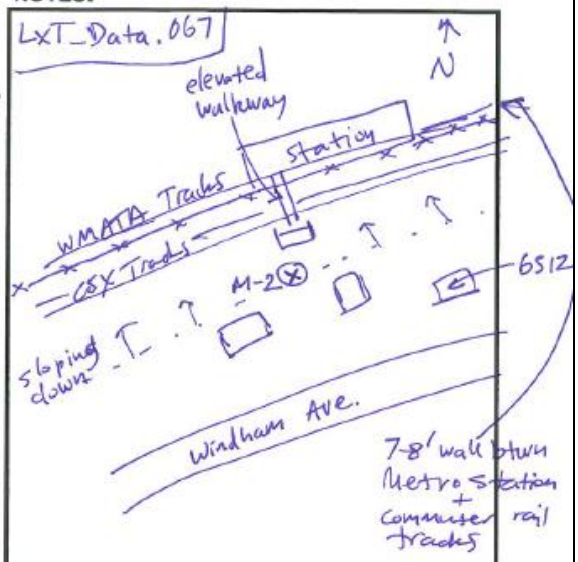
INSTRUMENTS:

LD LXT
BK 4230

Lat: 38.765787°
Long: -77.168495°

NOTES:

LXT_Data.067



meter located 5-ft above ground at same elevation as residence backyard

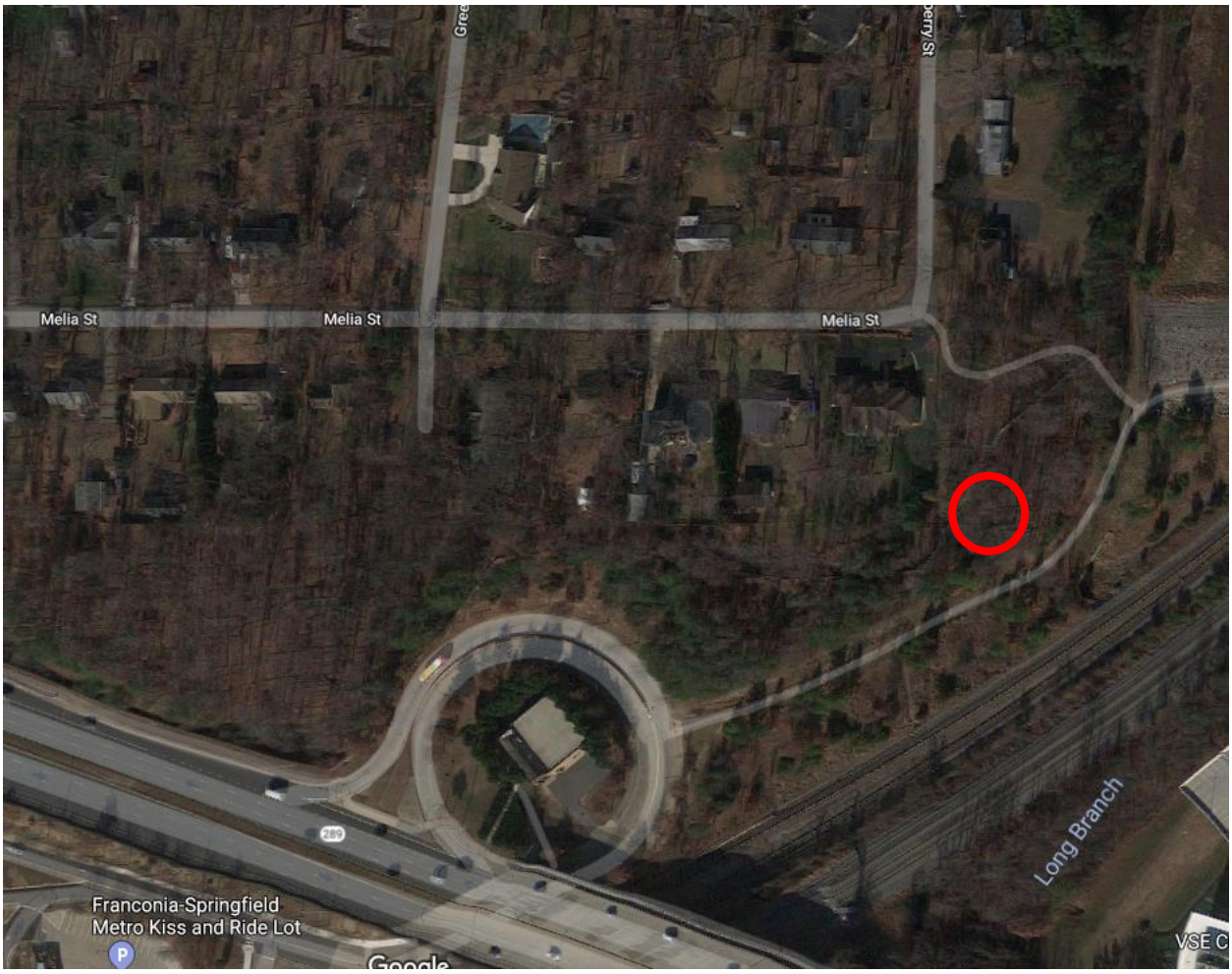
tracks look to be continuously welded rail (CWR)

couldn't hear Metro (WMATA) trains

Audible noise sources: ~~Metro~~ commuter station announcements, wind in trees, train horn, train passby, leaves rustling, distant construction vehicle, distant traffic, aircraft overpass

Events	Trains
	4:25 Amtrak: 1 loco, 7 cars
	4:44 VRE commuter pull into station
	4:46 1 loco, 8 cars

Site M-3: 6419 Melia St



PROJECT: Frontier Drive

MEAS SITE: M-3 : 6419 Melia Street (ambient) LxT_Data.053

DATE: 11/15/17 **STAFF:** Poling / Isoldi

MEAS NO	1		
START TIME	08:23		
END TIME	08:53		
INSTRUMENT	LD LxT		
BATTERY	77%		
LEQ	56.0		
CAL CHECK	94.01	/	/

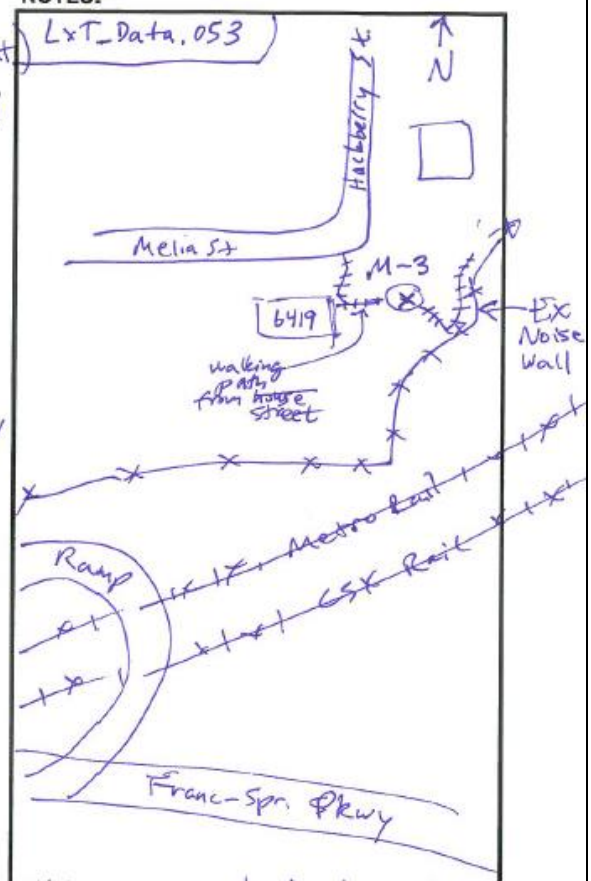
TRAFFIC

ROADWAY			
VEH SPEED			
AUTO			
MT			
HT			
BUS			
MOTO			
ROADWAY			
VEH SPEED			
AUTO			
MT			
HT			
BUS			
MOTO			
ROADWAY			
VEH SPEED			
AUTO			
MT			
HT			
BUS			
MOTO			

WEATHER

GENERAL	Sunny, clear skies
TEMP	31°F
% RH	89%
WIND	calm / light
ROAD COND.	dry

NOTES:



Noise sources: birds, distant traffic, aircraft overpass, train passbys, wind in trees, people walking by, distant train horn

8:48 walker passed SLM

8:49 "

INSTRUMENTS:

LD LXT S/N 3980 SLM

BK 4230 calibrator S/N 1639151

Longitude: 38.76943°

Latitude: -77.163856°

Trains Passby max: 63 dBA

Metro: ||||| ||

Freight:

Commuter: ||

VA Railway Express

CERTIFICATE OF CALIBRATION
23706-1
FOR LARSON DAVIS PRECISION INTEGRATING SOUND LEVEL METER

Model **LxT1** Serial No. **0003980**
ID No. **N/A**

With Microphone **377B02** Serial No. **146338**
With Preamplifier **PRMLxT1L** Serial No. **035954**

Customer: **WSP USA**
New York, NY 10119 P.O. No. **Verbal-Brian Isoldi**

was tested and met Larson Davis specifications at the points tested and as outlined in ANSI S1.4-1983 Type 1; IEC 61672-2002 Class1; 60651-2001 Type 1

on **20 DEC 2017** **BY HAROLD LYNCH**
Service Manager

As received and as left condition: Within Specification.
Re-calibration due on: **20 DEC 2018**

Certified References*

Mfg.	Type	Serial No.	Cal Date	Due Date
B&K	1049	1314996	09 JUN 2017	09 JUN 2018
B&K	2636	1423390	03 JAN 2017	03 JAN 2018
B&K	4226	2141942	01 DEC 2017	01 DEC 2018
B&K	4231	1770857	14 SEP 2017	14 SEP 2018
HP	34401A	MY45023668	10 FEB 2017	10 FEB 2018
HP	3458A	2823A07179	23 JUL 2017	23 JUL 2018

Performed in Compliance with ANSI, NCSL Z-540-1, 1994
and ISO 17025, ISO 9001:2008 Certification NQA No. 11252
*References are traceable to NIST (National Institute of Standards and Technology).

