NEW CARROLLTON AND LANDOVER YARDS IMPROVEMENTS

NOISE AND VIBRATION TECHNICAL MEMORANDUM

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY
OCTOBER 2014

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1.0 INTRODUCTION

The Federal Transit Administration (FTA), as the lead federal agency, and the Washington Metropolitan Area Transit Authority (WMATA), as the project sponsor, are preparing an Environmental Assessment (EA) for the proposed New Carrollton Yard and Landover Yard Improvements Project ("the project"). The EA is being prepared in accordance with the National Environmental Policy Act (NEPA) and other federal, state, and local laws and regulation.

This technical memorandum identifies the potential noise and vibration effects of the No Build and Build Alternatives for the project. The memorandum describes the following:

- Project alternatives
- Applicable regulations and guidance
- Methodology
- Existing Conditions
- Environmental Consequences

The findings of this analysis will be incorporated into the EA.

1.1 Project Purpose and Need

The purpose of the project is to provide additional storage capacity and re-organize certain track maintenance functions at WMATA's rail yards.

1.2 Project Alternatives

The EA for the project will evaluate a No Build Alternative and a single Build Alternative. The Build Alternative includes the same area improvements as the No Build Alternative, in addition to construction and operation of the project.

1.2.1 No Build Alternative

The No Build Alternative assumes that operations at New Carrollton Yard would continue, and that no development would occur at the Landover site. In terms of the broader regional transportation network, the No Build Alternative is defined as the existing highway and transit network and committed transportation improvements from the National Capital Region Transportation Planning Board's Financially Constrained Long Range Plan (CLRP). No planned improvements would occur within the project area at New Carrollton Yard or at the Landover site.

Under the No Build Alternative, WMATA would not be able to provide the necessary service and infrastructure improvements as outlined in the Rail Fleet Management Plan (RFMP), Momentum, or the Eight-Car Train Implementation Plan.

1.2.2 Build Alternative

The Build Alternative consists of the expansion of rail car storage capacity at New Carrollton Yard and construction of a new rail yard adjacent to and east of the Landover Metrorail Station along with a new parking structure. The proposed Landover Yard would provide storage and maintenance facilities for WMATA's CTEM division and TRST, which currently operate at New Carrollton Yard. As part of the project, the CTEM and TRST functions would move from New Carrollton Yard to Landover Yard. The construction of CTEM and TRST facilities at Landover Yard would precede the demolition of existing CTEM and TRST facilities at New Carrollton Yard. Once CTEM and TRST functions are moved to Landover Yard, the resulting space at New Carrollton Yard would be used to complete the expansion of facilities for rail car storage and equipment storage. The improvements at each site are described individually below. The EA assumes the project would be operational by 2018 to meet Metrorail system vehicle fleet expansion requirements needed by 2020.

The Build Alternative also assumes the planned regional transportation improvements contained in the CLRP that are part of the No Build Alternative.

New Carrollton Yard Improvements

The existing New Carrollton rail yard ("New Carrollton Yard") is approximately 36.8-acres in size and is located at 4440 Garden City Drive in Landover, Maryland. The Build Alternative proposes to expand capacity at New Carrollton Yard through the construction of an additional 120 rail car storage spaces and support facilities. The existing Service and Inspection (S&I) and Yard Control Tower functions would remain unchanged.

The following facilities would be constructed within and adjacent to the existing New Carrollton Yard if the Build Alternative is implemented:

- Fifteen storage tracks accommodating 120 rail cars:
    - Eight storage tracks accommodating 64 rail cars in the northwest corner of the yard (referred to as the "northwest storage tracks");
    - Seven storage tracks accommodating 56 rail cars in the northeast corner of the yard (referred to as the "northeast storage tracks");
    - Lead service tracks for the storage areas;
- One contractor storage track with access road in the southeast corner of the yard;
- Two maintenance-of-way (MOW) tracks;
- Reconfigured and expanded employee surface parking in the northern and eastern sections of the yard;
- New operations platform and a pedestrian bridge (connecting to the employee parking lot via an elevator/stair tower) serving the northwest storage tracks;
- Relocation of the existing control tower from the center of the yard to the top of the elevator/stair tower at the location of the pedestrian bridge. The relocated tower would be approximately 40 feet high;
- New operations building for the northeast storage tracks;
- Conversion of the existing Engineering Campaign building to a S&I building (building was originally built as a S&I building); and
- Conversion of an existing operations building to an Automatic Train Control (ATC) building and training facility.

WMATA would acquire adjacent property from Amtrak and Maryland Highway Administration (SHA) to accommodate the rail yard expansion. New storage tracks would be constructed within the existing rail yard, as well as on the Amtrak and SHA properties. The expanded facility would be approximately 39.5-acres in size. A project concept is provided in **Figure 1-1**. The total number of existing and future employees at New Carrollton Yard is summarized in **Table 1-1**.

Table 1-1: Existing and Future New Carrollton Yard Employees

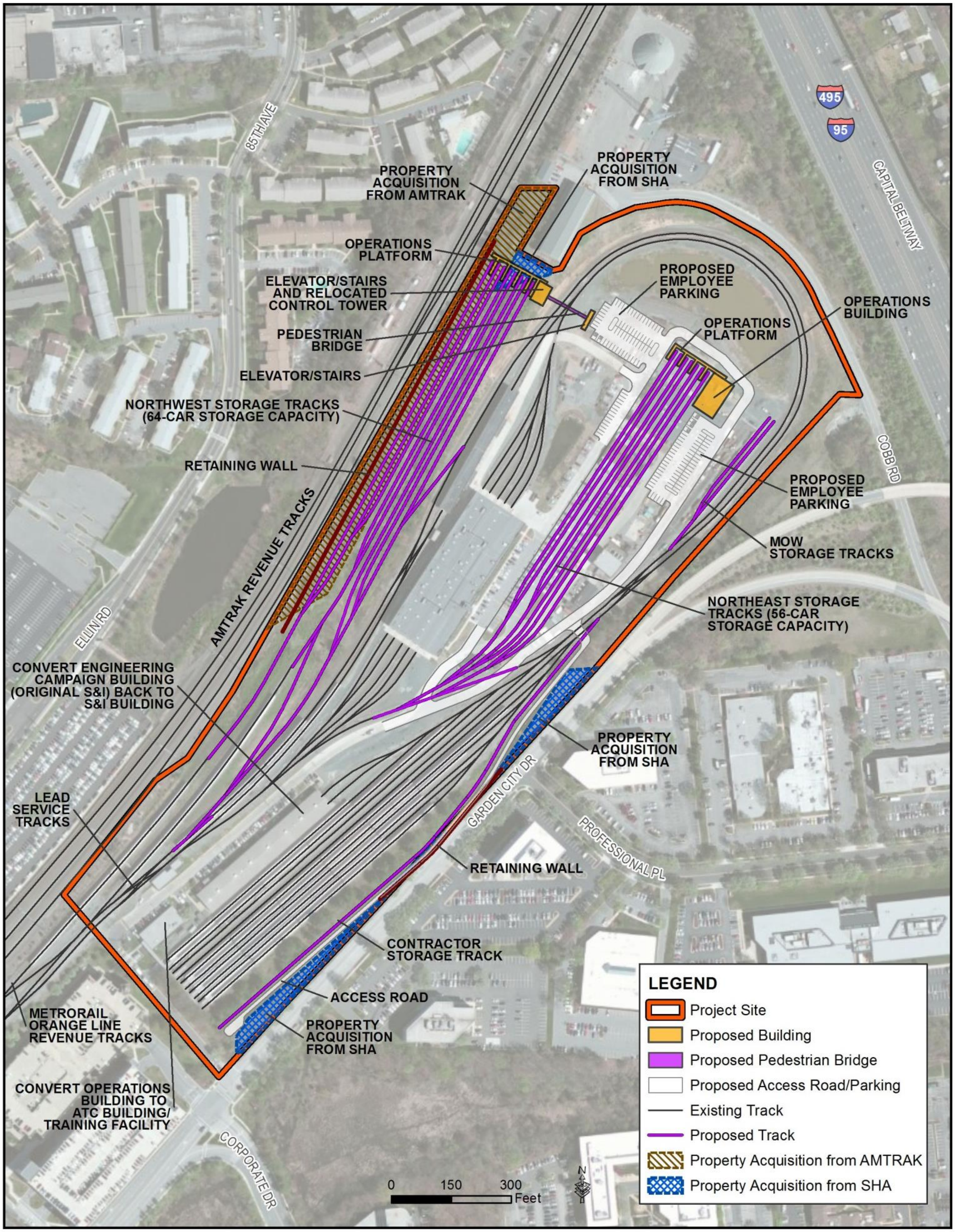
Activity	Existing Employees (2014)[a]	Future Employees (2025)[a]	Hours of Operation[a]
Metrorail Train Operators	83	131	Weekdays: 4:00am-1:00am Weekends: 6:00am-4:00am
S&I[b]	173	251	24-hour operations
Yard Control Tower	6	6	24-hour operations
CTEM	30	0[c]	24-hour operations
TRST	78	0[c]	24-hour operations
Total	370	388	

[a]Employee estimates and hours of operation provided by WMATA Space Needs Program. Hours of operations are assumed to be the same under the existing and future operations.

