PRELIMINARY NOISE ANALYSIS

Route 15 Bypass Interchange at Edwards Ferry Road an Fort Evans Road

Loudoun County, Virginia

PROJECT: 0015-253-306, P101
UPC: 89890

From: 0.2 Miles South of East Market Street
To: 0.3 Miles North of Edwards Ferry Road

Environmental Division
Virginia Department of Transportation

February 2018

Table of Contents

List of Figures

List of Tables

List of Appendices

1. Executive Summary

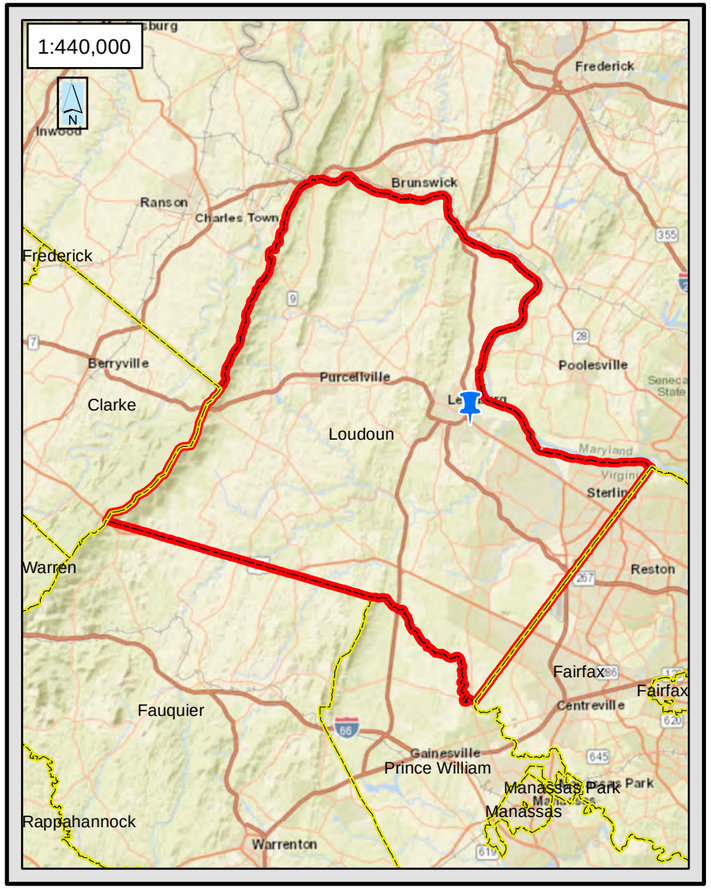
A preliminary noise analysis was completed which evaluated potential traffic noise impacts and abatement measures associated with the proposed Route 15 Bypass Interchange Project, in Loudoun County, Virginia. Potential traffic noise impacts were assessed in accordance with the procedures and criteria approved by the Federal Highway Administration (FHWA) and the Virginia Department of Transportation (VDOT). A project location map is shown in ***Figure 1***. A detailed display of the modeling results are shown in the figures located in ***Appendix A***.

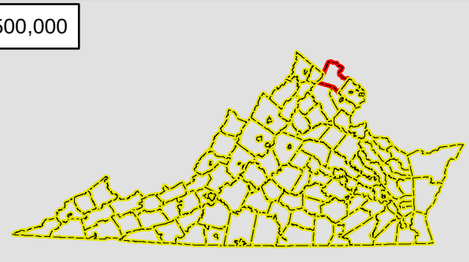
A total of 126 noise sensitive sites representing 188 residences, five commercial facilities, one pool, one hotel patio, one school and its associated playground area, and one church and its associated playground area were evaluated. A total of seven sites representing 13 residential units, are predicted to be impacted by traffic noise under the future design year (2040) build condition, due to levels approaching or exceeding the Noise Abatement Criteria (NAC). For all sites studied, the existing (2015) and the future design year (2040) build noise levels are predicted to range from 34 to 66 dBA and 36 to 67 dBA respectively.

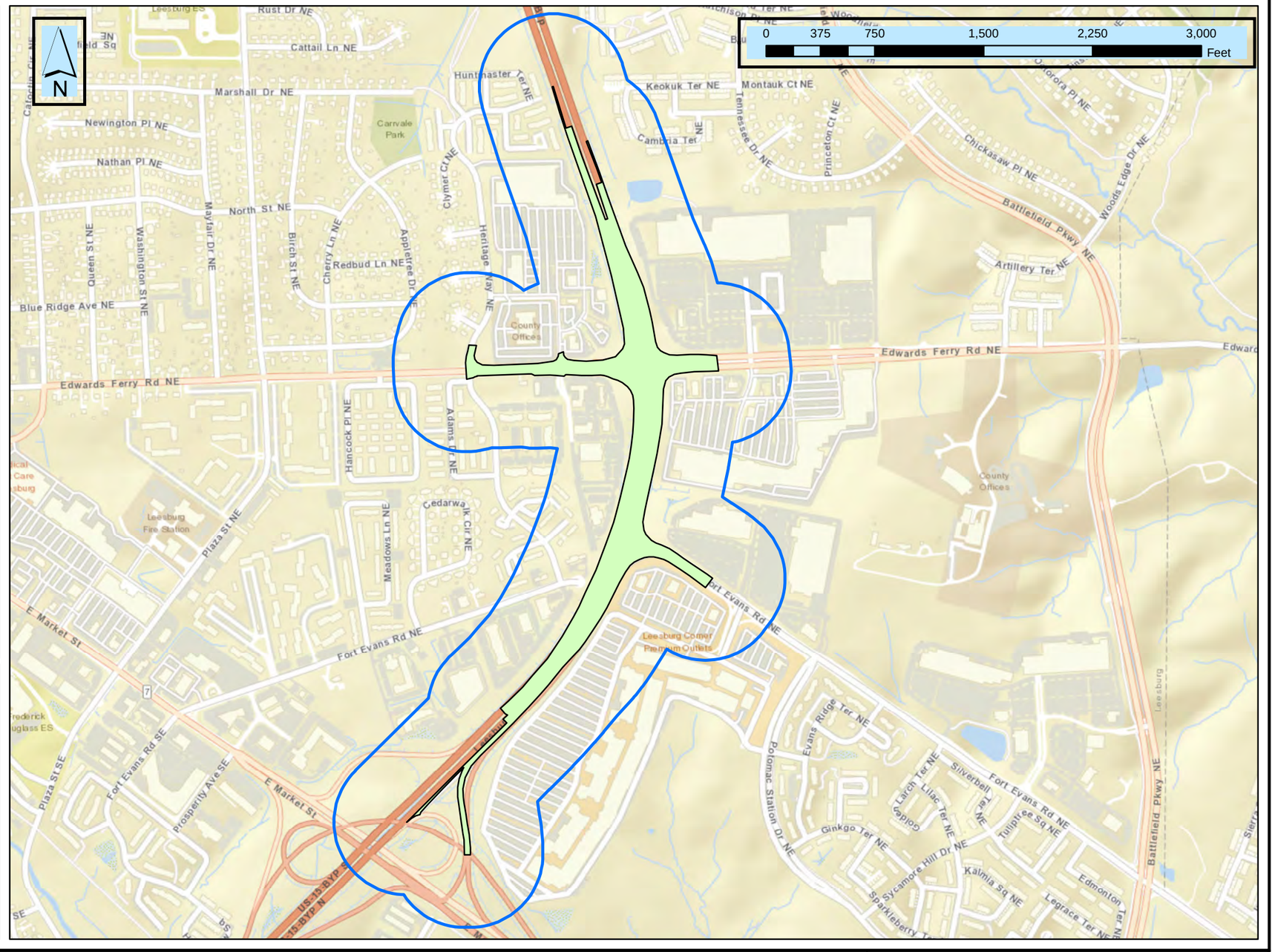
Noise abatement measures were evaluated where future noise impacts were predicted to occur. One barrier was evaluated as part of the preliminary noise analysis. The barrier was found to be both feasible and reasonable under the VDOT's State Noise Abatement Policy. The barrier extends 953 feet along the eastbound lane of Route 15. The barrier has an average height of approximately 19 feet and has a total surface area of 18,202 SF. The barrier benefits all seven impacted modeling sites representing 13 residential units. The barrier benefits an additional four non-impacted modeling sites representing eight residential units.

