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## WMAL North Bethesda Phase I & II Noise Analysis

Montgomery County, Maryland

Report #180319  
Project #TLB1501

For: Toll Bros. Inc.

By: Kody Snow

## 1 EXECUTIVE SUMMARY

Phoenix Noise & Vibration has conducted an analysis of transportation noise impact upon the WMAL North Bethesda property, a proposed residential development in Montgomery County, Maryland. Dependent upon the final site configuration, the residential development will consist of single-family residences, townhomes, and MPDUs, as well as outdoor activity areas. This study was limited to noise impact from Interstate 495, Interstate 270 Spur, and Interstate 270 Spur entrance and exit ramps for Democracy Boulevard, and included:

- On-site 24-hour noise level measurements.
- Computer modeling.
- Determination of existing and future noise levels.
- Requirements to meet Montgomery County's residential noise guidelines.

Noise impact upon the WMAL property will vary with height and location; therefore, noise levels have been presented at the ground level (5.5 feet) and upper level (25 feet). All calculated noise levels are "mitigated," and account for the presence of existing residences surrounding the property, other significant structures, trees, and surrounding topography. Structures along roadways act as noise barriers, providing protection from noise exposure and reducing the impact and extent of any potential mitigation, if any, to comply with Montgomery County's recommended noise level guidelines.

According to Montgomery County's noise level guidelines, outdoor noise levels are to be maintained below 65 dBA Ldn throughout designated outdoor activity areas (i.e. parks, backyards, playgrounds, etc.). With the proposed site plan and trees present on the site within the limit of disturbance, future noise levels above 65 dBA Ldn from the surrounding roadways will encroach onto the northern and southern portion of the site. The southern bounds of the site, along Interstate 495, will experience higher levels of roadway noise than the northern bounds.

A noise barrier will be required on the southern portion of the site to provide mitigation of future transportation noise levels within the rear yards of the future homes. Due to the forest retention requirements for the site, the removal of trees within the property's bounds for the construction of a noise barrier is not possible. Therefore, to provide mitigation of noise generated from Interstate 495 upon the property, a noise barrier has been modeled within the Maryland State Highway Administration (MDSHA) right-of-way. The noise barrier on the southern portion of the property, parallel to Interstate 495, will vary in height from 18-25 feet to mitigate noise levels to below 65 dBA Ldn at the ground level.

Of the proposed residences, 74 will be impacted by noise levels greater than 65 dBA Ldn at the upper level. With the construction of the southern noise barrier, the number of residences impacted by noise levels greater than 65 dBA Ldn will decrease to 53, with the highest level of noise impact being 68 dBA Ldn. When residential units are impacted by transportation noise levels greater than 65 dBA Ldn, Montgomery County requires further analysis of the proposed structures to determine if they are capable of maintaining indoor noise levels at the indoor noise level requirement of 45 dBA Ldn.

A building shell analysis has been conducted for the proposed home models to be offered at the site. With the construction of the noise barrier on the southern portion of the property, the 53 impacted residences throughout the development will require no modifications to comply with the indoor noise requirement of 45 dBA Ldn; i.e. Toll Bros standard building construction may be used in the 53 impacted homes to maintain the required 45 dBA Ldn indoor limit.

## **2 NOISE TERMINOLOGY**

### **2.1 dB vs. dBA**

While the standard unit of measurement for sound is the decibel (dB), discussions of noise impacting the human ear use “dBA.” The “A” refers to a frequency weighting network used to simulate the human ear’s unequal sensitivity to different frequencies. The A-weighted noise level is therefore more representative of a human’s perception of a noise environment than the unweighted overall noise level in dB and is currently used in most all environmental noise studies.

### **2.2 Ldn vs. Leq**

The day-night average noise level, or Ldn, is the equivalent sound pressure level averaged over a 24-hour period, obtained by adding 10 dB to sound pressure levels measured from 10:00 p.m. to 7:00 a.m. This 10 dB “penalty” accounts for the added sensitivity caused by noise generated during the nighttime hours.

The Ldn is NOT a measurement of the instantaneous noise level. It is very possible to have several short term events (tractor trailer, emergency vehicle siren, car horn, etc.) which generate a relatively high noise level (e.g. 85 dBA) during a given time period, yet have a more moderate overall Ldn value (e.g. 65 dBA Ldn).

The equivalent-continuous sound level, or Leq, is the sound level averaged over a given time period. The Leq does not include any penalties or adjustments. Generally, it is found that the Ldn value at a receiver is greater than or equal to the loudest hour Leq when measuring transportation noise. This is due to the 10 dB “penalty” that is accounted for in the Ldn calculation. Additionally, the Ldn value increases when traffic patterns shift from day to night.

### **2.3 Summing Noise Levels**

Noise levels from multiple sources do not add arithmetically; i.e. when two noise sources generate 60 dB individually, they do not produce 120 dB when combined. Noise levels are measured using a logarithmic scale; therefore they must be summed logarithmically. In the decibel scale, two identical, non-coherent noise sources having the same noise level produce a 3 dB increase above the condition of one source alone (i.e. two 80 dB lawnmowers running at the same time generates 83 dB).

Similarly, two different noise sources with a difference of 10 dB in their individual levels results in no measureable increase in noise when they are combined. Put another way, the quieter noise source does not increase the overall noise generated by the louder source; i.e. adding an 80 dB lawnmower into a noise environment where a 90 dB lawnmower is already running does not increase the noise level above 90 dB.



### 3 NOISE GUIDELINES

Traffic noise impact for proposed residential developments in Montgomery County is governed by Table 2-1 (reprinted in Table 1) on page 8 of the *Staff Guidelines for the Consideration of Transportation Noise Impacts In Land Use Planning and Development* (June 1983).

Accompanying this table is Map 2-1 (see Figure 1), indicating recommended outdoor noise levels not to be exceeded throughout the County.