[b]S&I employee estimates include employees from Car Maintenance (CMNT) and Automatic Train Control (ATC) departments.

[c]Future employees would move to CTEM and TRST facilities at Landover Yard.

Figure 1-1: New Carrollton Yard Project Concept



Proposed Landover Yard

The Landover Yard site, currently owned by WMATA, is approximately 18.7-acres in size and is located at 3000 Pennsy Drive in Hyattsville, Maryland. Currently, the site is undeveloped, except for the two southern tracts, which contain surface Park & Ride lots serving the adjacent Landover Metrorail Station. The Build Alternative consists of the construction of a new rail yard, commuter parking garage, and support facilities for CTEM and TRST at the site. The new commuter parking garage would replace all Metrorail surface Park & Ride spaces removed for the project. Existing CTEM and TRST facilities would be moved from their current location at New Carrollton Yard to the proposed Landover Yard. Track maintenance vehicles of various sizes and function would be stored in and operate from the rail yard. No Metrorail passenger rail cars (revenue vehicles) would be stored at Landover Yard. Approximately 190 employees would be based at Landover Yard.

The following facilities would be constructed at Landover Yard if the Build Alternative is implemented:

- Loop track around the southern portion of the rail yard;
- Lead and tail tracks for the rail yard;
- New CTEM and TRST building and eleven storage tracks for track equipment and maintenance vehicles;
- Six-level commuter Park & Ride facility, consisting of 848-spaces to replace the surface spaces displaced by construction. The structure would be constructed on an existing commuter lot, south of the rail yard and separated from the new yard by the Landover Metro Access Road.
- Employee surface parking lot and delivery area in the southern portion of the proposed yard;
- New track crossover on the Metrorail revenue tracks;
- Retaining wall in the southwest corner would be constructed to accommodate the bypass track; and
- Stormwater management area at the northern end of the rail yard.

No property acquisition would be necessary for the project, as the rail yard would be built on land owned by WMATA.

See **Figure 1-2** for the project concept and **Table 1-2** for a summary of existing and future employees at the proposed rail yard.

Table 1-2: Proposed Landover Yard Employees

Activity	Existing Employees (2014)[a]	Future Employees (2025)[a]	Hours of Operation[a]
CTEM	0 (30 at New Carrollton Yard)[b]	79	24-hour operations
TRST	0 (78 at New Carrollton Yard)[b]	111	24-hour operations
Total	0 (108 at New Carrollton Yard)[b]	190	

[a] Employee estimates and hours of operation provided by WMATA Space Needs Program.
[b] Existing employees at CTEM and TRST facilities at New Carrollton Yard, who would be transferred to the new Landover Yard. Currently no employees are based at the Landover project site.

Figure 1-2: Proposed Landover Yard Project Concept

1.3 Human Perception of Noise and Vibration

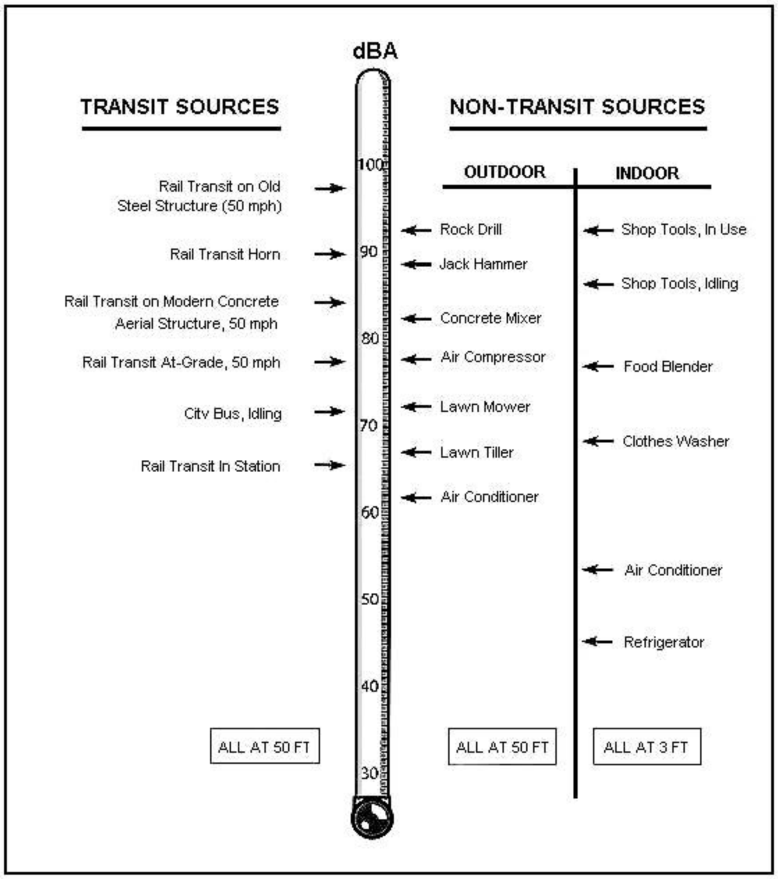
1.3.1 Noise

Noise is "unwanted sound" and, by this definition, the perception of noise is a subjective process. Several factors affect the actual level and quality of sound (or noise) as perceived by the human ear and can generally be described in terms of loudness, pitch (or frequency), and time variation. The loudness, or magnitude, of noise determines its intensity and is measured in decibels (dB) that can range from below 40 dB (the rustling of leaves) to over 100 dB (a rock concert). Pitch describes the character and frequency content of noise, such as the very low "rumbling" noise of stereo subwoofers or the very high-pitched noise of a piercing whistle. Finally, the time variation of noise sources can be characterized as continuous, such as with a building ventilation fan; intermittent, such as for trains passing by; or impulsive, such as pile-driving activities during construction.

Various sound qualities are used to quantify noise from transit sources, including a sound's loudness, duration, and tonal character. For example, the A-weighted decibel (dBA) is commonly used to describe the overall noise level because it more closely matches the human ear's response to audible frequencies. Because the A-weighted decibel scale is logarithmic, a 10 dBA increase in a noise level is generally perceived as a doubling of loudness, while a 3 dBA increase in a noise level is just barely perceptible to the human ear. Typical A-weighted sound levels from transit and other common sources are shown in **Figure 1-3**.

Several A-weighted noise descriptors are used to determine impacts from stationary and transit related sources including the L_{max}, which represents the maximum noise level that occurs during an event, such as a bus or train pass-by; the L_{eq}, which represents a level of constant noise with the same acoustical energy as the fluctuating noise levels observed during a given interval, such as one hour (L_{eq}(h)); the L_{90}, which represents the noise level exceeded 90 percent of the time and is used to establish the background ambient level; and the 24-hour day-night noise level (L_{dn}), which includes a 10-decibel penalty for all nighttime activity between 10:00 p.m. and 7:00 a.m.

Figure 1-3: Typical A-Weighted Noise Levels



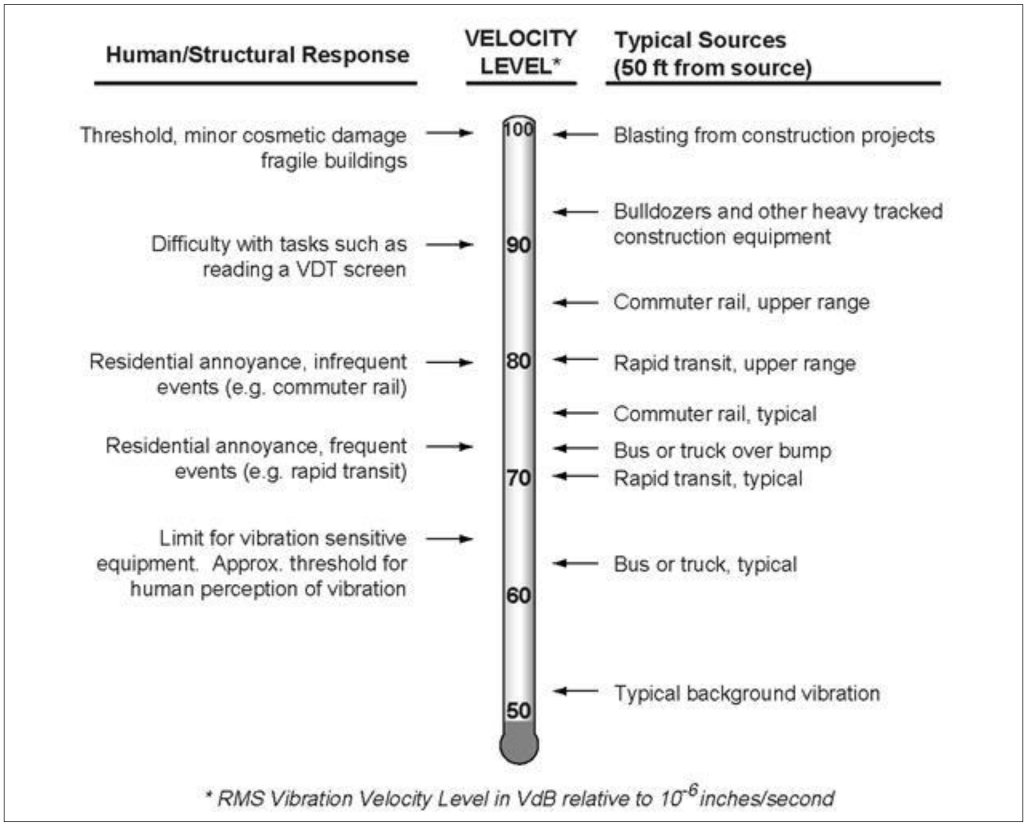
Source: Transit Noise and Vibration Impact Assessment, Federal Transit Administration, Washington, DC, May 2006.

