NOISE TECHNICAL REPORT

AUGUST 2013

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1. Introduction and Project Description

1.1 Introduction

The construction and operation of the Purple Line has the potential to increase noise levels at sensitive land uses near the project corridor. Whether an increase in noise generated from the operation of the proposed Purple Line light rail system is perceptible depends on the relationship between noises generated by the operations of the light rail transit system relative to existing community background noise levels. The following analysis describes the existing noise environment, estimates project-related noise exposure, and then compares the project generated noise levels against the appropriate FTA impact criteria..

This Noise Technical Report documents the impact assessment methodology used to evaluate potential noise impacts associated with the operation of the Preferred Alternative. The report provides an assessment at a series of representative receptor sites identified throughout the project study area, and it describes measures that have been incorporated into the design to reduce project-related noise.

The assessment of noise for the proposed Purple Line followed procedures outlined in the Federal Transit Administration (FTA) *Transit Noise and Vibration Impact Assessment* (May 2006) manual.

1.2 Project Description

The Purple Line is a proposed 16.2-mile transit line located north and northeast of Washington DC, inside the circumferential I-95/I-495 Capital Beltway. The Purple Line would extend between Bethesda in Montgomery County and New Carrollton in Prince George's County. The "Purple Line corridor" includes five major activity centers: Bethesda, Silver Spring, Takoma/Langley Park, College Park, and New Carrollton.

The purposes of the Purple Line project are the following:

- Provide faster, more direct, and more reliable east-west transit service connecting the major activity centers in the Purple Line corridor at Bethesda, Silver Spring, Takoma/Langley Park, College Park, and New Carrollton,
- Provide better connections to Metrorail services located in the corridor, and
- Improve connectivity to the communities in the corridor located between the Metrorail lines.

The noise analysis does not assess the effects of the No Build Alternative, or compare the Preferred Alternative to the No Build Alternative. Instead the Purple Line Preferred Alternative service operations, as described below, will be discussed and compared to FTA noise exposure and impact criteria.

1.2.1 Preferred Alternative

The Preferred Alternative would be at grade except for one short tunnel section and three sections elevated on structures. The Preferred Alternative would operate mainly in dedicated or exclusive lanes, providing fast, reliable transit operations.

There following 21 stations are planned for the Preferred Alternative:

- Bethesda
- Chevy Chase Lake
- Lyttonsville
- Woodside/16th Street
- Silver Spring Transit Center
- Silver Spring Library
- Riggs Road
- Adelphi Road/West Campus
- UM Campus Center
- East Campus
- College Park
- M Square

- Dale Drive
- Manchester Place
- Long Branch
- Piney Branch Road
- Takoma/Langley Transit Center
- Riverdale Park
- Beacon Heights
- Annapolis Road/Glenridge
- New Carrollton

Stations would include ticket vending machines, weather shelters for passengers, lighting, wayfinding and informational signage, trash receptacles, seating, and security equipment such as emergency telephones and closed circuit television cameras. Most riders would walk to the stations or transfer from other transit services. Access plans for each station have been developed to enhance pedestrian and transit access for nearby communities. The stations would have either side or center platforms depending on the site characteristics and space availability.

Two storage and maintenance facilities are proposed: one at Lyttonsville in Montgomery County and the other at Glenridge in Prince George's County. Additionally, traction power substations, used to convert electric power to appropriate voltage and type to power the light rail vehicles, would be required approximately every mile.

As part of the Preferred Alternative the permanent Capital Crescent Trail would be constructed within the Georgetown Branch right-of-way for a distance of 3.3 miles between Bethesda and the CSXT Metropolitan Branch. At the junction with the CSXT the trail is planned to continue on the north side of the CSXT corridor to the SSTC. The permanent Capital Crescent Trail would replace the existing Georgetown Branch Interim Trail which currently extends from Bethesda to Stewart Avenue within the Georgetown Branch right-of-way. The completion of the trail along the CSXT corridor is contingent on agreement with CSXT on the use of their property on the north side of the CSXT tracks for the trail. If agreement is not reached by the time the Purple Line construction occurs, MTA would construct the trail from Bethesda to Talbot Avenue. From Talbot Avenue to Silver Spring an interim signed bike route on local streets would be used. MTA will plan, design, and construct the permanent Capital Crescent Trail between Bethesda and Silver Spring concurrently with the Purple Line. The Capital Crescent Trail will be owned and operated by Montgomery County, which will be responsible for providing the funds to construct it.

2. Regulatory Context and Methodology

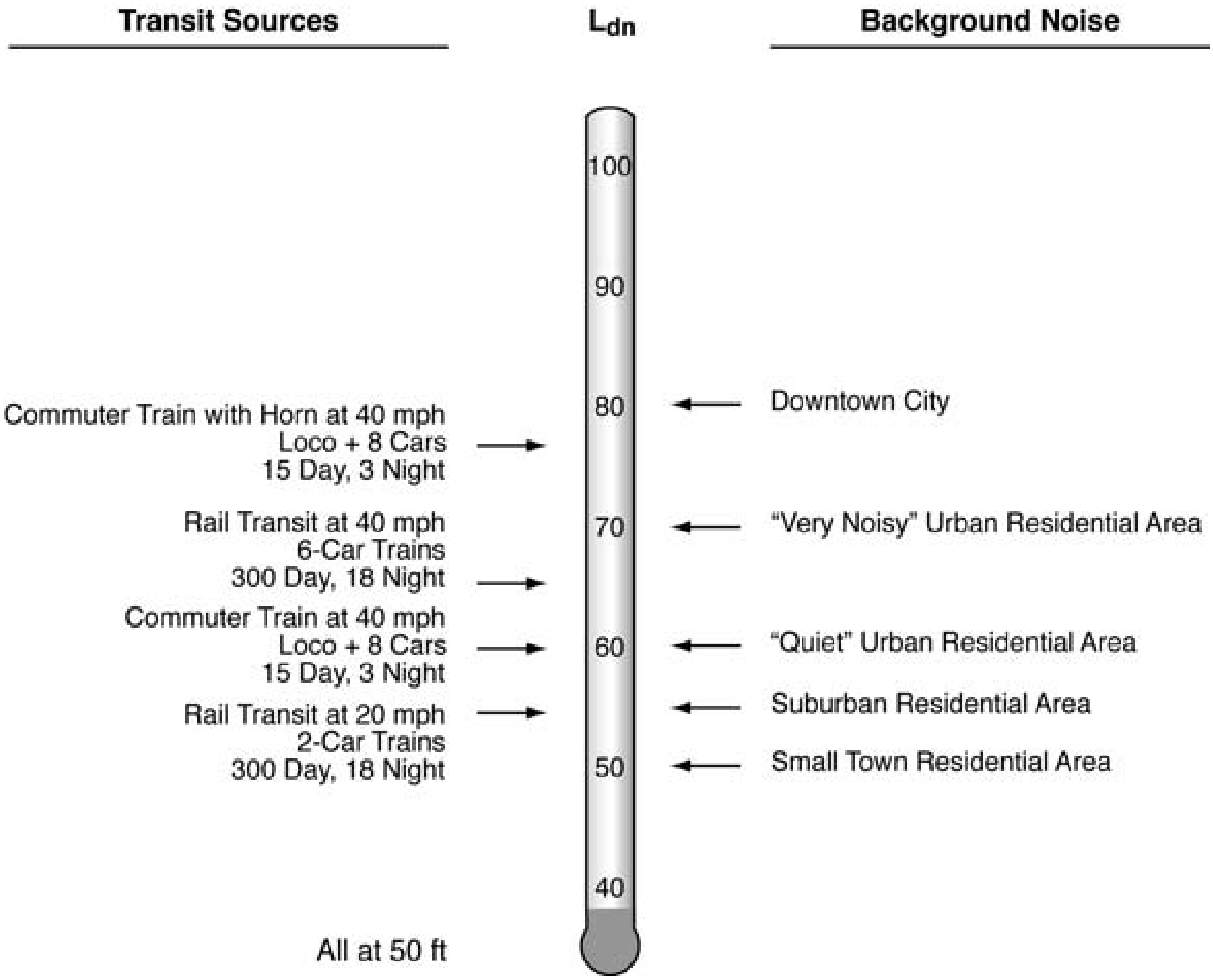
2.1 Overview of Noise

Noise is typically defined as unwanted or undesirable sound. Physically in the natural environment, sound is generated by the vibration of the air molecules. The vibrations of the air molecules result in small fluctuations in air pressure. A sound wave is created when a series of these pressure changes move through the air. Sound waves vibrate at different rates (number of times per second) or "frequencies." The faster an object vibrates, the higher the frequency of the sound wave and the resulting sound level. The basic parameters of environmental noise that affect human subjective response are: (1) intensity or level; (2) frequency content; and (3) variation with time. Intensity or level is determined by how greatly the sound pressure fluctuates above and below the atmospheric pressure, and is expressed on a logarithmic compressed scale in units of decibels (dB). By using this scale, the range of normally encountered sound can be expressed by values between 0 and 120 decibels. On a relative basis, a 3-decibel change in sound level generally represents a barely-noticeable change outside the laboratory, whereas a 10-decibel change in sound level would typically be perceived as a doubling (or halving) in the loudness of a sound.

The frequency content of noise is related to the tone or pitch of the sound, and is expressed based on the rate of the air pressure fluctuation in terms of cycles per second (called Hertz and abbreviated as Hz). The human ear can detect a wide range of frequencies from about 20 Hz to 17,000 Hz. However, because the sensitivity of human hearing varies with frequency, an octave band weighting system is commonly used when measuring environmental noise to provide a single number descriptor that correlates well with human subjective response to changes in sound. Noise levels measured using this weighting system are called "A-weighted" noise levels and are expressed in decibel notation as "dB(A)." The A-weighted noise level is widely accepted by acousticians as a best unit for describing human response to environmental noise and all federal and state impact criteria or exposure measures have been developed use the dB(A) weighting metric.

Because environmental noise fluctuates from moment to moment, it is common practice to condense all of this information into a single number, called the "equivalent" noise level (L_{eq}). L_{eq} can be thought of as the steady noise level that represents the same sound energy as the varying noise levels over a specified time period (typically 1-hour). Often the L_{eq} values over a 24-hour period are used to calculate cumulative noise exposure. One such measure is the Day-Night Sound Level (L_{dn}). The L_{dn} noise descriptor is the A-weighed L_{eq} for a 24-hour period with a 10-decibel penalty added to noise levels that occur during the nighttime hours (between 10 PM and 7 AM). The L_{dn} descriptor was developed to account for the fact that people tend to be more sensitive to sound during the typical sleeping hours. Many surveys have shown that L_{dn} is well correlated with human annoyance, and therefore this descriptor is widely used to describe how humans perceive environmental noise. Figure 1 provides examples of typical noise levels generated by various activities in terms of L_{dn}. While the extremes of L_{dn} are typically range from 50 dB(A) in a small town residential environment to 80 dB(A) in a downtown city, L_{dn} is generally found to range between 55 dB(A) and 75 dB(A) in most communities.

Figure 1. Typical Transit and Background Ldn Sound Levels



Source: Transit Noise and Vibration Impact Assessment, FTA, May 2006

2.2 Methodology

The following methodology was implemented for the noise analysis:

- Identify representative noise-sensitive properties and land uses within the study area that would potentially be adversely affected by the operation of the Preferred Alternative.
- Measure existing ambient noise levels at each representative noise-sensitive receptor location.
- Estimate project-related noise exposure levels at each receptor location and compare with the FTA impact criteria.
- Identify reasonable and feasible design refinements that would reduce project-related noise and incorporate them into the project.

2.3 FTA Criteria

The noise impact assessment was completed in accordance with procedures and analysis methodologies contained in the FTA's *Transit Noise and Vibration Impact Assessment* (FTA 2006). The initial review of the project aerial maps determined noise sensitive areas and/or receivers of interest were present within or adjacent to the proposed action.