**Table 1: Maximum Levels for Exterior Noise & Building Line<sup>1</sup> For Noise Sensitive Land Uses (Table 2-1).**

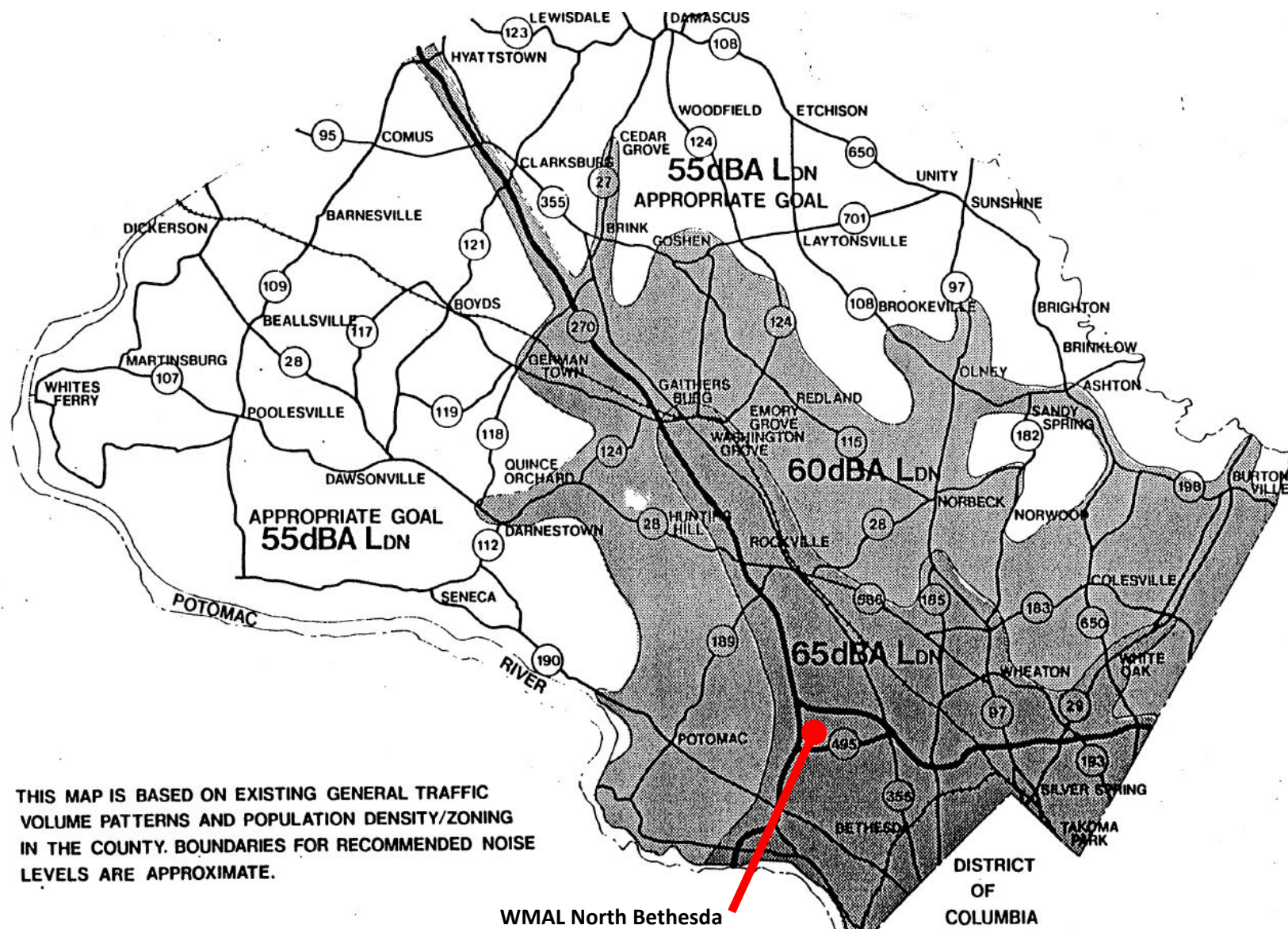
Guideline Value	Area of Application
Ldn = 55 dBA	This guideline is suggested as an appropriate goal in permanent rural areas of the County where residential zoning is for five or more acres per dwelling unit and background levels are low enough to allow maintenance of a 55 dBA Level. This guideline is consistent with Federal, State, and County goals for residential areas.
Ldn = 60 dBA	This is the basic residential noise guideline which will be applied in most areas of the County where suburban densities predominate. Maintenance of this level will protect health and substantially prevent activity interference both indoors and outdoors. Noise attenuation measures will be recommended to allow attainment of this level.
Ldn = 65 dBA	This guideline will generally be applied in the urban ring, freeway, and major highway corridor areas, where ambient levels are such that application of a stricter guideline would be infeasible or inequitable. Significant activity interference will occur outdoors and indoors if windows are partially opened, but available evidence indicates hearing is adequately protected. Noise attenuation measures will be strongly recommended to attain this level.

<sup>1</sup> Building line as used here refers to habitable structures only. It does not include garages, sheds, or recreational accessory buildings.

According to Map 2-1, the WMAL North Bethesda site is located within the 65 dBA Ldn noise zone, indicating that noise levels in outdoor activity areas throughout the site are recommended to be maintained at or below 65 dBA Ldn. Any outdoor area exposed to future transportation noise levels above 65 dBA Ldn typically requires further analysis to determine the mitigation designs necessary to comply with this recommendation.

When outdoor noise levels exceed 65 dBA Ldn, Montgomery County also requires an analysis of indoor noise levels in residential buildings. According to Sections 2.2.2 and 2.2.3 of the *Staff Guidelines*, any residential building impacted by noise levels above 65 dBA Ldn must be evaluated to certify that the building structure will be capable of maintaining indoor noise levels at 45 dBA Ldn.

Figure 1: Map 2-1 from *Staff Guidelines for the Consideration of Transportation Noise Impacts In Land Use Planning and Development* (June 1983).





## 4 SITE DESCRIPTION

WMAL North Bethesda (approximate property line shown in red in Figure 2) is located north of Interstate 495, east of the Interstate 270 Spur, and is also located south of Democracy Boulevard. In the vicinity of the site, the Interstate 270 Spur is composed of three northbound and three southbound lanes with entrance and exit lanes onto Democracy Boulevard. Interstate 495 is composed of three eastbound and three westbound lanes. Interstate 270 Spur is approximately 250 feet from the nearest property line, whereas Interstate 495 is approximately 40 feet from the nearest property line.

**Figure 2: Existing site and surroundings. Aerial image dated April 11, 2015, courtesy of Google Earth.**



## 5 NOISE MEASUREMENTS

On July 15 – 16, 2015, Phoenix Noise & Vibration conducted an on-site noise measurement survey to determine existing transportation noise levels throughout the site created by the Interstate 270 Spur and Interstate 495. This involved continuous noise level measurements and monitoring for one 24-hour period. Measurements were made using three Norsonic Type 118 and one Type 140 Precision Integrating Sound Level Meters. All meters were calibrated prior to the survey traceable to National Institute of Standards and Technology (NIST). Each meter meets the ANSI S1.4 standard for Type 1 sound level meters.

During the 24-hour measurement, noise levels were recorded and averaged over five-minute time intervals. Noise measurements were then used to calculate the site's 24-hour average day-night noise level (Ldn), which includes the 10 dBA penalty for noise levels measured during nighttime hours. Noise level measurements were made at the locations shown in Figure 3. Measurements were made at 5.5 feet (ground level, GL) and 25 feet (upper level, UL) above adjacent grade. Measurement results are presented in Table 1.

**Table 2: 24-hour noise measurement results.**

Measurement Location	Distance Above Grade (ft.)	Measured Noise Level (dBA Ldn)
A	25	64.3
B	5.5	63.7
	25	65.5
C	25	79.4

Figure 4 presents the roadway measurement results graphically, showing the noise level as measured in five-minute increments throughout the survey. Figure 4 indicates the actual measured values over the 24-hour period. While the 10 dBA nighttime penalty is not shown graphically, it was included in the Ldn calculations.

As presented in Table 2, the measured noise level at location B varied between the ground level and upper level. This difference is caused by absorption or shielding present at the ground level. At the ground level, grass, foliage, and topography provide absorption or shielding of noise generated by a roadway upon the receiving location. When determining the mitigation requirements for a multi-story residence it is valuable to know the difference in noise level at the ground and upper level, as the noise level upon the upper level (2<sup>nd</sup>-story) of residences is typically higher and will require a greater level of mitigation.

