NOISE ANALYSIS TECHNICAL REPORT

RICHMOND HIGHWAY (ROUTE 1) CORRIDOR IMPROVEMENTS PROJECT BETWEEN JEFF TODD WAY AND NAPPER ROAD, FAIRFAX COUNTY, VIRGINIA

Prepared in support of the Draft Environmental Assessment

RICHMOND HIGHWAY
CORRIDOR IMPROVEMENTS
www.virginiadot.org/richmondhighway

VDOT Project #: 0001-029-205, C501, P101, R201

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EXECUTIVE SUMMARY

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 §772 (23 CFR 772). These regulations state that a "Type I" traffic noise analysis is required if through travel lanes or interchange ramps are added. This report details the noise analysis for the Richmond Highway Corridor Improvements Environmental Assessment in Mount Vernon, Virginia. This noise analysis was conducted in accordance with FHWA and Virginia Department of Transportation (VDOT) noise assessment regulations and guidelines, in support of the Environmental Assessment.

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 also 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.

This study details the noise impact and mitigation assessment for the Existing Conditions (2016) and for design year (2045) No-Build and Build Alternatives. The traffic data used in the noise analysis is based upon VDOT's environmental traffic data (ENTRADA) analysis program. The worst noise hour was derived through an analysis of 15 AM and PM hours, which were then narrowed to the 7 AM, 3 PM and 4 PM hours by further analysis. Traffic volumes and speeds for those hours were modeled in FHWA's Traffic Noise Model (TNM), and the 3 PM hour was determined to produce the highest noise levels.

Numerous noise sensitive land uses exist on both northbound and southbound sides of Richmond Highway in the Study Area. See **Table ES-1** for a summary of predicted worst-hour noise level ranges.

Table ES-1: Predicted Worst-Hour Noise Levels for Modeled Receptors

CNE ID[1]	Area Land Use and Description	Range of Predicted Worst-Hour L_{eq}[2] Exterior Noise Levels, dB(A)[3]		
		Existing 2016	No-Build 2045	Build 2045
01	Candlewood Suites and Hampton Inn hotels	52-64	53-65	52-65
02	Best Western hotel and Belvoir Plaza Apartments	40-58	41-60	44-60
03	Residences on Talbott Farm Drive	47-61	48-63	52-68
04	Residences on Lukens Lane	51-51	52-52	53-53
05	Residences at Terrace Towne Homes on Walutes Circle	44-57	46-58	46-58
06	Residences on Wyngate Manor Court, Washington Square Apartments	39-64	41-66	42-68
07	Residences at Ray's Mobile Colony	51-65	52-66	53-67
08	Residences on Halfe Street and Radford Avenue	50-59	52-61	53-62
09	Mount Zephyr community of residences on Sonia Court	40-61	41-62	43-66
10	Residences and daycare center on Mohawk Lane and Washington Avenue	53-69	55-71	56-72

CNE ID[1]	Area Land Use and Description	Range of Predicted Worst-Hour L_{eq}[2] Exterior Noise Levels, dB(A)[3]		
		Existing 2016	No-Build 2045	Build 2045
11	Residences on Reddick Avenue	56-59	57-60	57-60
12	Residences on Central Avenue and Mary Evelyn Way	35-60	36-61	36-63
13	Residences in Parkside at Mount Vernon community, Vernon Heights Park	41-67	43-68	43-69
14	Spring Hills Mount Vernon assisted living facility	44-47	45-49	45-46
15	Residences on Shannons Green Way and Lamberts Lane	50-52	52-54	50-53
16	Residences on Mount Vernon Highway (southbound)	53-59	54-60	54-60
17	Residences on Mount Vernon Highway (northbound)	56-62	58-64	58-64
18	Residences on Napper Road and Brown Court, Little Hunting Creek Park	54-71	56-73	53-61
19	Residences at Spring Garden Apartments	53-70	54-72	54-72
20	Residences on Avery Park Court	60-60	62-62	63-64
21	Residences at Harmony Place Trailer Park on Pace Lane	52-70	54-71	57-65
22	Residences at Stony Brook Apartments on Buckman Road	54-55	55-56	57-58
23	Residences on Rolling Hills Avenue	57-70	58-72	58-63
24	Residences, pool at the Rolling Hills Apartments, and towne home community on Roxbury Lane	44-65	45-67	46-68
25	Residences on Martha Street	50-70	51-71	53-73
26	Residences at Mount Vernon Apartments on Russell Road	49-55	50-56	50-57
27	Residences on Gregory Drive and Main Street	52-56	53-58	54-58
28	Buckman Road KinderCare facility	59	60	62
29	Residences at multi-story apartment building at Pole Road and Buckman Road	54	56	58
30	Residences at Pembrook Village condominiums on Pembrook Drive	58	59	59
31	Residences at Pinewood South condominiums on Buckman Road	48-65	49-66	50-66
32	Residences on Woodlawn Garden Apartments on Blankenship Street and Graves Street	38-66	39-68	40-69
33	Residences at Skyview Park towne home community on Sky View Drive, Hallie Rose Street and Hallie Rose Place	42-54	43-56	46-57
34	Residences at Skyview Apartments, towne homes on Towne Manor Court	42-64	44-65	44-68
35	Residences on Highland Lane and Engleside Street, including a first-row commercial undeveloped parcel	51-68	53-69	53-70
37[4]	Roy Rogers restaurant outside dining area	67	68	68
38	Pole Road Park	60	61	59

[1] *Common Noise Environment Identification Number*
[2] *Equivalent Sound Level*
[3] *A-weighted decibel*
[4] *CNE 36 was omitted from consideration because it was determined to have no noise sensitive outdoor use.*

Noise barrier analyses are warranted for all common noise environments (CNEs) with noise impacts. Noise barriers were not studied at impacted CNEs 7, 10, 24 and 25 due to excessive access constraints. Noise barriers determined to be physically feasible were evaluated at heights of 15, 20, 25 and 30 feet to assess whether they meet acoustic feasibility, design goal, and reasonableness criteria.

Potential noise barriers were determined to be feasible and reasonable at CNEs 3, 13, 19, 32 and 34. Noise barriers that are shown to be feasible and reasonable in the preliminary design may not be feasible and reasonable in final design. All noise barriers would be further evaluated in final design to determine any engineering constraints associated with constructing the noise barrier.

Table ES-2 summarizes each barrier's feasibility, acoustical design details, benefited receptors, length, height, surface area, surface area per benefited receptor, and cost-reasonableness, where applicable.

Table ES-2: Summary of Barrier Characteristics

Barrier ID	CNE ID[1]	Barrier Length	Barrier Height	Surface Area (Square Feet)	Feasible?	Meets Design Goals?	Total Benefits	Barrier Square Feet per Benefited Receptor	Reason-able? (Square Feet per Benefit <1600)
1P	03	325	15	4,875	Yes	Yes	6	813	Yes
2P	06	576	30	17,280	No[2]	n/a	n/a	n/a	n/a
3P	07	Not studied due to access limits			No	n/a	n/a	n/a	n/a
4P	09	354	30	10,620	Yes	No[3]	n/a	n/a	n/a
5P	10	Not studied due to access limits			No	n/a	n/a	n/a	n/a
6P	13	351	15	5,265	Yes	Yes	40	132	Yes
7P	19	333	25	8,325	Yes	Yes	18	463	Yes
8P	24	Not studied due to access limits			No	n/a	n/a	n/a	n/a
9P	25	Not studied due to access limits			No	n/a	n/a	n/a	n/a
10P	31	216	30	6,480	No[2]	n/a	n/a	n/a	n/a
11P	32	755	20	15,100	Yes	Yes	39	387	Yes
12P	34	249	15	3,735	Yes	Yes	13	287	Yes

[1]*Common Noise Environment Identification Number*
[2] *Less than 50% impacted residences benefited.*
[3] *No impacted residences receive at least 7 dB(A) insertion loss*

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1. INTRODUCTION

This report documents the noise analysis conducted for the existing (2016) and future (2045) noise conditions in the Richmond Highway (Route 1) Corridor Improvements Study Area to support the Environmental Assessment (EA).

1.1 NOISE STUDY OVERVIEW

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 when through travel lanes or interchange ramps are added. This report details the noise impact analysis for the Richmond Highway Corridor Improvements Environmental Assessment in Mount Vernon, Virginia. This noise analysis was conducted in accordance with FHWA and Virginia Department of Transportation (VDOT) noise assessment regulations and guidelines.

This study details the noise impact assessment for the existing (2016) conditions and for the design year (2045) No-Build and proposed Build Alternative.

This report presents a description of noise terminology, the applicable standards and criteria, an evaluation of the existing noise conditions, a description of the computations of existing and future noise levels, a projection of future noise impact, and an evaluation of potential noise abatement measures. **Appendix A** provides a list of references, **Appendix B** presents the list of preparers, **Appendix C** presents all pertinent traffic data, **Appendix D** tabulates Traffic Noise Model (TNM) predicted noise level data, **Appendix E** tabulates noise monitoring field logs, **Appendix F** presents VDOT's Warranted, Feasible and Reasonable barrier worksheets, **Appendix G** presents VDOT project management response on alternative noise abatement measures, **Appendix H** provides site sketches, meter printouts, calibration and other pertinent correspondence, **Appendix I** presents all relevant TNM certifications, and **Appendix J** presents noise receptor location.

1.2 PROJECT DESCRIPTION

The VDOT, in cooperation with the FHWA, is preparing an EA for the Richmond Highway (Route 1) Corridor Improvements Project between Jeff Todd Way and Napper Road. Improvements are proposed for an approximate 2.9-mile section of Richmond Highway between Route 235 (Mount Vernon Memorial Highway – South) to 0.07 miles north of Route 235 (Mount Vernon Highway – North) at Napper Road. The environmental Study Area extends a little further north along the Richmond Highway to Sherwood Lane (**Figure 1-1**). The EA is being prepared in accordance with the National Environmental Policy Act (NEPA), FHWA regulations at 23 Code of Federal Regulations (CFR) § 771 and Technical Advisory T 6640.8, and Council on Environmental Quality (CEQ) guidance at 40 CFR §1500 -1508.

Based on historical connections to the state capital in Richmond, Route 1 is also known as the "Richmond Highway." Richmond Highway is the principal north-south route for local traffic in eastern Fairfax County for shopping and other general-purpose trips, and serves as a major commuter route and an alternate north-south route for nearby Interstate 95 (I-95). The section of Richmond Highway evaluated in this EA is in the southeast portion of Fairfax County between Hybla Valley to the north and Fort Belvoir to the south. Richmond Highway on either side of the Study Area has six general purpose

Figure 1-1: Project Location Map

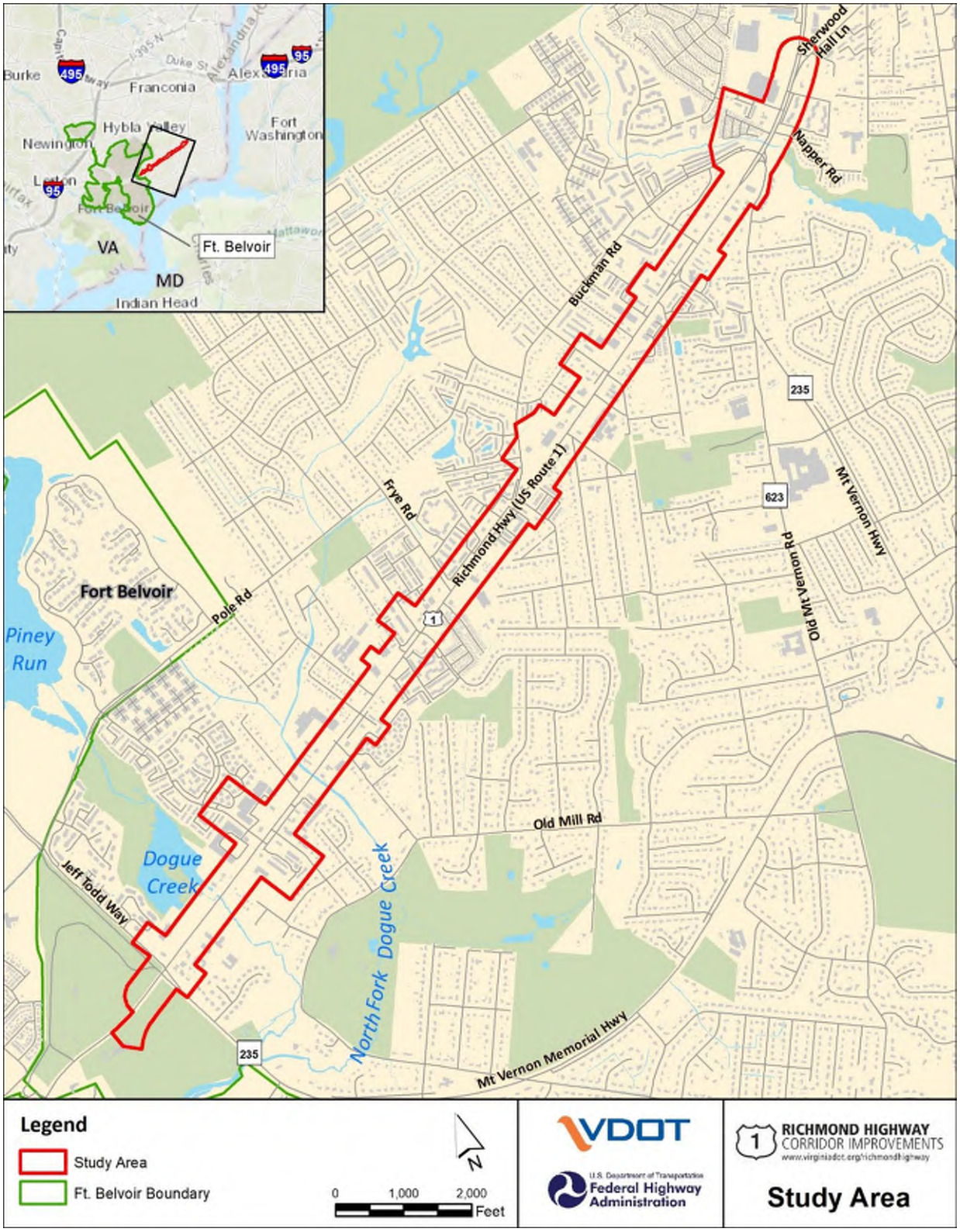
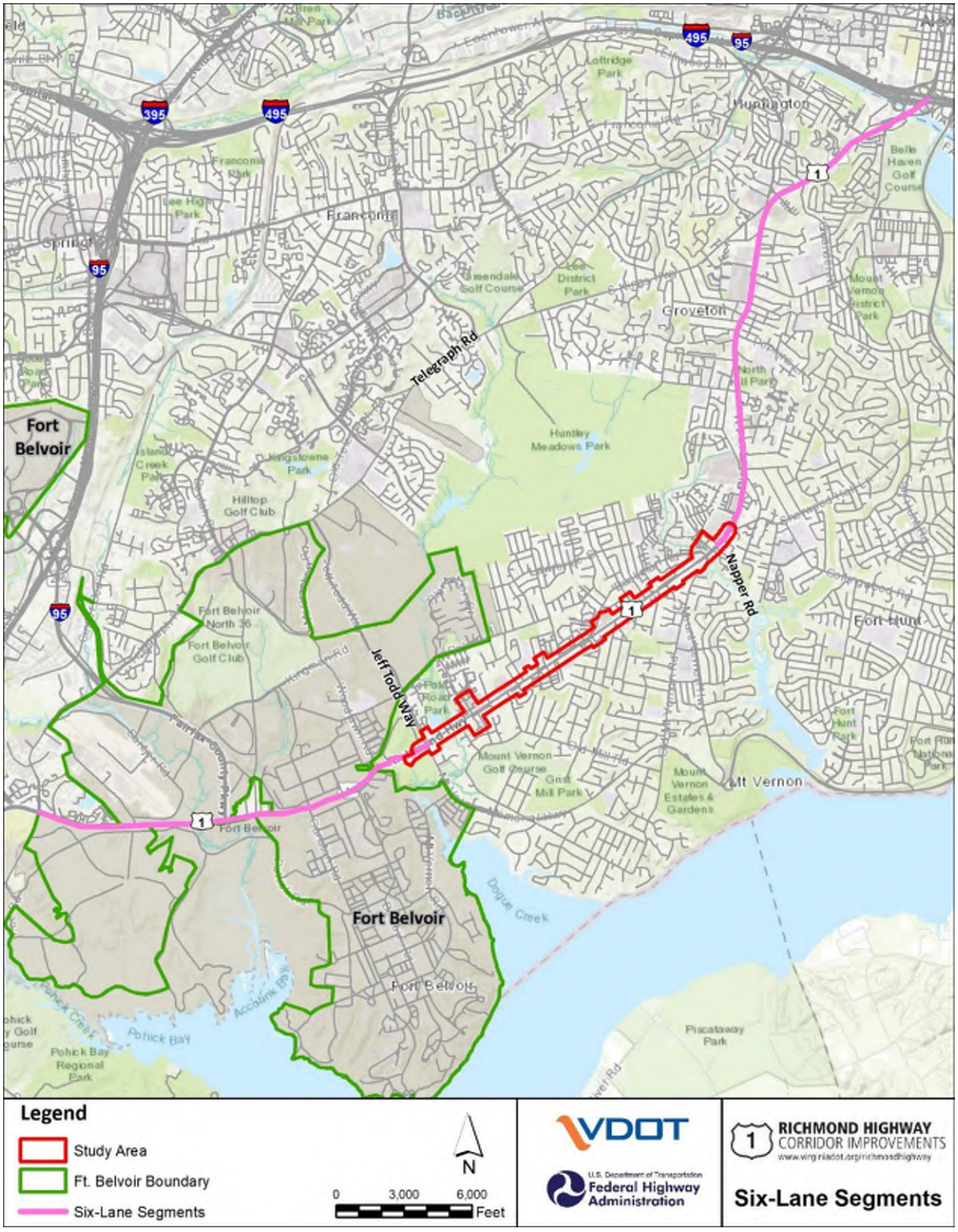


Figure 1-2: Richmond Highway Six-Lane Segments Adjacent to Study Area



lanes (**Figure 1-2**). Beginning at the southwest end of the current Study Area at the Mount Vernon Memorial Highway (VA 235)/Jeff Todd Way intersection, a construction project is underway that widens Richmond Highway to six lanes extending 3.68 miles south through Fort Belvoir and ending at Telegraph Road. Richmond Highway has also been previously widened to six general purpose lanes from approximately the Ladson Lane intersection in the northern Study Area, north to I-95/I-495.

1.3 PURPOSE AND NEED

The Richmond Highway Corridor Improvements EA will address the following purpose and needs:

- Accommodate Travel Demand – better accommodate existing and future travel demand at peak travel hours, reducing congestion and increasing corridor accessibility and mobility (including Bus Rapid Transit [BDT] implementation based on the Department of Rail and Public Transportation [DRPT] Multimodal Study [DRPT, 2015] and Fairfax County Board of Supervisors Resolution [Fairfax County, 2015])
- Improve Safety – implement access control; provide adequately spaced signalized intersections; provide turn lanes where needed; improve structures at natural stream crossings; and enhance pedestrian and bicycle facilities

1.4 ALTERNATIVES

1.4.1 No-Build Alternative

The No-Build Alternative includes continued road maintenance and repairs of existing transportation infrastructure within the Study Area. The Metropolitan Washington Council of Governments (MWCOG) Transportation Improvement Program does not have any planned improvement projects listed for Richmond Highway within the Study Area. The MWCOG Constrained Long-Range Plan includes the current study for widening Richmond Highway, and the separate study of future BRT in the Richmond Highway median from the Huntington Metro Station approximately 3.5 miles north of the Study Area, continuing approximately 8 miles south to the Woodbridge Virginia Railway Express Station, consistent with the DRPT Multimodal Study / Fairfax County Board of Supervisors Resolution. For the purposes of this study, the No-Build Alternative does not include either proposed project. The No-Build Alternative serves as the baseline against which the potential environmental effects of the Build Alternative are compared.