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.

The findings in this document are based on conceptual information. Therefore, 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 meet the established criteria and be recommended for construction. A Final Design Noise Analysis would be performed for this project based on detailed engineering information. Thus, any conclusions derived in the report should be considered preliminary in nature and subject to change.







Route 15 ByPass Intchge @ Edwards Ferry Rd & Fort Evans Rd
State Project: 0015-253-306, P101
UPC: 89890

Virginia Department of Transportation

Proposed Improvements

Noise Study Buffer (500 ft)

Project Location

Route 15 ByPass Interchange Project

Loudoun County

Figure 1
Project Location Map

2. Introduction

A preliminary noise analysis was completed which evaluated potential traffic noise impacts and abatement measures associated with the proposed Route 15 Bypass Interchange Project, in Loudoun County, Virginia. The subject project includes the construction of a grade-separated interchange on U.S. Route 15 Leesburg Bypass at Edwards Ferry Road and Fort Evans Road, replacing two signalized at-grade intersections. Pedestrian access will be provided across the bypass. The project limits extend from approximately 0.2 miles north of East Market Street to approximately 0.4 miles north of Edwards Ferry Road, for a total length of approximately 1.0 mile. The project will require right of way from adjacent property owners and will require utility relocation and easements, but no displacements are anticipated.

The purpose of the project is to provide congestion relief and reduce crash potential in an area that has experienced significant commercial growth. The need also exists for a safe pedestrian crossing, as there is a large volume of pedestrian traffic attempting to cross the bypass between the residential areas inside the bypass and the commercial development outside of the

The objective of this analysis is to assess the potential traffic noise impacts associated with the proposed roadway improvement project, and to evaluate potential noise abatement measures wherever impacts are predicted to occur.

This report documents a description of noise terminology, the applicable standards and criteria, a description of the computations of existing and future noise levels, a projection of future noise levels, identification of potential noise impacts, evaluate measures to mitigate noise impacts, noise abatement, and a discussion of construction noise.

3. Legislation and Noise Fundamentals

3.1 Regulatory Requirements

The Noise Control Act of 1972 gives the US Environmental Protection Agency (USEPA) the authority to establish noise regulations to control major noise sources, including motor vehicles and construction equipment. Furthermore, the USEPA is required to set noise emission standards for motor vehicles used for interstate commerce and the FHWA is required to enforce the USEPA noise emission standards through the Office of Motor Carrier Safety. The National Environmental Policy Act (NEPA) of 1969 gives broad authority and responsibility to Federal agencies to evaluate and mitigate adverse environmental impacts caused by Federal actions. FHWA is required to comply with NEPA including mitigating adverse highway traffic noise effects. The Federal-Aid Highway Act of 1970 mandates FHWA to develop standards for mitigating highway traffic noise. It also requires FHWA to establish traffic noise level criteria for various types of land uses. The Act prohibits FHWA approval of federal-aid highway projects unless adequate consideration has been made for noise abatement measures to comply with the standards. FHWA regulations for highway traffic noise for federal-aid highway projects are contained in 23 CFR 772. The regulations contain noise abatement criteria, which represent the maximum acceptable level of highway traffic noise for specific types of land uses. The regulations do not mandate that the abatement criteria be met in all situations, but rather require that reasonable and feasible efforts be made to provide noise mitigation when the abatement criteria are approached or exceeded.

The State Noise Abatement Policy was developed to implement the requirements of 23 Code of Federal Regulations (CFR) Part 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. This policy is applicable to Type I federal-aid highway projects.

3.2 Traffic Noise Descriptors

Noise is generally defined as unwanted or annoying sound. Airborne sound occurs by a rapid fluctuation of air pressure above and below atmospheric pressure. Sound pressure levels are usually measured and expressed in decibels (dB). The decibel scale is logarithmic and expresses 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, but rather a broad band of differing frequencies. The intensities of each frequency add to generate sound. Because the human ear does not respond to all frequencies equally, the method commonly used to quantify environmental noise consists of evaluating all of the frequencies of a sound according to a weighting system. It has been found that the A-weighted filter on a sound level meter, which includes circuits to differentially measure selected audible frequencies, 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 conglomeration of noise from distant sources, 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 hourly sound level, or Leq (h), is commonly used. Leq (h) describes a noise sensitive receptor's cumulative exposure from all noise-producing events over a one-hour period.

Because decibels are logarithmic units, sound levels cannot be added by ordinary arithmetic means. The following general relationships provide a basic understanding of sound generation and propagation:

- An increase, or decrease, of 10 dB will be perceived by a receptor to be a doubling, or halving, of the sound level
- Doubling the distance between a highway and receptor will produce a 3 dB sound level decrease
- A 3 dB sound level increase is barely detectable by the human ear

4. Impact Criteria and Methodology

4.1 Noise Abatement Criteria

The State Noise Abatement Policy has adopted the Noise Abatement Criteria (NAC) that have been established by FHWA (23 CFR 772) for determining traffic noise impacts for a variety of land uses. The NAC, listed in ***Table 1*** for various activities, represent the upper limit of acceptable traffic noise conditions and also 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 is given in terms of the hourly, A-weighted, equivalent sound level in decibels (dBA). The noise impact assessment is made using the guidelines listed in ***Table 1***. Noise-sensitive sites potentially affected by this project are classified as Category B, Category C, and Category D.

Table 1: FHWA Noise Abatement Criteria

Hourly A-Weighted Sound Level Decibels (dBA)			
Activity Category	**Activity Leq(h)**	**Evaluation Location**	**Description Of Activity Category**
A	57	Exterior	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended 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	---	Exterior	Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical) and warehousing
G	---	---	Undeveloped lands that are not permitted
Source: 23 CFR Part 772			
*: Includes undeveloped lands permitted for this activity category			

4.2 Definition of Noise Impact

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

- The predicted traffic noise levels approach or exceed the NAC, as shown in ***Table 1***. The VDOT State Noise Abatement Policy defines an approach level to be used when determining a traffic noise impact. The approach level shall be 1 dB(A) less than the NAC for Activity Categories A to E. For example, for a category B receptor, 66 dBA would be approaching 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 must be considered.