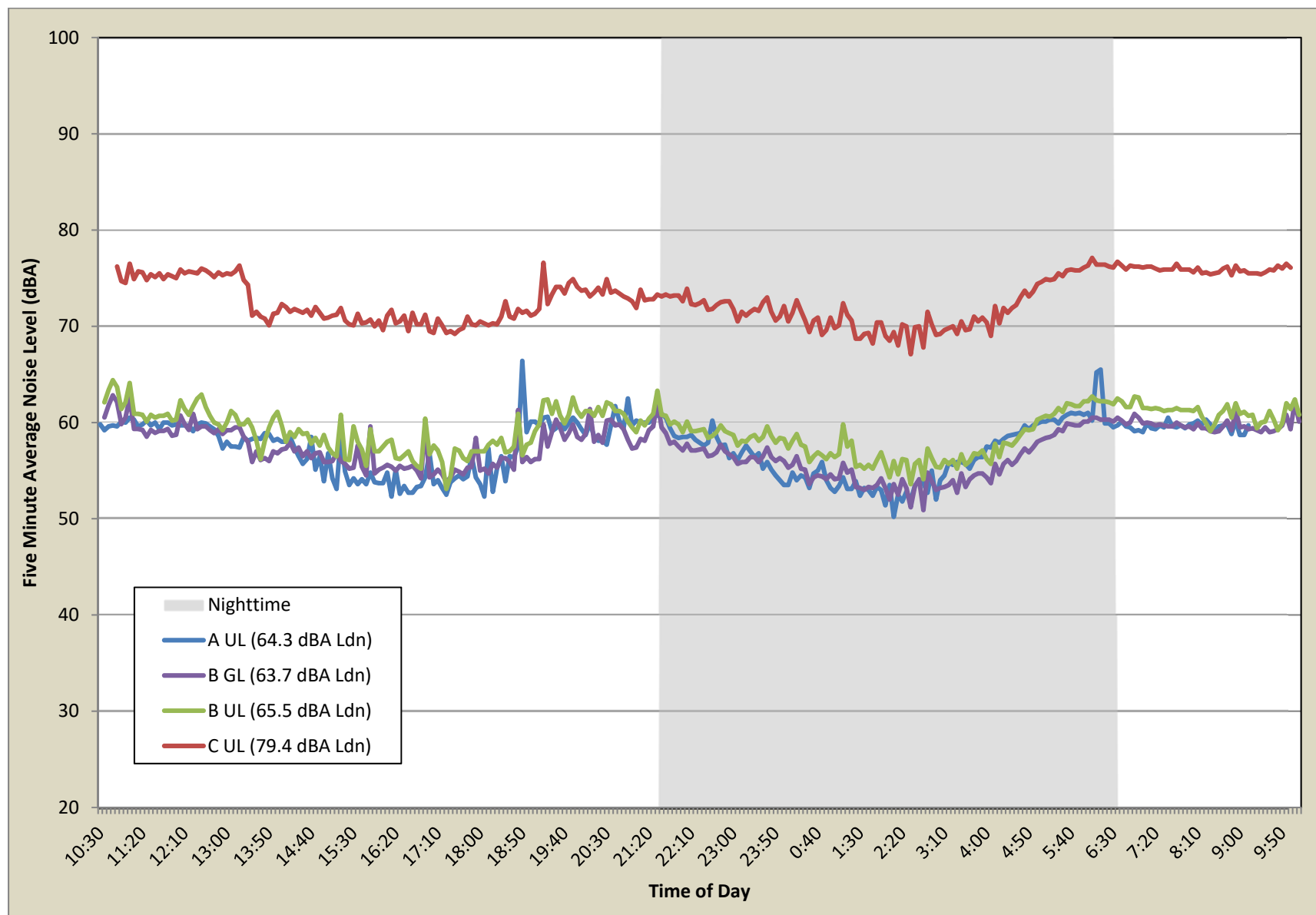
Note that some of the measurement locations contain isolated instances during the 24-hour measurement period at which the noise level appears inconsistent with the rest of the noise profile (i.e. peaks, spikes, or dips in the graph). These inconsistencies are typically due to extraneous occurrences unrelated to roadway noise, such as emergency sirens or temporary traffic congestion. Such short-term events, while producing a relatively high or low noise level and which may have a significant impact on the five-minute average, generally have an insignificant effect on the overall, 24-hour Ldn value.



Figure 3: Long-term noise measurement locations.



Figure 4: Five-minute average noise levels recorded during 24-hour noise survey.



## 6 COMPUTER MODELING

The existing site was computer modeled using the CadnaA software program, a three-dimensional noise propagation model capable of determining the noise level impact from multiple noise sources across vertical and horizontal surfaces while accounting for factors such as topography, ground absorption, reflections, and roadway data (traffic volumes, speeds, and vehicle classifications, etc.). Noise levels can be presented either in spot locations or as noise contours of equal value throughout a defined surface area.

### 6.1 Current Model

A current model was developed to simulate the existing site and its surroundings using an existing topographic map<sup>1</sup>, information taken from Montgomery County's GIS database, and data collected during the 24-hour measurement survey. The information was then used to input the existing topography, roadway alignments, and surrounding residences into the model. Calculated roadway noise levels were compared to the corrected on-site noise measurements.

Ground level and upper level unmitigated noise contours developed by the current model are presented on Drawings 2 and 3 of the Appendix, respectively. These contours represent the existing site conditions, i.e. with no buildings on the site.

### 6.2 Future Model

A future model was developed by altering the calibrated current model to include the projected roadway data, future site topography, and the buildings located within the future WMAL development.<sup>2</sup>

The future model calculated the “mitigated” noise levels throughout the site at the ground and upper level. Mitigated noise levels are calculated in the presence of future site topography, trees, and buildings, as well as all existing surrounding buildings, topography, and significant structures. Mitigated noise levels account for the effect of buildings, barriers, and other significant structures in reducing and reflecting roadway noise propagation and are more representative of the noise level actually experienced at a specific location.

Please note that the calculated future noise levels are accounting for mitigation provided by the presence of existing trees on the site. The amount of trees on the site have been limited to the outer bounds of the presented limit of disturbance (LOD), as provided on the site plan from ESE Consultants.

#### 6.2.1 Roadway Data

Average annual weekday traffic (AAWDT) volumes, vehicle percentages, and nighttime percentages were based upon the most recent data published by the Maryland State Highway Administration (MDSHA), as shown in Table 3.

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<sup>1</sup> Map of topography for the WMAL site was provided by ESE Consultants Inc., dated 30 October 2017.

<sup>2</sup> Site plan provided by ESE Consultants in AutoCAD format on 6 March 2018.



To estimate the future traffic volumes for Interstate 495 and the Interstate 270 Spur within the vicinity of the site, information published by MDSHA was used to determine the growth rate for the two roadways.<sup>3</sup> Within the published document, MDSHA provided the current (2017) annual average daily traffic (AADT) volumes and projected (2035) AADT volumes for Interstate 270 and the east and west Interstate 270 spurs. Based upon the provided AADTs, the MDSHA projects a growth rate of 0.3-0.5% over the 18-year period. While a growth rate of 0.3-0.5% was projected by MDSHA, a more conservative growth rate of 1% was used for the Interstate 270 spur and Interstate 495.

The 1% growth rate is based upon information provided by the traffic engineer for the project.<sup>4</sup> An analysis of an 8-year period and an 11-year period of the most recent AADT volumes on I-495 was completed, which showed a change of 0.5% and 1.2%, respectively. Therefore, it was advised by Wells + Associates that a 1% growth rate could be used for I-495 and the I-270 spur, while still remaining conservative. Please note that this is a decrease from the 2% growth rate previously used for this analysis.<sup>5</sup>

A growth rate was not provided for the ramps for Democracy Boulevard, therefore a conservative 2% increase in traffic compounded annually until 2038 was assumed.<sup>6</sup>

**Table 3: Roadway traffic data used in the computer models.**

Roadway	Existing AAWDT	2038 AAWDT	Nighttime Volume %	Truck %	Posted Speed Limit (mph)
I-270 Northbound Spur	73,581	90,681	15	9	55
I-270 Southbound Spur	67,739	83,481	24	8	55
I-270 NB Ramp onto Democracy Blvd EB	4,301	9,987	11	4	35
I-270 NB Ramp onto Democracy Blvd WB	4,166	6,314	8	4	35
Democracy Blvd EB Ramp onto I-270 NB	3,568	5,408	5	4	35
Democracy Blvd EB Ramp onto I-270 SB	3,646	5,526	10	4	35
Democracy Blvd WB Ramp onto I-270 SB	4,301	6,519	6	4	35
I-495 Eastbound	54,311	66,270	17	8	55
I-495 Westbound	61,314	74,815	19	8	55

<sup>3</sup> MDSHA – Montgomery County Interstate Construction Program, dated 1 December 2017.

<sup>4</sup> Anne M. (Nancy) Randall, AICP, Principal of Wells + Associates.

<sup>5</sup> Phoenix Noise & Vibration Report #150730, WMAL North Bethesda Phase I Noise Analysis, dated 25 April 2017.

<sup>6</sup> Montgomery County typically requires that roadway noise impact studies be conducted using the projected traffic volumes 20 years from the date of the study.