Note: For calibration data see enclosed pages.
The data represent both "as found" and "as left" conditions.

Reference Test Procedure: **ACCT Procedure LxT-831 Version 0.5.1.**

Temperature	Relative Humidity	Barometric Pressure
23°C	**26 %**	**994.21** hPa

Note: This calibration report shall not be reproduced, except in full, without written consent by Odin Metrology, Inc.

Signed:

ODIN METROLOGY, INC.
CALIBRATION OF SOUND & VIBRATION INSTRUMENTATION
3533 OLD CONEJO ROAD, SUITE 125 THOUSAND OAKS CA 91320
PHONE: (805) 375-0830 FAX: (805) 375-0405

Odin Metrology, Inc.
Calibration of Sound & Vibration Instruments

Certificate Number: **23706-2**

Certificate of Calibration for Brüel & Kjær Sound Level Calibrator

This calibration is performed by comparison with measurement reference standard pistonphones:

Type No.	4220	4228
Serial No.	1048473	1504084
Calibrated by	TE	TE
Cal Date	15 NOV 2017	15 NOV 2017
Due Date	15 NOV 2018	15 NOV 2018

a) Estimated uncertainty of comparison: ± **0.05** dB
b) Estimated uncertainty of calibration service for standard pistonphone: ± **0.06** dB
c) Total uncertainty: $\sqrt{a^2+b^2}$ = ± **0.08** dB
d) Expanded uncertainty (coverage factor k = 2 for 95% confidence level): = ± **0.16** dB

This acoustic calibrator has been calibrated using standards with values traceable to the National Institute of Standards and Technology. This calibration is traceable to NIST Test Number **TN-683/286992-15.**

CONDITION OF TEST		
Ambient Pressure	**994.21**	hPa
Temperature	**23**	°C
Relative Humidity	**26**	%
Date of Calibration	**20 DEC 2017**	
Re-calibration due on	**20 DEC 2018**	

The calibration of this acoustic calibrator was performed using a test system conforming to the requirements of ANSI/NCSLZ540-1, 1994, ISO 17025, and ISO 9001-2008, Certification NQA No. 11252.

Calibration procedure: Brüel & Kjær 4230, **23.7, 20171212.**

Calibration performed by

Harold Lynch, Service Manager

ODIN METROLOGY, INC.
3533 OLD CONEJO ROAD, SUITE 125
THOUSAND OAKS, CA 91320
PHONE: (805) 375-0830; FAX: (805) 375-0405

Calibrator type	**4230**
Serial no.	**1639151**
Submitted by	**WSP USA**
	New York, NY 10119
Purchase order no.	**Verbal-Brian Isoldi**
Asset no.	**N/A**

This calibrator has been found to perform **within** the specifications listed below at the normalized conditions stated.

SPL produced in coupler terminated by a loading volume of 1.333 cm^3	94.0 ± 0.3 dB
Frequency	1,000 Hz ± 15 Hz
Distortion	< 1% (serial # ≤ 1550000) < 1.5% (serial # >1550000)
Equivalent coupler volume	140 cm^3
At 1,013 hPa, 20°C, and 65% relative humidity	

PERFORMANCE AS RECEIVED		
Frequency	**1011.5**	Hz
SPL	**93.99**	dB
Volume Check (Tol.: ±0.12):	**+0.1**	dB
Distortion	**0.7**	%
Battery Voltage	**9.3**	V

Was repair or adjustment performed?	**No**
Were parts replaced?	**No**
Were batteries replaced?	**No**

FINAL PERFORMANCE		
Frequency	**1011.5**	Hz
SPL	**93.99**	dB
Volume Check (Tol.: ± 0.12):	**+0.1**	dB
Distortion	**0.7**	%

Note: This calibrator was **within** manufacturer's specifications as received.

Note: This calibration report shall not be reproduced, except in full, without written consent of Odin Metrology, Inc.

Appendix E – Predicted Noise Levels

Table E-1: Predicted Traffic Noise Level Results

CNE	Receptor*	Land Use	Category	NAC	No. DUs	Measured Existing Noise Level, dBA Leq(h)**	Predicted Worst Hour Traffic Noise Levels, dBA Leq(h)			Build vs Existing Difference, dBA^	Predicted NAC Impacts		
							Existing 2016	No-Build 2043	Build 2043		Existing 2016	No-Build 2043	Build 2043
2	R1	Res	B	66	1		59	60	62	3			
2	R2	Res	B	66	1		59	60	64	5			
2	R3	Res	B	66	1		59	59	61	2			
2	R4	Res	B	66	1		58	59	61	2			
2	R5	Res	B	66	1		60	60	66	6			1
2	R6	Res	B	66	1		61	62	66	4			1
2	R7	Res	B	66	1		63	64	66	3			1
2	R8	Res	B	66	1		63	64	66	3			1
2	R9	Res	B	66	1		62	63	65	3			
2	R10	Res	B	66	1		60	60	63	3			
2	R11	Res	B	66	1		56	57	61	5			
2	R12	Res	B	66	1	56	57	57	60	4			
2	R13	Res	B	66	1	56	57	58	59	3			
2	R14	Res	B	66	1	56	58	58	59	3			
2	R15	Res	B	66	1		57	58	60	2			
2	R16	Res	B	66	1		55	55	58	3			
2	R17	Res	B	66	1		53	54	56	3			
2	R18	Res	B	66	1		53	54	56	3			
2	R19	Res	B	66	1		53	54	56	3			
2	R20	Res	B	66	1		53	54	55	2			
2	R21	Res	B	66	1		57	57	60	4			
2	R22	Res	B	66	1		60	61	63	3			
3	R23	Res	B	66	1	63	61	62	62	1			
3	R24	Res	B	66	1	63	60	61	61	1			
3	R25	Res	B	66	1	63	60	61	61	1			
3	R26	Res	B	66	1	63	60	61	61	1			

CNE	Receptor*	Land Use	Category	NAC	No. DUs	Measured Existing Noise Level, dBA Leq(h)**	Predicted Worst Hour Traffic Noise Levels, dBA Leq(h)			Build vs Existing Difference, dBA^	Predicted NAC Impacts		
							Existing 2016	No-Build 2043	Build 2043		Existing 2016	No-Build 2043	Build 2043
3	R27	Res	B	66	1	63	60	61	61	1			
3	R28	Res	B	66	1	63	60	61	61	1			
3	R29	Res	B	66	1	63	61	61	61	1			
3	R30	Res	B	66	1	63	61	61	62	1			
3	R31	Res	B	66	1	63	61	61	61	1			
3	R32	Res	B	66	1	63	60	61	61	1			
3	R33	Res	B	66	1	63	59	60	60	1			
3	R34	Res	B	66	1	63	59	59	59	1			
4	R35	Res	B	66	1		63	67	65	2		1	
4	R36	Res	B	66	1		59	64	62	3			
4	R37	Res	B	66	1		57	62	60	4			
4	R38	Res	B	66	1		55	61	56	1			
4	R39	Res	B	66	1		54	60	53	-1			
4	R40	Res	B	66	1		54	60	51	-3			
4	R41	Res	B	66	1		53	59	50	-2			
4	R42	Office	E	71	1		55	57	57	2			
4	R44	Res	B	66	1		51	54	53	3			
4	R45	Res	B	66	1		50	53	53	3			
4	R46	Res	B	66	1		48	51	50	3			
4	R47	Res	B	66	1		47	50	50	2			
4	R48	Res	B	66	1		47	49	49	2			
4	R49	Res	B	66	1		46	49	48	2			
4	R50	Res	B	66	1		50	54	50	0			
4	R51	Res	B	66	1		50	54	50	0			
4	R52	Res	B	66	1		48	52	50	2			
4	R53	Res	B	66	1		47	50	50	3			
4	R54	Res	B	66	1		47	50	49	3			
4	R55	Res	B	66	1		46	49	48	2			

