Appendix H

Noise Technical Report

District Department of Transportation

Noise Technical Report

Pennsylvania Avenue / Minnesota Avenue, SE Intersection Improvements

Washington, DC

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EXECUTIVE SUMMARY

This report evaluates the potential noise impacts of two alternatives, the Revised Square Alternative and the Conventional Intersection Alternative, being considered for the Pennsylvania and Minnesota Avenues, SE Intersection Improvements EA in conformance with corresponding Federal regulations and guidance, and the National Environmental Policy Act (NEPA). The noise analysis presents the existing and future acoustical environment at various receivers located along Pennsylvania Avenue and Minnesota Avenue.

The determination of noise abatement measures and locations is in compliance with the Federal Highways Administration's Procedures for Abatement of Highway Traffic Noise and Construction Noise as presented in the Code of Federal Regulations, Title 23 Part 772 (23 CFR 772) and the District Department of Transportation's (DDOT) "Noise Policy".

Existing noise level measurements were conducted on March 21, 2013 at four representative sites in the project vicinity. The measurements were made in accordance with FHWA and ODOT guidelines using an integrating sound level analyzer meeting ANSI and IEC Type 1 specifications. Traffic counts were taken at each site, concurrent with the noise measurements.

The latest version of the FHWA's Traffic Noise Model, TNM®2.5[1], was used to model existing (2012), No Build (2040), Revised Square Alternative (2040), and Conventional Intersection Alternative (2040) for the peak noise hour noise levels within the study area. 22 representative noise receivers (representing 35 dwelling units), numbered N1 through N18, plus the four field sites, FS-1 through FS-4 were modeled. These receivers were selected to model representative noise impacts at areas consisting of residential, daycare, and recreational properties, as well as one place of worship.

Existing (2012) peak hour levels at the 16 residential locations, which represents 35 dwelling units, would range from 63.7 to 69.0 dBA L_{eq}(h). The noise levels at the category C locations would range from 67.4 to 71.1 dBA L_{eq}(h). The interior noise level at the category D location, N7, would be 41.1 dBA.

No build (2040) peak hour noise are predicted to exceed the NAC at 16 residential locations and four activity category C locations. The noise levels at the 16 residential locations would range from 65.6 to 70.3 dBA L_{eq}(h) and represents 35 dwelling units. The noise levels at the category C locations would range from 69.4 to 73.2 dBA L_{eq}(h).

Predicted future (2040) noise levels for the Revised Square Alternative and the Conventional Intersection Alternative would approach or exceed the NAC at 16 residential receivers and four activity category C locations. None of the predicted future noise levels would substantially exceed existing noise levels (DDOT has defined an increase over existing noise levels of 10 decibels or more as being substantial).

Based on the study completed, mitigation of noise impacts for the Pennsylvania Avenue/Minnesota Avenue improvements does not appear to be feasible or reasonable for

[1] M.C. Lau, C.S.Y. Lee, J.L. Rochat, E.R. Boeker, and G.C. Fleming. FHWA Traffic Noise Model® Users Guide (Version 2.5 Addendum). Federal Highway Administration, April 2004

either of the proposed alternatives. Due to the built out nature of the project area and local access requirements, noise mitigation in this urban environment is not possible. If it subsequently develops during final design that these conditions have substantially changed, noise abatement measures will be reviewed.

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Noise Technical Report

1.0 INTRODUCTION

The Federal Highway Administration (FHWA) in conjunction with the District Department of Transportation (DDOT) are proposing improvements to the Pennsylvania Avenue and Minnesota Avenue, SE intersection that would include the transfer of land from the National Park Service (NPS) to DDOT. The land transfer would facilitate the proposed reconfiguration of this intersection, also known as the "Twining Square" area in Southeast Washington, DC.

As shown in Figure 1, the proposed project is located at the western end of the Pennsylvania Avenue SE Great Streets corridor at the intersection of Pennsylvania Avenue with Minnesota Avenue, SE, in the immediate vicinity of Twining Square Park, also referred to as L'Enfant Square in the *Great Streets Framework Plan*. The study area is a complex and congested intersection and actually consists of two separate signalized intersections that are separated by 250 feet. The project intersection carries traffic to and from the bridges that cross the Anacostia River, as well as Minnesota Avenue SE. The proposed action includes improvements to the intersection to improve safety, mobility, and connectivity for pedestrians and motorists. A land transfer from NPS to DDOT would be necessary, pending National Capital Planning Commission (NCPC) approval, to carry out the proposed intersection improvements. Proposed improvements would not impact any private right-of-way.

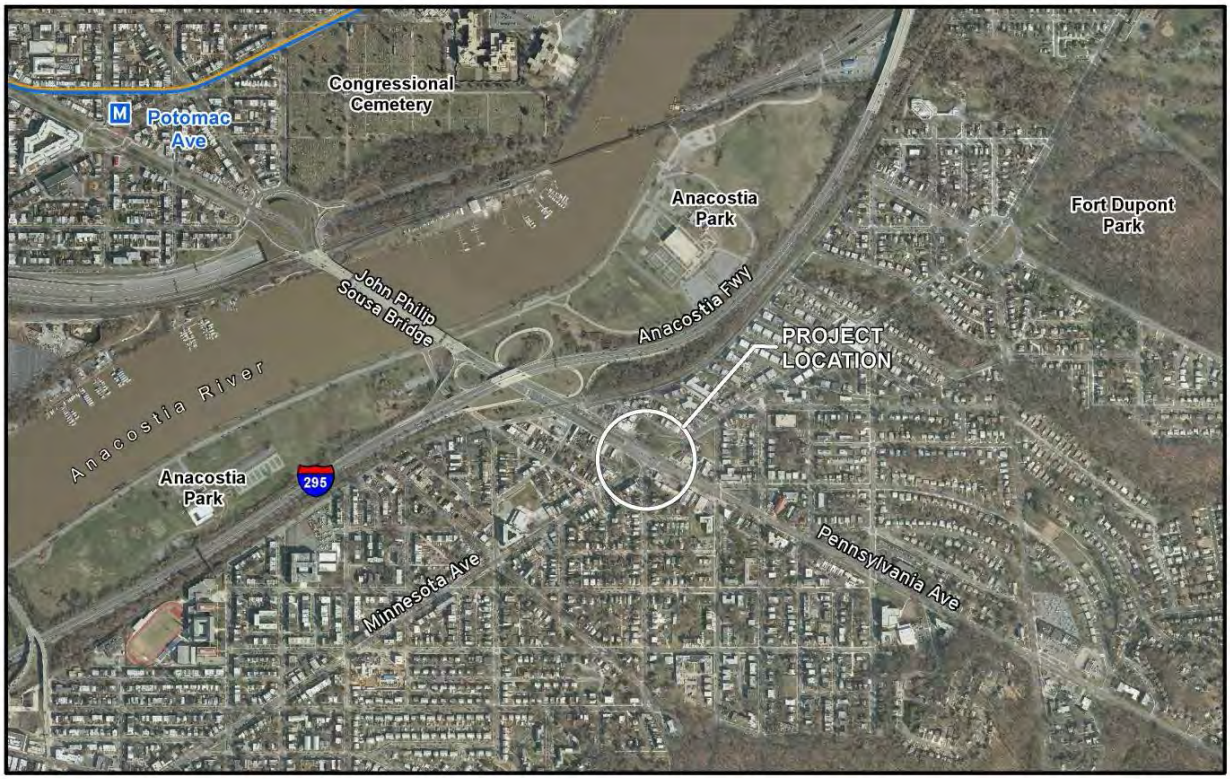


Figure 1
Project Location

The study area consists of medium-density residential, limited retail services, and recreational uses. The intersection contains four NPS reservations that are divided by roadways. The roadways split the reservations into areas that effectively function as traffic islands for pedestrians while crossing the street; the pieces of parkland are too small to function as "true" open space or green space as currently configured.