## **7 FUTURE NOISE IMPACT**

Future mitigated (i.e. with the presence of future buildings on the site) roadway noise levels at the ground and upper level are presented on Drawings 4 and 5 of the Appendix, respectively. With the future site conditions, both the ground and upper level future 65 dBA Ldn mitigated noise contours will be located within the property's bounds. Transportation noise levels generated by Interstate 495 will travel further onto the southern portion of the site than noise levels generated by the Interstate 270 Spur upon the northern portion of the site.

Though the site will be impacted by future noise levels greater than 65 dBA Ldn, compliance with Montgomery County's recommend noise level guidelines can be achieved with reasonable modifications to the site. Based upon the future mitigated ground level noise levels, 25 lots on the southern portion of the property will be impacted by noise levels above 65 dBA Ldn at the ground level. Mitigation in the form of a noise barrier will be required to provide mitigation for the rear yards of the residences and provide compliance with Montgomery County's noise level guidelines, see the mitigation section below for more detail. All other outdoor activity areas within the property will be exposed to noise levels less than 65 dBA Ldn, further mitigation is not required for those areas.

Furthermore, 72 of the proposed residences will be impacted by transportation noise levels between 65 and 73 dBA Ldn at the upper level. All other residences throughout the development will not be exposed to future transportation noise levels greater than 65 dBA Ldn.

## **8 MITIGATION**

According to Montgomery County's noise level guidelines for residential development, residential sites and buildings impacted by noise levels above 65 dBA Ldn require further analysis to determine the mitigation measures necessary to maintain noise levels in outdoor activity areas and indoor living spaces at 65 and 45 dBA Ldn, respectively.

### **8.1 Outdoor Mitigation**

As shown on Drawing 4, it has been determined that the future ground level 65 dBA Ldn mitigated noise contour will be located within the rear yards of residences on the southern portions of the site. Therefore, it is required that a noise barrier be constructed to reduce outdoor noise levels to below 65 dBA Ldn within the rear yard of the residences and provide compliance with Montgomery County's noise level guidelines.

Due to the forest retention requirements placed upon the WMAL property, the removal of trees for the construction of a noise barrier on the southern portion of the property is not possible, which creates a limitation on the placement of noise barriers for mitigation of roadway noise. As previously discussed, transportation noise from Interstate 495 impacts the southern portion of the property more than the Interstate 270 Spur upon the northern portion.

To provide mitigation upon the southern portion of the property a noise barrier has been modeled within the MDSHA right-of-way. The proposed barrier was modeled parallel to Interstate 495, connecting to the existing noise barrier to the east and stopping at the bridge for Greentree Road.

With the future site conditions, the barrier will be required to have a height of 18-25 feet above the existing grade to provide mitigation of the future 65 dBA Ldn ground level noise contour. See Drawings 6 and 7 of the Appendix for the barrier location.

## **8.2 Indoor Mitigation**

When a residential structure is impacted by transportation noise levels which exceed a governing threshold (65 dBA Ldn), further analysis (a “building shell analysis”) is required to determine if proposed building structures will be capable of reducing exterior noise levels to an acceptable indoor level.

With the construction of the noise barrier along Interstate 495, noise levels will be reduced to below 65 dBA Ldn within the rear yards of the 25 lots on the southern portion of the property. Additionally, the number of residences impacted by noise levels greater than 65 dBA Ldn will decrease from 72 to 53. The highest level of noise impact will also decrease from a level of 73 dBA Ldn to 68 dBA Ldn.

### **8.2.1 Building Shell Analysis**

A building shell analysis calculates the noise reduction provided by an exterior building partition (i.e. the composite assembly of the wall and any windows and doors) and the resulting interior noise level when impacted by a specific outdoor noise level. The noise reduction provided by an exterior partition is dependent upon the surface area each building element composing the partition occupies and the STC rating<sup>7</sup> of the individual elements.

STC ratings apply to one individual element. The composite STC rating is the overall STC rating of a partition with multiple elements (e.g. a wall with a window) and is usually controlled by the building element with the lowest individual STC rating. In residential construction, this is almost always the glass (windows and doors); therefore, the percentage of the exterior wall occupied by glass becomes critical. This also means the amount of outdoor noise heard inside a unit is primarily dependent on the glass percentage and STC rating, not the wall STC rating.

A building shell analysis was conducted for the 53 impacted residential lots. This analysis was conducted for the Toll Bros home models to be offered at the WMAL property:

- 24' Interior Town Home
- 24' End Town Home
- 35' Master Down
- 35' Master Up (Center Courtyard)
- 35' Master Up (Rear Yard)
- 45' Master Down
- 45' Master Up (2-Car Garage)
- 45' Master Up (3-Car Garage)

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<sup>7</sup> The Sound Transmission Class (STC) rating is a single number value which indicates a building element's (wall, window, door, roof, etc.) ability to reduce noise transmission from one side of the element to the other.

Room dimensions, window/door sizes, and exterior façade constructions were taken from architectural drawings and building elevations provided by Toll Bros. This information was accounted for in the building shell analysis calculations to determine the building element STC ratings necessary for all rooms to be below 45 dBA Ldn.

### 8.2.2 STC Ratings

The exterior noise impact upon each lot was first evaluated using Toll Bros' standard building construction (shown in Table 4) to determine if modifications (increased window and/or door STC ratings, exterior wall construction) will be required to maintain interior noise levels below 45 dBA Ldn. The respective window and door STC ratings are from Andersen Windows and Doors 400 Series product line.

**Table 3: Toll Bros' standard building construction.**

Building Element	Product Series	STC Rating of Standard Product
Fiber Cement Exterior Walls <sup>8</sup>	N/A	43 (est.)
Brick Exterior Walls	N/A	56 (est.)
Operating & Fixed Windows	Andersen 400 Series	27
Sliding Glass Doors		31
Patio Doors		31
Foyer Entry Doors		30

When exposed to a projected transportation noise level up to 68 dBA Ldn, Toll Bros' standard building construction will be capable of maintaining indoor noise levels below 45 dBA Ldn for the home models to be offered at WMAL. Modifications to exterior walls and proposed windows and doors will not be required for any of the 53 impacted residences to comply with the Montgomery County's indoor noise limit.

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<sup>8</sup> Exterior wall STC ratings are based upon a construction consisting of 2x4 wood studs, a minimum exterior layer of either ½-inch exterior grade drywall, OSB, or plywood with an interior layer of drywall and 3½ inches of fiberglass batt in the cavity.

## 9 CONCLUSION

Due to transportation noise generated by Interstate 495, the Interstate 270 spur, and the Interstate 270 spur exit/entrance ramps, 72 of the proposed residences at the WMAL site will be impacted by future transportation noise levels above 65 dBA Ldn, with a maximum noise level of 73 dBA Ldn. The addition of a noise barrier at the southern boundary of the site will provide mitigation of transportation noise at the ground and upper level, reducing the number of residences impacted by noise levels greater than 65 dBA Ldn to 53 at the upper level. Furthermore, the maximum level of noise impact upon residences will be reduced to 68 dBA Ldn with the noise barrier.

With the construction of the proposed noise barrier, noise levels greater than 65 dBA Ldn at the ground level will be reduced to within Montgomery County's outdoor noise level guidelines of 65 dBA Ldn for impacted residences. All outdoor activity areas throughout the residential development will be below 65 dBA Ldn at the ground level, as required by Montgomery County.