The noise criteria and descriptors required by FTA to determine impacts depend on land use type as shown in Table 1. The FTA criteria groups noise sensitive land uses into the following three categories:

- Category 1: Tracts of land where quiet is an essential element in their intended purpose. This category includes lands set aside for serenity and quiet and such land uses as recording studios and concert halls. National historic landmarks with significant outdoor usage would also be included in this category.
- Category 2: Residences and buildings where people normally sleep. This category includes residences, hospitals, motels, and hotels where sensitivity to nighttime noise is assumed to be of utmost importance.
- Category 3: Institutional land uses with primarily daytime and evening use. This category includes schools, libraries, theaters, and churches where it is important to avoid interference with such activities as speech, meditation, and concentration on reading material, as well as other uses listed in Table 1.

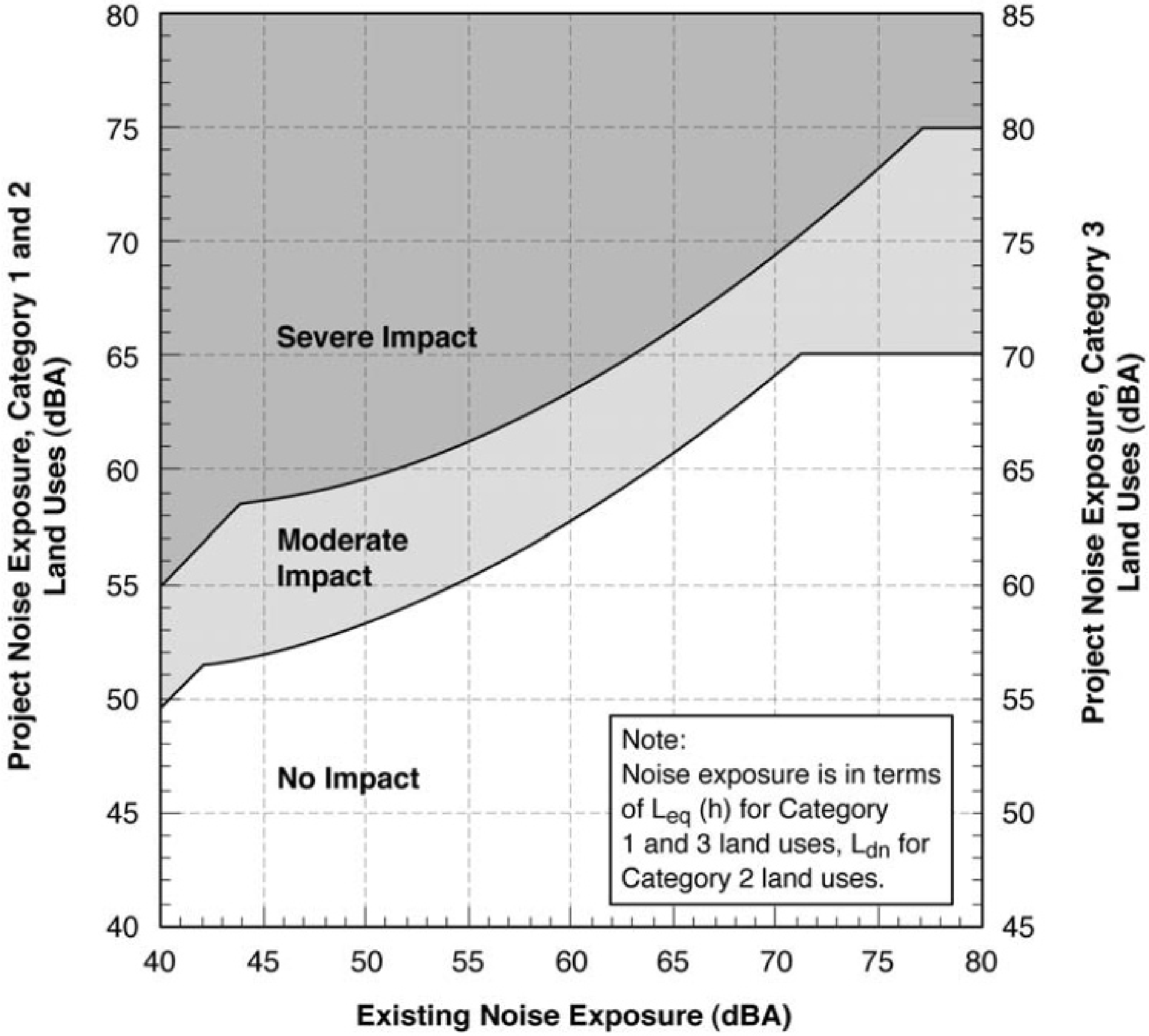
Table 1. FTA Land Use Categories and Metrics for Transit Noise Impact Criteria

Land Use Category	Noise Metric (dBA)	Description of Land Use Category
1	Outdoor $L_{eq}(h)$*	Tracts of land where quiet is an essential element in their intended purpose. This category includes lands set aside for serenity and quiet and such land uses as outdoor theater and concert pavilions.
2	Outdoor L_{dn}	Residences and buildings where people normally sleep. This category includes homes, hospitals and hotels where a nighttime sensitivity to noise is assumed to be of utmost importance.
3	Outdoor $L_{eq}(h)$*	Institutional land uses with primarily daytime and evening use. This category includes schools, libraries, and churches where it is important to avoid interference with such activities as speech, meditation and concentration on reading material. Active parks. Buildings with interior spaces where quiet is important, such as medical offices and conference rooms, recording studios and concert halls, fall into this category. Places of worship, meditation or study associated with cemeteries, monuments, museums and certain historical sites are also included.

Land use Categories 1 and 3 (primarily daytime uses) were assessed using the peak hour equivalent noise level ($L_{eq}(h)$) descriptor, while land use Category 2 (daytime and nighttime use) was assessed using the previously-described L_{dn} descriptor. Both the $L_{eq}(h)$ and L_{dn} descriptors report noise as dB(A) levels. The FTA criteria do not generally apply to industrial or commercial areas since those areas are generally not considered noise sensitive and are compatible with places consistent with high ambient noise conditions.

The FTA impact criteria compare existing measured ambient outdoor noise levels with the noise estimated to be generated solely by the transit noise sources as defined by the service operations of the Preferred Alternative. The severity of noise impact is characterized by two curves (illustrated in Figure 2) that allow for higher project noise exposure where there are higher levels of existing background noise, up to a threshold level beyond which project noise exposure would result in an impact. The left vertical axis in Figure 2 applies to FTA land use Categories 1 and 2 and the right vertical axis to Category 3. Noise levels above the top curve are considered to cause *Severe Impact* resulting in a substantial percentage of people living in the area to be highly annoyed by the new noise source. Noise levels in the range between the two curves are deemed to be *Moderate Impacts*, and levels below the bottom curve are deemed to cause *No Impact*. Table 2 shows this same information in a tabular format.

Figure 2. Noise Impact Criteria for Transit Projects



Source: Transit Noise and Vibration Impact Assessment, FTA, 2006

Table 2. Noise Levels Defining Impact for Transit Projects

Existing Noise Exposure* $L_{eq}(h)$ or L_{dn} (dBA)	Project Noise Impact Exposure,* $L_{eq}(h)$ or L_{dn} (dBA)					
	Category 1 or 2 Sites			Category 3 Sites		
	No Impact	Moderate Impact	Severe Impact	No Impact	Moderate Impact	Severe Impact
<43	< Ambient+10	Ambient + 10 to 15	>Ambient+15	<Ambient+15	Ambient + 15 to 20	>Ambient+20
43	<52	52-58	>58	<57	57-63	>63
44	<52	52-58	>58	<57	57-63	>63
45	<52	52-58	>58	<57	57-63	>63
46	<53	53-59	>59	<58	58-64	>64
47	<53	53-59	>59	<58	58-64	>64
48	<53	53-59	>59	<58	58-64	>64
49	<54	54-59	>59	<59	59-64	>64
50	<54	54-59	>59	<59	59-64	>64
51	<54	54-60	>60	<59	59-65	>65
52	<55	55-60	>60	<60	60-65	>65
53	<55	55-60	>60	<60	60-65	>65
54	<55	55-61	>61	<60	60-66	>66
55	<56	56-61	>61	<61	61-66	>66
56	<56	56-62	>62	<61	61-67	>67
57	<57	57-62	>62	<62	62-67	>67
58	<57	57-62	>62	<62	62-67	>67
59	<58	58-63	>63	<63	63-68	>68
60	<58	58-63	>63	<63	63-68	>68
61	<59	59-64	>64	<64	64-69	>69
62	<59	59-64	>64	<64	64-69	>69
63	<60	60-65	>65	<65	65-70	>70
64	<61	61-65	>65	<66	66-70	>70
65	<61	61-66	>66	<66	66-71	>71
66	<62	62-67	>67	<67	67-72	>72
67	<63	63-67	>67	<68	68-72	>72
68	<63	63-68	>68	<68	68-73	>73
69	<64	64-69	>69	<69	69-74	>74
70	<65	65-69	>69	<70	70-74	>74
71	<66	66-70	>70	<71	71-75	>75
72	<66	66-71	>71	<71	71-76	>76
73	<66	66-71	>71	<71	71-76	>76
74	<66	66-72	>72	<71	71-77	>77
75	<66	66-73	>73	<71	71-78	>78
76	<66	66-74	>74	<71	71-79	>79
77	<66	66-74	>74	<71	71-79	>79
>77	<66	66-75	>75	<71	71-80	>80

* L_{dn} is used for land use where nighttime sensitivity is a factor; L_{eq} during the hour of maximum transit noise exposure is used for land use involving only daytime activities.

Source: Transit Noise and Vibration Impact Assessment, Federal Transit Administration, May 2006

3. Affected Environment

The FTA recommends applying a screening procedure to determine if there is a likelihood of noise impact from a project. The areas defined by the screening distances are meant to be sufficiently large to encompass all potentially impacted locations, and they are determined using relatively high-capacity scenarios for a given project type. The FTA screening distance for transitways is 350 feet for sites with an unobstructed line of sight to the transit facility. For proposed yard and maintenance facilities, the screening distance is 1,000 feet. These screening distances were applied from the centerline of the proposed transit corridor to determine the study area limits for noise analysis purposes.

As depicted in Figure 3, eighty-three representative sites within this study area were chosen for noise monitoring and analysis. Within a given land use category, noise measurements recorded at one site may be representative of existing conditions and future noise exposure at that site and all other similarly located nearby sites within that FTA land use category. Therefore, some monitoring locations were selected on the basis of site equivalence where the measurement results collected at one site were applied to multiple sites. Physical and operational parameters that would produce the worst-case noise effect—such as train speed, frequency of operation, and distance to track—were accounted for in the determination of representative 24-hour noise measurement sites.

All field measurements were collected in accordance with the procedures described in FHWA's Measurement of Highway-Related Noise (Report Number FHWA-DP-96-046, May 1996). A calibrated set of Rion and Larson Davis noise measuring equipment was used in the study, including Rion NA-28 and NA-27 and Larson Davis (LD) 706 meters. The Rion equipment was used for all short-term peak hour noise readings, with the LD 706 noise meter used for collecting long-term noise measurements. All noise measurements were collected under acceptable weather and roadway conditions (rain free days with dry roadway pavements and wind speeds less than 12 mph).

The MTA requested access to residential properties throughout the corridor to monitor existing noise levels and received consent from all property owners prior to initiation of monitoring activities. Noise measurements were collected between January 2011 and June 2012. Table 3 provides a summary of the measurements collected at 13 park locations, 8 locations at the University of Maryland College Park campus, and 62 residential and institutional (e.g., schools, churches, and pools) sites.

As shown in Table 3, the calculated L_{dn} values based on measured L_{eq} noise levels at residential land uses within the study area ranged from 55 dB(A) at Receptor M-5 (single-family residences along Elm Street in Chevy Chase) to 78 dB(A) at Receptor Sites M-22 (multi-family residences along Falkland Lane in Silver Spring) and M-39 (a residential property on Erskine Road in College Park). In general, the lower L_{dn} noise levels occurred in suburban communities, while the higher noise levels typically occurred in more urban areas and adjacent to roadways with greater vehicular traffic.