CNE	Receptor*	Land Use	Category	NAC	No. DUs	Measured Existing Noise Level, dBA Leq(h)**	Predicted Worst Hour Traffic Noise Levels, dBA Leq(h)			Build vs Existing Difference, dBA^	Predicted NAC Impacts		
							Existing 2016	No-Build 2043	Build 2043		Existing 2016	No-Build 2043	Build 2043
4	R56	Res	B	66	1		46	48	47	2			
4	R57	Res	B	66	1		46	49	48	2			
4	R58	Res	B	66	1		46	49	49	3			
4	R59	Res	B	66	1		46	50	50	4			
4	R60	Res	B	66	1		47	50	51	4			
4	R61	Res	B	66	1		46	49	49	3			
4	R62	Res	B	66	1	54	44	47	47	3			
4	R63	Res	B	66	1	54	45	48	48	3			
4	R64	Res	B	66	1	54	46	49	49	3			
4	R65	Res	B	66	1	54	46	49	49	3			
4	R66	Res	B	66	1	54	46	49	50	4			
4	R67	Res	B	66	1	54	46	50	50	4			
4	R68	Res	B	66	1	54	46	50	50	4			
4	R69	Res	B	66	1	54	46	50	50	4			
4	R70	Res	B	66	1	54	46	50	50	4			
4	R71	Res	B	66	1	54	46	50	50	4			
4	R72	Res	B	66	1	54	47	50	50	4			
4	R73	Res	B	66	1	54	47	50	50	4			
4	R74	Res	B	66	1	54	47	50	50	4			
4	R75	Res	B	66	1	54	47	49	50	3			
4	R76	Res	B	66	1	54	47	49	50	3			
4	R77	Res	B	66	1	54	44	46	46	2			
4	R78	Res	B	66	1	54	44	46	46	2			
4	R79	Res	B	66	1	54	45	47	47	2			
4	R80	Res	B	66	1	54	45	47	47	2			
4	R81	Res	B	66	1	54	45	47	48	2			
4	R82	Res	B	66	1	54	45	48	48	3			
4	R83	Res	B	66	1	54	45	48	48	3			

CNE	Receptor*	Land Use	Category	NAC	No. DUs	Measured Existing Noise Level, dBA Leq(h)**	Predicted Worst Hour Traffic Noise Levels, dBA Leq(h)			Build vs Existing Difference, dBA^	Predicted NAC Impacts		
							Existing 2016	No-Build 2043	Build 2043		Existing 2016	No-Build 2043	Build 2043
4	R84	Res	B	66	1	54	46	48	48	3			
4	R85	Res	B	66	1	54	46	48	48	3			
4	R86	Res	B	66	1	54	46	48	48	3			
4	R87	Res	B	66	1	54	46	48	48	3			
4	R88	Res	B	66	1	54	46	48	48	3			
4	R89	Res	B	66	1	54	46	48	48	3			
5	R90^^	Institutional	C / D	66 / 51	1		45 / 20	48 / 23	47 / 22	2			
1	R91_15	Res	B	66	2		68	69	68	0	2	2	2
1	R91_25	Res	B	66	2		70	70	70	0	2	2	2
1	R91_35	Res	B	66	2		70	70	70	0	2	2	2
1	R91_45	Res	B	66	2		70	70	70	0	2	2	2
1	R91_55	Res	B	66	2		70	70	70	0	2	2	2
1	R91_65	Res	B	66	2		70	70	70	0	2	2	2
1	R92_15	Res	B	66	2		68	68	68	0	2	2	2
1	R92_25	Res	B	66	2		69	70	70	0	2	2	2
1	R92_35	Res	B	66	2		69	70	70	0	2	2	2
1	R92_45	Res	B	66	2		70	70	70	0	2	2	2
1	R92_55	Res	B	66	2		69	70	70	0	2	2	2
1	R92_65	Res	B	66	2		69	70	70	0	2	2	2
1	R93_15	Res	B	66	2		68	69	69	1	2	2	2
1	R93_25	Res	B	66	2		69	70	70	1	2	2	2
1	R93_35	Res	B	66	2		70	71	70	1	2	2	2
1	R93_45	Res	B	66	2		70	71	70	1	2	2	2
1	R93_55	Res	B	66	2		70	71	70	1	2	2	2
1	R93_65	Res	B	66	2		70	70	70	1	2	2	2
1	R94_15	Res	B	66	2		66	67	67	2	2	2	2
1	R94_25	Res	B	66	2		66	68	68	1	2	2	2
1	R94_35	Res	B	66	2		67	68	68	2	2	2	2

CNE	Receptor*	Land Use	Category	NAC	No. DUs	Measured Existing Noise Level, dBA Leq(h)**	Predicted Worst Hour Traffic Noise Levels, dBA Leq(h)			Build vs Existing Difference, dBA^	Predicted NAC Impacts		
							Existing 2016	No-Build 2043	Build 2043		Existing 2016	No-Build 2043	Build 2043
1	R94_45	Res	B	66	2		67	68	68	2	2	2	2
1	R94_55	Res	B	66	2		67	68	68	2	2	2	2
1	R94_65	Res	B	66	2		66	68	68	2	2	2	2
1	R95_15	Res	B	66	2		65	67	67	2		2	2
1	R95_25	Res	B	66	2		66	68	68	2	2	2	2
1	R95_35	Res	B	66	2		66	68	68	2	2	2	2
1	R95_45	Res	B	66	2		66	68	68	2	2	2	2
1	R95_55	Res	B	66	2		66	68	68	2	2	2	2
1	R95_65	Res	B	66	2		66	68	68	2	2	2	2
1	R96_5	Res	B	66	2		64	66	66	2		2	2
1	R96_15	Res	B	66	2		65	67	67	2		2	2
1	R96_25	Res	B	66	2		65	68	68	2		2	2
1	R96_35	Res	B	66	2		66	68	68	2	2	2	2
1	R96_45	Res	B	66	2		66	68	68	2	2	2	2
1	R96_55	Res	B	66	2		66	68	68	2	2	2	2
1	R97_5	Res	B	66	2		64	67	67	3		2	2
1	R97_15	Res	B	66	2		66	68	68	3	2	2	2
1	R97_25	Res	B	66	2		66	68	68	3	2	2	2
1	R97_35	Res	B	66	2		66	68	68	2	2	2	2
1	R97_45	Res	B	66	2		66	68	68	2	2	2	2
1	R97_55	Res	B	66	2		66	68	68	2	2	2	2
1	R98_5	Res	B	66	2		64	67	67	3		2	2
1	R98_15	Res	B	66	2		66	68	68	3	2	2	2
1	R98_25	Res	B	66	2		66	68	68	3	2	2	2
1	R98_35	Res	B	66	2		66	68	68	3	2	2	2
1	R98_45	Res	B	66	2		66	68	68	3	2	2	2
1	R98_55	Res	B	66	2		66	68	68	3	2	2	2
1	R99_5	Res	B	66	2		60	62	63	3			

CNE	Receptor*	Land Use	Category	NAC	No. DUs	Measured Existing Noise Level, dBA Leq(h)**	Predicted Worst Hour Traffic Noise Levels, dBA Leq(h)			Build vs Existing Difference, dBA^	Predicted NAC Impacts		
							Existing 2016	No-Build 2043	Build 2043		Existing 2016	No-Build 2043	Build 2043
1	R99_15	Res	B	66	2		61	64	64	3			
1	R99_25	Res	B	66	2		61	64	65	3			
1	R99_35	Res	B	66	2		62	64	65	3			
1	R99_45	Res	B	66	2		61	64	65	3			
1	R99_55	Res	B	66	2		61	64	64	3			
1	R100_5	Res	B	66	2		58	61	61	3			
1	R100_15	Res	B	66	2		59	62	62	3			
1	R100_25	Res	B	66	2		60	63	63	3			
1	R100_35	Res	B	66	2		60	63	63	3			
1	R100_45	Res	B	66	2		60	63	63	3			
1	R100_55	Res	B	66	2		60	63	63	3			
1	R101_5	Res	B	66	2		65	66	65	0		2	
1	R101_15	Res	B	66	2		68	69	69	0	2	2	2
1	R101_25	Res	B	66	2		69	70	70	0	2	2	2
1	R101_35	Res	B	66	2		70	70	70	0	2	2	2
1	R102_5	Res	B	66	2		65	66	65	0		2	
1	R102_15	Res	B	66	2		69	69	69	0	2	2	2
1	R102_25	Res	B	66	2		70	70	70	0	2	2	2
1	R102_35	Res	B	66	2		70	71	71	0	2	2	2
1	R103_5	Res	B	66	2		66	66	66	0	2	2	2
1	R103_15	Res	B	66	2		69	70	70	0	2	2	2
1	R103_25	Res	B	66	2		70	71	71	0	2	2	2
1	R103_35	Res	B	66	2		71	71	71	0	2	2	2
1	R104_5	Res	B	66	2		57	57	57	0			
1	R104_15	Res	B	66	2		59	60	60	0			
1	R104_25	Res	B	66	2		62	63	63	1			
1	R104_35	Res	B	66	2		63	64	64	1			
1	R105_5	Res	B	66	1		49	50	50	1			