1.3.2 Vibration

Ground-borne vibration associated with vehicle movements is usually the result of uneven interactions between wheels and the road or rail surfaces. Examples of such interactions (and subsequent vibrations) include train wheels over a jointed rail, an untrue rail car wheel with “flats,” and a motor vehicle wheel hitting a pothole, a manhole cover, or any other uneven surface. Typical ground-borne vibration levels from transit and other common sources are summarized in **Figure 1-4**. For example, typical ground-borne vibration levels at a receptor 50 feet from different transportation sources traveling at 50 miles per hour range from 61 VdB for trucks and buses, to 73 VdB for LRT vehicles, to 85 VdB for diesel locomotives. Similarly, a typical background vibration velocity level in residential areas is usually 50 VdB or lower, well below the threshold of perception for humans, which is around 65 VdB (FTA 2006). The typical background levels refer to ambient ground vibrations not related to any specific transportation source (e.g., naturally occurring ground vibration). This background vibration level is assumed to be fairly constant from site to site, except in the vicinity of active fault lines.

Unlike noise, which travels in air, transit vibration typically travels along the surface of the ground. Depending on the geological properties of the surrounding terrain and the type of building structure exposed to transit vibration, vibration propagation can be more or less efficient. Buildings with a solid foundation set in bedrock are “coupled” more efficiently to the surrounding ground and experience relatively higher vibration levels than buildings located in sandier soil. Heavier buildings (such as masonry structures) are less susceptible to vibration than wood-frame buildings because they absorb more vibration energy.

Figure 1-4: Typical Ground-Borne Vibration Levels



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

Vibration induced by passing vehicles can generally be discussed in terms of displacement, velocity, or acceleration. However, human responses and responses by monitoring instruments and other objects are most accurately described with velocity. Therefore, the vibration velocity level is used to assess vibration impacts from transit projects.

To describe the human response to vibration, the average vibration amplitude (called the root mean square, or RMS, amplitude) is used to assess impacts. The RMS velocity level is expressed in inches per second or VdB. All VdB vibration levels are referenced to 1 micro-inch per second (μips). Similar to noise decibels, vibration decibels are dimensionless because they are referenced to (i.e., divided by) a standard level (such as $1x10^{-6}$ ips in the U.S.). This convention allows compression of the scale over which vibration occurs, such as 40-100 VdB rather than 0.0001 ips to 0.1 ips.

2.0 REGULATORY FRAMEWORK

The noise and vibration assessment was prepared in accordance with guidelines set forth by FTA's *Transit Noise and Vibration Impact Assessment* (2006). The future predicted noise and vibration levels from the project were evaluated using both the FTA guidelines and the WMATA *Manual of Design Criteria for Maintaining and Continued Operation of Facilities and Systems* (2010). While the FTA criteria are used to evaluate cumulative noise exposure (such as L_{dn}), the WMATA criteria are used to evaluate instantaneous levels from single events (such as a single Metrorail pass-by) and activities at service and inspection yards.

2.1 FTA Criteria

2.1.1 Operational Noise Criteria

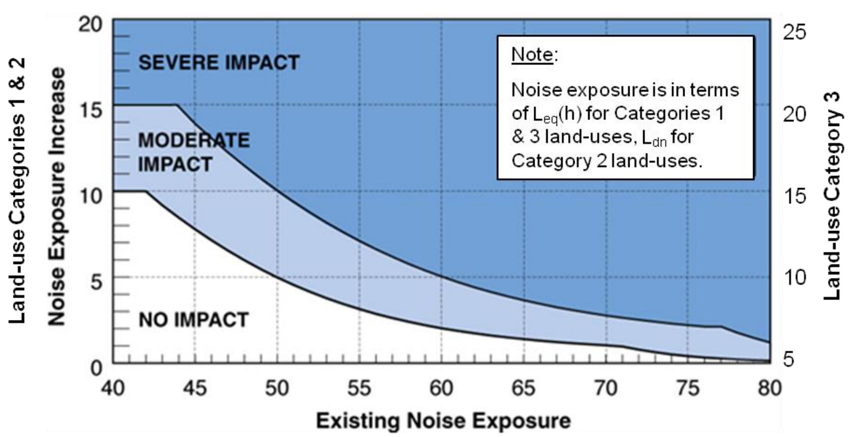
FTA's guidance manual, *Transit Noise and Vibration Impact Assessment,* presents the basic concepts, methods and procedures for evaluating the extent and severity of noise impacts from transit projects. Transit noise impacts are assessed based on land use categories and sensitivity to noise from transit sources under the FTA guidelines. As shown in **Figure 2-1**, the FTA noise impact criteria are defined by two curves that allow increasing project noise levels as existing noise increases up to a point, beyond which impact is determined based on project noise alone. The FTA land use categories and required noise metrics are described in **Table 2-1**.

Table 2-1: FTA Land-Use Categories and Noise Metrics

Land-Use Category	Noise Metric[1]	Description
1	$L_{eq}(h)$[1]	Tracts of land set aside for serenity and quiet, such as outdoor amphitheaters, concert pavilions, and historic landmarks.
2	L_{dn}[1]	Buildings used for sleeping such as residences, hospitals, hotels, and other areas where nighttime sensitivity to noise is of utmost importance.
3	$L_{eq}(h)$[1]	Institutional land uses with primarily daytime and evening uses including schools, libraries, churches, museums, cemeteries, historic sites, and parks, and certain recreational facilities used for study or meditation.

[1]Noise metrics include the Leq(h) or Average hourly equivalent noise level and the Ldn or 24-hour day-night noise level.
Source: FTA, 2006.

Figure 2-1: FTA Increase in Cumulative Noise Levels Allowed by Criteria



Source: FTA 2006

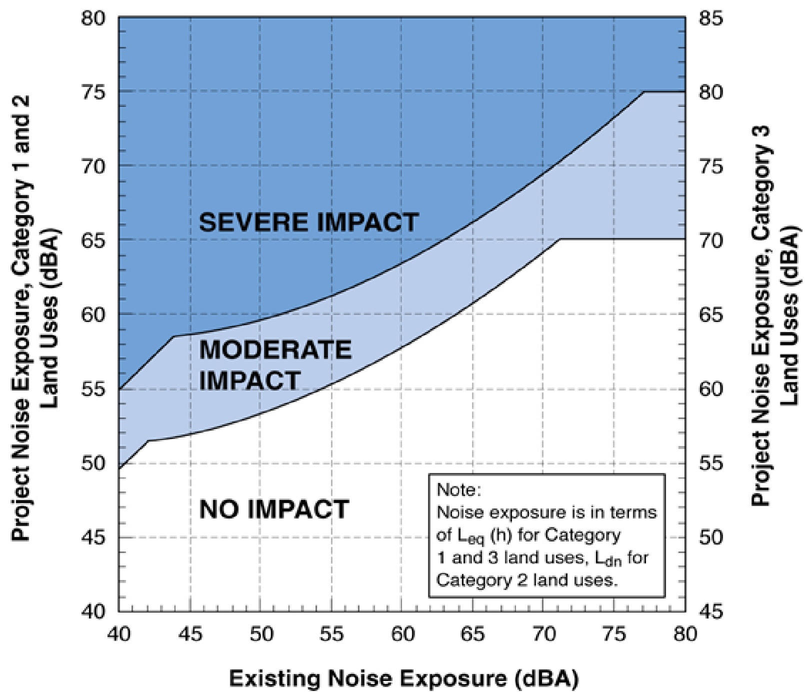
The FTA noise criteria are delineated into two categories: *moderate* and *severe* impact. The *moderate* impact threshold defines areas where the change in noise is noticeable but may not be sufficient to cause a strong, adverse community reaction. The *severe* impact threshold defines the noise limits above which a significant percentage of the population would be highly annoyed by new noise.