- The predicted traffic noise levels are substantially higher than the existing noise levels. The VDOT State Noise Abatement Policy defines a substantial noise increase as when predicted highway traffic noise levels exceed existing noise levels by 10 dBA or more. For example, if a receptor's existing noise level is 50 dBA, and if 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.

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 environmental benefit of the proposed abatement.

4.3 Highway Noise Computation Model

A review of the project corridor has established roadway traffic as the dominant source of noise for the build alternative. Since roadway noise can be determined accurately through computer modeling techniques for areas that are dominated by road traffic, design year traffic noise calculations have been performed using the Federal Highway Administration's Traffic Noise Model (FHWA TNM®) Version 2.5, which is the latest approved version. The FHWA TNM ® was developed and sponsored by the U. S. Department of Transportation and John A. Volpe National Transportation Systems Center, Acoustics facility. The TNM estimates vehicle noise emissions and resulting noise levels based on reference energy mean emission levels. The existing and proposed alignments (horizontal and vertical) are input into the model, along with the receptor locations, traffic volumes of cars, medium trucks (vehicles with 2 axles and 6 tires,) heavy trucks, average vehicle speeds, pavement type, and any traffic control devices. The TNM uses its acoustic algorithms to predict noise levels at the selected receptor locations by taking into account sound propagation variables such as, atmospheric absorption, divergence, intervening ground, barriers, building rows, and sometimes heavy vegetation.

4.4 Data Sources

4.4.1 Roadways and Alignments

The survey files for the existing condition that were used for the noise analysis were provided by the VDOT NOVA District. The design files for the proposed build condition scenario were provided by HNTB Corporation. A majority of the existing elevations used for the modeling efforts were taken from the VDOT survey data. However, Geographic Information Systems (GIS) data was used to augment survey data in areas not covered by VDOT survey data. The existing GIS elevation data was obtained from the project Triangulated Irregular Network (TIN) file, and from the 2005 statewide TIN files, available courtesy of the Virginia Geographic Information Network (VGIN) and the Virginia Information Technologies Agency (VITA). The TIN file is a vector based representation of the physical land surface made up of irregularly distributed points with 3D coordinates (x,y,z) that are arranged in a network of non-overlapping triangles. Elevations for the proposed future design build condition were obtained from the appropriate plan and profile design files for the project.

4.4.2 Traffic Volumes and Flow Control

Traffic data for traffic noise computations were supplied by HNTB Corporation as AM, PM and weekend peak volumes. The data consisted of operating speeds by roadway segment for the 2015 existing condition, and future design-year (2040) build and no-build conditions. Separate medium and heavy

truck percentages were provided for each roadway segment. As required by FHWA and VDOT, the noise analysis was performed for the loudest hour of the day. Noise levels have been predicted for that hour of the day when the vehicle volume, operating speed, and number of trucks (vehicles with 3 or more axles) combine to produce the worst noise conditions. According to 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. Upon the completion of the loudest hour analysis, the loudest was shown to occur at different times depending on the area of the project corridor. For the noise sensitive sites north of Edwards Ferry Road, the AM peak hour was shown to represent the loudest conditions. For the noise sensitive sites south of the Edwards Ferry Road, the weekend peak hour was shown to be the loudest hour. Both the posted speeds and operating speeds were used in the noise analysis depending on which of the two was shown to be higher per the roadway segment. The traffic volumes that were used for this study are located in ***Appendix B***.

4.4.3 Receptors

A total of 126 noise sensitive sites representing 188 residences, five commercial facilities, one pool, one hotel patio, one school and its associated playground area, and one church and its associated playground area were evaluated. The corridor also consists of several commercial facilities with no apparent outdoor use. These facilities were not included as part of the noise analysis. The location of all the receptors modeled in the TNM can be found in ***Appendix A.*** Receptor locations were identified based on aerial photo review and site verification during a site visit. A default height of five feet above the base ground elevation was used to represent all first floor sites. A height of 12 foot above ground was used for the second floor receptors. Specific receptor placement in the model is generally based on exterior areas where there is frequent human use.

4.4.4 Terrain Lines

Terrain lines were used in the model to represent important and intervening terrain features associated with the proposed project, such as drainage ditches, roadway centerlines, and general changes in elevation. The elevation data for the terrain lines was based on the project's TIN file.

4.4.5 Barriers

The project corridor currently consists of an existing noise barrier. The barrier is located on the north bound lanes of Route 15, just north of the Walmart Supercenter in CNE F. The barrier was designed to provide noise mitigation for the residential homes at the Huntmaster Terrace NE. The parameters for the existing data were obtained from survey file, which was provided by VDOT's Survey Section.

5. Existing Noise Environment

To assess existing noise conditions within the project study area, short term noise monitoring was conducted. During the noise monitoring, a windshield survey of noise-sensitive land uses and identification of major sources of acoustical shielding was conducted to supplement the mapping provided.

Noise monitoring was conducted in the vicinity of noise-sensitive land uses near the proposed project alignment. The noise monitoring characterized existing noise levels in the study area but were not necessarily conducted during the loudest hour of the day. The monitoring data can be used as the baseline

against which probable future noise levels are compared and potential impacts assessed. A validation exercise was carried out to evaluate the accuracy of the noise prediction model, and is presented in ***Section 5.2***, along with additional information about the computation methods.

5.1 Short Term Noise Monitoring

The purpose of noise monitoring is to gather data that is used to develop a comparison between the monitored results and the output obtained from the noise prediction model. This exercise is performed to validate the model so that it can be used with confidence to determine the worst hour noise levels, and predict the future noise levels.

Short-term noise measurements of 15 minutes duration were obtained at three sites on August 9, 2017, within the project corridor. These short-term measurements were collected using a Larson Davis System 824 Type I (precision) noise meter. Prior to noise monitoring, the noise meter was calibrated to 114 dB using CAL200 precision acoustic calibrator. Readings were in the A-weighted scale and were reported in decibels (dBA). The data collection procedure involved the Leq measurements in consecutive 1-second interval. This method allows individual time intervals that include noise events unrelated to traffic noise (such as aircraft over flights) to be excluded from consideration. Data collected by the noise meter included time, average noise level (Leq), maximum noise level (Lmax), and instantaneous peak noise level (Lpk) for each interval. Hourly average noise levels (Leq (h)) were derived at each location from the 15 minute Leq values. Existing noise measurements were collected under meteorologically acceptable conditions when the pavement was dry and winds were calm or light. Additional data collected at each monitoring location included atmospheric conditions such as wind speed, humidity, and ambient temperature. Measurements were conducted based on the acceptable collection of existing noise level readings according to the FHWA Report, FHWA-PD-96-046, "Measurement of Highway Related Noise."

