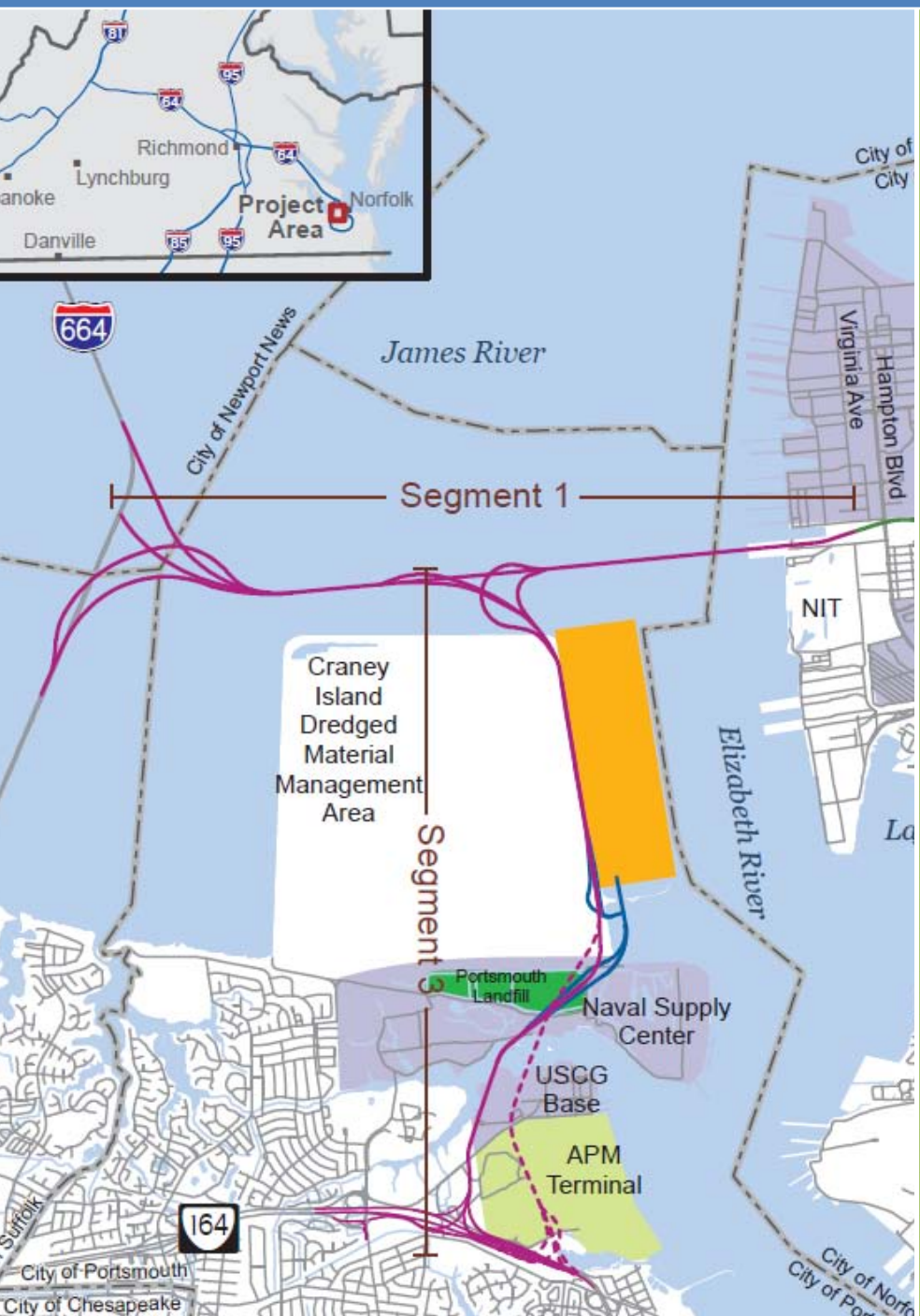
State Project: 0064-114-F12, PE-102
UPC: 99587

From: I-664/Monitor-Merrimac Memorial Bridge Tunnel in Hampton Roads, VA

To: I-564 at Naval Station Norfolk in Norfolk, VA and to Route 164 in Portsmouth, VA

Reevaluation of Hampton Roads Crossing Study: Selected Alternative CBA 9 - Segment 1 & Segment 3

DRAFT Noise Analysis Technical Report



Baker

Michael Baker Jr., Inc.

November 2011

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NOISE ANALYSIS TECHNICAL REPORT

1. EXECUTIVE SUMMARY

In compliance with Title 23 of the Code of Federal Regulations, Part 772 (23 CFR Part 772), the following noise assessment has been prepared and will be provided by the Virginia Department of Transportation (VDOT) to local officials.

VDOT has issued an updated Traffic Noise Abatement Policy to replace the previous policy. The new policy became effective July 13, 2011 and has been updated as of September 16, 2011. This report follows the noise analysis documentation format guide in Section 13 of the new policy. It has been consolidated, where appropriate and/or applicable, to reduce the number of pages.

The proposed Type I project consists of a new alignment highway reevaluation of Segments 1 and 3 of the Hampton Roads Crossing Study (HRCS) Environmental Impact Statement. Overall, there are 26 Category B receptors that are predicted to approach or exceed the criteria for the 2034 design year Build Alternative.

A barrier analysis was performed for the 26 impacted residences. The preliminary analysis results showed that a reasonable and feasible set of overlapping barriers can be constructed according to VDOT noise policy. As a result, further abatement consideration is warranted and the project is proposed to be carrier into final design. Please note that the noise evaluation is preliminary and a more detailed review will be completed during the final design stage. As such, this noise barrier that was found to be feasible and reasonable during the preliminary noise analysis may not be found to be feasible and reasonable during the final design noise analysis. No other barrier locations were analyzed.

2. INTRODUCTION

This Technical Report summarizes the methods used for the noise analysis reevaluation of the Hampton Roads Crossing Study (HRCS) selected alternative, Candidate Build Alternative 9 (CBA 9), Segments 1 & 3. The analysis and report were prepared in accordance with VDOT's *Highway Traffic Noise Impact Analysis Guidance Manual*, Version 1, July 2011. This report provides a stand-alone, comprehensive documentation of the changes in the sound level environment as a result of the proposed project and serves as a support document to the Environmental Assessment (EA) being prepared for the project. In accordance with the requirements of the National Environmental Policy Act (NEPA) and related regulations, the results of the overall project reevaluation will be documented in an EA.

This reevaluation report documents the results of a noise analysis for the HRCS CBA 9 – Segments 1 and 3 in the Hampton Roads area, locally referred to as Patriot's Crossing. Highway traffic noise impact analysis, abatement procedures, criteria, coordination requirements, and reporting guidance are based on Title 23 of the Code of Federal Regulations, Part 772, the Federal Highway Administration's (FHWA) Procedures for Abatement of Highway Traffic Noise and Construction Noise, (23 CFR 772). All transportation improvement projects developed in accordance with the Virginia Department of Transportation's (VDOT) guidelines conform to the mandates and guidance of FHWA.

It is VDOT's policy to assess highway traffic noise impacts of transportation improvement projects and, when potential noise impacts are identified, to give consideration to the incorporation of appropriate avoidance and/or mitigation measures into the design and construction of federal or federally-funded Type I transportation improvement projects. Before noise abatement measures can be considered, the appropriate level of highway traffic noise analysis must be completed to adequately address whether noise abatement measures are warranted, feasible, and reasonable. This assessment is required to justify recommendations to construct any highway traffic noise mitigation measures. This project is identified as a Type I highway noise project because it is a construction of a highway on new location.

2.1 PROJECT DESCRIPTION

The Virginia Department of Transportation (VDOT) and the Federal Highway Administration (FHWA) are reevaluating the Hampton Roads Crossing Study (HRCS) Environmental Impact Statement. The selected Build Alternative is referred to as Candidate Build Alternative 9 (CBA 9) and is made up of five independent segments. As stated in the 2001 Final Environmental Impact Statement (FEIS), the selected Build Alternative can be constructed in segments with each segment contributing to project purpose and need and each segment having logical termini and independent utility.[1] For this project, VDOT is reevaluating two segments of the selected Build Alternative (design year 2034), as described below and illustrated in Figure 1.

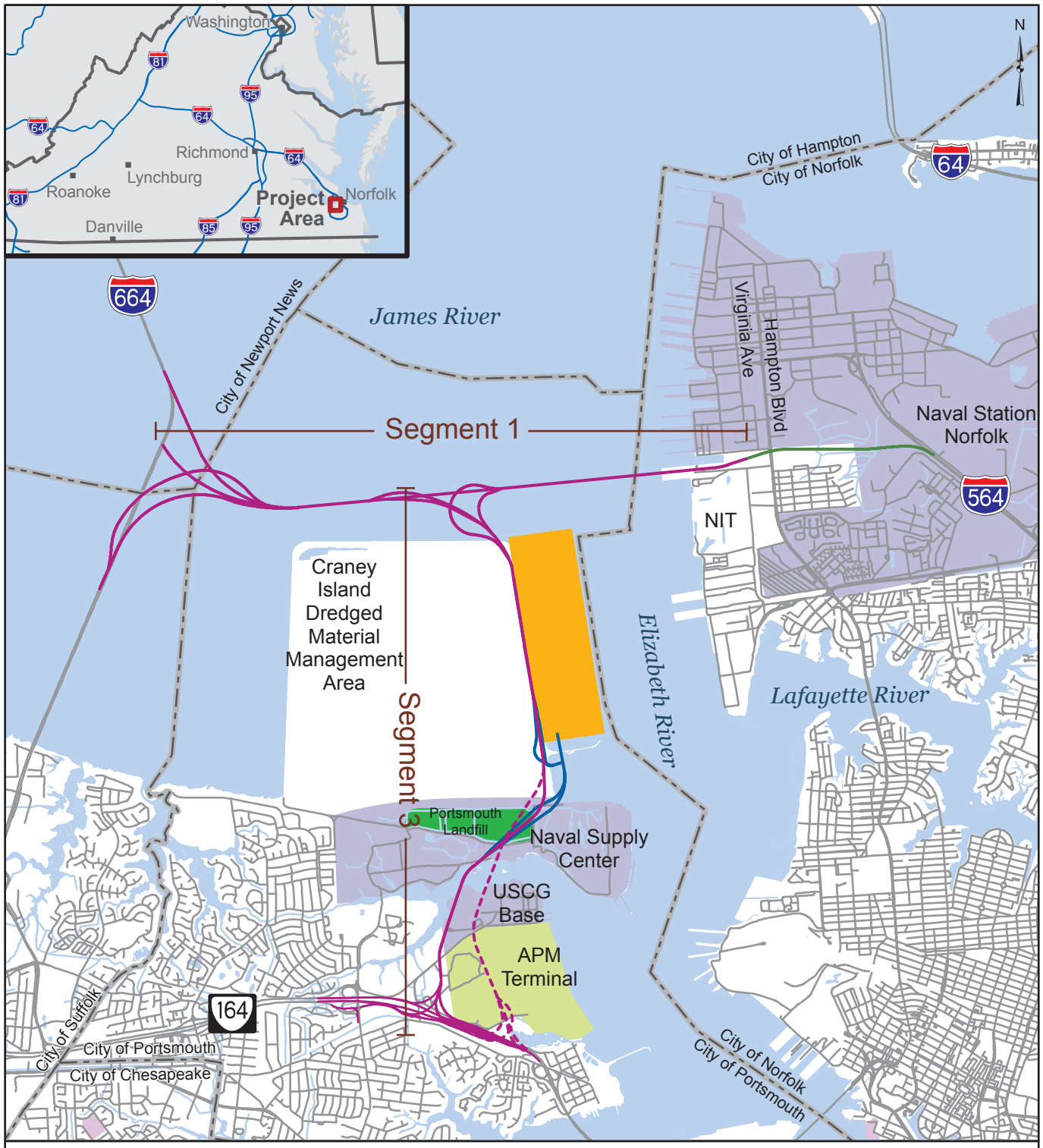
2.2 BUILD ALTERNATIVE

For the Build Alternative, the segments being reevaluated consist of CBA 9 - Segment 1 and Segment 3 for a combined length of 15 miles. The design year is 2034. The Build Alternative was originally referred to as the Third Crossing and is now locally referred to as Patriot's Crossing.

2.2.1 CBA 9 - SEGMENT 1

Segment 1 would be on new alignment from the I-664 Monitor-Merrimac Memorial Bridge Tunnel in Hampton Roads, Virginia to its connection with the planned I-564 Intermodal Connector at Virginia Avenue near Naval Station Norfolk in Norfolk, Virginia. Segment 1 includes a new interchange near the south approach structure of the Monitor-Merrimac Memorial Bridge Tunnel that would connect to a

[1] Federal Highway Administration and the Virginia Department of Transportation. *Hampton Roads Crossing Study: Final Environmental Impact Study and Section 4(f) Evaluation*. March 2001. Page S-14.



Legend

- HRCS CBA 9 - Segments 1 & 3
- VA Port Authority Craney Island Interchange
- Proposed I-564 Connector
- Craney Island Expansion Area
- Original Alignment of Segment 3 No Longer Under Consideration

Figure 1: Project Location Map

0 0.5 1 2
Miles

HRCS EA

new roadway and bridge tunnel extending from I-664 to the planned I-564 Intermodal Connector in Norfolk. This interchange would provide access to the existing Monitor-Merrimac Memorial Bridge Tunnel and would provide a connection along the east side of Craney Island to VA 164 in Portsmouth. The eastern terminus for Segment 1 was shortened to Virginia Avenue because it would now connect with the planned I-564 Connector rather than I-564 farther to the east.

The length of Segment 1 is approximately 6.3 miles. Segment 1 includes a tunnel under the Elizabeth River so as not to impede shipping traffic. Two tunnels would be required to accommodate two lanes for eastbound traffic and two lanes for westbound traffic.

2.2.2 CBA 9 – SEGMENT 3

Segment 3 would be on new alignment and would extend from its connection with Segment 1 north of Craney Island southward to its connection with VA 164. The length of Segment 3 is approximately 5.7 miles. The southern portion of Segment 3, from the Craney Island Marine Terminal (CIMT) southward to VA 164, is now locally referred to as the Craney Island Connector Road.

Following the CTB's selection of CBA 9 in 2001, regional transportation plans accounted for the future construction of a dedicated corridor for Segment 3, from the CIMT to VA 164. The corridor alignment was included in the Hampton Roads Planning District Commission's 2030 Long-Range Transportation Plan and VDOT's 2001 HRCS FEIS. However, after the original alignment for Segment 3 was adopted, the privately-owned APM Terminal was constructed within the limits of Segment 3. Construction of the APM Terminal makes it necessary to shift a portion of Segment 3 to the west to avoid potential impacts to the terminal.

In a subsequent, separate study led by the Virginia Port Authority (VPA), the VPA worked with VDOT to design a road and rail connection between VA 164 and Craney Island (i.e., the Craney Island Connector Road). For the VPA, the Craney Island Connector Road is essential for providing additional transportation capacity needed to handle the increasing cargo demands with the opening of the Craney Island Marine Terminal. As an initial step in gaining access to VA 164, VDOT requested the VPA perform an Interchange Modification Report (IMR) to identify a feasible and functional alignment for the proposed connection between VA 164 and the future CIMT. The VPA ensured that the shifted alignment of the southern portion of Segment 3 would still provide a successful and efficient connection to the northern portion of Segment 3 and Segment 1. In 2010, the Craney Island Marine Terminal IMR received approval from VDOT and the Federal Highway Administration (FHWA) with respect to the proposed conceptual geometric design of the Craney Island interchange with VA 164 and the shifted alignment of Segment 3.[2]

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[2] Kimley-Horn and Associates, Inc. for the Virginia Port Authority. *Craney Island Marine Terminal: Interchange Modification Report Executive Summary*. March 2010. Page 1.

The original Segment 3 alignment and the shifted alignment of Segment 3 are illustrated on Figure 1. The shifted alignment of Segment 3 is the alignment under consideration for this project.

2.2.3 New Points of Access

Segments 1 and 3 would provide five new points of access:

- At its western terminus, Segment 1 would provide a new interchange near the south approach structure of the Monitor-Merrimac Memorial Bridge Tunnel and would connect to a new roadway and bridge tunnel extending from I-664 to the I-564 Connector in Norfolk. This new interchange would provide Segment 1 access to the existing I-664 Monitor-Merrimac Memorial Bridge Tunnel.
- At its eastern terminus, Segment 1 would provide a through-travel connection to the proposed I-564 Connector near Virginia Avenue in Norfolk. In addition, restricted access would be provided in the vicinity of Virginia Avenue. This restricted access would be gated and would be limited to authorized Naval Station Norfolk traffic and to authorized Norfolk International Terminal (NIT) traffic.
- A new interchange would be provided where Segment 1 and Segment 3 connect to the north of Craney Island.
- For Segment 3, a new interchange would be provided on Craney Island to provide additional access to the Virginia Port Authority's Craney Island Marine Terminal, the U.S. Navy Fuel Depot, the U.S. Coast Guard Support Center, and the APM Container Terminal port facility in Portsmouth.
- For Segment 3, at its southern terminus, a new interchange would be provided where Segment 3 connects to VA 164.