In most cases, when a new transit source is proposed, the level of impact at any specific site can be established by comparing the predicted future project noise level at the site to the existing noise level at the site. However, at New Carrollton Yard, the existing noise sources (e.g., Metrorail operations) change as a result of the project (i.e. the yard is reconfigured), and so it is not possible to define project noise separately from existing noise. In other words, for the project, changes are proposed to an existing transit system, as opposed to a new project in an area previously without transit. In this case, the existing noise can be determined and a new future noise can be calculated, but it is not possible to accurately describe what constitutes the "project noise." For Landover Yard, the project noise is added to the existing noise to come up with a new cumulative noise. However, at the

New Carrollton Yard, the existing noise is dominated by a source that would change due to the project, so it would be incorrect to add the project noise to the existing noise. Consequently, the baseline noise levels used for comparison at New Carrollton Yard were the predicted future (Opening Year) noise levels under the No Build Alternative. The Opening Year No Build condition was compared with the calculated future noise for the Build Alternative using the cumulative form of the noise criteria shown in **Figure 2-1**. Noise impacts at sensitive receptors in the vicinity of the Landover Yard were evaluated using **Figure 2-2**.

The average day-night noise level over a 24-hour period (L_{dn}) was used to characterize noise exposure for residential areas (FTA Category 2). The L_{dn} descriptor describes a receiver's cumulative noise exposure from all events over a full 24 hours, with events between 10:00 pm and 7:00 am increased by 10 decibels to account for greater nighttime sensitivity to noise. For other noise-sensitive land uses, such as parks and schools (FTA Category 3), the average hourly equivalent noise level (L_{eq}(h)) was used to represent the rail corridor's peak operating period.

Figure 2-2: FTA Noise Impact Criteria for Transit Projects



Source: FTA 2006

2.1.2 Operational Vibration Criteria

The FTA vibration criteria for evaluating ground-borne vibration impacts from train pass-bys at nearby sensitive receptors are shown in **Table 2-2**. These vibration criteria are related to ground-borne vibration levels that are expected to result in human annoyance and are based on RMS velocity levels expressed in VdB referenced to one micro inch per second (µips). FTA's experience with community response to ground-borne vibration indicates that when there are only a few train events per day, it would take higher vibration levels to evoke the same community response that would be expected from more frequent events. This experience is taken into account in the FTA criteria by distinguishing between projects with frequent, occasional, or infrequent events. The frequent events category is defined as more than 70 events per day, the occasional events category is defined as between 30 and 70 events per day, and the infrequent events category is defined as less than 30 events per day. To be conservative, the FTA frequent criteria were used to assess ground-borne vibration impacts in the study area.

Table 2-2: Ground-Borne RMS Vibration Impact Criteria for Annoyance during Operations and Construction

Receptor Land Use		RMS Vibration Levels (VdB)			Ground-borne Noise Levels (dBA)		
Category	Description	Frequent Events	Occasional Events	Infrequent Events	Frequent Events	Occasional Events	Infrequent Events
1	Buildings where low vibration is essential for interior operations	65	65	65	N/A	N/A	N/A
2	Residences and buildings where people normally sleep	72	75	80	35	38	43
3	Daytime institutional and office use	75	78	83	40	43	48
Specific Buildings	TV/Recording Studios/Concert Halls	65	65	65	25	25	25
	Auditoriums	72	80	80	30	38	38
	Theaters	72	80	80	35	43	43

Source: "Transit Noise and Vibration Impact Assessment", Federal Transit Administration, Washington, DC, May 2006.

However, because the FTA criteria do not incorporate existing vibration, additional impact from future vibration sources was evaluated based on a significant increase in vibration of 3 VdB or more above the Baseline Condition. For the project (which is proposed in an existing rail corridor with both freight and Metrorail activity), if the existing train vibration exceeds the impact criteria shown in **Table 2-2**, additional impact (or exceedance of the criteria) would occur only if the project significantly increases the resultant vibration 3 VdB or more than the existing vibration under the Baseline Condition (predicted vibration levels under the No Build Alternative).

The vibration criteria levels shown in **Table 2-2** are defined in terms of human annoyance for different land use categories, such as high sensitivity (Category 1), residential (Category 2), and institutional (Category 3). In general, the vibration threshold of human perceptibility is approximately 65 VdB.

2.2 WMATA Criteria

During the construction and development of the initial Metrorail rapid transit system in the 1970s, design criteria were developed specifically for the WMATA system. The most current version of these design criteria is described in the WMATA *Manual of Design Criteria for Maintaining and Continued Operation of Facilities and Systems*[1]. The WMATA criteria for "Criteria for Maximum Airborne Noise from Train Operations" were used to evaluate impacts from Metrorail pass-bys and operations within the study area. The WMATA *Manual of Design Criteria* is intended to provide design criteria for all community-related noise and vibration control problems relating to the construction and operations of the WMATA Metrorail System.

2.2.1 Noise Criteria

As shown in **Table 2-3**, the WMATA design criteria for Metrorail operations and randomly occurring noises from service and inspection yards (such as wheel squeal or railcar auxiliary equipment) were developed for various types of buildings in each of the land use area categories listed in **Table 2-4**. These noise limits are based on the maximum level that would not cause significant intrusion or alteration of the pre-existing noise environment and represent noise levels that are considered acceptable for the type of land use in each area. The criteria presented in **Table 2-3** should be applied at the nearest affected residential properties. If necessary to be compatible with existing noise ordinances, the criteria should apply at the WMATA property line or the boundary line dividing the industrial/commercial and residential zones.

[1] WMATA *Manual of Design Criteria for Maintaining and Continued Operation of Facilities and Systems*, Section 16, Washington Metropolitan Area Transit Authority, Department of Operations Services, Office of Engineering Support Services, Release 9, February 18, 2010.

Other than the multi-family residences at Lenox Court on 85th Avenue, all of the other nearby sensitive land uses identified in the vicinity of New Carrollton Yard are well outside the FTA screening distance of 1,000 feet. Similarly, the closest residences in the vicinity of the proposed Landover Yard include a densely-populated neighborhood of single-family house along Parkwood Street. Both of these yards are located adjacent to Amtrak's Northeast Corridor (NEC) and major highways. Therefore, the WMATA criterion for evaluating maximum noise impacts from Metrorail operations at both the New Carrollton and the Landover Yards for residences near industrial/highway sources is 70 dBA.

Table 2-3: WMATA Residential Noise Criteria for Metrorail Operations at Service and Inspections Yards (dBA)

Community Area Category		Maximum Noise Level
I	Low-density Residential	55
II	Average Residential	55
III	High-density Residential	65
IV	Commercial	65
V	Industrial/Highway	70

Note: The WMATA criteria should be applied at the nearest affected residential properties.
Source: WMATA 2010.

Table 2-4: General Categories of Communities along WMATA Metrorail System Corridors

Area Category	Area Description	Typical Ambient Noise Levels (Average or L50*)	Typical Day/Night Exposure Levels Ldn**
I	Low Density urban residential, open space park, suburban residential or quiet recreation area. No nearby highways or boulevards.	40-50 (day) 35-45 (night)	Below 55
II	Average urban residential, quiet apartments and hotels, open space, suburban residential, or occupied outdoor areas near busy streets.	45-55 (day) 40-50 (night)	50-60
III	High Density urban residential, average semi-residential/commercial areas, urban parks, museum, and non-commercial public building areas.	50-60 (day) 45-55 (night)	55-65
IV	Commercial areas with office buildings, retail stores, etc., primarily daytime occupancy. Central Business Districts.	60-70	Over 60
V	Industrial areas or Freeway and Highway Corridors	Over 60	Over 65

* - L50 is the long-term statistical median noise level.
** - Ldn is the day-night sound level.
Source: WMATA 2010.

2.2.2 Vibration Criteria

The appropriate vibration criteria for maximum ground-borne vibration for various types of residential buildings are shown in **Table 2-5**. These criteria apply to measurements of vertical vibration of floor surfaces within the buildings. Based on the surrounding predominant land uses identified in the vicinity of the proposed project, the WMATA criterion for evaluating ground-borne vibration impacts from train operations at the Lenox Court high-density residences is 75 VdB (Industrial/Highway). Similarly, the WMATA criterion for evaluating ground-borne vibration impacts from train operations at the single-family residences along Parkwood Street is also 75 VdB, associated with Industrial/Highway land uses.

Table 2-5: Criteria for Maximum Ground-borne Vibration from Train Operations for Buildings with Sleeping Areas

Community Area	Category	Maximum Pass-by Ground-borne Vibration Velocity Level (dB re 10^{-6} in/sec)		
		Single Family Dwellings	Multi Family Dwellings	Commercial Buildings
I	Low Density Residential	72	72	72
II	Average Residential	72	72	75
III	High Density Residential	72	75	75
IV	Commercial	72	75	75
V	Industrial/Highway	75	75	75

[1] The WMATA criteria are generally applicable outdoors at the nearside of the nearest occupied building or area under consideration, but not less than 50 ft from track centerline.
Source: WMATA 2010.