Measured L_{eq} noise levels at parks within the study area ranged from 52 dB(A) at Receptor P-3 (Rock Creek Stream Valley Park) to 77 dB(A) at Receptor P-11 (Glenridge Community Park). L_{eq} noise levels measured at University of Maryland receptors within the study area ranged from 57 dB(A) at Receptor UMD-1 (Ludwig Field & Kehoe Track) to 68 dB(A) at Receptor UMD-3 (Health Center on Campus Drive). Calculated L_{dn} noise levels based on measurements taken at residential properties located within the university campus property along Rossborough Drive ranged from 66 dB(A) at Site UMD-8 (Leonardtown Housing) to 71 dB(A) at Site UMD-7 (Fraternity Housing). Measured L_{eq} noise levels at institutional receptors in the study area ranged from 52 dB(A) at Receptor M-16 (Rock Creek Pool on Grubb Road) to 74 dB(A) at Receptor M-19A (Rosemary Hills Elementary School). Based on the field measurement data, the high ambient noise conditions reported at some residential and other noise-sensitive monitoring locations reflect their close proximity to active roadways and existing freight rail corridors.

Figure 3. Representative Noise Monitoring and Assessment Locations

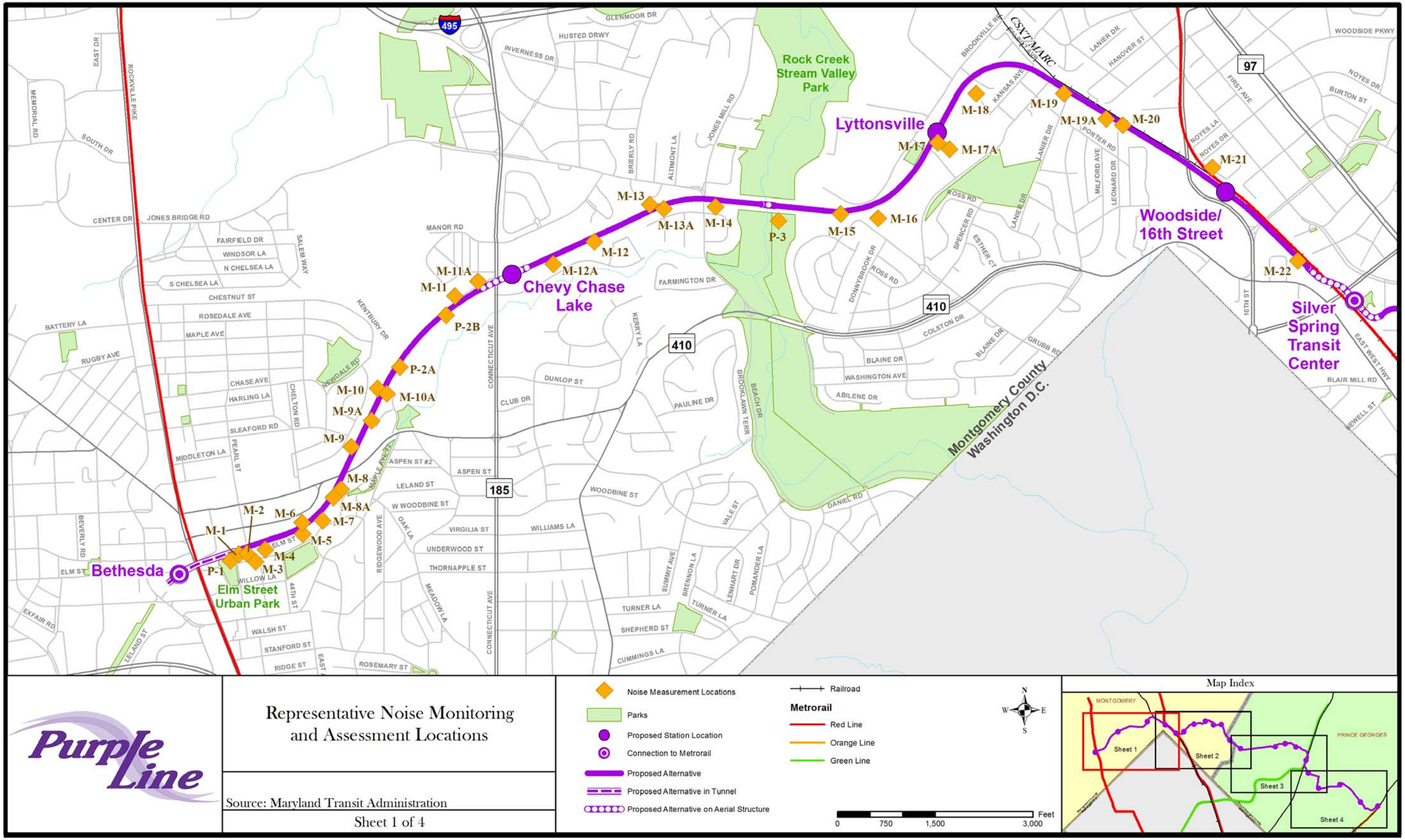


Figure 3. Representative Noise Monitoring and Assessment Locations (continued)

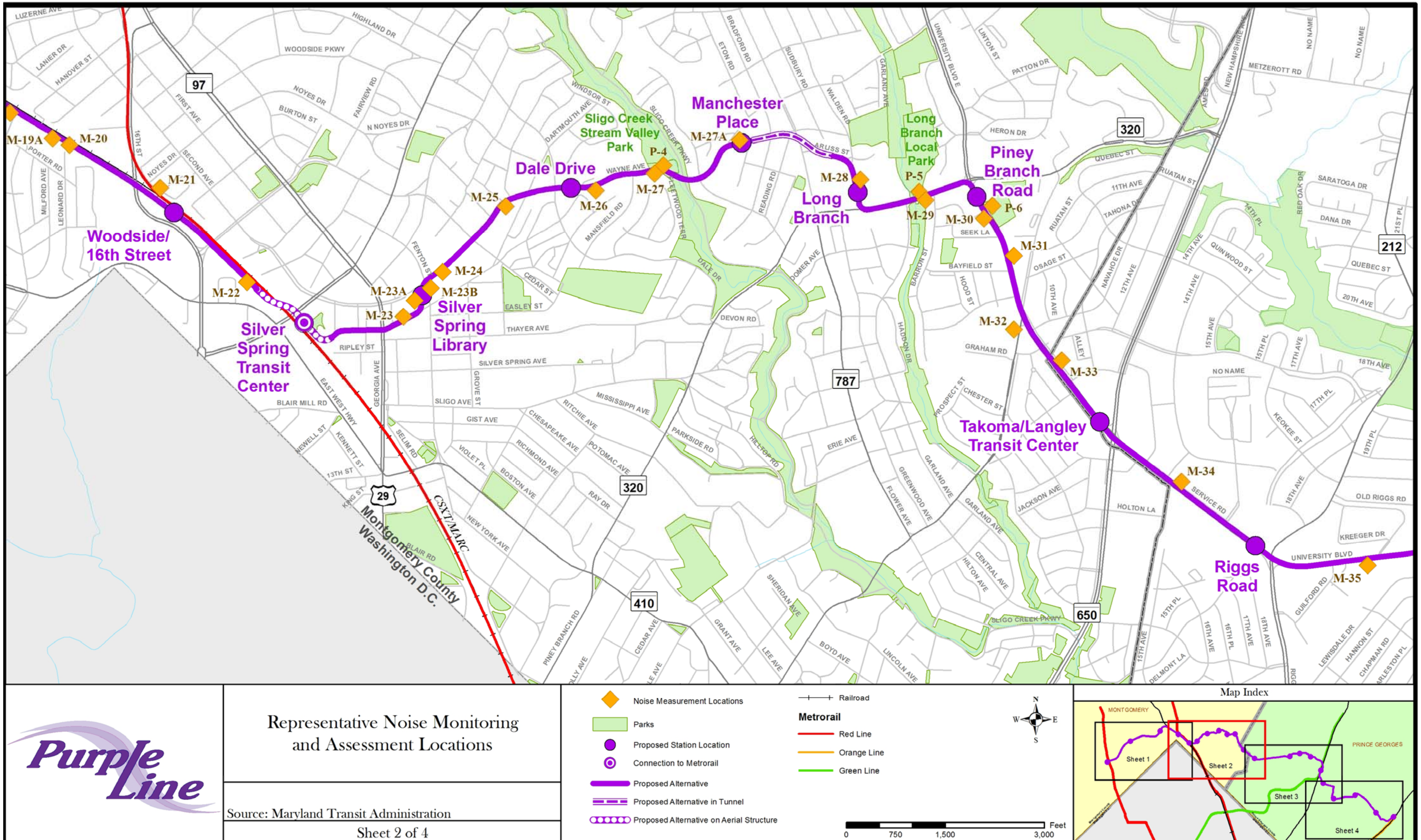


Figure 3. Representative Noise Monitoring and Assessment Locations (continued)

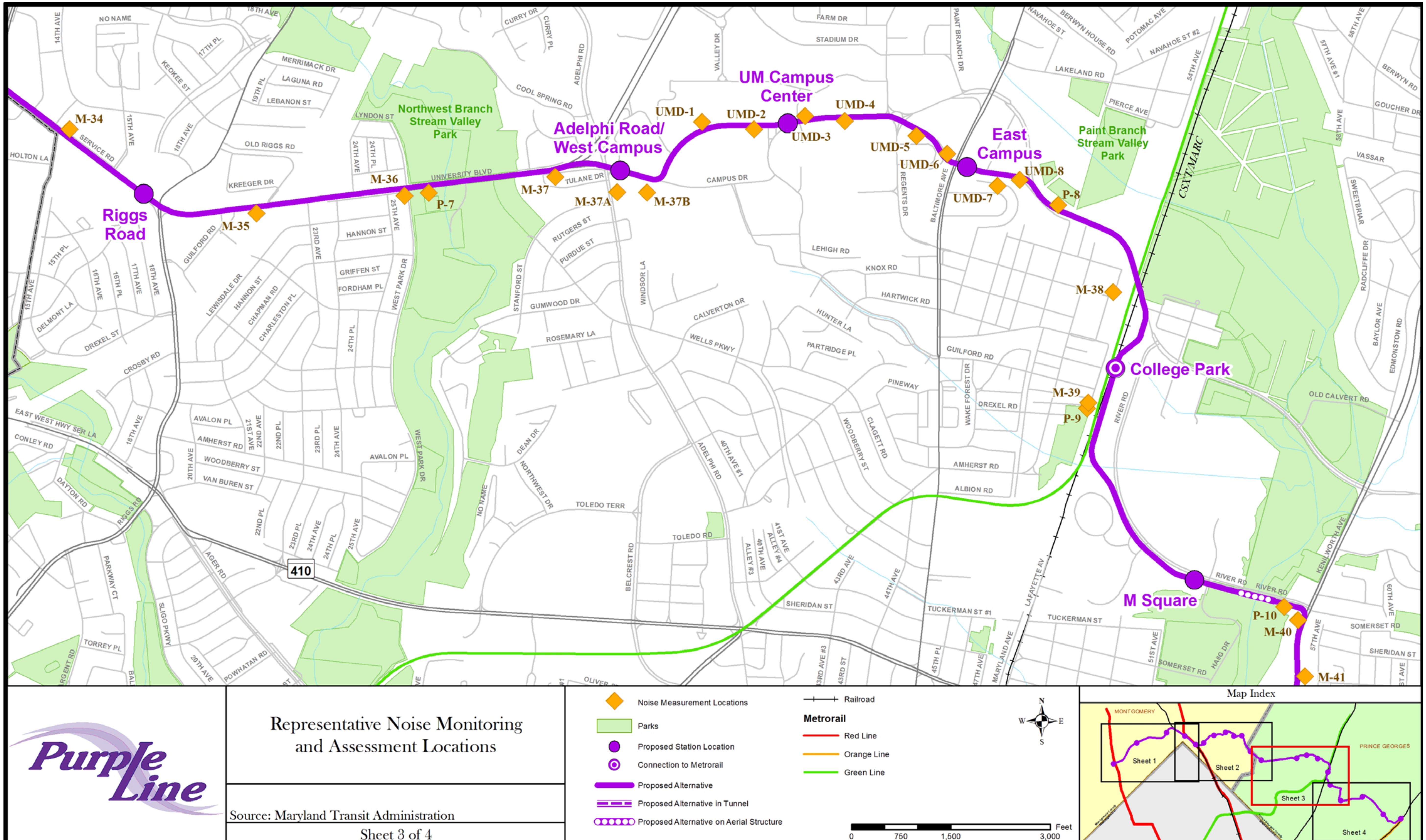


Figure 3. Representative Noise Monitoring and Assessment Locations (continued)