2.2.4 Roadway Design

Design criteria were established to meet all applicable VDOT, FHWA, and AASHTO criteria. The overall design for CBA 9 is a limited access urban freeway at 65 mph. The roadway design components have not changed since the original CBA 9 was endorsed by the CTB in 2001.

Segment 1 and Segment 3 would have four lanes (two in each direction) along the new roadway, bridge, and tunnel. While the HRCS FEIS stated that Segment 1 would include a three-tube tunnel typical section to cross the Elizabeth River and connect to Norfolk, only two of the three tubes are being reevaluated as part of this EA: one tube for two lanes of eastbound vehicular traffic and one tube for two lanes of westbound vehicular traffic. However, the third tube proposed for multimodal travel could be constructed at a future date but is not part of this phase of the project. The widening of I-664 on the Peninsula and the Southside, including the Monitor-Merrimac Memorial Bridge Tunnel multimodal component of the selected alternative, are not currently being studied as part of this reevaluation because they are not part of this phase of construction. However, construction of Segment 1 and Segment 3 will not preclude the future implementation of the multimodal elements of the segments.

2.2.5 TUNNEL DESIGN COMPONENTS

There are no noise sensitive receptors near the tunnel. Its design components have not changed since the original CBA 9 was endorsed by the CTB in 2001. The exception to this is the delayed consideration and construction of the proposed third tunnel that would accommodate the multimodal component of Segment 1. Figure 2 illustrates the proposed tunnel typical section.

2.2.6 ISLAND DESIGN COMPONENTS

The tunnel will originate on artificial islands built on either side of the shipping channel. Segment 1 will require one island on the west side of the Norfolk Harbor Channel. The island will measure about 285 feet wide at its top.[3]

2.2.7 EXISTING NOISE BARRIER COMPONENTS

There are two existing noise barriers located west of the Cedar Lane interchange in each direction along VA 164. Neither of these barriers is currently proposed to be physically impacted (moved/reconstructed) as a result of the proposed action. In the southwest quadrant of this interchange, the eastbound on-ramp to VA 164 is proposed to be removed and the existing eastbound VA 164 off-ramp is proposed to be moved farther away from the nearby residences. The eastern end of this barrier is located along the property boundaries of the abutting residences to the off-ramp. Though a portion of the existing off-ramp road will no longer be in use and the ramp will be farther away, it is proposed that the noise barrier remain in the same location. There is no need to move the existing barrier closer to the new ramp location since there are no predicted impacts to the residences behind the barrier in the design year build condition.

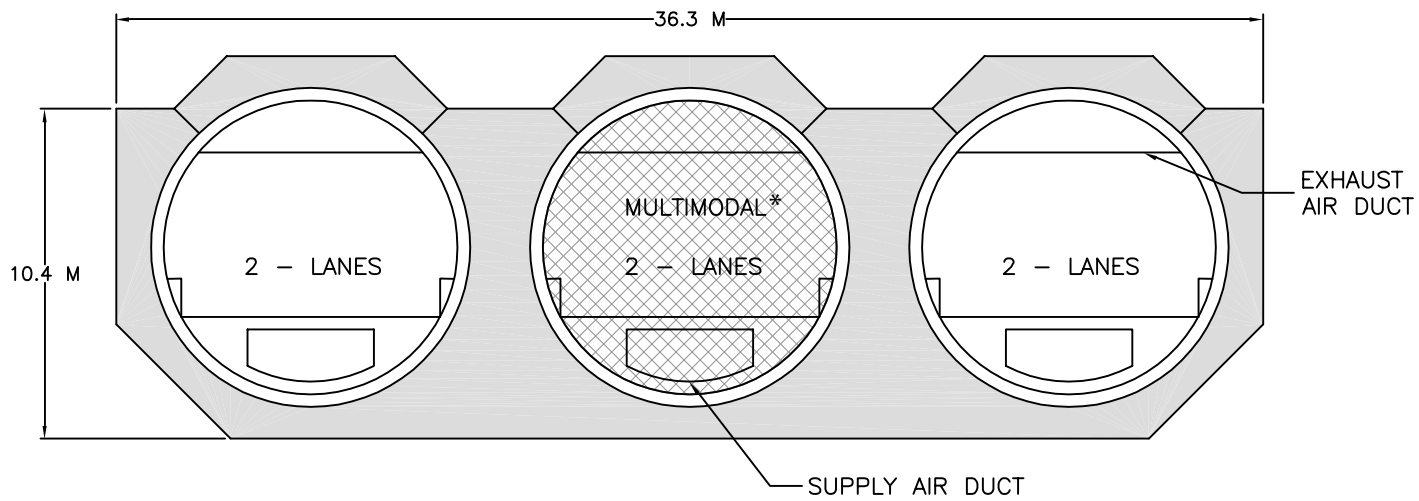
3. METHODOLOGY

3.1 FHWA AND STATE NOISE POLICY

Noise impact is determined by comparing future project sound levels: (1) to a set of Noise Abatement Criteria (NAC) for a particular land use category, and (2) to existing sound levels. The FHWA noise standards (contained in 23 CFR 772) and VDOT's noise policy state that traffic noise impacts require consideration of abatement when worst-hour sound levels approach or exceed the NAC listed in Table 1.

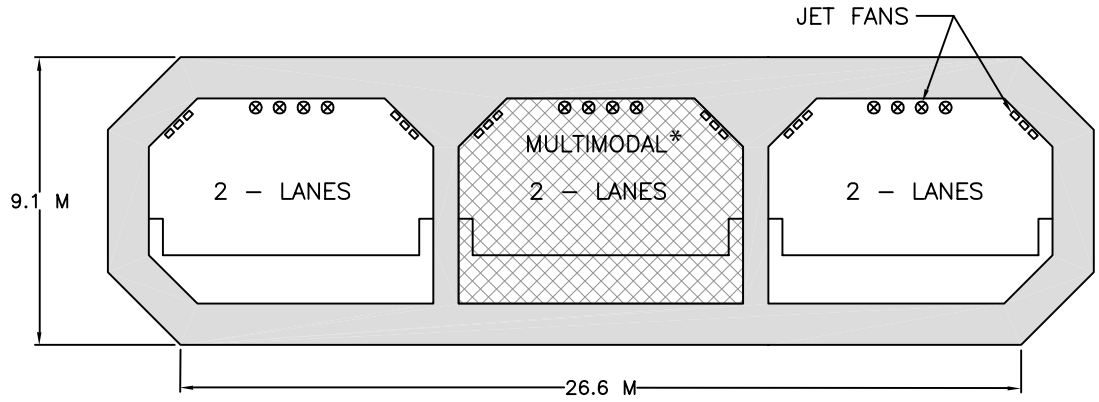
Additionally, The FHWA noise standards and VDOT's noise policy also define impacts to occur if there is a substantial increase in design year sound levels. A substantial noise increase has been defined by VDOT as a 10 dB(A) increase above existing noise levels for all noise-sensitive exterior activity categories.

[3] Ibid. Pages 37 – 40.



STEEL TUNNEL OPTION

* Multimodal Option is not being studied in this reevaluation.



CONCRETE TUNNEL OPTION

* Multimodal Option is not being studied in this reevaluation.

Figure 2: Typical Sections of Optional Tunnel Designs

Multimodal Component not included in this phase of HRCS CBA 9 - Segments 1 & 3

3.2 MONITORING AND MODELING METHODOLOGY

Short-term peak noise period monitoring was performed at two representative locations within the one Common Noise Environment (CNE) to validate the FHWA TNM. Each monitoring period was 20-minutes in duration and was performed on September 2nd, 2011.

Noise modeling of existing and future roadways is an effective tool for predicting noise levels, noise impacts, and the potential benefits of noise abatement. Noise modeling associated with a roadway transportation improvement project is a dynamic process that evolves to address and answer questions related to noise impacts and the potential benefits of noise abatement.

The process includes several steps. Generally, the analysis procedure includes noise model validation (through the use of noise measurements), modeling of existing worst noise hour, modeling of future "no-build" conditions, and modeling of future "build" conditions associated with a proposed transportation improvement project.

3.3 ANALYSIS PROCEDURE AND YEARS CONSIDERED

The currently approved FHWA TNM (current version 2.5) is the applicable tool for the prediction of existing and future noise levels associated with transportation improvement projects. The years considered in the analysis were the base (existing) year 2010 and the design year 2034.

TABLE 1: 23 CFR 772 NOISE ABATEMENT CRITERIA

TABLE 1 TO PART 772—NOISE ABATEMENT CRITERIA [Hourly A–Weighted Sound Level decibels (dB(A))[1]]				
Activity category	**Activity Leq(h)**	**Criteria[2] L10(h)**	**Evaluation location**	**Activity description**
A	57	60	Exterior	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B[3]	67	70	Exterior	Residential.
C[3]	67	70	Exterior	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings.
D	52	55	Interior	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios.
E[3]	72	75	Exterior	Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in A–D or F.
F			Exterior	Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing.
G				Undeveloped lands that are not permitted.

[1] Either Leq(h) or L10(h) (but not both) may be used on a project.
[2] The Leq(h) and L10(h) Activity Criteria values are for impact determination only, and are not design standards for noise abatement measures.
[3] Includes undeveloped lands permitted for this activity category.

Source: VDOT Highway Traffic Noise Impact Analysis Guidance Manual, 7/11.
Note: VDOT uses Leq(h), not L10(h), for highway traffic noise analyses.

4. EXISTING HIGHWAY TRAFFIC NOISE ENVIRONMENT (MONITORED AND MODELED DATA)

4.1 LAND USES, CNES, MONITORED RESULTS, AND METER CALIBRATION

Existing land uses within 500 feet of the proposed improvements consist of residential, industrial (Norfolk International Terminal, APM Terminal, Norfolk Southern Railroad) and military uses (Naval Station Norfolk, Navy Fuel Depot, and Coast Guard Support Center). However, most of the area within 500 feet of the proposed bridge-tunnel consists of the James River and the Elizabeth River.

There are three CNE's in the project area; 1) the residential area located immediately south of the VA 164/Segment 3 interchange; 2) the residential area in the southwest quadrant of the Cedar Lane interchange behind the VA 164 eastbound existing noise barrier and; 3) the residential area in the northwest quadrant of the Cedar Lane interchange, behind the VA 164 westbound existing noise barrier.

Existing worst noise hour conditions were determined by measuring noise levels in the field for receptors for validation purposes and subsequently, with the TNM. One noise measurement site was chosen to represent the potentially affected receptors in the CNE located south of the proposed interchange. Measurements were not performed for the two residential areas behind the existing noise barriers along eastbound and westbound VA 164. The VA 164 traffic could not be seen from these locations and the barriers are not proposed to be impacted (moved/altered) at this time as a result of the proposed project. (Note: Zero impacts were predicted in the design year build scenario in these 2 locations.) Table 2 shows the field measurement results and the corresponding modeled validation sound level. The meter was calibrated before and after the measurement reading. The meter calibration certificate is included in the Appendix C.

Table 2: Measured Sound Levels (dBA) and Validation

Site Location	Measured Sound Levels	Modeled Sound Levels (Validation)	Sound Level Difference	Time Period	1-hour Traffic Composition (Approximately)
Residence: West Norfolk Road (Receptor 12)	64.4	65.3	0.9	9:09-9:24 AM 9/2/2011	Autos = 2,040 Medium Trucks = 80 Heavy Trucks = 320 Motorcycles = 0 Buses = 0

Source: Michael Baker Jr., Inc.

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

4.2 EXISTING AND FUTURE TRAFFIC COMPOSITION

A summary of existing and future traffic for the analysis years is provided, as is peak average daily traffic (ADT) and percent truck traffic for the project. The source(s) for the traffic data and forecasts are also cited, including key assumptions. For this reevaluation, the traffic data presented in the 2001 HRCS Final Environmental Impact Statement (FEIS) was updated, as was the traffic data for the air analysis. To develop updated traffic volumes, the Hampton Roads Regional Travel Demand Model was used (as instructed by VDOT) for the intermediate year of 2018 and the design year of 2034. The latest adopted Regional Model is 2030, thus 2034 volumes were derived from the growth rate calculated from 2018 to 2030. Additionally, traffic volumes were developed to update the base year conditions from the year 2000 to 2010. These volumes were interpolated, as needed, for the specific project analysis.

For the No-Build and Build Alternatives, the ADT and peak hour volumes are presented in Table 3 for the Base Year 2000 and Table 4 for the Design Year 2034. As mentioned, the updated based year 2010 volumes [not shown] were interpolated, as needed, from the 2000 and 2018 volumes. These 2010 volumes are included in Appendix C which includes the TNM input/output files for the existing case model runs.

Truck volumes were developed based on previously published truck percentages from the HRCS FEIS, as well as from projected truck traffic due to developments on Craney Island and the Craney Island Eastward Expansion Project. The truck traffic was obtained from the *Craney Island Marine Terminal: Interchange Modification Report*.[4] Depending on the facility, projected truck traffic percentages are in the following ranges (Table 5):

- Heavy Truck Volume = 2% to 7%
- Medium Truck Volume = 2% to 3%

Truck volumes are expected to increase along with non-truck traffic causing no change to the actual percentage of trucks on the roadways in the interim and design years.

5. FUTURE HIGHWAY TRAFFIC NOISE ENVIRONMENT (MODELED DATA)

The project is currently not on or part of the interstate system. As a result, no-build noise levels are not required for this environmental assessment and reevaluation.

Table 6 shows the modeled highway traffic noise results. The modeled receptor locations are presented in Figure 3.

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[4] Kimley-Horn and Associates, Inc. for the Virginia Port Authority. *Craney Island Marine Terminal: Interchange Modification Report*. March 2010. Page 1.

TABLE 3: BASE YEAR 2000 VOLUMES

Facility	2000		
	2000 ADT	2000 Peak Hour, Per Lane Volume from 2001 HRCS FEIS	Per lane capacity from 2001 HRCS FEIS
I-64 Hampton Roads Bridge Tunnel	86,200	2,160	1,700
I-664 MMBT (North of Pat Cross)	60,400	1,510	1,750
Segment 3 (Segment 1 - VA 164)	NA	NA	1,950
Segment 1 (West of Segment 3)	NA	NA	1,950
Segment 1 (East of Segment 3)	NA	NA	1,950
US 17 James River Bridge*	28,600	720	1,700
I-64 (I-664 to Mercury Blvd.)	135,900	2,270	2,250
I-64 HOV (I-664 to Mercury Blvd.)	0	0	
I-664 (I-64 - Downtown Newport News)	60,800	1,010	1,850
Jefferson Avenue (I-664 - Mercury Blvd.)	28,700	480	825
I-64 (I-564 - I-264)	140,400	2,340	2,175
I-64 HOV (I-564 - I-264)	1,339	30	
I-64 (I-464 - I-664)	63,800	1,600	2,250
VA 164 Western Freeway (I-664 – Midtown Tunnel)	21,700	540	2,000
I-264 (Newtown Rd - Witchduck Rd)	202,400	2,530	2,125
I-264 HOV (Newtown Rd - Witchduck Rd)	2,638	130	
VA 337 Hampton Blvd. (Lafayette River–Midtown Tunnel)	44,100	1,100	850
I-264 Downtown Tunnel	106,800	2,670	1,700
US 58 Midtown Tunnel	45,800	2,290	1,600

Source: Michael Baker Jr., Inc.

TABLE 4: DESIGN YEAR 2034 NO-BUILD AND BUILD VOLUMES

Facility	2034			
	No-Build ADT	No-Build Peak Hour, Per Lane Volume	Build Alt. ADT	Build Alt. Peak Hour, Per Lane Volume
I-64 Hampton Roads Bridge Tunnel	113,800	2,850	100,400	2,510
I-664 MMBT (North of Pat Cross)	98,100	2,450	134,700	3,370
Segment 3 (Segment 1 - VA 164)	NA	NA	53,600	1,340
Segment 1 (West of Segment 3)	NA	NA	74,100	1,850
Segment 1 (East of Segment 3)	NA	NA	90,400	2,260
US 17 James River Bridge	65,400	1,640	70,600	1,770
I-64 (I-664 to Mercury Blvd.)	197,800	3,300	192,600	3,210
I-64 HOV (I-664 to Mercury Blvd.)	1,868		1,980	100
I-664 (I-64 - Downtown Newport News)	101,200	1,690	107,600	1,790
Jefferson Avenue (I-664 - Mercury Blvd.)	34,900	580	40,300	670
I-64 (I-564 - I-264)	168,600	2,810	173,300	2,890
I-64 HOV (I-564 - I-264)	1,792	40	1,833	50
I-64 (I-464 - I-664)	96,300	2,410	94,300	2,360
VA 164 Western Freeway (I-664 – Midtown Tunnel)	83,700	2,090	74,900	1,870
I-264 (Newtown Rd - Witchduck Rd)	255,700	3,200	257,300	3,220
I-264 HOV (Newtown Rd - Witchduck Rd)	3,994	200	4,098	200
VA 337 Hampton Blvd. (Lafayette River– Midtown Tunnel)	46,900	1,170	43,700	1,090
I-264 Downtown Tunnel	124,900	3,120	119,000	2,980
US 58 Midtown Tunnel	70,800	3,540	57,600	2,880

Source: Michael Baker Jr., Inc.