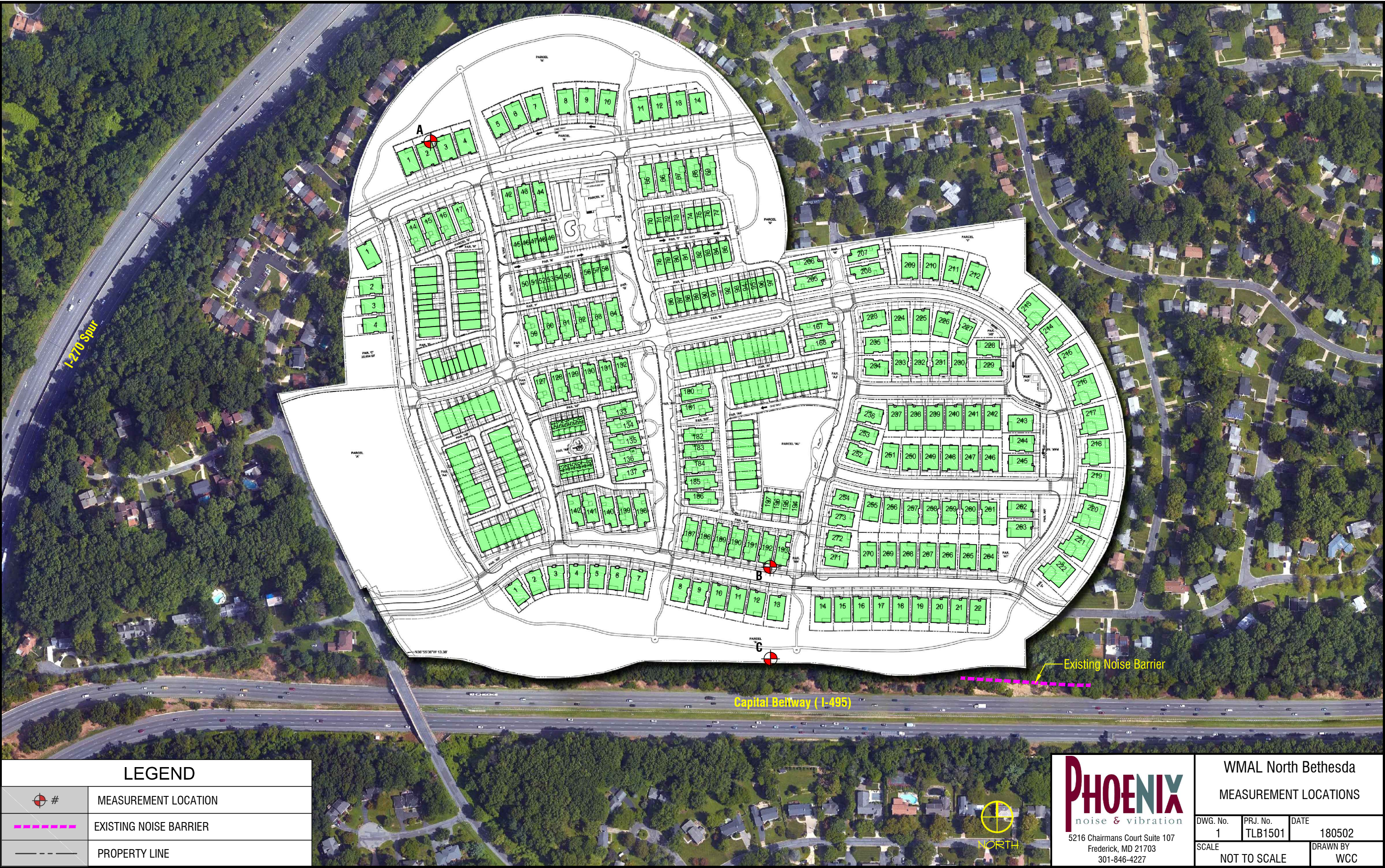
An analysis of the architecture for the proposed home models has been conducted. With the construction of the barrier along the southern portion of the property, modifications to Toll Bros' standard building construction will not be required for the 53 impacted residences. Stated differently, fiber cement and brick exterior walls, along with the standard window and door products will be capable of maintaining interior noise levels below 45 dBA Ldn for these residences.

The remaining residences will not be impacted by noise levels above 65 dBA Ldn. These residences will meet Montgomery County's indoor noise level requirement of 45 dBA Ldn with Toll Bros' standard building construction.

**Please Note:** The results of this Phase I & II Noise Analysis have been based upon the site and architectural information made available at the time of this study, including existing and proposed topography, existing and roadway alignments, projected roadway traffic volumes, the proposed building layout, and proposed building architecture. Should any of this information be altered, additional analysis will be required to determine if the results and recommendations presented herein are capable of reducing outdoor and indoor noise levels to comply with Montgomery County's recommend noise level guidelines for residential development.

## **APPENDIX**





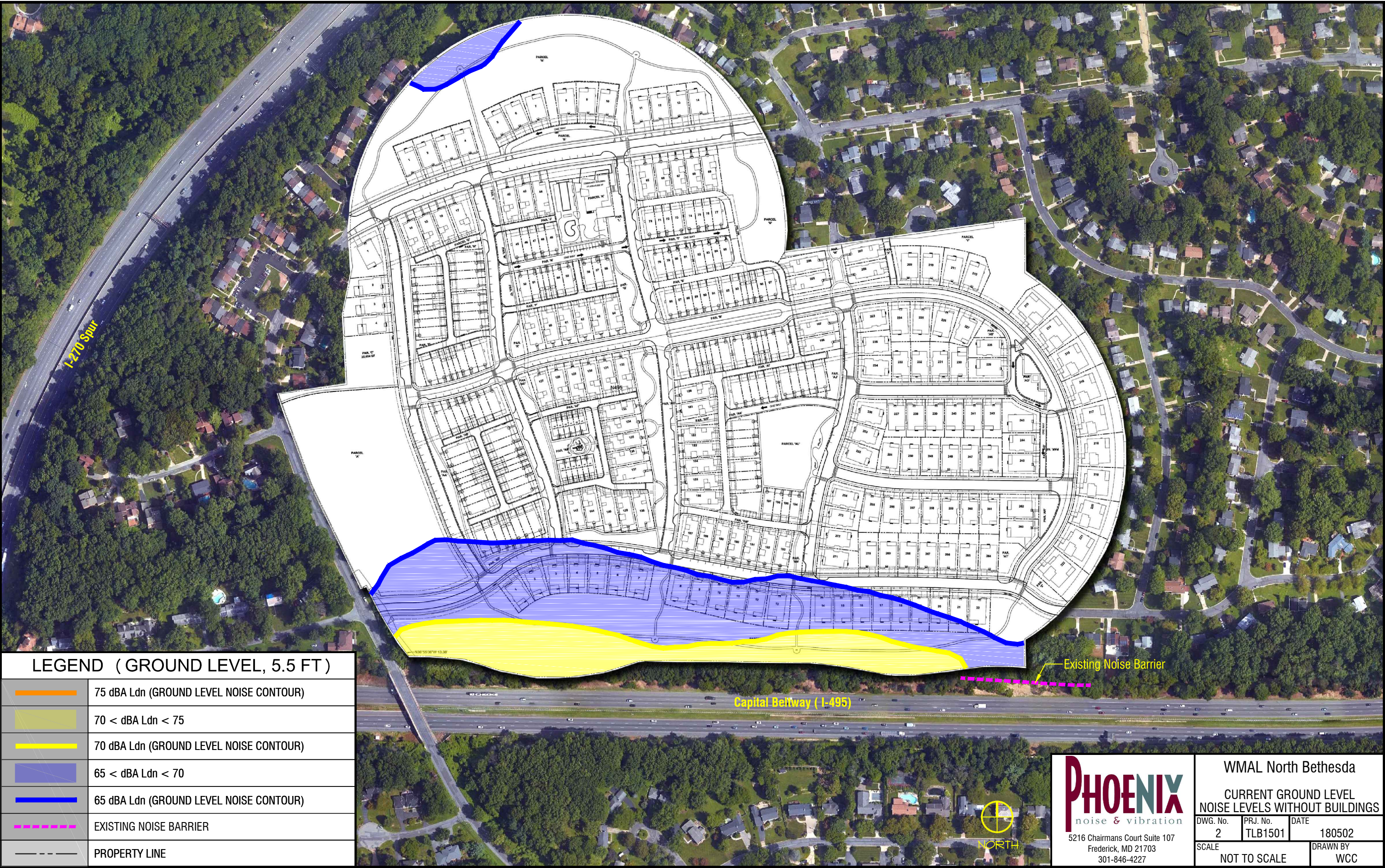
LEGEND

	MEASUREMENT LOCATION
	EXISTING NOISE BARRIER
	PROPERTY LINE

**PHOENIX**  
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5216 Chairmans Court Suite 107  
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301-846-4227