Currently, two alternatives, the Revised Square Alternative and the Conventional Intersection Alternative, are being considered for the Pennsylvania and Minnesota Avenues, SE Intersection Improvements EA.

The Revised Square Alternative, shown in Figure 2, would improve the intersection to create a "traffic square" concept, which would require all vehicles, with the exception of through-movements on Pennsylvania Avenue, to go around the expanded center islands. This alternative improves the roadway alignment and configuration to promote traffic-calming circulation to improve safety for pedestrians and vehicles at the intersection. Under this alternative, the traffic signal configuration is simplified and the left-turning conflict is removed.

Pennsylvania Avenue would bisect the center of the "square," and turning movements would be directed around the perimeter of the "square." This perimeter route acts to calm the traffic, similar to how a traffic circle works by allowing vehicles to enter and exit the square at locations identified by the intersecting streets. It would also reduce vehicular speeds by providing short straight distances between tight radius turns, at the presumed four corners of the square. The Revised Square Alternative would reduce the interaction between pedestrians and vehicles, and would also improve the existing and new crosswalk facilities, which would be re-surfaced and re-painted to make them highly visible to motorists and pedestrians. The crosswalk alignments and refuge areas for pedestrians would be significantly enhanced and improved sidewalks and green space frontage would be provided for local residences and businesses.

Figure 2
Revised Square Alternative

The Conventional Intersection Alternative, shown in Figure 3, would be redesigned into a conventional at-grade intersection with all vehicle turning movements permitted for all approaches, with the exception of 25th Street, which would remain one-way southbound. The design would improve the existing split roadway system that currently contains two complex intersections by reducing the multiple traffic movements into one signalized intersection. This alternative would provide for left-turn movements in all directions and increases the left-turn bay storage length for vehicles. Under this alternative, the median across L'Enfant Square would be enclosed to eliminate commute cut-through traffic. This alternative increases the available street parking along L'Enfant Square SE to the north of the "square" and would reduce the traffic volume adjacent to those residences. As a whole, this alternative changes the intersection operationally, but does not improve safety at the intersection or improve the interaction between pedestrians and vehicles.

The Conventional Intersections has two options for the movement of one-way traffic to the north and west of the "square" on L'Enfant Square SE. Either one-way movement would work operationally: If traffic flows one-way to the west and south on L'Enfant Square SE, commuter traffic could cut-through the "square" to avoid the Pennsylvania/Minnesota intersection and the right-turning vehicle/pedestrian conflict to the west of the square would remain. If traffic flows one-way to the north and east on this roadway, cut-through traffic would not be an issue and the vehicle/pedestrian conflict would be greatly reduced.

Figure 3
Conventional Intersection Alternative

2.0 NOISE ANALYSIS OVERVIEW

This report evaluates the potential noise impacts of the alternatives within the Pennsylvania and Minnesota Avenues, SE Intersection Improvements project in conformance with corresponding Federal regulations and guidance, and the National Environmental Policy Act (NEPA). The noise analysis presents the existing and future acoustical environments at various receivers located along Pennsylvania Avenue and Minnesota Avenue.

The determination of noise abatement measures and locations is in compliance with the Federal Highways Administration's Procedures for Abatement of Highway Traffic Noise and Construction Noise as presented in the Code of Federal Regulations, Title 23 Part 772 (23 CFR 772) and the DDOT's "Standard Procedure for Analysis and Abatement of Highway Traffic Noise (Noise Policy)".

Basic Noise Information

Noise is defined as unwanted and disruptive sound. The ear is sensitive to this pressure variation and perceives it as sound. The intensity of these pressure variations causes the ear to discern different levels of loudness. These pressure differences are most commonly measured in decibels.

The decibel (dB) is the unit of measurement for sound. The decibel scale audible to humans spans approximately 140 dB. A level of zero decibels corresponds to the lower limit of audibility, while 140 decibels produces a sensation more akin to pain than sound. The decibel scale is a logarithmic representation of the actual sound pressure variations. Therefore, a 26 percent change in the energy level only changes the sound level one dB. The human ear would not detect this change except in an acoustical laboratory. A doubling of the energy level would result in a three-dB increase, which would be barely perceptible in the natural environment. A tripling in energy sound level would result in a clearly noticeable change of five-dB in the sound level. A change of ten times the energy level would result in a ten-dB change in the sound level. This would be perceived as a doubling (or halving) of the apparent loudness.

The human ear has a non-linear sensitivity to noise. To account for this in noise measurements, electronic weighting scales are used to define the relative loudness of different frequencies. The "A" weighting scale is widely used in environmental work because it closely resembles the non-linearity of human hearing. Therefore, the unit of measurement for an A-weighted noise level is dBA.

Traffic noise is not constant. It varies as each vehicle passes through a certain location. The time-varying characteristics of environmental noise are analyzed statistically to determine the duration and intensity of noise exposure. In an urban environment, noise is made up of two distinct parts. One is ambient or background noise. Wind noise and distant traffic noise make up the acoustical environment surrounding the project. These sounds are not readily recognized, but combine to produce a non-irritating ambient sound level. This background sound level varies throughout the day, being lowest at night and highest during the day. The other component of urban noise is intermittent and louder than the background noise. Transportation noise and local industrial noise are examples of this type of noise. It is for these reasons that environmental noise is analyzed statistically.

The statistical descriptor used for traffic noise is Leq. Leq is the constant, average sound level, which over a period of time contains the same amount of sound energy as the varying levels of the traffic noise. The Leq correlates reasonably well the effects of noise on people. It is also easily measurable with integrating sound level meters. The time period for traffic noise is 1-hour. Therefore, the unit of measure for traffic noise is Leq(h) dBA.