TABLE 5: TRUCK PERCENTAGES

Year	Traffic Data	Hampton Roads Bridge Tunnel (I-64)	Monitor-Merrimac Memorial Bridge Tunnel (I-664)	Segment 1 (East of Segment 3)	Segment 3 (Near VA 164)
2034 No-Build	ADT	113,800	98,100	-	-
	Heavy Truck Volume	2,280	5,260	-	-
	(% of ADT)	2%	5%	-	-
	Medium Truck Volume	2,280	3,370	-	-
	(% of ADT)	2%	3%	-	-
2034 Build	ADT	100,400	134,700	90,400	53,600
	Heavy Truck Volume	2,010	6,930	5,440	3,970
	(% of ADT)	2%	5%	6%	7%
	Medium Truck Volume	2,010	4,630	3,110	1,840
	(% of ADT)	2%	3%	3%	3%

Source: Michael Baker Jr., Inc.

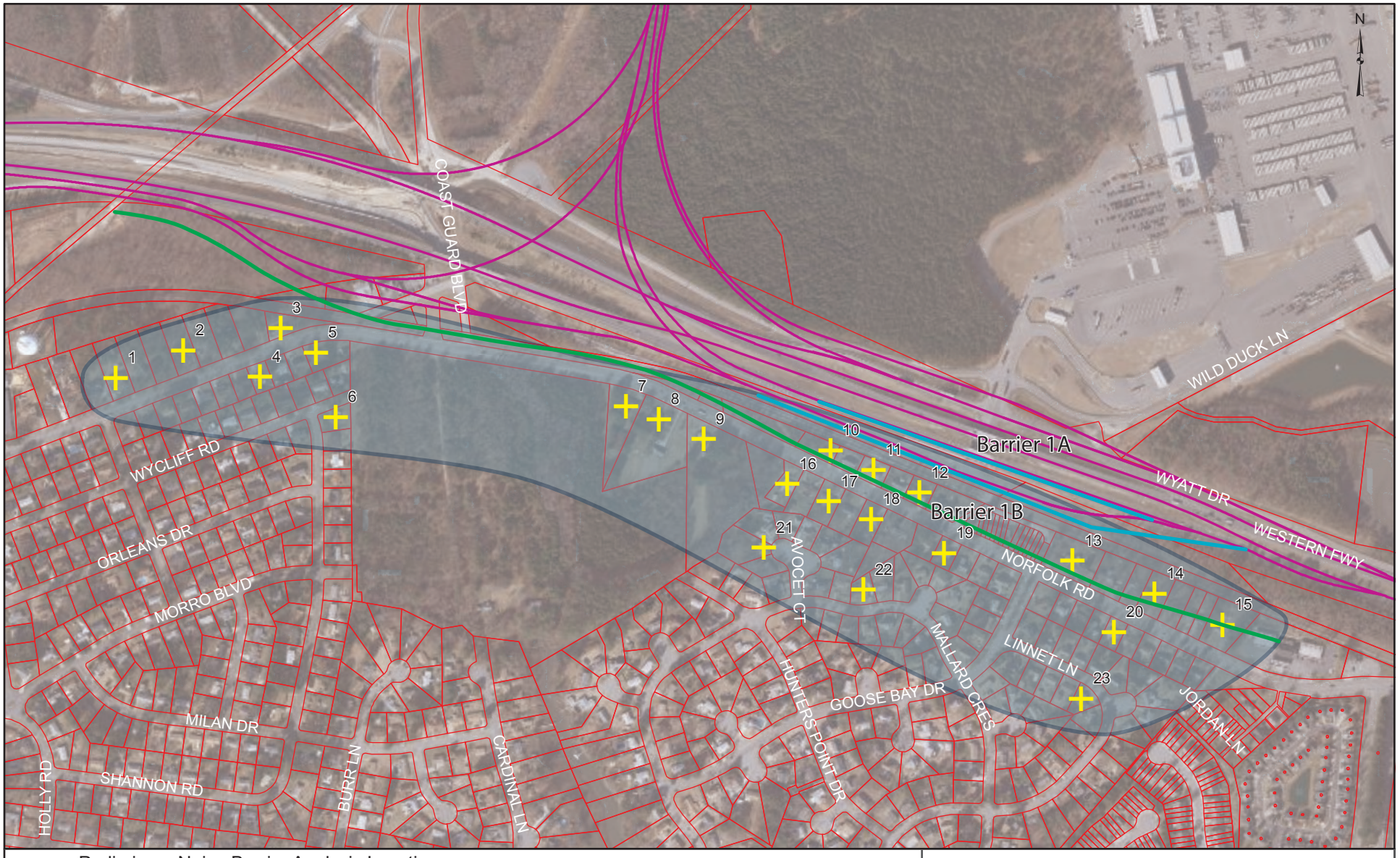
TABLE 6: EXISTING AND DESIGN YEAR MODELED SOUND LEVELS

Receptor ID / Number	Number of Receptors	NAC	Existing Leq	Year 2034 Build Leq	Substantial Increase Impact?	NAC Impact?
1	3	B	56	58	N	N
2	3	B	58	60	N	N
3	4	B	60	63	N	N
4	3	B	57	58	N	N
5	6	B	59	62	N	N
6	3	B	55	57	N	N
7	1	B	64	64	N	N
8	1	B	64	64	N	N
9	1	B	63	63	N	N
10	2	B	66	68	N	Y
11	2	B	66	67	N	Y
12 (Measurement site, also)	2	B	66	67	N	Y
13	16	B	67	67	N	Y
14	4	B	66	66	N	Y
15	4	B	66	65	N	N
16	3	B	62	63	N	N
17	2	B	63	63	N	N
18	3	B	63	63	N	N
19	4	B	63	62	N	N
20	5	B	61	61	N	N
21	7	B	56	57	N	N
22	10	B	57	57	N	N
23	11	B	55	55	N	N

TABLE 6 (CONTINUED): EXISTING AND DESIGN YEAR MODELED SOUND LEVELS

Receptor ID / Number	Number of Receptors	NAC	Existing Leq	Year 2034 Build Leq	Substantial Increase Impact?	NAC Impact?
24	4	B	61	62	N	N
25	3	B	61	62	N	N
26	5	B	61	62	N	N
27	3	B	60	62	N	N
28	3	B	59	61	N	N
29	4	B	56	58	N	N
30	4	B	53	54	N	N
31	12	B	55	57	N	N
32	9	B	55	56	N	N
33	13	B	52	54	N	N
34	4	B	59	60	N	N
35	9	B	60	61	N	N
36	4	B	59	61	N	N
37	5	B	60	61	N	N
38	4	B	58	59	N	N
39	4	B	55	56	N	N
40	5	B	53	54	N	N
41	1	B	55	57	N	N
42	7	B	55	57	N	N
43	7	B	57	58	N	N
44	8	B	56	58	N	N
45	10	B	54	55	N	N

Source: Michael Baker Jr., Inc.



Preliminary Noise Barrier Analysis Location

Common Noise Environment #1

Noise Receptor

66 dBA (2034 Build, No Barrier)

Build Alternative CBA 9 - Segment 3

Parcel Lines

N
W E
S

0 610 1,220
Feet

Figure 3: Noise Receptors and Preliminary Noise Barrier Analysis Location VA 164 Interchange

HRCS EA

6. HIGHWAY TRAFFIC NOISE CONSIDERATION AND ABATEMENT ALTERNATIVES

6.1 COMPARISON OF THE TOTAL NOISE LEVELS AND DETERMINATION OF IMPACTS

The sound levels are predicted to change from (-1)-3 dBA over the existing condition from a combination of the new roadway location and the predicted traffic volume changes. (Please note that the mainline traffic volumes on VA 164 decrease over the No-Build Alternative as a result of the proposed project and that the mainline is also shifted away from the receptors.)

There are a total of 26 receptors predicted to approach or exceed 67 dBA for category B receivers, as shown in Table 6. As mentioned previously, there are industrial land uses in the project area (NAC F) but these land use types do not have a noise criteria and are not analyzed.

6.2 ABATEMENT CONSIDERATIONS

The following abatement measures were considered for receptors with predicted impacts in the design year build condition: traffic management measures, alteration of horizontal and/or vertical alignments, acquisition of real property to serve as a buffer zone (Type I projects only), noise insulation for NAC D land uses and noise barriers.

Traffic management measures such as traffic control devices, signing to restrict certain vehicle types, time-of-day restrictions, speed limit changes and exclusive lane designations are not reasonable or feasible. Traffic control devices such as traffic signals and stop signs are not applicable to a controlled access highway. Restricting certain vehicles types and/or time-of-day constraints are not practical since some of the land use is heavy industrial that generates heavy vehicle activities that require access to enter and exit the region around the clock. A substantial decrease in speed would be needed to provide a noticeable sound level reduction because a 10 mph speed reduction would result in only a 2 dBA decrease in sound levels (approximate). Reducing the speed would not accomplish the goal of moving people and goods effectively in the area. Furthermore, the enforcement of lower speeds in this corridor is not a practical or effective solution for noise control. Exclusive lane designation are not practical in the impacted area since there is a lot of weaving, merging and diverging as a result of the complex interchange ramp configurations to and from VA 164 and Segment 3 (Craney Island), Cedar Lane and APM Terminals Boulevard.

The horizontal and vertical alignment is conceptual, though it is a new alternative having been moved to the west from its previous location. Nonetheless, the build alternative is bound by the required engineering limitations with the roadway design as well as incorporating abutting property lines. It was also developed to minimize and/or avoid impacts to potentially sensitive areas and to reduce/eliminate right-of-way acquisition. Any significant sound level reductions at impacted locations as a result of horizontal modifications would require large shifts in the alignment and might also require realigning the interchange ramp alignments for proper radii, potentially taking out more residences. Additionally, the mainline of VA 164 is already shifted slightly farther away from the residences to accommodate the proposed interchange ramps.

Vertical alignment alteration is also not considered to be a feasible noise abatement measure. As mentioned, the build alternative was developed to minimize impacts. The complexity of the interchange and connector road designs would preclude any possible notable sound level reductions, if any could be achieved at all. Essentially, there are just too many road links that have to be properly "interwoven" to make the alternative viable by engineering design rules.

For the acquisition of real property variable, Generally, VDOT would build reasonable and feasible mitigation within the acquired right-of-way. The acquisition of property to serve as buffer zones is not practical in this environment because the existing residential group already abuts the existing highway property.

Noise insulation for NAC D land uses is not applicable since there are no interior sound levels impacts as a result of the proposed project.

Additionally, the 2009 General Assembly passed Chapter 120 (HB 2577, as amended by HB2025), which amends the Code of Virginia by adding in Article 15 of Chapter 1 of Title 33.1 a section numbered 33.1-223.2:21, relating to highway noise abatement. House Bill 2025 States: Requires that whenever the Commonwealth Transportation Board or the Department plan for or undertake any highway construction or improvement project and such project includes or may include the requirement for the mitigation of traffic noise impacts, first consideration should be given to the use of noise reducing design and low noise pavement materials and techniques in lieu of construction of noise walls or sound barriers. Vegetative screening, such as the planting of appropriate conifers, in such a design would be utilized to act as a visual screen if visual screening is required. In an effort to honor the intent of HB 2025 and since there are predicted future impacts as a result of the proposed project, we have included a series of responses to the possible alternative noise reducing designs, quiet pavement technology and visual screening techniques. The responses to HB 2577 (as amended by HB 2025) are included in Appendix E.

As a result, noise barriers would be the best currently available abatement measure to reduce sound levels for the impacted area. In order for noise barriers to be included in a project, they must be determined to be both feasible and reasonable in accordance with VDOT's Noise Policy and are discussed in the following sections.

Feasibility Criteria: To determine feasibility of a highway traffic noise barrier, the following two conditions shall be considered:

(1) A minimum 5 dB(A) highway traffic noise reduction at impacted receptors. VDOT requires that fifty percent (50%) 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.

Reasonableness Criteria: A determination of noise barrier reasonableness will include the consideration of the parameters listed in the following subsections. The parameters used during the NEPA process are also used during the Final Design Phase when making a determination of noise barrier reasonableness. When performing a reasonableness analysis for the NEPA document, some parameters (e.g., desires of the impacted community) will not yet be quantifiable. Questions relating to these parameters will be answered in the *Warranted, Feasible, and Reasonable Worksheets* to determine the proposed noise barrier's reasonableness. (Note – All of the reasonableness factors listed below must collectively be achieved for a noise abatement measure to be deemed reasonable.)

6.2.1 Viewpoints of the Benefited Receptors

Viewpoints of all benefited receptors shall be solicited through certified mailings and enough responses must be obtained to document a decision as to whether or not there is a desire for the proposed noise abatement measure. Fifty percent (50%) or more of the respondents shall be required to favor the noise abatement measure in determining reasonableness. A final survey and determination shall occur after the approved final design noise analysis; however, comments will be considered throughout the entire design process.

6.2.2 Cost-effectiveness

VDOT's noise barrier cost effectiveness value is based upon a Maximum Square Footage of Abatement per Benefited Receptor (MaxSF/BR) value of 1,600. This MaxSF/BR criterion shall be applied statewide as part of the noise barrier reasonableness determination process for all types of projects. It replaces the previously used "Cost per Benefited Receptor" criteria.

6.2.3 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. It is a comparison of the design year noise level with the abatement measure to the design year noise level without the abatement measure. The design goal is not the same as acoustic feasibility, which is the minimum level of effectiveness of a noise abatement measure. Acoustic feasibility indicates that the noise abatement measure can, at a minimum, achieve a discernible reduction in noise levels. VDOT's design goal is 7 dB(A) of insertion loss for at least one impacted receptor.

6.2.4 Category C Land Use Activity Areas

The detailed methodology and formula for calculating cost effectiveness for abatement of special activity areas is presented in Appendix E of the VDOT Guidance Manual. For this project, there are no NAC C land use areas within 500 feet of the project area.

6.2.5 Other NAC Land Use Activity Areas

There are no receptors within 500 feet of the proposed project that require interior evaluations for NAC D land uses and no NAC E exterior receptor sites such as hotels, offices and restaurants. Exterior NAC F receptors such as industrial and retail facilities are not analyzed because there are no sound level impacts criteria for these types of activities. Additionally, there are no NAC G undeveloped lands within 500 feet of the proposed project since most of the proposed highway is either on structure above water,

under water in a tunnel, on or near developed military base property, or in existing densely developed industrial and/or residential land use areas.

6.3 ABATEMENT COMMITMENTS AND RECOMMENDATIONS

The *Warranted, Feasible, and Reasonable Worksheet* summarizes the variables used to determine if a noise barrier will be recommended to be carrier forward to the final design stage. This worksheet is included in Appendix D.

A barrier analysis was performed for the 26 impacted residences in one CNE. An initial preliminary barrier height of 16' was used. At this time, overlapping barriers are required because of the existing APM Terminal Boulevard interchange. One of the barriers will likely have to be on structure for most of its length unless the new ramp is to be built on fill. The barrier would have to be alongside the eastbound on-ramp that is carrying traffic from Segment 3 and the Cedar Lane eastbound interchange on-ramp. As a result, this barrier base is elevated above the receptor heights. The other barrier will follow the on and off-ramps to/from APM Terminal Boulevard. This barrier will follow the ground elevations alongside the ramps. After the initial 16' height run, the barrier set was then reduced by height and length to determine if abatement was still reasonable and feasible. The preliminary results are discussed below:

Feasibility: A minimum 5 dBA reduction must be achieved for 50 percent of the impacted receptors. The preliminary barrier analysis height was initially set at 16 feet with approximate lengths of 2,110' for Barrier 1A and 2400' for Barrier 1B. At this height and length, the minimum reduction was achieved for 26 of the 26 impacted receptors (100%), plus additional reductions to some non-impacted sites. This initial design was also deemed to be reasonable. In an effort to lower costs and still maintain reasonableness and feasibility, reduced heights and lengths were also run in TNM. The preliminary analysis results indicate that at a barrier height of 12' and a length of approximately 1,800' for Barrier 1A (Barrier 1B is the same length), the barrier set still provides the minimum reduction to 100% of the impacted residences, plus additional reductions to some non-impacted sites and was also deemed to be reasonable. Final survey elevations have not yet been determined, which will be an important variable in barrier placement and final height.

Additional information: there is an active railroad line located between the residences and the highway. Existing sound level measurements and future year modeling was performed for periods of highway traffic noise activity only. The preliminary noise barrier set will not reduce noise from the train operations. Furthermore, an alternate barrier placement would likely not be possible between the rail line and the residences because VDOT does not own the right-of-way. In lieu of these variables, it is recommended that an absorptive treatment be considered on the residential side of the proposed barrier. The highway side does not require absorptive treatment since there are no noise-sensitive receptors on the north side of VA 164 in this area. Other engineering feasibility factors are unknown at this time.