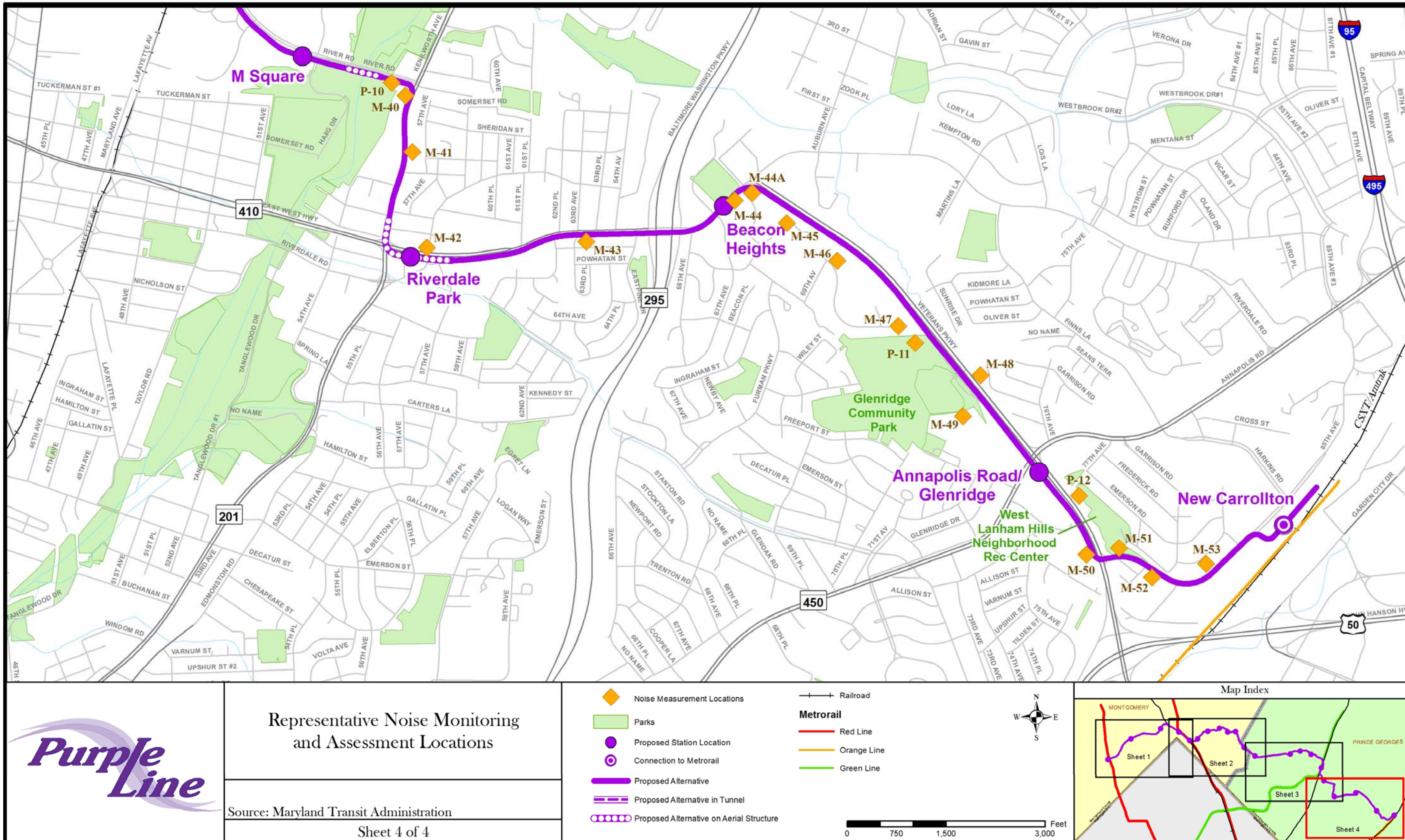


Table 3. Summary of Existing Measured Sound Levels

Site ID	Description of Measurement Location	Measurement Date	Land Use	Measured Ambient Noise Levels (dB(A))[1]
Parks				
P-1	Elm Street Park	10/4/11	Park	66 Leq
P-2A	Columbia Country Club (West)	11/1/11	Park	60 Leq
P-2B	Columbia Country Club (East)	11/1/11	Park	60 Leq
P-3	Rock Creek Park	10/4/11	Park	52 Leq
P-4	Sligo Creek Park	8/11/11	Park	69 Leq
P-5	Long Branch Trail Park	8/11/11	Park	68 Leq
P-6	New Hampshire Park	8/11/11	Park	65 Leq
P-7	Northwest Branch Stream Park	10/5/11	Park	65 Leq
P-8	Paint Branch Stream Park	2/21/12	Park	73 Leq
P-9	Calvert Park	6/26/12	Park	67 Leq
P-10	Anacostia River Stream Park	4/25/12	Park	61 Leq
P-11	Glenridge Community Park	10/5/11	Park	77 Leq
P-12	West Lanham Hills Park	10/5/11	Park	60 Leq
University of Maryland				
UMD-1	Ludwig Field & Kehoe Track	12/13/11	School	57 Leq
UMD-2	Union Drive (Benjamin Bldg)	12/13/11	School	63 Leq
UMD-3	Campus Drive (Health Center)	12/12/11	School	68 Leq
UMD-4	Campus Drive (Hornbake Library)	12/12/11	School	65 Leq
UMD-5	Mitchell Building	12/12/11	School	60 Leq
UMD-6	Turner Hall Visitor Center	12/13/11	School	59 Leq
UMD-7	Rossborough Dr. (Fraternity Housing)	1/24/11	Residential	71 Ldn
UMD-8	Rossborough Dr. (Leonardtown Housing)	1/24/11	Residential	66 Ldn
Residences and Institutions				
M-1	4509 Elm St.	3/17/11	Residential	58 Ldn
M-2	4505 Elm St.	3/17/11	Residential	57 Ldn
M-3	4502 Elm St.	3/17/11	Residential	56 Ldn
M-4	4407 Elm St.	5/3/11	Residential	57 Ldn
M-5	4305 Elm St.	3/18/11	Residential	55 Ldn
M-6	The Family Academy	4/15/12	Institutional	59 Leq
M-7	4210 Oakridge Ln.	3/18/11	Residential	56 Ldn
M-8	7602 Lynn Dr.	3/18/11	Residential	56 Ldn
M-8A	Lynn Dr.	3/18/11	Residential	56 Ldn
M-9	4302 Kentbury Dr.	2/21/11	Residential	57 Ldn
M-9A	Edgevale Ct.	2/21/11	Residential	57 Ldn
M-10	8003 Kentbury Dr.	8/4/11	Residential	65 Ldn
M-10A	Edgevale St.	8/4/11	Residential	65 Ldn
M-11	3939 Newdale Dr.	8/4/11	Residential	64 Ldn
M-11A	Newdale Dr.	8/4/11	Residential	64 Ldn
M-12	Hamlet Pl.	8/8/11	Residential	62 Ldn
M-12A	Chevy Chase Lake Dr.	8/8/11	Residential	62 Ldn
M-13	3326 Jones Bridge Ct.	8/8/11	Residential	62 Ldn
M-13A	W Coquelin Terrace	8/8/11	Residential	62 Ldn
M-14	3225 Coquelin Terrace	8/8/11	Residential	66 Ldn
M-15	Apt. on Terrace Drive	8/8/11	Residential	70 Ldn
M-16	Grubb Rd. (Rock Creek Pool)	4/5/12	Institutional	52 Leq

Table 3. Summary of Existing Measured Sound Levels (continued)

Site ID	Description of Measurement Location	Measurement Date	Land Use	Measured Ambient Noise Levels (dB(A))[1]
M-17	2481 Lyttonsville Road	4/5/12	Institutional	62 Leq
M-17A	2481 Lyttonsville Road	4/15/12	Residential	62 Ldn
M-18	810 Albert Stewart Ln.	8/8/11	Residential	66 Ldn
M-19	8906 Talbot Ave.	8/10/11	Residential	74 Ldn
M-19A	Rosemary Hills Elementary School	8/10/11	Institutional	74 Leq
M-20	Apt. on Rosemary Hills Dr.	2/21/11	Residential	72 Ldn
M-21	3rd Ave.	8/10/11	Residential	73 Ldn
M-22	North Falkland Ln.	8/10/11	Residential	78 Ldn
M-23	949 Bonifant St.	3/28/12	Institutional	62 Leq
M-24	Saint Michael Church	3/28/12	Institutional	66 Leq
M-25	Springdale Rd. and Wayne Ave.	8/10/11	Residential	71 Ldn
M-26	Bonifant St. and Wayne Ave.	8/11/11	Residential	68 Ldn
M-27	Wayne Ave.	8/11/11	Residential	70 Ldn
M-28	Arliss St.	8/11/11	Residential	65 Ldn
M-29	Piney Branch Rd.	8/11/11	Residential	71 Ldn
M-30	University Blvd.	8/11/11	Residential	69 Ldn
M-31	Bayfield St. and University Blvd.	8/16/11	Residential	76 Ldn
M-32	Takoma Park Spanish Church	3/28/11	Institutional	69 Leq
M-33	1020 University Blvd.	8/16/11	Residential	67 Ldn
M-34	14th Ave and University Blvd.	8/16/11	Residential	76 Ldn
M-35	University Blvd.	8/16/11	Residential	72 Ldn
M-36	W Park Dr.	8/16/11	Residential	70 Ldn
M-37	3400 Tulane Dr.	8/17//11	Residential	72 Ldn
M-38	Columbia Ave.	6/26/12	Residential	67 Ldn
M-39	Erskine Rd.	6/26/12	Residential	78 Ldn
M-40	First Korean Presbyterian Church	4/25/12	Institutional	61 Leq
M-41	Kenilworth Ave.	8/17//11	Residential	72 Ldn
M-42	5800 58th Ave.	8/17//11	Residential	76 Ldn
M-43	9100 63th Ave.	8/17//11	Residential	75 Ldn
M-44	Patterson St. and Riverdale Rd.	9/12/11	Residential	70 Ldn
M-44A	Patterson St.	9/12/11	Residential	70 Ldn
M-45	Patterson Dr.	2/27/11	Residential	58 Ldn
M-46	Rosalie Ln.	9/12/11	Residential	68 Ldn
M-47	6532 Rosalie Ln.	9/12/11	Residential	68 Ldn
M-48	Jefferson St.	4/25/12	Residential	64 Ldn
M-49	Glenridge Elementary School	2/27/11	Institutional	57 Leq
M-50	Chesapeake Landing Apt.	6/20/12	Residential	57 Ldn
M-51	Decatur Rd.	9/19/11	Institutional	62 Leq
M-52	Hanson Oak Dr.	9/19/11	Residential	67 Ldn
M-53	4913 78th Ave.	9/19/11	Residential	63 Ldn

[1] For parks, schools, and institutions, peak hours for monitoring were chosen to match train peak time operation; for residences, day-night noise levels were calculated based on measured hourly L_{eq} values.

4. Environmental Consequences

4.1 Long-term Operational Effects

4.1.1 Noise Sources Related to LRT Vehicle Operations

Transit Line Operating Assumptions

Project-related noise levels were estimated for each of the 83 representative sites described in Section 3. Noise level estimates were completed in accordance with the FTA calculation methodologies and procedures using the "General Assessment" guidelines described in *Transit Noise and Vibration Impact Assessment* (May 2006). The FTA noise calculation process considers distance to the transitway, type of track, train length, train speed, service frequencies (headways), and presence of at-grade crossovers (areas where the train and street traffic intersect). An onboard warning device or bell was assumed to be sounded on trains that operated in the vicinity of stations and/or certain at-grade crossings, with the assumption that the device or bell would be activated within approximately five seconds of a train approaching a station or grade crossing.