A summary of the short-term noise monitoring results are presented in ***Table 2***. For each site, the table lists the assigned site number, the location and a description of the associated land use for each site, the monitored sound level, and the dominant sources of noise at each site. Fifteen minute traffic data (vehicle volume composition and speed) were also recorded on roadways which were visible from the monitoring site and significantly contributed to the overall noise level. Traffic was grouped into one of the three categories: automobiles, medium trucks and heavy trucks, per VDOT procedure. The 15-minute traffic data was converted to one hour traffic data for validation of the noise model.

The location of each noise monitoring site in relation to the project roadway is depicted on the graphics in Appendix A. The field data sheets are presented in ***Appendix C***. The monitored Leq in the study corridor ranged from 54.2 dBA to 59.7 dBA. Traffic noise from Route 15 was the dominant source of noise within the study area.

Table 2: Short-term Noise Monitoring Summary

Site	Location	Land-use Description	Dominant Sources of Noise	Leq (dBA)
M1	Behind the existing noise barrier at the residences at Huntmaster Terrace NE	Residence	Route 15	54.2
M2	End of Keokuk Terrace Lane	Residence	Route15	58.5
M3	End of Cul-de-sac @ Fort Evans Road NE	N/A	Route 15	59.7

NOTE: 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.

5.2 Noise Model Validation

The modeling process began with model validation, as per VDOT requirements. This was accomplished by comparing the monitored noise levels and the noise levels generated by the computer model, using traffic volumes and speeds that were encountered during the monitoring process. This validation ensures that reported changes between the existing and future design-year conditions are due to changes in traffic, and not discrepancies between monitoring and modeling techniques. A difference of ±3 dBA or less between the monitored and modeled levels is considered acceptable, since this is the limit of change detectable by a typical human ear.

The model validation was performed for the existing traffic conditions. However, since no 24-hour monitoring was performed to obtain the existing loudest hour, the existing noise levels obtained during the 15 minute monitoring sessions were not reported as the project's existing noise levels. Instead, existing worst case hour noise levels obtained from TNM after model validation were used as the existing noise levels for the project area.

A summary of the model validation is provided in ***Table 3***. As shown, for the validated sites, the difference between the modeled and monitored noise levels ranges from 0.2 to 2.3 dBA. The predicted levels that were modeled in the TNM differ from the recorded levels due to several factors: The complex intervening terrain features within the project area can be difficult to accurately capture, the precision of the supplemental input elevation data, and environmental factors such as wind, temperature, relative humidity, cloud cover, or atmospheric pressure. Site M1 was not validated because there were no traffic counts that were done at this site. Route 15 is blocked by an existing noise barrier at this location, which made it challenging to count traffic during the validation exercise.

Table 3: Noise Model Validation

Site	Monitored Noise Level (dBA)	Predicted Noise Level (dBA)	Difference (Predicted – Monitored) (dB)
M1	54.2	N/A	N/A
M2	58.5	60.8	2.3
M3	59.7	59.9	0.2

5.3 Undeveloped Lands and Permitted Developments

Highway traffic noise analyses 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.

Upon coordinating with the County, it was confirmed there were no permitted lands within the project corridor.

5.4 Modeled Existing Environment

For reporting purposes, the project area was divided into areas of Common Noise Environments (CNEs). CNEs are defined as a group of receptors within the same Activity Category ***(Table 1)*** that are exposed to similar noise sources and levels; traffic volumes, traffic mix, and speed; and topographic features. In accordance with VDOT guidance, noise sensitive receptors within 500 feet of the construction limits are considered as part of the evaluation.

All residential noise sensitive sites were modeled under NAC B. The playground areas and the indoor noise levels were modeled under NAC C and NAC D respectively. The commercial facilities were modeled under NAC E.

No noise sensitive sites are predicted to be impacted by traffic noise under the existing condition due to levels approaching or exceeding the NAC. For all studied sites, the existing year exterior noise levels range from 34 to 63 dBA. A description of the CNEs is provided below. The figures in Appendix A depict the location of the CNE's described below. Appendix A contains graphics with all of the modeled receptor locations by CNE.

CNE A – Southwest Quadrant of Route 15/Route 7 InterchangeCNE A is located in the southwest quadrant of Route 15/Route 7 interchange. CNE A consists of one receptor (site A1), which represents the outdoor use at the Hampton Inn and Suites.

Existing noise levels within CNE A are predicted to be 59 dBA. The site is not predicted to be impacted by traffic noise under the existing (2015) condition.

CNE B – West of Route 15, South of Edwards Ferry Road

CNE B is located west of Route 15, north of Fort Evans Road NE. CNE B consists of 19 sites representing 40 residential homes (B1-B16) and one school, the Montessori School. The school is represented by one site (B19) and two sites representing an outdoor playground (B17-18).

Site B19 was used to evaluate the interior noise levels at the Montessori School. Indoor noise levels at the school were evaluated under Activity Category D in Table 1 (FHWA Noise Abatement Criteria). The existing (2015) condition noise level for the exterior is predicted to be 66 dBA. Since the exterior for the school building is composed of masonry material and modern air conditioning is installed, the reduction in noise levels in the interior as a result of the building is predicted to be 25 dBA (FHWA "Highway Traffic Noise Analysis and Abatement Policy and Guidance," December 2011). Therefore the indoor noise level for the school is not predicted to experience noise impact (Under Activity Category D indoor NAC) in the existing condition.

Existing noise levels within CNE B are predicted to range from 53 to 60 dBA. None of these sites are predicted to be impacted by traffic noise under the existing (2015) condition.

CNE C – Bob Evans and Panera Bread Restaurants

CNE C is located at the southeast corner of the Route 15/Fort Evans Road NE intersection. CNE C consists of 2 sites (C1 and 2) representing 2 outdoor dining areas for Bob Evans and Panera restaurants.

Existing noise levels within CNE C are predicted to range from 53 to 61 dBA. None of the sites are predicted to be impacted by traffic noise under the existing (2015) condition.

CNE D – Chipotle Restaurant

CNE D is located at the southeast corner of the Route 15/Edwards Ferry Road NE intersection. CNE D consists of one site (D1), representing one outdoor dining area for Chipotle Restaurant.

Existing noise levels within CNE D are predicted to be 62 dBA. The site is not predicted to be impacted by traffic noise under the existing (2015) condition.

CNE E – Burger King and Leesburg Public House Restaurants

CNE E is located northwest of the Route 15/Edwards Ferry Road NE intersection. CNE E consists of 2 sites (E1 and E2), representing outdoor dining for Burger King and Leesburg Public House Restaurant.

Existing noise levels within CNE E are predicted to range from 55 to 56 dBA. None of the sites are predicted to be impacted by traffic noise under the existing (2015) condition.

CNE F – Foxchase at Exeter Condominiums

CNE F is located west of Route 15, north of Edwards Ferry Road NE. CNE F consists of 20sites (F1-F20), representing 40 residential homes.

Existing noise levels within CNE F are predicted to range from 42 to 58 dBA. None of the sites are predicted to be impacted by traffic noise under the existing (2015) condition.

CNE G – Edwards Landing Townhomes
CNE G is located east of Route 15, north of Edwards Ferry Road NE. CNE G consists of 21 sites (G1-G19), representing 39 residential homes.