2.3 Prince George's County

There are no regional noise criteria from the Prince George's County Code (Subtitle 19, Pollution, Division 2, Noise Control, Section 19-120) that specify maximum allowable noise limits. Instead, the Prince George's County noise ordinance establishes only a qualitative prohibition on nuisance noise, such as amplified radios or tools. However, these criteria are not applicable to transit projects and were not used to assess impact as part of this study.

3.0 METHODOLOGY

Noise and vibration impacts were evaluated using the FTA's "General Assessment" guidelines and WMATA's *Manuel of Design Criteria* to reflect the type of input data available. The FTA's "General Assessment" guidelines are more than adequate to assess the potential for impact during the environmental phase of the project. If impacts are predicted, a more detailed and refined vibration monitoring program may be necessary during final design to verify (or dismiss) any impacts that were predicted using the default FTA guidelines. The following assumptions were applied for the prediction modeling analysis:

For yard operations, yard operations are expected to include the following:

- 100 percent of Metrorail vehicles are expected to depart the yard before 7:00 am;
- 75 percent of Metrorail vehicles are expected to access and egress the yard between 10:00 am and 8:00 pm;
- 100 percent of Metrorail vehicles are expected to return to the yard after 10:00 pm;
- A maximum Metrorail operating speed of 15 miles per hour (mph) was applied in all areas of the yard;
- For modeling purposes, yard activities assumed every vehicle was an eight-car train at New Carrollton and Landover;
- New Carrollton Yard
    - 40 train events split equally between the daytime and nighttime periods (Existing/No Build Condition);
    - 72 train events split equally between the daytime and nighttime periods (Build Alternative);
- Landover Yard
    - Maintenance-of-way (MOW) equipment is assumed to operate with an equivalent noise exposure of 40 trains events, split equally between the daytime and nighttime periods (Build Alternative);
- Observations made during the monitoring of existing Metrorail operations at New Carrollton Yard are extrapolated to incorporate the increased capacity of each yard brought on by the proposed project; and
    - Both yards are assumed to operate at the same capacity at night as during the day.

Rail operations along the NEC for Metrorail, Amtrak, MARC and CSX freight are based on the following:

- Metrorail:
  - 7-minute headways during the peak period for all Orange Line trains between Vienna/Fairfax and New Carrollton;
  - 7.5-minute headways during all transitional periods (i.e., peak to off-peak) for all Orange Line trains;
  - 12-minute headways during all late night periods between 9:30 pm and 3:00 am and the early morning period between 5:00-6:00 am for all Orange Line trains;
  - As a conservative assumption, a Friday Metrorail schedule was used with an operating schedule of 5:00 am to 3:00 am with peak and shoulder-peak periods occurring 6:00-9:00 am and 3:30-6:30 pm;
  - Eight-car trains were assumed for all peak periods of the day, while a six-vehicle consist was assumed for all off-peak periods, and a 7-vehicle consist was assumed for all transitional periods between the peak and off-peak periods; and
  - Based on default FTA reference noise levels, a single Metrorail vehicle operating at 50 mph on ballast-and-tie track with continuous welded rail track generates a maximum noise level of 80 dBA at 50 feet from the track centerline.
- Amtrak:
  - Average daily train operations for Amtrak service between Baltimore and Washington was tabulated for Acela Express, Northeast Regional, Cardinal, Carolinian, Crescent, Palmetto, Silver Meteor, Silver Star and Vermonter;
  - Average daily Amtrak service includes 63 daytime trains and 14 nighttime trains;
  - Average travel speed is 40 miles per hour (mph) with an eight-car train and no locomotives; and
  - Operating data was applied equally to both the Existing/No Build Condition and the Build Alternative, since they are unaffected by the proposed project elements.
- MARC:
  - Average daily train operations for the Maryland Area Regional Commuter (MARC) service between Baltimore and Washington was tabulated for an average weekday period;
  - Average daily MARC service includes 46 daytime trains and 10 nighttime trains;
  - Average travel speed is 40 miles per hour (mph) with two locomotives and 5-car bi-level railcars; and
  - Operating data was applied equally to both the Existing/No Build Condition and the Build Alternative, since they are unaffected by the proposed project elements.
- CSX freight:
  - No CSX train events were observed during a 2-day noise monitoring period between April 8-10, 2014;
  - Average daily train operations for CSX freight rail service between Baltimore and Washington was estimated for an average weekday period;
  - Average daily CSX service includes one daytime train and one nighttime train;
  - Average travel speed is 25 miles per hour (mph) with two locomotives and 20 railcars; and
  - Operating data was applied equally to both the Existing/No Build Condition and the Build Alternative, since they are unaffected by the proposed project elements;
- Receptor distances to the closest existing and future Metrorail yard tracks are summarized in **Table 3-1**.
- A 5-dBA adjustment factor was applied for Site M3 at the Landover Yard to account for shielding provided by the existing highway noise barrier running along John Hanson Highway (U.S. Route 50) just north of the site.

Table 3-1: Receptor Distances to the Existing and Future Rail Sources1

Receptor		Mainline Tracks		Yard		
ID	Description	NEC	WMATA	Near Tracks	Squeal	Midpoint
M1	Lenox Court, 85th Avenue	192	1,700	450	955	690
M2	Lenox Court, 85th Avenue	115	2,300	428	535	980
M3	Parkwood Street	380	480	600	--	720

[1] Receptor distances, which are measured from the building façade, are reported in feet.
Source: AECOM, June 2014.

4.0 EXISTING CONDITIONS

To determine the existing background noise levels at sensitive receptors in the vicinity of New Carrollton and Landover Yards, a noise-monitoring program was conducted at the three representative locations shown in **Figures 4-1 and 4-2**, and described in **Table 4-1**. Hourly equivalent A-weighted noise levels (L_{eq}(h) in dBA) were measured over a 24-hour period at two representative sites to determine the average ambient conditions during a typical weekday. At New Carrollton Yard, the representative sites included multi-family residences in the Lenox Court development along 85th Avenue (or FTA Category 2 land-uses) closest to the proposed rail yard expansion. At the Landover Yard, the representative site included a single-family residence along Parkwood Street (or FTA Category 2 land-uses) closest to the proposed rail yard.

The noise measurements document existing noise sources, such as Metrorail activities associated with the rail yard (New Carrollton Yard only), commuter rail operations as part of the MARC service, national rail operations as part of Amtrak's NEC service, and CSX freight train operations. Additionally, background noise is also dominated by motor vehicle traffic along the Capital Beltway (I-95 and I-495) at New Carrollton Yard and U.S. 50 for both the Landover site and New Carrollton Yard.

The sound-level meters that were used to measure current noise conditions (Brüel & Kjær Model 2236 and Larson Davis Model 820) meet or exceed the American National Standards Institute (ANSI) standards for Type I accuracy and quality. The sound-level meters were calibrated using a Brüel & Kjær Model 4231 before and after each measurement. All measurements were conducted according to ANSI Standard S1.13-2005, Measurement of Sound Pressure Levels in Air. All noise levels are reported in dBA, which best approximates the sensitivity of human hearing.

4.1 New Carrollton Yard

The results of the baseline monitoring program at sensitive receptors in the vicinity of the existing New Carrollton Yard are described in the following subsections.

4.1.1 Noise

In accordance with FTA guidelines, 24-hour day-night noise levels (L_{dn} in dBA) were developed based on the monitoring results. However, noise levels at Sites M1 and M2 in the vicinity of New Carrollton Yard are reported for disclosure only, since the Existing Condition was modeled. Baseline noise levels were conducted continuously between April 8-10, 2014 at Sites M1, M2 and M3 over a 24-hour period to document the hourly variation in ambient noise levels in the area. **Figure 4-1** shows the locations of the representative noise monitoring sites in the vicinity of New Carrollton and Landover Yards. Sites M1 and M2 are in the vicinity of New Carrollton Yard, while Site M3 is in the vicinity of Landover Yard and is assessed in Section 4.2.1.

The intent of the noise monitoring program was not to document the background noise level at every receptor, but to strategically select monitoring sites that were representative of the other land uses closest to the proposed yard expansion. Therefore, the Lenox Court condominiums along 85th Avenue are the only noise-sensitive land-uses with the FTA screening distance of 1,000 feet of New Carrollton Yard.

As shown in **Table 4-1**, the measured day-night noise levels in the vicinity of the proposed New Carrollton Yard range from 65 dBA at Site M2 (multi-family residences at Lenox Court closest to the Capital Beltway) to 66 dBA at Site M1 (multi-family residences at Lenox Court farthest from the Capital Beltway). These levels are dominated by noise from rail operations along the NEC due to Amtrak, MARC and CSX freight rail. Measured maximum noise levels from Amtrak passbys range from 76 to 85 dBA at Site M1 and 70 to 77 dBA at Site M2. The hourly variation in noise levels is shown graphically in the Appendix of this report. Since the residential communities are adjacent to both highway and rail corridors, such as the Capital Beltway and the NEC rail corridor, the background noise levels are representative of dense mixed-use highway corridors.