WMAL North Bethesda MEASUREMENT LOCATIONS		
DWG. No. 1	PRJ. No. TLB1501	DATE 180502
SCALE NOT TO SCALE		DRAWN BY WCC





LEGEND ( GROUND LEVEL, 5.5 FT )	
	75 dBA Ldn (GROUND LEVEL NOISE CONTOUR)
	70 < dBA Ldn < 75
	70 dBA Ldn (GROUND LEVEL NOISE CONTOUR)
	65 < dBA Ldn < 70
	65 dBA Ldn (GROUND LEVEL NOISE CONTOUR)
	EXISTING NOISE BARRIER
	PROPERTY LINE

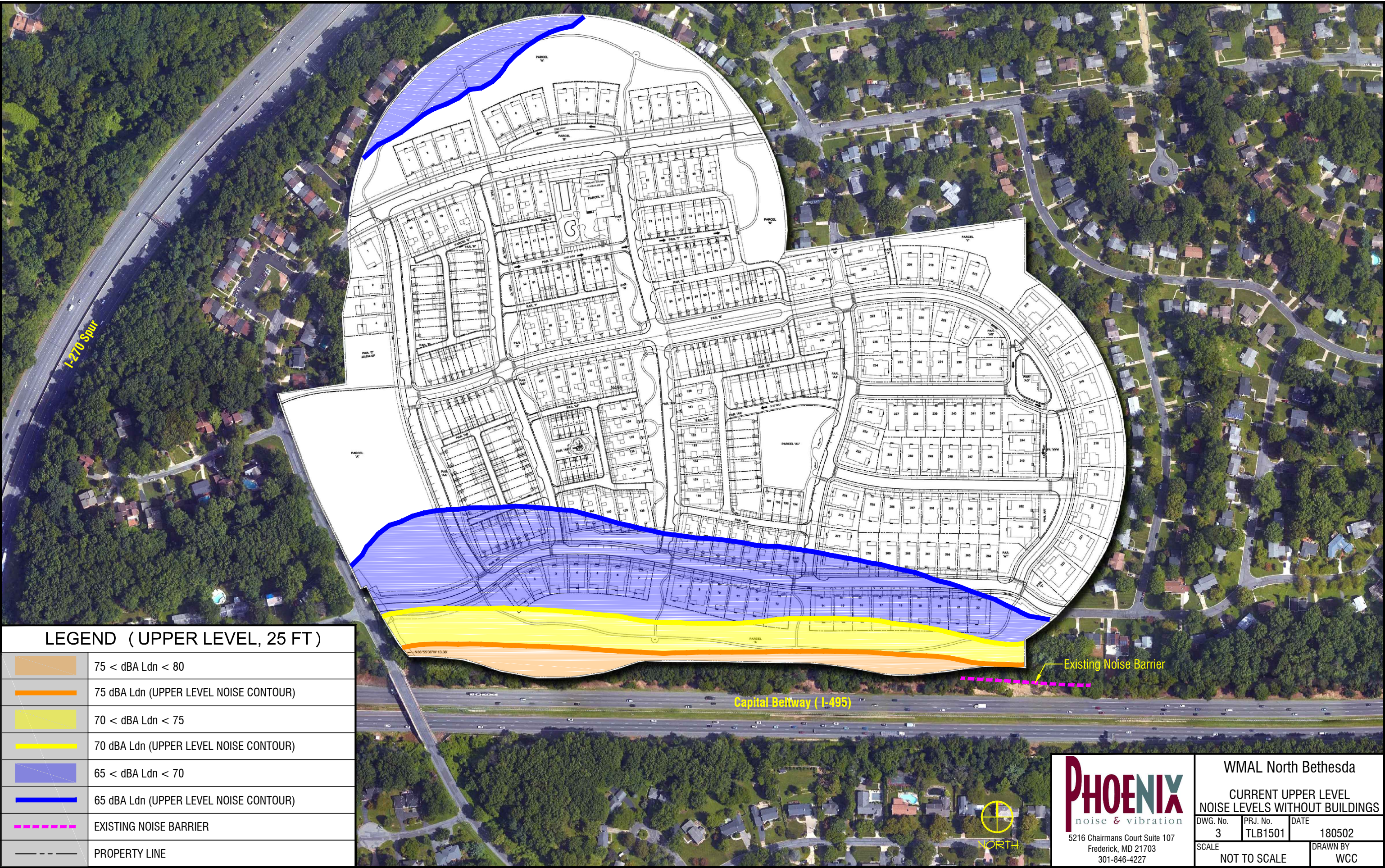
5216 Chairmans Court Suite 107  
Frederick, MD 21703  
301-846-4227

WMAL North Bethesda

CURRENT GROUND LEVEL  
NOISE LEVELS WITHOUT BUILDINGS

DWG. No. 2	PRJ. No. TLB1501	DATE 180502
SCALE NOT TO SCALE		DRAWN BY WCC





LEGEND ( UPPER LEVEL, 25 FT )

	75 < dBA Ldn < 80
	75 dBA Ldn (UPPER LEVEL NOISE CONTOUR)
	70 < dBA Ldn < 75
	70 dBA Ldn (UPPER LEVEL NOISE CONTOUR)
	65 < dBA Ldn < 70
	65 dBA Ldn (UPPER LEVEL NOISE CONTOUR)
	EXISTING NOISE BARRIER
	PROPERTY LINE

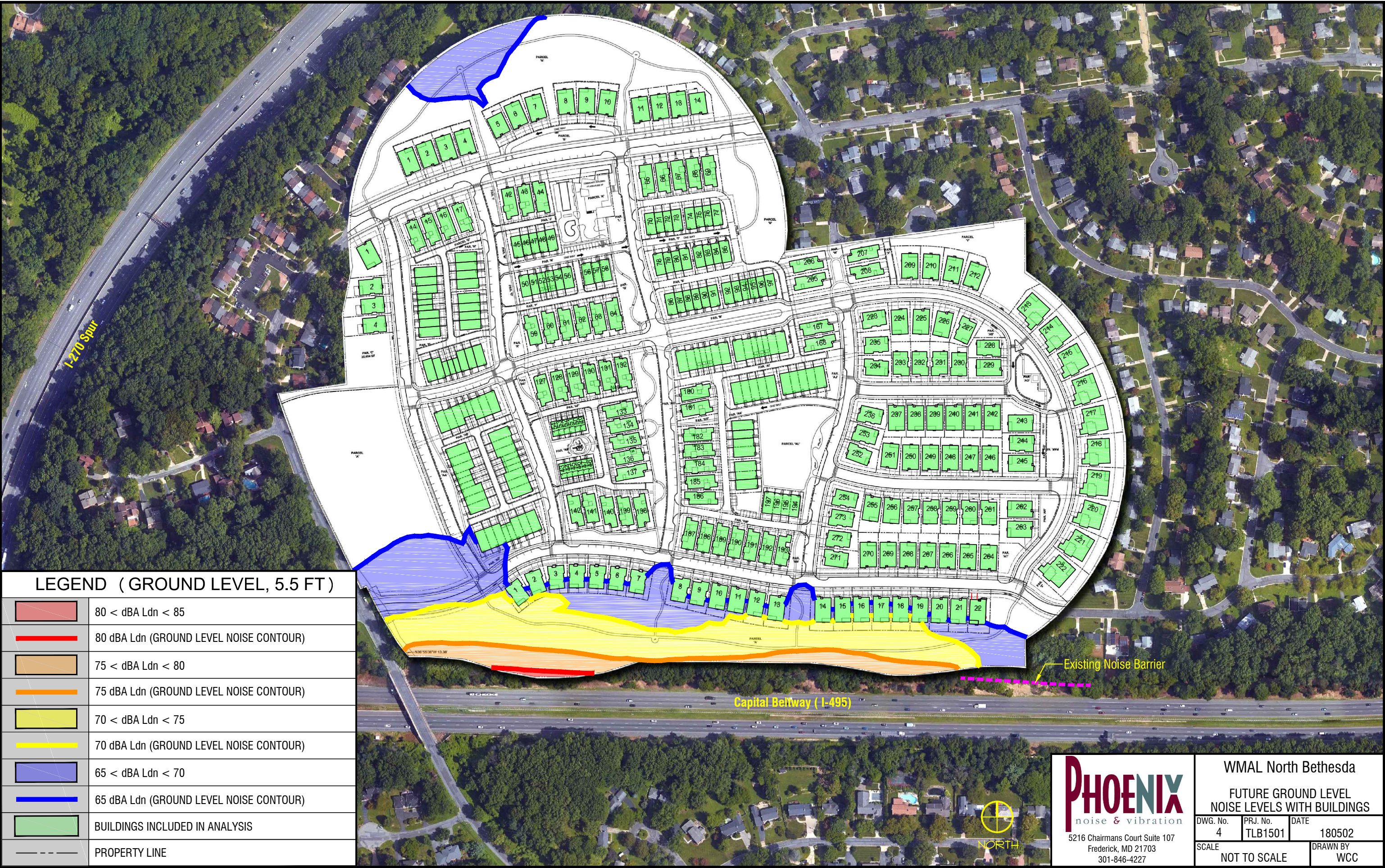
5216 Chairmans Court Suite 107  
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301-846-4227