Highway noise sources have been divided into five types of vehicles; automobiles (A), medium trucks (MT), heavy trucks (HT), Buses (B) and Motorcycles (MC). Each vehicle type is defined as follows[2]:

- Automobiles – all vehicles with two axles and four tires, includes passenger vehicles and light trucks, less than 10,000 pounds.
- Medium trucks – all vehicles having two axles and six tires, vehicle weight between 10,000 and 26,000 pounds.
- Heavy trucks – all vehicles having three or more axles, vehicle weight greater than 26,000 pounds.
- Buses – all vehicles designed to carry more than nine passengers.
- Motorcycles – all vehicles with two or three tires and an open-air driver/passenger compartment.

[2] G.S. Anderson, C.S.Y. Lee, G.G. Fleming and C. Menge, "FHWA Traffic Noise Model®, Version 1.0 User's Guide", Federal Highway Administration, January 1998, p.60.

Noise levels produced by highway vehicles can be attributed to three major categories:

- Running gear and accessories (tires, drive train, fan and other auxiliary equipment)
- Engine (intake and exhaust noise, radiation from engine casing)
- Aerodynamic and body noise

Tire sound levels increase with vehicle speed but also depend upon road surface, vehicle weight, tread design and wear. Change in any of these can vary noise levels. At lower speeds, especially in trucks and buses, the dominant noise source is the engine and related accessories.

Noise Model and Analysis

The FHWA's Procedures for Abatement of Highway Traffic Noise and Construction Noise is presented in the Code of Federal Regulations, Title 23 Part 772 (23 CFR 772). This regulation, plus other guidance documents written to explain the regulation, sets forth the process for performing a traffic noise analysis. The process includes the following:

- Identify existing and proposed land uses in the study area;
- Determine existing noise levels either:
    - through modeling, or
    - noise measurements with concurrent classification counts of vehicles passing the noise monitoring site;
- Validate predicted noise levels through comparison between measured and predicted levels;
- Model future design year traffic noise levels which will yield the worst hourly traffic noise on a regular basis (PM peak hour noise levels);
- Identify locations that would be exposed to a noise impact based upon the Noise Abatement Criteria (NAC) as presented in Table 1;
- Model noise abatement measures to mitigate the predicted design year traffic noise impacts; and
- Modeling must be performed with FHWA's most recent version of the Traffic Noise Model® (TNM).

DDOT's Noise Policy is the District's tool for implementing 23 CFR 772. The NAC, which is presented in 23 CFR 772, establishes the noise abatement criteria for various land uses. The noise level descriptor used is the equivalent sound level, L_{eq}, defined as the steady state sound level which, in a stated time period (usually one hour), contains the same sound energy as the actual time-varying sound.

Noise abatement measures will be considered when the predicted noise levels approach or exceed those values shown for the appropriate activity category in Table 1, or when the predicted traffic noise levels substantially exceed the existing noise levels. DDOT has defined the approach value as being 1 dBA less than the noise levels shown in Table 1. DDOT has defined an increase over existing noise levels of 10 decibels or more as being substantial.

TNM® is FHWA's "computer program for highway traffic noise prediction and analysis."[3] The following parameters are used in this model to calculate an hourly $L_{eq}(h)$ at a specific receiver location:

- Distance between roadway and receiver;
- Relative elevations of roadway and receiver;
- Hourly traffic volume in light-duty (two axles, four tires), medium-duty (two axles, six tires), and heavy-duty (three or more axles) vehicles;
- Vehicle speed;
- Ground absorption; and
- Topographic features, including retaining walls and berms.

The Pennsylvania Avenue/Minnesota Avenue study area consists of medium-density residential, retail, and recreational areas. The criteria stated in Table 1 below will help to determine whether or not the proposed project will impact uses throughout the corridor.

[3] Ibid, Report Documentation Page.

Table 1: Noise Abatement Criteria (NAC)
Hourly A-Weighted Sound Level-Decibels (dBA)

Activity Category	Activity Criteria $L_{eq}(h)$	Evaluation Location	Activity Description
A	57	Exterior	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B	67	Exterior	Residential
C	67	Exterior	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, daycare centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings.
D	52	Interior	Auditoriums, daycare centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios.
E	72	Exterior	Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in A-D or F.
F	N/A	N/A	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	N/A	N/A	Undeveloped lands that are not permitted.

Source: "District of Columbia Department of Transportation Noise Policy", District Department of Transportation, July 11, 2011,

3.0 NOISE MEASUREMENTS

Existing noise level measurements were conducted on March 21, 2013 at four representative sites in the project vicinity. A 20-minute measurement was taken at each site. The measurements were made in accordance with FHWA and DDOT guidelines using an integrating sound level analyzer meeting ANSI and IEC Type 1 specifications. Traffic counts were taken at each site, concurrent with the noise measurements. Traffic data were obtained at all the field sites. Table 2 contains observed traffic data, a site description, date, start time and duration of the noise measurements. The measurement locations were selected adjacent to the proposed alignments. The noise measurement sites and modeled noise receiver locations are shown on Figure 2 and Figure 3. The field data sheets are presented in ***Attachment 1***.

Table 2: Measured Existing Noise Levels
Pennsylvania Avenue/Minnesota Avenue Intersection Improvements
Washington, DC

Field Site #	Site Description	Date	Start Time	Duration (minutes)	Traffic[1)]						Noise Level, dBA $L_{eq}(h)$
					Roadway	A[a]	MT[b]	HT[c]	Buses[d]	Speed mph	
FS-1	Vacant lot on north side of L'Enfant Square SE between 2404 and 2420 L'Enfant Square SE.	03/21/2013	8:00 am	20	L'Enfant Square WB	84	0	0	0	5 to 15	61.5
FS-2	Twining Square, 27 ft. north to L'Enfant Square. 29 ft. south to WB Pennsylvania Avenue, 109 ft. west to 54 ft. to SB Minnesota Avenue.	03/21/2013	8:30 am	20	Pennsylvania Avenue (EB and WB); Minnesota Avenue (SB)	1,330	17	25	23	15 to 40	73.1
FS-3	Terrace next to sidewalk. 30 ft. to EB Pennsylvania Avenue. 76 ft. to north corner of 2529 Pennsylvania Avenue.	03/21/2013	9:00 am	20	Pennsylvania Avenue (EB and WB)	931	21	14	6	25 to 35	71.1
FS-4	NPS reservation area. Surrounded by L'Enfant Square SE and SB Minnesota Avenue, south of Pennsylvania Avenue. 16 ft. east of L'Enfant Square SE, 38 ft. west of SB Minnesota Avenue.	03/21/2013	9:30 am	20	Pennsylvania Avenue (EB); Minnesota Avenue (NB and SB); L'Enfant Square SB	629	18	22	17	20 to 35	69.7

1) Vehicle counts classified as follows:
   a. Autos (A) defined as vehicles with 2-axles and 4-tires.
   b. Medium trucks (MT) defined as vehicles with 2-axles and 6-tires.
   c. Heavy trucks (HT) defined as vehicles with 3 or more axles.
   d. Buses defined as vehicles carrying more than 9 passengers.