Table 4-1: Baseline Noise Levels Measured in the Vicinity of the New Carrollton and Landover Rail Yards (in dBA)

Receptor	Description	Land Use	Date	24-Hour Ldn
M1	Lenox Court, 85th Avenue	Residence	April 8-10, 2014	66
M2	Lenox Court, 85th Avenue	Residence	April 8-10, 2014	65
M3	Parkwood Street	Residence	April 8-10, 2014	67

Source: AECOM, June 2014.

4.1.1 Vibration

Baseline vibration measurements were not conducted at residences due to the distance between the yard and the closest receptors. However, background vibration levels are dominated by existing rail operations due to MARC, Amtrak and CSX freight train pass-bys along the NEC located between Sites M1 and M2 and New Carrollton Yard. Metrorail operations at the rail yard are much too slow to result in significant or noticeable vibration levels, even at the closest residences.

4.2 Proposed Landover Yard

The results of the baseline monitoring program at sensitive receptors in the vicinity of the proposed Landover Yard are described in the following subsections.

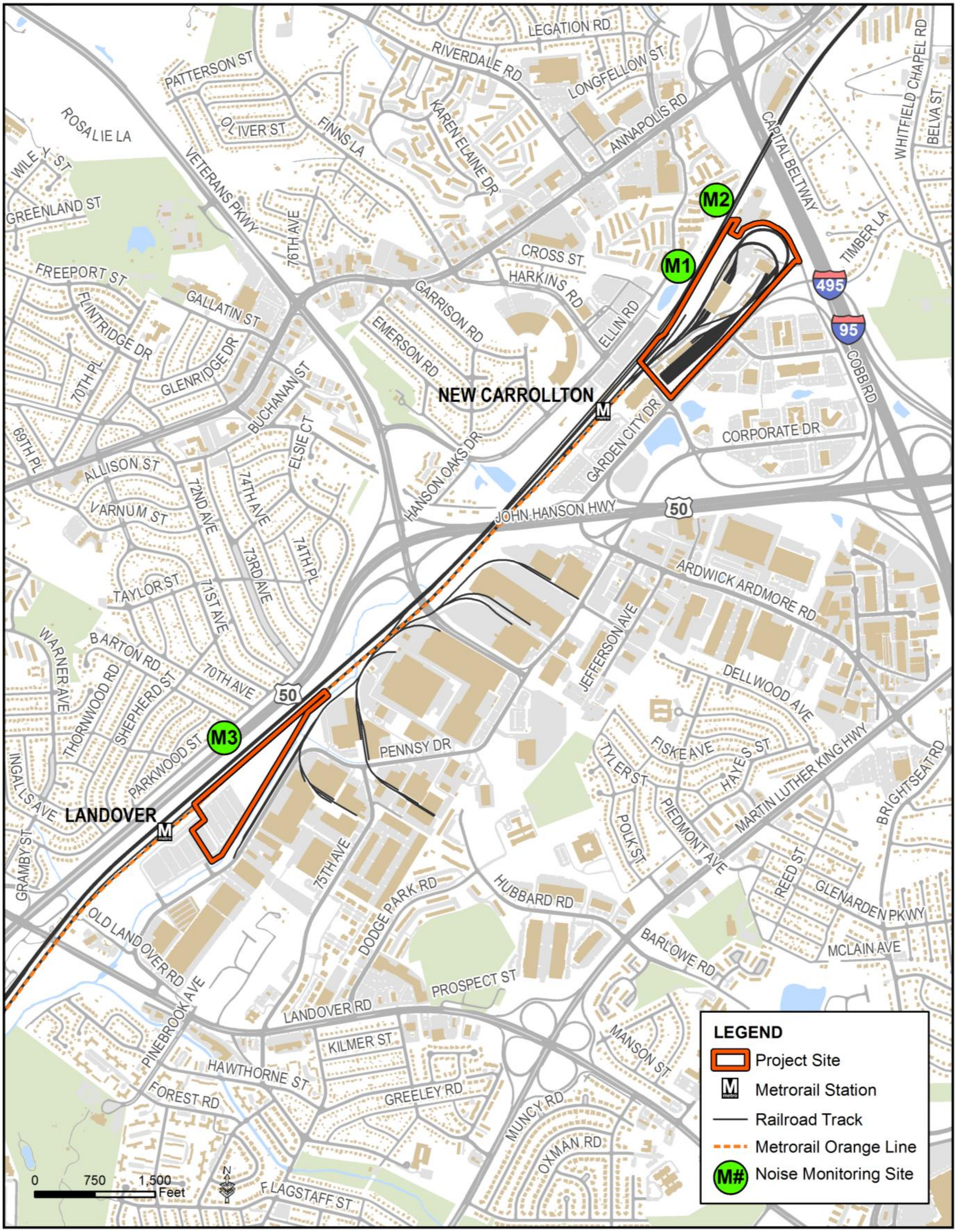
4.2.1 Noise

In accordance with FTA guidelines, 24-hour day-night noise levels (or L_{dn} in dBA) were developed based on the monitoring results. Baseline noise levels were conducted continuously between April 8-10, 2014 at Site M3 over a 24-hour period to document the hourly variation in ambient noise levels in the area.

The intent of the noise monitoring program was not to document the background noise level at every receptor, but to strategically select monitoring sites that were representative of the other land uses closest to the proposed yard expansion. Therefore, a single-family residence along Parkwood Street directly opposite the proposed Landover Yard was selected to be representative of all residences along Parkwood Street and the neighborhood in general.

As shown in **Table 4-1**, the measured day-night noise level in the vicinity of the proposed Landover Yard is 67 dBA at Site M3 (a single-family residence along Parkwood Street). These levels are dominated by noise from rail operations along the NEC, due to Metrorail, Amtrak, MARC and CSX freight rail. Measured maximum noise levels range from 62-66 dBA for Metrorail pass-bys to 70-73 dBA for Amtrak passbys at Site M3. The hourly variation in noise levels is shown graphically in the Appendix of this document. Since the residential communities represented by Site M3 are adjacent to both highway and rail corridors, such as U.S. 50 and the NEC, the background noise levels are representative of dense mixed-use highway corridors.

Figure 4-1: Representative Baseline Noise Monitoring Sites in the Vicinity of New Carrollton and Landover Yard



4.2.2 Vibration

Baseline vibration measurements were not conducted at residences, due to the distance between the proposed yard and the closest receptors. However, background vibration levels are dominated by existing rail operations due to Metrorail, MARC, Amtrak and CSX freight train pass-bys along the NEC located between Site M3 and the proposed Landover Yard.

5.0 ENVIRONMENTAL CONSEQUENCES

5.1 No Build Alternative

No impacts are expected to this resource under the No Build Alternative because no project elements would be constructed.

5.1.1 Noise

Future noise levels under the No Build Condition should be similar to those under the existing conditions. The area in the vicinity of the rail yard is affected by Metrorail activities at the rail yard, as well as other rail operations from MARC, Amtrak and CSX freight trains. Existing motor vehicle traffic along the Capital Beltway also contributes to the ambient noise levels. The No Build Condition would not cause any new noise impacts.

Future noise levels under the No Build Alternative are anticipated to be similar to those under existing conditions. The study area is characterized by urban communities that will continue to include several major transportation-related sources of ambient noise, such as the NEC rail corridor and traffic along the Capital Beltway.

Based on the results of the recent Metropolitan Washington Council of Governments (MWCOG) version 2.2 regional travel model and the traffic impact analysis included as part of the *Transportation Technical Memorandum* (Appendix B) of the EA, traffic in the study area is not expected to increase between 2014 and 2016; therefore, no FTA noise impacts are expected under the No Build Condition.

While the FTA criteria consider the change in noise levels from a baseline condition, the WMATA criteria for evaluating train pass-by noise impacts are based on the noise level at a point in time. Maximum measured noise levels from Metrorail operations at the rail yard (wheel squeal) range from 56 dBA at Site M2 to 62 dBA at Site M1. Neither of these noise levels exceeds the WMATA Metrorail service and inspection criterion of 75 dBA.

5.1.2 Vibration

Unlike noise, which is assessed using cumulative noise levels over one-hour and 24-hour periods, transit vibration impacts are assessed based on individual events, such as a train pass-by. Future vibration levels under the No Build Condition are expected to be similar to those currently experienced under existing conditions. Since existing vibration is dominated by existing rail traffic along the NEC, these levels are expected to remain the same under the No Build Condition. Since no project components or design elements are proposed under the No Build Condition, the alternative would not cause any new vibration impacts.