Existing noise levels within CNE G are predicted to range from 34 to 63 dBA. None of the sites are predicted to be impacted by traffic noise under the existing (2015) condition.

Noise levels for some of the sites are in the thirty decibel range due to the shielding from the surrounding structures. The reported noise levels may be actually lower than what is actually experienced in the CNE due to ambient noise.

The noise receptors within the CNE were placed on the decks for the respective homes. The majority of the decks are elevated on the second floor. A height of 12 foot above ground was used for these decks.

CNE H – Heritage Square Condominiums
CNE H is located south of Edwards Ferry Road, just west of Heritage Way NE. CNE H consists of 11 (H1-H11) sites, representing 22 residential homes

Existing noise levels within CNE H are predicted to range from 48 to 58 dBA. None of the sites are predicted to be impacted by traffic noise under the existing (2015) condition.

CNE I – The Glen Apartments and one single residents
CNE I is located south of Edwards Ferry Road, just east of Heritage Way NE. CNE I consists of 15 sites (I1-I15) representing one single family home, 39 residential units at the Glen Apartments, and one swimming pool located at the same apartments. The residential units at the apartment have three levels - first, second, and third story. Each of the levels were modeled to obtain noise levels associated with the balconies for the respective floors.

Between the Glen Apartments and Edwards Ferry Road, there is an open area which doesn't have apparent outdoor use. Because of this, the area was not included in the noise analysis.

Existing noise levels within CNE I are predicted to range from 43 to 60 dBA. None of the sites are predicted to be impacted by traffic noise under the existing (2015) condition.

CNE J – Residential Homes North of Edwards Ferry Road
CNE J is located north of Edwards Ferry Road, just west of Heritage Way NE. CNE J consists of eight sites (J1-J8) representing seven single family homes, one playground at the Cross Roads Baptist Church, and one site representing the indoor noise levels at that same church.

Site J1 was used to evaluate the interior noise levels at the church. Indoor noise levels at the church were evaluated under Activity Category D in Table 1 (FHWA Noise Abatement Criteria). The existing (2015) condition noise level for the exterior is predicted to be 55 dBA. Since the exterior for the church building is composed of masonry material and modern air conditioning is installed, the reduction in noise levels in the interior as a result of the building is predicted to be 25 dBA (FHWA "Highway Traffic Noise Analysis and Abatement Policy and Guidance," December 2011). Therefore the indoor noise level for the church is not predicted to experience noise impact (Under Activity Category D indoor NAC) in the existing condition.

Existing noise levels within CNE J are predicted to range from 47 to 50 dBA. None of the sites are predicted to be impacted by traffic noise under the existing (2015) condition.

6. Future Noise Environment

Noise levels in the study area were predicted for the future design year build (2040) condition and the using the TNM. An analysis of future design year no-build (2040) noise levels is not required for this traffic noise study since the project is not related to the interstate, nor is there section 4(f) constructive use, as stated in the VDOT State Noise Abatement Policy.

Assessment of traffic noise impact requires these comparisons:

(1) The noise levels under design year build conditions must be compared to the applicable NAC. This comparison determines if the impact criteria has been met under future build conditions and can be used to assist in noise compatible land use planning.

Noise impacts are predicted under the future design year build condition (2040) due to noise levels approaching or exceeding the NAC. Calculated noise levels for all noise sensitive sites and conditions are listed in ***Table 4***.

6.1 Build Alternative

A total of seven sites (G4-G10) representing 13 residential units, are predicted to be impacted by traffic noise under the future design year (2040) build condition, due to levels approaching or exceeding the Noise Abatement Criteria (NAC). For all studied sites, the future design year (2040) build noise levels range from 36 to 67 dBA.

CNE A – Southwest Quadrant of Route 15/Route 7 Interchange
Future design year build noise levels within CNE A are predicted to be 61 dBA. No sites are predicted to be impacted by traffic noise under the future design year build (2040) condition.

CNE B – West of Route 15, South of Edwards Ferry Road
Future design year build noise levels within CNE B are predicted to range from 56 to 61 dBA. No sites are predicted to be impacted by traffic noise under the future design year build (2040) condition.

There is a drop in the noise levels at site B19 between the existing condition and the future build condition. The decrease in noise levels is due to the proposed elevated Bypass, which increases the distance between the noise source and the receiver. B19 is the only site experiencing this trend in the CNE since it is closest to the proposed edge of pavement.

CNE C – Bob Evans and Panera Bread Restaurants.
Future design year build noise levels within CNE C are predicted to range from 53 to 61 dBA. No sites are predicted to be impacted by traffic noise under the future design year build (2040) condition.

CNE D – Chipotle Restaurant
Future design year build noise levels within CNE D are predicted to be 64 dBA. No sites are predicted to be impacted by traffic noise under the future design year build (2040) condition.

CNE E – Burger King and Leesburg Public House Restaurant
Future design year build noise levels within CNE E are predicted to range from 59 to 61 dBA. No sites are predicted to be impacted by traffic noise under the future design year build (2040) condition.

CNE F – Foxchase at Exeter Condominiums
Future design year build noise levels within CNE F are predicted to range from 46 to 63 dBA. No sites are predicted to be impacted by traffic noise under the future design year build (2040) condition.

The CNE consists of an existing noise barrier. Since there are no noise impacts that were identified behind this barrier under the design year 2040; subsequently the barrier was not reevaluated for reasonableness and feasibility per the VDOT's State Noise Abatement Policy.

CNE G – Edwards Landing Townhomes
Future design year build noise levels within CNE G are predicted to range from 36 to 67 dBA. A total of seven sites (G4-G10) representing 13 residential units, are predicted to be impacted by traffic noise under the future design year (2040) build condition.

CNE H – Heritage Square Condominiums
Future design year build noise levels within CNE H are predicted to range from 50 to 60 dBA. No sites are predicted to be impacted by traffic noise under the future design year build (2040) condition.

CNE I – The Glen Apartments and one single residents
Future design year build noise levels within CNE I are predicted to range from 45 to 58 dBA. No sites are predicted to be impacted by traffic noise under the future design year build (2040) condition.

CNE J – Residential Homes North of Edwards Ferry Road
Future design year build noise levels within CNE J are predicted to range from 51 to 53 dBA. No sites are predicted to be impacted by traffic noise under the future design year build (2040) condition.