Reasonableness: The viewpoints of the benefited receptors are not available at this time. These viewpoints will be collected during the final design phase.

For cost effectiveness, the total square footage of the initial 16' barrier set is approximately 72,073 square feet. A total of 57 receptors are predicted to receive the 5 dBA minimum reduction. The barrier is reasonable. The cost effectiveness formula result (1,264 ft^2) is below the 1,600 ft^2 per benefited receptor criteria (72,073/57 = 1,264).

For the reduced 12' height and shorter length barrier set, the total amount of square footage is approximately 50,287. A total of 40 receptors are predicted to receive the 5 dBA minimum reduction with this configuration. The barrier is reasonable. The cost effectiveness formula result (1,257 ft^2) is below the 1,600 ft^2 per benefited receptor criteria (50,287/40 = 1,257).

The noise reduction design goal of 7 dBA was met for 26 impacted receptors at the initial 16' height configuration and at the 12' height and reduced length configuration.

Table 7 shows the analyzed barrier lengths and heights as well as the respective insertion loss results.

Conclusion: Based on the above analysis variables, further abatement consideration is warranted. Noise abatement was evaluated where noise impacts are predicted to occur. The noise evaluation is preliminary and a more detailed review will be completed during the final design stage. As such, noise barriers that are found to be feasible and reasonable during the preliminary noise analysis may not be found to be feasible and reasonable during the final design noise analysis. Conversely, noise barriers that were not considered feasible and reasonable may meet the established criteria and be recommended for construction.

7. CONSTRUCTION NOISE CONSIDERATION AND ABATEMENT OPPORTUNITIES

Temporary construction activities are to be performed in accordance with VDOT construction noise provisions. Construction noise provisions are contained in Section 107.16(b)3 Noise of the 2007 *VDOT Road and Bridge Specifications*. 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.

TABLE 7: INSERTION LOSSES FOR PRELIMINARY BARRIER CONFIGURATIONS

Receptor ID Number	Number of Receptors	Year 2034 Build Leq	Insertion Loss with 16' height Barrier 1A- ~2110' long Barrier 1B- ~2400' long	Insertion Loss with 12' height Barrier 1A- ~1800' long Barrier 1B- ~2400' long
7	1	64	0	0
8	1	64	1	1
9	1	63	2	1
10	2	68	13	8
11	2	67	13	9
12	2	67	11	9
13	16	67	13	9
14	4	66	8	7
15	4	65	5	4
16	3	63	6	4
17	2	63	7	6
18	3	63	7	6
19	4	62	8	7
20	5	61	6	5
21	7	58	3	3
22	10	57	5	4
23	11	55	4	3

Note: there were no rounding errors when the Insertion Loss calculations were made using tenths of decibels as per example "g." on page 13 of the VDOT guidance manual (Barrier Insertion Loss [I.L.] = examples "c – d" = 65.5 dBA -55.9 dBA = 9.6 dBA shall be reported as 10 dBA)

- 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 P.M. and 6 A.M. 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.

There is only one area most likely to notice the temporary construction activities. It is the residential land use along West Norfolk Road located south of VA 164 to the east and west of the new interchange. The residences to the west will be approximately 500 feet from the ramp construction. The residences to the east abut the VA 164 corridor, buffered only by the railroad tracks. As long as the standard measures of the provisions are followed, then no special mitigation measures beyond the specifications are proposed at this time.

8. PUBLIC INVOLVEMENT/LOCAL OFFICIALS CONSIDERATION

FHWA and VDOT policies require that VDOT provide 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 must include information on noise-compatible land-use planning, noise impact zones in undeveloped land in the highway project corridor, and federal participation in Type II projects (noise abatement only). This section of the report provides that information, as well as information about VDOT's noise abatement program.

VDOT's current noise policy outlines VDOT's approach to communication with local officials and provides information and resources on highway noise and noise-compatible land-use adjacent to highways to minimize the potential impacts of highway traffic noise. The brochure titled "Entering the Quiet Zone" 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 well-written and comprehensive guide addressing these noise-compatible land-use planning strategies, with significant detailed information. This document is available through FHWA's Website, at http://www.fhwa.dot.gov/environment/noise/noise_compatible_planning/federal_approach/audible_landscape/al00.cfm.

Noise level contours are lines of equal noise exposure that typically parallel roadway alignments and are often times useful to local officials in undeveloped corridors. Highway traffic noise is considered a linear noise source and sound levels can drop considerably over distance. The degree that sound levels decrease can vary based on a number of different factors including objects that shield the roadway noise, terrain features, and ground cover type (e.g., pavement, grass, or snow). The use of noise level contours has become increasingly popular over the last several years, as they have been implemented in planning programs for undeveloped areas with roadway noise influence. Through conscious planning efforts and noise contour generation, municipal officials can restrict future development inside the noise impact zone (i.e., the area within the 66-dBA noise contour). Figure 3 showed the approximate 66-dbA noise level contour within the CNE when considering the proposed improvements and the Design Year (2034) traffic volumes, speeds, and composition.

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. Currently, the distance to the 66 dBA contour is approximately 310 feet and approximately 175 feet to the 71 dBA contour from the center of the eastbound on-ramp travel lane.

Finally, public meetings and/or workshops are an appropriate forum to discuss and present the findings of the environmental studies to the public. The public meetings are not currently scheduled. Nonetheless, information shown at these meetings will include displays of the conceptual design, project schedules, environmental effects information ,and all pertinent noise analysis information. In the Final Design phase of the project, specific public meetings will be organized with communities where noise abatement is considered warranted, feasible, and reasonable in accordance with VDOT's three-phased approach. While noise abatement may be identified as warranted, feasible, and reasonable in this report, a final determination will not be made until final design.

APPENDICES

APPENDIX A: LIST OF PREPARERS AND REVIEWERS

Andrew P. Kuchta, Air & Noise Technical Manager, nearly 30 years experience performing noise analyses for more than half of the State DOTs throughout the United States, numerous state EPA's, several Turnpike/Toll Road Agencies, several federal level projects (including a 10-year analysis for the NY-NJ District of the Army Corps of Engineers and various projects for the US-VISIT program under the Department of Homeland Security), numerous FAA airport noise analyses, and several commuter and freight train projects.

Susan Manes, Senior Environmental Planner and Project Manager, nearly 25 years experience in the management and production of NEPA documents for transportation projects ranging from simple Categorical Exclusions (CEs) to complex and controversial Environmental Impact Statements (EISs). She has worked on over 50 transportation-related NEPA projects; serving as the Project Manager and/or lead document preparer on 29 of those, coordinating with technical managers and staff to evaluate design impacts, as well as avoidance and minimization measures to ensure federal, state, and local regulatory compliance and permit acquisition.

APPENDIX B: TNM CERTIFICATION FOR NOISE TECHNICAL MANAGER

The TNM certification is on file with VDOT.

APPENDIX C: NOISE METER DATA, FIELD MEASUREMENT DATA, AND TNM INPUTS AND OUTPUTS

Appendix C is included, starting on the following page. Electronic copies of the model runs will be retained in the technical files.

APPENDIX D: WARRANTED, FEASIBLE, AND REASONABLE WORKSHEET

Appendix D is included, following Appendix C.

APPENDIX E: HB 2577 (AMENDED BY HB 2025)

Appendix E is included, following Appendix D.

APPENDIX C: NOISE METER DATA, FIELD MEASUREMENT DATA, AND TNM INPUTS AND OUTPUTS

Scantek, Inc.
CALIBRATION LABORATORY

ISO 17025: 2005, ANSI/NCSL Z540:1994 Part 1 and relevant requirements of ISO 9002:1994 ACCREDITED by NVLAP (an ILAC and APLAC signatory)

NVLAP®

NVLAP Lab Code: 200625-0

Calibration Certificate No.21236

Instrument:	**Acoustical Calibrator**	*Date Calibrated:*	**3/16/2010**	
Model:	**407744**	*Status:*	**Received**	**Sent**
Manufacturer:	**Extech**	*In tolerance:*	**X**	**X**
Serial number:	**Z206457**	*Out of tolerance:*		
Class (IEC 60942):	**2**	*See comments:*		
Barometer type:		*Contains non-accredited tests:*	__Yes _X_ No	
Barometer s/n:				

Customer:	**Scantek, Inc.**	*Address:*	**6450 Dobbin Rd. Suite A**
Tel/Fax:	**410-290-7726 / -9167**		**Columbia, MD 21045**

Tested in accordance with the following procedures and standards:
Calibration of Acoustical Calibrators, Scantek Inc., 06/06/2005

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

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	31071	Jul 7, 2009	Scantek, Inc./ NVLAP	Jul 7, 2010
DS-360-SRS	Function Generator	88077	Aug 19, 2008	ACR Env./ A2LA	Aug 19, 2010
34401A-Agilent Technologies	Digital Voltmeter	MY47011118	Aug 19, 2009	ACR Env./ A2LA	Aug 19, 2010
HM30-Thommen	Meteo Station	1040170/39633	Jul 10, 2009	Transcat / A2LA	Jul 10, 2010
140-Norsonic	Real Time Analyzer	1403978	Mar 4, 2010	Scantek, Inc. / NVLAP	Mar 4, 2011
HMP233-Vaisala Oyj	Humidity & Temp. Transmitter	V3820001	Nov 25, 2009	Scantek, Inc. / NVLAP	May 25, 2011
PC Program 1018 Norsonic	Calibration software	v.5.0	Validated July 2009	-	
1253-Norsonic	Calibrator	31959	Dec 7, 2009	Scantek, Inc./ NVLAP	Dec 7, 2010
1203-Norsonic	Preamplifier	92268	Jan 4, 2010	Scantek, Inc./ NVLAP	Jan 4, 2011
4180-Bruel&Kjaer	Microphone	2246115	Dec 14, 2009	NPL (UK) / UKAS	Dec 14, 2011

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

Calibrated by	Javier Albarracin	Checked by	Mariana Buzduga
Signature	[signature]	Signature	[signature]
Date	3/16/2010	Date	3/17/2010

Calibration Certificates or Test Reports shall not be reproduced, except in full, without written approval of the laboratory.
This Calibration Certificate or Test Reports shall not be used to claim product certification, approval or endorsement by NVLAP, NIST, or any agency of the federal government.
Document stored as: C:\Nor1504\CalCal\Results\Ex407744_Z206457_M1.doc

Certificate of Calibration

Certificate No.: 1320170

Object	Precision Sound Level Meter Nor-132
Supplier	Norsonic AS
Type	Nor-132
Serial number	1322870
Client	

Calibration complies with the following standard(s)

IEC 61672-1:2002 class 2
IEC 60651 type 2
IEC 60804 type 2
IEC 61260 class 1
ANSI S1.4-1983 (R2001) with and. S1.4A-1985 class 2
ANSI S1.43-1997 (R2002) class 2
ANSI S1.11-2004 class 2
DIN 45 657, Applicable parts
Norsonic production standard set for the Nor-132

Instrumentation used for calibration traceable to

Electrical Parameters: MT, Norway
Acoustical Parameters: PTB, Germany
Environmental Parameters: IKM, Norway. Justervesenet. Norway

SW version(s):	1.0.746
Id no.:	2709416
Accessories:	Nor-1229 Microphone: 529
Comments	None

Date of calibration	**Calibration interval recommended**
3/23/2010	2 years

The environmental parameters applicable to this calibration are kept well within limits ensuring negligible deviation on obtained measurement results.

Calibrated by

Anders Amundsen

Sign.

AA

Norsonic AS, P.B 24, 3421 Lierskogen. Visitor address: Gunnersbråtan 2, Tranby, Norway.
Phone +47 32858900 Fax: +47 32852208. email: norsonic@online.no

NOISE SURVEY SHEET

EQUIPMENT: METER Norsonics 132 CALIBRATOR EXTECH 407744

CALIBRATION: START 102.0 dB END 102.0 dB

RESPONSE: FAST X SLOW ____ A-WEIGHTING X BATTERY CHECK X

WEATHER DATA: CLOUDY ~~Clear, Mid 80's~~ LOW 70'S, Winds < ~~12 mph~~ CALM

TRAFFIC DATA		
ROAD	164 EB	164 WB
AUTOS	260	250
MED TRKS	5	15
HVY TRKS	40	40
DURATION	15 min	15 min

DATE: 09/02/2011

SITE #: APT ON W. NORFOLK

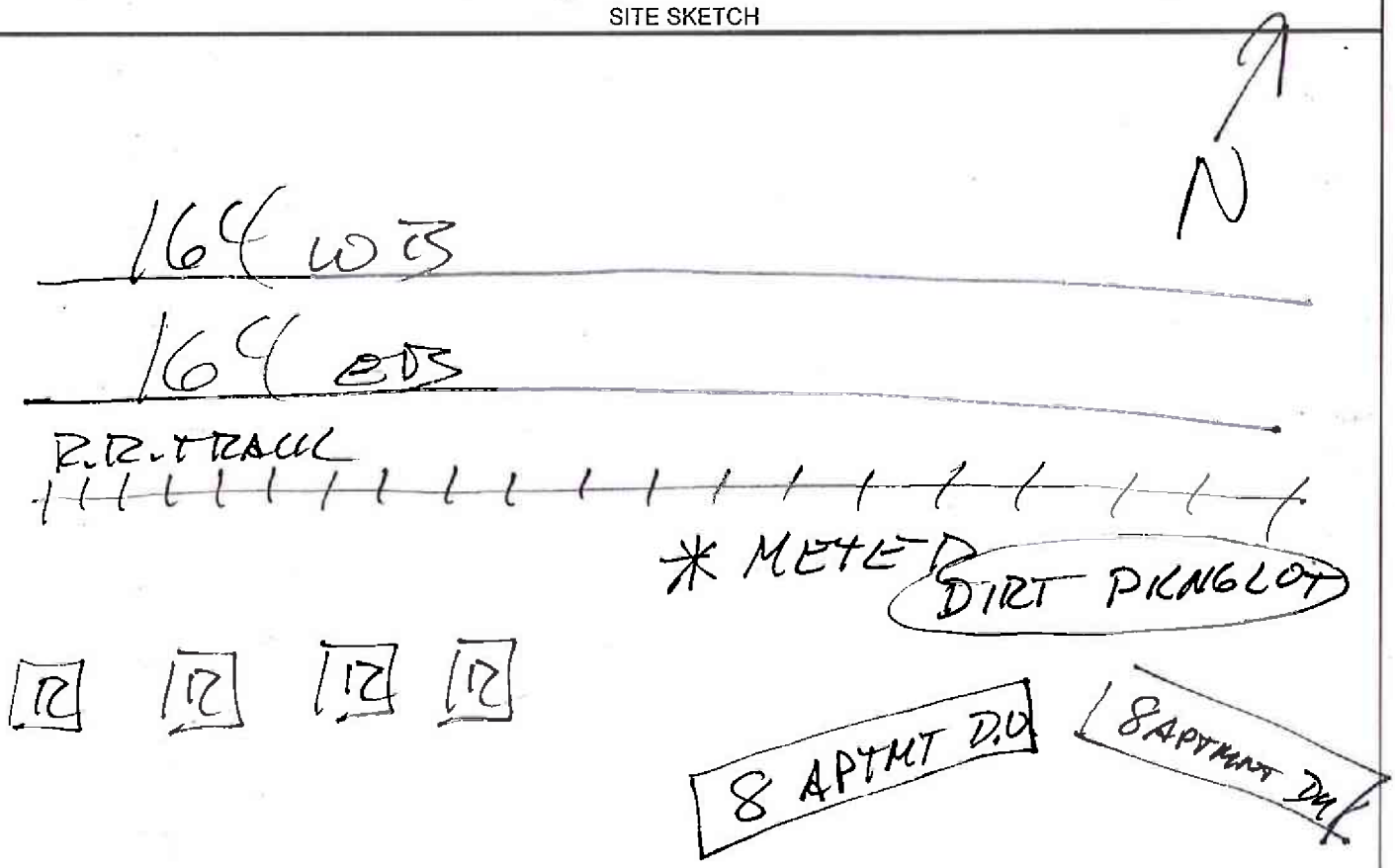
START: 9:09

END: 9:24

LEQ: 64.4

SPEED: ~60 mph.