1.4.2 Build Alternative

The Build Alternative is generated from the 2015 *US Route 1 Multimodal Alternatives Analysis* Locally Preferred Alternative (Alternative 4 BRT / Metrorail Hybrid) selected by Fairfax County and the Department of Rail and Public Transportation (DRPT). The identified Build Alternative is to widen Richmond Highway from a four-lane undivided roadway to divided six-lane facility with bicycle and pedestrian accommodations, and a median wide enough to accommodate BRT as called for in the DRPT Multimodal Study/ Fairfax County Board of Supervisors Resolution. The median would be maintained as a grass strip until the implementation of the BRT.

1.5 STUDY AREA – NOISE SENSITIVE LAND USES

Noise sensitive land uses in the project Study Area include residential properties, including upper floor balconies and ground level patios on the exterior of several multi-family apartment buildings in the Study Area. Also present are two daycare centers, community pools, an outdoor restaurant dining facility and a couple hotels with limited outdoor use facilities.

2. METHODOLOGY

2.1 FHWA AND VDOT REGULATIONS AND GUIDELINES

The noise analysis of the Richmond Highway Project was assessed in accordance with FHWA and VDOT noise assessment regulations and guidelines. The State Noise Abatement Policy was developed to implement the requirements of 23 Code of Federal Regulations (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 Noise Report Development and Guidance Document (Version 5) Updated: August 3, 2015, and the National Environmental Policy Act of 1969. The current VDOT State Noise Abatement Policy became effective on July 13, 2011 and was last updated on July 15, 2015.

2.2 NOISE ABATEMENT CRITERIA AND SOUND LEVEL METRICS

To assess the degree of impact of highway traffic and noise on human activity, the FHWA established Noise Abatement Criteria (NAC) for different categories of land use (see **Table 2-1**). The NAC are given in terms of the hourly, A-weighted, equivalent sound level in decibels (dB(A)). The A-weighted sound level is a single number measure of sound intensity with weighted frequency characteristics that corresponds to human subjective response to noise. Most environmental noise (and the A-weighted sound level) fluctuates from moment to moment, and it is common practice to characterize the fluctuating level by a single number called the equivalent sound level (L_{eq}). The L_{eq} is the value or level of a steady, non-fluctuating sound that represents the same sound energy as the actual time-varying sound evaluated over the same time period. For traffic noise assessment, L_{eq} is typically evaluated over a one-hour period, and may be denoted as $L_{eq}(h)$.

2.3 DEFINITION OF NOISE IMPACT

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

- The predicted traffic noise levels (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 dB(A) less than the Noise Abatement Criteria for Activity Categories A to E. For example, for a category B receptor, 66 dB(A) would be approaching 67 dB(A) 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. 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 dB(A) or more for all noise sensitive exterior activity categories. For example, if a receptor's existing noise level is 50 dB(A), and if the future noise level is 60 dB(A), 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 environmental benefit.

Table 2-1: FHWA Noise Abatement Criteria

Activity Category	$L_{eq}(h)$[1]	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[2]	67 (Exterior)	Residential
C[2]	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)

Source: 23 CFR §772.
[1] Hourly Equivalent A-weighted Sound Level (dB(A))
[2] Includes undeveloped lands permitted for this activity category

FHWA and VDOT policy also requires evaluations of undeveloped lands if they are considered "permitted", that is, 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.

2.4 ANALYSIS PROCEDURE

When predicted design year Build Alternative noise levels approach or exceed the NAC during the loudest hour of the day or cause a substantial increase in existing noise, consideration of traffic noise reduction measures is necessary. If it is found that such mitigation measures would cause adverse social, economic, or environmental effects that outweigh the benefits received, they may be dismissed from consideration. For this study, noise levels throughout the Study Area were determined for existing (2016) conditions and for the design year (2045) No-Build and Build Alternatives.

All noise-sensitive land uses potentially affected by the project are near roads for which traffic data was developed as part of the environmental study. Therefore, all noise levels were computed from the

appropriate worst-hour traffic data. The computation methods and computed noise levels appear in the following section.

2.5 TRAFFIC NOISE MODEL (TNM)

All traffic noise computations for this study were conducted using the latest version of the FHWA Traffic Noise Model (FHWA TNM 2.5). The FHWA 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 the FHWA 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.

2.6 NOISE MODEL INPUTS

Available project engineering plans, topographic contours and building information were used to create a three-dimensional model in TNM of the geometry of the existing and future design roadway configurations and the surrounding terrain and buildings. The noise modeling also accounted for such factors as propagation over different types of ground (acoustically soft and hard ground), elevated roadway sections, significant shielding effects from local terrain and structures, distance from the road, traffic speed, and hourly traffic volumes including percentage of medium and heavy trucks. To fully characterize existing and future noise levels at all noise-sensitive land uses in the Study Area, many noise prediction receivers (also called “receptors” and “sites”) were added to the measurement sites in the TNM model. Some receptors were modeled to more precisely represent the multi-level condominium exterior uses directly adjacent to the proposed widening. TNM run files are submitted with this report, with TNM printed data available upon request.

2.7 ADDITIONAL NOISE MODEL INPUT DATA

Several well-constructed existing brick privacy fences are aligned along the proposed alignment. These fences were modeled as barriers for both Existing and 2045 Build conditions, where they were not in conflict with the improvements. Privacy fences made of wood can have air gaps and experience deterioration; therefore, such fences have the potential for not providing adequate noise reduction. Per Section 6.3.5 of the VDOT Noise Guidance Manual, such privacy fences are not modeled as noise barriers.

3. EXISTING NOISE ENVIRONMENT

3.1 NOISE MONITORING

3.1.1 Noise Monitoring Methodology

A noise monitoring program was conducted along the Richmond Highway corridor, consistent with FHWA and VDOT recommended procedures to document existing ambient noise levels in noise-sensitive locations in the study corridor, and to provide a means for validation of the noise prediction model. Short-term (less than one hour) noise measurements were conducted at fourteen locations in the Study Area. Long-term monitoring of 24 hours’ duration was not performed with this project since it was unnecessary given the availability of detailed traffic analysis for AM and PM loudest-hour traffic volumes for Existing, and Build conditions.

3.1.2 Noise Monitoring Schedule

Short-term noise monitoring of 30 minutes' duration was conducted on September 1, 2016. The data collection procedure involved measurements of individual one-minute L_{eq} so that the minutes including noise events unrelated to traffic noise (such as aircraft operations) could later be separated or excluded, and the total measurement period L_{eq} could be determined both with and without the minutes that included these events. By comparing the two totals, the significance of non-traffic events to the overall noise level can be determined for the measurement period. Traffic video was recorded during each measurement session in order to provide a basis for the model validation effort.

3.1.3 Noise Monitoring Instrumentation

Noise measurements were conducted with RK&K-owned Rion NL06 and Metrosonic dB 3080 Type 2 sound level meters. The noise measurement instrumentation was field calibrated regularly during the measurement program, as well as having calibrations traceable to the National Institute of Standards and Technology.

3.1.4 Noise Monitoring Locations

Measurement locations are shown in **Figures 3-1** through **3-4** in **Appendix J**, with short-term site numbers denoted with the prefix "M". Measurement locations and noise levels are shown in **Table 3-1**.

3.1.5 Noise Monitoring Documentation

Appendix E provides details of the data acquired during the noise measurement program, including noise monitor output and traffic counts, while **Appendix H** includes site sketches, photographs, and noise monitor specifications.

3.1.6 Noise Monitoring Results

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 Common Noise Environment to validate the computer noise model.

The measured short-term noise levels appear in **Table 3-1** as equivalent sound levels (L_{eq}), along with site address and measurement date, start time and duration. The measured "Total" L_{eq} range from 56 dB(A) at the fenced residential area of 8722 Talbott Farm Dr (Site M-02) to 66 dB(A) at the front row residential location at 8719 Talbott Farm Drive (Site M-03). The measurement results also show that the measured Total L_{eq} and the Traffic-Only L_{eq} are identical except at site M-01, as minimal extraneous noise sources were observed.

Table 3-1: Short-Term Noise Measurement Results[1]

Site	Address	Date	Time Start	Duration (minutes)	Total L_{eq}[2], dB(A)[3]	Traffic Only L_{eq}, dB(A)
M-01	8743 Richmond Hwy Belvoir Plaza Apartments	9/1/2016	16:08	30	57	56
M-02	8722 Talbott Farm Dr	9/1/2016	16:08	30	56	56
M-03	8719 Talbott Farm Dr	9/1/2016	16:08	30	66	66
M-04	8662 Walutes Cir	9/1/2016	16:08	30	56	56
M-05	8535 Engleside St	9/1/2016	14:48	30	57	57
M-06	8535 Wyngate Manor Ct	9/1/2016	14:48	30	60	60
M-07	8583 Richmond Hwy Washington Square Apartments	9/1/2016	14:48	30	64	64
M-08	8424 Sky View Dr Skyview Apartments	9/1/2016	14:48	30	63	63
M-09	8488 Richmond Hwy Woodlawn Garden Apartments	9/1/2016	13:33	30	60	60
M-10	8467 Diablo Ct	9/1/2016	13:33	30	58	58
M-11	4260 Buckman Rd Pinewood South Condominiums	9/1/2016	13:33	30	63	63
M-12	4241 Sonia Ct	9/1/2016	13:33	30	57	57
M-13	8354 Hunter Murphy Cir	9/1/2016	12:14	30	60	60
M-14	3707 Rolling Hills Ave Rolling Hills Apartments (pool)	9/1/2016	12:14	30	59	59

[1] Site locations shown on map in Figure 1. Detailed data presented in Appendix E.
[2]Equivalent Sound Level
[3]A-weighted decibel

3.1.7 Noise Model Validation

A validation of the noise modeling assumptions was conducted using the traffic counted on nearby roadways simultaneous with the noise measurement at each site, as input to the noise prediction model. These observed traffic counts are provided in the **Appendix E** field logs. Computed noise levels based on the counted traffic were compared to the measured noise levels to confirm the assumptions about aspects of the TNM model, such as the acoustical shielding provided by intervening terrain and existing noise barriers. The modeling assumptions were refined, as necessary, to obtain appropriate agreement between the computed and measured values. The validated modeling assumptions at the measurement sites and for the existing geometry were then extended to the design year alternative and applied at prediction locations where no measurements were made.

Predicted noise levels at all but one of the measurement sites where validation was conducted using the counted traffic as input to the model were within the 3 dB(A) requirement. Noise levels at site M-09 were over-predicted by +4.2 dB(A). This is almost certainly due to the presence of a continuous line of parked

cars along the service road between the receptor and mainline, which could not be modeled sufficiently in TNM. The overall average difference between measured and computed levels is +0.4 dB(A). The comparison of measured versus computed sound levels at each the measurement sites is shown in **Table 3-2**.

Table 3-2: Computed vs. Measured Sound Levels at Measurement Sites

Site No.	Address	Land Use	Measured L_{eq}[1] dB(A)[2] (Traffic-only)	Computed L_{eq} dB(A)	Difference
M-01	8743 Richmond Hwy Belvoir Plaza Apartments	Residential	56.3	58.3	2.0
M-02	8722 Talbott Farm Dr	Residential	56.3	55.5	-0.8
M-03	8719 Talbott Farm Dr	Residential	66	64.7	-1.3
M-04	8662 Walutes Cir	Residential	55.5	55.9	0.4
M-05	8535 Engleside St	Residential	58.5	61.3	2.8
M-06	8535 Wyngate Manor Ct	Residential	59.7	60.8	1.1
M-07	8583 Richmond Hwy Washington Square Apartments	Residential	63.5	63.6	0.1
M-08	8424 Sky View Dr Skyview Apartments	Residential	62.5	64.3	1.8
M-09	8488 Richmond Hwy Woodlawn Garden Apartments	Residential	59.5	63.7	4.2
M-10	8467 Diablo Ct	Residential	57.9	55.4	-2.5
M-11	4260 Buckman Rd Pinewood South Condominiums	Residential	62.9	63.3	0.4
M-12	4241 Sonia Ct	Residential	57.3	57.2	-0.1
M-13	8354 Hunter Murphy Cir	Residential	60.2	57.5	-2.7
M-14	3707 Rolling Hills Ave Rolling Hills Apartments (pool)	Residential	58.7	58.6	-0.1
Overall Average					**+0.4**

[1]*Equivalent Sound Level*
[2]*A-weighted decibel*

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.

Coordination with the Fairfax County Building Plan Review division and database review using Fairfax County's Land Development Information History website resulted in no proposed noise sensitive land uses permitted within the project corridor.

3.3 COMMON NOISE ENVIRONMENT (CNE) DETERMINATION AND RECEPTOR CATEGORIZATION

Receptors are grouped into "Common Noise Environments" (CNEs) per current guidance from FHWA and VDOT. Each of these areas has similar sources of noise and similar land uses within it. For this section of the report, the ranges of noise levels and the projected noise impact are summarized by CNE.

CNE boundaries are identified in **Figures 3-1** and **3-2** for areas with noise-sensitive land use. Areas that do not have noise-sensitive land uses are not identified with CNE boundaries; such land use is Activity Category E, F, or G, that is commercial with no exterior activity areas, industrial, or undeveloped, respectively.

CNE 01 represents the Candlewood Suites and Hampton Inn hotels. One exterior use area was identified at each hotel. This area is classified as Category E.

CNE 02 represents the multi-story Best Western hotel (Category E) and multi-story Belvoir Plaza Apartments (Category B). No outdoor use areas were identified at the hotel. The apartment building has outdoor patios and balconies. A privacy fence at this location is made of wood and has air gaps, therefore, the fence has the potential for not providing adequate noise reduction. Per Section 6.3.5 of the VDOT Noise Guidance Manual, the privacy fence at this location was not modeled as a noise barrier in the Build condition.

CNE 03 represents towne homes on Talbott Farm Drive. This area is classified as Category B.

CNE 04 represents two single-family homes on Lukens Lane. This area is classified as Category B.

CNE 05 represents the Terrace Towne Homes on Walutes Circle. This area is classified as Category B.

CNE 06 represents towne homes on Wyngate Manor Court and the multi-story Washington Square Apartments. This area is classified as Category B.

CNE 07 represents Ray's Mobile Colony on Denfield and Greenleaf Streets. This area is classified as Category B.

CNE 08 represents several single-family homes on Halfe Street and Radford Avenue. This area is classified as Category B.

CNE 09 represents the Mount Zephyr community of single-family homes on Sonia Court. This area is classified as Category B. The CNE also consists of an open area directly behind the brick privacy fence, a drainage area with no outdoor use, and a gazebo that would be noise sensitive (Category C). Since the gazebo would be displaced by the proposed improvements, it was not included as part of the Build Alternative noise analysis.

CNE 10 represents several single-family homes and Creative Learning School daycare center on Mohawk Lane and Washington Avenue. The single-family homes are classified as Category B; the daycare is classified as Category C.

CNE 11 represents several single-family homes on Reddick Avenue. This area is classified as Category B.

CNE 12 represents the Vernon Heights community of towne homes and single-family homes on Central Avenue and Mary Evelyn Way. A privacy fence at this location is made of solid brick, as such it was included in the noise models for the existing case and future build cases. This fence is not likely to be impacted by the proposed improvements. This area is classified as Category B.

CNE 13 represents a towne homes in the Parkside at Mount Vernon community on Shannons Green Way and Hunter Murphy Circle. The residences are classified as Category B. This CNE also includes Vernon Heights Park, which is classified as Category C.

CNE 14 represents the Spring Hills Mount Vernon assisted living facility on Shannons Green Way and Lamberts Lane, where two outdoor use areas were identified. This area is classified as Category B.

CNE 15 represents several towne homes on Shannons Green Way and Lamberts Land. This area is classified as Category B.

CNE 16 represents several single-family homes on the southbound side of Mount Vernon Highway. This area is classified as Category B.

CNE 17 represents several single-family homes on the northbound side of Mount Vernon Highway. This area is classified as Category B.

CNE 18 represents several single-family homes on Napper Road and Brown Court. This area is classified as Category B. This CNE also includes Little Hunting Creek Park, which is classified as Category C.

CNE 19 represents the Spring Garden Apartments community on Richmond Highway, comprised of several multi-story structures with patios and balconies. This area is classified as Category B.

CNE 20 represents several town homes at Avery Park Court. This area is classified as Category B.

CNE 21 represents the Harmony Place Trailer Park on Pace Lane. This area is classified as Category B.

CNE 22 represents the Stony Brook Apartments on Buckman Road. This area is classified as Category B.

CNE 23 represents several single-family homes on Rolling Hills Avenue. This area is classified as Category B.

CNE 24 represents a pool, patio and balconies at the Rolling Hills Apartments complex, as well as a towne home community on Roxbury Lane. This area is classified as Category B.

CNE 25 represents several single-family homes on Martha Street. This area is classified as Category B.

CNE 26 represents the patios and balconies in an apartment building in the Mount Vernon Apartments complex on Russell Road. This area is classified as Category B.

CNE 27 represents several single-family and towne homes on Gregory Drive and Main Street. This area is classified as Category B.

CNE 28 represents a playground area at the Buckman Road KinderCare facility on Buckman Road. This area is classified as Category C.

CNE 29 represents a multi-story apartment building, with patios and balconies, at the intersection of Pole Road and Buckman Road. This area is classified as Category B.

CNE 30 represents the Pembrook Village condominium community on Pembrook Drive, which includes second-story balconies. This area is classified as Category B.

CNE 31 represents the Pinewood South condominium community on Buckman Road, consisting of multi-story buildings with patios and balconies. Also represented are towne homes on Diablo Court. This area is classified as Category B.

CNE 32 represents the Woodlawn Garden Apartments on Blankenship Street and Graves Street, consisting of several multi-story buildings with patios and balconies. This area is classified as Category B.

CNE 33 represents the Skyview Park towne home community on Sky View Drive, Hallie Rose Street and Hallie Rose Place. This area is classified as Category B.

CNE 34 represents the Skyview Apartments, with patios and balconies, on Sky View Drive. Also represented is a towne home community on Towne Manor Court. This area is classified as Category B.

CNE 35 represents several single-family homes on Highland Lane and Engleside Street, as well as a first-row commercial undeveloped parcel (Category E). The residential area is classified as Category B.

(There is no CNE 36 because the area previously examined was determined to have no noise sensitive outdoor use.)

CNE 37 represents an outdoor dining area at the Roy Rogers restaurant at Richmond Highway and Jeff Todd Way. The area consists of four tables with integral benches, with each table accommodating at least four patrons. This area is classified as Category E.

CNE 38 represents Pole Road Park, classified as Category C.

3.4 WORST NOISE HOUR

The analysis showed that the 1500 PM Peak Hour represented the worst noise hour of the day in the design year, as the highest free-flow traffic volumes were determined to exist for this hour on Richmond Highway.