Source: HNTB Corporation, March 2013

Measured vs. Modeled

TNM® 2.5 was used to validate the predicted noise levels through comparison with the measured and predicted noise levels. Traffic was counted and classified concurrently with each noise measurement by vehicle type: cars, medium trucks, heavy trucks, and buses. Traffic counts, concurrent with the noise measurements, were taken at four measurement sites. The traffic data from the four sites were used in the model. The site by site comparison is presented in Table 3. All four field site modeled data compared within 0-3 dB of the measured noise levels. This represents reasonable correlation since the human ear can barely distinguish a 3 dBA change in the $L_{eq}(h)$ noise level in the urban environment.

Table 3: Comparison of Measured and Modeled Noise Levels
Pennsylvania Avenue/Minnesota Avenue Intersection Improvements
Washington DC

Field Site	Noise Level, dBA $L_{eq}(h)$		Difference in Noise Level, dBA $L_{eq}(h)$ (Modeled Minus Measured)
	Measured	Modeled	
FS-1	61.5	63.8	2.3
FS-2	73.1	72.2	-0.9
FS-3	71.1	68.1	-3.0
FS-4	69.7	69.0	-0.7

Source: HNTB Corporation, March 2013

4.0 NOISE MODELING

The latest version of the FHWA's Traffic Noise Model, TNM®2.5[4], was used to model existing (2012), No Build (2040), Revised Square Alternative (2040), and Conventional Intersection Alternative (2040) for the peak noise hour noise levels within the study area. 22 representative noise receivers (representing 35 dwelling units), numbered N1 through N18, plus the four field sites, FS-1 through FS-4, as shown on Figure 2 and 3, were modeled. Modeled receivers are identical on Figure 2 and Figure 3, except for Field Site 4 (FS-4). The Revised Square Alternative alignment results in FS-4 being on the pavement. Thus, FS-4 was moved approximately 70 feet northeast for the Revised Square Alternative model. These receivers were selected to model representative noise impacts at areas consisting of residential, daycare, and recreational properties, as well as one place of worship. There are multiple commercial and retail properties throughout the project area that do not have areas of outdoor areas of frequent human use, so locations were not modeled. The results of the computer modeling are presented in Table 4.

[4] M.C. Lau, C.S.Y. Lee, J.L. Rochat, E.R. Boeker, and G.C. Fleming. FHWA Traffic Noise Model® Users Guide (Version 2.5 Addendum). Federal Highway Administration, April 2004

Table 4: PM Peak Hour Noise Levels, dBA Leq(h)
Pennsylvania Avenue/Minnesota Avenue Intersection Improvements
Washington, DC

Receiver Location	Land Use	Activity Category	Activity Criteria	Dwelling Units	Noise Level, L_{eq}(h) (dBA)			
			Leq (h)		Existing (2012)	No Build (2040)	Revised Square (2040)	Conventional Intersection (2040)
N1	Residential	B	67	3	69.0	**70.3**	**70.3**	**71.0**
N2	Daycare	C	67	0	67.4	**69.4**	**69.3**	**69.7**
FS-3	Retail	F	N/A	0	71.0	73.0	71.9	72.5
N3	Daycare	C	67	0	69.2	**71.3**	**70.3**	**70.6**
N4	Residential	B	67	3	67.1	**68.4**	**68.7**	**69.2**
N5	Residential	B	67	2	66.6	**67.7**	**67.8**	**68.1**
N6	Residential	B	67	3	66.1	**67.1**	**67.1**	**67.1**
N7	Place of Worship	D	52	0	41.1*	41.7*	41.6*	41.3*
N8	Residential	B	67	3	66.0	**67.2**	**67.3**	**66.8**
FS-4	Park	C	67	0	70.0	**71.5**	**73.1**	**70.2**
N9	Residential	B	67	1	65.4	**67.3**	**68.0**	**67.7**
N10	Residential	B	67	2	63.7	**65.6**	**66.3**	**66.0**
N11	Residential	B	67	2	63.9	**65.7**	**66.9**	**66.2**
FS-1	Residential	B	67	1	63.9	**65.7**	**66.9**	**66.1**
N12	Residential	B	67	2	64.7	**66.4**	**67.5**	**66.9**
N13	Residential	B	67	2	65.2	**66.8**	**67.8**	**67.3**
N14	Residential	B	67	2	65.9	**67.4**	**68.2**	**67.9**
N15	Residential	B	67	2	66.9	**68.2**	**68.9**	**68.8**
N16	Residential	B	67	1	67.3	**68.6**	**69.1**	**69.3**
N17	Residential	B	67	3	67.5	**68.6**	**68.8**	**69.6**
N18	Residential	B	67	3	67.5	**68.6**	**68.6**	**69.6**
FS-2	Park	C	67	0	71.1	**73.2**	**72.8**	**73.7**

___ - Indicates impacted receptor. A receptor is impacted if the predicted noise level approaches or exceeds DDOT NAC, as shown on Table 1.

* - N7 Building Type was classified as – Masonry and Window Condition – Single Glazed. Therefore the 'Noise Reduction Due to Exterior of the Structure' is 25 dB as defined on *Table 6: Building Noise Reduction Factors* (page 30) in the "Highway Traffic Noise: Analysis and Abatement Guidance", FHWA, January 2011.

5.0 IMPACT ASSESSMENT

Existing (2012) peak hour levels at the 16 residential locations, which represents 35 dwelling units, would range from 63.7 to 69.0 dBA $L_{eq}(h)$. The noise levels at the category C locations would range from 67.4 to 71.1 dBA $L_{eq}(h)$. The interior noise level at the category D location, N7, would be 41.1 dBA. As shown in Table 4, the noise levels at 25 of the 35 dwelling units are presently approaching or exceeding 67 dBA, as are the noise levels in the park and at the daycare.

No build (2040) peak hour noise are predicted to exceed the NAC at 16 residential locations and four activity category C locations. The noise levels at the 16 residential locations would range from 65.6 to 70.3 dBA $L_{eq}(h)$ and represents 35 dwelling units. The noise levels at the category C locations would range from 69.4 to 73.2 dBA $L_{eq}(h)$. The interior analysis at the category D location, N7, did not approach or exceed the 52 dBA $L_{eq}(h)$ criteria.

Predicted future (2040) noise levels for the Revised Square Alternative would approach or exceed the NAC at 16 residential receivers and the same four activity category C locations identified under the No Build noise levels. The noise levels at the 16 residential locations would range from 69.3 to 73.1 dBA $L_{eq}(h)$, representing 35 dwelling units. The noise levels at the category C locations would range from 66.6 to 73.1 dBA $L_{eq}(h)$. None of the predicted future noise levels would substantially exceed existing noise levels (DDOT has defined an increase over existing noise levels of 10 decibels or more as being substantial). The interior analysis at the category D location, N7, did not approach or exceed the 52 dBA $L_{eq}(h)$ criteria.