SITE SKETCH



BACKGROUND NOISE CRICKETS

MAJOR SOURCES VA 164

UNUSUAL EVENTS NONE

OTHER NOTES NONE

MBJr. Inc
APK

1 November 2011
TNM 2.5

INPUT: ROADWAYS
PROJECT/CONTRACT: Patriots Crossing
RUN: Existing Condition

Average pavement type shall be used unless a State highway agency substantiates the use of a different type with the approval of FHWA

Roadway Name	Width	Points Name	No.	Coordinates (pavement) X	Y	Z	Flow Control Control Device	Speed Constraint	Percent Vehicles Affected	Segment Pvmt Type	On Struct?
	ft			ft	ft	ft		mph	%		
164 EB1	44.0	point1	1	12,096,280.0	3,483,937.0	14.00				Average	
		point2	2	12,101,558.0	3,484,109.5	14.00					
eb off ramp to cedar	22.0	point3	3	12,101,558.0	3,484,109.5	14.00				Average	
		point4	4	12,102,372.0	3,484,068.2	17.00				Average	
		point5	5	12,102,585.0	3,483,956.5	21.00				Average	
		point6	6	12,102,799.0	3,483,804.0	24.00				Average	
		point7	7	12,103,002.0	3,483,671.8	27.00				Average	
		point8	8	12,103,205.0	3,483,631.2	31.00				Average	
		point9	9	12,103,531.0	3,483,641.2	34.00					
164 eb2	44.0	point10	10	12,101,558.0	3,484,109.5	14.00				Average	
		point11	11	12,102,575.0	3,484,129.2	14.00				Average	
		point12	12	12,103,114.0	3,484,139.5	14.00				Average	
		point13	13	12,103,673.0	3,484,119.0	13.00					
eb on-ramp from cedar	22.0	point22	22	12,103,536.0	3,483,708.0	34.00				Average	
		point23	23	12,103,273.0	3,483,708.0	30.00				Average	
		point24	24	12,103,097.0	3,483,753.5	27.00				Average	
		point25	25	12,102,994.0	3,483,884.0	24.00				Average	
		point26	26	12,103,047.0	3,484,042.2	21.00				Average	
		point27	27	12,103,210.0	3,484,092.0	17.00				Average	
		point28	28	12,103,673.0	3,484,119.0	13.00					
164 eb3	44.0	point29	29	12,103,673.0	3,484,119.0	13.00				Average	
		point14	14	12,104,191.0	3,484,098.8	14.00				Average	
		point15	15	12,104,862.0	3,484,007.2	15.00				Average	
		point16	16	12,105,563.0	3,483,881.0	16.00				Average	
		point70	70	12,105,955.0	3,483,773.2	16.50				Average	

		point17	17	12,106,316.0	3,483,631.2	17.00				Average	
		point75	75	12,107,326.0	3,483,241.5	25.50				Average	
		point64	64	12,108,337.0	3,482,852.0	34.00				Average	Y
		point66	66	12,108,745.0	3,482,686.5	34.00				Average	
		point68	68	12,109,523.0	3,482,396.2	17.00				Average	
		point18	18	12,110,354.0	3,482,099.8	22.00				Average	
		point19	19	12,110,666.0	3,481,984.5	27.00				Average	
		point20	20	12,110,869.0	3,481,849.8	34.00				Average	
		point21	21	12,111,971.0	3,479,833.2	14.00					
164 wb1	44.0	point30	30	12,112,069.0	3,479,900.2	14.00				Average	
		point31	31	12,110,972.0	3,481,885.5	34.00				Average	
		point32	32	12,110,719.0	3,482,056.0	27.00				Average	
		point33	33	12,110,388.0	3,482,181.0	22.00				Average	
		point69	69	12,109,572.0	3,482,470.2	27.00				Average	
		point67	67	12,108,794.0	3,482,756.2	34.00				Average	
		point65	65	12,108,374.0	3,482,926.0	34.00				Average	
		point34	34	12,106,397.0	3,483,803.5	17.00				Average	
		point35	35	12,105,995.0	3,483,951.5	16.00				Average	
		point36	36	12,105,601.0	3,484,070.5	15.00				Average	
		point37	37	12,104,964.0	3,484,185.5	14.00				Average	
		point38	38	12,104,240.0	3,484,253.2	13.00				Average	
		point39	39	12,103,644.0	3,484,273.2	13.00					
wb off ramp to cedar	22.0	point40	40	12,103,644.0	3,484,273.2	13.00				Average	
		point41	41	12,103,211.0	3,484,323.2	16.00				Average	
		point42	42	12,103,039.0	3,484,373.0	19.00				Average	
		point43	43	12,102,963.0	3,484,513.0	22.00				Average	
		point44	44	12,103,013.0	3,484,653.0	25.00				Average	
		point45	45	12,103,117.0	3,484,711.5	28.00				Average	
		point46	46	12,103,270.0	3,484,747.8	31.00				Average	
		point47	47	12,103,523.0	3,484,738.8	34.00					
164 wb2	44.0	point48	48	12,103,644.0	3,484,273.2	13.00				Average	
		point49	49	12,103,107.0	3,484,278.0	14.00				Average	
		point50	50	12,102,556.0	3,484,273.5	14.00				Average	
		point51	51	12,102,109.0	3,484,246.2	14.00					
164 wb3	44.0	point52	52	12,102,109.0	3,484,246.2	14.00				Average	
		point76	76	12,101,550.0	3,484,230.5	14.00				Average	
		point53	53	12,096,284.0	3,484,090.2	14.00					
wb on-ramp from cedar	22.0	point54	54	12,103,531.0	3,484,811.0	34.00				Average	

		point55	55	12,103,273.0	3,484,811.0	30.00				Average	
		point56	56	12,103,065.0	3,484,788.5	26.00				Average	
		point57	57	12,102,871.0	3,484,698.0	22.00				Average	
		point58	58	12,102,356.0	3,484,341.2	18.00				Average	
		point77	77	12,102,120.0	3,484,267.5	14.00				Average	
		point59	59	12,101,550.0	3,484,230.5	14.00					
cedar	96.0	point60	60	12,103,737.0	3,482,312.8	15.00				Average	
		point61	61	12,103,561.0	3,483,677.0	34.00				Average	Y
		point62	62	12,103,552.0	3,484,784.0	34.00				Average	
		point63	63	12,103,570.0	3,485,531.5	14.00					
apm off-ramp	24.0	point71	71	12,107,326.0	3,483,241.5	25.50				Average	
		point72	72	12,108,260.0	3,482,744.5	14.00					
Roadway15	12.0	point73	73	12,108,260.0	3,482,744.5	14.00	Onramp	55.00	100	Average	
		point74	74	12,109,523.0	3,482,396.2	17.00					

MBJr. Inc 1 November 2
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INPUT: TRAFFIC FOR LAeq1h Percentages
PROJECT/CONTRACT: Patriots Crossing
RUN: Existing Condition

Roadway Name	Points Name	No.	Segment Total Volume	Autos		MTrucks		HTrucks		Buses		Motorcycles	
				P	S	P	S	P	S	P	S	P	S
			veh/hr	%	mph	%	mph	%	mph	%	mph	%	mph
164 EB1	point1	1	2765	90	55	3	55	7	55	0	0	0	0
	point2	2											
eb off ramp to cedar	point3	3	135	90	55	3	55	7	55	0	0	0	0
	point4	4	135	90	55	3	55	7	55	0	0	0	0
	point5	5	135	90	55	3	55	7	55	0	0	0	0
	point6	6	135	90	55	3	55	7	55	0	0	0	0
	point7	7	135	90	55	3	55	7	55	0	0	0	0
	point8	8	135	90	55	3	55	7	55	0	0	0	0
	point9	9											
164 eb2	point10	10	2630	90	55	3	55	7	55	0	0	0	0
	point11	11	2630	90	55	3	55	7	55	0	0	0	0
	point12	12	2630	90	55	3	55	7	55	0	0	0	0
	point13	13											
eb on-ramp from cedar	point22	22	223	90	45	3	45	7	45	0	0	0	0
	point23	23	223	90	45	3	45	7	45	0	0	0	0
	point24	24	223	90	45	3	45	7	45	0	0	0	0
	point25	25	223	90	45	3	45	7	45	0	0	0	0
	point26	26	223	90	45	3	45	7	45	0	0	0	0
	point27	27	223	90	45	3	45	7	45	0	0	0	0
	point28	28											
164 eb3	point29	29	2853	90	55	3	55	7	55	0	0	0	0
	point14	14	2853	90	55	3	55	7	55	0	0	0	0

	point15	15	2853	90	55	3	55	7	55	0	0	0	0
	point16	16	2853	90	55	3	55	7	55	0	0	0	0
	point70	70	2853	90	55	3	55	7	55	0	0	0	0
	point17	17	2853	90	55	3	55	7	55	0	0	0	0
	point75	75	2853	90	55	3	55	7	55	0	0	0	0
	point64	64	2853	90	55	3	55	7	55	0	0	0	0
	point66	66	2853	90	55	3	55	7	55	0	0	0	0
	point68	68	2853	90	55	3	55	7	55	0	0	0	0
	point18	18	2853	90	55	3	55	7	55	0	0	0	0
	point19	19	2853	90	55	3	55	7	55	0	0	0	0
	point20	20	2853	90	55	3	55	7	55	0	0	0	0
	point21	21											
164 wb1	point30	30	2853	90	55	3	55	7	55	0	0	0	0
	point31	31	2853	90	55	3	55	7	55	0	0	0	0
	point32	32	2853	90	55	3	55	7	55	0	0	0	0
	point33	33	2853	90	55	3	55	7	55	0	0	0	0
	point69	69	2853	90	55	3	55	7	55	0	0	0	0
	point67	67	2853	90	55	3	55	7	55	0	0	0	0
	point65	65	2853	90	55	3	55	7	55	0	0	0	0
	point34	34	2853	90	55	3	55	7	55	0	0	0	0
	point35	35	2853	90	55	3	55	7	55	0	0	0	0
	point36	36	2853	90	55	3	55	7	55	0	0	0	0
	point37	37	2853	90	55	3	55	7	55	0	0	0	0
	point38	38	2853	90	55	3	55	7	55	0	0	0	0
	point39	39											
wb off ramp to cedar	point40	40	223	90	45	3	45	7	45	0	0	0	0
	point41	41	223	90	45	3	45	7	45	0	0	0	0
	point42	42	223	90	45	3	45	7	45	0	0	0	0
	point43	43	223	90	45	3	45	7	45	0	0	0	0
	point44	44	223	90	45	3	45	7	45	0	0	0	0
	point45	45	223	90	45	3	45	7	45	0	0	0	0
	point46	46	223	90	45	3	45	7	45	0	0	0	0
	point47	47											
164 wb2	point48	48	2630	90	55	3	55	7	55	0	0	0	0

	point49	49	2630	90	55	3	55	7	55	0	0	0	0
	point50	50	2630	90	55	3	55	7	55	0	0	0	0
	point51	51											
164 wb3	point52	52	2630	90	55	3	55	7	55	0	0	0	0
	point76	76	2765	90	55	3	55	7	55	0	0	0	0
	point53	53											
wb on-ramp from cedar	point54	54	135	90	45	3	45	7	45	0	0	0	0
	point55	55	135	90	45	3	45	7	45	0	0	0	0
	point56	56	135	90	45	3	45	7	45	0	0	0	0
	point57	57	135	90	45	3	45	7	45	0	0	0	0
	point58	58	135	90	45	3	45	7	45	0	0	0	0
	point77	77	135	90	45	3	45	7	45	0	0	0	0
	point59	59											
cedar	point60	60	1100	90	45	3	45	7	45	0	0	0	0
	point61	61	1100	90	45	3	45	7	45	0	0	0	0
	point62	62	1100	90	45	3	45	7	45	0	0	0	0
	point63	63											
apm off-ramp	point71	71	38	45	25	5	25	50	25	0	0	0	0
	point72	72											
Roadway15	point73	73	75	85	25	1	25	14	25	0	0	0	0
	point74	74											

MBJr. Inc
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TNM 2.5

INPUT: RECEIVERS
PROJECT/CONTRACT: Patriots Crossing
RUN: Existing Condition

Receiver Name	No.	#DUs	Coordinates (ground) X	Y	Z	Height above Ground	Input Sound Levels and Criteria: Existing LAeq1h	Impact Criteria LAeq1h	Impact Criteria Sub'l	NR Goal	Active in Calc.
			ft	ft	ft	ft	dBA	dBA	dB	dB	
1	1	3	12,104,566.0	3,483,293.0	17.00	4.92	0.00	66	10.0	8.0	Y
2	2	3	12,104,855.0	3,483,389.8	16.00	4.92	0.00	66	10.0	8.0	Y
3	3	4	12,105,339.0	3,483,424.5	15.00	4.92	0.00	66	10.0	8.0	Y
4	4	3	12,105,133.0	3,483,179.2	14.00	4.92	0.00	66	10.0	8.0	Y
5	5	6	12,105,499.0	3,483,272.0	11.00	4.92	0.00	66	10.0	8.0	Y
6	6	3	12,105,570.0	3,483,025.0	10.00	4.92	0.00	66	10.0	8.0	Y
7	7	1	12,106,806.0	3,483,098.8	15.00	4.92	0.00	66	10.0	8.0	Y
8	8	1	12,106,982.0	3,483,024.2	15.00	4.92	0.00	66	10.0	8.0	Y
9	9	1	12,107,212.0	3,482,916.0	14.00	4.92	0.00	66	10.0	8.0	Y
10	10	2	12,107,635.0	3,482,895.0	15.00	4.92	0.00	66	10.0	8.0	Y
11	11	2	12,107,882.0	3,482,793.2	14.00	4.92	0.00	66	10.0	8.0	Y
12	12	2	12,108,075.0	3,482,707.0	14.00	4.92	0.00	66	10.0	8.0	Y
13	13	16	12,108,493.0	3,482,564.5	13.00	4.92	0.00	66	10.0	8.0	Y
14	14	4	12,108,922.0	3,482,369.8	12.00	4.92	0.00	66	10.0	8.0	Y
15	15	4	12,109,265.0	3,482,230.8	11.00	4.92	0.00	66	10.0	8.0	Y
16	16	3	12,107,512.0	3,482,775.2	12.00	4.92	0.00	66	10.0	8.0	Y
17	17	2	12,107,675.0	3,482,696.5	14.00	4.92	0.00	66	10.0	8.0	Y
18	18	3	12,107,860.0	3,482,605.0	13.00	4.92	0.00	66	10.0	8.0	Y
19	19	4	12,108,181.0	3,482,447.8	13.00	4.92	0.00	66	10.0	8.0	Y
20	20	5	12,108,912.0	3,482,100.0	12.00	4.92	0.00	66	10.0	8.0	Y
21	21	7	12,107,315.0	3,482,499.2	10.00	4.92	0.00	66	10.0	8.0	Y
22	22	10	12,107,827.0	3,482,305.0	12.00	4.92	0.00	66	10.0	8.0	Y

23	23	11	12,108,781.0	3,481,841.2	10.00	4.92	0.00	66	10.0	8.0	Y
24	28	4	12,100,857.0	3,484,008.5	14.00	4.92	0.00	66	10.0	8.0	Y
25	29	3	12,101,143.0	3,484,020.2	14.00	4.92	0.00	66	10.0	8.0	Y
26	30	5	12,101,447.0	3,484,020.2	14.00	4.92	0.00	66	10.0	8.0	Y
27	31	3	12,101,851.0	3,484,020.2	14.00	4.92	0.00	66	10.0	8.0	Y
28	32	3	12,102,131.0	3,483,985.0	14.00	4.92	0.00	66	10.0	8.0	Y
29	33	4	12,102,383.0	3,483,897.5	14.00	4.92	0.00	66	10.0	8.0	Y
30	34	4	12,102,804.0	3,483,611.0	14.00	4.92	0.00	66	10.0	8.0	Y
31	35	12	12,102,032.0	3,483,745.5	14.00	4.92	0.00	66	10.0	8.0	Y
32	36	9	12,101,143.0	3,483,692.8	14.00	4.92	0.00	66	10.0	8.0	Y
33	37	13	12,102,026.0	3,483,447.2	14.00	4.92	0.00	66	10.0	8.0	Y
34	38	4	12,103,388.0	3,483,418.0	15.00	4.92	0.00	66	10.0	8.0	Y
35	39	9	12,100,851.0	3,484,316.5	14.00	4.92	0.00	66	10.0	8.0	Y
36	40	4	12,101,564.0	3,484,382.8	14.00	4.92	0.00	66	10.0	8.0	Y
37	41	5	12,101,944.0	3,484,376.8	14.00	4.92	0.00	66	10.0	8.0	Y
38	42	4	12,102,255.0	3,484,435.2	14.00	4.92	0.00	66	10.0	8.0	Y
39	43	4	12,102,540.0	3,484,610.8	13.00	4.92	0.00	66	10.0	8.0	Y
40	44	5	12,102,692.0	3,484,955.8	12.00	4.92	0.00	66	10.0	8.0	Y
41	45	1	12,103,126.0	3,485,055.2	13.00	4.92	0.00	66	10.0	8.0	Y
42	46	7	12,102,330.0	3,484,675.0	14.00	4.92	0.00	66	10.0	8.0	Y
43	47	7	12,101,851.0	3,484,534.8	14.00	4.92	0.00	66	10.0	8.0	Y
44	48	8	12,101,202.0	3,484,546.5	14.00	4.92	0.00	66	10.0	8.0	Y
45	49	10	12,102,020.0	3,484,792.0	14.00	4.92	0.00	66	10.0	8.0	Y

MBJr. Inc
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1 November 2011
TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS
PROJECT/CONTRACT: Patriots Crossing
RUN: Existing Condition
BARRIER DESIGN: INPUT HEIGHTS

Average pavement type shall be used unless a State highway agency substantiates the use of a different type with approval of FHWA.