Traffic volumes associated with only the PM Worst Noise Hour were used for all roadways in this analysis. Long-term monitoring to determine the Worst Noise Hour was not necessary as all required traffic data was provided by Fairfax County and then processed before being incorporated into the noise analysis.

Appendix C provides tables of worst noise hour existing and future traffic data used in the noise model for all roadways in the Study Area.

3.5 MODELED EXISTING ENVIRONMENT

The Existing noise environment was assessed for 2016; No-Build and Build noise environments were assessed for Design Year 2045.

The Existing condition includes many privacy fences between community developments and Richmond Highway, particularly on the northbound side of the highway. Some of these fences would be impacted by the proposed widening. Not all existing walls or privacy fences offer significant noise reduction; some are sturdily built (brick or no-gap wood slats), while others offer little or no acoustic benefit. Fences that

are deemed acoustically significant (all brick) are modeled as noise barriers in TNM. All existing wall heights are typically less than 8 feet.

Numerous impacts are predicted in some CNEs for the Worst-Hour Existing condition, particularly those front-row properties with direct exposure to the roadway. While some existing privacy fences offer limited protection from highway noise, they are also often flanked by noise transmitted through access gaps along the existing alignment. See **Table 3-3** for predicted Worst-Hour Existing noise level ranges, which includes noise levels for Build and No-Build conditions. No-Build and Build noise levels are discussed in the next section.

Table 3-3: Predicted Worst-Hour Noise Levels for Modeled Receptors

CNE ID[1]	Area Land Use and Description	Range of Predicted Worst-Hour L_{eq}[2] Exterior Noise Levels, dB(A)[3]		
		Existing 2016	No-Build 2045	Build 2045
01	Candlewood Suites and Hampton Inn hotels	52-64	53-65	52-65
02	Best Western hotel and Belvoir Plaza Apartments	40-58	41-60	44-60
03	Residences on Talbott Farm Drive	47-61	48-63	52-68
04	Residences on Lukens Lane	51-51	52-52	53-53
05	Residences at Terrace Towne Homes on Walutes Circle	44-57	46-58	46-58
06	Residences on Wyngate Manor Court, Washington Square Apartments	39-64	41-66	42-68
07	Residences at Ray's Mobile Colony	51-65	52-66	53-67
08	Residences on Halfe Street and Radford Avenue	50-59	52-61	53-62
09	Mount Zephyr community of residences on Sonia Court	40-61	41-62	43-66
10	Residences and daycare center on Mohawk Lane and Washington Avenue	53-69	55-71	56-72
11	Residences on Reddick Avenue	56-59	57-60	57-60
12	Residences on Central Avenue and Mary Evelyn Way	35-60	36-61	36-63
13	Residences in Parkside at Mount Vernon community, Vernon Heights Park	41-67	43-68	43-69
14	Spring Hills Mount Vernon assisted living facility	44-47	45-49	45-46
15	Residences on Shannons Green Way and Lamberts Lane	50-52	52-54	50-53
16	Residences on Mount Vernon Highway (southbound)	53-59	54-60	54-60
17	Residences on Mount Vernon Highway (northbound)	56-62	58-64	58-64
18	Residences on Napper Road and Brown Court, Little Hunting Creek Park	54-71	56-73	53-61
19	Residences at Spring Garden Apartments	53-70	54-72	54-72
20	Residences on Avery Park Court	60-60	62-62	63-64
21	Residences at Harmony Place Trailer Park on Pace Lane	52-70	54-71	57-65
22	Residences at Stony Brook Apartments on Buckman Road	54-55	55-56	57-58
23	Residences on Rolling Hills Avenue	57-70	58-72	58-63
24	Residences, pool at the Rolling Hills Apartments, and towne home community on Roxbury Lane	44-65	45-67	46-68
25	Residences on Martha Street	50-70	51-71	53-73
26	Residences at Mount Vernon Apartments on Russell Road	49-55	50-56	50-57
27	Residences on Gregory Drive and Main Street	52-56	53-58	54-58

CNE ID[1]	Area Land Use and Description	Range of Predicted Worst-Hour L_{eq}[2] Exterior Noise Levels, dB(A)[3]		
		Existing 2016	No-Build 2045	Build 2045
28	Buckman Road KinderCare facility	59	60	62
29	Residences at multi-story apartment building at Pole Road and Buckman Road	54	56	58
30	Residences at Pembrook Village condominiums on Pembrook Drive	58	59	59
31	Residences at Pinewood South condominiums on Buckman Road	48-65	49-66	50-66
32	Residences on Woodlawn Garden Apartments on Blankenship Street and Graves Street	38-66	39-68	40-69
33	Residences at Skyview Park towne home community on Sky View Drive, Hallie Rose Street and Hallie Rose Place	42-54	43-56	46-57
34	Residences at Skyview Apartments, towne homes on Towne Manor Court	42-64	44-65	44-68
35	Residences on Highland Lane and Engleside Street, including a first-row commercial undeveloped parcel	51-68	53-69	53-70
37	Roy Rogers restaurant outside dining area	67	68	68
38	Pole Road Park	60	61	59

[1] *Common Noise Environment Identification Number*
[2] *Equivalent Sound Level*
[3] *A-weighted decibel*

4. FUTURE NOISE ENVIRONMENT

4.1 MODELED FUTURE ENVIRONMENT

As with the Existing condition, many noise impacts are predicted for the Worst-Hour No-Build condition. No-Build noise levels are generally 1 to 2 dB(A) greater than Existing levels. Build noise levels are also generally slightly higher than No-Build levels. Build condition noise impacts are predicted at CNEs 3, 6, 7, 9, 10, 13, 19, 24, 25, 31, 32 and 34.

The Build Alternative would impact existing privacy fences at CNEs 3 and 9. The Build Alternative impact assessment model includes evaluations of noise walls at these communities, since these areas are predicted to be impacted.

Some receptors evaluated in the Existing and No-Build analyses are no longer applicable in the Build analysis due to conflicts with the proposed widening, i.e. at CNEs 18, 21 and 23. Also, Build noise levels at some first-row receptors are predicted to be lower than those for Existing and No-Build due to higher elevations and wider footprint associated with the proposed design, resulting in reduced line-of-sight between those receptors and far side travel lanes, most significantly at the first row of CNE 21.

Several multi-story apartment and condominium buildings with patios and balconies are throughout the Study Area, in CNEs 2, 6, 19, 22, 29, 30, 31, 32 and 34. Predicted noise levels are generally greater at the higher elevation receptors. First-row units that directly face the highway are more likely to be impacted than those with indirect or limited exposure, i.e. those that are oriented perpendicularly to the highway

or on a side of building that does not face the highway. In the latter case, the building itself provides shielding from the roadway.

Several hotels are in the Study Area, i.e. in CNEs 1 and 2. CNE 1 hotels have an outside area with chairs and tables for guests or employees, but no balconies or patios for guest rooms. None of the hotels in CNE 2 have outdoor use areas for guests. Neither of these CNEs are predicted to be impacted.

An undeveloped wooded lot in CNE 35 is predicted to experience a noise level of 70 dB(A), but this is below the NAC impact criteria for a Category E property.

Three parks - Vernon Heights Park (CNE 13), Little Hunting Creek Park (CNE 18) and Pole Road Park (CNE 38) - are not predicted to be impacted by the improvements. Only Vernon Heights Park has an area of outdoor use (a path) within the 500-foot analysis limit. The path in Vernon Heights Park is predicted to experience identical noise levels for both Existing and Build conditions at 51 dB(A).

4.2 NOISE ABATEMENT DETERMINATION

4.2.1 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 which 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 noise barriers
- Construction of earth berms

Additionally, the Noise Policy Code of Virginia (HB 2577, as amended by HB 2025) states: 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 G**.

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. These traffic control measures would be counterproductive to the project's objective of alleviating traffic and reducing congestion. Reducing speeds will not be an effective noise mitigation measure since a substantial decrease in speed is necessary to provide adequate noise reduction.

Alteration of Horizontal and Vertical Alignments: The alteration of the horizontal and vertical alignment has been considered to reduce or eliminate the impacts created by the proposed project. Shifting the horizontal alignment is not practical given the nature of the widening and a median wide enough to accommodate BRT as called for in the DRPT Multimodal Study / Fairfax County Board of Supervisors Resolution. Even if possible, such shifts often create undesirable impacts such as right-of-way acquisition, temporary/permanent easements, and retaining walls. Shifting the roadway alignment away from the impacted residences often increases impacts to receptors located on the opposite side of the proposed roadway.

Insulation: 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 would 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 Noise Barriers / Berms: Construction of noise barriers can be an effective way to reduce noise levels at areas of outdoor activity. Noise barriers can be wall structures, earth 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. Earth berms are not considered a viable mitigation option throughout the project area, and would not likely be evaluated in the final design stage.

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.

For this project, noise barriers are the only feasible mitigation option for impacted receptors.

4.2.2 Feasibility Criteria

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

(1) At least a 5 dB(A) 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 dB(A) of reduction. VDOT requires that fifty percent (50 percent) or more of the impacted receptors experience 5 dB(A) 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).

4.2.3 Reasonableness Criteria

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

- The viewpoints of the benefited receptors
- Cost effectiveness value
- Noise reduction design goal

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 dB(A) 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 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.

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, meaning that at least one impacted receptor is predicted to achieve a 7 dB(A) 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 dB(A) 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 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).

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 receptors 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 in order 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. This calculation was not applicable to this project.

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 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.

4.2.4 Noise Barrier Evaluation

Noise barrier analyses are warranted for all CNEs with noise impacts. Noise barriers were not studied at impacted CNEs 7, 10, 24 and 25 due to excessive access constraints. Noise barriers determined to be physically feasible were evaluated at heights of 15, 20, 25 and 30 feet to assess whether they meet acoustic feasibility, design goal, and reasonableness criteria.

Potential noise barriers are predicted to be feasible and reasonable at CNEs 3, 13, 19, 32 and 34. Noise barriers that are shown to be feasible and reasonable in the preliminary design may not be feasible and reasonable in final design. All noise barriers would be further evaluated in final design to determine any engineering constraints associated with constructing the noise barrier.

Barrier 1P is a potential barrier for the northern portion of CNE 03 as shown in **Appendix J** Figure 3-1. Located along the northbound side of Richmond Highway just north of Cooper Road, the potential noise barrier would benefit all three impacted receptors and three non-impacted receptors on Talbott Farm Drive. The barrier would be 325 feet in length and 15 feet in height, with a surface area of 4,875 square feet. Barrier 1P would be feasible because it would benefit all impacted receptors, and reasonable because it would meet the 7-dB(A) noise reduction design goal for three impacted receptors and has a surface area per benefited receptor value of 813, below VDOT's maximum value of 1,600. Wooden privacy fences with brick columns exist at this location, and having air gaps they do not have the potential to provide adequate noise reduction. Per Section 6.3.5 of the VDOT Noise Guidance Manual, the privacy fences at this location were not modeled as noise barriers in the Build condition. One fence would be impacted by the proposed improvements.

Barrier 2P is a potential barrier system consisting of three barriers for the northern portion of CNE 06 as shown in **Appendix J** Figure 3-2. Located along the northbound side of Richmond Highway, from south of Wyngate Manor Court to south of Forest Place, the potential barrier system would benefit two of eight impacted receptors and 11 non-impacted receptors below the points of intersection on Wyngate Manor Court and Washington Square Apartments, which has balconies on all floors. Barrier 2P is not feasible because it would not benefit 50 percent of impacted receptors. A couple privacy fences exist at this location and are made of wood and have air gaps, and therefore have the potential for not providing adequate noise reduction. Per Section 6.3.5 of the VDOT Noise Guidance Manual, privacy fences at this location are not modeled as noise barriers.

Barrier 3P was considered for CNE 07, located along the northbound side of Richmond Highway at Denfield and Greenleaf Streets as shown in **Appendix J** Figure 3-2. However, access requirements make mitigation not feasible.

Barrier 4P is a potential barrier for the northern portion of CNE 09 as shown in **Appendix J** Figure 3-3. Located along the northbound side of Richmond Highway, north of Radford Avenue, this barrier would benefit one of the two impacted receptors and five non-impacted receptors on Sonia Court. Barrier 4P would be feasible because it would benefit 50 percent of impacted receptors, but not reasonable because it would not meet the 7-dB(A) noise reduction design goal for one impacted receptor.

Barrier 5P was considered for CNE 10, located along the northbound side of Richmond Highway south of Mohawk Lane as shown in **Appendix J** Figure 3-3. However, access requirements make mitigation not feasible.

Barrier 6P is a potential barrier for the northern portion of CNE 13 as shown in Figures 3-3 and 3-4. Located along the northbound side of Richmond Highway, north of Central Avenue, the potential barrier would benefit 11 of 16 impacted receptors and 29 non-impacted receptors on Hunter Murphy Circle and Shannons Green Way. The barrier would be 351 feet in length and 15 feet in height, with a surface area of 5,265 square feet. Barrier 6P would be feasible because it would benefit more than 50 percent of impacted receptors, and reasonable because it would meet the 7-dB(A) noise reduction design goal for nine impacted receptors and has a surface area per benefited receptor value of 132, well below VDOT's maximum value of 1,600. A privacy fence at this location is made of wood and has air gaps, and therefore has the potential for not providing adequate noise reduction. Per Section 6.3.5 of the VDOT Noise Guidance Manual, the privacy fence at this location was not modeled as a noise barrier.

Barrier 7P is a potential barrier for the northern portion of CNE 19 as shown in **Appendix J** Figure 3-4. Located along the northbound side of Richmond Highway, north of Napper Road, this barrier would

benefit 14 of 16 impacted receptors and 4 non-impacted receptors that are below the points of intersection in Spring Garden Apartments, which has balconies on all floors. The barrier would be 333 feet in length and 25 feet in height, with a surface area of 8,325 square feet. Barrier 7P would be feasible because it would benefit at least 50 percent of impacted receptors, and reasonable because it would meet the 7-dB(A) noise reduction design goal for 10 impacted receptors and has a surface area per benefited receptor value of 463, below VDOT's maximum value of 1,600.

Barrier 8P was considered for CNE 24, located along the southbound side of Richmond Highway, north of Roxbury Drive, as shown in **Appendix J** Figure 3-3. Access requirements make mitigation not feasible.

Barrier 9P was considered for CNE 25, located along the southbound side of Richmond Highway, at Martha Street, as shown in **Appendix J** Figure 3-3. However, access requirements make mitigation not feasible.

Barrier 10P is a potential barrier for the southern portion of CNE 31 as shown in **Appendix J** Figure 3-3. Located along the southbound side of Richmond Highway, at Buckman Road, this barrier would benefit two of five impacted receptors and one non-impacted receptor that are below the points of intersection in Pinewood South condominiums, which has balconies on all floors. The analyzed barrier is 216 feet in length and 30 feet in height, with a surface area of 6,480 square feet. Barrier 10P is not feasible because it would not benefit at least 50 percent of impacted receptors.

Barrier 11P is a potential barrier system consisting of two barriers for the southern portion of CNE 32 as shown in **Appendix J** Figure 3-2. Located along the southbound side of Richmond Highway, north of Frye Road, this barrier system would benefit 26 of 31 impacted receptors and 13 non-impacted receptors that are below the points of intersection at Woodlawn Garden Apartments, which has balconies on all floors. The barrier system would be 755 feet in total length and 20 feet in height, with a surface area of 15,100 square feet. Barrier 11P would be feasible because it would benefit at least 50 percent of impacted receptors, and reasonable because it would meet the 7-dB(A) noise reduction design goal for 19 impacted receptors and has a surface area per benefited receptor value of 387, below VDOT's maximum of 1,600.

Barrier 12P is a potential barrier for the southern portion of CNE 34 as shown in **Appendix J** Figure 3-2. Located along the southbound side of Richmond Highway just south of Sky View Drive, the potential noise barrier would benefit all three impacted receptors and 10 non-impacted receptors on Towne Manor Court. The barrier would be 249 feet in length and 15 feet in height, with a surface area of 3,735 square feet. Barrier 12P would be feasible because it would benefit all impacted receptors, and reasonable because it would meet the 7-dB(A) noise reduction design goal for all impacted receptors and has a surface area per benefited receptor value of 287, well below VDOT's maximum value of 1,600. Wooden privacy fences exist at this location, and having air gaps they do not have the potential to provide adequate noise reduction. Per Section 6.3.5 of the VDOT Noise Guidance Manual, the privacy fences at this location were not modeled as noise barriers in the Build condition.

See **Table 4-1** for a summary of barrier characteristics.

Table 4-1: Summary of Barrier Characteristics

Barrier ID	CNE ID[1]	Barrier Length	Barrier Height	Surface Area (Square Feet)	Feasible?	Meets Design Goals?	Total Benefits	Barrier Square Feet per Benefited Receptor	Reason-able? (Square Feet per Benefit <1600)
1P	03	325	15	4,875	Yes	Yes	6	813	Yes
2P	06	576	30	17,280	No[2]	n/a	n/a	n/a	n/a
3P	07	Not studied due to access limits			No	n/a	n/a	n/a	n/a
4P	09	354	30	10,620	Yes	No[3]	n/a	n/a	n/a
5P	10	Not studied due to access limits			No	n/a	n/a	n/a	n/a
6P	13	351	15	5,265	Yes	Yes	40	132	Yes
7P	19	333	25	8,325	Yes	Yes	18	463	Yes
8P	24	Not studied due to access limits			No	n/a	n/a	n/a	n/a
9P	25	Not studied due to access limits			No	n/a	n/a	n/a	n/a
10P	31	216	30	6,480	No[2]	n/a	n/a	n/a	n/a
11P	32	755	20	15,100	Yes	Yes	39	387	Yes
12P	34	249	15	3,735	Yes	Yes	13	287	Yes

[1]*Common Noise Environment Identification Number*

[2] *Less than 50% impacted residences benefited.*

[3] *No impacted residences receive at least 7 dB(A) insertion loss*

5. CONSTRUCTION NOISE

VDOT is also concerned with noise generated during the construction phase of the proposed project. The degree of construction noise impact would 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 would occur as a result of roadway construction measures are anticipated to be temporary in nature and would 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 would 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.

- The Department 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.
- The Department 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.

6. PUBLIC INVOLVEMENT PROCESS

6.1 NOISE COMPATIBLE PLANNING

6.1.1 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 for undeveloped lands within the project corridor. The aforementioned details are provided below. Additional information about VDOT's noise abatement program has also been included in this section.

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 provides 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

6.1.2 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 distance from the edge of roadway to 71 dB(A) is predicted to be 30 feet; for 66 dB(A), the distance is 120 feet.

6.1.3 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.

6.2 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 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 percent 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 of the results of the public survey will be prepared and submitted to the FHWA.

APPENDIX A REFERENCES

23 CFR Part 772, as amended 75 FR 39820, July 13, 2010; Effective date July 13, 2011 – "Procedures for Abatement of Highway Traffic Noise and Construction Noise", Federal Highway Administration, U.S. Department of Transportation.
http://www.fhwa.dot.gov/environment/noise/regulations_and_guidance/

Fairfax County. 2015. *Report of Actions of the Fairfax County Board of Supervisors Tuesday May 12, 2015*. Retrieved May 2016 at http://www.fairfaxcounty.gov/government/board/meetings/2015/may-12.htm.

