4900 Moorland Lane
Phase I Noise Analysis

Montgomery County, Maryland

Report No. 180220
Project No. ZOM1801

For: ZOM Mid-Atlantic

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1. EXECUTIVE SUMMARY

Phoenix Noise & Vibration has conducted an analysis of transportation noise impact upon 4900 Moorland Lane, a proposed multistory building in Montgomery County, Maryland. Upon completion, the building will contain six residential floors, two levels of underground parking, and rooftop pool and terrace areas. This study, limited to noise impact from surrounding roadways, primarily Arlington Road, Edgemoor Lane, and Moorland Lane, included:

- 24-hour noise level measurements and computer modeling.
- Determination of existing and future noise levels.
- Preliminary mitigation recommendations to meet Montgomery County’s residential noise regulations.

Noise impact at 4900 Moorland Lane will vary with height; therefore, impact has been presented at the ground level throughout the site and across all future building façades. Impact is presented in varying levels of noise indicating the future roadway noise level. The noise levels presented are due only to surrounding roadways and do not account for noise from other sources such as construction, mechanical noise, environmental noise, etc.

Calculated noise levels upon the property, future building façades, and the rooftop are “mitigated,” accounting for the presence of existing topography, surrounding buildings, and significant structures, as well as the future building. Structures along roadways act as noise barriers, providing protection from noise exposure and reducing the impact and extent of any potential mitigation required, if any, to comply with Montgomery County’s noise regulations.

Noise levels throughout the rooftop amenity areas, including the pool and terrace areas, will be below 65 dBA Ldn. Additional mitigation for these outdoor areas will not be required.

Most residential units located on the west elevation and less than half of the residential units located on the north and south elevations will be exposed to future transportation noise levels above 65 dBA Ldn (and up to 67 dBA Ldn along the lower levels of the west elevation facing Arlington Road). These units require further analysis to determine whether the proposed building architecture will be capable of maintaining interior noise levels at the required limit. This analysis can only be conducted once architectural plans are further developed, typically after the Design Development drawing submission. If necessary, interior noise levels can be maintained below 45 dBA Ldn by increasing the sound transmission class (STC) ratings of the exterior building components.

The remaining residential units, including the entire east elevation, most of the north and south elevations, and a small portion on the west elevation, will not be exposed to future transportation noise levels above 65 dBA Ldn. Modifications to these units will not be required; i.e. the building’s planned exterior walls and standard windows/doors can be used to maintain interior noise levels below 45 dBA Ldn.
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**

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).

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 measurable 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 Regulation

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 outdoor noise level requirements not to be exceeded throughout the County.

Table 1: Maximum Levels for Exterior Noise & Building Line\(^1\) For Noise Sensitive Land Uses (Table 2-1).

<table>
<thead>
<tr>
<th>Guideline Value</th>
<th>Area of Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ldn = 55 dBA</td>
<td>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.</td>
</tr>
<tr>
<td>Ldn = 60 dBA</td>
<td>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 interiors and outdoors. Noise attenuation measures will be recommended to allow attainment of this level.</td>
</tr>
<tr>
<td>Ldn = 65 dBA</td>
<td>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 interiors if windows are partially opened, but available evidence indicates hearing is adequately protected. Noise attenuation measures will be strongly recommended to attain this level.</td>
</tr>
</tbody>
</table>

\(^1\)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, 4900 Moorland Lane is located within the 65 dBA Ldn noise zone, indicating that noise levels in outdoor activity areas throughout the site should be maintained at 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 requirement.

When outdoor noise levels exceed 65 dBA Ldn, Montgomery County also requires an analysis of interior 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 interior 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).

This map is based on existing general traffic volume patterns and population density/zoning in the county. Boundaries for recommended noise levels are approximate.

4900 Moorland Lane
4. **SITE DESCRIPTION**

4900 Moorland Lane (shown in Figure 2, building outline in red) is located to the east of Arlington Road, north of Edgemoor Lane, and south of Moorland Lane.

In the vicinity of the site, Arlington Road is composed of two northbound and two southbound lanes, while Edgemoor Lane is composed of two eastbound and two westbound lanes. Moorland Lane is composed of one eastbound and one westbound lane.

**Figure 2:** Existing site (proposed building outlined in red) and surroundings. Aerial image dated December 19, 2016, courtesy of Google Earth.
5. **Noise Measurements**

On January 31 – February 1, 2018, Phoenix Noise & Vibration conducted an on-site noise measurement survey to determine existing transportation noise levels throughout the site. This involved continuous noise level measurements and monitoring for one 24-hour period. Measurements were made using three Norsonic Type 118 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. Measurements were made at 25 feet above adjacent grade to represent the noise impact upon upper floors of the future multifamily building.

Measurement results are presented in Table 2. Noise level measurements were made at the locations shown on Drawing 1 of the Appendix. Figure 3 presents the survey results graphically, showing the noise level as measured in five-minute increments throughout the survey. Figure 3 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.