Table 4: Predicted Noise Levels

Receptor Number	NAC	Land Use	No. of Dwelling / Recreational Units*	Predicted Noise Levels (dBA)	Predicted Noise Levels (dBA)	Noise Abatement Criteria** (dBA)	Abatement Considered
				Existing Condition (2015)	Build Condition (2040)		
CNE A – Southwest Quadrant of Route 15/Route 7 Interchange							
A1	E	Hotel-Patio	1	59	61	66	No
CNE B – West of Route 15, South of Edwards Ferry Road							
B1	B	Residential	2	55	57	65	No
B2	B	Residential	2	56	57	66	No
B3	B	Residential	2	56	57	66	No
B4	B	Residential	2	57	58	66	No
B5	B	Residential	4	55	57	65	No
B6	B	Residential	3	56	57	66	No
B7	B	Residential	4	53	56	63	No

Receptor Number	NAC	Land Use	No. of Dwelling / Recreational Units*	Predicted Noise Levels (dBA)	Predicted Noise Levels (dBA)	Noise Abatement Criteria** (dBA)	Abatement Considered
				Existing Condition (2015)	Build Condition (2040)		
B8	B	Residential	3	53	56	63	No
B9	B	Residential	2	53	57	63	No
B10	B	Residential	3	54	57	64	No
B11	B	Residential	2	55	58	65	No
B12	B	Residential	2	55	58	65	No
B13	B	Residential	2	56	59	66	No
B14	B	Residential	2	57	60	66	No
B15	B	Residential	3	57	59	66	No
B16	B	Residential	2	56	58	66	No
B17	C	School-Recreational	1	57	59	66	No
B18	C	School-Recreational	1	60	61	66	No
B19	D	School-Interior	1	66	64	(51)	No
				(41)	(39)		
CNE C – Bob Evans and Panera Bread Restaurants.							
C1	E	Commercial-Outdoor Sitting Area	1	61	61	66	No
C2	E	Commercial-Outdoor Sitting Area	1	53	53	63	No
CNE D – Chipotle Restaurant							
D1	E	Commercial-Outdoor Sitting	1	62	64	66	No
CNE E – Burger King and Leesburg Public House Restaurants							
E1	E	Commercial-Outdoor Sitting	1	55	59	65	No
E2	E	Commercial-Outdoor Sitting	1	56	60	66	No
CNE F – Foxchase at Exeter Condominiums							
F1	B	Residential	2	57	59	66	No
F2	B	Residential	2	55	58	65	No

Receptor Number	NAC	Land Use	No. of Dwelling / Recreational Units*	Predicted Noise Levels (dBA)	Predicted Noise Levels (dBA)	Noise Abatement Criteria** (dBA)	Abatement Considered
				Existing Condition (2015)	Build Condition (2040)		
F3	B	Residential	2	55	58	65	No
F4	B	Residential	2	50	54	60	No
F5	B	Residential	2	45	48	55	No
F6	B	Residential	2	42	46	52	No
F7	B	Residential	2	42	46	52	No
F8	B	Residential	2	46	49	56	No
F9	B	Residential	2	54	58	64	No
F10	B	Residential	2	54	58	64	No
F11	B	Residential	2	55	59	65	No
F12	B	Residential	2	58	63	66	No
F13	B	Residential	2	51	55	61	No
F14	B	Residential	2	52	56	62	No
F15	B	Residential	2	50	54	60	No
F16	B	Residential	2	51	54	61	No
F17	B	Residential	2	46	51	56	No
F18	B	Residential	2	49	53	59	No
F19	B	Residential	2	50	53	60	No
F20	B	Residential	2	50	54	60	No
CNE G – Edwards Landing Townhomes							
G1	B	Residential	1	54	57	64	No
G2	B	Residential	2	54	57	64	No
G3	B	Residential	2	58	61	66	No
G4	B	Residential	2	63	67	66	Yes
G5	B	Residential	2	63	67	66	Yes
G6	B	Residential	2	63	67	66	Yes
G7	B	Residential	1	63	67	66	Yes
G8	B	Residential	2	63	67	66	Yes
G9	B	Residential	2	62	66	66	Yes

Receptor Number	NAC	Land Use	No. of Dwelling / Recreational Units*	Predicted Noise Levels (dBA)	Predicted Noise Levels (dBA)	Noise Abatement Criteria** (dBA)	Abatement Considered
				Existing Condition (2015)	Build Condition (2040)		
G10	B	Residential	2	62	66	66	Yes
G11	B	Residential	2	52	54	62	No
G12	B	Residential	2	34	36	44	No
G13	B	Residential	2	34	36	44	No
G14	B	Residential	2	45	50	55	No
G15	B	Residential	2	61	65	66	No
G16	B	Residential	2	55	60	65	No
G17	B	Residential	2	53	58	63	No
G18	B	Residential	2	59	65	66	No
G19	B	Residential	2	59	64	66	No
G20	B	Residential	2	58	63	66	No
G21	B	Residential	1	56	62	66	No
CNE H – Heritage Square Condominiums							
H1	B	Residential	2	56	58	66	No
H2	B	Residential	2	52	54	62	No
H3	B	Residential	2	49	52	59	No
H4	B	Residential	2	48	50	58	No
H5	B	Residential	2	58	60	66	No
H6	B	Residential	2	53	55	63	No
H7	B	Residential	2	49	51	59	No
H8	B	Residential	2	49	51	59	No
H9	B	Residential	2	50	53	60	No
H10	B	Residential	2	48	51	58	No
H11	B	Residential	2	57	60	66	No
CNE I – The Glen Apartments and one single residents							
I1-1st	B	Residential	1	52	55	62	No
I1-2nd	B	Residential	1	55	57	65	No
I1-3rd	B	Residential	1	56	58	66	No

Receptor Number	NAC	Land Use	No. of Dwelling / Recreational Units*	Predicted Noise Levels (dBA)	Predicted Noise Levels (dBA)	Noise Abatement Criteria** (dBA)	Abatement Considered
				Existing Condition (2015)	Build Condition (2040)		
I2-1st	B	Residential	1	51	54	61	No
I2-2nd	B	Residential	1	54	56	64	No
I2-3rd	B	Residential	1	55	57	65	No
I3-1st	B	Residential	1	51	54	61	No
I3-2nd	B	Residential	1	53	56	63	No
I3-3rd	B	Residential	1	54	56	64	No
I4-1st	B	Residential	1	50	53	60	No
I4-2nd	B	Residential	1	52	55	62	No
I4-3rd	B	Residential	1	54	56	64	No
I5-1st	B	Residential	1	49	52	59	No
I5-2nd	B	Residential	1	51	53	61	No
I5-3rd	B	Residential	1	56	54	66	No
I6-1st	B	Residential	1	46	50	56	No
I6-2nd	B	Residential	1	49	51	59	No
I6-3rd	B	Residential	1	52	52	62	No
I7-1st	B	Residential	1	44	47	54	No
I7-2nd	B	Residential	1	47	48	57	No
I7-3rd	B	Residential	1	49	49	59	No
I8-1st	B	Residential	1	44	47	54	No
I8-2nd	B	Residential	1	47	48	57	No
I8-3rd	B	Residential	1	49	50	59	No
I9-1st	B	Residential	1	53	57	63	No
I9-2nd	B	Residential	1	56	57	66	No
I9-3rd	B	Residential	1	59	58	66	No
I10-1st	B	Residential	1	53	57	63	No
I10-2nd	B	Residential	1	56	57	66	No
I10-3rd	B	Residential	1	60	58	66	No
I11-1st	B	Residential	1	49	53	59	No