CNE	Receptor*	Land Use	Category	NAC	No. DUs	Measured Existing Noise Level, dBA Leq(h)**	Predicted Worst Hour Traffic Noise Levels, dBA Leq(h)			Build vs Existing Difference, dBA^	Predicted NAC Impacts		
							Existing 2016	No-Build 2043	Build 2043		Existing 2016	No-Build 2043	Build 2043
1	R105_15	Res	B	66	1		48	50	50	1			
1	R105_25	Res	B	66	1		49	50	50	1			
1	R105_35	Res	B	66	1		51	52	52	1			
1	R106_5	Res	B	66	1		48	50	50	2			
1	R106_15	Res	B	66	1		48	49	49	2			
1	R106_25	Res	B	66	1		48	50	50	2			
1	R106_35	Res	B	66	1		51	52	52	1			
1	R107_5	Res	B	66	1		57	58	58	1			
1	R107_15	Res	B	66	1		60	60	61	1			
1	R107_25	Res	B	66	1		61	61	62	1			
1	R107_35	Res	B	66	1		61	62	62	1			
1	R108_5	Res	B	66	2		63	64	64	0			
1	R108_15	Res	B	66	2		67	67	67	0	2	2	2
1	R108_25	Res	B	66	2		69	69	69	0	2	2	2
1	R108_35	Res	B	66	2		69	69	69	0	2	2	2
1	R109_5	Res	B	66	1		67	67	67	0	1	1	1
1	R109_15	Res	B	66	1		70	71	70	0	1	1	1
1	R109_25	Res	B	66	1		71	72	72	0	1	1	1
1	R109_35	Res	B	66	1		72	72	72	0	1	1	1
1	R110_5	Res	B	66	2		65	66	65	0		2	
1	R110_15	Res	B	66	2		68	68	68	0	2	2	2
1	R110_25	Res	B	66	2		70	70	70	0	2	2	2
1	R110_35	Res	B	66	2		70	71	71	0	2	2	2
1	R111_5	Res	B	66	2		60	60	60	1			
1	R111_15	Res	B	66	2		61	62	62	1			
1	R111_25	Res	B	66	2		64	64	64	1			
1	R111_35	Res	B	66	2		65	66	66	1		2	2
1	R112_5	Res	B	66	2		57	58	58	1			

CNE	Receptor*	Land Use	Category	NAC	No. DUs	Measured Existing Noise Level, dBA Leq(h)**	Predicted Worst Hour Traffic Noise Levels, dBA Leq(h)			Build vs Existing Difference, dBA^	Predicted NAC Impacts		
							Existing 2016	No-Build 2043	Build 2043		Existing 2016	No-Build 2043	Build 2043
1	R112_15	Res	B	66	2		60	60	60	1			
1	R112_25	Res	B	66	2		62	63	63	1			
1	R112_35	Res	B	66	2		63	63	63	1			
1	R113_5	Res	B	66	1		67	67	67	0	1	1	1
1	R113_15	Res	B	66	1		69	70	70	1	1	1	1
1	R113_25	Res	B	66	1		71	71	71	1	1	1	1
1	R113_35	Res	B	66	1		71	72	72	1	1	1	1
1	R114_5	Res	B	66	1		67	67	67	0	1	1	1
1	R114_15	Res	B	66	1		69	70	70	0	1	1	1
1	R114_25	Res	B	66	1		72	72	72	1	1	1	1
1	R114_35	Res	B	66	1		72	73	72	0	1	1	1
1	R115_5	Res	B	66	1		64	65	65	1			
1	R115_15	Res	B	66	1		65	66	66	1		1	1
1	R115_25	Res	B	66	1		68	68	68	1	1	1	1
1	R115_35	Res	B	66	1		68	69	69	1	1	1	1
1	R116_5	Res	B	66	1		58	58	58	1			
1	R116_15	Res	B	66	1		61	62	62	1			
1	R116_25	Res	B	66	1		65	65	65	1			
1	R116_35	Res	B	66	1		65	66	66	1		1	1
1	R117_5	Res	B	66	2		67	67	67	1	2	2	2
1	R117_15	Res	B	66	2		69	69	69	1	2	2	2
1	R117_25	Res	B	66	2		71	71	71	1	2	2	2
1	R117_35	Res	B	66	2		71	72	72	1	2	2	2
1	R118_5	Res	B	66	2		67	68	68	1	2	2	2
1	R118_15	Res	B	66	2		68	69	69	1	2	2	2
1	R118_25	Res	B	66	2		71	71	71	1	2	2	2
1	R118_35	Res	B	66	2		71	72	72	1	2	2	2
1	R119_5	Res	B	66	2		59	60	60	1			

CNE	Receptor*	Land Use	Category	NAC	No. DUs	Measured Existing Noise Level, dBA Leq(h)**	Predicted Worst Hour Traffic Noise Levels, dBA Leq(h)			Build vs Existing Difference, dBA^	Predicted NAC Impacts		
							Existing 2016	No-Build 2043	Build 2043		Existing 2016	No-Build 2043	Build 2043
1	R119_15	Res	B	66	2		60	61	61	1			
1	R119_25	Res	B	66	2		63	64	64	1			
1	R119_35	Res	B	66	2		65	66	66	1		2	2
1	R120_5	Res	B	66	2		55	56	56	1			
1	R120_15	Res	B	66	2		56	56	56	1			
1	R120_25	Res	B	66	2		57	57	57	1			
1	R120_35	Res	B	66	2		59	60	60	1			
1	R121_5	Res	B	66	1		58	59	59	1			
1	R121_15	Res	B	66	1		59	59	59	1			
1	R121_25	Res	B	66	1		60	60	60	1			
1	R121_35	Res	B	66	1		61	61	61	1			
1	R122_5	Res	B	66	1		63	64	64	1			
1	R122_15	Res	B	66	1		65	65	65	1			
1	R122_25	Res	B	66	1		66	67	67	1	1	1	1
1	R122_35	Res	B	66	1		66	67	67	1	1	1	1
1	R123_5	Res	B	66	1		64	65	65	1			
1	R123_15	Res	B	66	1		65	66	66	1		1	1
1	R123_25	Res	B	66	1		67	67	67	1	1	1	1
1	R123_35	Res	B	66	1		67	68	68	1	1	1	1
1	R124_5	Res	B	66	1		57	58	58	1			
1	R124_15	Res	B	66	1		59	59	59	1			
1	R124_25	Res	B	66	1		59	60	60	1			
1	R124_35	Res	B	66	1		60	61	61	1			
1	R125_5	Res	B	66	2		67	68	68	1	2	2	2
1	R125_15	Res	B	66	2		69	70	70	1	2	2	2
1	R125_25	Res	B	66	2		71	72	72	1	2	2	2
1	R125_35	Res	B	66	2		71	72	72	1	2	2	2
1	R126_5	Res	B	66	2		68	68	68	1	2	2	2

CNE	Receptor*	Land Use	Category	NAC	No. DUs	Measured Existing Noise Level, dBA Leq(h)**	Predicted Worst Hour Traffic Noise Levels, dBA Leq(h)			Build vs Existing Difference, dBA^	Predicted NAC Impacts		
							Existing 2016	No-Build 2043	Build 2043		Existing 2016	No-Build 2043	Build 2043
1	R126_15	Res	B	66	2		70	70	70	1	2	2	2
1	R126_25	Res	B	66	2		71	72	72	1	2	2	2
1	R126_35	Res	B	66	2		71	72	72	1	2	2	2
1	R127_5	Res	B	66	2		59	60	60	1			
1	R127_15	Res	B	66	2		62	63	63	1			
1	R127_25	Res	B	66	2		63	64	64	1			
1	R127_35	Res	B	66	2		64	64	65	1			
1	R128_5	Res	B	66	2		61	62	62	1			
1	R128_15	Res	B	66	2		64	65	65	1			
1	R128_25	Res	B	66	2		65	66	66	1		2	2
1	R128_35	Res	B	66	2		65	66	66	1		2	2
1	R129_5	Res	B	66	2		64	65	65	1			
1	R129_15	Res	B	66	2		67	67	67	1	2	2	2
1	R129_25	Res	B	66	2		67	68	68	1	2	2	2
1	R129_35	Res	B	66	2		67	68	68	1	2	2	2
1	R130_5	Res	B	66	2		53	54	54	0			
1	R130_15	Res	B	66	2		53	53	53	1			
1	R130_25	Res	B	66	2		54	55	55	1			
1	R130_35	Res	B	66	2		56	57	57	1			
1	R131_5	Res	B	66	2		53	55	55	2			
1	R131_15	Res	B	66	2		54	56	56	2			
1	R131_25	Res	B	66	2		55	57	57	2			
1	R131_35	Res	B	66	2		57	58	58	2			
1	R132_5	Res	B	66	2		55	55	55	0			
1	R132_15	Res	B	66	2		55	56	56	1			
1	R132_25	Res	B	66	2		57	57	57	0			
1	R132_35	Res	B	66	2		59	59	59	1			
1	R133_5	Res	B	66	2		53	54	54	1			