"Highway Traffic Noise: Analysis and Abatement Guidance", Federal Highway Administration, U.S. DOT, June 2010, revised January 2011.
http://www.fhwa.dot.gov/environment/noise/regulations_and_guidance/analysis_and_abatement_guidance/revguidance.pdf

"Highway Traffic Noise Impact Analysis Guidance Manual" (Version 7), Virginia Department of Transportation, July 2011, revised July 2015.
http://www.virginiadot.org/projects/resources/noisewalls/Highway_Traffic_Noise_Impact_Analysis_Guidance_Manual.pdf

"State Noise Abatement Policy", Virginia Department of Transportation, effective July 13, 2011.
http://www.virginiadot.org/projects/resources/noisewalls/State_Noise_Abatement_Policy.pdf

Virginia Department of Rail and Public Transportation (DRPT). 2015. *Route 1 Multimodal Alternatives Analysis Final Report*. Retrieved May 2016 at http://www.drpt.virginia.gov/transit/major-transit-initiatives/major-transit-planning/route-1-mutlimodal-alternatives-analysis/.

APPENDIX B LIST OF PREPARERS / REVIEWERS

This appendix lists the preparers of this noise study report.

Preparers with Rummel, Klepper & Kahl, LLP are as follows:

- Kevin Hughes – Design Manager
- George Tye – Acoustic Engineer
- Stuart Samberg – Project Manager, traffic analysis
- Susan Miller – Project Planner
- Erin Beckmann – Associate Engineer

APPENDIX C TRAFFIC DATA

This appendix compiles the traffic data used in the noise analysis modeling. Hourly-hour vehicle volumes, truck percentages, and speeds were developed by Rummel, Klepper & Kahl, LLP in coordination with data provided by the Virginia Department of Transportation.

APPENDIX D TNM PREDICTED NOISE LEVEL DATA

This appendix includes data predicted by TNM for Existing, No-Build and Build conditions.

CNE	NAC	Receptor	Existing 2016	No-Build 2045	Build 2045	Build 2045 with Potential Barrier	IL	Impacted and Benefited?	Not Impacted and Benefited?
1	E	R-01	64	65	65				
1	E	R-02	52	53	52				
2	B	R-16	45	47	52				
2	B	R-17	49	51	53				
2	B	R-18	40	41	44				
2	B	R-19	42	43	50				
2	B	R-20	45	46	50				
2	B	R-21	64	65	65				
2	B	R-22	52	53	52				
2	B	R-23	56	57	58				
2	B	R-24	58	60	60				
2	B	R-25	58	60	60				
2	B	R-26	53	55	54				
2	B	R-27	55	57	57				
2	B	R-28	56	57	57				
2	B	R-29	50	51	51				
2	B	R-30	52	54	55				
2	B	R-31	53	55	55				
2	B	R-32	45	47	53				
2	B	R-33	50	52	56				
3	B	R-34	61	63	68	57	11	YES	
3	B	R-35	61	62	66	57	9	YES	
3	B	R-36	59	60	63	57	6		YES
3	B	R-37	58	59	62	57	5		YES
3	B	R-38	56	57	60	55	4		
3	B	R-39	55	56	58	54	4		
3	B	R-40	60	62	68	60	8	YES	
3	B	R-41	58	59	65	60	5		YES
3	B	R-42	55	57	62	58	4		
3	B	R-43	53	54	59	55	4		
3	B	R-44	47	48	54	45	9		
3	B	R-45	55	56	62	58	3		
3	B	R-46	55	57	62	60	3		
3	B	R-47	59	60	62	62	1		
3	B	R-48	56	57	57	57	1		
3	B	R-49	56	58	57	57	0		
3	B	R-50	56	57	57	57	0		
3	B	R-51	54	56	55	55	0		
3	B	R-52	53	54	54	54	0		
3	B	R-53	50	52	52	52	0		
3	B	R-54	50	52	54	53	0		
3	B	R-55	50	51	53	53	0		
3	B	R-56	50	52	54	53	0		
3	B	R-57	51	52	54	52	2		
4	B	R-58	51	52	53				

CNE	NAC	Receptor	Existing 2016	No-Build 2045	Build 2045	Build 2045 with Potential Barrier	IL	Impacted and Benefited?	Not Impacted and Benefited?
4	B	R-59	51	52	53				
5	B	R-60	54	55	56				
5	B	R-61	54	56	56				
5	B	R-62	55	56	57				
5	B	R-63	56	57	58				
5	B	R-64	57	58	58				
5	B	R-65	52	53	53				
5	B	R-66	48	49	49				
5	B	R-67	48	49	50				
5	B	R-68	44	46	46				
5	B	R-69	48	50	50				
5	B	R-70	49	50	50				
5	B	R-71	51	52	52				
6	B	R-72	63	64	68				
6	B	R-73	59	60	66				
6	B	R-74	57	58	65				
6	B	R-75	55	57	64				
6	B	R-76	54	56	63				
6	B	R-77	53	55	62				
6	B	R-78	46	48	53				
6	B	R-79	45	46	47				
6	B	R-80	45	46	47				
6	B	R-81	45	46	47				
6	B	R-82	45	46	47				
6	B	R-83	45	46	48				
6	B	R-84	49	50	54				
6	B	R-85	56	57	59				
6	B	R-86	49	50	51				
6	B	R-87	42	43	44				
6	B	R-88	41	42	44				
6	B	R-89	41	42	43				
6	B	R-90	40	42	43				
6	B	R-91	40	42	43				
6	B	R-92	40	41	42				
6	B	R-93	39	41	42				
6	B	R-94	52	53	61				
6	B	R-95	52	54	59				
6	B	R-96	53	55	57				
6	B	R-97	54	55	57				
6	B	R-98	53	55	56				
6	B	R-99	46	47	49				
6	B	R-100	45	47	49				
6	B	R-101	45	47	48				
6	B	R-102	45	46	47				
6	B	R-103	44	45	46				
6	B	R-104	43	44	45				
6	B	R-105	60	61	63				
6	B	R-106	61	63	64				
6	B	R-107	62	63	64				
6	B	R-108	58	59	62				

CNE	NAC	Receptor	Existing 2016	No-Build 2045	Build 2045	Build 2045 with Potential Barrier	IL	Impacted and Benefited?	Not Impacted and Benefited?
6	B	R-109	60	62	63				
6	B	R-110	61	62	63				
6	B	R-111	54	55	58				
6	B	R-112	57	58	60				
6	B	R-113	58	59	60				
6	B	R-114	53	54	57				
6	B	R-115	56	57	59				
6	B	R-116	57	58	59				
6	B	R-117	49	51	52				
6	B	R-118	52	54	56				
6	B	R-119	53	55	56				
6	B	R-120	48	50	51				
6	B	R-121	52	53	55				
6	B	R-122	52	54	55				
6	B	R-123	61	63	67				
6	B	R-124	64	65	68				
6	B	R-125	64	66	67				
6	B	R-126	59	61	66				
6	B	R-127	63	64	66				
6	B	R-128	63	65	67				
6	B	R-129	55	57	62				
6	B	R-130	60	61	64				
6	B	R-131	61	62	64				
6	B	R-132	54	55	61				
6	B	R-133	59	60	62				
6	B	R-134	59	61	63				
6	B	R-135	51	52	56				
6	B	R-136	55	56	59				
6	B	R-137	56	57	59				
6	B	R-138	50	51	54				
6	B	R-139	54	55	58				
6	B	R-140	55	56	58				
6	B	R-141	54	55	56				
6	B	R-142	56	58	58				
6	B	R-143	56	58	58				
6	B	R-144	52	54	54				
6	B	R-145	55	56	57				
6	B	R-146	55	56	57				
6	B	R-147	48	50	56				
6	B	R-148	57	58	60				
6	B	R-149	58	59	60				
6	B	R-150	49	50	55				
6	B	R-151	56	57	59				
6	B	R-152	57	58	59				
6	B	R-153	50	51	55				
6	B	R-154	55	56	58				
6	B	R-155	56	57	58				
6	B	R-156	51	53	56				
6	B	R-157	56	58	59				
6	B	R-158	57	58	59				

CNE	NAC	Receptor	Existing 2016	No-Build 2045	Build 2045	Build 2045 with Potential Barrier	IL	Impacted and Benefited?	Not Impacted and Benefited?
6	B	R-159	51	52	55				
6	B	R-160	56	57	59				
6	B	R-161	57	58	59				
6	B	R-162	49	51	54				
6	B	R-163	55	57	58				
6	B	R-164	56	58	58				
6	B	R-165	50	51	57				
6	B	R-166	56	57	59				
6	B	R-167	57	58	59				
6	B	R-168	49	50	56				
6	B	R-169	55	56	58				
6	B	R-170	56	58	58				
6	B	R-171	49	50	53				
6	B	R-172	54	56	57				
6	B	R-173	55	57	57				
6	B	R-174	49	50	53				
6	B	R-175	54	55	56				
6	B	R-176	55	56	57				
7	B	R-177	63	65	66				
7	B	R-178	61	62	64				
7	B	R-179	59	60	62				
7	B	R-180	57	58	60				
7	B	R-181	56	57	58				
7	B	R-182	54	56	57				
7	B	R-183	53	55	56				
7	B	R-184	53	54	55				
7	B	R-185	52	53	54				
7	B	R-186	51	52	53				
7	B	R-187	64	66	67				
7	B	R-188	62	63	65				
7	B	R-189	60	62	63				
7	B	R-190	59	60	62				
7	B	R-191	57	59	60				
7	B	R-192	56	58	59				
7	B	R-193	55	57	58				
7	B	R-194	54	56	57				
7	B	R-195	54	55	56				
7	B	R-196	53	54	55				
7	B	R-197	52	53	54				
7	B	R-198	51	52	53				
7	B	R-199	65	66	67				
7	B	R-200	61	62	63				
7	B	R-201	59	60	61				
7	B	R-202	58	59	60				
7	B	R-203	56	58	58				
7	B	R-204	55	57	57				
7	B	R-205	55	56	57				
7	B	R-206	54	55	56				
7	B	R-207	53	55	55				
7	B	R-208	52	54	54				

CNE	NAC	Receptor	Existing 2016	No-Build 2045	Build 2045	Build 2045 with Potential Barrier	IL	Impacted and Benefited?	Not Impacted and Benefited?
7	B	R-209	52	53	54				
7	B	R-210	51	53	53				
7	B	R-211	52	53	53				
7	B	R-212	52	53	54				
7	B	R-213	53	54	54				
7	B	R-214	53	55	55				
7	B	R-215	54	56	56				
7	B	R-216	55	56	57				
7	B	R-217	56	57	58				
7	B	R-218	64	65	66				
7	B	R-219	59	61	62				
7	B	R-220	58	59	60				
7	B	R-221	57	58	59				
8	B	R-222	59	61	62				
8	B	R-223	57	59	60				
8	B	R-224	56	57	57				
8	B	R-225	54	55	55				
8	B	R-226	52	53	54				
8	B	R-227	51	52	53				
9	B	R-228	59	60	65				
9	B	R-229	59	60	65				
9	B	R-230	59	60	65				
9	B	R-231	59	60	66				
9	B	R-232	59	61	66				
9	B	R-233	60	61	65				
9	B	R-234	61	62	65				
9	B	R-235	60	61	63				
9	B	R-236	58	59	61				
9	B	R-237	57	58	59				
9	B	R-238	56	57	58				
9	B	R-239	54	56	57				
9	B	R-240	53	55	56				
9	B	R-241	49	51	55				
9	B	R-242	48	49	52				
9	B	R-243	46	47	48				
9	B	R-244	46	48	49				
9	B	R-245	47	48	49				
9	B	R-246	49	50	52				
9	B	R-247	53	55	56				
8	B	R-248	51	52	53				
9	B	R-249	40	41	43				
9	B	R-250	40	42	43				
9	B	R-251	41	43	44				
9	B	R-252	43	44	45				
9	B	R-253	43	45	46				
9	B	R-254	44	46	47				
9	B	R-255	47	48	49				
9	C	R-1015	60	61	displaced				
8	B	R-256	50	52	52				
10	B	R-257	63	65	66				

CNE	NAC	Receptor	Existing 2016	No-Build 2045	Build 2045	Build 2045 with Potential Barrier	IL	Impacted and Benefited?	Not Impacted and Benefited?
10	B	R-258	60	61	63				
10	B	R-259	57	58	60				
10	B	R-260	55	56	58				
10	B	R-261	53	55	56				
10	B	R-262	54	55	56				
10	C	R-263	60	61	63				
10	B	R-264	69	71	72				
11	B	R-265	59	60	60				
11	B	R-266	58	59	59				
11	B	R-267	57	58	57				
11	B	R-268	56	57	57				
12	B	R-269	59	60	62				
12	B	R-270	57	59	60				
12	B	R-271	57	58	59				
12	B	R-272	56	57	58				
12	B	R-273	60	61	63				
12	B	R-274	59	60	61				
12	B	R-275	58	59	60				
12	B	R-276	56	58	58				
12	B	R-277	55	57	57				
12	B	R-278	54	56	56				
12	B	R-279	53	54	55				
12	B	R-280	58	59	60				
12	B	R-281	53	54	55				
12	B	R-282	51	52	53				
12	B	R-283	49	50	51				
12	B	R-284	47	49	50				
12	B	R-285	46	48	48				
12	B	R-286	45	47	47				
12	B	R-287	50	51	52				
12	B	R-288	50	52	52				
12	B	R-289	51	52	53				
12	B	R-290	51	52	53				
12	B	R-291	50	51	52				
12	B	R-292	48	49	50				
12	B	R-293	46	48	48				
12	B	R-294	48	49	50				
12	B	R-295	47	48	49				
12	B	R-296	44	45	46				
12	B	R-297	38	39	40				
12	B	R-298	37	39	39				
12	B	R-299	37	38	38				
12	B	R-300	36	37	37				
12	B	R-301	35	36	36				
12	B	R-302	35	37	37				
12	B	R-303	46	48	48				
12	B	R-304	49	50	49				
12	B	R-305	58	59	61				
12	B	R-306	54	55	57				
12	B	R-307	52	53	55				

CNE	NAC	Receptor	Existing 2016	No-Build 2045	Build 2045	Build 2045 with Potential Barrier	IL	Impacted and Benefited?	Not Impacted and Benefited?
12	B	R-308	51	53	53				
12	B	R-309	58	59	61				
12	B	R-310	54	55	56				
12	B	R-311	52	53	55				
12	B	R-312	51	52	53				
13	B	R-313	58	59	64	52	12		YES
13	B	R-314	56	58	62	51	11		YES
13	B	R-315	55	56	61	49	11		YES
13	B	R-316	54	55	58	48	10		YES
13	B	R-317	52	53	56	46	10		YES
13	B	R-318	51	52	54	45	9		YES
13	B	R-319	50	51	53	44	8		YES
13	B	R-320	49	50	51	44	8		YES
13	B	R-321	45	47	48	43	5		YES
13	B	R-322	44	46	47	41	6		YES
13	B	R-323	56	57	61	50	12		YES
13	B	R-324	54	55	59	48	11		YES
13	B	R-325	53	54	57	47	10		YES
13	B	R-326	51	53	55	45	9		YES
13	B	R-327	50	52	53	44	9		YES
13	B	R-328	49	51	52	44	9		YES
13	B	R-329	49	50	51	43	8		YES
13	B	R-330	48	49	50	43	8		YES
13	B	R-331	60	61	69	60	8	YES	
13	B	R-332	60	61	69	60	8	YES	
13	B	R-333	60	62	69	60	9	YES	
13	B	R-334	61	62	69	60	8	YES	
13	B	R-335	61	63	69	61	8	YES	
13	B	R-336	62	63	69	61	8	YES	
13	B	R-337	62	63	69	61	8	YES	
13	B	R-338	62	63	69	62	7	YES	
13	B	R-339	63	65	69	63	6	YES	
13	B	R-340	61	63	68	63	5	YES	
13	B	R-341	63	64	68	64	4		
13	B	R-342	64	65	69	66	3		
13	B	R-343	65	66	68	66	2		
13	B	R-344	66	67	68	66	2		
13	B	R-345	67	68	68	67	1		
13	B	R-346	50	51	53	50	3		
13	B	R-347	51	52	54	51	3		
13	B	R-348	51	52	55	52	3		
13	B	R-349	51	52	55	53	2		
13	B	R-350	51	52	54	54	1		
13	B	R-351	49	51	52	46	6		YES
13	B	R-352	48	49	51	45	6		YES
13	B	R-353	47	48	50	44	6		YES
13	B	R-354	46	48	49	44	5		YES
13	B	R-355	46	47	48	43	5		YES
13	B	R-356	45	47	48	43	5		YES
13	B	R-357	44	46	47	43	4		

CNE	NAC	Receptor	Existing 2016	No-Build 2045	Build 2045	Build 2045 with Potential Barrier	IL	Impacted and Benefited?	Not Impacted and Benefited?
13	B	R-358	57	58	59	59	0		
13	B	R-359	56	57	57	57	0		
13	B	R-360	55	56	56	56	0		
13	B	R-361	54	55	55	55	0		
13	B	R-362	53	54	54	54	0		
13	B	R-363	52	53	53	53	0		
13	B	R-364	51	52	52	52	0		
12	B	R-364	58	59	60				
12	B	R-365	58	60	60				
12	B	R-366	59	60	60				
12	B	R-367	59	60	60				
13	B	R-369	44	45	47	47	0		
13	B	R-370	41	43	43	43	0		
13	B	R-371	42	43	43	42	1		
13	B	R-372	50	52	51	51	0		
13	B	R-373	50	51	50	50	0		
13	B	R-374	49	50	50	50	0		
13	B	R-375	48	50	49	49	0		
13	B	R-376	48	49	49	49	0		
13	B	R-377	47	48	49	43	6		YES
13	B	R-378	47	48	49	43	5		YES
13	B	R-379	46	48	48	43	5		YES
13	B	R-380	46	47	47	42	5		YES
13	B	R-381	45	47	46	42	4		
13	B	R-382	44	46	45	40	5		
13	B	R-383	59	60	65	56	10		YES
13	B	R-384	61	63	68	56	12	YES	
13	C	R-1012	51	52	51	51	0		
13	C	R-1013	54	55	54	54	0		
14	B	R-385	47	49	46				
14	B	R-386	44	45	45				
15	B	R-387	51	53	50				
15	B	R-388	51	53	50				
15	B	R-389	51	52	50				
15	B	R-390	51	52	50				
15	B	R-391	51	52	50				
15	B	R-392	52	53	53				
15	B	R-393	51	53	52				
15	B	R-394	51	52	51				
15	B	R-395	51	52	51				
15	B	R-396	51	52	51				
15	B	R-397	50	52	51				
15	B	R-398	52	54	53				
15	B	R-399	51	52	52				
16	B	R-400	58	60	59				
16	B	R-401	59	60	60				
16	B	R-402	57	58	57				
16	B	R-403	57	58	58				
16	B	R-404	57	59	58				
16	B	R-405	54	55	54				