Predicted future (2040) noise levels for the Conventional Intersection Alternative would approach or exceed the NAC at 16 residential receivers and the same four activity category C locations identified under the No Build and Revised Square Alternative noise levels. The noise levels at the 16 residential locations would range from 66.0 to 71.0 dBA $L_{eq}(h)$, representing 35 dwelling units. The noise levels at the category C locations would range from 69.7 to 73.7 dBA $L_{eq}(h)$. None of the predicted future noise levels would substantially exceed existing noise levels (DDOT has defined an increase over existing noise levels of 10 decibels or more as being substantial). The interior analysis at the category D location, N7, did not approach or exceed the 52 dBA $L_{eq}(h)$ criteria.

6.0 NOISE ABATEMENT MEASURES

Within the framework of DDOT's criteria, various methods were reviewed to mitigate the noise impact of the proposed improvements. Among those considered were traffic management measures (reduction of speed limits, restriction of truck traffic to specific times of the day, a total prohibition of trucks), alteration of horizontal and vertical alignments, acquisition of real property or interests therein to serve as a buffer zone to preempt development which would be adversely impacted by traffic noise, and noise insulation of Activity Category D land use facilities listed in Table 1, the construction of berms, and the construction of noise barriers.

Reductions of speed limits, although acoustically beneficial, are seldom practical unless the design speed of the proposed roadway is also reduced. Restriction or prohibition of trucks is counter to the project purpose and need. Design criteria, recommended termini

and the preliminary design process leading to the preferred alternative preclude substantial horizontal and vertical alignment shifts that would produce noticeable changes in the projected acoustical environment. Acquisition of undeveloped property for buffer zones is typically neither feasible nor reasonable due to the amount of land needed to create an acoustically effective buffer zone and the desire to keep as much land as possible in the local community's tax base. There are no Activity Category D land use facilities that approach or exceed the NAC, so noise insulation was not considered.

A noise berm or barrier must be long enough and tall enough to minimize the noise coming over the top or around the ends of the barrier, such that the noise barrier, according to DDOT's Noise Policy, dated April 5, 2011, provides at least a 5 dB(A) reduction at impacted receptors to be considered feasible. In addition, the noise barrier or berm cannot restrict pedestrian or vehicular access for the mitigation to be considered feasible. The berm or barrier cannot have any holes in the barrier which would seriously degrade the noise reduction capability of the berm or barrier. The construction of noise berms along this project would not be feasible due to the limited space between the traffic and the receptors.

There is limited space to construct noise barriers between the traffic and receptors. However, all the receptors have access to a parking lane in front of the residences; see Figures 3-15 and 3-16. The length of the barriers would be limited by line of sight requirements at intersections. Providing pedestrian access from the residences to the parked cars would create a number of holes in each noise barrier. Therefore, it is not feasible to construct a noise barrier that would provide a 5 dB(A) reduction for the residences abutting the local streets throughout the project area.

7.0 UNDEVELOPED LANDS

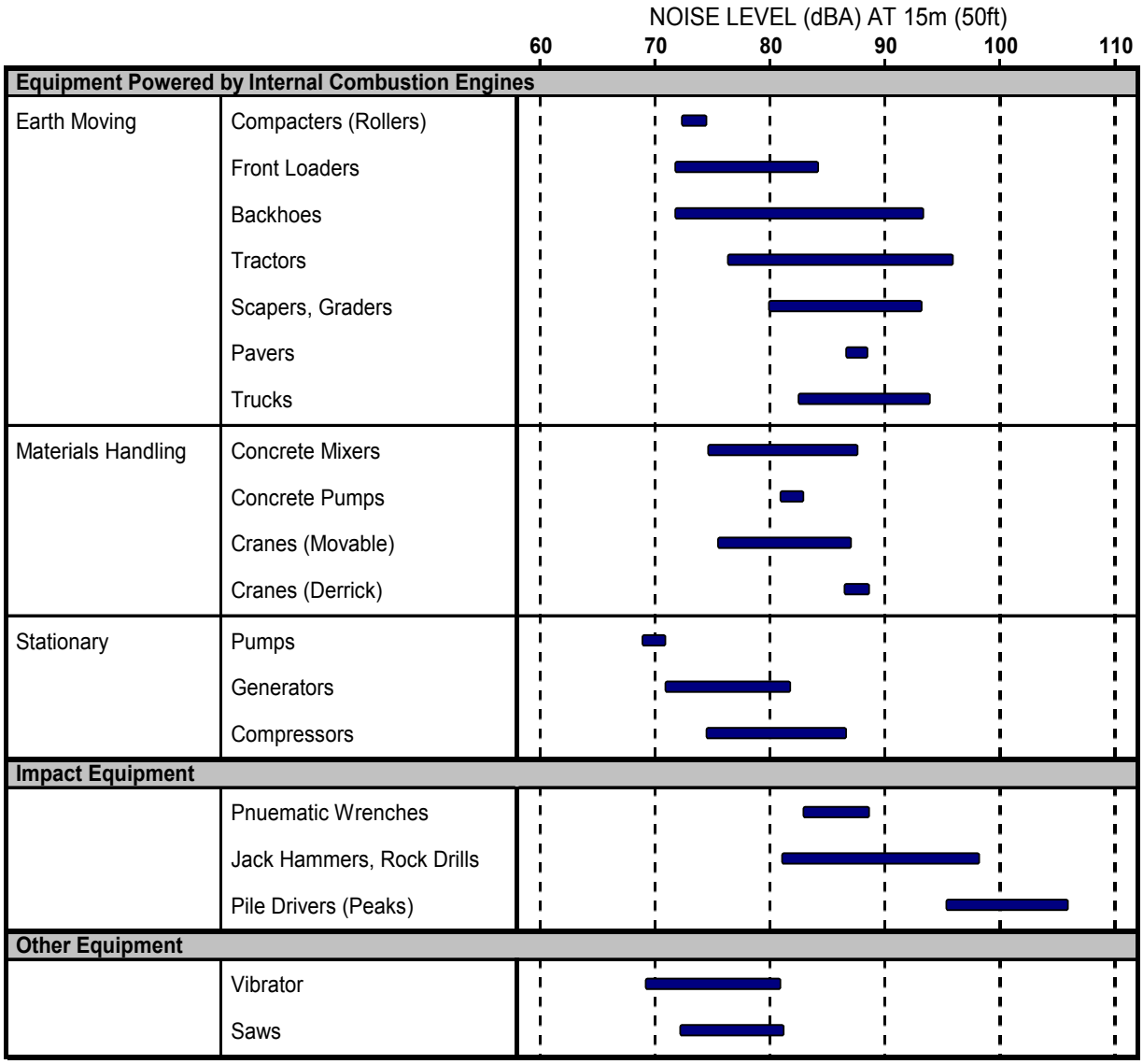
Traditionally, setback distances to 66 and 71 dB(A) $L_{eq}(h)$ are developed to assist local planning authorities in developing land use control over the remaining undeveloped lands along the project in order to prevent further development of incompatible land use based on predicted noise levels. However, the project area surrounding the Pennsylvania Avenue and Minnesota Avenue intersection is completely built out and therefore setback distances would not assist for this project.