ATMOSPHERICS: 68 deg F, 50% RH

Receiver Name	No.	#DUs	Existing LAeq1h	No Barrier LAeq1h Calculated	Crit'n	Increase over existing Calculated	Crit'n Sub'l Inc	Type Impact	With Barrier Calculated LAeq1h	Noise Reduction Calculated	Goal	Calculated minus Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
1	1	3	0.0	56.3	66	56.3	10	----	56.3	0.0	8	-8.0
2	2	3	0.0	57.8	66	57.8	10	----	57.8	0.0	8	-8.0
3	3	4	0.0	59.7	66	59.7	10	----	59.7	0.0	8	-8.0
4	4	3	0.0	56.6	66	56.6	10	----	56.6	0.0	8	-8.0
5	5	6	0.0	58.6	66	58.6	10	----	58.6	0.0	8	-8.0
6	6	3	0.0	55.0	66	55.0	10	----	55.0	0.0	8	-8.0
7	7	1	0.0	63.9	66	63.9	10	----	63.9	0.0	8	-8.0
8	8	1	0.0	63.5	66	63.5	10	----	63.5	0.0	8	-8.0
9	9	1	0.0	62.5	66	62.5	10	----	62.5	0.0	8	-8.0
10	10	2	0.0	65.8	66	65.8	10	----	65.8	0.0	8	-8.0
11	11	2	0.0	65.9	66	65.9	10	----	65.9	0.0	8	-8.0
12	12	2	0.0	65.9	66	65.9	10	----	65.9	0.0	8	-8.0
13	13	16	0.0	66.9	66	66.9	10	Snd Lvl	66.9	0.0	8	-8.0
14	14	4	0.0	66.3	66	66.3	10	Snd Lvl	66.3	0.0	8	-8.0
15	15	4	0.0	65.8	66	65.8	10	----	65.8	0.0	8	-8.0
16	16	3	0.0	62.1	66	62.1	10	----	62.1	0.0	8	-8.0
17	17	2	0.0	62.7	66	62.7	10	----	62.7	0.0	8	-8.0
18	18	3	0.0	62.6	66	62.6	10	----	62.6	0.0	8	-8.0
19	19	4	0.0	62.6	66	62.6	10	----	62.6	0.0	8	-8.0
20	20	5	0.0	61.1	66	61.1	10	----	61.1	0.0	8	-8.0
21	21	7	0.0	56.0	66	56.0	10	----	56.0	0.0	8	-8.0
22	22	10	0.0	56.6	66	56.6	10	----	56.6	0.0	8	-8.0
23	23	11	0.0	54.9	66	54.9	10	----	54.9	0.0	8	-8.0

24	28	4	0.0	60.8	66	60.8	10	----	60.8	0.0	8	-8.0
25	29	3	0.0	60.9	66	60.9	10	----	60.9	0.0	8	-8.0
26	30	5	0.0	60.6	66	60.6	10	----	60.6	0.0	8	-8.0
27	31	3	0.0	60.0	66	60.0	10	----	60.0	0.0	8	-8.0
28	32	3	0.0	58.7	66	58.7	10	----	58.7	0.0	8	-8.0
29	33	4	0.0	56.0	66	56.0	10	----	56.0	0.0	8	-8.0
30	34	4	0.0	52.6	66	52.6	10	----	52.6	0.0	8	-8.0
31	35	12	0.0	55.2	66	55.2	10	----	55.2	0.0	8	-8.0
32	36	9	0.0	54.6	66	54.6	10	----	54.6	0.0	8	-8.0
33	37	13	0.0	52.1	66	52.1	10	----	52.1	0.0	8	-8.0
34	38	4	0.0	59.1	66	59.1	10	----	59.1	0.0	8	-8.0
35	39	9	0.0	60.4	66	60.4	10	----	60.4	0.0	8	-8.0
36	40	4	0.0	59.2	66	59.2	10	----	59.2	0.0	8	-8.0
37	41	5	0.0	59.5	66	59.5	10	----	59.5	0.0	8	-8.0
38	42	4	0.0	58.0	66	58.0	10	----	58.0	0.0	8	-8.0
39	43	4	0.0	54.8	66	54.8	10	----	54.8	0.0	8	-8.0
40	44	5	0.0	52.8	66	52.8	10	----	52.8	0.0	8	-8.0
41	45	1	0.0	55.4	66	55.4	10	----	55.4	0.0	8	-8.0
42	46	7	0.0	55.0	66	55.0	10	----	55.0	0.0	8	-8.0
43	47	7	0.0	56.7	66	56.7	10	----	56.7	0.0	8	-8.0
44	48	8	0.0	56.2	66	56.2	10	----	56.2	0.0	8	-8.0
45	49	10	0.0	53.5	66	53.5	10	----	53.5	0.0	8	-8.0

Dwelling Units	# DUs	Noise Reduction		
		Min	Avg	Max
		dB	dB	dB
All Selected	228	0.0	0.0	0.0
All Impacted	20	0.0	0.0	0.0
All that meet NR Goal	0	0.0	0.0	0.0

MBJr Inc.
APK

1 November 2011
TNM 2.5

INPUT: ROADWAYS
PROJECT/CONTRACT: Patriots Crossing
RUN: Design Year Build Alt

Average pavement type shall be used unless a State highway agency substantiates the use of a different type with the approval of FHWA

Roadway Name	Width	Points Name	No.	Coordinates (pavement) X	Y	Z	Flow Control Control Device	Speed Constraint	Percent Vehicles Affected	Segment Pvmt Type	On Struct?
	ft			ft	ft	ft		mph	%		
164 EB1	44.0	point1	1	12,096,280.0	3,483,937.0	14.00				Average	
		point2	2	12,101,558.0	3,484,109.5	14.00					
eb off ramp to cedar	22.0	point3	3	12,101,558.0	3,484,109.5	14.00				Average	
		point4	4	12,102,220.0	3,484,064.2	17.00				Average	
		point5	5	12,102,433.0	3,483,964.5	21.00				Average	
		point6	6	12,102,643.0	3,483,864.0	24.00				Average	
		point7	7	12,102,882.0	3,483,827.2	27.00				Average	
		point8	8	12,103,181.0	3,483,838.8	31.00				Average	
		point9	9	12,103,537.0	3,483,880.2	34.00					
164 eb2	44.0	point10	10	12,101,558.0	3,484,109.5	14.00				Average	
		point11	11	12,102,575.0	3,484,129.2	14.00				Average	
		point12	12	12,103,114.0	3,484,139.5	14.00				Average	
		point13	13	12,103,673.0	3,484,151.0	13.00					
164 eb3	44.0	point29	29	12,103,673.0	3,484,151.0	13.00				Average	
		point14	14	12,104,213.0	3,484,126.2	14.00				Average	
		point15	15	12,104,884.0	3,484,016.0	15.00				Average	
		point16	16	12,105,563.0	3,483,866.5	16.00				Average	
		point70	70	12,105,951.0	3,483,751.2	16.50				Average	
		point17	17	12,106,316.0	3,483,631.2	17.00				Average	
		point158	158	12,107,196.0	3,483,301.0	25.50				Average	
		point64	64	12,108,163.0	3,482,965.2	34.00				Average	Y
		point66	66	12,108,500.0	3,482,841.2	34.00				Average	
		point159	159	12,109,025.0	3,482,657.2	25.50				Average	
		point68	68	12,109,978.0	3,482,242.0	17.00					
164 wb1	44.0	point30	30	12,112,069.0	3,479,900.2	14.00				Average	

		point31	31	12,110,972.0	3,481,885.5	34.00				Average	
		point32	32	12,110,719.0	3,482,056.0	27.00				Average	
		point33	33	12,110,388.0	3,482,181.0	22.00					
wb off ramp to cedar	22.0	point40	40	12,103,644.0	3,484,273.2	13.00				Average	
		point41	41	12,103,211.0	3,484,323.2	16.00				Average	
		point42	42	12,103,039.0	3,484,373.0	19.00				Average	
		point43	43	12,102,963.0	3,484,513.0	22.00				Average	
		point44	44	12,103,013.0	3,484,653.0	25.00				Average	
		point45	45	12,103,117.0	3,484,711.5	28.00				Average	
		point46	46	12,103,270.0	3,484,747.8	31.00				Average	
		point47	47	12,103,523.0	3,484,738.8	34.00					
164 wb2	44.0	point48	48	12,103,644.0	3,484,273.2	13.00				Average	
		point49	49	12,103,107.0	3,484,278.0	14.00				Average	
		point50	50	12,102,556.0	3,484,273.5	14.00				Average	
		point51	51	12,102,109.0	3,484,246.2	14.00					
164 wb3	44.0	point52	52	12,102,109.0	3,484,246.2	14.00				Average	
		point163	163	12,101,550.0	3,484,230.5	14.00				Average	
		point53	53	12,096,284.0	3,484,090.2	14.00					
wb on-ramp from cedar	22.0	point54	54	12,103,531.0	3,484,811.0	34.00				Average	
		point55	55	12,103,273.0	3,484,811.0	30.00				Average	
		point56	56	12,103,065.0	3,484,788.5	26.00				Average	
		point57	57	12,102,871.0	3,484,698.0	22.00				Average	
		point58	58	12,102,356.0	3,484,341.2	18.00				Average	
		point164	164	12,102,120.0	3,484,267.5	14.00				Average	
		point59	59	12,101,550.0	3,484,230.5	14.00					
cedar	96.0	point60	60	12,103,737.0	3,482,312.8	15.00				Average	
		point61	61	12,103,537.0	3,483,880.2	34.00				Average	Y
		point62	62	12,103,552.0	3,484,784.0	34.00				Average	
		point63	63	12,103,570.0	3,485,531.5	14.00					
Craney SB	44.0	point71	71	12,107,749.0	3,488,835.8	14.00				Average	
		point72	72	12,106,963.0	3,486,478.0	14.00				Average	
		point73	73	12,106,908.0	3,486,306.0	14.00				Average	
		point74	74	12,106,878.0	3,486,125.2	14.00					
Craney SB to WB	32.0	point75	75	12,106,878.0	3,486,125.2	14.00				Average	
		point76	76	12,106,849.0	3,485,851.2	14.00				Average	
		point77	77	12,106,885.0	3,485,106.0	14.00				Average	
		point78	78	12,106,884.0	3,484,967.8	14.00				Average	
		point79	79	12,106,868.0	3,484,863.5	14.00				Average	

		point80	80	12,106,836.0	3,484,728.8	14.00				Average	
		point81	81	12,106,781.0	3,484,596.0	14.00				Average	
		point82	82	12,106,696.0	3,484,463.0	14.00				Average	
		point83	83	12,106,597.0	3,484,342.5	14.00				Average	
		point84	84	12,106,465.0	3,484,232.5	14.00				Average	
		point85	85	12,106,302.0	3,484,136.8	14.00				Average	
		point86	86	12,106,132.0	3,484,076.5	14.00				Average	
		point87	87	12,105,939.0	3,484,048.2	14.00				Average	
		point88	88	12,105,764.0	3,484,055.2	14.00				Average	
		point89	89	12,105,606.0	3,484,087.2	14.00				Average	
		point90	90	12,104,975.0	3,484,211.2	14.00				Average	
		point91	91	12,104,246.0	3,484,273.2	14.00				Average	
		point92	92	12,103,644.0	3,484,273.2	13.00					
Roadway16	44.0	point93	93	12,106,878.0	3,486,125.2	14.00				Average	
		point94	94	12,106,868.0	3,485,853.2	14.00				Average	
		point95	95	12,106,920.0	3,485,110.8	14.00				Average	
		point96	96	12,106,913.0	3,484,967.2	26.00				Average	
		point97	97	12,106,895.0	3,484,850.2	37.00				Average	Y
		point98	98	12,106,760.0	3,484,214.2	49.00				Average	Y
		point99	99	12,106,751.0	3,484,094.8	49.00				Average	Y
		point100	100	12,106,751.0	3,483,935.2	45.00				Average	Y
		point101	101	12,106,758.0	3,483,821.8	41.00				Average	Y
		point102	102	12,106,790.0	3,483,685.2	37.00				Average	Y
		point103	103	12,106,847.0	3,483,547.0	35.00				Average	Y
		point104	104	12,106,936.0	3,483,419.2	34.00				Average	Y
		point105	105	12,107,056.0	3,483,298.8	34.00				Average	Y
		point106	106	12,107,198.0	3,483,223.0	30.00					
164 eb3-2	44.0	point108	108	12,109,978.0	3,482,242.0	17.00				Average	
		point18	18	12,110,354.0	3,482,099.8	22.00				Average	
		point19	19	12,110,666.0	3,481,984.5	27.00				Average	
		point20	20	12,110,869.0	3,481,849.8	34.00				Average	
		point21	21	12,111,971.0	3,479,833.2	14.00					
164 wb1-2	44.0	point109	109	12,110,388.0	3,482,181.0	22.00				Average	
		point69	69	12,109,400.0	3,482,566.5	27.00				Average	
		point67	67	12,108,510.0	3,482,905.0	34.00				Average	
		point65	65	12,108,181.0	3,483,022.2	34.00				Average	
		point157	157	12,107,216.0	3,483,372.2	25.50				Average	
		point34	34	12,106,372.0	3,483,794.0	17.00				Average	

		point35	35	12,105,995.0	3,483,951.5	16.00				Average	
		point36	36	12,105,601.0	3,484,070.5	15.00				Average	
		point37	37	12,104,964.0	3,484,185.5	14.00				Average	
		point38	38	12,104,240.0	3,484,253.2	13.00				Average	
		point39	39	12,103,644.0	3,484,273.2	13.00					
a64 WB to NB	32.0	point110	110	12,110,388.0	3,482,181.0	22.00				Average	
		point111	111	12,109,159.0	3,482,724.5	28.00				Average	
		point112	112	12,108,549.0	3,483,018.0	34.00				Average	Y
		point113	113	12,108,221.0	3,483,135.2	34.00				Average	Y
		point114	114	12,107,452.0	3,483,394.5	19.00				Average	
		point115	115	12,107,169.0	3,483,641.8	17.00				Average	
		point116	116	12,106,986.0	3,483,940.2	16.00				Average	
		point117	117	12,106,902.0	3,484,291.2	15.00				Average	
		point118	118	12,106,926.0	3,484,809.8	14.00					
craney nb	44.0	point119	119	12,106,926.0	3,484,809.8	14.00				Average	
		point120	120	12,106,954.0	3,485,126.5	14.00				Average	
		point121	121	12,106,910.0	3,485,868.2	14.00				Average	
		point122	122	12,106,914.0	3,486,103.5	14.00				Average	
		point123	123	12,106,942.0	3,486,303.0	14.00				Average	
		point124	124	12,107,787.0	3,488,815.8	14.00					
shared eb on-off ramp	32.0	point125	125	12,104,419.0	3,483,995.2	15.00				Average	
		point126	126	12,104,786.0	3,483,939.5	17.00				Average	
		point127	127	12,105,129.0	3,483,792.0	19.00					
EB to NB Craney	32.0	point128	128	12,105,129.0	3,483,792.0	19.00				Average	
		point129	129	12,105,420.0	3,483,648.2	25.00				Average	Y
		point130	130	12,105,703.0	3,483,592.5	31.00				Average	Y
		point131	131	12,105,990.0	3,483,616.5	37.00				Average	Y
		point132	132	12,106,293.0	3,483,712.0	37.00				Average	Y
		point133	133	12,106,492.0	3,483,839.8	36.00				Average	Y
		point134	134	12,106,684.0	3,484,059.0	29.00				Average	Y
		point135	135	12,106,807.0	3,484,250.5	22.00				Average	Y
		point136	136	12,106,926.0	3,484,809.8	14.00					
cedar eb on-ramp	22.0	point137	137	12,103,537.0	3,483,880.2	34.00				Average	
		point138	138	12,104,164.0	3,483,991.2	24.00				Average	
		point139	139	12,104,419.0	3,483,995.2	15.00					
eb to nb Craney 1	32.0	point140	140	12,101,558.0	3,484,109.5	14.00				Average	
		point141	141	12,103,114.0	3,484,111.0	14.00				Average	
		point142	142	12,103,620.0	3,484,103.2	14.00				Average	

		point143	143	12,104,419.0	3,483,995.2	15.00					
Cedar EB to a64	32.0	point144	144	12,105,129.0	3,483,792.0	19.00				Average	
		point145	145	12,105,389.0	3,483,597.0	21.00				Average	
		point146	146	12,105,682.0	3,483,507.2	23.00				Average	
		point147	147	12,106,706.0	3,483,352.8	25.00				Average	Y
		point148	148	12,106,916.0	3,483,306.5	27.00				Average	Y
		point149	149	12,107,198.0	3,483,223.0	30.00					
NB-EB On-ramp to 164	12.0	point150	150	12,107,198.0	3,483,223.0	30.00				Average	Y
		point151	151	12,108,093.0	3,482,903.5	34.00				Average	Y
		point152	152	12,108,514.0	3,482,755.5	34.00				Average	Y
		point160	160	12,109,246.0	3,482,498.8	25.50				Average	Y
		point161	161	12,109,612.0	3,482,370.5	21.25				Average	Y
		point107	107	12,109,978.0	3,482,242.0	17.00					
apm off-ramp	24.0	point153	153	12,106,916.0	3,483,306.5	30.00				Average	
		point154	154	12,108,260.0	3,482,744.5	14.00					
APM on-ramp	20.0	point155	155	12,108,260.0	3,482,744.5	14.00	Onramp	55.00	100	Average	
		point162	162	2,108,882.0	3,482,530.0	15.50				Average	
		point156	156	12,109,612.0	3,482,370.5	17.00					