CNE	NAC	Receptor	Existing 2016	No-Build 2045	Build 2045	Build 2045 with Potential Barrier	IL	Impacted and Benefited?	Not Impacted and Benefited?
16	B	R-406	53	54	54				
17	B	R-407	62	63	63				
17	B	R-408	62	63	63				
17	B	R-409	62	63	62				
17	B	R-410	62	63	63				
17	B	R-411	62	63	63				
17	B	R-412	62	64	64				
17	B	R-413	57	58	58				
17	B	R-414	56	58	58				
18	B	R-415	65	66	61				
18	B	R-416	57	59	56				
18	B	R-417	59	61	57				
18	B	R-418	57	58	56				
18	B	R-419	55	57	54				
18	B	R-420	54	56	53				
18	B	R-421	59	61	57				
18	B	R-422	58	60	58				
18	B	R-423	57	59	57				
18	B	R-424	55	57	55				
18	B	R-425	54	56	54				
18	B	R-426	54	56	54				
18	B	R-427	71	73	displaced				
18	C	R-1014	61	62	61				
19	B	R-428	64	66	65	62	3		
19	B	R-429	69	71	71	67	5	YES	
19	B	R-430	69	71	71	67	4		
19	B	R-431	64	66	65	60	5		YES
19	B	R-432	69	71	71	64	7	YES	
19	B	R-433	69	70	71	64	6	YES	
19	B	R-434	64	65	63	57	6		YES
19	B	R-435	69	71	71	62	8	YES	
19	B	R-436	69	71	71	63	8	YES	
19	B	R-437	67	69	64	60	4		
19	B	R-438	70	72	72	65	7	YES	
19	B	R-439	70	72	72	65	7	YES	
19	B	R-440	55	57	55	55	0		
19	B	R-441	59	61	60	60	0		
19	B	R-442	59	61	60	60	0		
19	B	R-443	53	55	54	52	3		
19	B	R-444	58	60	59	56	3		
19	B	R-445	58	60	59	56	3		
19	B	R-446	56	58	60	57	3		
19	B	R-447	60	62	62	59	3		
19	B	R-448	60	62	62	59	3		
19	B	R-449	53	54	55	53	2		
19	B	R-450	57	59	59	57	2		
19	B	R-451	58	59	60	58	2		
19	B	R-452	56	57	57	57	0		
19	B	R-453	60	62	62	62	0		
19	B	R-454	61	62	62	62	0		

CNE	NAC	Receptor	Existing 2016	No-Build 2045	Build 2045	Build 2045 with Potential Barrier	IL	Impacted and Benefited?	Not Impacted and Benefited?
20	B	R-456	60	62	63				
20	B	R-457	60	62	63				
20	B	R-458	60	62	63				
20	B	R-459	60	62	63				
20	B	R-460	60	62	63				
20	B	R-461	60	62	63				
20	B	R-462	60	62	63				
20	B	R-463	60	62	64				
20	B	R-464	60	62	64				
21	B	R-465	63	64	62				
21	B	R-466	61	63	60				
21	B	R-467	67	69	65				
21	B	R-468	66	68	64				
21	B	R-469	65	66	64				
21	B	R-470	63	65	62				
21	B	R-471	61	62	61				
21	B	R-472	60	61	61				
21	B	R-473	60	61	59				
21	B	R-474	58	60	59				
21	B	R-475	58	60	59				
21	B	R-476	59	61	59				
21	B	R-477	52	54	58				
21	B	R-478	64	65	62				
21	B	R-479	70	71	displaced				
21	B	R-480	65	66	59				
21	B	R-481	62	64	61				
21	B	R-482	61	62	60				
21	B	R-483	59	61	60				
21	B	R-484	58	60	59				
21	B	R-485	58	60	59				
21	B	R-486	57	59	58				
21	B	R-487	56	57	58				
21	B	R-488	55	57	57				
21	B	R-489	55	56	57				
21	B	R-490	57	59	60				
21	B	R-491	57	58	59				
21	B	R-492	57	58	59				
21	B	R-493	57	58	59				
21	B	R-494	56	58	59				
21	B	R-495	58	59	59				
21	B	R-496	57	58	58				
21	B	R-497	59	60	60				
21	B	R-498	58	60	60				
21	B	R-499	58	59	60				
21	B	R-500	57	59	60				
21	B	R-501	57	59	60				
22	B	R-502	55	56	58				
22	B	R-503	54	55	57				
23	B	R-504	57	58	59				
23	B	R-505	59	60	62				

CNE	NAC	Receptor	Existing 2016	No-Build 2045	Build 2045	Build 2045 with Potential Barrier	IL	Impacted and Benefited?	Not Impacted and Benefited?
23	B	R-506	60	62	62				
23	B	R-507	61	62	62				
23	B	R-508	61	62	63				
23	B	R-509	61	62	63				
23	B	R-510	58	59	65				
23	B	R-511	58	59	65				
23	B	R-512	57	59	58				
23	B	R-513	69	71	displaced				
23	B	R-514	70	71	displaced				
23	B	R-515	70	72	displaced				
24	B	R-516	57	58	57				
24	B	R-517	60	61	62				
24	B	R-518	61	62	63				
24	B	R-519	57	59	59				
24	B	R-520	60	61	62				
24	B	R-521	61	63	63				
24	B	R-522	57	58	58				
24	B	R-523	60	61	62				
24	B	R-524	61	63	63				
24	B	R-525	57	58	58				
24	B	R-526	60	61	62				
24	B	R-527	61	62	63				
24	B	R-528	60	61	62				
24	B	R-529	63	64	64				
24	B	R-530	63	65	65				
24	B	R-531	57	58	58				
24	B	R-532	59	61	62				
24	B	R-533	61	62	62				
24	B	R-534	57	58	58				
24	B	R-535	59	61	62				
24	B	R-536	61	62	62				
24	B	R-537	54	56	56				
24	B	R-538	54	55	55				
24	B	R-539	54	55	55				
24	B	R-540	54	55	55				
24	B	R-541	53	55	55				
24	B	R-542	53	55	55				
24	B	R-543	53	55	55				
24	B	R-544	53	54	54				
24	B	R-545	53	55	55				
24	B	R-546	53	54	54				
24	B	R-547	52	54	53				
24	B	R-548	52	53	53				
24	B	R-549	52	53	53				
24	B	R-550	52	54	53				
24	B	R-551	53	54	54				
24	B	R-552	54	55	55				
24	B	R-553	54	55	55				
24	B	R-554	54	55	55				
24	B	R-555	54	55	54				

CNE	NAC	Receptor	Existing 2016	No-Build 2045	Build 2045	Build 2045 with Potential Barrier	IL	Impacted and Benefited?	Not Impacted and Benefited?
24	B	R-556	53	55	54				
24	B	R-557	53	55	54				
24	B	R-558	53	55	54				
24	B	R-559	53	55	54				
24	B	R-560	53	54	53				
24	B	R-561	49	50	50				
24	B	R-562	45	46	46				
24	B	R-563	44	46	46				
24	B	R-564	44	45	46				
24	B	R-565	49	50	50				
24	B	R-566	53	55	54				
24	B	R-567	54	55	56				
24	B	R-568	55	57	57				
24	B	R-569	55	57	57				
24	B	R-570	56	57	57				
24	B	R-571	56	57	57				
24	B	R-572	56	58	58				
24	B	R-573	57	58	59				
24	B	R-574	57	59	60				
24	B	R-575	58	59	61				
24	B	R-576	59	60	62				
24	B	R-577	60	61	63				
24	B	R-578	61	62	64				
24	B	R-579	62	63	65				
24	B	R-580	63	65	66				
24	B	R-581	65	67	68				
25	B	R-582	58	59	62				
25	B	R-583	53	55	56				
25	B	R-584	52	53	54				
25	B	R-585	70	71	73				
25	B	R-586	61	63	65				
25	B	R-587	51	52	54				
25	B	R-588	50	51	53				
26	B	R-589	49	50	50				
26	B	R-590	52	53	55				
26	B	R-591	54	55	56				
26	B	R-592	50	52	52				
26	B	R-593	53	54	56				
26	B	R-594	55	56	57				
27	B	R-595	56	58	58				
27	B	R-596	55	56	56				
27	B	R-597	56	58	58				
27	B	R-598	55	57	56				
27	B	R-599	52	53	54				
27	B	R-600	52	54	54				
27	B	R-601	53	54	54				
27	B	R-602	53	54	54				
27	B	R-603	53	54	54				
27	B	R-604	53	55	55				
31	B	R-605	61	63	62				

CNE	NAC	Receptor	Existing 2016	No-Build 2045	Build 2045	Build 2045 with Potential Barrier	IL	Impacted and Benefited?	Not Impacted and Benefited?
31	B	R-606	64	65	66				
31	B	R-607	65	66	66				
31	B	R-608	65	66	66				
31	B	R-609	61	62	61				
31	B	R-610	63	65	65				
31	B	R-611	64	65	66				
31	B	R-612	64	66	66				
31	B	R-613	48	49	50				
31	B	R-614	52	53	52				
31	B	R-615	54	55	55				
31	B	R-616	48	49	50				
31	B	R-617	52	53	53				
31	B	R-618	53	55	55				
31	B	R-619	52	53	54				
31	B	R-620	55	56	57				
31	B	R-621	56	57	58				
31	B	R-622	52	54	54				
31	B	R-623	55	56	57				
31	B	R-624	56	57	58				
31	B	R-625	52	54	54				
31	B	R-626	54	56	57				
31	B	R-627	56	57	58				
31	B	R-628	52	54	54				
31	B	R-629	54	56	57				
31	B	R-630	56	57	58				
31	B	R-631	51	52	52				
31	B	R-632	54	55	56				
31	B	R-633	55	56	57				
31	B	R-634	51	52	52				
31	B	R-635	54	55	56				
31	B	R-636	55	56	57				
31	B	R-637	51	53	54				
31	B	R-638	56	57	57				
31	B	R-639	57	58	60				
31	B	R-640	51	52	53				
31	B	R-641	56	57	56				
31	B	R-642	57	58	59				
31	B	R-643	58	59	60				
31	B	R-644	58	59	60				
31	B	R-645	57	59	59				
31	B	R-646	57	58	59				
31	B	R-647	57	58	59				
31	B	R-648	57	58	58				
31	B	R-649	57	58	59				
31	B	R-650	57	58	59				
31	B	R-651	56	57	57				
31	B	R-652	55	56	56				
31	B	R-653	54	56	55				
31	B	R-654	54	55	55				
31	B	R-655	53	55	55				

CNE	NAC	Receptor	Existing 2016	No-Build 2045	Build 2045	Build 2045 with Potential Barrier	IL	Impacted and Benefited?	Not Impacted and Benefited?
31	B	R-656	53	54	54				
32	B	R-657	65	67	65	60	5		YES
32	B	R-658	66	68	67	61	6	YES	
32	B	R-659	66	68	68	62	6	YES	
32	B	R-660	65	67	65	60	5		YES
32	B	R-661	66	68	67	61	6	YES	
32	B	R-662	66	68	68	62	6	YES	
32	B	R-663	65	67	66	63	4		
32	B	R-664	66	67	68	64	4		
32	B	R-665	66	68	68	64	4		
32	B	R-666	65	67	66	62	4		
32	B	R-667	66	67	67	63	5	YES	
32	B	R-668	66	68	68	63	4		
32	B	R-669	66	67	68	61	7	YES	
32	B	R-670	66	67	68	62	6	YES	
32	B	R-671	66	67	69	63	6	YES	
32	B	R-672	66	67	68	60	8	YES	
32	B	R-673	66	67	68	61	7	YES	
32	B	R-674	66	67	69	62	7	YES	
32	B	R-675	65	66	65	56	9		YES
32	B	R-676	65	67	68	58	11	YES	
32	B	R-677	66	67	68	59	10	YES	
32	B	R-678	65	66	65	56	9		YES
32	B	R-679	65	67	68	57	11	YES	
32	B	R-680	66	67	68	58	10	YES	
32	B	R-681	65	66	66	54	13	YES	
32	B	R-682	65	66	67	55	12	YES	
32	B	R-683	65	67	68	57	11	YES	
32	B	R-684	65	66	66	54	12	YES	
32	B	R-685	65	66	67	55	12	YES	
32	B	R-686	65	67	67	57	10	YES	
32	B	R-687	64	66	66	55	11	YES	
32	B	R-688	65	66	66	56	11	YES	
32	B	R-689	65	67	67	58	9	YES	
32	B	R-690	64	66	65	56	10		YES
32	B	R-691	65	66	66	56	10	YES	
32	B	R-692	65	67	67	58	9	YES	
32	B	R-693	55	56	55	55	0		
32	B	R-694	57	58	57	56	1		
32	B	R-695	57	58	57	57	1		
32	B	R-696	55	55	55	55	0		
32	B	R-697	56	57	57	56	1		
32	B	R-698	57	58	57	57	1		
32	B	R-699	55	55	55	55	0		
32	B	R-700	56	57	56	56	0		
32	B	R-701	56	57	57	56	0		
32	B	R-702	55	55	55	55	0		
32	B	R-703	56	56	56	56	0		
32	B	R-704	56	57	57	56	0		
32	B	R-705	52	54	52	47	5		YES

CNE	NAC	Receptor	Existing 2016	No-Build 2045	Build 2045	Build 2045 with Potential Barrier	IL	Impacted and Benefited?	Not Impacted and Benefited?
32	B	R-706	54	55	54	47	7		YES
32	B	R-707	54	56	55	49	6		YES
32	B	R-708	51	52	52	47	5		YES
32	B	R-709	52	54	53	47	6		YES
32	B	R-710	53	54	54	49	5		YES
32	B	R-711	56	57	56	58	1		
32	B	R-712	58	60	60	59	1		
32	B	R-713	59	60	60	59	1		
32	B	R-714	56	57	56	58	1		
32	B	R-715	58	60	60	59	1		
32	B	R-716	59	60	60	59	1		
32	B	R-717	46	47	47	44	2		
32	B	R-718	46	47	47	45	2		
32	B	R-719	48	49	49	47	2		
32	B	R-720	46	47	47	46	2		
32	B	R-721	47	48	48	47	1		
32	B	R-722	48	49	49	48	1		
32	B	R-723	47	48	47	46	1		
32	B	R-724	48	49	48	48	1		
32	B	R-725	48	49	49	48	1		
32	B	R-726	47	48	48	47	1		
32	B	R-727	49	49	49	48	1		
32	B	R-728	49	49	49	49	0		
32	B	R-729	50	50	50	50	0		
32	B	R-730	51	51	51	51	0		
32	B	R-731	51	51	51	51	0		
32	B	R-732	50	51	51	50	0		
32	B	R-733	51	51	51	51	0		
32	B	R-734	51	52	52	52	0		
32	B	R-735	55	56	56	55	1		
32	B	R-736	58	59	59	57	2		
32	B	R-737	59	60	60	59	1		
32	B	R-738	54	56	56	54	1		
32	B	R-739	58	59	58	56	2		
32	B	R-740	58	60	60	58	1		
32	B	R-741	53	54	54	53	1		
32	B	R-742	56	57	56	55	1		
32	B	R-743	57	58	58	57	1		
32	B	R-744	52	54	54	53	1		
32	B	R-745	55	57	55	54	1		
32	B	R-746	56	57	57	56	1		
32	B	R-747	51	52	52	51	1		
32	B	R-748	54	55	54	53	1		
32	B	R-749	55	56	56	55	1		
32	B	R-750	50	52	52	51	1		
32	B	R-751	53	54	54	53	2		
32	B	R-752	54	55	55	54	1		
32	B	R-753	45	46	47	43	4		
32	B	R-754	45	46	47	44	3		
32	B	R-755	47	49	49	47	2		

CNE	NAC	Receptor	Existing 2016	No-Build 2045	Build 2045	Build 2045 with Potential Barrier	IL	Impacted and Benefited?	Not Impacted and Benefited?
32	B	R-756	46	47	48	44	5		YES
32	B	R-757	46	47	49	43	5		YES
33	B	R-897	43	44	51				
33	B	R-898	42	44	50				
33	B	R-899	43	44	49				
33	B	R-900	42	44	47				
33	B	R-901	43	44	49				
33	B	R-902	42	43	50				
33	B	R-903	42	43	51				
33	B	R-904	43	44	51				
33	B	R-905	50	51	53				
33	B	R-906	50	52	53				
33	B	R-907	50	52	53				
33	B	R-908	49	50	51				
33	B	R-909	45	47	47				
33	B	R-910	44	46	46				
33	B	R-911	44	45	46				
33	B	R-912	54	56	57				
33	B	R-913	54	55	56				
33	B	R-914	53	54	55				
33	B	R-915	52	53	53				
34	B	R-930	62	63	63	62	1		
34	B	R-931	63	65	64	63	1		
34	B	R-932	64	65	65	64	1		
34	B	R-933	60	62	61	61	1		
34	B	R-934	62	63	63	62	1		
34	B	R-935	63	64	63	63	1		
34	B	R-936	58	59	59	59	1		
34	B	R-937	60	62	61	61	1		
34	B	R-938	61	62	62	61	0		
34	B	R-939	57	58	58	58	1		
34	B	R-940	60	61	60	60	1		
34	B	R-941	60	61	61	60	0		
34	B	R-942	54	56	56	56	0		
34	B	R-943	58	59	59	59	0		
34	B	R-944	58	60	59	59	0		
34	B	R-945	53	55	55	55	0		
34	B	R-946	57	58	58	58	0		
34	B	R-947	58	59	59	58	0		
34	B	R-948	52	53	54	53	0		
34	B	R-949	56	57	57	57	0		
34	B	R-950	57	58	58	57	0		
34	B	R-951	57	58	68	56	12	YES	
34	B	R-952	55	57	67	56	11	YES	
34	B	R-953	54	56	66	56	9	YES	
34	B	R-954	54	55	65	56	9		YES
34	B	R-955	53	54	64	55	9		YES
34	B	R-956	52	53	63	54	9		YES
34	B	R-957	49	50	60	49	11		YES
34	B	R-958	48	49	58	51	8		YES

CNE	NAC	Receptor	Existing 2016	No-Build 2045	Build 2045	Build 2045 with Potential Barrier	IL	Impacted and Benefited?	Not Impacted and Benefited?
34	B	R-959	47	49	58	46	11		YES
34	B	R-960	46	48	56	46	11		YES
34	B	R-961	46	47	56	45	10		YES
34	B	R-962	45	46	55	45	10		YES
34	B	R-969	45	46	47	48	7		YES
34	B	R-970	43	44	45	47	0		
34	B	R-971	42	44	44	47	1		
34	B	R-972	44	46	47	47	1		
34	B	R-973	45	46	47	47	1		
34	B	R-974	45	46	48	50	0		
34	B	R-975	45	47	48	47	0		
34	B	R-976	46	47	48	45	0		
34	B	R-977	46	48	56	44	0		
34	B	R-978	46	47	56	47	0		
34	B	R-979	45	46	55	47	0		
34	B	R-980	52	53	55	48	0		
34	B	R-981	45	47	48	48	0		
34	B	R-982	46	47	48	48	0		
35	B	R-994	53	55	56				
35	B	R-995	51	53	54				
35	B	R-996	57	58	59				
35	B	R-997	52	54	55				
35	E	R-998	68	69	70				
35	B	R-999	61	62	63				
35	B	R-1000	58	59	61				
35	B	R-1001	56	57	59				
35	B	R-1002	54	55	57				
35	B	R-1003	55	56	57				
35	B	R-1004	52	54	54				
35	B	R-1005	53	54	55				
35	B	R-1006	51	53	53				
37	E	R-1007	67	68	68				
29	B	R-1008	54	56	58				
30	B	R-1009	58	59	59				
28	C	R-1010	59	60	62				
38	C	R-1011	60	61	59				

APPENDIX E NOISE MONITORING FIELD LOGS

This appendix includes data acquired during the noise monitoring measurement program, including noise monitor output and traffic counts resulting from video recording.