8.0 CONSTRUCTION NOISE

The major construction elements of this project are expected to be demolition, hauling, grading, and paving. Construction of the proposed improvements and local rerouting of traffic for either alternative will result in a temporary increase in the ambient noise levels for properties in the project area, especially along Pennsylvania Avenue and Minnesota Avenue. General construction noise impacts for passerby and those individuals living or working near the project can be expected particularly from demolition, earth moving, and paving operations. Equipment associated with construction generally includes backhoes, graders, pavers, concrete trucks, compressors, and other miscellaneous heavy equipment. Table 5 lists some typical peak operating noise levels at a distance of 15 m (50 feet), grouping construction equipment according to mobility and operating characteristics. Considering the relatively short-term nature of construction noise, impacts are not expected to be substantial. The transmission loss characteristics of

nearby structures are believed to be sufficient to moderate the effects of intrusive construction noise.

Table 5: Construction Equipment Sound Levels



SOURCE: U.S. Report to the President and Congress on Noise, February, 1972.

9.0 CONCLUSION

Based on the study completed, mitigation of noise impacts for the Pennsylvania Avenue/Minnesota Avenue improvements is not feasible for either of the proposed alternatives. Due to the built out nature of the project area and local access requirements, noise mitigation in this urban environment is not possible. If it subsequently develops during final design that these conditions have substantially changed, noise abatement measures will be reviewed.

10.0 REFERENCES

Anderson, G. S., C.S.Y. Lee, G.G. Fleming and C. Menge, "FHWA Traffic Noise Model®, Version 1.0 User's Guide", Federal Highway Administration, January 1998, p. 60.

Lau, Michael C., Cynthia S. Y. Lee, Gregg G. Judith L. Rochat, Eric R. Boeker, and Gregg C. Fleming. FHWA Traffic Noise Model® Users Guide (Version 2.5 Addendum). Federal Highway Administration, April 2004.

"Highway Traffic Noise: Analysis and Abatement Guidance", FHWA, January 2011.

"Noise Policy", District of Columbia Department of Transportation's, July 11, 2011.

ATTACHMENT 1
Field Data Measurement Sheets

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HNTB

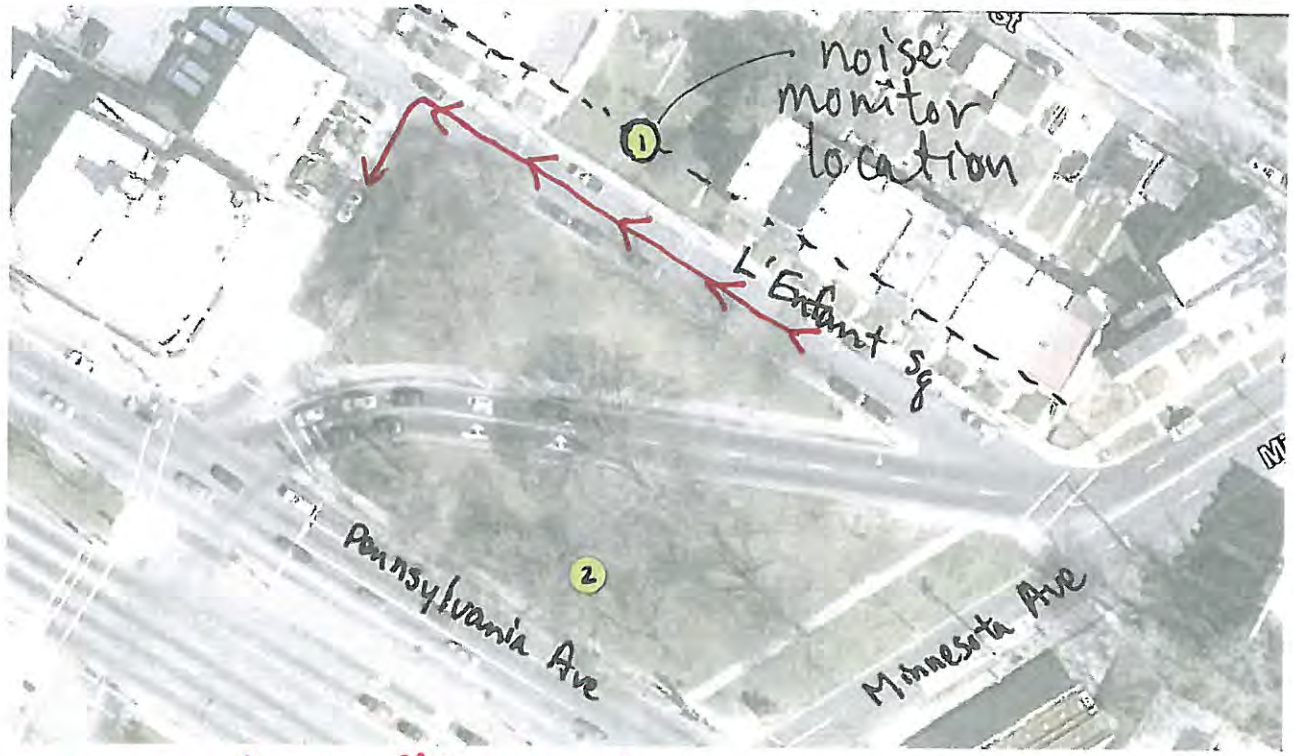
NOISE MEASUREMENT DATA SHEET

PROJECT: Pennsylvania Ave JOB #: 48934 BY: R. Bassarab + A. McDonald
SITE: 1 DATE: 3/21/2013 TIME: 8:00 AM
CALIBRATION: 113.8 at 1K Hz dB.
RESPONSE: FAST / [SLOW] WEIGHTING: [A] / C / LIN.

TRAFFIC DATA		
ROAD (Name/Dir)	L'Enfant Sq WB	
AUTOS	84	
MED TRKS	0	
HVY TRKS	0	
BUS	0	
MOTORCYCLE	0	
SPEED	<5 to 15 mph	

EQUIPMENT	
INSTRUMENT	
SLM MANUFACTURER	Norsonic
SLM MODEL	Type 118
SLM	S / N 31483
PREAMPLIFIER – Type 1206	S / N 30522
MICROPHONE – Type 1225	S / N 52318
CALIBRATOR – Type 1251	S / N 30825

SITE SKETCH



MEASUREMENT DATA	Duration 20 min	Leq 63.3	

WEATHER DATA: WIND SPEED (MPH) 5-10 DIR. NNW TEMP. 35 HUMIDITY 40% CLOUD COVER overcast
BACKGROUND NOISE: ~~traffic~~ chirping birds 10-20ft, Penn/Minn ambient 60-62
MAJOR SOURCES: CARS on L'ENFANT
UNUSUAL EVENTS: horns honking, 04:50-05:30 police siren
OTHER NOTES:

HNTB

NOISE MEASUREMENT DATA SHEET

PROJECT: Pennsylvania Ave JOB #: 48934 BY: R. Bassarab + A. McDonald

SITE: 2 DATE: 3/21/2013 TIME: 8:30 AM

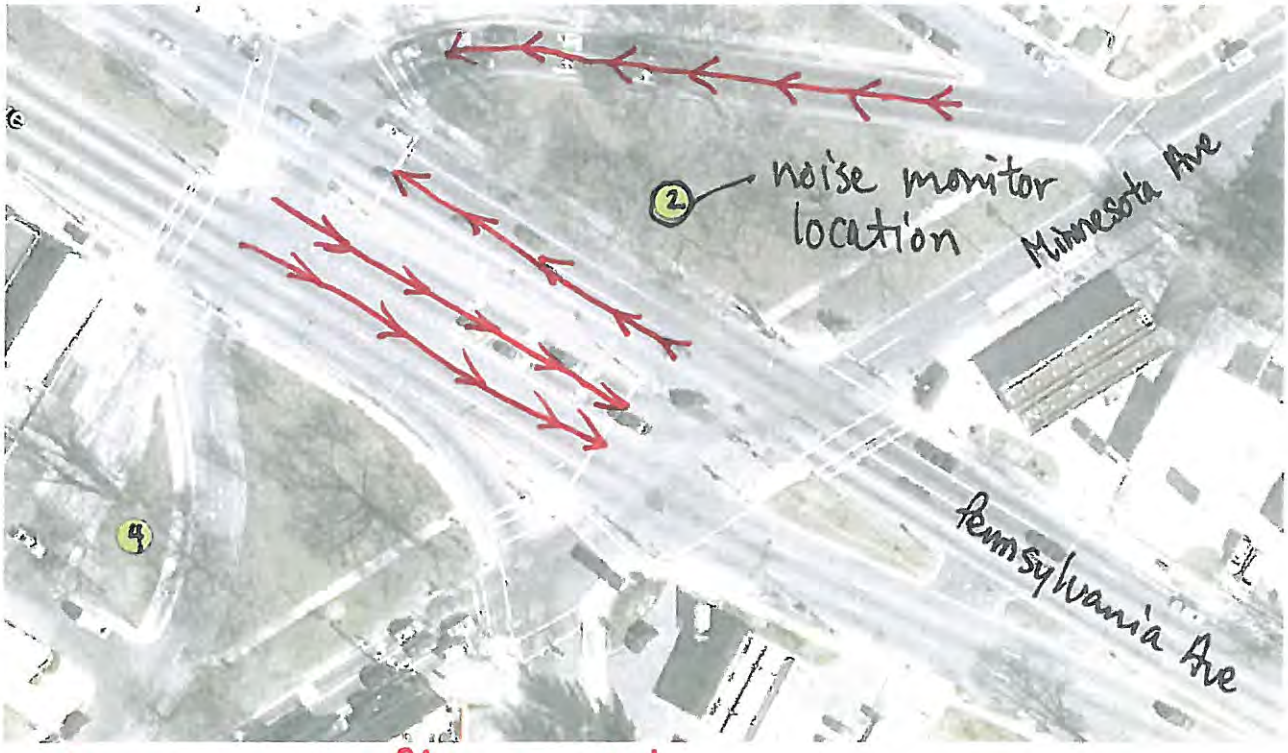
CALIBRATION: 113.8 at 1K Hz dB.

RESPONSE: FAST / [SLOW] WEIGHTING: [A] / C / LIN.

TRAFFIC DATA		
ROAD (Name/Dir)	Various (See below)	
AUTOS	1330	
MED TRKS	17	
HVY TRKS	25	
BUS	23	
MOTORCYCLE	0	
SPEED	15 to 40mph	

EQUIPMENT	
INSTRUMENT	
SLM MANUFACTURER	Norsonic
SLM MODEL	Type 118
SLM	S / N 31483
PREAMPLIFIER – Type 1206	S / N 30522
MICROPHONE – Type 1225	S / N 52318
CALIBRATOR – Type 1251	S / N 30825

SITE SKETCH



MEASUREMENT DATA	Duration 20 min	Leq 74.4	

WEATHER DATA WIND SPEED (MPH) 5-10 DIR. N TEMP. 35 HUMIDITY 40% CLOUD COVER overcast

BACKGROUND NOISE n/a

MAJOR SOURCES Penn traffic, tour buses, trucks

UNUSUAL EVENTS 15:50 - 16:42 ambulance

OTHER NOTES

HNTB

NOISE MEASUREMENT DATA SHEET

PROJECT: Pennsylvania Ave JOB #: 48934 BY: R. Bassarab + A. McDonald

SITE: 3 DATE: 3/21/2013 TIME: 9:00 AM

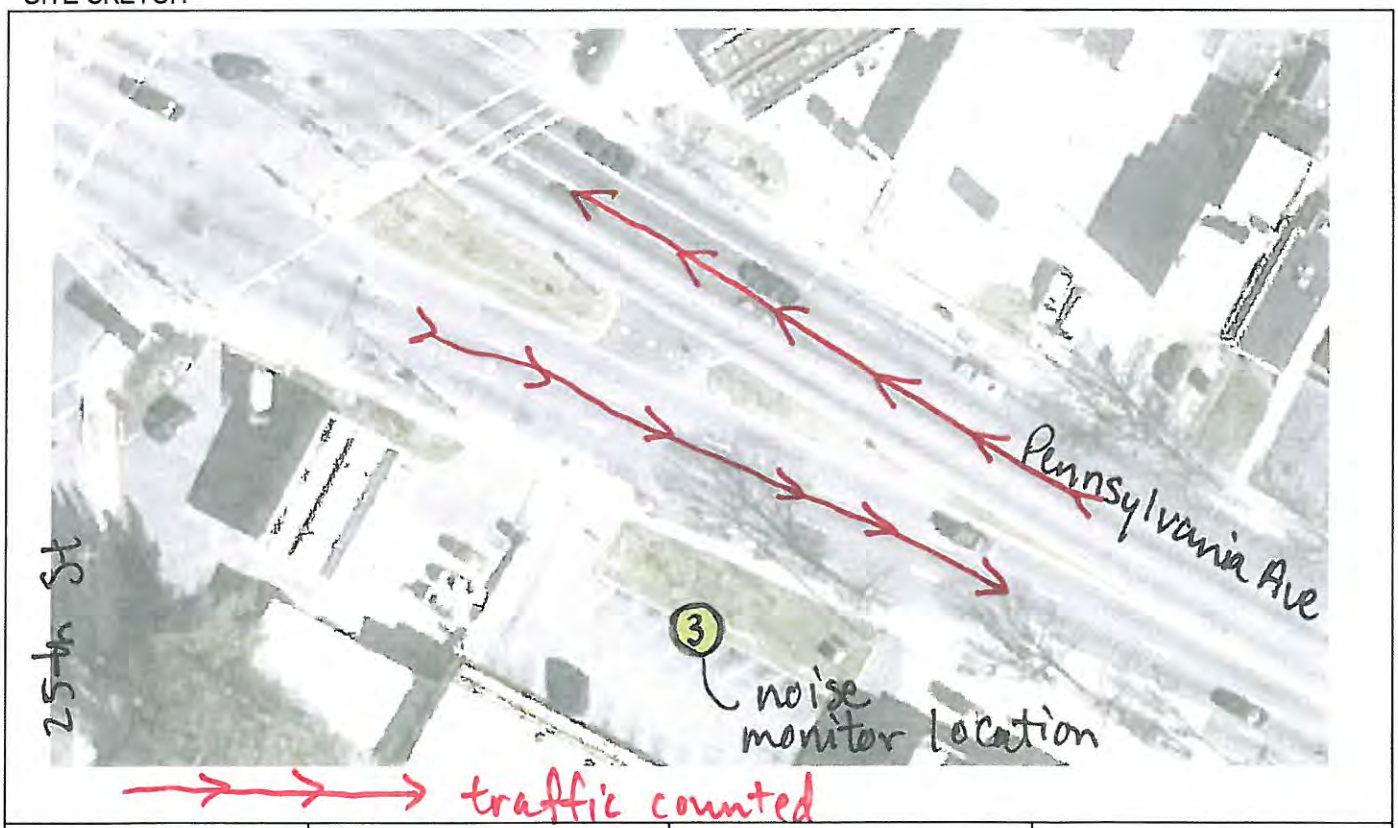
CALIBRATION: 113.8 at 1K Hz dB.