The calculations also included the prediction of noise associated with yard and maintenance facility activities, as well as train movements within, into, and out of yard and maintenance facilities. Receptors located within 1,000 feet of the Lyttonsville Yard included M-15, M-16, M-17, M-17A, and M-18; those nearest the Glenridge Maintenance Facility site are M-47, M-48, and M-49.

Changes in noise levels generated by highway vehicles were also evaluated for receptors whose distance between the roadway and receptor would be reduced by half or more, or where a buffer, such as a row of houses, would be removed. These changes occur along Piney Road (properties represented by Receptor M-29) and Riverdale Road (properties represented by Receptor M-43).

The operating characteristics were based on operational design criteria of the Preferred Alternative and are summarized below:

- Total daily operations were determined based on 6-minute headways during peak periods of the day (6 AM to 9 AM and 3:30 PM to 6:30 PM), 10-minute headways during off-peak periods (9 AM to 3:30 PM and 6:30 PM to 9 PM), and 12-minute headways during the late night and early morning periods (9 PM to 1:00 AM and 5 AM to 6 AM). This service frequency was used to predict future noise levels under the Preferred Alternative.
- The LRT operations data are summarized in Table 4 for various peak and off-peak periods of the day. This service frequency is representative of a typical weekday, which includes an operating period between 5:00 AM and 1:00 AM.
- Operating conditions assumed a two-vehicle train would be used for all periods of the day and night.
- Proposed train operating speeds were taken from projected speed profiles of the Preferred Alternative based on vehicle performance characteristics and system maximum design speed of 50 mph within the project study corridor. LRT travel speeds were modeled for both eastbound and westbound directions with speeds ranging from 10 to 50 miles per hour.
- In accordance with MTA operating practices, onboard warning devices or bells would be sounded within five seconds of the train approaching a station or grade crossing, with a maximum noise level of 78 dB(A) at 50 feet. Depending on the actual train speed, the distance within which the warning bells would be sounded ranged from 100 feet at 15 mph to 400 feet at 55 mph.
- At all grade crossings with flashers and gates, stationary crossing bells would also ring for approximately five seconds during the lowering of the gates arms. However, at grade crossings with traffic or pedestrian controls signals, no crossing bells or gates were assumed.

- In accordance with current MTA procedures, onboard warning bells would also be sounded for approximately five seconds as trains approach the station. At an average speed of approximately 30 mph, the warning bells would be sounded within a distance of 200 feet of the station.
- The LRT train would operate on a mix of track types (e.g., Ballasted, Direct Fixation, Green Track, and Embedded). Although, several case studies have shown that noise levels can be reduced after use of vegetation in Track (Green Tracks), the noise modeling did not account for any reduction due the use of the Green Tracks, which is being considered within the existing Georgetown Branch right-of-way.
- Between Bethesda and Rock Creek Stream Valley Park, the transitway design would have a four-foot high noise wall on the south side of the transitway. On the north side of the transitway, either the trail would be elevated more than four feet above the tracks or a four-foot high noise wall would be included between the Capital Crescent Trail and the adjacent community. The four-foot high noise/retaining wall would provide a 4 dB reduction of LRT vehicle-related noise levels.
- LRT vehicles would be manufactured with vehicle skirt panels to reduce the noise caused by the interaction of, and friction between, the wheels pressing down on the rails as the train travels along the transitway. This design feature was predicted to reduce the vehicle noise by 8 dB along the entire length of the project corridor. For portions of the Purple Line corridor near the four-foot high barrier/retaining walls, the combination of both measures was estimated to provide a 12 dB noise reduction.
- To provide greater operational flexibility, special track work, such as crossovers, are proposed at several locations along the Preferred Alternative. Crossovers allow trains to move between parallel tracks. Noise from crossovers comes from a small gap in the central part of the switch known as a "frog." This noise analysis incorporated the noise associated with crossovers.

Table 4. Purple Line Preferred Alternative Operating Characteristics

Time of Day	Headway (Minutes)	No. of Trips/Hour	Total Number of Trips
5 AM to 6 AM	12	5	5
6 AM to 7 AM	6	10	10
7 AM to 9 AM	6	10	20
9 AM to 3:30 PM	10	6	39
3:30 PM to 6:30 PM	6	10	30
6:30 PM to 9 PM	10	6	15
9 PM to 10 PM	12	5	5
10 PM to 1 AM	12	5	15

Operational Noise Effects

The predicted sound levels from operations with the Preferred Alternative are summarized in Table 5 for each of the representative receptor locations where ambient noise levels were measured. The predicted sound levels were compared to the existing sound levels at each location to identify sites that would result in future operational noise exposure constituting either an FTA-based moderate impact or severe impact condition. The analysis found that none of the studied representative sensitive receptors would experience project-related sound levels that would exceed the FTA Severe Impact threshold. Moderate impacts due to Purple Line operations are projected to occur at 11 residential properties comprising seven single-family residences represented by Receptors M-26, M-27A, and M-52, and four apartment buildings (containing a total of approximately 140 units) represented by sites M-23A, M-27A, M-28, and M-44. Five sites (M-23A, M-26, M-27A, M-28 and M-44) are representative of residential properties that are within 200 feet of a station. The sixth site, M-52, is located within 200 feet of a grade crossing. The noise exposure projected at all of these sites is due primarily to horn soundings which are required as the LRT approaches stations and grade crossings.

Noise exposure levels at all other receptor sites depicted in Figure 3 are projected to remain below FTA Moderate Impact threshold.

Highway noise analyses were completed in areas where the distance between the roadway and receptor would be reduced by half or more, or where a buffer, such as a row of houses, would be removed. This condition occurs at Receptors M-29 and M-43, adjacent to Piney Branch and Riverside roadways respectively. Predicted existing and future roadway design noise levels at these receptors were determined using the FHWA Traffic Noise Model® (FHWA TNM v2.5). Short-term noise measurements were recorded at these receptors, and traffic count data was collected concurrently with the noise measurements. The data was inputted into TNM, and the model's estimated noise levels were compared to measured levels. The validation results indicated that measured versus modeled noise levels were within the acceptable 3 dB(A) range at both M-29 and M-43. Using future design year 2040 traffic volumes, TNM was used to predict future noise levels at these receptors. When combining the noise levels obtained from the traffic noise analyses with levels obtained from the LTR noise analyses, as indicated in Table 5, it was found that there was no impact attributed to the widening of Piney Branch and Riverdale Roads at either receptor site M-29 or M-43.

4.1.2 Other Noise Sources

In addition to LRT vehicle operations, other noise sources associated with the Preferred Alternative include the public address (PA) system at stations, wheel squeal, and the traction power substations (TPSS). Following is a qualitative description of each noise source and related methods to reduce the noise associated with each source:

- PA systems would be installed at stations to announce LRT arrivals and departures and provide other information to patrons.
- Wheel squeal can occur when steel-wheel LRT vehicles traverse tight radius curves. It is very difficult to predict when and where wheel squeal would occur. Generally, the potential for wheel squeal exists when the radius of track curvature is less than 600 feet. Within the Purple Line corridor, 20 tight radius (< 600 feet) curve locations occur along the transitway alignment.
- The Preferred Alternative includes TPSS, installed at approximately one-mile intervals, to provide electrical power for light rail vehicles. The primary noise from the TPSS is the transformer hum.

With proper design and implementation of mitigation measures described below, these other noise sources would not cause additional noise impacts.

4.1.3 Avoidance and Minimization

As noted above, it is assumed that the LRT vehicles would be designed to include vehicle skirt panels to reduce the noise caused by LRT operations, and a combination of noise walls and retaining walls would be incorporated between Bethesda and Rock Creek Stream Valley Park to reduce operational noise for the adjacent communities.

MTA will minimize the noise from the Preferred Alternative operations as follows:

- The PA systems will have volume adjustment controls designed to maintain announcement volume at the specified noise levels, as appropriate. With proper use, short-term noise from the PA system announcements is not expected to be a noise annoyance to residential communities adjacent to stations.
- The TPSS will be designed in accordance with the MTA design criteria, which are intended to minimize the noise from the transformer hum.

Table 5. Noise Analysis Summary

Receptor		Land Use		Track Type	Cross-overs	Warning Device	Distance to Tracks Centerline (feet)	Maximum Speed (mph)	Existing Noise (dB(A))	Project-related Noise (dB(A))	FTA Criteria		FTA Impact?
ID	Description	Type[1]	FTA								Moderate	Severe	
P-1	Elm St. Park	Park	3	Green	Yes	No	240	37/45	66 Leq	37	67	73	No
P-2A	Columbia Country Club (West)	Park	3	Green	No	No	42	45	60 Leq	49	63	69	No
P-2B	Columbia Country Club (East)	Park	3	Green	No	No	30	45	60 Leq	51	63	69	No
P-3	Rock Creek Park	Park	3	Green	Yes	No	233	45	52 Leq	38	60	66	No
P-4	Sligo Creek Park	Park	3	Embedded	No	No	52	10	69 Leq	42	69	75	No
P-5	Long Branch Trail Park	Park	3	Embedded	No	No	64	30	68 Leq	50	68	74	No
P-6	New Hampshire Park	Park	3	Ballasted	No	Yes	127	15	65 Leq	56	66	72	No
P-7	Northwest Branch Stream Park	Park	3	Ballasted	No	No	105	35	65 Leq	45	66	72	No
P-8	Paint Branch Stream Park	Park	3	Embedded	No	No	58	21/17	74 Leq	47	71	78	No
P-9	Calvert Park	Park	3	Ballasted	Yes	No	260	37	67 Leq	40	68	73	No
P-10	Anacostia River Stream Park	Park	3	Ballasted	No	Yes	57	57	61 Leq	61	64	70	No
P-11	Glenridge Community Park	Park	3	Ballasted	No	No	285	45	64 Leq	41	66	71	No
P-12	West Lanham Hills Park	Park	3	Ballasted	No	No	238	40/32	60 Leq	40	63	69	No
UMD-1	Ludwig Field & Kehoe Track	SCH	3	Embedded	No	No	100	10	57 Leq	38	62	68	No
UMD-2	Union Drive (Benjamin Bldg)	SCH	3	Embedded	No	No	53	10	63 Leq	42	65	71	No
UMD-3	Campus Drive (Health Center)	SCH	3	Embedded	No	Yes	43	10	68 Leq	63	68	74	No
UMD-4	Campus Drive (Hornbake Library)	SCH	3	Embedded	No	No	50	10	65 Leq	42	66	72	No
UMD-5	Mitchell Building	SCH	3	Embedded	Yes	No	25	15	60 Leq	53	63	69	No
UMD-6	Turner Hall Visitor Center	SCH	3	Embedded	No	No	95	15	59 Leq	41	63	69	No
UMD-7	Rossborough Dr. (Fraternity Housing)	RES	2	Embedded	No	Yes	185	15	71 Ldn	61	66	71	No
UMD-8	Rossborough Dr. (Leonardtown Housing)	RES	2	Embedded	No	No	65	17/21	66 Ldn	50	62	68	No

Table 5. Noise Analysis Summary (continued)