CNE	Receptor*	Land Use	Category	NAC	No. DUs	Measured Existing Noise Level, dBA Leq(h)**	Predicted Worst Hour Traffic Noise Levels, dBA Leq(h)			Build vs Existing Difference, dBA^	Predicted NAC Impacts		
							Existing 2016	No-Build 2043	Build 2043		Existing 2016	No-Build 2043	Build 2043
1	R133_15	Res	B	66	2		55	55	56	1			
1	R133_25	Res	B	66	2		57	57	58	1			
1	R133_35	Res	B	66	2		58	58	59	1			
1	R134_5	Res	B	66	1		50	51	51	1			
1	R134_15	Res	B	66	1		50	51	51	1			
1	R134_25	Res	B	66	1		52	53	53	1			
1	R134_35	Res	B	66	1		54	55	55	1			
1	R135_5	Res	B	66	1		49	50	50	1			
1	R135_15	Res	B	66	1		49	50	50	1			
1	R135_25	Res	B	66	1		49	50	50	2			
1	R135_35	Res	B	66	1		50	51	51	1			
1	R136_5	Res	B	66	2		53	53	53	0			
1	R136_15	Res	B	66	2		53	54	54	1			
1	R136_25	Res	B	66	2		55	56	56	1			
1	R136_35	Res	B	66	2		57	57	57	1			
1	R137_5	Res	B	66	2		56	57	58	2			
1	R137_15	Res	B	66	2		56	58	59	2			
1	R137_25	Res	B	66	2		57	59	59	2			
1	R137_35	Res	B	66	2		58	59	60	2			
1	R138_5	Res	B	66	1		65	65	65	0			
1	R138_15	Res	B	66	1		67	67	67	0	1	1	1
1	R138_25	Res	B	66	1		69	69	69	1	1	1	1
1	R138_35	Res	B	66	1		69	70	70	1	1	1	1
1	R139_5	Res	B	66	1		63	64	64	0			
1	R139_15	Res	B	66	1		66	66	66	0	1	1	1
1	R139_25	Res	B	66	1		69	69	69	1	1	1	1
1	R139_35	Res	B	66	1		69	70	70	1	1	1	1
1	R140_5	Res	B	66	2		52	52	52	0			

CNE	Receptor*	Land Use	Category	NAC	No. DUs	Measured Existing Noise Level, dBA Leq(h)**	Predicted Worst Hour Traffic Noise Levels, dBA Leq(h)			Build vs Existing Difference, dBA^	Predicted NAC Impacts		
							Existing 2016	No-Build 2043	Build 2043		Existing 2016	No-Build 2043	Build 2043
1	R140_15	Res	B	66	2		52	52	52	1			
1	R140_25	Res	B	66	2		53	54	54	1			
1	R140_35	Res	B	66	2		55	56	56	1			
1	R141_5	Res	B	66	1		57	59	59	3			
1	R141_15	Res	B	66	1		57	59	60	3			
1	R141_25	Res	B	66	1		58	60	61	3			
1	R141_35	Res	B	66	1		58	60	61	3			
1	R142_5	Res	B	66	1		61	61	61	0			
1	R142_15	Res	B	66	1		64	64	64	1			
1	R142_25	Res	B	66	1		64	65	65	1			
1	R142_35	Res	B	66	1		64	65	65	1			
4	R153	Res	B	66	1		65	67	67	2		1	1
4	R154	Res	B	66	1		64	66	66	2		1	1
4	R155	Res	B	66	1		65	66	66	2		1	1
4	R156	Res	B	66	1		64	66	66	2		1	1
4	R157	Res	B	66	1		65	67	67	2		1	1
4	R158	Res	B	66	1		65	67	67	2		1	1
4	R159	Res	B	66	1		64	66	66	2		1	1
4	R160	Res	B	66	1		65	67	67	2		1	1
4	R161	Res	B	66	1		65	66	66	2		1	1
4	R162	Res	B	66	1		56	58	58	2			
4	R163	Res	B	66	1		55	57	57	2			
4	R164	Res	B	66	1		57	59	58	2			
4	R165	Res	B	66	1		56	58	58	2			
4	R166	Res	B	66	1		55	57	57	2			
4	R167	Res	B	66	1		55	57	57	2			
4	R168	Res	B	66	1		54	56	56	2			
4	R169	Res	B	66	1		54	56	56	2			

CNE	Receptor*	Land Use	Category	NAC	No. DUs	Measured Existing Noise Level, dBA Leq(h)**	Predicted Worst Hour Traffic Noise Levels, dBA Leq(h)			Build vs Existing Difference, dBA^	Predicted NAC Impacts		
							Existing 2016	No-Build 2043	Build 2043		Existing 2016	No-Build 2043	Build 2043
4	R170	Res	B	66	1		56	59	58	2			
4	R171	Res	B	66	1		48	51	51	2			
4	R172	Res	B	66	1		48	51	51	2			
4	R173	Res	B	66	1		48	50	50	2			
4	R174	Res	B	66	1		48	50	50	2			
4	R175	Res	B	66	1		48	50	50	2			
4	R176	Res	B	66	1		48	50	50	2			
1	R178	Common Area	B	66	1		54	54	54	1			
1	R179	Common Area	B	66	1		60	62	62	3			
1	R180	Pool	B	66	1		56	57	57	1			

* "_##" after receptor number indicates receptor elevation (in feet) above ground for multi-level receptor arrays. "5" is ground level, "15" is 2nd level, etc…

** measured during peak AM or PM periods

^ based on lower of the existing noise level determined through measurements and TNM modeling

^^ For receptor R90, predicted noise levels are shown as "Exterior / Interior" assuming a 25 dBA exterior-interior noise reduction for a masonry structure with closed single-glazed windows.

Table E-2: Predicted Total Noise Level Results

CNE	Receptor	Land Use	Category	NAC	No. DUs	Measured Existing Noise Level, dBA Leq(h)*	Predicted Worst Hour Rail Noise Level, dBA Leq(h)**	Predicted Worst Hour Total Noise Level, dBA Leq(h)^			Build vs Existing Increase, dBA~	Predicted NAC Impacts^^		
								Existing 2016	No-Build 2016	Build 2043		Existing 2016	No-Build 2016	Build 2043
2	R12	Res	B	66	1	56	55	59	59	61	5			
2	R13	Res	B	66	1	56	55	59	59	60	4			
2	R14	Res	B	66	1	56	55	59	60	60	4			
4	R23	Res	B	66	1	63	60	64	64	64	1			
4	R24	Res	B	66	1	63	60	63	63	63	0			
4	R25	Res	B	66	1	63	60	63	63	63	0			
4	R26	Res	B	66	1	63	60	63	63	64	1			
4	R27	Res	B	66	1	63	60	63	63	64	1			
4	R28	Res	B	66	1	63	60	63	63	63	0			
4	R29	Res	B	66	1	63	60	63	64	64	1			
4	R30	Res	B	66	1	63	60	63	64	64	1			
4	R31	Res	B	66	1	63	60	63	64	64	1			
4	R32	Res	B	66	1	63	60	63	63	64	1			
4	R33	Res	B	66	1	63	60	63	63	63	0			
4	R34	Res	B	66	1	63	60	62	62	63	0			
5	R73	Res	B	66	1	54	52	53	54	54	0			
5	R74	Res	B	66	1	54	52	53	54	54	0			
5	R75	Res	B	66	1	54	52	53	54	54	0			
5	R76	Res	B	66	1	54	52	53	54	54	0			
5	R88	Res	B	66	1	54	52	53	54	54	0			
5	R89	Res	B	66	1	54	52	53	54	54	0			

* measured during peak AM or PM periods

** predicted for loudest traffic hour of 5 - 6 PM at receptors within 500-ft of rail corridor (see Appendix F for more details)

^ cumulative noise level from predicted traffic (see Table E-1) and rail noise levels

~ based on comparison of total noise level to measured existing noise level, when available

Appendix F – Predicted Rail Noise Levels

Table F-1: Rail Source Noise Emission Levels

Fixed Guideway Source	Reference SEL (dBA)	Average No. / Train	Throttle Setting	K	Track Adjustment (dB)	Speed (mph)	No. Trains in Worst Hour	Worst Hour Leq(h) at 50 ft (dBA)
WMATA Rail Car, 50 mph	82	6	N/A	N/A	0	50	15	65.9
WMATA Rail Car, 10 mph	82	6	N/A	N/A	0	10	15	52.0
VA Rail Exp Locomotive, 50 mph	92	1	4	-10	N/A	50	2	59.4
VA Rail Exp Car, 50 mph	82	8	N/A	N/A	0	50	2	58.4
VA Rail Exp Locomotive, 10 mph	92	1	4	-10	N/A	10	2	66.4
VA Rail Exp Car, 10 mph	82	8	N/A	N/A	0	10	2	44.5