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

<table>
<thead>
<tr>
<th>Measurement Location</th>
<th>Height Above Existing Grade (feet)</th>
<th>Measured Noise Level (dBA Ldn)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>25</td>
<td>64</td>
</tr>
<tr>
<td>B</td>
<td>25</td>
<td>65</td>
</tr>
<tr>
<td>C</td>
<td>25</td>
<td>61</td>
</tr>
</tbody>
</table>

Note that 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 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 little effect on the overall, 24-hour Ldn value.
Figure 3: Five-minute average noise levels recorded during 24-hour noise survey.
6. **Computer Modeling**

The existing and future sites were 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, buildings, barriers, surface 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 information provided on the site’s existing site plan,\(^1\) the Montgomery County GIS, and data collected during the 24-hour measurement survey, inputting existing topography, roadway alignments, and buildings. Roadway noise levels were calibrated using the on-site noise measurements by adjusting the modeled input until the modeled noise level output matched the measured values.

6.2. **Future Model**

A future model was developed by altering the calibrated current model to include the projected roadway data and the future multifamily building. Currently there are no plans to alter any of the roadways in the vicinity of the site; therefore, the existing roadway alignments were used in the future model. Additionally, future topography was not available at the time of the analysis. It was clarified by Soltesz that aside from a 1-foot change in elevation near the south entrance of the building, the future topography will stay the same as the existing topography. Once available, future topography can be incorporated and the noise level throughout the site can be recalculated; however, it is not expected to significantly change the future impact.

The future model calculated the projected noise levels throughout the site at the ground level before and after the full build-out of the proposed building (shown on Drawings 2 and 3 of the Appendix, respectively). Drawing 2 indicates the future noise levels throughout the site in absence of the future building, while Drawing 3 indicates the future noise levels once the building is constructed.

The future noise impact was also calculated across all future building facades (shown on Drawing 4 of the Appendix). The varying colors on the building elevations on Drawing 4 represent the future noise impact at that location. Note how the noise level changes with respect to height and orientation to the roadways.

All noise levels presented on Drawings 3 and 4 are “mitigated” noise levels, calculated in the presence of the future building, as well as all existing surrounding buildings, topography, and significant structures. Mitigated noise levels account for the effect of buildings and other

\(^{1}\) Provided by Soltesz on January 23, 2018.
significant structures in reducing and reflecting roadway noise propagation and are more representative of the noise level actually experienced at a specific location.

6.3. Roadway Data

Average annual weekday traffic (AAWDT) volumes, vehicle percentages, and nighttime percentages for the roadways were based upon the most recent data published by the Maryland State Highway Administration (MDSHA). MDSHA does not typically provide future traffic data; therefore, a conservative, 2% increase in traffic compounded annually until 2038 was assumed.\(^2\) MDSHA does not maintain data for Edgemoor Lane or Moorland Lane; therefore, data for these roadways were estimated based on observations kept throughout the on-site noise measurements. All necessary traffic data is provided in Table 3.

<table>
<thead>
<tr>
<th>Roadway</th>
<th>2016 AAWDT</th>
<th>2038 AAWDT</th>
<th>Nighttime Volume %</th>
<th>Truck %</th>
<th>Posted Speed Limit (mph)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arlington Road</td>
<td>12,251</td>
<td>18,940</td>
<td>5</td>
<td>1</td>
<td>25</td>
</tr>
<tr>
<td>Woodmont Avenue</td>
<td>15,874</td>
<td>24,541</td>
<td>7</td>
<td>2(^a)</td>
<td>30</td>
</tr>
<tr>
<td>Edgemoor Lane(^a)</td>
<td>4,360</td>
<td>6,479</td>
<td>5</td>
<td>5</td>
<td>25</td>
</tr>
<tr>
<td>Moorland Lane(^a)</td>
<td>1,880</td>
<td>2,849</td>
<td>5</td>
<td>4</td>
<td>25</td>
</tr>
<tr>
<td>Wisconsin Avenue</td>
<td>35,441</td>
<td>54,791</td>
<td>10</td>
<td>2</td>
<td>25</td>
</tr>
<tr>
<td>Old Georgetown Road (East of Woodmont Avenue)</td>
<td>11,952</td>
<td>18,474</td>
<td>8</td>
<td>5(^a)</td>
<td>30</td>
</tr>
<tr>
<td>Old Georgetown Road (West of Woodmont Avenue)</td>
<td>32,462</td>
<td>50,186</td>
<td>7</td>
<td>5</td>
<td>25</td>
</tr>
</tbody>
</table>

A. Estimated roadway data based upon on-site observations.
B. MDSHA does not maintain truck percentages for these roadways; therefore, the percentages were estimated based upon the surrounding roadway data.

6.4. Future Noise Impact

Noise levels in the rooftop pool and terrace areas will be below 65 dBA Ldn due to the height above the roadways and shielding provided by the future multifamily building. Mitigation for these public outdoor areas will not be required to comply with the Montgomery County outdoor limit.

Future transportation noise levels were calculated across each future building elevation (see Drawing 4 of the Appendix). Noise impact upon the 4900 Moorland Lane building elevations is summarized in Table 4.