5.2 Build Alternative

5.2.1 New Carrollton Yard

Noise

Since the project would expand existing activities at New Carrollton Yard, noise from the Build Alternative was determined using the FTA prediction procedures. The FTA evaluation criteria were used to assess 24-hour impacts at residences (especially during the most sensitive nighttime period when people are sleeping), while the WMATA criteria were used to assess maximum noise from Metrorail operations at the rail yard.

Since the closest noise-sensitive sites for this project include only residential receptors, the L_{dn} descriptor was used to reflect the particularly heightened sensitivity to nighttime noise. Predicted noise levels are shown in **Table 5-1** under the Build Alternative. The table compares noise levels for representative receptor locations for existing conditions and the Build Alternative. As shown in **Table 5-1**, the future noise levels from the expanded New Carrollton Yard at the closest noise-sensitive receptors are predicted to range from 64.8 dBA at Site M1 (Lenox Court residences farthest from the Capital Beltway) to 68.6 dBA at Site M2 (Lenox Court residences closest to the Capital Beltway). Based on the result of the prediction analysis, the increase in noise between the predicted Existing or No Build Condition and the future Build Alternative at Site M2 is not predicted to exceed the FTA allowable increase criteria of 1.4 dBA for *moderate* impact. The impact analysis evaluated the cumulative noise effects from all existing and new future sources including rail operations along the NEC and yard activity at New Carrollton Yard. Overall, no exceedance of the FTA Category 2 (residential areas) *moderate* or *severe* impact criteria is predicted under the Build Alternative.

Table 5-1: Existing and Predicted Noise Levels at Select Receivers near the New Carrollton Yard – FTA Criteria

Receiver Description		FTA Cat.	Noise Metric	L_{dn} Noise Levels (dBA)				FTA Allowable Increase Criteria[1]		
				Measured	Future Conditions		Project			
ID	Address			Existing	No Build	Build	Change	MOD	SEV	Impact
M1	Lenox Court residences farthest from the Capital Beltway	2	L_{dn}	66	64.3	64.8	0.5	1.3	3.4	No
M2	Lenox Court residences closest to the Capital Beltway	2	L_{dn}	65	67.9	68.6	0.7	1.4	3.7	No

[1] The FTA criteria represent the allowable increase between the No Build and Build Alternatives.
Source: AECOM, June 2014.

Unlike the FTA criteria, which utilize a cumulative noise metric, the WMATA criteria utilize the maximum noise level from an event. As summarized in **Table 5-2**, maximum noise levels from Metrorail yard operations under the Build Alternative are predicted to range from 50 dBA at Site M2 to 62 at Site M1 due to wheel squeal at the turn-around curve. All of these noise levels are the same as the noise levels under the No Build Condition. As shown in **Table 5-2**, the No Build Condition is dominated by train operations along the Northeast Corridor (NEC), which range from 68 dBA Lmax at Site M3 to 81 dBA at Site M2. However, since the WMATA criteria do not account for the change in noise from existing conditions, maximum pass-by noise levels from Metrorail operations and activities at the yard under the Build Alternative were evaluated independently. Actual field measurements were conducted to document wheel squeal at the turn-around curve and noise from future activity levels closer to the Lenox Court residences were predicted. As a result, maximum noise levels under the Build Alternative due to yard activities are not predicted to exceed the WMATA criterion of 70 dBA at Sites M1 and M2. Therefore, no impacts are predicted at the closest residences near New Carrollton Yard due to wheel squeal or other yard activities because actual field measurements of the observed wheel squeal are well below the WMATA criterion of 70 dBA.

Vibration

Future vibration levels under the Build Alternative are expected to be similar to those currently experienced under existing conditions. Since existing vibration is dominated by existing rail traffic along the NEC rather than the rail yard, these levels are expected to remain the same under the Build Alternative. Therefore, no exceedances of the FTA or the WMATA impact criteria are expected under the Build Alternative because the yard tracks at over 400 feet away and are well outside the FTA screening distance of 200 feet.

Table 5-2: Predicted Maximum Noise Levels and WMATA Impact Criteria at Select Receivers

ID	Receiver Address	Noise Levels (dBA)			WMATA Criteria[1]	
		Existing NEC[2]	Build Alternative			
			Activities	Squeal[3]	Cat.	Limit
M1	Lenox Court residences farthest from the Capital Beltway	75	54	68	V, Ind/Hwy	70
M2	Lenox Court residences closest to the Capital Beltway	81	50	56	V, Ind/Hwy	70
M3	Residences along Parkwood Street	68	53	--	V, Ind/Hwy	70

1 The "WMATA Criteria for Noise from Transit System Ancillary Facilities" are reported for land-use Area Category III, which includes high density urban residential and average semi-residential/commercial areas.
2 NEC represents the maximum noise levels from existing train passbys along the Northeast Corridor.
3 Wheel squeal noise for the future Build Alternative are based on actual field measurements because the yard curve would not change.
Source: AECOM, June 2014.

5.2.2 Proposed Landover Yard

Noise

Since the project would introduce a new stationary source, which include general yard activities, noise from the Build Alternative was determined using the FTA prediction procedures including the criteria should in **Figure 2-2**. The FTA evaluation criteria were used to assess 24-hour impacts at residences (especially during the most sensitive nighttime period when people are sleeping), while the WMATA criteria were used to assess maximum noise from Metrorail operations at the rail yard.

Since the closest noise-sensitive sites for this project include only residential receptors, the L_{dn} descriptor was used to reflect the particularly heightened sensitivity to nighttime noise. Predicted noise levels for the Build Alternative are shown in **Table 5-3**. The table compares noise levels for one representative receptor location for Existing/No Build Conditions and the Build Alternative. As shown in **Table 5-3**, the future noise level from the proposed rail yard at the closest noise-sensitive receptor is predicted at 59 dBA at Site M3 (a residence along Parkwood Street). Based on the result of the modeling analysis, the L_{dn} noise level of 59 dBA is not predicted to exceed the FTA absolute thresholds for *moderate* impact of 62 dBA. The impact analysis evaluated the cumulative noise effects from all existing and new future sources including rail operations along the NEC and yard activity at the proposed Landover Yard. Overall, no exceedance of the FTA Category 2 (residential areas) *moderate* or *severe* impact criteria is predicted under the Build Alternative at Landover Yard.

Table 5-3: Existing and Predicted Noise Levels at Select Receivers from the Landover Yard – FTA Criteria

ID	Receiver Address	FTA Cat.	Noise Metric	Noise Levels (dBA)			FTA Absolute Criteria1		
				Measured	Future Conditions				
				Existing	No Build	Build	MOD	SEV	Impact
M3	6290 Parkwood Street	2	Ldn	67	58.7	58.9	62	67	No

1 The FTA criteria represent the absolute limits for the Build Alternative.
Source: AECOM, June 2014.

Unlike the FTA criteria that utilize a cumulative noise metric, the WMATA criteria utilize the maximum noise level from an event. As shown in **Table 5-2**, the maximum noise level from Metrorail yard operations for the Build Alternative at Site M3 is 53 dBA and therefore is not predicted to exceed the WMATA threshold of 70 dBA for Category V residences.

Vibration

Future vibration levels under the Build Alternative are expected to be similar to those currently experienced under existing conditions. Since existing vibration is dominated by existing rail traffic along the NEC rather than the rail yard, these levels are expected to remain the same under the Build Alternative. Therefore, no exceedances of the FTA or the WMATA impact criteria are expected under the Build Alternative because the yard tracks at over 600 feet are well outside the FTA screening distance of 200 feet.

5.3 Construction Impacts

Noise levels from temporary construction activities as part of the New Carrollton and Landover Yard project, could be a nuisance at nearby sensitive receptors. Noise levels during construction are difficult to predict and vary depending on the types of construction activity and the types of equipment used for each stage of work. Heavy machinery, the major source of noise in construction, is constantly moving in unpredictable patterns and is not usually at one location very long. Project construction activities could include site excavation, relocating utilities, and track laying. Although these general excavation activities typically include earth-moving equipment, heavy-duty impulsive equipment, such as pile drivers, may be utilized by the selected contractor. All construction activities would need to comply with the limits and guidelines included in the WMATA “Manual of Design Criteria” so as to minimize noise and vibration in the community.

5.4 Potential Avoidance, Minimization and Mitigation Measures

Since none of the predicted noise and vibration levels from the New Carrollton or Landover Yards is predicted to exceed the FTA or the WMATA impact criteria, no mitigation measures are required. Therefore, the proposed project is predicted to be in full compliance with all applicable noise and vibration criteria.

6.0 REFERENCES

ANSI. American National Standard S12.9-1992/Part 2. Quantities and Procedures for Description and Measurement of Environmental Sound. Part 2: Measurement of Long-term, Wide-Area Sound. Standards Secretariat, Acoustical Society of America, New York, NY.

ANSI. American National Standard S12.9-1993/Part 3. *Quantities and Procedures for Description and Measurement of Environmental Sound.* Part 3: Short-Term Measurements with an Observer Present. Standards Secretariat, Acoustical Society of America, New York, NY.