Receptor		Land Use		Track Type	Cross-overs	Warning Device	Distance to Tracks Centerline (feet)	Maximum Speed (mph)	Existing Noise (dB(A))	Project-related Noise (dB(A))	FTA Criteria		FTA Impact?
*ID	Description	Type[1]	FTA								Moderate	Severe	
M-1	4509 Elm St.	RES	2	Green	Yes	No	72	37/45	58 Ldn	49	57	63	No
M-2	4505 Elm St.	RES	2	Green	Yes	No	104	40/45	57 Ldn	47	57	63	No
M-3	4502 Elm St.	RES	2	Green	No	No	263	45	56 Ldn	41	56	63	No
M-4	4407 Elm St.	RES	2	Green	No	No	138	45	57 Ldn	45	57	63	No
M-5	4305 Elm St.	RES	2	Green	No	No	115	45	55 Ldn	46	56	62	No
M-6	The Family Academy	SCH	3	Green	No	No	44	45	59 Leq	53	63	69	No
M-7	4210 Oakridge Ln.	RES	2	Green	No	No	130	45	56 Ldn	46	56	63	No
M-8	7602 Lynn Dr.	RES	2	Green	No	No	66	45	56 Ldn	50	56	63	No
M-8A	Lynn Dr.	RES	2	Green	No	No	40	45	56 Ldn	53	56	63	No
M-9	4302 Kentbury Dr.	RES	2	Green	No	No	62	45	57 Ldn	50	57	63	No
M-9A	Edgevale Ct.	RES	2	Green	No	No	40	45	57 Ldn	53	57	63	No
M-10	8003 Kentbury Dr.	RES	2	Green	No	No	94	45	65 Ldn	48	61	67	No
M-10A	Edgevale St.	RES	2	Green	No	No	74	45	65 Ldn	49	61	67	No
M-11	3939 Newdale Dr.	RES	2	Green	No	No	117	45	64 Ldn	50	61	66	No
M-11A	Newdale Dr.	RES	2	Direct Fixation	No	Yes	120	43/35	64 Ldn	59	61	66	No
M-12	Hamlet Pl.	RES	2	Green	No	No	70	50	62 Ldn	51	59	65	No
M-12A	Chevy Chase Lake Dr.	RES	2	Green	No	No	120	35/45	62 Ldn	57	59	65	No
M-13	3326 Jones Bridge Ct.	RES	2	Green	No	No	81	45	62 Ldn	49	59	65	No
M-13A	W Coquelin Terrace	RES	2	Green	No	No	63	45	62 Ldn	50	59	65	No
M-14	3225 Coquelin Terrace	RES	2	Green	No	No	113	45	66 Ldn	47	62	68	No
M-15[2]	Apt. on Terrace Drive	RES	2	Green	No	No	48	50	70 Ldn	58	65	70	No
M-16[2]	Grubb Rd. (Rock Creek Pool)	INS	3	Green	No	No	160	45	52 Leq	50	60	66	No
M-17[2]	2481 Lyttonsville Road	INS	3	Ballasted	No	No	85	20/15	62 Leq	61	64	70	No

Table 5. Noise Analysis Summary (continued)

Receptor		Land Use									FTA Criteria		
ID	Description	Type[1]	FTA	Track Type	Cross-overs	Warning Device	Distance to Tracks Centerline (feet)	Maximum Speed (mph)	Existing Noise (dB(A))	Project-related Noise (dB(A))	Moderate	Severe	FTA Impact?
M-17A[2]	2481 Lyttonsville Road	RES	2	Ballasted	No	No	290	20/15	62 Ldn	56	59	65	No
M-18[2]	810 Albert Stewart Ln.	RES	2	Embedded	No	Yes	228	35	66 Ldn	57	62	68	No
M-19	8906 Talbot Ave.	RES	2	Ballasted	No	No	81	37/45	74 Ldn	52	66	73	No
M-19A	Rosemary Hills Elementary School	SCH	3	Ballasted	No	No	69	45	74 Leq	50	71	78	No
M-20	Apt. on Rosemary Hills Dr.	RES	2	Ballasted	No	No	20	45	72 Ldn	62	66	72	No
M-21	3rd Ave.	RES	2	Direct Fixation	No	Yes	168	20	73 Ldn	60	66	72	No
M-22	North Falkland Ln.	RES	2	Ballasted	No	No	45	45	78 Ldn	57	66	76	No
M-22A	Silver Spring Transit Center	RES	2	Ballasted	No	Yes	100	45	78 Ldn	59	66	76	No
M-23	949 Bonifant St.	INS	3	Embedded	No	No	50	10	62 Leq	42	64	70	No
M-23A	Apartment Bldg. on Wayne Ave.	RES	2	Embedded	No	Yes	140	10	67 Ldn	64	63	68	Yes
M-23B	First Baptist Church	CHC	3	Embedded	No	Yes	130	10	66 Leq	58	67	71	No
M-24	Saint Michael Church	CHC	3	Embedded	No	No	70	20	66 Leq	47	67	73	No
M-25	Springdale Rd. and Wayne Ave.	RES	2	Embedded	No	No	45	10	71 Ldn	43	66	71	No
M-26	Bonifant St. and Wayne Ave.	RES	2	Embedded	No	Yes	93	10	68 Ldn	65	63	69	Yes
M-27	Wayne Ave.	RES	2	Embedded	No	No	62	10	70 Ldn	44	65	70	No
M-27A	Manchester Place	RES	2	Embedded	Yes	Yes	42	10	70 Ldn	69	65	70	Yes
M-28	Arliss St.	RES	2	Embedded	No	Yes	60	20/10	65 Ldn	65	61	67	Yes
M-29	Piney Branch Rd.	RES	2	Embedded	No	No	63	30	71 Ldn	64	66	71	No
M-30	University Blvd.	RES	2	Ballasted	No	Yes	95	15	69 Ldn	63	64	70	No
M-31	Bayfield St. and University Blvd.	RES	2	Ballasted	Yes	No	88	35	76 Ldn	50	66	75	No
M-32	Takoma Park Spanish Church	CHC	3	Ballasted	No	No	230	35	69 Leq	40	69	75	No
M-33	1020 University Blvd.	RES	2	Ballasted	No	No	97	35	67 Ldn	49	63	68	No
M-34	14th Ave and University Blvd.	RES	2	Ballasted	Yes	No	95	35	76 Ldn	50	66	75	No

Table 5. Noise Analysis Summary (continued)

Receptor		Land Use		Track Type	Cross-overs	Warning Device	Distance to Tracks Centerline (feet)	Maximum Speed (mph)	Existing Noise (dB(A))	Project-related Noise (dB(A))	FTA Criteria		FTA Impact?
ID	Description	Type	FTA								Moderate	Severe	
M-35	University Blvd.	RES	2	Ballasted	No	No	104	35	72 Ldn	49	66	72	No
M-36	W Park Dr.	RES	2	Ballasted	No	No	105	35	70 Ldn	49	65	70	No
M-37	3400 Tulane Dr.	RES	2	Ballasted	No	No	113	20/30	72 Ldn	45	66	72	No
M-37A	Apartment Bldg. on Adelphi	RES	2	Ballasted	Yes	Yes	375	20	62 Ldn	56	59	65	No
M-37B	University Baptist Church	CHC	3	Ballasted	Yes	Yes	200	20	60 Leq	53	63	69	No
M-38	Columbia Ave.	RES	2	Embedded	No	No	408	21/17	67 Ldn	38	63	68	No
M-39	Erskine Rd.	RES	2	Ballasted	Yes	No	260	37	78 Ldn	44	66	76	No
M-40	First Korean Presbyterian Church	CHC	3	Ballasted	No	Yes	57	10	61 Leq	61	64	70	No
M-41	Kenilworth Ave.	RES	2	Ballasted	Yes	No	110	30	72 Ldn	48	66	72	No
M-42	5800 58th Ave.	RES	2	Ballasted	No	Yes	162	21/33	76 Ldn	60	66	75	No
M-43	9100 63th Ave.	RES	2	Ballasted	No	Yes	100	35	75 Ldn	63	66	74	No
M-44	Patterson St. and Riverdale Rd.	RES	2	Ballasted	No	Yes	61	10/21	70 Ldn	65	65	70	Yes
M-44A	Patterson St.	RES	2	Ballasted	No	No	85	25	70 Ldn	47	65	70	No
M-45	Patterson Dr.	RES	2	Ballasted	No	No	218	35/45	58 Ldn	45	57	63	No
M-46	Rosalie Ln.	RES	2	Ballasted	No	No	253	45	68 Ldn	45	63	69	No
M-47[2]	6532 Rosalie Ln.	RES	2	Ballasted	Yes	No	285	45	68 Ldn	49	63	69	No
M-48[2]	Jefferson St.	RES	2	Ballasted	No	Yes	220	35/40	64 Ldn	58	61	66	No
M-49[2]	Glenridge Elementary School	SCH	3	Ballasted	Yes	Yes	380	37/45	57 Leq	53	62	68	No
M-50	Chesapeake Landing Apt.	RES	2	Ballasted	No	No	61	27/10	57 Ldn	48	57	63	No
M-51	Decatur Rd.	INS	3	Ballasted	No	No	173	25	62 Leq	43	64	70	No
M-52	Hanson Oak Dr.	RES	2	Ballasted	No	Yes	70	25	67 Ldn	63	63	68	Yes
M-53	4913 78th Ave.	RES	2	Ballasted	No	Yes	228	25	63 Ldn	58	60	66	No

4.1.4 Mitigation

MTA's analysis found that the further minimization and mitigation of operational noise at impacted sites is not reasonable. Much of the noise impact is derived from use of transit warning horns at stations and crossings, and eliminating the transit horn is not possible due to safety concerns. Another common noise-reduction measure – the construction of noise walls – is not feasible for this project because these barriers would block driveway access and pedestrian walkways, as well as introducing visual impacts. Therefore, these additional measures are not proposed.

4.2 Short-term Construction Effects

4.2.1 Construction Methods

Constructing the Purple Line would involve a wide range of activities, including clearing the rail right-of-way, tunnel construction, constructing grade crossings, bridge construction, yard and maintenance facility construction, laying track, and constructing stations and other system elements.

Stations, shafts, cut-and-cover tunnels, and portals require very similar construction techniques. Excavation associated with the cut-and-cover construction would result in noise generated by backhoes, bulldozers, cranes, concrete mixers, concrete delivery trucks, dump trucks, delivery trucks, front-end loaders, pile drivers, and jackhammers. A general discussion of noise associated with the major construction operations for new tunnel construction, cut-and-cover construction, and work at various yards is presented below.

Airborne noise from tunneling activity, including noise generated from tunnel boring machines, is not anticipated to be discernible in outdoor areas, as most noise would be contained underground and would be masked by existing ambient noise. However, noise impacts are anticipated during hauling of excavated materials from the muck shafts and the shipping of liner segments, concrete, and other materials to the shafts.

Noise at construction sites is generated by both mobile and stationary sources. Mobile equipment such as dozers, scrapers, and graders may operate in a cyclic fashion in which a period of full power is followed by a period of reduced power. Mobile equipment such as delivery trucks may produce steady noise and are generally associated with supply of materials to the construction sites and disposal of waste materials from construction sites. Stationary equipment consists primarily of non-mobile equipment that generates noise from one general area and includes items such as pumps, generators, and compressors. These types of equipment typically operate at a constant noise level under normal operation and are classified as non-impact equipment. Other types of stationary equipment such as pile drivers, jackhammers, pavement breakers, and blasting operations produce variable, sporadic noise and impact-type noises.

4.2.2 Potential Impacts

Noise levels during construction are difficult to predict, and they vary depending on the type and duration of construction activity and the number and type of equipment used during each stage of work. Specifically, the location of sensitive receptors in relation to the construction activity and the duration of construction activities affect the potential for noise impact. Track-related construction would move continuously along the corridor; therefore, the duration of exposure to construction-related noise at any one property would be limited.

Some specialized construction work does have a greater potential to create noise impacts. This includes the following types of work:

- Tunneling operations (Plymouth Street tunnel)
- Pile driving
- Heavy equipment use (Silver Spring Transit Center and associated structures, and sections along the transitway with extensive bridge and retaining wall work).

However, the noise impacts for these activities would be realized only for sensitive receptors in close proximity to these specific locations and not along the entire length of the transitway.

4.2.3 Avoidance and Minimization

As part of the Purple Line contract specification documents, MTA would establish performance standards for construction equipment to reduce noise associated with the construction activities. MTA is committed to abiding by local noise ordinances, whenever feasible and reasonable, in accordance with its own performance standards, which will include, but not necessarily be limited to, the following:

- Conduct construction activities during the daytime whenever possible.
- Conduct truck loading, unloading, and hauling operations in a manner that minimizes noise.
- Route construction equipment and other vehicles carrying spoil, concrete, or other materials over routes that would cause the least disturbance to residents in the vicinity of the activity.
- Locate site stationary equipment away from residential areas to the extent reasonably feasible within the site/staging area.
- Employ the best available control technologies to limit excessive noise when working near residences
- Adequately notify the public in advance of construction operations and schedules including methods such as construction-alert publications and a Noise Complaint Hotline to handle complaints quickly.