Figure F-1: Detailed Rail Noise Level Calculations

Assumptions:	Train travels at 50 mph when approaching and departing station						
	Train travels at 10 mph while pulling into the station						
Receptor:	**R-14, CNE 2**						
Condition:	Build						
Source	Description:	WMATA Rail Car, 50 mph	VA Rail Exp Locomotive, 50 mph	VA Rail Exp Car, 50 mph	WMATA Rail Car, 10 mph	VA Rail Exp Locomotive, 10 mph	VA Rail Exp Car, 10 mph
	Leq(h) at 50 ft (dBA):	65.9	59.4	58.4	52.0	66.4	44.5
	Calculate Source? (Y/N):	Y	Y	Y	N	N	N
Path	Distance from source (ft):	340	420	420	0	0	0
	Distance correction (dB):	12.5	13.9	13.9			
	Barrier attenuation (dB):	0	0	0	0	0	0
	Building attenuation (dB):	0	0	0	0	0	0
	Tree attenuation (dB):	0	0	0	0	0	0
	Total shielding (dB):	0	0	0	0	0	0
Receiver	Source Leq(h) at receptor (dBA):	53.5	45.5	44.6	0.0	0.0	0.0
	Total Leq(h) at receptor:	**54.6**					
Receptor:	**R-32, CNE 3**						
Condition:	Build						
Source	Description:	WMATA Rail Car, 50 mph	VA Rail Exp Locomotive, 50 mph	VA Rail Exp Car, 50 mph	WMATA Rail Car, 10 mph	VA Rail Exp Locomotive, 10 mph	VA Rail Exp Car, 10 mph
	Leq(h) at 50 ft (dBA):	65.9	59.4	58.4	52.0	66.4	44.5
	Calculate Source? (Y/N):	N	N	N	Y	Y	Y
Path	Distance from source (ft):	0	0	0	205	140	140
	Distance correction (dB):				9.2	6.7	6.7
	Barrier attenuation (dB):	0	0	0	0	0	0
	Building attenuation (dB):	0	0	0	0	0	0
	Tree attenuation (dB):	0	0	0	0	0	0
	Total shielding (dB):	0	0	0	0	0	0
Receiver	Source Leq(h) at receptor (dBA):	0.0	0.0	0.0	42.8	59.7	37.8
	Total Leq(h) at receptor:	**59.8**					
Receptor:	**R-76, CNE 4**						
Condition:	Build						
Source	Description:	WMATA Rail Car, 50 mph	VA Rail Exp Locomotive, 50 mph	VA Rail Exp Car, 50 mph	WMATA Rail Car, 10 mph	VA Rail Exp Locomotive, 10 mph	VA Rail Exp Car, 10 mph
	Leq(h) at 50 ft (dBA):	65.9	59.4	58.4	52.0	66.4	44.5
	Calculate Source? (Y/N):	N	Y	Y	N	N	N
Path	Distance from source (ft):	0	225	225	0	0	0
	Distance correction (dB):		9.8	9.8			
	Barrier attenuation (dB):	0	0	0	0	0	0
	Building attenuation (dB):	0	0	0	0	0	0
	Tree attenuation (dB):	0	0	0	0	0	0
	Total shielding (dB):	0	0	0	0	0	0
Receiver	Source Leq(h) at receptor (dBA):	0.0	49.6	48.6	0.0	0.0	0.0
	Total Leq(h) at receptor:	**52.2**					

Appendix G – Noise Barrier Analysis Results

Table G-1: Noise Barrier 1 Results

Receptor	Land Use	Category	NAC	No. DUs	Predicted Worst Hour Traffic Noise Levels, dBA Leq(h)		Insertion Loss, dBA	No. Impacts	No. Benefited	No. Impacted and Benefited	No. Impacted meeting NRDG
					Build 2043, No Barrier	Build 2043, w/ Barrier					
R91_15	Res	B	66	2	68	56	12	2	2	2	2
R91_25	Res	B	66	2	70	62	8	2	2	2	2
R92_15	Res	B	66	2	68	57	11	2	2	2	2
R92_25	Res	B	66	2	70	62	8	2	2	2	2
R93_15	Res	B	66	2	69	57	12	2	2	2	2
R93_25	Res	B	66	2	70	63	7	2	2	2	2
R94_15	Res	B	66	2	67	58	9	2	2	2	2
R94_25	Res	B	66	2	68	61	7	2	2	2	2
R95_15	Res	B	66	2	67	60	7	2	2	2	2
R95_25	Res	B	66	2	68	63	5	2	2	2	
R96_5	Res	B	66	2	66	59	7	2	2	2	2
R96_15	Res	B	66	2	67	61	6	2	2	2	
R96_25	Res	B	66	2	68	62	6	2	2	2	
R97_5	Res	B	66	2	67	57	10	2	2	2	2
R97_15	Res	B	66	2	68	58	10	2	2	2	2
R97_25	Res	B	66	2	68	59	9	2	2	2	2
R98_5	Res	B	66	2	67	56	11	2	2	2	2
R98_15	Res	B	66	2	68	56	12	2	2	2	2
R98_25	Res	B	66	2	68	57	11	2	2	2	2
R99_5	Res	B	66	2	63	55	8		2		
R99_15	Res	B	66	2	64	56	8		2		
R99_25	Res	B	66	2	65	56	9		2		
R100_5	Res	B	66	2	61	59	2				
R100_15	Res	B	66	2	62	60	2				
R100_25	Res	B	66	2	63	60	3				
R101_5	Res	B	66	2	65	56	9		2		
R101_15	Res	B	66	2	69	58	11	2	2	2	2

Receptor	Land Use	Category	NAC	No. DUs	Predicted Worst Hour Traffic Noise Levels, dBA Leq(h)		Insertion Loss, dBA	No. Impacts	No. Benefited	No. Impacted and Benefited	No. Impacted meeting NRDG
					Build 2043, No Barrier	Build 2043, w/ Barrier					
R101_25	Res	B	66	2	70	62	8	2	2	2	2
R102_5	Res	B	66	2	65	55	10		2		
R102_15	Res	B	66	2	69	57	12	2	2	2	2
R102_25	Res	B	66	2	70	62	8	2	2	2	2
R103_5	Res	B	66	2	66	56	10	2	2	2	2
R103_15	Res	B	66	2	70	56	14	2	2	2	2
R103_25	Res	B	66	2	71	61	10	2	2	2	2
R104_5	Res	B	66	2	57	47	10		2		
R104_15	Res	B	66	2	60	48	12		2		
R104_25	Res	B	66	2	63	48	15		2		
R105_5	Res	B	66	1	50	50	0				
R105_15	Res	B	66	1	50	49	1				
R105_25	Res	B	66	1	50	49	1				
R106_5	Res	B	66	1	50	49	1				
R106_15	Res	B	66	1	49	49	0				
R106_25	Res	B	66	1	50	49	1				
R107_5	Res	B	66	1	58	54	4				
R107_15	Res	B	66	1	61	55	6		1		
R107_25	Res	B	66	1	62	56	6		1		
R108_5	Res	B	66	2	64	52	12		2		
R108_15	Res	B	66	2	67	53	14	2	2	2	2
R108_25	Res	B	66	2	69	56	13	2	2	2	2
R109_5	Res	B	66	1	67	55	12	1	1	1	1
R109_15	Res	B	66	1	70	55	15	1	1	1	1
R109_25	Res	B	66	1	72	58	14	1	1	1	1
R110_5	Res	B	66	2	65	54	11		2		
R110_15	Res	B	66	2	68	54	14	2	2	2	2
R110_25	Res	B	66	2	70	55	15	2	2	2	2
R111_5	Res	B	66	2	60	49	11		2		

Receptor	Land Use	Category	NAC	No. DUs	Predicted Worst Hour Traffic Noise Levels, dBA Leq(h)		Insertion Loss, dBA	No. Impacts	No. Benefited	No. Impacted and Benefited	No. Impacted meeting NRDG
					Build 2043, No Barrier	Build 2043, w/ Barrier					
R111_15	Res	B	66	2	62	49	13		2		
R111_25	Res	B	66	2	64	49	15		2		
R112_5	Res	B	66	2	58	49	9		2		
R112_15	Res	B	66	2	60	49	11		2		
R112_25	Res	B	66	2	63	50	13		2		
R113_5	Res	B	66	1	67	54	13	1	1	1	1
R113_15	Res	B	66	1	70	55	15	1	1	1	1
R113_25	Res	B	66	1	71	56	15	1	1	1	1
R114_5	Res	B	66	1	67	55	12	1	1	1	1
R114_15	Res	B	66	1	70	55	15	1	1	1	1
R114_25	Res	B	66	1	72	57	15	1	1	1	1
R115_5	Res	B	66	1	65	52	13		1		
R115_15	Res	B	66	1	66	53	13	1	1	1	1
R115_25	Res	B	66	1	68	54	14	1	1	1	1
R116_5	Res	B	66	1	58	50	8		1		
R116_15	Res	B	66	1	62	50	12		1		
R116_25	Res	B	66	1	65	50	15		1		
R117_5	Res	B	66	2	67	56	11	2	2	2	2
R117_15	Res	B	66	2	69	57	12	2	2	2	2
R117_25	Res	B	66	2	71	58	13	2	2	2	2
R118_5	Res	B	66	2	68	55	13	2	2	2	2
R118_15	Res	B	66	2	69	56	13	2	2	2	2
R118_25	Res	B	66	2	71	57	14	2	2	2	2
R119_5	Res	B	66	2	60	52	8		2		
R119_15	Res	B	66	2	61	51	10		2		
R119_25	Res	B	66	2	64	51	13		2		
R120_5	Res	B	66	2	56	46	10		2		
R120_15	Res	B	66	2	56	47	9		2		
R120_25	Res	B	66	2	57	48	9		2		