U.S. Department of Transportation, Federal Transit Administration (FTA). 2006. FTA-VA-90-1003-06. *Transit Noise and Vibration Impact Assessment.* Office of Planning and Environment. Washington, DC.

APPENDIX G-1: EXPANDED NOISE MONITORING RESULTS

Expanded Noise Monitoring Results

- Figure A-1: Noise Monitoring Results at Site M1 (Residence, Lenox Court South, New Carrollton, MD) on April 8-10, 2014
- Figure A-2: Noise Monitoring Results at Site M2 (Residence, Lenox Court South, New Carrollton, MD) on April 8-10, 2014
- Figure A-3: Noise Monitoring Results at Site M3 (Residence, 6920 Parkwood Street, Landover, MD) on April 9-10, 2014

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Figure A-1: Noise Monitoring Results at Site M1 (Residence, Lenox Court South, New Carrollton, MD) on April 8-10, 2014

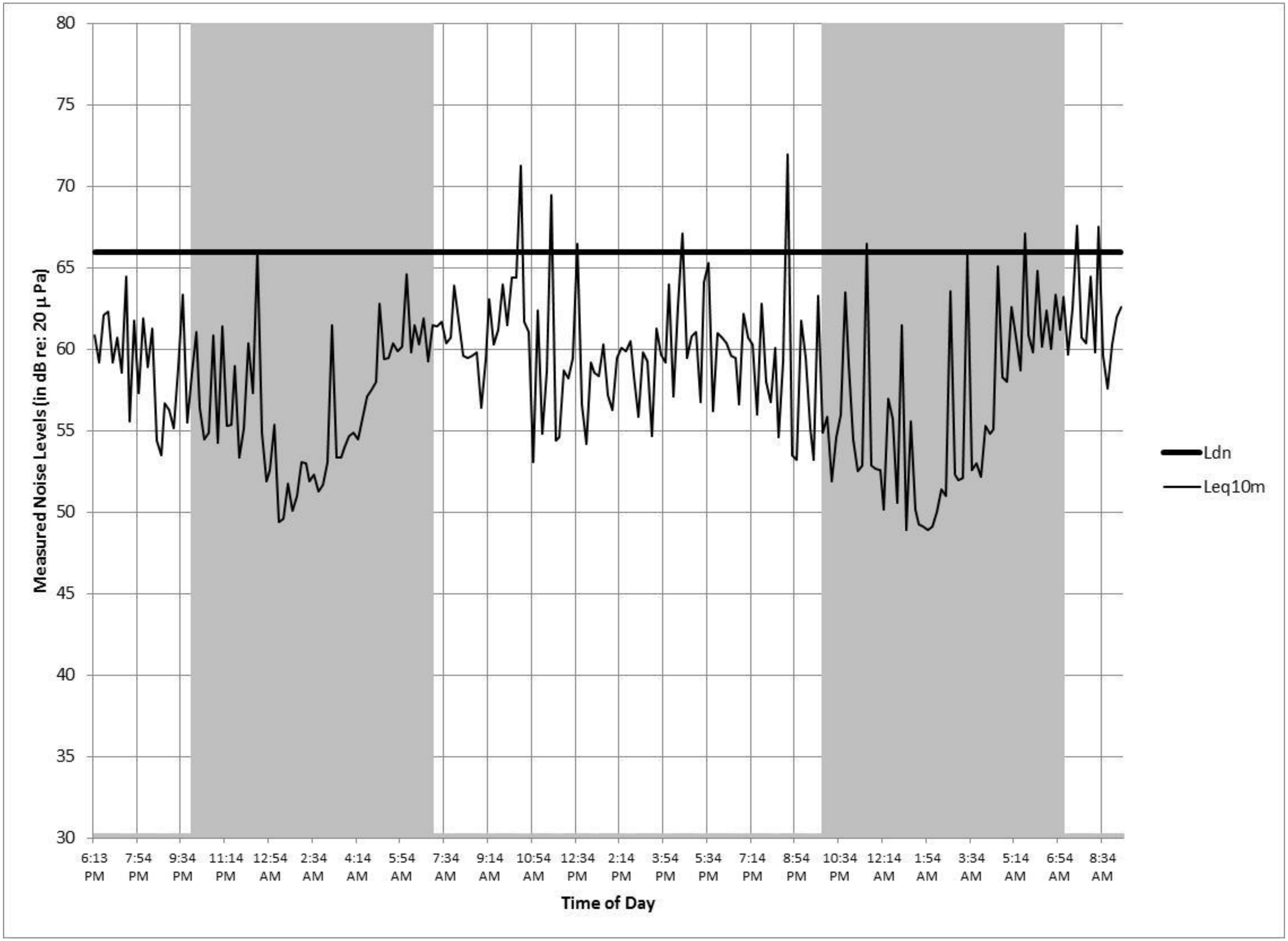

Figure A-2: Noise Monitoring Results at Site M2 (Residence, Lenox Court South, New Carrollton, MD) on April 8-10, 2014

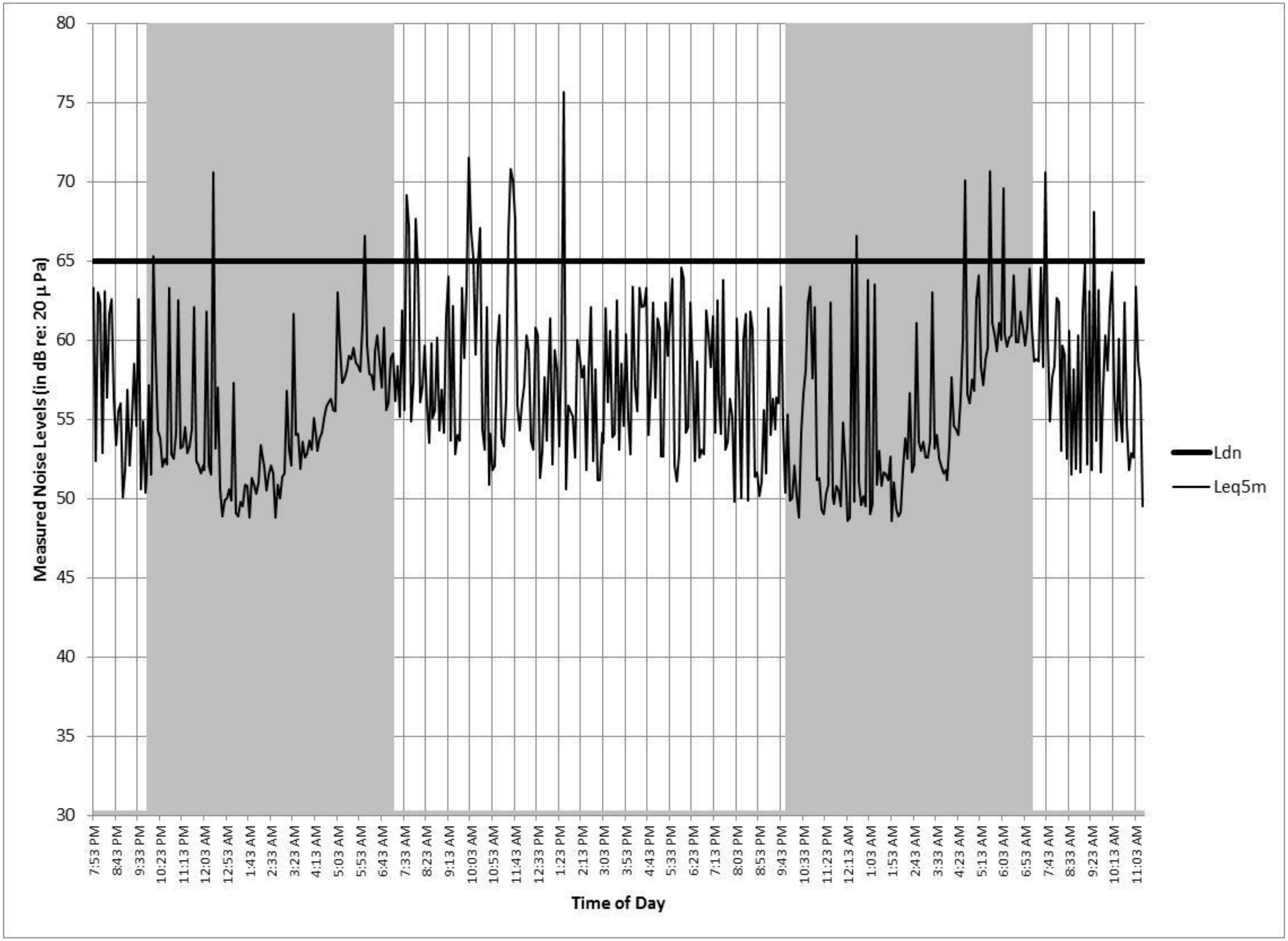

Figure A-3: Noise Monitoring Results at Site M3 (Residence, 6920 Parkwood Street, Landover, MD) on April 9-10, 2014