5. References

Federal Transit Administration (FTA). T*ransit Noise and Vibration Impact Assessment*. U.S. Department of Transportation Report No. FTA-VA-90-1003-06, May 2006.

Federal Highway Administration (FHWA) *Measurement of Highway-Related Noise,* Report Number FHWA-DP-96-046, May 1996

APPENDIX A – List of Acronyms and Abbreviations

APPENDIX A

List of Acronyms and Abbreviations

CLRP	Constrained Long Range Plan
dB(A)	A-Weighted Noise Level
DC	Washington, DC
FTA	Federal Transit Administration
LD	Larson Davis
L_{dn}	Day-night Noise Level
L_{eq}	Equivalent Noise Level
LRT	Light Rail Transit
MARC	Maryland Area Regional Commuter
mph	Miles per hour
MPO	Metropolitan Planning Organization
MTA	Maryland Transit Administration
MWCOG	Metropolitan Washington Council of Governments
NEPA	National Environmental Policy Act
UMD	University of Maryland

APPENDIX B – Glossary/Terminology

APPENDIX B

Glossary/Terminology

A-weighting: A standardized filter used to alter the sensitivity of a sound level meter with respect to frequency so that the instrument is less sensitive at low and high frequencies where the human ear is less sensitive. Also written as dB(A).

Ambient: The pre-project background noise or vibration level.

Alignment: The horizontal location of a railroad or transit system as described by curved and tangent track.

At-grade: a junction at which two or more transport axes cross at the same level (or grade).

Consist: The total number and type of cars, locomotives, or transit vehicles in a train set.

Criteria: Plural form of "criterion," the relationship between a measure of exposure (e.g., noise or vibration level) and its corresponding effect.

Crossover: Two turnouts with the track between the frogs arranged to form a continuous passage between two nearby and generally parallel tracks.

Cumulative: The summation of individual noises into a single total value related to the effect over time.

Decibel: The standard unit of measurement for sound pressure level and vibration level. Technically, a decibel is the unit of level which denotes the ratio between two quantities that are proportional to power; the number of decibels is 10 times the logarithm of this ratio. Also written as dB.

Descriptor: A quantitative metric used to identify a specific measure of noise level.

Equivalent Level: The level of a steady noise which, in a stated time period and at a stated location, has the same sound energy as the time-varying noise. Also written as L_{eq}.

Frequency: The number of times that a periodically occurring quantity repeats itself in a specified period. With reference to noise and vibration signals, the number of cycles per second.

Grade crossing: The point where a rail line and a motor vehicle road intersect.

Hourly Equivalent Noise Level: The time-averaged A-weighted equivalent noise level, over a 1-hour period, usually calculated between integral hours. Also written as L_{eq}(h).

Light Rail Transit (LRT): A mode of public transit with tracked vehicles in multiple units operating in mixed traffic conditions on streets as well as sections of exclusive right-of-way. Vehicles are generally powered by electricity from overhead lines.

Noise: Any disagreeable or undesired sound or other audible disturbance.

Preferred Alternative: The build alternative that is studied in detail in the FEIS (this alternative is a modified/refined/updated version of the Locally Preferred Alternative).

Receiver/Receptor: A stationary far-field position at which noise or vibration levels are specified.

Sound: A physical disturbance in a medium that is capable of being detected by the human ear.

Transit center: a sheltered waiting area where multiple mass transportation routes converge; there are two on the alignment, the Silver Spring Transit Center and the Takoma/Langley Transit Center

Wheel Squeal: The noise produced by wheel-rail interaction, particularly on a curve where the radius of curvature is smaller than allowed by the separation of the axles in a wheel set.

APPENDIX C – Calibration Certificates

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.22903

Instrument:	**Noise Dosimeter / SLM**	*Date Calibrated:* **11/29/2010** *Cal Due:*		
Model:	**Spark 706**	*Status:*	**Received**	**Sent**
Manufacturer:	**Larson Davis**	*In tolerance:*	X	X
Serial number:	**01596**	*Out of tolerance:*		
Tested with:	**Microphone MRP002 s/n B0404**	*See comments:*		
		Contains non-accredited tests: __Yes X No		
Type (class):	**2**	*Calibration service:* __ Basic X Standard		
Customer:	**Environmental Acoustics, Inc.**	*Address:* **1400 Hummel Avenue**		
Tel/Fax:	**717-737-4751 / 717-737-4754**	**Lemoyne, PA 17043**		

Tested in accordance with the following procedures and standards:
Calibration of Sound Level Meters, Scantek Inc., 06/07/2005
SLM & Dosimeters – Acoustical Tests, Scantek Inc., 06/15/2005

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

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	25747	Dec 24, 2009	Scantek, Inc./ NVLAP	Dec 24, 2010
DS-360-SRS	Function Generator	61646	Nov 13, 2009	ACR Env. / A2LA	Nov 13, 2011
HM30-Thommen	Meteo Station	1040170	Jun 26, 2010	ACR Env. / A2LA	Dec 26, 2011
HMP233-Vaisala Oyj	Humidity & Temp. Transmitter	V3820001	Nov 25, 2009	ACR Env. / A2LA	May 25, 2011
PC Program 1019 Norsonic	Calibration software	v.5.0	Validated July 2009	-	-
1253-Norsonic	Calibrator	25726	Dec 7, 2009	Scantek, Inc./ NVLAP	Dec 7, 2010
4226-Brüel&Kjær	Multifunction calibrator	2305103	Apr 13, 2010	Scantek, Inc./ NVLAP	Apr 13, 2011

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

Environmental conditions:

Temperature (°C)	Barometric Pressure (kPa)	Relative Humidity (%)
23.6 °C	101.88 kPa	30.9 %RH

Calibrated by	Valentin Buzduga	**Checked by**	Mariana Buzduga
Signature		Signature	
Date	11/29/2010	Date	11/29/2010

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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.22901

Instrument:	**Noise Dosimeter / SLM**	*Date Calibrated:* **11/29/2010** *Cal Due:*		
Model:	**Spark 706**	*Status:*	**Received**	**Sent**
Manufacturer:	**Larson Davis**	*In tolerance:*	X	X
Serial number:	**01365**	*Out of tolerance:*		
Tested with:	**Microphone MPR002 s/n B0556**	*See comments:*		

Contains non-accredited tests: __Yes _X_ No
Calibration service: __ Basic _X_ Standard

Type (class): **2**

Customer: **Environmental Acoustics, Inc.**
Tel/Fax: **717-737-4751 / 717-737-4754**
Address: **1400 Hummel Avenue, Lemoyne, PA 17043**

Tested in accordance with the following procedures and standards:
Calibration of Sound Level Meters, Scantek Inc., 06/07/2005
SLM & Dosimeters – Acoustical Tests, Scantek Inc., 06/15/2005

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

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	25747	Dec 24, 2009	Scantek, Inc./ NVLAP	Dec 24, 2010
DS-360-SRS	Function Generator	61646	Nov 13, 2009	ACR Env. / A2LA	Nov 13, 2011
HM30-Thommen	Meteo Station	1040170	Jun 26, 2010	ACR Env. / A2LA	Dec 26, 2011
HMP233-Vaisala Oyj	Humidity & Temp. Transmitter	V3820001	Nov 25, 2009	ACR Env. / A2LA	May 25, 2011
PC Program 1019 Norsonic	Calibration software	v.5.0	Validated July 2009	-	-
1253-Norsonic	Calibrator	25726	Dec 7, 2009	Scantek, Inc./ NVLAP	Dec 7, 2010
4226-Brüel&Kjær	Multifunction calibrator	2305103	Apr 13, 2010	Scantek, Inc./ NVLAP	Apr 13, 2011

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

Environmental conditions:

Temperature (°C)	Barometric Pressure (kPa)	Relative Humidity (%)
24.2 °C	101.71 kPa	30.2 %RH

Calibrated by	Valentin Buzduga	**Checked by**	Mariana Buzduga
Signature		Signature	
Date	11/29/2010	Date	11/29/2010

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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.22902

Instrument:	**Noise Dosimeter / SLM**	*Date Calibrated:* **11/29/2010** *Cal Due:*		
Model:	**Spark 706**	*Status:*	**Received**	**Sent**
Manufacturer:	**Larson Davis**	*In tolerance:*	X	X
Serial number:	**01595**	*Out of tolerance:*		
Tested with:	**Microphone MRP002 s/n B0565**	*See comments:*		

Contains non-accredited tests: __Yes **X** No
Type (class): **2** *Calibration service:* __ Basic **X** Standard

Customer: **Environmental Acoustics, Inc.**
Tel/Fax: **717-737-4751 / 717-737-4754**
Address: **1400 Hummel Avenue Lemoyne, PA 17043**

Tested in accordance with the following procedures and standards:
Calibration of Sound Level Meters, Scantek Inc., 06/07/2005
SLM & Dosimeters – Acoustical Tests, Scantek Inc., 06/15/2005

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

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	25747	Dec 24, 2009	Scantek, Inc./ NVLAP	Dec 24, 2010
DS-360-SRS	Function Generator	61646	Nov 13, 2009	ACR Env. / A2LA	Nov 13, 2011
HM30-Thommen	Meteo Station	1040170	Jun 26, 2010	ACR Env. / A2LA	Dec 26, 2011
HMP233-Vaisala Oyj	Humidity & Temp. Transmitter	V3820001	Nov 25, 2009	ACR Env. / A2LA	May 25, 2011
PC Program 1019 Norsonic	Calibration software	v.5.0	Validated July 2009	-	-
1253-Norsonic	Calibrator	25726	Dec 7, 2009	Scantek, Inc./ NVLAP	Dec 7, 2010
4226-Brüel&Kjær	Multifunction calibrator	2305103	Apr 13, 2010	Scantek, Inc./ NVLAP	Apr 13, 2011

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

Environmental conditions:

Temperature (°C)	Barometric Pressure (kPa)	Relative Humidity (%)
24.1 °C	101.76 kPa	31.2 %RH

Calibrated by	Valentin Buzduga	**Checked by**	Mariana Buzduga
Signature		Signature	
Date	11/29/2010	Date	11/29/2010

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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.22904

Instrument:	**Acoustical Calibrator**	*Date Calibrated:* **11/29/2010**	*Cal Due:*	
Model:	**Cal150**	*Status:*	**Received**	**Sent**
Manufacturer:	**Larson Davis**	*In tolerance:*	X	X
Serial number:	**3047**	*Out of tolerance:*		
Class (IEC 60942):	**2**	*See comments:*		
Barometer type:		*Contains non-accredited tests:* __Yes _X_ No		
Barometer s/n:				

Customer: **Environmental Acoustics, Inc.**
Tel/Fax: **717-737-4751 / 717-737-4754**
Address: **1400 Hummel Avenue, Lemoyne, PA 17043**

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 6, 2010	Scantek, Inc./ NVLAP	Jul 6, 2011
DS-360-SRS	Function Generator	88077	Aug 17, 2010	ACR Env./ A2LA	Aug 17, 2012
34401A-Agilent Technologies	Digital Voltmeter	MY47011118	Aug 17, 2010	ACR Env./ A2LA	Aug 17, 2011
HM30-Thommen	Meteo Station	1040170/39633	Jun 26, 2010	ACR Env./ A2LA	Dec 26, 2011
140-Norsonic	Real Time Analyzer	1403978	Mar 4, 2010	Scantek, Inc. / NVLAP	Mar 4, 2011
PC Program 1018 Norsonic	Calibration software	v.5.0	Validated July 2009	-	
1253-Norsonic	Calibrator	28326	Dec 7, 2009	Scantek, Inc./ NVLAP	Dec 7, 2010
1203-Norsonic	Preamplifier	14051	Sep 10, 2010	Scantek, Inc./ NVLAP	Sep 10, 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	Valentin Buzduga	Checked by	Mariana Buzduga
Signature		Signature	
Date	11/29/2010	Date	11/29/2010

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PCB PIEZOTRONICS
A PCB GROUP COMPANY

Certificate of Calibration and Conformance

Certificate Number 2011-147996

Instrument Model 706, Serial Number 01596, was calibrated on 24AUG2011. The instrument meets factory specifications per Procedure D0001.8035, ANSI S1.4-Type 2 1983, ANSI S1.25-Type 2 1991, IEC 60651-Type 2 1979, IEC 60804-Type 2 1985 and IEC 61252-am1-2000.