Receptor Number	NAC	Land Use	No. of Dwelling / Recreational Units*	Predicted Noise Levels (dBA)	Predicted Noise Levels (dBA)	Noise Abatement Criteria** (dBA)	Abatement Considered
				Existing Condition (2015)	Build Condition (2040)		
I11-2nd	B	Residential	1	52	53	62	No
I11-3rd	B	Residential	1	54	55	64	No
I12-1st	B	Residential	1	48	52	58	No
I12-2nd	B	Residential	1	50	53	60	No
I12-3rd	B	Residential	1	52	54	62	No
I13-1st	B	Residential	1	43	45	53	No
I13-2nd	B	Residential	1	44	46	54	No
I13-3rd	B	Residential	1	46	48	56	No
I14	C	Pool	1	47	50	57	No
I15	B	Residential	1	51	54	61	No
CNE J – Residential Homes North of Edwards Ferry Road							
J1	D	Church-Interior	1	55	57	(51)	No
				(30)	(32)		
J2	C	Church Playground	1	50	52	60	No
J3	B	Residential	2	50	53	60	No
J4	B	Residential	1	48	53	58	No
J5	B	Residential	1	49	52	59	No
J6	B	Residential	1	47	51	57	No
J7	B	Residential	1	48	52	58	No
J8	B	Residential	1	48	52	58	No
(#)	Represents Interior Noise Levels						
*	Dwelling Units may refer to residential and/or recreational units						
**	Criteria based on NAC or substantial increase, whichever is lower						
	Indicates noise impact (NAC Only)						

7. Noise Abatement

Noise Abatement Determination is a three-phased approach. The first phase of the process is to determine if highway traffic noise abatement consideration is warranted for the affected communities and/or affected receptors. The warranted criterion specifically pertains to traffic noise impacted receptors, defined back in ***Section 4.2***. Since predicted noise levels for the future design year build (2040) condition either approach or exceed the NAC, per VDOT's State Noise Abatement Policy, noise abatement considerations are warranted for these impacted noise sensitive areas. Satisfying the warranted criterion is the considered to be the first phase ***(Phase 1)*** of the three-phased noise abatement criteria. ***Phases 2 and 3*** of the noise abatement criteria to considering noise abatement measures for determining feasibility and reasonableness are discussed in ***Sections 7.2 and 7.3.*** Following the completion of all three phases, a determination can be made related to the feasibility and reasonableness of the noise abatement options.

7.1 Abatement Measures Evaluation

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 which have the potential to provide considerable noise reductions, under certain circumstances. Mitigation measures considered for this project include:

- Traffic Control Measures
- Alteration of Horizontal and Vertical Alignments
- Acoustical Insulation of Public-Use and Non-Profit Facilities
- Acquisition of Buffer Land
- Construction of Earth Berms;
- Construction of Noise Barriers;

Traffic Control Measures (TCM): Traffic control measures, such as speed limit restrictions, truck traffic restrictions, and other traffic control measures that may be considered for the reduction of noise emission levels are not practical for this project. Reducing speeds will not be an effective noise mitigation measure since a substantial decrease in speed is necessary to provide adequate noise reduction. Typically, a 10 mph reduction in speed will result in only a 2 dBA decrease in noise level, which would not eliminate all impacts.

Alteration of Horizontal and Vertical Alignments:
The horizontal alignment for US Route 15 was developed with the intent of limiting right-of-way impacts to parcels abutting the roadway. The project area is heavily urbanized with both residential and commercial land uses. The current proposed design was developed through analysis of alternatives and in close coordination with the Town of Leesburg, which owns and maintains US Route 15 within the project limits. The proposed design achieves project objectives while minimizing impacts and capital costs. Sensitive receptors are located on both sides of the US Route 15 right-of-way. There is little flexibility in the location of the US Route 15 alignment due to right-of-way constraints and the need to stage construction activities while maintaining sufficient roadway capacity to accommodate traffic demand. The typical section for US Route 15 incorporates a narrow median that maximizes separation between through traffic lanes and sensitive receptors.

The vertical alignment for US Route 15 was designed to minimize earthwork, construction cost, and right-of-way impacts. The proposed design replaces at-grade signalized intersections along US Route 15 at Edwards Ferry Road and Fort Evans Road with grade-separations, with US Route 15 carried over the local roads. The preferred alternative was identified based on an analysis of multiple alternatives and in close coordination with the Town of Leesburg. A grade-separation of US Route 15 under the local roads was considered, but was not selected as the preferred alternative due to the cost associated with earthwork and retaining walls, utility relocations, and the need to pump stormwater to the receiving watercourse.

Acoustical Insulation of Public-Use and Non-Profit Facilities: This noise abatement measure option applies only to public and institutional use buildings. Since no public use or institutional structures are anticipated to have interior noise levels exceeding FHWA's interior NAC, this noise abatement option will not be applied.

Acquisition of Buffering Land: The purchase of property for noise barrier construction or 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 (*e.g.*, in terms of residential displacements), which were determined to outweigh the benefits of land acquisition.

Construction of Berms / Noise Barriers: Construction of noise barriers can be an effective way to reduce noise levels at areas of outdoor activity. Noise barriers can be wall structures, earthen berms, or a combination of the two. The effectiveness of a noise barrier depends on the distance and elevation difference between roadway and receptor and the available placement location for a barrier. Gaps between overlapping noise barriers also decrease the effectiveness of the barrier, as opposed to a single connected barrier. The barrier's ability to attenuate noise decreases as the gap width increases.

Noise walls and earth berms are often implemented into the highway design in response to the identified noise impacts. The effectiveness of a freestanding (post and panel) noise barrier and an earth berm of equivalent height are relatively consistent; however an earth berm is perceived as a more aesthetically pleasing option. The use of earth berms is not always an option due to the excessive space they require adjacent to the roadway corridor. At a standard slope of 2:1, every one-foot in height would require four feet of horizontal width. This requirement becomes more complex in urban settings where residential properties often abut the proposed roadway corridor. In these situations, implementation of earth berms can require significant property acquisitions to accommodate noise mitigation. The cost associated with the acquisition of property to construct a berm can significantly increase the total costs to implement this form of noise mitigation.

Availability of fill material to construct the berm also needs to be considered. On proposed projects where proposed grading yields excess waste material, earth berms are often cost effective mitigation options. On balance or borrow projects the implementation of earth berms is often an expensive solution due to the need to identify, acquire, and transport the material to the project site. Berms were not considered for this project.

As a general practice, noise barriers are most effective when placed at a relatively high point between the roadway and the impacted noise sensitive land use. To achieve the greatest benefit from a potential noise barrier, the goal of the barrier should focus on breaking the line-of-sight (to the greatest degree possible) from the roadway to the receptor. 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.

The effectiveness of a noise barrier is measured by examining the barrier's capability to reduce future noise levels. Noise reduction is measured by comparing design year pre- and post-barrier noise levels. This difference between unabated and abated noise levels is known as insertion loss (IL). The following discussion presents potential mitigation measures for each of the impacted noise sensitive land uses.

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 will be given to these measures during the final design stage, where feasible. The response from project management is included in ***Appendix D.***

According to VDOT guidelines, potential mitigation measures for warranted receptors must also be assessed for feasibility and reasonableness.

7.2 Feasibility Criterion for Noise Barriers

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.