MBJr Inc. 1 November 2
APK TNM 2.5

INPUT: TRAFFIC FOR LAeq1h Percentages
PROJECT/CONTRACT: Patriots Crossing
RUN: Design Year Build Alt

Roadway	Points													
Name	Name	No.	Segment											
			Total	Autos		MTrucks		HTrucks		Buses		Motorcycles		
			Volume	P	S	P	S	P	S	P	S	P	S	
			veh/hr	%	mph	%	mph	%	mph	%	mph	%	mph	
164 EB1	point1	1	3940	90	55	3	55	7	55	0	0	0	0	
	point2	2												
eb off ramp to cedar	point3	3	200	90	45	3	45	7	45	0	0	0	0	
	point4	4	200	90	45	3	45	7	45	0	0	0	0	
	point5	5	200	90	45	3	45	7	45	0	0	0	0	
	point6	6	200	90	45	3	45	7	45	0	0	0	0	
	point7	7	200	90	45	3	45	7	45	0	0	0	0	
	point8	8	200	90	45	3	45	7	45	0	0	0	0	
	point9	9												
164 eb2	point10	10	3850	90	55	3	55	7	55	0	0	0	0	
	point11	11	3850	90	55	3	55	7	55	0	0	0	0	
	point12	12	3850	90	55	3	55	7	55	0	0	0	0	
	point13	13												
164 eb3	point29	29	2070	90	55	3	55	7	55	0	0	0	0	
	point14	14	2070	90	55	3	55	7	55	0	0	0	0	
	point15	15	2070	90	55	3	55	7	55	0	0	0	0	
	point16	16	2070	90	55	3	55	7	55	0	0	0	0	
	point70	70	2070	90	55	3	55	7	55	0	0	0	0	
	point17	17	2070	90	55	3	55	7	55	0	0	0	0	
	point158	158	2070	90	55	3	55	7	55	0	0	0	0	
	point64	64	2070	90	55	3	55	7	55	0	0	0	0	
	point66	66	2070	90	55	3	55	7	55	0	0	0	0	

	point159	159	2070	90	55	3	55	7	55	0	0	0	0
	point68	68											
164 wb1	point30	30	3740	90	55	3	55	7	55	0	0	0	0
	point31	31	3740	90	55	3	55	7	55	0	0	0	0
	point32	32	3740	90	55	3	55	7	55	0	0	0	0
	point33	33											
wb off ramp to cedar	point40	40	330	90	45	3	45	7	45	0	0	0	0
	point41	41	330	90	45	3	45	7	45	0	0	0	0
	point42	42	330	90	45	3	45	7	45	0	0	0	0
	point43	43	330	90	45	3	45	7	45	0	0	0	0
	point44	44	330	90	45	3	45	7	45	0	0	0	0
	point45	45	330	90	45	3	45	7	45	0	0	0	0
	point46	46	330	90	45	3	45	7	45	0	0	0	0
	point47	47											
164 wb2	point48	48	2880	90	55	3	55	7	55	0	0	0	0
	point49	49	2880	90	55	3	55	7	55	0	0	0	0
	point50	50	2880	90	55	3	55	7	55	0	0	0	0
	point51	51											
164 wb3	point52	52	2880	90	55	3	55	7	55	0	0	0	0
	point163	163	3080	90	55	3	55	7	55	0	0	0	0
	point53	53											
wb on-ramp from cedar	point54	54	200	90	45	3	45	7	45	0	0	0	0
	point55	55	200	90	45	3	45	7	45	0	0	0	0
	point56	56	200	90	45	3	45	7	45	0	0	0	0
	point57	57	200	90	45	3	45	7	45	0	0	0	0
	point58	58	200	90	45	3	45	7	45	0	0	0	0
	point164	164	200	90	45	3	45	7	45	0	0	0	0
	point59	59											
cedar	point60	60	1539	90	45	3	45	7	45	0	0	0	0
	point61	61	1539	90	45	3	45	7	45	0	0	0	0
	point62	62	1539	90	45	3	45	7	45	0	0	0	0
	point63	63											
Craney SB	point71	71	2680	90	55	3	55	7	55	0	0	0	0
	point72	72	2680	90	55	3	55	7	55	0	0	0	0

	point73	73	2680	90	55	3	55	7	55	0	0	0	0
	point74	74											
Craney SB to WB	point75	75	1340	90	45	3	45	7	45	0	0	0	0
	point76	76	1340	90	45	3	45	7	45	0	0	0	0
	point77	77	1340	90	45	3	45	7	45	0	0	0	0
	point78	78	1340	90	45	3	45	7	45	0	0	0	0
	point79	79	1340	90	45	3	45	7	45	0	0	0	0
	point80	80	1340	90	45	3	45	7	45	0	0	0	0
	point81	81	1340	90	45	3	45	7	45	0	0	0	0
	point82	82	1340	90	45	3	45	7	45	0	0	0	0
	point83	83	1340	90	45	3	45	7	45	0	0	0	0
	point84	84	1340	90	45	3	45	7	45	0	0	0	0
	point85	85	1340	90	45	3	45	7	45	0	0	0	0
	point86	86	1340	90	45	3	45	7	45	0	0	0	0
	point87	87	1340	90	45	3	45	7	45	0	0	0	0
	point88	88	1340	90	45	3	45	7	45	0	0	0	0
	point89	89	1340	90	45	3	45	7	45	0	0	0	0
	point90	90	1340	90	45	3	45	7	45	0	0	0	0
	point91	91	1340	90	45	3	45	7	45	0	0	0	0
	point92	92											
Roadway16	point93	93	1340	90	45	3	45	7	45	0	0	0	0
	point94	94	1340	90	45	3	45	7	45	0	0	0	0
	point95	95	1340	90	45	3	45	7	45	0	0	0	0
	point96	96	1340	90	45	3	45	7	45	0	0	0	0
	point97	97	1340	90	45	3	45	7	45	0	0	0	0
	point98	98	1340	90	45	3	45	7	45	0	0	0	0
	point99	99	1340	90	45	3	45	7	45	0	0	0	0
	point100	100	1340	90	45	3	45	7	45	0	0	0	0
	point101	101	1340	90	45	3	45	7	45	0	0	0	0
	point102	102	1340	90	45	3	45	7	45	0	0	0	0
	point103	103	1340	90	45	3	45	7	45	0	0	0	0
	point104	104	1340	90	45	3	45	7	45	0	0	0	0
	point105	105	1340	90	45	3	45	7	45	0	0	0	0
	point106	106											

164 eb3-2	point108	108	3740	90	55	3	55	7	55	0	0	0	0
	point18	18	3740	90	55	3	55	7	55	0	0	0	0
	point19	19	3740	90	55	3	55	7	55	0	0	0	0
	point20	20	3740	90	55	3	55	7	55	0	0	0	0
	point21	21											
164 wb1-2	point109	109	1870	90	55	3	55	7	55	0	0	0	0
	point69	69	1870	90	55	3	55	7	55	0	0	0	0
	point67	67	1870	90	55	3	55	7	55	0	0	0	0
	point65	65	1870	90	55	3	55	7	55	0	0	0	0
	point157	157	1870	90	55	3	55	7	55	0	0	0	0
	point34	34	1870	90	55	3	55	7	55	0	0	0	0
	point35	35	1870	90	55	3	55	7	55	0	0	0	0
	point36	36	1870	90	55	3	55	7	55	0	0	0	0
	point37	37	1870	90	55	3	55	7	55	0	0	0	0
	point38	38	1870	90	55	3	55	7	55	0	0	0	0
	point39	39											
a64 WB to NB	point110	110	1870	90	45	3	45	7	45	0	0	0	0
	point111	111	1870	90	45	3	45	7	45	0	0	0	0
	point112	112	1870	90	45	3	45	7	45	0	0	0	0
	point113	113	1870	90	45	3	45	7	45	0	0	0	0
	point114	114	1870	90	45	3	45	7	45	0	0	0	0
	point115	115	1870	90	45	3	45	7	45	0	0	0	0
	point116	116	1870	90	45	3	45	7	45	0	0	0	0
	point117	117	1870	90	45	3	45	7	45	0	0	0	0
	point118	118											
craney nb	point119	119	3740	90	45	3	45	7	45	0	0	0	0
	point120	120	3740	90	45	3	45	7	45	0	0	0	0
	point121	121	3740	90	45	3	45	7	45	0	0	0	0
	point122	122	3740	90	45	3	45	7	45	0	0	0	0
	point123	123	3740	90	45	3	45	7	45	0	0	0	0
	point124	124											
shared eb on-off ramp	point125	125	2200	90	45	3	45	7	45	0	0	0	0
	point126	126	2200	90	45	3	45	7	45	0	0	0	0
	point127	127											

EB to NB Craney	point128	128	1870	90	45	3	45	7	45	0	0	0	0
	point129	129	1870	90	45	3	45	7	45	0	0	0	0
	point130	130	1870	90	45	3	45	7	45	0	0	0	0
	point131	131	1870	90	45	3	45	7	45	0	0	0	0
	point132	132	1870	90	45	3	45	7	45	0	0	0	0
	point133	133	1870	90	45	3	45	7	45	0	0	0	0
	point134	134	1870	90	45	3	45	7	45	0	0	0	0
	point135	135	1870	90	45	3	45	7	45	0	0	0	0
	point136	136											
cedar eb on-ramp	point137	137	330	90	45	3	45	7	45	0	0	0	0
	point138	138	330	90	45	3	45	7	45	0	0	0	0
	point139	139											
eb to nb Craney 1	point140	140	1870	90	45	3	45	7	45	0	0	0	0
	point141	141	1870	90	45	3	45	7	45	0	0	0	0
	point142	142	1870	90	45	3	45	7	45	0	0	0	0
	point143	143											
Cedar EB to a64	point144	144	330	90	45	3	45	7	45	0	0	0	0
	point145	145	330	90	45	3	45	7	45	0	0	0	0
	point146	146	330	90	45	3	45	7	45	0	0	0	0
	point147	147	330	90	45	3	45	7	45	0	0	0	0
	point148	148	330	90	45	3	45	7	45	0	0	0	0
	point149	149											
NB-EB On-ramp to 164	point150	150	1670	90	45	3	45	7	45	0	0	0	0
	point151	151	1670	90	45	3	45	7	45	0	0	0	0
	point152	152	1670	90	45	3	45	7	45	0	0	0	0
	point160	160	1670	90	45	3	45	7	45	0	0	0	0
	point161	161	1670	90	45	3	45	7	45	0	0	0	0
	point107	107											
apm off-ramp	point153	153	170	45	25	5	25	50	25	0	0	0	0
	point154	154											
APM on-ramp	point155	155	290	85	25	1	25	14	25	0	0	0	0
	point162	162	290	85	25	1	25	14	25	0	0	0	0
	point156	156											

MBJr Inc.
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TNM 2.5

INPUT: RECEIVERS
PROJECT/CONTRACT: Patriots Crossing
RUN: Design Year Build Alt

Receiver Name	No.	#DUs	Coordinates (ground) X	Y	Z	Height above Ground	Input Sound Levels and Criteria: Existing LAeq1h	Impact Criteria LAeq1h	Impact Criteria Sub'l	NR Goal	Active in Calc.
			ft	ft	ft	ft	dBA	dBA	dB	dB	
1	1	3	12,104,566.0	3,483,293.0	17.00	4.92	0.00	66	10.0	8.0	
2	2	3	12,104,855.0	3,483,389.8	16.00	4.92	0.00	66	10.0	8.0	
3	3	4	12,105,322.0	3,483,416.0	15.00	4.92	0.00	66	10.0	8.0	
4	4	3	12,105,133.0	3,483,179.2	14.00	4.92	0.00	66	10.0	8.0	
5	5	6	12,105,539.0	3,483,291.0	11.00	4.92	0.00	66	10.0	8.0	
6	6	3	12,105,570.0	3,483,025.0	10.00	4.92	0.00	66	10.0	8.0	
7	7	1	12,106,806.0	3,483,098.8	15.00	4.92	0.00	66	10.0	8.0	
8	8	1	12,106,982.0	3,483,024.2	15.00	4.92	0.00	66	10.0	8.0	
9	9	1	12,107,212.0	3,482,916.0	14.00	4.92	0.00	66	10.0	8.0	
10	10	2	12,107,635.0	3,482,895.0	15.00	4.92	0.00	66	10.0	8.0	
11	11	2	12,107,882.0	3,482,793.2	14.00	4.92	0.00	66	10.0	8.0	
12	12	2	12,108,075.0	3,482,707.0	14.00	4.92	0.00	66	10.0	8.0	
13	13	16	12,108,493.0	3,482,564.5	13.00	4.92	0.00	66	10.0	8.0	
14	14	4	12,108,922.0	3,482,369.8	12.00	4.92	0.00	66	10.0	8.0	
15	15	4	12,109,265.0	3,482,230.8	11.00	4.92	0.00	66	10.0	8.0	Y
16	16	3	12,107,512.0	3,482,775.2	12.00	4.92	0.00	66	10.0	8.0	
17	17	2	12,107,675.0	3,482,696.5	14.00	4.92	0.00	66	10.0	8.0	
18	18	3	12,107,860.0	3,482,605.0	13.00	4.92	0.00	66	10.0	8.0	
19	19	4	12,108,181.0	3,482,447.8	13.00	4.92	0.00	66	10.0	8.0	
20	20	5	12,108,912.0	3,482,100.0	12.00	4.92	0.00	66	10.0	8.0	
21	21	7	12,107,315.0	3,482,499.2	10.00	4.92	0.00	66	10.0	8.0	
22	22	10	12,107,827.0	3,482,305.0	12.00	4.92	0.00	66	10.0	8.0	

23	23	11	12,108,781.0	3,481,841.2	10.00	4.92	0.00	66	10.0	8.0	
24	28	4	12,100,857.0	3,484,008.5	14.00	4.92	0.00	66	10.0	8.0	Y
25	29	3	12,101,143.0	3,484,020.2	14.00	4.92	0.00	66	10.0	8.0	Y
26	30	5	12,101,447.0	3,484,020.2	14.00	4.92	0.00	66	10.0	8.0	Y
27	31	3	12,101,851.0	3,484,020.2	14.00	4.92	0.00	66	10.0	8.0	Y
28	32	3	12,102,131.0	3,483,985.0	14.00	4.92	0.00	66	10.0	8.0	Y
29	33	4	12,102,383.0	3,483,897.5	14.00	4.92	0.00	66	10.0	8.0	Y
30	34	4	12,102,804.0	3,483,611.0	14.00	4.92	0.00	66	10.0	8.0	Y
31	35	12	12,102,032.0	3,483,745.5	14.00	4.92	0.00	66	10.0	8.0	Y
32	36	9	12,101,143.0	3,483,692.8	14.00	4.92	0.00	66	10.0	8.0	Y
33	37	13	12,102,026.0	3,483,447.2	14.00	4.92	0.00	66	10.0	8.0	Y
34	38	4	12,103,388.0	3,483,418.0	15.00	4.92	0.00	66	10.0	8.0	Y
35	39	9	12,100,851.0	3,484,316.5	14.00	4.92	0.00	66	10.0	8.0	Y
36	40	4	12,101,564.0	3,484,382.8	14.00	4.92	0.00	66	10.0	8.0	Y
37	41	5	12,101,944.0	3,484,376.8	14.00	4.92	0.00	66	10.0	8.0	Y
38	42	4	12,102,255.0	3,484,435.2	14.00	4.92	0.00	66	10.0	8.0	Y
39	43	4	12,102,540.0	3,484,610.8	13.00	4.92	0.00	66	10.0	8.0	Y
40	44	5	12,102,692.0	3,484,955.8	12.00	4.92	0.00	66	10.0	8.0	Y
41	45	1	12,103,126.0	3,485,055.2	13.00	4.92	0.00	66	10.0	8.0	Y
42	46	7	12,102,330.0	3,484,675.0	14.00	4.92	0.00	66	10.0	8.0	Y
43	47	7	12,101,851.0	3,484,534.8	14.00	4.92	0.00	66	10.0	8.0	Y
44	49	8	12,101,202.0	3,484,546.5	14.00	4.92	0.00	66	10.0	8.0	Y
45	51	10	12,102,020.0	3,484,792.0	14.00	4.92	0.00	66	10.0	8.0	Y

MBJr Inc.
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1 November 2011
TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS
PROJECT/CONTRACT: Patriots Crossing
RUN: Design Year Build Alt
BARRIER DESIGN: INPUT HEIGHTS

Average pavement type shall be used unless a State highway agency substantiates the use of a different type with approval of FHWA.