Instrument found to be in calibration as received: NO
Date Calibrated: 24AUG2011
Calibration due:

Calibration Standards Used

MANUFACTURER	MODEL	SERIAL NUMBER	INTERVAL	CAL. DUE	TRACEABILITY NO.
Larson Davis	LDSigGn/2209	0589 / 0103	12 Months	07DEC2011	2010-137207

Reference Standards are traceable to the National Institute of Standards and Technology (NIST)

Calibration Environmental Conditions

Temperature: 24 ° Centigrade

Relative Humidity: 34 %

Affirmations

This Certificate attests that this instrument has been calibrated under the stated conditions with Measurement and Test Equipment (M&TE) Standards traceable to the U.S. National Institute of Standards and Technology (NIST). All of the Measurement Standards have been calibrated to their manufacturers' specified accuracy / uncertainty. Evidence of traceability and accuracy is on file at Provo Engineering & Manufacturing Center. An acceptable accuracy ratio between the Standard(s) and the item calibrated has been maintained. This instrument meets or exceeds the manufacturer's published specification unless noted.

This calibration complies with the requirements of ISO 17025 and ANSI Z540. The collective uncertainty of the Measurement Standard used does not exceed 25% of the applicable tolerance for each characteristic calibrated unless otherwise noted.

The results documented in this certificate relate only to the item(s) calibrated or tested. A one year calibration is recommended, however calibration interval assignment and adjustment are the responsibility of the end user. This certificate may not be reproduced, except in full, without the written approval of the issuer.

"As Received" data unavailable due to unit failure.

Signed: Nick Rasmussen
Technician: Nick Rasmussen

Provo Engineering and Manufacturing Center, 1681 West 820 North, Provo, Utah 84601
Toll Free: 888.258.3222 Telephone: 716.926.8243 Fax: 716.926.8215
ISO 9001-2008 Certified

PCB PIEZOTRONICS
A PCB GROUP COMPANY

Certificate of Calibration and Conformance

Certificate Number 2011-147997

Instrument Model MPR002, Serial Number B0404, was calibrated on 24AUG2011. The instrument meets factory specifications per Procedure D0001.8159.

Instrument found to be in calibration as received: NO
Date Calibrated: 24AUG2011
Calibration due:

Calibration Standards Used

MANUFACTURER	MODEL	SERIAL NUMBER	INTERVAL	CAL. DUE	TRACEABILITY NO.
Larson Davis	2559	2847	12 Months	08NOV2011	2010-136103
Larson Davis	LDSigGn/2209	0612 / 0102	12 Months	07JAN2012	2011-138241
Larson Davis	900B	3382	12 Months	01APR2012	2011-141691

Reference Standards are traceable to the National Institute of Standards and Technology (NIST)

Calibration Environmental Conditions

Temperature: 24 ° Centigrade

Relative Humidity: 34 %

Affirmations

This Certificate attests that this instrument has been calibrated under the stated conditions with Measurement and Test Equipment (M&TE) Standards traceable to the U.S. National Institute of Standards and Technology (NIST). All of the Measurement Standards have been calibrated to their manufacturers' specified accuracy / uncertainty. Evidence of traceability and accuracy is on file at Provo Engineering & Manufacturing Center. An acceptable accuracy ratio between the Standard(s) and the item calibrated has been maintained. This instrument meets or exceeds the manufacturer's published specification unless noted.

This calibration complies with the requirements of ISO 17025 and ANSI Z540. The collective uncertainty of the Measurement Standard used does not exceed 25% of the applicable tolerance for each characteristic calibrated unless otherwise noted.

The results documented in this certificate relate only to the item(s) calibrated or tested. A one year calibration is recommended, however calibration interval assignment and adjustment are the responsibility of the end user. This certificate may not be reproduced, except in full, without the written approval of the issuer.

See "As Received" data.

Signed: Nick Rasmussen

Technician: Nick Rasmussen

Provo Engineering and Manufacturing Center, 1681 West 820 North, Provo, Utah 84601
Toll Free: 888.258.3222 Telephone: 716.926.8243 Fax: 716.926.8215
ISO 9001-2008 Certified

Scantek, Inc.
CALIBRATION LABORATORY

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

NVLAP®

NVLAP Lab Code: 200625-0

Calibration Certificate No.25205

Instrument:	**Noise Dosimeter / SLM**	*Date Calibrated:* **12/23/2011**	*Cal Due:*	
Model:	**Spark 706**	*Status:*	**Received**	**Sent**
Manufacturer:	**Larson Davis**	*In tolerance:*	X	X
Serial number:	**01365**	*Out of tolerance:*		
Tested with:	**Microphone MPR002 s/n B0556**	*See comments:*		
	Preamplifier	*Contains non-accredited tests:* __Yes **X** No		
Type (class):	**2**	*Calibration service:* __ Basic **X** Standard		
Customer:	**Environmental Acoustics, Inc.**	*Address:* **1400 Hummel Avenue**		
Tel/Fax:	**717-737-4751 / -4754**	**Lemoyne, PA 17043**		

Tested in accordance with the following procedures and standards:
Calibration of Sound Level Meters, Scantek Inc., Rev. 6/7/2005
SLM & Dosimeters – Acoustical Tests, Scantek Inc., Rev. 7/6/2011

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

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	25747	Jul 1, 2011	Scantek, Inc./ NVLAP	Jul 1, 2012
DS-360-SRS	Function Generator	61646	Nov 16, 2011	ACR Env./ A2LA	Nov 16, 2013
34401A-Agilent Technologies	Digital Voltmeter	MY41022043	Dec 9, 2011	ACR Env. / A2LA	Dec 9, 2012
DPI 141-Druck	Pressure Indicator	790/00-04	Dec 13, 2010	ACR Env./ A2LA	Dec 13, 2012
HMP233-Vaisala Oyj	Humidity & Temp. Transmitter	V3820001	Jul 29, 2011	Vaisala / A2LA	Jul 29, 2012
PC Program 1019 Norsonic	Calibration software	v.5.2	Validated Mar 2011	Scantek, Inc.	-
1251-Norsonic	Calibrator	30878	Dec 13, 2011	Scantek, Inc./ NVLAP	Dec 13, 2012
4226-Brüel&Kjær	Multifunction calibrator	2305103	Apr 13, 2011	Scantek, Inc./ NVLAP	Apr 13, 2012

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

Environmental conditions:

Temperature (°C)	Barometric pressure (kPa)	Relative Humidity (%)
24.1 °C	100.61 kPa	43.8 %RH

Calibrated by	Valentin Buzduga	**Checked by**	Mariana Buzduga
Signature		Signature	
Date	12/23/2011	Date	12/23/2011

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Scantek, Inc.
CALIBRATION LABORATORY

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

NVLAP®

NVLAP Lab Code: 200625-0

Calibration Certificate No.25206

Instrument:	**Noise Dosimeter / SLM**
Model:	**Spark 706**
Manufacturer:	**Larson Davis**
Serial number:	**01595**
Tested with:	**Microphone MPR002 s/n B0565** **Preamplifier**
Type (class):	**2**
Customer:	**Environmental Acoustics, Inc.**
Tel/Fax:	**717-737-4751 / -4754**

Date Calibrated: **12/23/2011** *Cal Due:*

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

Contains non-accredited tests: __ **Yes** _X_ **No**
Calibration service: __ **Basic** _X_ **Standard**

Address: **1400 Hummel Avenue**
Lemoyne, PA 17043

Tested in accordance with the following procedures and standards:
Calibration of Sound Level Meters, Scantek Inc., Rev. 6/7/2005
SLM & Dosimeters – Acoustical Tests, Scantek Inc., Rev. 7/6/2011

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

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	25747	Jul 1, 2011	Scantek, Inc./ NVLAP	Jul 1, 2012
DS-360-SRS	Function Generator	61646	Nov 16, 2011	ACR Env./ A2LA	Nov 16, 2013
34401A-Agilent Technologies	Digital Voltmeter	MY41022043	Dec 9, 2011	ACR Env. / A2LA	Dec 9, 2012
DPI 141-Druck	Pressure Indicator	790/00-04	Dec 13, 2010	ACR Env./ A2LA	Dec 13, 2012
HMP233-Vaisala Oyj	Humidity & Temp. Transmitter	V3820001	Jul 29, 2011	Vaisala / A2LA	Jul 29, 2012
PC Program 1019 Norsonic	Calibration software	v.5.2	Validated Mar 2011	Scantek, Inc.	-
1251-Norsonic	Calibrator	30878	Dec 13, 2011	Scantek, Inc./ NVLAP	Dec 13, 2012
4226-Brüel&Kjær	Multifunction calibrator	2305103	Apr 13, 2011	Scantek, Inc./ NVLAP	Apr 13, 2012

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

Environmental conditions:

Temperature (°C)	Barometric pressure (kPa)	Relative Humidity (%)
21.5 °C	100.35 kPa	45 %RH

Calibrated by	Valentin Buzduga	**Checked by**	Mariana Buzduga
Signature		Signature	
Date	12/23/2011	Date	12/23/2011

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Scantek, Inc.
CALIBRATION LABORATORY

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

NVLAP®

NVLAP Lab Code: 200625-0

Calibration Certificate No.25204

Instrument:	**Acoustical Calibrator**	*Date Calibrated:* **12/22/2011** *Cal Due:*		
Model:	**Cal150**	*Status:*	**Received**	**Sent**
Manufacturer:	**Larson Davis**	*In tolerance:*	X	X
Serial number:	**3047**	*Out of tolerance:*		
Class (IEC 60942):	**2**	*See comments:*		
Barometer type:		*Contains non-accredited tests:* __Yes _X_ No		
Barometer s/n:				

Customer:	**Environmental Acoustics, Inc.**	*Address:*	**1400 Hummel Avenue**
Tel/Fax:	**717-737-4751 / -4754**		**Lemoyne, PA 17043**

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

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

Instrument - Manufacturer	Description	S/N	Cal. Date	Traceability evidence Cal. Lab / Accreditation	Cal. Due
483B-Norsonic	SME Cal Unit	25747	Jul 1, 2011	Scantek, Inc./ NVLAP	Jul 1, 2012
DS-360-SRS	Function Generator	61646	Nov 16, 2011	ACR Env./ A2LA	Nov 16, 2013
34401A-Agilent Technologies	Digital Voltmeter	MY41022043	Dec 9, 2011	ACR Env. / A2LA	Dec 9, 2012
DPI 141-Druck	Pressure Indicator	790/00-04	Dec 13, 2010	ACR Env./ A2LA	Dec 13, 2012
HMP233-Vaisala Oyj	Humidity & Temp. Transmitter	V3820001	Jul 29, 2011	Vaisala / A2LA	Jul 29, 2012
8903A-HP	Audio Analyzer	2514A05691	Dec 1, 2010	ACR Env./ A2LA	Dec 1, 2013
PC Program 1018 Norsonic	Calibration software	v.5.2	Validated March 2011	Scantek, Inc.	-
4134-Brüel&Kjær	Microphone	173368	Dec 13, 2011	Scantek, Inc. / NVLAP	Dec 13, 2012
1203-Norsonic	Preamplifier	14059	Jan 5, 2011	Scantek, Inc./ NVLAP	Jan 5, 2012

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

Calibrated by	Valentin Buzduga	**Checked by**	Mariana Buzduga
Signature		Signature	
Date	12/22/2011	Date	12/22/2011

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