Site	Year	Date	Time	Duration	Leq dB(A)
M-01	2016	1-Sep	16:08:39	0:01:00	55.6
M-01	2016	1-Sep	16:09:39	0:01:00	57.3
M-01	2016	1-Sep	16:10:39	0:01:00	57.1
M-01	2016	1-Sep	16:11:39	0:01:00	53.4
M-01	2016	1-Sep	16:12:39	0:01:00	55.8
M-01	2016	1-Sep	16:13:39	0:01:00	56.9
M-01	2016	1-Sep	16:14:39	0:01:00	55.8
M-01	2016	1-Sep	16:15:39	0:01:00	57.6
M-01	2016	1-Sep	16:16:39	0:01:00	55
M-01	2016	1-Sep	16:17:39	0:01:00	55.7
M-01	2016	1-Sep	16:18:39	0:01:00	57.4
M-01	2016	1-Sep	16:19:39	0:01:00	55.3
M-01	2016	1-Sep	16:20:39	0:01:00	58.8
M-01	2016	1-Sep	16:21:39	0:01:00	60.9
M-01	2016	1-Sep	16:22:39	0:01:00	55.7
M-01	2016	1-Sep	16:23:39	0:01:00	56.3
M-01	2016	1-Sep	16:24:39	0:01:00	59.6
M-01	2016	1-Sep	16:25:39	0:01:00	53.5
M-01	2016	1-Sep	16:26:39	0:01:00	54.5
M-01	2016	1-Sep	16:27:39	0:01:00	56
M-01	2016	1-Sep	16:28:39	0:01:00	57.1
M-01	2016	1-Sep	16:29:39	0:01:00	59
M-01	2016	1-Sep	16:30:39	0:01:00	56.5
M-01	2016	1-Sep	16:31:39	0:01:00	53.5
M-01	2016	1-Sep	16:32:39	0:01:00	56.6
M-01	2016	1-Sep	16:33:39	0:01:00	54.3
M-01	2016	1-Sep	16:34:39	0:01:00	52.6
M-01	2016	1-Sep	16:35:39	0:01:00	56.7
M-01	2016	1-Sep	16:36:39	0:01:00	54.1
M-01	2016	1-Sep	16:37:39	0:01:00	54.9
M-02	2016	1-Sep	16:08:34	0:01:00	55.6
M-02	2016	1-Sep	16:09:34	0:01:00	55.5
M-02	2016	1-Sep	16:10:34	0:01:00	57.8
M-02	2016	1-Sep	16:11:34	0:01:00	54.1
M-02	2016	1-Sep	16:12:34	0:01:00	55.8
M-02	2016	1-Sep	16:13:34	0:01:00	57.1
M-02	2016	1-Sep	16:14:34	0:01:00	52.8
M-02	2016	1-Sep	16:15:34	0:01:00	57.9
M-02	2016	1-Sep	16:16:34	0:01:00	55.3
M-02	2016	1-Sep	16:17:34	0:01:00	52.7
M-02	2016	1-Sep	16:18:34	0:01:00	57.1

Site	Year	Date	Time	Duration	Leq dB(A)
M-02	2016	1-Sep	16:19:34	0:01:00	54.7
M-02	2016	1-Sep	16:20:34	0:01:00	55.1
M-02	2016	1-Sep	16:21:34	0:01:00	57.6
M-02	2016	1-Sep	16:22:34	0:01:00	55.9
M-02	2016	1-Sep	16:23:34	0:01:00	55.3
M-02	2016	1-Sep	16:24:34	0:01:00	59.4
M-02	2016	1-Sep	16:25:34	0:01:00	53.7
M-02	2016	1-Sep	16:26:34	0:01:00	53.7
M-02	2016	1-Sep	16:27:34	0:01:00	57
M-02	2016	1-Sep	16:28:34	0:01:00	53.3
M-02	2016	1-Sep	16:29:34	0:01:00	55.3
M-02	2016	1-Sep	16:30:34	0:01:00	56.8
M-02	2016	1-Sep	16:31:34	0:01:00	53.1
M-02	2016	1-Sep	16:32:34	0:01:00	57.2
M-02	2016	1-Sep	16:33:34	0:01:00	54.4
M-02	2016	1-Sep	16:34:34	0:01:00	56.9
M-02	2016	1-Sep	16:35:34	0:01:00	62.2
M-02	2016	1-Sep	16:36:34	0:01:00	55.7
M-02	2016	1-Sep	16:37:34	0:01:00	54.8
M-03	2016	1-Sep	16:08:36	0:01:00	62.4
M-03	2016	1-Sep	16:09:36	0:01:00	66.4
M-03	2016	1-Sep	16:10:36	0:01:00	68.2
M-03	2016	1-Sep	16:11:36	0:01:00	61.4
M-03	2016	1-Sep	16:12:36	0:01:00	67
M-03	2016	1-Sep	16:13:36	0:01:00	67.8
M-03	2016	1-Sep	16:14:36	0:01:00	61.1
M-03	2016	1-Sep	16:15:36	0:01:00	68.9
M-03	2016	1-Sep	16:16:36	0:01:00	65.9
M-03	2016	1-Sep	16:17:36	0:01:00	64.4
M-03	2016	1-Sep	16:18:36	0:01:00	67.8
M-03	2016	1-Sep	16:19:36	0:01:00	64.5
M-03	2016	1-Sep	16:20:36	0:01:00	63.7
M-03	2016	1-Sep	16:21:36	0:01:00	68.9
M-03	2016	1-Sep	16:22:36	0:01:00	65.3
M-03	2016	1-Sep	16:23:36	0:01:00	64.2
M-03	2016	1-Sep	16:24:36	0:01:00	67.8
M-03	2016	1-Sep	16:25:36	0:01:00	61.7
M-03	2016	1-Sep	16:26:36	0:01:00	64.9
M-03	2016	1-Sep	16:27:36	0:01:00	67.1
M-03	2016	1-Sep	16:28:36	0:01:00	62.9
M-03	2016	1-Sep	16:29:36	0:01:00	66.6
M-03	2016	1-Sep	16:30:36	0:01:00	67.6
M-03	2016	1-Sep	16:31:36	0:01:00	62.7
M-03	2016	1-Sep	16:32:36	0:01:00	67.9
M-03	2016	1-Sep	16:33:36	0:01:00	65.1
M-03	2016	1-Sep	16:34:36	0:01:00	66.3

Site	Year	Date	Time	Duration	Leq dB(A)
M-03	2016	1-Sep	16:35:36	0:01:00	67.2
M-03	2016	1-Sep	16:36:36	0:01:00	63.7
M-03	2016	1-Sep	16:37:36	0:01:00	65.9
M-04	2016	1-Sep	16:08:35	0:01:00	56.1
M-04	2016	1-Sep	16:09:35	0:01:00	56.2
M-04	2016	1-Sep	16:10:35	0:01:00	57
M-04	2016	1-Sep	16:11:35	0:01:00	55.3
M-04	2016	1-Sep	16:12:35	0:01:00	56.9
M-04	2016	1-Sep	16:13:35	0:01:00	55.3
M-04	2016	1-Sep	16:14:35	0:01:00	53.4
M-04	2016	1-Sep	16:15:35	0:01:00	57.2
M-04	2016	1-Sep	16:16:35	0:01:00	53.8
M-04	2016	1-Sep	16:17:35	0:01:00	53.9
M-04	2016	1-Sep	16:18:35	0:01:00	55.7
M-04	2016	1-Sep	16:19:35	0:01:00	57.4
M-04	2016	1-Sep	16:20:35	0:01:00	56.4
M-04	2016	1-Sep	16:21:35	0:01:00	55.5
M-04	2016	1-Sep	16:22:35	0:01:00	53.8
M-04	2016	1-Sep	16:23:35	0:01:00	56.2
M-04	2016	1-Sep	16:24:35	0:01:00	55.7
M-04	2016	1-Sep	16:25:35	0:01:00	52.5
M-04	2016	1-Sep	16:26:35	0:01:00	54.1
M-04	2016	1-Sep	16:27:35	0:01:00	56
M-04	2016	1-Sep	16:28:35	0:01:00	53.2
M-04	2016	1-Sep	16:29:35	0:01:00	55.4
M-04	2016	1-Sep	16:30:35	0:01:00	54.1
M-04	2016	1-Sep	16:31:35	0:01:00	54
M-04	2016	1-Sep	16:32:35	0:01:00	55.3
M-04	2016	1-Sep	16:33:35	0:01:00	54.2
M-04	2016	1-Sep	16:34:35	0:01:00	55.6
M-04	2016	1-Sep	16:35:35	0:01:00	58.5
M-04	2016	1-Sep	16:36:35	0:01:00	53.7
M-04	2016	1-Sep	16:37:35	0:01:00	54.6
M-05	2016	1-Sep	14:47:59	0:01:00	56.5
M-05	2016	1-Sep	14:48:59	0:01:00	59.1
M-05	2016	1-Sep	14:49:59	0:01:00	59.2
M-05	2016	1-Sep	14:50:59	0:01:00	58.4
M-05	2016	1-Sep	14:51:59	0:01:00	56.3
M-05	2016	1-Sep	14:52:59	0:01:00	58.2
M-05	2016	1-Sep	14:53:59	0:01:00	58.6
M-05	2016	1-Sep	14:54:59	0:01:00	56.5
M-05	2016	1-Sep	14:55:59	0:01:00	57.8
M-05	2016	1-Sep	14:56:59	0:01:00	55.1
M-05	2016	1-Sep	14:57:59	0:01:00	57.8
M-05	2016	1-Sep	14:58:59	0:01:00	55.8
M-05	2016	1-Sep	14:59:59	0:01:00	60.3

Site	Year	Date	Time	Duration	Leq dB(A)
M-05	2016	1-Sep	15:00:59	0:01:00	56.1
M-05	2016	1-Sep	15:01:59	0:01:00	56.8
M-05	2016	1-Sep	15:02:59	0:01:00	56.6
M-05	2016	1-Sep	15:03:59	0:01:00	58.8
M-05	2016	1-Sep	15:04:59	0:01:00	59.3
M-05	2016	1-Sep	15:05:59	0:01:00	58.5
M-05	2016	1-Sep	15:06:59	0:01:00	57.2
M-05	2016	1-Sep	15:07:59	0:01:00	58.2
M-05	2016	1-Sep	15:08:59	0:01:00	58.7
M-05	2016	1-Sep	15:09:59	0:01:00	58.7
M-05	2016	1-Sep	15:10:59	0:01:00	59.3
M-05	2016	1-Sep	15:11:59	0:01:00	56.2
M-05	2016	1-Sep	15:12:59	0:01:00	59.7
M-05	2016	1-Sep	15:13:59	0:01:00	61.9
M-05	2016	1-Sep	15:14:59	0:01:00	59
M-05	2016	1-Sep	15:15:59	0:01:00	62
M-05	2016	1-Sep	15:16:59	0:01:00	60
M-06	2016	1-Sep	14:47:47	0:01:00	56.8
M-06	2016	1-Sep	14:48:47	0:01:00	59.6
M-06	2016	1-Sep	14:49:47	0:01:00	58.2
M-06	2016	1-Sep	14:50:47	0:01:00	59.8
M-06	2016	1-Sep	14:51:47	0:01:00	65.9
M-06	2016	1-Sep	14:52:47	0:01:00	58.4
M-06	2016	1-Sep	14:53:47	0:01:00	60.2
M-06	2016	1-Sep	14:54:47	0:01:00	58.1
M-06	2016	1-Sep	14:55:47	0:01:00	58.6
M-06	2016	1-Sep	14:56:47	0:01:00	59
M-06	2016	1-Sep	14:57:47	0:01:00	58.5
M-06	2016	1-Sep	14:58:47	0:01:00	58.6
M-06	2016	1-Sep	14:59:47	0:01:00	58.2
M-06	2016	1-Sep	15:00:47	0:01:00	58.8
M-06	2016	1-Sep	15:01:47	0:01:00	58.8
M-06	2016	1-Sep	15:02:47	0:01:00	59
M-06	2016	1-Sep	15:03:47	0:01:00	57.2
M-06	2016	1-Sep	15:04:47	0:01:00	59.1
M-06	2016	1-Sep	15:05:47	0:01:00	59.2
M-06	2016	1-Sep	15:06:47	0:01:00	59.3
M-06	2016	1-Sep	15:07:47	0:01:00	59.3
M-06	2016	1-Sep	15:08:47	0:01:00	59.8
M-06	2016	1-Sep	15:09:47	0:01:00	61.1
M-06	2016	1-Sep	15:10:47	0:01:00	59.8
M-06	2016	1-Sep	15:11:47	0:01:00	60.4
M-06	2016	1-Sep	15:12:47	0:01:00	58.8
M-06	2016	1-Sep	15:13:47	0:01:00	62.2
M-06	2016	1-Sep	15:14:47	0:01:00	57.1
M-06	2016	1-Sep	15:15:47	0:01:00	60.3

Site	Year	Date	Time	Duration	Leq dB(A)
M-06	2016	1-Sep	15:16:47	0:01:00	58.9
M-07	2016	1-Sep	14:48:04	0:01:00	60.8
M-07	2016	1-Sep	14:49:04	0:01:00	64
M-07	2016	1-Sep	14:50:04	0:01:00	62.3
M-07	2016	1-Sep	14:51:04	0:01:00	63.4
M-07	2016	1-Sep	14:52:04	0:01:00	62.9
M-07	2016	1-Sep	14:53:04	0:01:00	62.8
M-07	2016	1-Sep	14:54:04	0:01:00	65
M-07	2016	1-Sep	14:55:04	0:01:00	62.7
M-07	2016	1-Sep	14:56:04	0:01:00	63.4
M-07	2016	1-Sep	14:57:04	0:01:00	63.8
M-07	2016	1-Sep	14:58:04	0:01:00	62.3
M-07	2016	1-Sep	14:59:04	0:01:00	63.3
M-07	2016	1-Sep	15:00:04	0:01:00	62.8
M-07	2016	1-Sep	15:01:04	0:01:00	64.5
M-07	2016	1-Sep	15:02:04	0:01:00	64.2
M-07	2016	1-Sep	15:03:04	0:01:00	64
M-07	2016	1-Sep	15:04:04	0:01:00	62.6
M-07	2016	1-Sep	15:05:04	0:01:00	63.9
M-07	2016	1-Sep	15:06:04	0:01:00	63.3
M-07	2016	1-Sep	15:07:04	0:01:00	63.2
M-07	2016	1-Sep	15:08:04	0:01:00	63.5
M-07	2016	1-Sep	15:09:04	0:01:00	65.9
M-07	2016	1-Sep	15:10:04	0:01:00	63.5
M-07	2016	1-Sep	15:11:04	0:01:00	64.2
M-07	2016	1-Sep	15:12:04	0:01:00	64
M-07	2016	1-Sep	15:13:04	0:01:00	63.6
M-07	2016	1-Sep	15:14:04	0:01:00	63.8
M-07	2016	1-Sep	15:15:04	0:01:00	62.4
M-07	2016	1-Sep	15:16:04	0:01:00	64.3
M-07	2016	1-Sep	15:17:04	0:01:00	62.9
M-08	2016	1-Sep	14:47:34	0:01:00	61.3
M-08	2016	1-Sep	14:48:34	0:01:00	61.3
M-08	2016	1-Sep	14:49:34	0:01:00	62.5
M-08	2016	1-Sep	14:50:34	0:01:00	62.1
M-08	2016	1-Sep	14:51:34	0:01:00	62
M-08	2016	1-Sep	14:52:34	0:01:00	61.6
M-08	2016	1-Sep	14:53:34	0:01:00	61.7
M-08	2016	1-Sep	14:54:34	0:01:00	62
M-08	2016	1-Sep	14:55:34	0:01:00	61.4
M-08	2016	1-Sep	14:56:34	0:01:00	62.2
M-08	2016	1-Sep	14:57:34	0:01:00	63.1
M-08	2016	1-Sep	14:58:34	0:01:00	61.3
M-08	2016	1-Sep	14:59:34	0:01:00	62.9
M-08	2016	1-Sep	15:00:34	0:01:00	61.7
M-08	2016	1-Sep	15:01:34	0:01:00	63.3

Site	Year	Date	Time	Duration	Leq dB(A)
M-08	2016	1-Sep	15:02:34	0:01:00	63.1
M-08	2016	1-Sep	15:03:34	0:01:00	61.7
M-08	2016	1-Sep	15:04:34	0:01:00	62.6
M-08	2016	1-Sep	15:05:34	0:01:00	62.2
M-08	2016	1-Sep	15:06:34	0:01:00	62.1
M-08	2016	1-Sep	15:07:34	0:01:00	62.3
M-08	2016	1-Sep	15:08:34	0:01:00	64
M-08	2016	1-Sep	15:09:34	0:01:00	64.7
M-08	2016	1-Sep	15:10:34	0:01:00	61.5
M-08	2016	1-Sep	15:11:34	0:01:00	63.9
M-08	2016	1-Sep	15:12:34	0:01:00	61
M-08	2016	1-Sep	15:13:34	0:01:00	62.5
M-08	2016	1-Sep	15:14:34	0:01:00	61.8
M-08	2016	1-Sep	15:15:34	0:01:00	63.9
M-08	2016	1-Sep	15:16:34	0:01:00	62.9
M-09	2016	1-Sep	13:32:36	0:01:00	60.8
M-09	2016	1-Sep	13:33:36	0:01:00	57.9
M-09	2016	1-Sep	13:34:36	0:01:00	61.4
M-09	2016	1-Sep	13:35:36	0:01:00	59.8
M-09	2016	1-Sep	13:36:36	0:01:00	58
M-09	2016	1-Sep	13:37:36	0:01:00	59.3
M-09	2016	1-Sep	13:38:36	0:01:00	57.9
M-09	2016	1-Sep	13:39:36	0:01:00	59.6
M-09	2016	1-Sep	13:40:36	0:01:00	58.1
M-09	2016	1-Sep	13:41:36	0:01:00	59.8
M-09	2016	1-Sep	13:42:36	0:01:00	60.1
M-09	2016	1-Sep	13:43:36	0:01:00	59.4
M-09	2016	1-Sep	13:44:36	0:01:00	59.9
M-09	2016	1-Sep	13:45:36	0:01:00	57.5
M-09	2016	1-Sep	13:46:36	0:01:00	59.8
M-09	2016	1-Sep	13:47:36	0:01:00	57.5
M-09	2016	1-Sep	13:48:36	0:01:00	60.5
M-09	2016	1-Sep	13:49:36	0:01:00	63.3
M-09	2016	1-Sep	13:50:36	0:01:00	59.2
M-09	2016	1-Sep	13:51:36	0:01:00	60.6
M-09	2016	1-Sep	13:52:36	0:01:00	58.4
M-09	2016	1-Sep	13:53:36	0:01:00	60
M-09	2016	1-Sep	13:54:36	0:01:00	57.6
M-09	2016	1-Sep	13:55:36	0:01:00	58.2
M-09	2016	1-Sep	13:56:36	0:01:00	59.2
M-09	2016	1-Sep	13:57:36	0:01:00	59.5
M-09	2016	1-Sep	13:58:36	0:01:00	60.4
M-09	2016	1-Sep	13:59:36	0:01:00	58
M-09	2016	1-Sep	14:00:36	0:01:00	60.2
M-09	2016	1-Sep	14:01:36	0:01:00	57.4
M-10	2016	1-Sep	13:32:31	0:01:00	54.2