WMAL North Bethesda

CURRENT UPPER LEVEL  
NOISE LEVELS WITHOUT BUILDINGS

DWG. No. 3	PRJ. No. TLB1501	DATE 180502
SCALE NOT TO SCALE		DRAWN BY WCC





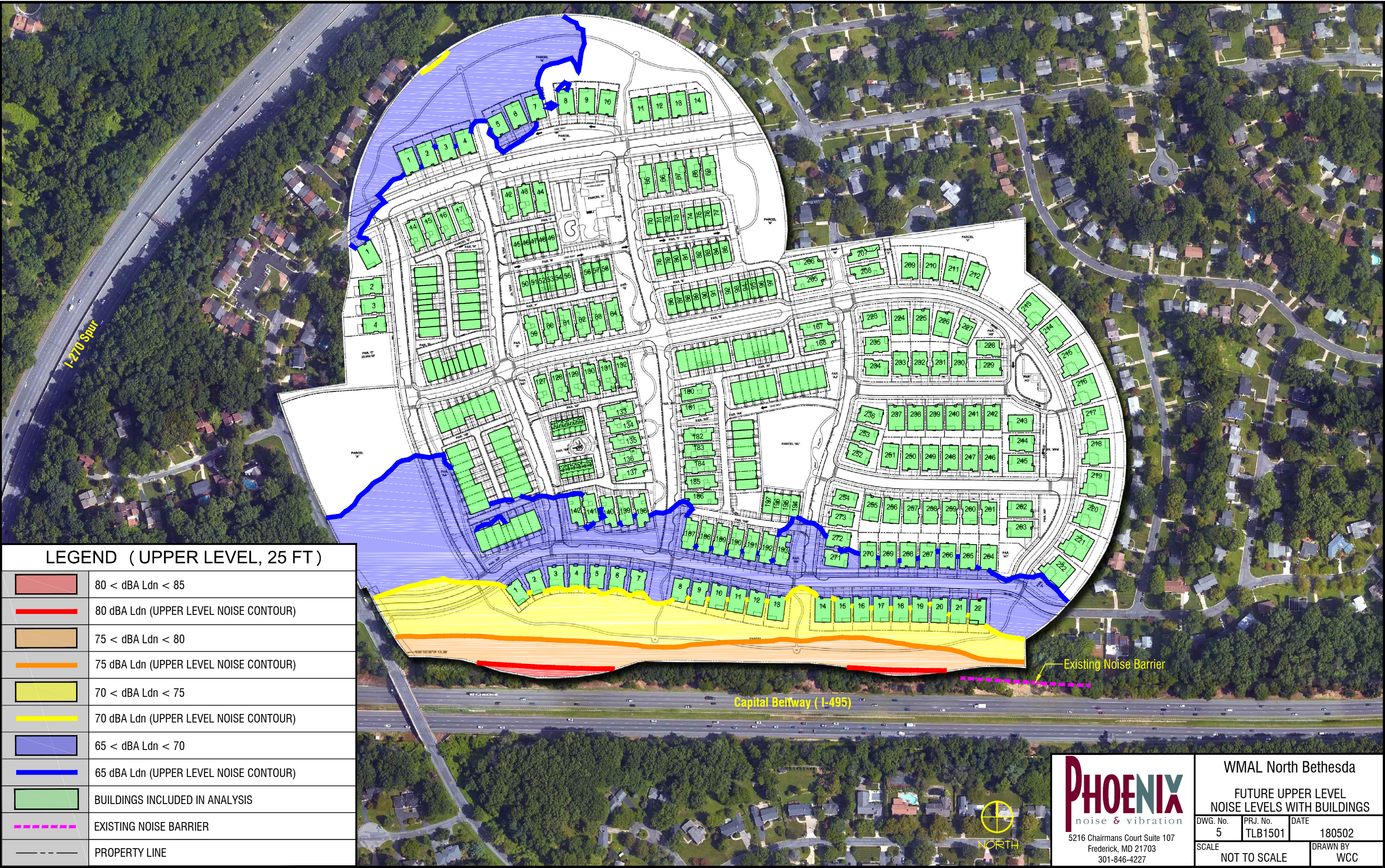
LEGEND ( GROUND LEVEL, 5.5 FT)

	80 < dBA Ldn < 85
	80 dBA Ldn (GROUND LEVEL NOISE CONTOUR)
	75 < dBA Ldn < 80
	75 dBA Ldn (GROUND LEVEL NOISE CONTOUR)
	70 < dBA Ldn < 75
	70 dBA Ldn (GROUND LEVEL NOISE CONTOUR)
	65 < dBA Ldn < 70
	65 dBA Ldn (GROUND LEVEL NOISE CONTOUR)
	BUILDINGS INCLUDED IN ANALYSIS
	PROPERTY LINE

**PHOENIX**  
noise & vibration  
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WMAL North Bethesda		
FUTURE GROUND LEVEL NOISE LEVELS WITH BUILDINGS		
DWG. No. 4	PRJ. No. TLB1501	DATE 180502
SCALE NOT TO SCALE	DRAWN BY WCC	





LEGEND ( UPPER LEVEL, 25 FT )	
<div></div>	80 < dBA Ldn < 85
<div></div>	80 dBA Ldn (UPPER LEVEL NOISE CONTOUR)
<div></div>	75 < dBA Ldn < 80
<div></div>	75 dBA Ldn (UPPER LEVEL NOISE CONTOUR)
<div></div>	70 < dBA Ldn < 75
<div></div>	70 dBA Ldn (UPPER LEVEL NOISE CONTOUR)
<div></div>	65 < dBA Ldn < 70
<div></div>	65 dBA Ldn (UPPER LEVEL NOISE CONTOUR)
<div></div>	BUILDINGS INCLUDED IN ANALYSIS
<div></div>	EXISTING NOISE BARRIER
<div></div>	PROPERTY LINE