ATMOSPHERICS: 68 deg F, 50% RH

Receiver Name	No.	#DUs	Existing LAeq1h	No Barrier LAeq1h Calculated	Crit'n	Increase over existing Calculated	Crit'n Sub'l Inc	Type Impact	With Barrier Calculated LAeq1h	Noise Reduction Calculated	Goal	Calculated minus Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
1	1	3	0.0	57.8	66	57.8	10	----	57.8	0.0	8	-8.0
2	2	3	0.0	60.0	66	60.0	10	----	60.0	0.0	8	-8.0
3	3	4	0.0	63.4	66	63.4	10	----	63.4	0.0	8	-8.0
4	4	3	0.0	58.2	66	58.2	10	----	58.2	0.0	8	-8.0
5	5	6	0.0	61.6	66	61.6	10	----	61.6	0.0	8	-8.0
6	6	3	0.0	57.0	66	57.0	10	----	57.0	0.0	8	-8.0
7	7	1	0.0	63.6	66	63.6	10	----	63.6	0.0	8	-8.0
8	8	1	0.0	63.2	66	63.2	10	----	63.2	0.0	8	-8.0
9	9	1	0.0	63.1	66	63.1	10	----	63.1	0.0	8	-8.0
10	10	2	0.0	67.6	66	67.6	10	Snd Lvl	67.6	0.0	8	-8.0
11	11	2	0.0	67.4	66	67.4	10	Snd Lvl	67.4	0.0	8	-8.0
12	12	2	0.0	67.0	66	67.0	10	Snd Lvl	67.0	0.0	8	-8.0
13	13	16	0.0	67.2	66	67.2	10	Snd Lvl	67.2	0.0	8	-8.0
14	14	4	0.0	65.5	66	65.5	10	----	65.5	0.0	8	-8.0
15	15	4	0.0	65.3	66	65.3	10	----	65.3	0.0	8	-8.0
16	16	3	0.0	62.7	66	62.7	10	----	62.7	0.0	8	-8.0
17	17	2	0.0	62.9	66	62.9	10	----	62.9	0.0	8	-8.0
18	18	3	0.0	62.5	66	62.5	10	----	62.5	0.0	8	-8.0
19	19	4	0.0	62.2	66	62.2	10	----	62.2	0.0	8	-8.0
20	20	5	0.0	60.9	66	60.9	10	----	60.9	0.0	8	-8.0
21	21	7	0.0	57.2	66	57.2	10	----	57.2	0.0	8	-8.0
22	22	10	0.0	56.9	66	56.9	10	----	56.9	0.0	8	-8.0
23	23	11	0.0	54.9	66	54.9	10	----	54.9	0.0	8	-8.0

24	28	4	0.0	62.1	66	62.1	10	----	62.1	0.0	8	-8.0
25	29	3	0.0	62.2	66	62.2	10	----	62.2	0.0	8	-8.0
26	30	5	0.0	62.0	66	62.0	10	----	62.0	0.0	8	-8.0
27	31	3	0.0	62.1	66	62.1	10	----	62.1	0.0	8	-8.0
28	32	3	0.0	60.8	66	60.8	10	----	60.8	0.0	8	-8.0
29	33	4	0.0	57.9	66	57.9	10	----	57.9	0.0	8	-8.0
30	34	4	0.0	53.8	66	53.8	10	----	53.8	0.0	8	-8.0
31	35	12	0.0	56.8	66	56.8	10	----	56.8	0.0	8	-8.0
32	36	9	0.0	55.7	66	55.7	10	----	55.7	0.0	8	-8.0
33	37	13	0.0	53.5	66	53.5	10	----	53.5	0.0	8	-8.0
34	38	4	0.0	60.3	66	60.3	10	----	60.3	0.0	8	-8.0
35	39	9	0.0	61.3	66	61.3	10	----	61.3	0.0	8	-8.0
36	40	4	0.0	60.6	66	60.6	10	----	60.6	0.0	8	-8.0
37	41	5	0.0	61.0	66	61.0	10	----	61.0	0.0	8	-8.0
38	42	4	0.0	59.4	66	59.4	10	----	59.4	0.0	8	-8.0
39	43	4	0.0	56.3	66	56.3	10	----	56.3	0.0	8	-8.0
40	44	5	0.0	54.4	66	54.4	10	----	54.4	0.0	8	-8.0
41	45	1	0.0	57.0	66	57.0	10	----	57.0	0.0	8	-8.0
42	46	7	0.0	56.6	66	56.6	10	----	56.6	0.0	8	-8.0
43	47	7	0.0	58.3	66	58.3	10	----	58.3	0.0	8	-8.0
44	49	8	0.0	57.5	66	57.5	10	----	57.5	0.0	8	-8.0
45	51	10	0.0	55.2	66	55.2	10	----	55.2	0.0	8	-8.0

Dwelling Units	# DUs	Noise Reduction		
		Min	Avg	Max
		dB	dB	dB
All Selected	228	0.0	0.0	0.0
All Impacted	22	0.0	0.0	0.0
All that meet NR Goal	0	0.0	0.0	0.0

MB Jr., Inc. 1 November 2011
APK TNM 2.5

INPUT: BARRIERS
PROJECT/CONTRACT: Patriots Crossing
RUN: 16 ft prelim barrier analysis

Barrier Name	Type	Height Min	Height Max	If Wall $ per Unit Area	If Berm $ per Unit Vol.	Top Width	Run:Rise	Add'tnl $ per Unit Length
		ft	ft	$/sq ft	$/cu yd	ft	ft:ft	$/ft
Barrier# 1A	W	0.00	99.99	0.00				0.00
Barrier# 1B	W	0.00	99.99	0.00				0.00

Points Name	No.	Coordinates (bottom) X	Y	Z	Height at Point	Segment Seg Ht Increment	Perturbs #Up	#Dn	On Struct?	Important Reflections?
		ft	ft	ft	ft	ft				
point4	4	12,107,343.0	3,483,148.0	30.00	16.00	2.00	7	3		
point5	5	12,107,639.0	3,483,043.2	32.00	16.00	2.00	7	3		
point6	6	12,108,074.0	3,482,881.8	34.00	16.00	2.00	7	3		
point7	7	12,108,489.0	3,482,736.8	34.00	16.00	2.00	7	3		
point8	8	12,109,330.0	3,482,450.8	24.00	16.00					
point10	10	12,107,331.0	3,483,111.8	25.00	16.00	2.00	7	3		
point11	11	12,107,617.0	3,482,990.2	22.00	16.00	2.00	7	3		
point12	12	12,108,243.0	3,482,716.5	14.00	16.00	2.00	7	3		
point13	13	12,108,873.0	3,482,500.8	15.50	16.00	2.00	7	3		
point15	15	12,109,234.0	3,482,424.8	18.40	16.00	2.00	7	3		
point14	14	12,109,596.0	3,482,348.8	21.30	16.00					

MB Jr., Inc. 1 November 2011
APK TNM 2.5

RESULTS: BARRIER DESCRIPTIONS
PROJECT/CONTRACT: Patriots Crossing
RUN: 16 ft prelim barrier analysis
BARRIER DESIGN: INPUT HEIGHTS

Barriers

Name	Type	Heights along Barrier			Length	If Wall	If Berm			Cost
		Min	Avg	Max		Area	Volume	Top Width	Run:Rise	
		ft	ft	ft	ft	sq ft	cu yd	ft	ft:ft	$
Barrier# 1A	W	16.00	16.00	16.00	2106	33694				0
Barrier# 1B	W	16.00	16.00	16.00	2399	38379				0
									Total Cost:	0

MB Jr., Inc.
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1 November 2011
TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS
PROJECT/CONTRACT: Patriots Crossing
RUN: 16 ft prelim barrier analysis
BARRIER DESIGN: INPUT HEIGHTS
ATMOSPHERICS: 68 deg F, 50% RH

Average pavement type shall be used unless a State highway agency substantiates the use of a different type with approval of FHWA.

Receiver Name	No.	#DUs	Existing LAeq1h	No Barrier LAeq1h Calculated	Crit'n	Increase over existing Calculated	Crit'n Sub'l Inc	Type Impact	With Barrier Calculated LAeq1h	Noise Reduction Calculated	Goal	Calculated minus Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
7	7	1	0.0	63.5	66	63.5	10	----	63.4	0.1	8	-7.9
8	8	1	0.0	62.9	66	62.9	10	----	62.5	0.4	8	-7.6
9	9	1	0.0	62.6	66	62.6	10	----	61.0	1.6	8	-6.4
10	10	2	0.0	65.3	66	65.3	10	----	54.9	10.4	8	2.4
11	11	2	0.0	65.4	66	65.4	10	----	54.2	11.2	8	3.2
12	12	2	0.0	65.1	66	65.1	10	----	56.4	8.7	8	0.7
13	13	16	0.0	64.9	66	64.9	10	----	54.3	10.6	8	2.6
14	14	4	0.0	64.2	66	64.2	10	----	57.5	6.7	8	-1.3
15	15	4	0.0	64.8	66	64.8	10	----	60.4	4.4	8	-3.6
16	16	3	0.0	62.1	66	62.1	10	----	57.1	5.0	8	-3.0
17	17	2	0.0	62.3	66	62.3	10	----	55.8	6.5	8	-1.5
18	18	3	0.0	61.9	66	61.9	10	----	55.1	6.8	8	-1.2
19	19	4	0.0	61.7	66	61.7	10	----	54.3	7.4	8	-0.6
20	20	5	0.0	60.5	66	60.5	10	----	55.3	5.2	8	-2.8
21	21	7	0.0	56.8	66	56.8	10	----	54.0	2.8	8	-5.2
22	22	10	0.0	56.9	66	56.9	10	----	51.5	5.4	8	-2.6
23	23	11	0.0	55.0	66	55.0	10	----	51.2	3.8	8	-4.2

Dwelling Units	# DUs	Noise Reduction Min	Avg	Max
		dB	dB	dB
All Selected	78	0.1	5.7	11.2
All Impacted	0	0.0	0.0	0.0
All that meet NR Goal	22	8.7	10.2	11.2

MB Jr., Inc.
APK

1 November 2011
TNM 2.5
Calculated with TNM 2.5

RESULTS: SOUND LEVELS
PROJECT/CONTRACT: Patriots Crossing
RUN: 16 ft prelim barrier analysis
BARRIER DESIGN: 12 feet

ATMOSPHERICS: 68 deg F, 50% RH

Average pavement type shall be used unless a State highway agency substantiates the use of a different type with approval of FHWA.

Receiver Name	No.	#DUs	Existing LAeq1h	No Barrier LAeq1h Calculated	Crit'n	Increase over existing Calculated	Crit'n Sub'l Inc	Type Impact	With Barrier Calculated LAeq1h	Noise Reduction Calculated	Goal	Calculated minus Goal
			dBA	dBA	dBA	dB	dB		dBA	dB	dB	dB
7	7	1	0.0	63.5	66	63.5	10	----	63.4	0.1	8	-7.9
8	8	1	0.0	62.9	66	62.9	10	----	62.7	0.2	8	-7.8
9	9	1	0.0	62.6	66	62.6	10	----	61.7	0.9	8	-7.1
10	10	2	0.0	65.3	66	65.3	10	----	59.2	6.1	8	-1.9
11	11	2	0.0	65.4	66	65.4	10	----	58.2	7.2	8	-0.8
12	12	2	0.0	65.1	66	65.1	10	----	58.0	7.1	8	-0.9
13	13	16	0.0	64.9	66	64.9	10	----	58.0	6.9	8	-1.1
14	14	4	0.0	64.2	66	64.2	10	----	59.0	5.2	8	-2.8
15	15	4	0.0	64.8	66	64.8	10	----	61.2	3.6	8	-4.4
16	16	3	0.0	62.1	66	62.1	10	----	58.7	3.4	8	-4.6
17	17	2	0.0	62.3	66	62.3	10	----	57.4	4.9	8	-3.1
18	18	3	0.0	61.9	66	61.9	10	----	56.4	5.5	8	-2.5
19	19	4	0.0	61.7	66	61.7	10	----	55.5	6.2	8	-1.8
20	20	5	0.0	60.5	66	60.5	10	----	56.4	4.1	8	-3.9
21	21	7	0.0	56.8	66	56.8	10	----	54.7	2.1	8	-5.9
22	22	10	0.0	56.9	66	56.9	10	----	52.5	4.4	8	-3.6
23	23	11	0.0	55.0	66	55.0	10	----	51.9	3.1	8	-4.9

Dwelling Units	# DUs	Noise Reduction Min	Avg	Max
		dB	dB	dB
All Selected	78	0.1	4.2	7.2
All Impacted	0	0.0	0.0	0.0
All that meet NR Goal	0	0.0	0.0	0.0

APPENDIX D: WARRANTED, FEASIBLE, AND REASONABLE WORKSHEET

VDOT Highway Traffic Noise Abatement
Warranted, Feasible, and Reasonable Worksheet

Note: Not all questions apply depending on the design phase which may cause differing answers between preliminary and final design phase. Answers to the questions may change depending on the design phase of the project.

Date:	22-Sep-11
Project No. and UPC:	0064-114-F12, PE-102, UPC 99587
County:	City of Portsmouth
District:	Hampton Roads
Barrier System ID:	
Community Name and/or CNE#	1
Noise Abatement Category(s)	B
Design phase:	Preliminary design

	Warranted	
1	Community Documentation (if applicable)	
a.	Date community was permitted. (Per 23CFR 772 this is the date the building permit was issued).	
b.	Date of approval for the Categorical Exclusion (CE), Record of Decision (ROD), or Finding of No Significant Impact (FONSI):	pending
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."	NA
2	Criteria requiring consideration of noise abatement	
a.	Project causes design year noise levels to approach or exceed the Noise Abatement Criteria?	Yes
b.	Project causes a substantial noise increase of 10 dB(A) or more?	No

	Feasibility	
1	Impacted receptor units	
a.	Number of impacted receptor units:	26
b.	Number of impacted receptor units receiving 5 dB(A) or more insertion loss (IL):	26
c.	Percentage of impacted receptor units receiving 5 dB(A) or more IL	100%
d.	Is the percentage 50 or greater?	Yes
2	Will placement of the noise barrier cause engineering or safety conflicts, e.g drainage issues or site distance issues?	No
3	Will placement of the noise barrier restrict access to vehicular or pedestrian travel?	No
4	Will placement of the noise barrier conflict with existing utility locations?	No

	Reasonableness	
1	**Surface Area (Square foot)-Benefit Factors**	
a.	Surface Area (Total square foot) of the proposed noise barrier. (ft^2)	50,287 SF
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.	9
d.	Total number of benefited receptors.	35
e.	Surface Area per benefited receptor unit. (ft^2/BR)	1,437 SF/BR
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	**Additional Noise Barrier Details**	
a.	Length of the proposed noise barrier. (ft)	4,191 ft
b.	Height range of the proposed noise barrier. (ft)	- ft
c.	Average height of the proposed noise barrier. (ft)	12 ft
d.	Cost per square foot. ($/$ft^2$)	$36/SF
e.	Total Barrier Cost ($)	$1,810,332
f.	Barrier Material	NA
3	**Community Desires Related to the Barrier**	
	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.”	

Decision	
Is the Noise Barrier(s) WARRANTED?	Yes
Is the Noise Barrier(s) FEASIBLE?	Yes
Is the Noise Barrier(s) REASONABLE?	Yes

Additional Reasons for Decision:
None.

APPENDIX E: HB 2577 (AMENDED BY HB 2025)

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.

Response: This report is representative of a preliminary reevaluation analysis. As a result, the design will be subject to modifications. During final design, efforts to further minimize noise impacts will be addressed. Such measures may include horizontal and/or vertical alignment shifts as suggested.

At this time, a preliminary response based on professional experience and judgment is provided, again, keeping in mind that this will be addressed during final design: The horizontal alignment for this project was developed with the intent of limiting impacts to the developed areas abutting VA 164 and providing enough room for the myriad of ramps that will comprise the new interchange and its tie-ins into the existing interchanges located to the east and west of the proposed interchange. The preliminary design provides a logical first-cut solution to meet these goals. Shifting the horizontal alignment closer to the developed areas will likely create undesirable impacts such as right-of-way acquisition, temporary/permanent easements, retaining walls and may impact the existing sound barriers.

The preliminary vertical alignment for this project was developed with the intent of holding the existing grade for VA 164 as much as possible. It is likely that placing the roadway in a deep cut is not feasible given that it would require a total reconstruction of the corridor. (Michael Baker Jr., Inc.)

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

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

Comment: Can landscaping be utilized to act as a visual screen if visual screening is required?

Response: This report is representative of a preliminary reevaluation analysis. During final design, efforts to further minimize noise impacts will be addressed. Such measures may include landscaping and berms as visual screens. These landscaping measures must be placed outside of the clear zone, must not decrease driver sight distance, and must not require additional right of way. (Michael Baker Jr., Inc.)

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