Site	Year	Date	Time	Duration	Leq dB(A)
M-10	2016	1-Sep	13:33:31	0:01:00	53.3
M-10	2016	1-Sep	13:34:31	0:01:00	53.3
M-10	2016	1-Sep	13:35:31	0:01:00	55.9
M-10	2016	1-Sep	13:36:31	0:01:00	55.3
M-10	2016	1-Sep	13:37:31	0:01:00	56
M-10	2016	1-Sep	13:38:31	0:01:00	54.9
M-10	2016	1-Sep	13:39:31	0:01:00	57.5
M-10	2016	1-Sep	13:40:31	0:01:00	56.4
M-10	2016	1-Sep	13:41:31	0:01:00	54.6
M-10	2016	1-Sep	13:42:31	0:01:00	59.3
M-10	2016	1-Sep	13:43:31	0:01:00	57
M-10	2016	1-Sep	13:44:31	0:01:00	62.1
M-10	2016	1-Sep	13:45:31	0:01:00	59.8
M-10	2016	1-Sep	13:46:31	0:01:00	60.1
M-10	2016	1-Sep	13:47:31	0:01:00	61
M-10	2016	1-Sep	13:48:31	0:01:00	57.4
M-10	2016	1-Sep	13:49:31	0:01:00	59.4
M-10	2016	1-Sep	13:50:31	0:01:00	61
M-10	2016	1-Sep	13:51:31	0:01:00	61
M-10	2016	1-Sep	13:52:31	0:01:00	59.5
M-10	2016	1-Sep	13:53:31	0:01:00	56.7
M-10	2016	1-Sep	13:54:31	0:01:00	55.6
M-10	2016	1-Sep	13:55:31	0:01:00	55.3
M-10	2016	1-Sep	13:56:31	0:01:00	55
M-10	2016	1-Sep	13:57:31	0:01:00	56.1
M-10	2016	1-Sep	13:58:31	0:01:00	57.4
M-10	2016	1-Sep	13:59:31	0:01:00	57.5
M-10	2016	1-Sep	14:00:31	0:01:00	59.3
M-10	2016	1-Sep	14:01:31	0:01:00	55.8
M-11	2016	1-Sep	13:33:01	0:01:00	61.6
M-11	2016	1-Sep	13:34:01	0:01:00	62.6
M-11	2016	1-Sep	13:35:01	0:01:00	66.6
M-11	2016	1-Sep	13:36:01	0:01:00	58.8
M-11	2016	1-Sep	13:37:01	0:01:00	61.4
M-11	2016	1-Sep	13:38:01	0:01:00	60.3
M-11	2016	1-Sep	13:39:01	0:01:00	60
M-11	2016	1-Sep	13:40:01	0:01:00	64.5
M-11	2016	1-Sep	13:41:01	0:01:00	64.1
M-11	2016	1-Sep	13:42:01	0:01:00	63.8
M-11	2016	1-Sep	13:43:01	0:01:00	61.5
M-11	2016	1-Sep	13:44:01	0:01:00	61.2
M-11	2016	1-Sep	13:45:01	0:01:00	60.6
M-11	2016	1-Sep	13:46:01	0:01:00	57
M-11	2016	1-Sep	13:47:01	0:01:00	61.7
M-11	2016	1-Sep	13:48:01	0:01:00	70.5
M-11	2016	1-Sep	13:49:01	0:01:00	65

Site	Year	Date	Time	Duration	Leq dB(A)
M-11	2016	1-Sep	13:50:01	0:01:00	59.3
M-11	2016	1-Sep	13:51:01	0:01:00	64
M-11	2016	1-Sep	13:52:01	0:01:00	59.6
M-11	2016	1-Sep	13:53:01	0:01:00	60.3
M-11	2016	1-Sep	13:54:01	0:01:00	61.6
M-11	2016	1-Sep	13:55:01	0:01:00	57.7
M-11	2016	1-Sep	13:56:01	0:01:00	61.3
M-11	2016	1-Sep	13:57:01	0:01:00	59.2
M-11	2016	1-Sep	13:58:01	0:01:00	64
M-11	2016	1-Sep	13:59:01	0:01:00	59.2
M-11	2016	1-Sep	14:00:01	0:01:00	60
M-11	2016	1-Sep	14:01:01	0:01:00	62
M-11	2016	1-Sep	14:02:01	0:01:00	65.5
M-12	2016	1-Sep	13:32:52	0:01:00	57.9
M-12	2016	1-Sep	13:33:52	0:01:00	55.9
M-12	2016	1-Sep	13:34:52	0:01:00	57
M-12	2016	1-Sep	13:35:52	0:01:00	55.4
M-12	2016	1-Sep	13:36:52	0:01:00	56.2
M-12	2016	1-Sep	13:37:52	0:01:00	55.5
M-12	2016	1-Sep	13:38:52	0:01:00	52.3
M-12	2016	1-Sep	13:39:52	0:01:00	56.9
M-12	2016	1-Sep	13:40:52	0:01:00	54.9
M-12	2016	1-Sep	13:41:52	0:01:00	57
M-12	2016	1-Sep	13:42:52	0:01:00	57.1
M-12	2016	1-Sep	13:43:52	0:01:00	56.5
M-12	2016	1-Sep	13:44:52	0:01:00	57.6
M-12	2016	1-Sep	13:45:52	0:01:00	56
M-12	2016	1-Sep	13:46:52	0:01:00	58.2
M-12	2016	1-Sep	13:47:52	0:01:00	55.5
M-12	2016	1-Sep	13:48:52	0:01:00	58.5
M-12	2016	1-Sep	13:49:52	0:01:00	57.7
M-12	2016	1-Sep	13:50:52	0:01:00	58.4
M-12	2016	1-Sep	13:51:52	0:01:00	57.7
M-12	2016	1-Sep	13:52:52	0:01:00	58.6
M-12	2016	1-Sep	13:53:52	0:01:00	59.4
M-12	2016	1-Sep	13:54:52	0:01:00	53.7
M-12	2016	1-Sep	13:55:52	0:01:00	57
M-12	2016	1-Sep	13:56:52	0:01:00	54.3
M-12	2016	1-Sep	13:57:52	0:01:00	58.9
M-12	2016	1-Sep	13:58:52	0:01:00	59
M-12	2016	1-Sep	13:59:52	0:01:00	59.7
M-12	2016	1-Sep	14:00:52	0:01:00	60.3
M-12	2016	1-Sep	14:01:52	0:01:00	55.3
M-13	2016	1-Sep	12:14:07	0:01:00	59
M-13	2016	1-Sep	12:15:07	0:01:00	57
M-13	2016	1-Sep	12:16:07	0:01:00	59.9

Site	Year	Date	Time	Duration	Leq dB(A)
M-13	2016	1-Sep	12:17:07	0:01:00	61.6
M-13	2016	1-Sep	12:18:07	0:01:00	58.7
M-13	2016	1-Sep	12:19:07	0:01:00	61.7
M-13	2016	1-Sep	12:20:07	0:01:00	64.4
M-13	2016	1-Sep	12:21:07	0:01:00	62.8
M-13	2016	1-Sep	12:22:07	0:01:00	63.7
M-13	2016	1-Sep	12:23:07	0:01:00	62.9
M-13	2016	1-Sep	12:24:07	0:01:00	59.9
M-13	2016	1-Sep	12:25:07	0:01:00	59.6
M-13	2016	1-Sep	12:26:07	0:01:00	62.8
M-13	2016	1-Sep	12:27:07	0:01:00	61.1
M-13	2016	1-Sep	12:28:07	0:01:00	60.4
M-13	2016	1-Sep	12:29:07	0:01:00	59.8
M-13	2016	1-Sep	12:30:07	0:01:00	56.9
M-13	2016	1-Sep	12:31:07	0:01:00	57.9
M-13	2016	1-Sep	12:32:07	0:01:00	57.3
M-13	2016	1-Sep	12:33:07	0:01:00	58.5
M-13	2016	1-Sep	12:34:07	0:01:00	60.2
M-13	2016	1-Sep	12:35:07	0:01:00	58.4
M-13	2016	1-Sep	12:36:07	0:01:00	58.9
M-13	2016	1-Sep	12:37:07	0:01:00	58
M-13	2016	1-Sep	12:38:07	0:01:00	59
M-13	2016	1-Sep	12:39:07	0:01:00	58.4
M-13	2016	1-Sep	12:40:07	0:01:00	57.7
M-13	2016	1-Sep	12:41:07	0:01:00	60
M-13	2016	1-Sep	12:42:07	0:01:00	56
M-13	2016	1-Sep	12:43:07	0:01:00	58.8
M-14	2016	1-Sep	12:13:49	0:01:00	55.5
M-14	2016	1-Sep	12:14:49	0:01:00	55.3
M-14	2016	1-Sep	12:15:49	0:01:00	54.8
M-14	2016	1-Sep	12:16:49	0:01:00	56.9
M-14	2016	1-Sep	12:17:49	0:01:00	58.2
M-14	2016	1-Sep	12:18:49	0:01:00	59.6
M-14	2016	1-Sep	12:19:49	0:01:00	59.8
M-14	2016	1-Sep	12:20:49	0:01:00	60.5
M-14	2016	1-Sep	12:21:49	0:01:00	61.6
M-14	2016	1-Sep	12:22:49	0:01:00	59.9
M-14	2016	1-Sep	12:23:49	0:01:00	60.6
M-14	2016	1-Sep	12:24:49	0:01:00	57.7
M-14	2016	1-Sep	12:25:49	0:01:00	62.4
M-14	2016	1-Sep	12:26:49	0:01:00	61.4
M-14	2016	1-Sep	12:27:49	0:01:00	59.2
M-14	2016	1-Sep	12:28:49	0:01:00	58.2
M-14	2016	1-Sep	12:29:49	0:01:00	56.2
M-14	2016	1-Sep	12:30:49	0:01:00	56.1
M-14	2016	1-Sep	12:31:49	0:01:00	54.7

Site	Year	Date	Time	Duration	Leq dB(A)
M-14	2016	1-Sep	12:32:49	0:01:00	58
M-14	2016	1-Sep	12:33:49	0:01:00	63.9
M-14	2016	1-Sep	12:34:49	0:01:00	58.6
M-14	2016	1-Sep	12:35:49	0:01:00	58.7
M-14	2016	1-Sep	12:36:49	0:01:00	56.5
M-14	2016	1-Sep	12:37:49	0:01:00	62.4
M-14	2016	1-Sep	12:38:49	0:01:00	56.3
M-14	2016	1-Sep	12:39:49	0:01:00	57.2
M-14	2016	1-Sep	12:40:49	0:01:00	57.2
M-14	2016	1-Sep	12:41:49	0:01:00	55.2
M-14	2016	1-Sep	12:42:49	0:01:00	56.5

Traffic was recorded on video during short-term noise monitoring on September 1, 2016, with the results shown below.

Traffic Measurement Session	Roadway	Cars	Medium Trucks	Heavy Trucks	Buses	Motorcycles
12:14 – 12-44	Route 1 NB	584	25	4	2	1
12:14 – 12-44	Route 1 SB	618	11	6	2	1
13:33 – 14:03	Route 1 NB	597	10	7	7	1
13:33 – 14:03	Route 1 SB	574	9	6	5	1
14:48 – 15:18	Route 1 NB	611	15	2	8	2
14:48 – 15:18	Route 1 SB	612	11	3	5	2
16:09 – 16:39	Route 1 NB	712	11	1	5	2
16:09 – 16:39	Route 1 SB	618	12	3	4	0

APPENDIX F WARRANTED, FEASIBLE AND REASONABLE WORKSHEETS

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:	August 8, 2017
Project No. and UPC:	VDOT Project #: 0001-029-205, C501, P101, R201 UPC#: 107187
County:	Fairfax
Facility:	Richmond Hwy
Barrier System ID:	1P
Noise Abatement Category(s)	B
Community Name and/or CNE#	CNE 03

Design phase: [X] 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). — TBD
   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." — [X] Yes [ ] No

2. Criteria requiring consideration of noise abatement
   a. Project causes design year noise levels to approach or exceed the Noise Abatement Criteria? — [X] Yes [ ] No
   b. Project causes a substantial noise increase of 10 dBA or more? — [ ] Yes [X] No

Feasibility

1. Impacted receptor units
   a. Number of impacted receptor units: — 3
   b. Number of impacted receptor units receiving 5 dBA or more insertion loss (IL): — 3
   c. Percentage of impacted receptor units receiving 5 dB(A) or more IL — 100
   d. Is the percentage 50 or greater? — [X] 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. (ft^2)	4,875
b. Impacted noise sensitive receptor(s) receiving 5 dB(A) IL or more.	3
c. Non-impacted noise sensitive receptor(s) receiving 5 dB(A) IL or more.	3
d. Total number of benefited receptors.	6
e. Surface Area per benefited receptor unit. (ft^2/BR)	813
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." ☐ Yes ☐ No

3. Additional Noise Barrier Details

a. Length of the proposed noise barrier	325
b Height range of the proposed noise barrier	15
c. Average height of the proposed noise barrier	15
d Cost per square foot. ($/$ft^2$)	$42
e. Total Barrier Cost ($)	$204,750
f. Additional comments (if applicable)	
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: REASONABLENESS IS PENDING COMMUNITY DECISION

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:	August 8, 2017
Project No. and UPC:	VDOT Project #: 0001-029-205, C501, P101, R201 UPC#: 107187
County:	Fairfax
Facility:	Richmond Hwy
Barrier System ID:	2P
Noise Abatement Category(s)	B
Community Name and/or CNE#	CNE 06

Design phase: [X] 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). — TBD
   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." — [X] Yes [ ] No

2. Criteria requiring consideration of noise abatement
   a. Project causes design year noise levels to approach or exceed the Noise Abatement Criteria? — [X] Yes [ ] No
   b. Project causes a substantial noise increase of 10 dBA or more? — [ ] Yes [X] No

Feasibility

1. Impacted receptor units
   a. Number of impacted receptor units: — 8
   b. Number of impacted receptor units receiving 5 dBA or more insertion loss (IL): — 2
   c. Percentage of impacted receptor units receiving 5 dB(A) or more IL — 25
   d. Is the percentage 50 or greater? — [ ] Yes [X] 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) _____
   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 _____
   b Height range of the proposed noise barrier _____
   c. Average height of the proposed noise barrier _____
   d Cost per square foot. ($/ft²) $42
   e. Total Barrier Cost ($) _____
   f. Additional comments (if applicable) _____
   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: _____

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:	August 8, 2017
Project No. and UPC:	VDOT Project #: 0001-029-205, C501, P101, R201 UPC#: 107187
County:	Fairfax
Facility:	Richmond Hwy
Barrier System ID:	4P
Noise Abatement Category(s)	B
Community Name and/or CNE#	CNE 09

Design phase: [X] 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). — TBD
   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." — [X] Yes [ ] No

2. Criteria requiring consideration of noise abatement
   a. Project causes design year noise levels to approach or exceed the Noise Abatement Criteria? — [X] Yes [ ] No
   b. Project causes a substantial noise increase of 10 dBA or more? — [ ] Yes [X] No

Feasibility

1. Impacted receptor units
   a. Number of impacted receptor units: — 2
   b. Number of impacted receptor units receiving 5 dBA or more insertion loss (IL): — 1
   c. Percentage of impacted receptor units receiving 5 dB(A) or more IL — 50
   d. Is the percentage 50 or greater? — [X] 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. (ft^2)	10,620
b. Impacted noise sensitive receptor(s) receiving 5 dB(A) IL or more.	1
c. Non-impacted noise sensitive receptor(s) receiving 5 dB(A) IL or more.	5
d. Total number of benefited receptors.	6
e. Surface Area per benefited receptor unit. (ft^2/BR)	1,770
f. Is (1e) less than or equal to the maximum square feet per benefited receptor (MaxSF/BR) value of 1600?	No
g. Does the barrier provide an IL of at least 7 dB(A) for at least one impacted receptor in the design year?	No

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	354
b Height range of the proposed noise barrier	30
c. Average height of the proposed noise barrier	30
d Cost per square foot. ($/$ft^2$)	$42
e. Total Barrier Cost ($)	$446,040
f. Additional comments (if applicable)	
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: _____

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:	August 8, 2017
Project No. and UPC:	VDOT Project #: 0001-029-205, C501, P101, R201 UPC#: 107187
County:	Fairfax
Facility:	Richmond Hwy
Barrier System ID:	6P
Noise Abatement Category(s)	B
Community Name and/or CNE#	CNE 13

Design phase: [X] 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). — TBD
   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." — [X] Yes [ ] No

2. Criteria requiring consideration of noise abatement
   a. Project causes design year noise levels to approach or exceed the Noise Abatement Criteria? — [X] Yes [ ] No
   b. Project causes a substantial noise increase of 10 dBA or more? — [ ] Yes [X] No

Feasibility

1. Impacted receptor units
   a. Number of impacted receptor units: — 16
   b. Number of impacted receptor units receiving 5 dBA or more insertion loss (IL): — 11
   c. Percentage of impacted receptor units receiving 5 dB(A) or more IL — 69%
   d. Is the percentage 50 or greater? — [X] 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)	5,265
b. Impacted noise sensitive receptor(s) receiving 5 dB(A) IL or more.	11
c. Non-impacted noise sensitive receptor(s) receiving 5 dB(A) IL or more.	29
d. Total number of benefited receptors.	40
e. Surface Area per benefited receptor unit. (ft²/BR)	132
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." ☐ Yes ☐ No

3. Additional Noise Barrier Details

a. Length of the proposed noise barrier	351
b Height range of the proposed noise barrier	15
c. Average height of the proposed noise barrier	15
d Cost per square foot. ($/ft²)	$42
e. Total Barrier Cost ($)	$221,130
f. Additional comments (if applicable)	
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: REASONABLENESS PENDING COMMUNITY DECISION

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:	August 8, 2017
Project No. and UPC:	VDOT Project #: 0001-029-205, C501, P101, R201 UPC#: 107187
County:	Fairfax
Facility:	Richmond Hwy
Barrier System ID:	7P
Noise Abatement Category(s)	B
Community Name and/or CNE#	CNE 19

Design phase: [X] 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). — TBD
   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." — [X] Yes [ ] No

2. Criteria requiring consideration of noise abatement
   a. Project causes design year noise levels to approach or exceed the Noise Abatement Criteria? — [X] Yes [ ] No
   b. Project causes a substantial noise increase of 10 dBA or more? — [ ] Yes [X] No

Feasibility

1. Impacted receptor units
   a. Number of impacted receptor units: — 16
   b. Number of impacted receptor units receiving 5 dBA or more insertion loss (IL): — 14
   c. Percentage of impacted receptor units receiving 5 dB(A) or more IL — 87.5
   d. Is the percentage 50 or greater? — [X] 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)	8,325
b. Impacted noise sensitive receptor(s) receiving 5 dB(A) IL or more.	14
c. Non-impacted noise sensitive receptor(s) receiving 5 dB(A) IL or more.	4
d. Total number of benefited receptors.	18
e. Surface Area per benefited receptor unit. (ft²/BR)	463
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." ☐ Yes ☐ No

3. Additional Noise Barrier Details

a. Length of the proposed noise barrier	333
b Height range of the proposed noise barrier	25
c. Average height of the proposed noise barrier	25
d Cost per square foot. ($/ft²)	$42
e. Total Barrier Cost ($)	$349,650
f. Additional comments (if applicable)	
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: REASONABLENESS PENDING COMMUNITY DECISION