PHOENIX

noise & vibration

5216 Chairmans Court Suite 107

Frederick, MD 21703

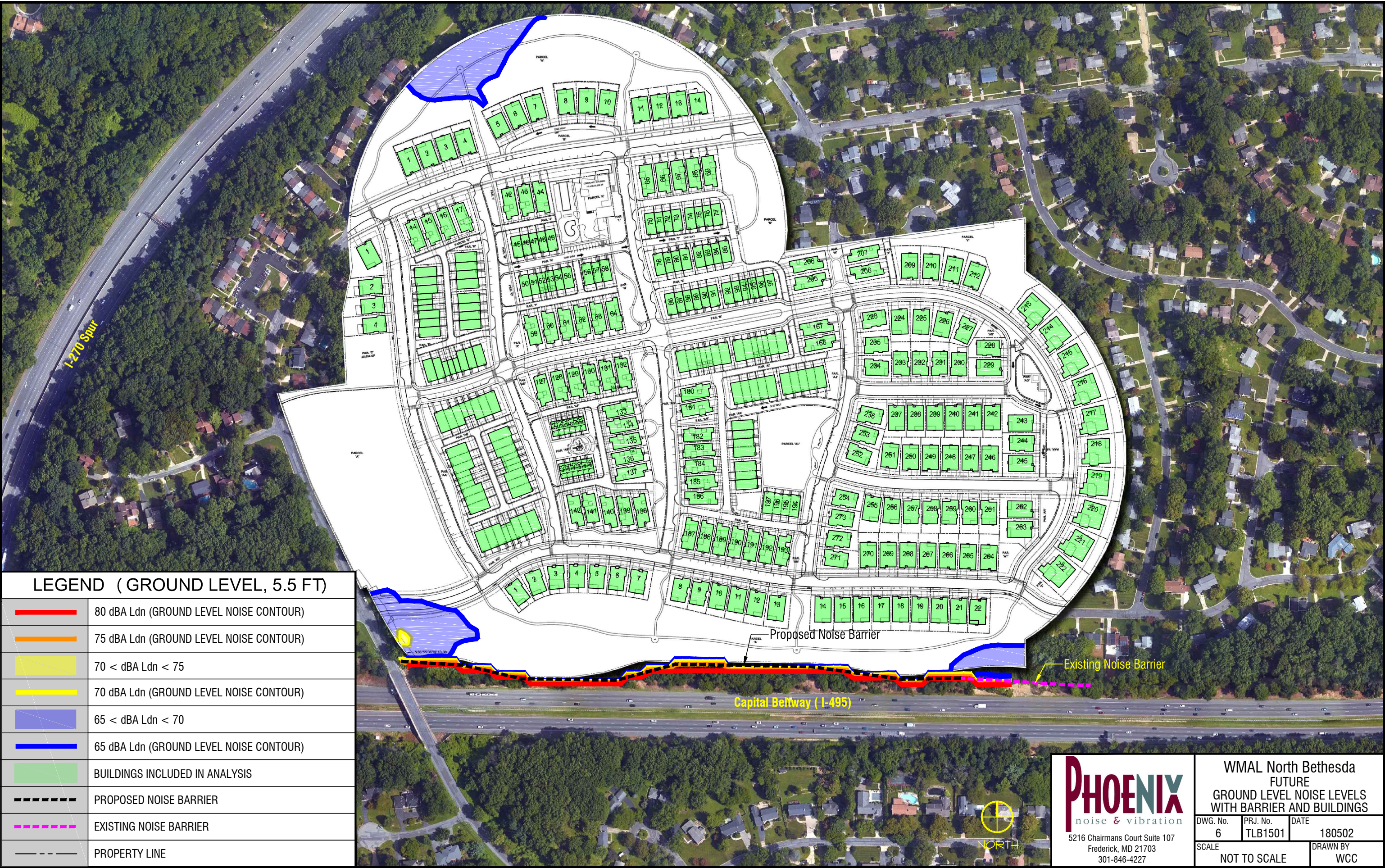
301-846-4227

WMAL North Bethesda

FUTURE UPPER LEVEL NOISE LEVELS WITH BUILDINGS

DWG. No.	PRJ. No.	DATE
5	TLB1501	180502
SCALE	DRAWN BY	
NOT TO SCALE	WCC	





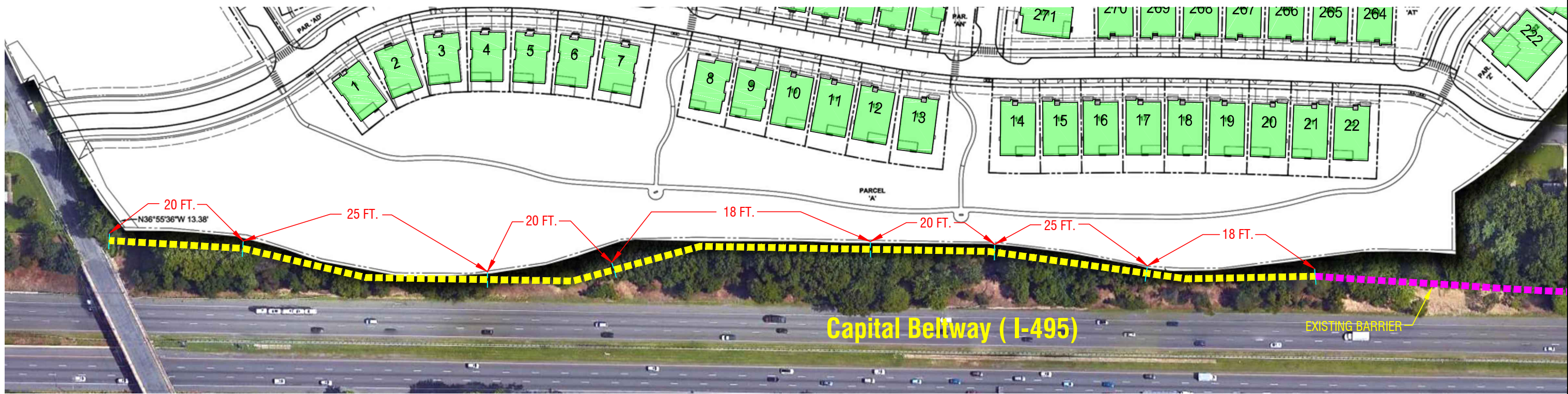
LEGEND ( GROUND LEVEL, 5.5 FT)

	80 dBA Ldn (GROUND LEVEL NOISE CONTOUR)
	75 dBA Ldn (GROUND LEVEL NOISE CONTOUR)
	70 < dBA Ldn < 75
	70 dBA Ldn (GROUND LEVEL NOISE CONTOUR)
	65 < dBA Ldn < 70
	65 dBA Ldn (GROUND LEVEL NOISE CONTOUR)
	BUILDINGS INCLUDED IN ANALYSIS
	PROPOSED NOISE BARRIER
	EXISTING NOISE BARRIER
	PROPERTY LINE

**PHOENIX**  
noise & vibration  
5216 Chairmans Court Suite 107  
Frederick, MD 21703  
301-846-4227

WMAL North Bethesda FUTURE GROUND LEVEL NOISE LEVELS WITH BARRIER AND BUILDINGS		
DWG. No. 6	PRJ. No. TLB1501	DATE 180502
SCALE NOT TO SCALE		DRAWN BY WCC





SOUTHERN BARRIER LOCATION

LEGEND	
	TOP OF WALL (NOISE BARRIER) ABOVE GRADE
	BUILDINGS INCLUDED IN ANALYSIS
	PROPOSED NOISE BARRIER
	EXISTING NOISE BARRIER



5216 Chairmans Court Suite 107  
Frederick, MD 21703  
301-846-4227

WMAL North Bethesda  
ENLARGED VIEWS  
OF SOUTHERN NOISE BARRIER

DWG. No. 7	PRJ. No. TLB1501	DATE 180502
SCALE NOT TO SCALE		DRAWN BY WCC