Receptor	Land Use	Category	NAC	No. DUs	Predicted Worst Hour Traffic Noise Levels, dBA Leq(h)		Insertion Loss, dBA	No. Impacts	No. Benefited	No. Impacted and Benefited	No. Impacted meeting NRDG
					Build 2043, No Barrier	Build 2043, w/ Barrier					
R121_5	Res	B	66	1	59	46	13		1		
R121_15	Res	B	66	1	59	46	13		1		
R121_25	Res	B	66	1	60	46	14		1		
R122_5	Res	B	66	1	64	50	14		1		
R122_15	Res	B	66	1	65	49	16		1		
R122_25	Res	B	66	1	67	49	18	1	1	1	1
R123_5	Res	B	66	1	65	52	13		1		
R123_15	Res	B	66	1	66	51	15	1	1	1	1
R123_25	Res	B	66	1	67	51	16	1	1	1	1
R124_5	Res	B	66	1	58	46	12		1		
R124_15	Res	B	66	1	59	48	11		1		
R124_25	Res	B	66	1	60	49	11		1		
R125_5	Res	B	66	2	68	57	11	2	2	2	2
R125_15	Res	B	66	2	70	59	11	2	2	2	2
R125_25	Res	B	66	2	72	60	12	2	2	2	2
R126_5	Res	B	66	2	68	59	9	2	2	2	2
R126_15	Res	B	66	2	70	60	10	2	2	2	2
R126_25	Res	B	66	2	72	61	11	2	2	2	2
R127_5	Res	B	66	2	60	56	4				
R127_15	Res	B	66	2	63	59	4				
R127_25	Res	B	66	2	64	61	3				
R128_5	Res	B	66	2	62	57	5		2		
R128_15	Res	B	66	2	65	60	5		2		
R128_25	Res	B	66	2	66	61	5	2	2	2	
R129_5	Res	B	66	2	65	60	5		2		
R129_15	Res	B	66	2	67	62	5	2	2	2	
R129_25	Res	B	66	2	68	63	5	2	2	2	
R130_5	Res	B	66	2	54	43	11		2		
R130_15	Res	B	66	2	53	45	8		2		

Receptor	Land Use	Category	NAC	No. DUs	Predicted Worst Hour Traffic Noise Levels, dBA Leq(h)		Insertion Loss, dBA	No. Impacts	No. Benefited	No. Impacted and Benefited	No. Impacted meeting NRDG
					Build 2043, No Barrier	Build 2043, w/ Barrier					
R130_25	Res	B	66	2	55	45	10		2		
R131_5	Res	B	66	2	55	53	2				
R131_15	Res	B	66	2	56	54	2				
R131_25	Res	B	66	2	57	55	2				
R132_5	Res	B	66	2	55	45	10		2		
R132_15	Res	B	66	2	56	46	10		2		
R132_25	Res	B	66	2	57	46	11		2		
R133_5	Res	B	66	2	54	51	3				
R133_15	Res	B	66	2	56	51	5		2		
R133_25	Res	B	66	2	58	52	6		2		
R134_5	Res	B	66	1	51	48	3				
R134_15	Res	B	66	1	51	48	3				
R134_25	Res	B	66	1	53	49	4				
R135_5	Res	B	66	1	50	49	1				
R135_15	Res	B	66	1	50	49	1				
R135_25	Res	B	66	1	50	49	1				
R136_5	Res	B	66	2	53	44	9		2		
R136_15	Res	B	66	2	54	44	10		2		
R136_25	Res	B	66	2	56	45	11		2		
R137_5	Res	B	66	2	58	56	2				
R137_15	Res	B	66	2	59	57	2				
R137_25	Res	B	66	2	59	57	2				
R138_5	Res	B	66	1	65	51	14		1		
R138_15	Res	B	66	1	67	51	16	1	1	1	1
R138_25	Res	B	66	1	69	52	17	1	1	1	1
R139_5	Res	B	66	1	64	52	12		1		
R139_15	Res	B	66	1	66	53	13	1	1	1	1
R139_25	Res	B	66	1	69	54	15	1	1	1	1
R140_5	Res	B	66	2	52	42	10		2		

Receptor	Land Use	Category	NAC	No. DUs	Predicted Worst Hour Traffic Noise Levels, dBA Leq(h)		Insertion Loss, dBA	No. Impacts	No. Benefited	No. Impacted and Benefited	No. Impacted meeting NRDG
					Build 2043, No Barrier	Build 2043, w/ Barrier					
R140_15	Res	B	66	2	52	43	9		2		
R140_25	Res	B	66	2	54	45	9		2		
R141_5	Res	B	66	1	59	58	1				
R141_15	Res	B	66	1	60	58	2				
R141_25	Res	B	66	1	61	59	2				
R142_5	Res	B	66	1	61	53	8		1		
R142_15	Res	B	66	1	64	55	9		1		
R142_25	Res	B	66	1	65	60	5		1		
R178	Common Area	B	66	1	54	48	6		1		
R179	Common Area	B	66	1	62	58	4				
R180	Pool	B	66	1	57	52	5		1		

Table G-2: Noise Barrier 2 (In-Kind Replacement Wall) Results[1]

Receptor	Land Use	Category	NAC	No. DUs	Predicted Build 2043 Worst-Hour Noise Level with Barrier, dBA Leq(h)	Predicted Insertion Loss, dBA		Insertion Loss Difference from Existing, dBA
						Existing Wall	Replacement Wall	
R1	Res	B	66	1	59	2	4	2
R2	Res	B	66	1	55	3	9	6
R3	Res	B	66	1	58	1	3	2
R4	Res	B	66	1	58	1	3	2
R5	Res	B	66	1	59	4	7	3
R6	Res	B	66	1	60	2	6	4
R7	Res	B	66	1	61	1	5	4
R8	Res	B	66	1	60	0	6	6
R9	Res	B	66	1	60	0	5	5
R10	Res	B	66	1	57	1	6	5
R11	Res	B	66	1	55	4	7	3
R12	Res	B	66	1	56	4	6	2
R13	Res	B	66	1	57	4	5	1
R14	Res	B	66	1	58	1	2	1
R15	Res	B	66	1	57	1	3	2
R16	Res	B	66	1	54	2	4	2
R17	Res	B	66	1	52	2	4	2
R18	Res	B	66	1	52	3	5	2
R19	Res	B	66	1	53	3	4	1
R20	Res	B	66	1	54	2	2	0
R21	Res	B	66	1	57	3	5	2
R22	Res	B	66	1	60	2	4	2

Note 1: In-kind replacement noise walls are not subject to the VDOT reasonableness criteria. Noise reduction represents the performance of the noise wall system, which includes the existing noise wall sections that the Barrier 2 replacement wall section will tie into.

Appendix H – Warranted, Feasible, and Reasonable Worksheets

Appendix F Warranted, Feasible, and Reasonable Worksheet

Note: the answers provided in the worksheet may differ between preliminary and final design. This worksheet is available in a protected digital format upon request.

Date:	4/3/18
Project No. and UPC:	2677-029-204, UPC 106742
County:	Fairfax
Facility:	Frontier Dr, Franconia-Springfield Pkwy
Barrier System ID:	Barrier 1
Noise Abatement Category(s)	B
Community Name and/or CNE#	CNE 1, Residences at Springfield Station
Design phase:	☒ Preliminary Design ☐ Final Design

Warranted

1. Community Documentation (if applicable)
   a. Date community was permitted. (Per 23CFR 772 this is the date the building permit was issued). N/A
   b. Date of approval for the Categorical Exclusion (CE), Record of Decision (ROD), or Finding of No Significant Impact (FONSI): N/A
   c. Does the date in 1.a precede the date in 1.b? If yes, proceed to Warranted Item 2. If no, consideration of noise abatement is not warranted. Proceed to "Decision" block and answer "no" to warranted question. As the reason for this decision, state that "Community was permitted after the date of approval of CE, ROD, or FONSI, as appropriate." ☐ Yes ☐ No

2. Criteria requiring consideration of noise abatement
   a. Project causes design year noise levels to approach or exceed the Noise Abatement Criteria? ☒ Yes ☐ No
   b. Project causes a substantial noise increase of 10 dB(A) or more? ☐ Yes ☒ No

Feasibility

1. Impacted receptor units
   a. Number of impacted receptor units: 108
   b. Number of impacted receptor units receiving 5 dB(A) or more insertion loss (IL): 108
   c. Percentage of impacted receptor units receiving 5 dB(A) or more IL 100%
   d. Is the percentage 50 or greater? ☒ Yes ☐ No

2 Will placement of the noise barrier cause engineering or safety conflicts, e.g. drainage or site distance issues? ☐ Yes ☒ No

3 Will placement of the noise barrier restrict access to vehicular or pedestrian travel? ☐ Yes ☒ No

4 Will placement of the noise barrier conflict with existing utility locations? ☐ Yes ☒ No

Reasonableness

1. Cost-Benefit Factors
   a. Surface Area (Total square foot) of the proposed noise barrier. (ft²) 71,490
   b. Impacted noise sensitive receptor(s) receiving 5 dB(A) IL or more. 108
   c. Non-impacted noise sensitive receptor(s) receiving 5 dB(A) IL or more. 100
   d. Total number of benefited receptors. 208
   e. Surface Area per benefited receptor unit. (ft²/BR) 344
   f. Is (1e) less than or equal to the maximum square feet per benefited receptor (MaxSF/BR) value of 1600? YES
   g. Does the barrier provide an IL of at least 7 dB(A) for at least one impacted receptor in the design year? YES

2. Community Desires Related to the Barrier
   a. Do at least 50 percent of the benefited receptor unit owner(s) and renters desire the noise barrier? If yes, continue to "decision" block. If no, the barrier can be considered not to be reasonable. Proceed to "decision" block and answer "no" to reasonableness question. As the reason for this decision, state that "The majority of the impacted receptor unit owners do not desire the barrier." TBD in final design ☐ Yes ☐ No

3. Additional Noise Barrier Details
   a. Length of the proposed noise barrier 2,383 ft
   b Height range of the proposed noise barrier 30 ft
   c. Average height of the proposed noise barrier 30 ft
   d Cost per square foot. ($/ft²) 42
   e. Total Barrier Cost ($) $3,002,580
   f. Additional comments (if applicable) * see below
   g. Barrier material ☐ Absorptive ☐ Reflective

Decision

Is the Noise Barrier(s) WARRANTED?	☒ Yes	☐ No
Is the Noise Barrier(s) FEASIBLE?	☒ Yes	☐ No
Is the Noise Barrier(s) REASONABLE?	☒ Yes	☐ No

Additional Reasons for Decision:

* shorter height (22-ft tall) barrier also found to be feasible and reasonable. See noise report for additional details

Appendix F Warranted, Feasible, and Reasonable Worksheet

Note: the answers provided in the worksheet may differ between preliminary and final design. This worksheet is available in a protected digital format upon request.