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:	August 8, 2017
Project No. and UPC:	VDOT Project #: 0001-029-205, C501, P101, R201 UPC#: 107187
County:	Fairfax
Facility:	Richmond Hwy
Barrier System ID:	10P
Noise Abatement Category(s)	B
Community Name and/or CNE#	CNE 31

Design phase: [X] 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). — TBD
   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." — [X] Yes [ ] No

2. Criteria requiring consideration of noise abatement
   a. Project causes design year noise levels to approach or exceed the Noise Abatement Criteria? — [X] Yes [ ] No
   b. Project causes a substantial noise increase of 10 dBA or more? — [ ] Yes [X] No

Feasibility

1. Impacted receptor units
   a. Number of impacted receptor units: — 5
   b. Number of impacted receptor units receiving 5 dBA or more insertion loss (IL): — 2
   c. Percentage of impacted receptor units receiving 5 dB(A) or more IL — 40
   d. Is the percentage 50 or greater? — [ ] Yes [X] 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) _____
   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 _____
   b Height range of the proposed noise barrier _____
   c. Average height of the proposed noise barrier _____
   d Cost per square foot. ($/ft²) $42
   e. Total Barrier Cost ($) _____
   f. Additional comments (if applicable) _____
   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: _____

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:	August 8, 2017
Project No. and UPC:	VDOT Project #: 0001-029-205, C501, P101, R201 UPC#: 107187
County:	Fairfax
Facility:	Richmond Hwy
Barrier System ID:	11P
Noise Abatement Category(s)	B
Community Name and/or CNE#	CNE 32

Design phase: [X] 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). — TBD
   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." — [X] Yes [ ] No

2. Criteria requiring consideration of noise abatement
   a. Project causes design year noise levels to approach or exceed the Noise Abatement Criteria? — [X] Yes [ ] No
   b. Project causes a substantial noise increase of 10 dBA or more? — [ ] Yes [X] No

Feasibility

1. Impacted receptor units
   a. Number of impacted receptor units: — 31
   b. Number of impacted receptor units receiving 5 dBA or more insertion loss (IL): — 26
   c. Percentage of impacted receptor units receiving 5 dB(A) or more IL — 84%
   d. Is the percentage 50 or greater? — [X] 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. (ft^2): 15100
   - b. Impacted noise sensitive receptor(s) receiving 5 dB(A) IL or more.: 26
   - c. Non-impacted noise sensitive receptor(s) receiving 5 dB(A) IL or more.: 13
   - d. Total number of benefited receptors.: 39
   - e. Surface Area per benefited receptor unit. (ft^2/BR): 387
   - 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." ☐ Yes ☐ No

3. Additional Noise Barrier Details
   - a. Length of the proposed noise barrier: 755
   - b Height range of the proposed noise barrier: 20
   - c. Average height of the proposed noise barrier: 20
   - d Cost per square foot. ($/$ft^2$): $42
   - e. Total Barrier Cost ($): $634,200
   - f. Additional comments (if applicable):
   - 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: REASONABLENESS PENDING COMMUNITY DECISION

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:	August 8, 2017
Project No. and UPC:	VDOT Project #: 0001-029-205, C501, P101, R201 UPC#: 107187
County:	Fairfax
Facility:	Richmond Hwy
Barrier System ID:	12P
Noise Abatement Category(s)	B
Community Name and/or CNE#	CNE 34

Design phase: [X] 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). — TBD
   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." — [X] Yes [ ] No

2. Criteria requiring consideration of noise abatement
   a. Project causes design year noise levels to approach or exceed the Noise Abatement Criteria? — [X] Yes [ ] No
   b. Project causes a substantial noise increase of 10 dBA or more? — [ ] Yes [X] No

Feasibility

1. Impacted receptor units
   a. Number of impacted receptor units: — 3
   b. Number of impacted receptor units receiving 5 dBA or more insertion loss (IL): — 3
   c. Percentage of impacted receptor units receiving 5 dB(A) or more IL — 100%
   d. Is the percentage 50 or greater? — [X] 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)	3,735
b. Impacted noise sensitive receptor(s) receiving 5 dB(A) IL or more.	3
c. Non-impacted noise sensitive receptor(s) receiving 5 dB(A) IL or more.	10
d. Total number of benefited receptors.	13
e. Surface Area per benefited receptor unit. (ft²/BR)	287
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." ☐ Yes ☐ No

3. Additional Noise Barrier Details

a. Length of the proposed noise barrier	249
b Height range of the proposed noise barrier	15
c. Average height of the proposed noise barrier	15
d Cost per square foot. ($/ft²)	$42
e. Total Barrier Cost ($)	$156,870
f. Additional comments (if applicable)	
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: REASONABLENESS PENDING COMMUNITY DECISION

APPENDIX G RESPONSE FROM PROJECT MANAGER ON ALTERNATIVE NOISE ABATEMENT MEASURES

This appendix will include a memo and survey sent to the VDOT project manager about the potential for use of alternative noise abatement measures, pursuant to Virginia House Bill 2577.

RK&K
81 Mosher Street | Baltimore, MD 21217 | P 410.728.2900 | T 800.787.3755 | www.rkk.com

October 23, 2017

MEMORANDUM

TO: Anissa Brown, District Assistant Environmental Manager

FROM: George Tye, Acoustic Engineer

SUBJECT: UPC 107187, Richmond Highway (Route 1) Corridor Improvements Project
Virginia HB 2577 form

The 2009 General Assembly passed Chapter 120 (HB 2577), 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 2577 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 2577 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 (410) 728-2900 or L.J. Muchenje 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)

Engineers | Construction Managers | Planners | Scientists

Response: The alteration of the horizontal and vertical alignment has been considered to reduce or eliminate noise impacts predicted for the proposed project; however, this is not feasible due to the limited available right of way and dense commercial and residential use adjacent to the existing Richmond Highway alignment. Similarly, speed limit restrictions will not be an effective noise mitigation measure since a substantial decrease in speed would be necessary to provide adequate noise reduction.

Comment: Can the project support the use of low noise pavement in lieu of construction of noise walls or sound barriers? (Materials Division to address)

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: While landscaping is viewed as an acceptable visual screening measure, it is not practical for this project because right of way is very limited in the areas where noise and visual impacts are predicted to occur.

Note: Please provide the name of each responder.

Anissa Brown

APPENDIX H SITE SKETCHES, METER PRINTOUTS, CALIBRATION AND OTHER PERTINENT CORRESPONDENCE

Site M-01, Photograph #1

Site M-01, Photograph #2

Site M-02, Photograph #1

Site M-02, Photograph #2

Site M-03, Photograph #1

Site M-03, Photograph #2

Site M-04, Photograph #1

Site M-04, Photograph #2

Site M-05, Photograph #1

Site M-05, Photograph #2

Site M-06, Photograph #1

Site M-06, Photograph #2

Site M-07, Photograph #1

Site M-07, Photograph #2

Site M-08, Photograph #1

Site M-08, Photograph #2

Site M-09, Photograph #1

Site M-09, Photograph #2

Site M-10, Photograph #1

Site M-10, Photograph #2

Site M-11, Photograph #1

Site M-11, Photograph #2

Site M-12, Photograph #1

Site M-12, Photograph #2

Site M-13, Photograph #1

Site M-13, Photograph #2

Site M-14, Photograph #1

Site M-14, Photograph #2

Scantek, Inc.
CALIBRATION LABORATORY

ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1
ACCREDITED by NVLAP (an ILAC MRA signatory)

NVLAP®
NVLAP Lab Code: 200625-0

Calibration Certificate No.34066

Instrument:	**Acoustical Calibrator**	*Date Calibrated:* **6/12/2015** *Cal Due:*			
Model:	**CL304**	*Status:*	**Received**	**Sent**
Manufacturer:	**Metrosonics**	*In tolerance:*	X	X
Serial number:	**7465**	*Out of tolerance:*		
Class (IEC 60942):	**1**	*See comments:*		
Barometer type:		*Contains non-accredited tests:*	**__Yes _X_ No**	
Barometer s/n:				
Customer:	**RK&K**	*Address:*	**81 Mosher Street,**	
Tel/Fax:	**410-462-9320 / 410-728-2834**		**Baltimore, MD 21217**	

Tested in accordance with the following procedures and standards:
Calibration of Acoustical Calibrators, Scantek Inc., Rev. 10/1/2010

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

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
4838-Norsonic	SME Cal Unit	31052	Oct 7, 2014	Scantek, Inc./ NVLAP	Oct 7, 2015
DS-360-SRS	Function Generator	33584	Sep 30, 2013	ACR Env./ A2LA	Sep 30, 2015
34401A-Agilent Technologies	Digital Voltmeter	US36120731	Oct 1, 2014	ACR Env. / A2LA	Oct 1, 2015
HM30-Thommen	Meteo Station	1040170/39633	Oct 3, 2014	ACR Env./ A2LA	Oct 3, 2015
8903-HP	Audio Analyzer	2514A05691	Dec 12, 2013	ACR Env. / A2LA	Dec 12, 2016
PC Program 1018 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
4134-Brüel&Kjær	Microphone	173368	Nov 10, 2014	Scantek, Inc. / NVLAP	Nov 10, 2015
1203-Norsonic	Preamplifier	14052	Aug 22, 2014	Scantek, Inc./ NVLAP	Aug 22, 2015

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

Calibrated by:	Lydon Dawkins	**Authorized signatory:**	Valentin Buciuga
Signature	Lydon Dawkins	Signature	
Date	6/12/2015	Date	6/15/2015

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Scantek, Inc.

CALIBRATION LABORATORY
ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1
ACCREDITED by NVLAP (an ILAC MRA signatory)

NVLAP®

NVLAP Lab Code: 200625-0

Calibration Certificate No. 34069

Instrument: **Sound Level Meter/Dosimeter**
Model: **dB-3080**
Manufacturer: **Metrosonics**
Serial number: **2032**
ID number:
Tested with: **Microphone MK3100R 10755**

Date Calibrated: **6/15/2015** *Due:*

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

Contains non accredited tests: __Yes_X_No
Calibration service: _X_ **Basic** __**Standard**

Customer: **RK&K**
Phone/Fax: **410-728-2900/-3160**

Address: **81 Mosher Street**
Baltimore, MD 21217

Tested in accordance with the following procedures and standards:
- Calibration of SLM & Dosimeters - Acoustical Tests, Scantek, Inc. Rev.7/6/2011

Instrumentation used for calibration:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence: Cal. Lab / Accreditation	Cal. Due
1253 - Norsonic	Calibrator	25726	Nov 8, 2013	Scantek Inc. / NVLAP	Nov 8, 2014
4226 Bruel & Kjaer	Multifunction Calibrator	2305103	Jul 26, 2013	Scantek, Inc./ NVLAP	Jul 26, 2014
HM30-Thommen	Meteo Station	1040170/39633	Sep 30, 2013	ACR Env./ A2LA	Sep 30, 2014

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

Environmental conditions

Temperature [°C]	Barometric Pressure [kPa]	Relative Humidity [%]
22.8	**100.00**	**56.3**

Calibrated by:	Lydon Dawkins	Authorized signatory:	Valentin Buzduga
Signature	Lydon Dawkins	Signature	
Date	6/15/2015	Date	6/16/2015

Scantek, Inc.

CALIBRATION LABORATORY
ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1
ACCREDITED by NVLAP (an ILAC MRA signatory)

NVLAP®

NVLAP Lab Code: 200625-0

Calibration Certificate No. 34070

Instrument:	**Sound Level Meter/Dosimeter**	*Date Calibrated:*	**6/15/2015** *Due:*
Model:	**dB-3080**	*Status:*	**Received** / **Sent**
Manufacturer:	**Metrosonics**	*In tolerance:*	X / X
Serial number:	**2033**	*Out of tolerance:*	
ID number:		*See comments:*	
Tested with:	**Microphone MK3100R 12052**	*Contains non accredited tests:*	__Yes X No
		Calibration service:	X Basic __Standard
Customer:	**RK&K**	*Address:*	**81 Mosher Street**
Phone/Fax:	**410-728-2900/-3160**		**Baltimore, MD 21217**

Tested in accordance with the following procedures and standards:

- Calibration of SLM & Dosimeters - Acoustical Tests, Scantek, Inc. Rev.7/6/2011

Instrumentation used for calibration:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence: Cal. Lab / Accreditation	Cal. Due
1253 - Norsonic	Calibrator	25726	Nov 8, 2013	Scantek Inc. / NVLAP	Nov 8, 2014
4226 Bruel & Kjaer	Multifunction Calibrator	2305103	Jul 26, 2013	Scantek, Inc./ NVLAP	Jul 26, 2014
HM30-Thermnen	Meteo Station	10401703/39633	Sep 30, 2013	ACR Env./ A2LA	Sep 30, 2014

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

Environmental conditions

Temperature [°C]	Barometric Pressure [kPa]	Relative Humidity [%]
22.5	**100.00**	**51.0**

Calibrated by:	Lydon Dawkins	Authorized signatory:	Valentin Buzduga
Signature	Lydon Dawkins	Signature	
Date	6/15/2015	Date	6/15/2015

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Scantek, Inc.

CALIBRATION LABORATORY
ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1
ACCREDITED by NVLAP (an ILAC MRA signatory)

NVLAP®

NVLAP Lab Code: 200825-0

Calibration Certificate No. 34068

Instrument:	**Sound Level Meter/Dosimeter**	*Date Calibrated:*	**6/15/2015**	*Due:*	
Model:	**dB-3080**	*Status:*	**Received**		**Sent**
Manufacturer:	**Metrosonics**	*In tolerance:*	X		X
Serial number:	**3130**	*Out of tolerance:*			
ID number:		*See comments:*			
Tested with:	**Microphone MK3100R 13314**	*Contains non accredited tests:*	__Yes_X_No		
		Calibration service:	_X_ **Basic** __ **Standard**		
Customer:	**RK&K**	*Address:*	**81 Mosher Street**		
Phone/Fax:	**410-728-2900/-3160**		**Baltimore, MD 21217**		

Tested in accordance with the following procedures and standards:

- Calibration of SLM & Dosimeters - Acoustical Tests, Scantek, Inc. Rev.7/6/2011

Instrumentation used for calibration:

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence: Cal. Lab / Accreditation	Cal. Due
1253 - Norsonic	Calibrator	25726	Nov 8, 2013	Scantek Inc. / NVLAP	Nov 8, 2014
4226 Bruel & Kjaer	Multifunction Calibrator	2305103	Jul 26, 2013	Scantek, Inc./ NVLAP	Jul 26, 2014
HM30-Thommen	Meteo Station	1040170/39633	Sep 30, 2013	ACR Env./ A2LA	Sep 30, 2014

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

Environmental conditions

Temperature [°C]	Barometric Pressure [kPa]	Relative Humidity [%]
22.8	**100.00**	**49.7**

Calibrated by:	Lydon Dawkins	Authorized signatory:	Valentin Buzduga
Signature	Lydon Dawkins	Signature	
Date	6/15/2015	Date	6/15/2015

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Scantek, Inc.
CALIBRATION LABORATORY

ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1
ACCREDITED by NVLAP (an ILAC MRA signatory)

NVLAP®
NVLAP Lab Code: 200625-0

Calibration Certificate No.34064

Instrument:	**Sound Level Meter**
Model:	**NL06**
Manufacturer:	**Rion**
Serial number:	**00380352**
Tested with:	**Microphone UC52 s/n 79631** **Preamplifier NH19 s/n 88551**
Type (class):	**2**
Customer:	**RK & K**
Tel/Fax:	**410-462-9320 / 410-728-2834**

Date Calibrated: **6/12/2015** *Cal Due:*

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

Contains non-accredited tests: __Yes X No
Calibration service: __ Basic X Standard
Address: **81 Mosher Street, Baltimore, MD 21217**

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

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

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
4838-Norsonic	SME Cal Unit	31052	Oct 7, 2014	Scantek, Inc./ NVLAP	Oct 7, 2015
DS-360-SRS	Function Generator	33584	Sep 30, 2013	ACR Env./ A2LA	Sep 30, 2015
34401A-Agilent Technologies	Digital Voltmeter	US36120731	Oct 1, 2014	ACR Env. / A2LA	Oct 1, 2015
HM30-Thommen	Meteo Station	1040170/39633	Oct 3, 2014	ACR Env./ A2LA	Oct 3, 2015
PC Program 1019 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
1251-Norsonic	Calibrator	30878	Nov 10, 2014	Scantek, Inc./ NVLAP	Nov 10, 2015
4226-Brüel&Kjær	Multifunction calibrator	2305103	Jul 28, 2014	Scantek, Inc./ NVLAP	Jul 28, 2015

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

Environmental conditions:

Temperature (°C)	Barometric pressure (kPa)	Relative Humidity (%)
24.0	99.93	44.6

Calibrated by:	Lydon Dawkins	Authorized signatory:	Valentin Buzdoga
Signature	Lydon Dawkins	Signature	
Date	6/12/2015	Date	6/15/2015

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Scantek, Inc.
CALIBRATION LABORATORY

ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1
ACCREDITED by NVLAP (an ILAC MRA signatory)

NVLAP®
NVLAP Lab Code: 200625-0

Calibration Certificate No.34065

Instrument:	**Acoustical Calibrator**	*Date Calibrated:* **6/11/2015** *Cal Due:*		
Model:	**NC-73**	*Status:*	**Received**	**Sent**
Manufacturer:	**Rion**	*In tolerance:*	X	X
Serial number:	**10417650**	*Out of tolerance:*		
Class (IEC 60942):	**2**	*See comments:*		
Barometer type:		*Contains non-accredited tests:* __Yes _X_ No		
Barometer s/n:				
Customer:	**RK&K**	*Address:*	**81 Mosher Street,**	
Tel/Fax:	**410-462-9320 / 410-728-2834**		**Baltimore, MD 21217**	

Tested in accordance with the following procedures and standards:
Calibration of Acoustical Calibrators, Scantek Inc., Rev. 10/1/2010

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

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	31052	Oct 7, 2014	Scantek, Inc./ NVLAP	Oct 7, 2015
DS-360-SRS	Function Generator	33584	Sep 30, 2013	ACR Env./ A2LA	Sep 30, 2015
34401A-Agilent Technologies	Digital Voltmeter	US36120731	Oct 1, 2014	ACR Env. / A2LA	Oct 1, 2015
HM30-Thommen	Meteo Station	1040170/39633	Oct 3, 2014	ACR Env./ A2LA	Oct 3, 2015
8903-HP	Audio Analyzer	2514A05691	Dec 12, 2013	ACR Env. / A2LA	Dec 12, 2016
PC Program 1018 Norsonic	Calibration software	v.6.1T	Validated Nov 2014	Scantek, Inc.	-
4134-Brüel&Kjær	Microphone	173368	Nov 10, 2014	Scantek, Inc. / NVLAP	Nov 10, 2015
1203-Norsonic	Preamplifier	14052	Aug 22, 2014	Scantek, Inc./ NVLAP	Aug 22, 2015

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

Calibrated by:	Lydon Dawkins	**Authorized signatory:**	Valentin Buzduga
Signature	Lydon Dawkins	Signature	
Date	6/11/2015	Date	6/15/2015

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APPENDIX I TNM CERTIFICATES

FHWA TNM 2.5 Certification of George Tye is provided.

Certificate of Continuing Education

This is to certify that

George Tye

has satisfactorily completed 32 hours of training on

FHWA TRAFFIC NOISE MODEL 2.5

conducted by

Bowlby & Associates, Inc.

Franklin, TN

October 30 - November 2, 2012

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

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

APPENDIX J NOISE RECEPTOR LOCATION MAPS