RESPONSE: FAST / [SLOW] WEIGHTING: [A] / C / LIN.

TRAFFIC DATA		
ROAD (Name/Dir)	Pennsylvania Ave (EB/WB)	
AUTOS	931	
MED TRKS	21	
HVY TRKS	14	
BUS	6	
MOTORCYCLE	0	
SPEED	25 to 35 mph	

EQUIPMENT	
INSTRUMENT	
SLM MANUFACTURER	Norsonic
SLM MODEL	Type 118
SLM	S / N 31483
PREAMPLIFIER – Type 1206	S / N 30522
MICROPHONE – Type 1225	S / N 52318
CALIBRATOR – Type 1251	S / N 30825

SITE SKETCH



MEASUREMENT DATA	Duration 20 min	Leq 71.1	

WEATHER DATA WIND SPEED (MPH) 5-10 DIR. N TEMP. 35 HUMIDITY 40% CLOUD COVER overcast

BACKGROUND NOISE n/a

MAJOR SOURCES

UNUSUAL EVENTS n/a

OTHER NOTES

HNTB

NOISE MEASUREMENT DATA SHEET

PROJECT: Pennsylvania Ave JOB #: 48934 BY: R. Bassarab + A. McDonald

SITE: 4 DATE: 3/21/2013 TIME: 9:30 AM

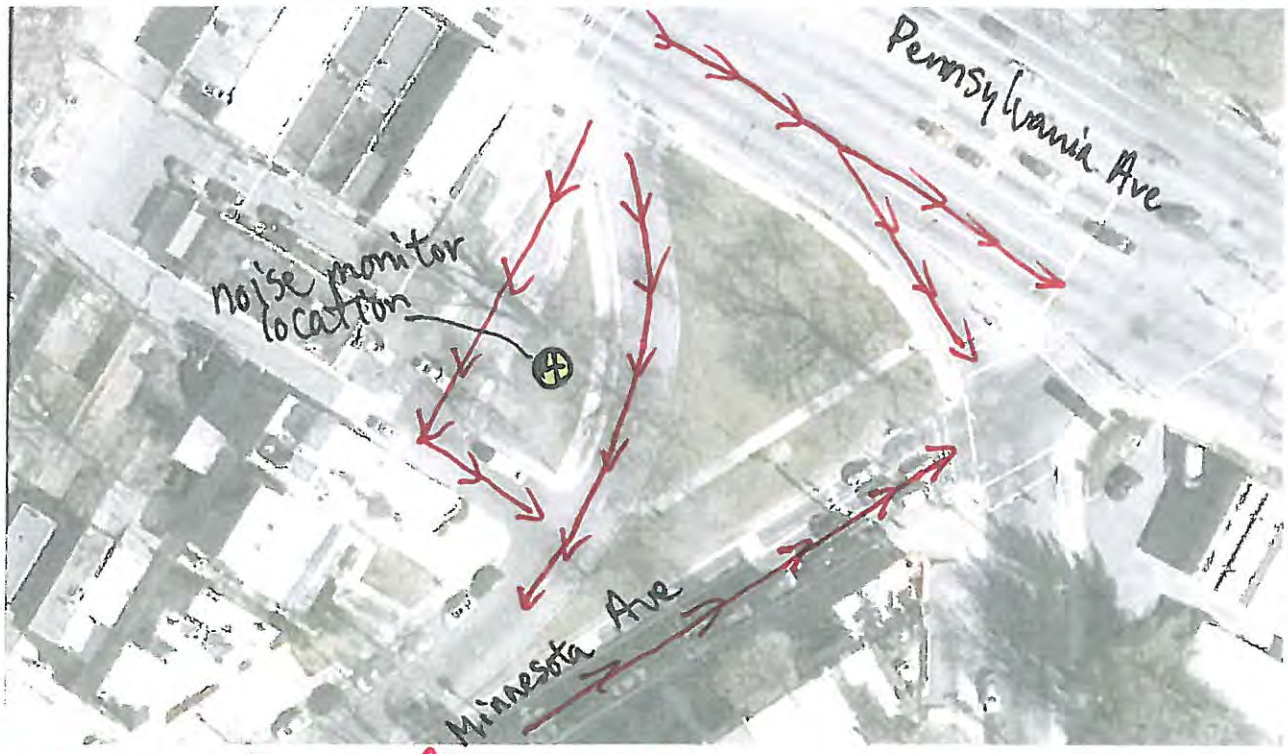
CALIBRATION: 113.8 at 1K Hz dB.

RESPONSE: FAST / [SLOW] WEIGHTING: [A] / C / LIN.

TRAFFIC DATA		
ROAD (Name/Dir)	Various	
AUTOS	629	
MED TRKS	18	
HVY TRKS	22	
BUS	17	
MOTORCYCLE	0	
SPEED	20 to 35 mph	

EQUIPMENT	
INSTRUMENT	
SLM MANUFACTURER	Norsonic
SLM MODEL	Type 118
SLM	S / N 31483
PREAMPLIFIER – Type 1206	S / N 30522
MICROPHONE – Type 1225	S / N 52318
CALIBRATOR – Type 1251	S / N 30825

SITE SKETCH



MEASUREMENT DATA	Duration 20 min	Leq 69.7	

WEATHER DATA WIND SPEED (MPH) 5-10 DIR. N TEMP. 35 HUMIDITY 39% CLOUD COVER overcast

BACKGROUND NOISE n/a

MAJOR SOURCES

UNUSUAL EVENTS n/a

OTHER NOTES