Date: 4/3/18
Project No. and UPC: 2677-029-204, UPC 106742
County: Fairfax
Facility: Frontier Drive, Franconia-Springfield Pkwy
Barrier System ID: Barrier 2
Noise Abatement Category(s) B
Community Name and/or CNE# CNE 2

Design phase: ☒ Preliminary Design ☐ Final Design

Warranted

1. Community Documentation (if applicable)
   a. Date community was permitted. (Per 23CFR 772 this is the date the building permit was issued). N/A
   b. Date of approval for the Categorical Exclusion (CE), Record of Decision (ROD), or Finding of No Significant Impact (FONSI): N/A
   c. Does the date in 1.a precede the date in 1.b? If yes, proceed to Warranted Item 2. If no, consideration of noise abatement is not warranted. Proceed to "Decision" block and answer "no" to warranted question. As the reason for this decision, state that "Community was permitted after the date of approval of CE, ROD, or FONSI, as appropriate." ☐ Yes ☐ No

2. Criteria requiring consideration of noise abatement in-kind replacement barrier
   a. Project causes design year noise levels to approach or exceed the Noise Abatement Criteria? ☒ Yes ☐ No
   b. Project causes a substantial noise increase of 10 dB(A) or more? ☐ Yes ☒ No

Feasibility

1. Impacted receptor units
   a. Number of impacted receptor units: 4
   b. Number of impacted receptor units receiving 5 dB(A) or more insertion loss (IL): 4
   c. Percentage of impacted receptor units receiving 5 dB(A) or more IL 100%
   d. Is the percentage 50 or greater? ☒ Yes ☐ No

2 Will placement of the noise barrier cause engineering or safety conflicts, e.g. drainage or site distance issues? ☐ Yes ☒ No

3 Will placement of the noise barrier restrict access to vehicular or pedestrian travel? ☐ Yes ☒ No

4 Will placement of the noise barrier conflict with existing utility locations? ☐ Yes ☒ No

Reasonableness

1. Cost-Benefit Factors

not subject to reasonableness considerations

   a. Surface Area (Total square foot) of the proposed noise barrier. (ft²) _____
   b. Impacted noise sensitive receptor(s) receiving 5 dB(A) IL or more. _____
   c. Non-impacted noise sensitive receptor(s) receiving 5 dB(A) IL or more. _____
   d. Total number of benefited receptors. _____
   e. Surface Area per benefited receptor unit. (ft²/BR) _____
   f. Is (1e) less than or equal to the maximum square feet per benefited receptor (MaxSF/BR) value of 1600? _____
   g. Does the barrier provide an IL of at least 7 dB(A) for at least one impacted receptor in the design year? _____

2. Community Desires Related to the Barrier
   a. Do at least 50 percent of the benefited receptor unit owner(s) and renters desire the noise barrier? If yes, continue to "decision" block. If no, the barrier can be considered not to be reasonable. Proceed to "decision" block and answer "no" to reasonableness question. As the reason for this decision, state that "The majority of the impacted receptor unit owners do not desire the barrier." ☐ Yes ☐ No

3. Additional Noise Barrier Details
   a. Length of the proposed noise barrier — 1,125 ft
   b Height range of the proposed noise barrier — 16 ft
   c. Average height of the proposed noise barrier — 16 ft
   d Cost per square foot. ($/ft²) — 42
   e. Total Barrier Cost ($) — $756,000
   f. Additional comments (if applicable) — * see below
   g. Barrier material — ☐ Absorptive ☐ Reflective

Decision

Is the Noise Barrier(s) WARRANTED?	☒ Yes	☐ No
Is the Noise Barrier(s) FEASIBLE?	☒ Yes	☐ No
Is the Noise Barrier(s) REASONABLE?	N/A ☐ Yes	☐ No

Additional Reasons for Decision: * Barrier to replace section of existing noise wall physically impacted by project. Provides equal or greater noise reduction as existing wall.

Appendix I – TNM Certification Certificates

Certificate of Continuing Education

This is to certify that

Jacob Poling

has satisfactorily completed 29 hours of training on

FHWA TRAFFIC NOISE MODEL 2.5

conducted by

Bowlby & Associates, Inc.

Shoreview, MN
June 20-23, 2017

William Bowlby, Ph.D., P.E.
Bowlby & Associates, Inc.

Darlene Reiter, Ph.D., P.E.
Bowlby & Associates, Inc.

Certificate of Continuing Education

This is to certify that

Brian Isoldi

has satisfactorily completed 30 hours of training on

FHWA TRAFFIC NOISE MODEL 2.5

And 8 hours of training on

TRAFFIC NOISE FUNDAMENTALS

conducted by

Bowlby & Associates, Inc.

Franklin, Tennessee
September 26-30, 2016

William Bowlby, Ph.D., P.E.
Bowlby & Associates, Inc.

Darlene Reiter, Ph.D., P.E.
Bowlby & Associates, Inc.

Appendix J – Alternative Abatement Measures Response Form

COMMONWEALTH of VIRGINIA

DEPARTMENT OF TRANSPORTATION
1401 EAST BROAD STREET
RICHMOND, VIRGINIA 23219-2000

Stephen Brich
Commissioner

April 3, 2018

MEMORANDUM

TO: Zamir Mirza, Project Manager
Steve Varner, Environmental Contact

FROM: LJ Muchenje PE, Noise Abatement

SUBJECT: UPC 106742

The 2009 General Assembly passed Chapter 120 (HB 2577, as amended by HB2025), which amends the Code of Virginia by adding in Article 15 of Chapter 1 of Title 33.1 a section numbered 33.1-223.2:21, relating to highway noise abatement.

House Bill 2025 States: Requires that whenever the Commonwealth Transportation Board or the Department plan for or undertake any highway construction or improvement project and such project includes or may include the requirement for the mitigation of traffic noise impacts, first consideration should be given to the use of noise reducing design and low noise pavement materials and techniques in lieu of construction of noise walls or sound barriers. Vegetative screening, such as the planting of appropriate conifers, in such a design would be utilized to act as a visual screen if visual screening is required.

In an effort to honor the intent of HB 2025 we are asking for your input (per Chapter VI of Materials Division's Manual of Instruction and Section 2B-3 Determination of Roadway Design of the VDOT Road Design manual (pages 2B-5 and 2B-6)). As part of the Noise Technical Report and technical files, we are seeking your professional opinion by providing comments for the project noted above. Please distribute this memorandum to the appropriate District staff and combine all responses into one response.

Should you have any questions, please contact me at (804) 371-6768. Thank you for your time and consideration regarding this request.

Comment: Is noise reducing design feasible in lieu of construction of noise walls or sound barriers? For example, the roadway alignment can be shifted away from noise sensitive receptors or the roadway can be placed in deep cut (Location & Design to address)

Response: The potential noise barriers identified in the project's noise study are located adjacent to existing and proposed ramps for the Frontier Drive (Route 2677) and Franconia-Springfield Parkway (Route 289) interchange. As the interchange is located between existing development and a Metrorail station site, the area is highly constrained and changes to the alignment and profile are not feasible.

- The noise wall located in the northwest quadrant of the interchange (Barrier 1) is located along an existing ramp that is not being modified by the project, so no changes to the alignment of that ramp are feasible.
- The noise wall located in the northeast quadrant of the interchange (Barrier 2) is an in-kind replacement for a section of an existing noise wall that runs along the existing interchange ramps. To provide a braided ramp facility, the existing ramps must be shifted closer to the existing homes to the north to facilitate providing a safe design that meets VDOT standards and allows the appropriate design speed, vertical clearances and lane transitions. Due to the ties to existing facilities and the need for appropriate vertical clearances where the ramps cross, the ramps are already in a significant cut, as they are pushing into the hillside adjacent to the existing ramps.

(Robert Kalbach, PE – Design Manager, WSP USA Inc.)

Comment: Can the project support the use of low noise pavement in lieu of construction of noise walls or sound barriers?

Response: The Virginia Department of Transportation is not authorized by the Federal Highway Administration to use "quiet pavement" at this time as a form of noise mitigation. Upon completion of the Quiet Pavement Pilot Program and approval from FHWA, the use of "quiet pavement" will be given additional consideration.

Comment: Can landscaping be utilized to act as a visual screen if visual screening is required? (Location & Design to address)

Response: Yes, where sufficient space adjacent to the noise barrier exists. Screening of the northeast quadrant noise wall (Barrier 2) should be feasible; screening of the northwest noise wall (Barrier 1) may not be feasible due to lack of physical space.
(Robert Kalbach, PE – Design Manager, WSP USA Inc.)

Note: Please provide the name of each responder.