- Noise barriers must reduce design year noise levels by 5 dBA (or more) for fifty percent (50%) (or more) of impacted receptors;
- The determination that it is possible to design and construct the noise abatement measure, based on factors such as safety, barrier height, topography, drainage, utilities, maintenance access, and general access to adjacent properties.

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

7.3 Reasonableness Criterion for Noise Barriers

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.

- **The Viewpoints of the 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.

- **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.

For non-residential properties such as parks and public use facilities, a special calculation is performed in order to quantify the 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.

- **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 a 7 dB(A) of insertion loss for at least one impacted receptor. 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 dB(A) reduction is required to meet the feasibility criteria, the following tiered noise barrier abatement goals should be used to govern barrier design and optimization.

- Reduction of future highway traffic noise by 7 dB(A) 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).

7.4 Noise Abatement Summary

A total of seven sites (G4-G10) representing 13 residential units, are predicted to be impacted by traffic noise under the future design year (2040) build condition, due to levels approaching or exceeding the NAC. One noise barrier was evaluated for areas predicted to be impacted by traffic noise under the future design year (2040) build condition. A barrier unit cost of $42/ Square Feet (SF) was used to calculate the noise barrier's cost. However, this cost only accounts for material and installation costs, and does not include any other additional costs that may be associated with the noise barrier such as utility relocation. The barrier locations are shown on the graphics located in Appendix A. A barrier summary table of the evaluated barriers is shown in ***Table 5***. Details of the insertion losses associated with these evaluated barriers are listed in ***Table 6***. Warranted, Feasible, and Reasonable Worksheets were completed for the evaluated barriers and are included in Appendix E.

Barrier 1

Barrier 1 is located within CNE G and extends along the Route 15 eastbound lane. The barrier is designed to benefit the impacted sites G4-G10. The barrier has a total length would be 953 feet. The barrier has height range of 17.2 to 22.16 feet,has an average height of 19.2 feet, and has a total surface area of 18,202 SF. The barrier provides a noise reduction of 5-10 dBA. The barrier would benefit all

seven impacted sites (G4-G10), representing 13 residential units. The barrier benefits an additional four non-impacted sites (G3, G15,G16 and G18), representing eight residential units. The barrier is considered feasible since it provides at least 5 dBA of noise reduction to 100% (greater than 50%) of the impacted sites. The barrier is also considered reasonable since it results in a ratio of 867 Square Foot per Benefitted Receptor (SF/BR). This barrier meets the 7 dBA design goal since it provides noise reduction of at least 7 dBA or greater to at least one impacted site. Therefore Barrier 1 is considered feasible and reasonable in accordance with VDOT's State Noise Abatement Policy.

Table 5: Evaluated Noise Barrier Parameters

Barrier	Insertion Loss (IL)	Height (Range) (ft)	Total Length (ft)	Total Area (SF)	Benefitted	Area/Benefitted	Cost ($42/ft^2)
Barrier 1	5-14	17.20-22.16	953	18,202	21	867	$764,498

Table 6: Noise Barrier Insertion Loss

Receptor Number	No. of Dwelling / Recreational Units*	Predicted Future Design Build Noise Levels (2040 – NO Barrier)(dBA)	Predicted Future Design Build Noise Levels (2040 – with Barrier) (dBA)	Insertion Loss (IL)** (dBA)
Barrier 1 Summary				
G1	1	57	55	2
G2	2	57	55	2
G3	2	61	56	5
G4	2	67	59	8
G5	2	67	59	8
G6	2	67	58	9
G7	1	67	58	9
G8	2	67	57	10
G9	2	66	57	9
G10	2	66	57	9
G11	2	54	52	2
G12	2	36	35	1
G13	2	36	36	1
G14	2	50	46	4

Receptor Number	No. of Dwelling / Recreational Units*	Predicted Future Design Build Noise Levels (2040 – NO	Predicted Future Design Build Noise Levels (2040 – with	Insertion Loss (IL)** (dBA)
G15	2	65	56	9
G16	2	60	55	5
G17	2	58	55	3
G18	2	65	59	5
G19	2	64	60	4
G20	2	63	60	4
G21	1	62	59	3
*	Dwelling Units may refer to residential and/or recreational units			
**	Insertion Loss (IL) Sound Levels May be Different Due to Rounding			
	Indicates noise impact			
	Indicates at least a 5dB benefit			

8. Construction Noise Considerations

VDOT is also concerned with noise generated during the construction phase of the proposed project. While the degree of construction noise impact will vary, as 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 considered to be 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.

The specifications have been reproduced below:

- The Contractor's operations shall be performed so that exterior noise levels measured during a noise-sensitive activity shall not exceed 80 decibels. Such noise level measurements shall be taken at a point on the perimeter of the construction limit that is closest to the adjoining property on which a noise-sensitive activity is occurring. A noise sensitive activity is any activity for which lowered noise levels are essential if the activity is to serve its intended purpose and not present an unreasonable public nuisance. Such activities include, but are not limited to, those associated with residences, hospitals, nursing homes, churches, schools, libraries, parks, and recreational areas.

- VDOT may monitor construction-related noise. If construction noise levels exceed 80 decibels during noise sensitive activities, the Contractor shall take corrective action before proceeding with operations. The Contractor shall be responsible for costs associated with the abatement of

construction noise and the delay of operations attributable to noncompliance with these requirements.

- VDOT may prohibit or restrict to certain portions of the project any work that produces objectionable noise between 10 PM and 6 AM. If other hours are established by local ordinance, the local ordinance shall govern.

- Equipment shall in no way be altered so as to result in noise levels that are greater than those produced by the original equipment.

- When feasible, the Contractor shall establish haul routes that direct his vehicles away from developed areas and ensure that noise from hauling operations is kept to a minimum.

- These requirements shall not be applicable if the noise produced by sources other than the Contractor's operation at the point of reception is greater than the noise from the Contractor's operation at the same point.

9. Public Involvement Process

9.1 Public Involvement Efforts

For noise barriers that are determined to be feasible and reasonable, the affected public 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 public hearing process. As part of the final design noise analysis, for barriers that are determined to be feasible and reasonable, input from the impacted property owners and renters must be obtained through citizen surveys via certified mail. Of the votes tallied, 50% or more must be in favor of a proposed noise barrier in order 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, or noise barrier survey addendum report, will be prepared after the voting process has finished, which documents the voting results and summary of public comments of the noise barrier public survey process. This report is then submitted to the FHWA.

9.2 Information for Local Government Officials

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 information on noise-compatible land-use planning, noise impact zones in undeveloped land in the highway project corridor. This section of the report provides that information, as well as information about VDOT's noise abatement program.

Noise-Compatible Land-Use Planning

Sections 12.1 and 12.2 of VDOT's 2011 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/audible_landscape/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. Any noise sensitive sites within these zones should be considered noise impacted if no barrier is present to reduce sound levels. The graphics in ***Appendix A*** show the predicted 66 dB contours for the project.

Note – As shown in Appendix A, the 66 dB contour line mostly does not extend beyond the existing noise barriers. Contours are only shown when they extend past the existing noise barriers or where there are gaps in the barriers

VDOT's Noise Abatement Program

Information on VDOT's noise abatement 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.