\(^2\)Montgomery County typically requires that roadway noise impact studies be conducted using the projected traffic volumes 20 years from the date of the study.
Table 4: Noise impact upon 4900 Moorland Lane residential units.

<table>
<thead>
<tr>
<th>Building Elevation</th>
<th>Maximum Future Noise Impact (dBA Ldn)</th>
</tr>
</thead>
<tbody>
<tr>
<td>North</td>
<td>65</td>
</tr>
<tr>
<td>East</td>
<td>&lt;65</td>
</tr>
<tr>
<td>South</td>
<td>65</td>
</tr>
<tr>
<td>West</td>
<td>67</td>
</tr>
</tbody>
</table>

Most of the future residential units on the west elevation, as well as a small portion of the units on the north and south elevations, will be exposed to transportation noise levels above 65 dBA Ldn, with maximum impact up to 67 dBA Ldn for the lower levels along Arlington Road. Residential units exposed to noise levels above 65 dBA Ldn require further analysis (see Section 7.2 below) to determine the mitigation measures necessary to maintain interior noise levels below 45 dBA Ldn.

The remaining residential units, including the entire east elevation, most of the north and south elevations, and a small portion of the west elevation, will not be exposed to future transportation noise levels above 65 dBA Ldn. These residences require no further analysis or modifications to comply with Montgomery County’s residential noise regulation.

7. Mitigation

According to Montgomery County’s noise regulations for residential development, residential sites and buildings impacted by noise levels above 65 dBA Ldn (at any height) require further analysis to determine the mitigation measures necessary to maintain noise levels in outdoor activity areas and interior living spaces below 65 and 45 dBA Ldn, respectively.

7.1. Outdoor Noise Levels

Noise levels in the proposed rooftop areas, including the pool and terrace areas, will be below 65 dBA Ldn. Under the current building and site design, further mitigation for the site’s public outdoor activity areas will not be necessary to comply with the Montgomery County outdoor limit.

7.2. Interior Noise Levels

7.2.1. Building Shell Analysis

According to the future noise levels shown on Drawing 4, most of the residential units located on the west elevation as well as a small portion of the residential units on the north and south elevations will be exposed to noise levels above 65 dBA Ldn. Residential buildings exposed to noise levels above 65 dBA Ldn require further analysis to determine whether the proposed building construction will be capable of maintaining interior noise levels below 45 dBA Ldn. This evaluation, or “building shell analysis,” calculates a room’s interior noise level based upon
its exterior noise level, the Sound Transmission Class (STC) ratings\(^3\) of its various building components, the amount of exposed exterior wall area, and the room’s size and finish.

Modifications to standard building construction may not be necessary for all units impacted by future noise levels above 65 dBA Ldn. It is possible that the proposed standard building construction will provide sufficient noise reduction to maintain the required 45 dBA Ldn interior noise level for outdoor noise levels above 65 dBA Ldn.

A detailed evaluation of the proposed architecture for 4900 Moorland Lane cannot be conducted at this time, as well-developed architectural drawings (floor plans, unit plans, building elevations, window/door schedule) are not yet available; therefore the specific mitigation designs (i.e. wall, window, and door STC ratings) required for residential units to comply with Montgomery County’s interior noise level limit cannot yet be accurately determined.

When architectural drawings are further developed (typically during the Design Development phase), noise impact will be analyzed on a floor-by-floor basis for each individual residential unit impacted by transportation noise levels above 65 dBA Ldn. Likewise, mitigation requirements will also be provided for each individual residential unit. Calculating minimum STC ratings specific to each unit reduces “overbuilding” (i.e. installing windows/doors with unnecessarily high STC ratings).

To aid in the early phases of the design process and provide information on the factors that influence noise reduction in residential buildings, general mitigation design guidelines and explanations are provided in the section that follows.

7.2.2. STC Rating Requirements

The noise reduction provided by a building structure, and the resulting interior noise level, are primarily dependent upon the percentage of the exterior wall surface area occupied by “non-wall” items and the STC ratings of these items. These items, typically windows and doors, act as “holes” in what would otherwise be a relatively effective exterior wall, significantly reducing its ability to prevent noise transmission. Consequently the exterior surface area occupied by windows and doors is a significant issue. This information is recorded and tracked so that the STC ratings of exterior elements can be adjusted accordingly until the required interior noise level is achieved.

While the wall construction is also an important factor, the “holes” in the wall (i.e. the windows and doors) must be addressed first if the noise reduction of the overall building shell is to be significantly increased and the interior noise level decreased. This can be accomplished by reducing the size of existing windows/doors and/or increasing the STC ratings of windows/doors.

Table 5 and Table 6 illustrate this concept, indicating window/door STC rating requirements based upon the window/door (or glass) area when using either cementitous/Hardi panel or

\(^3\) The STC rating is a single number value which describes a building element’s (wall, window, door, roof, etc.) ability to reduce noise transmission from one side of the partition to the other.
brick/masonry exterior walls.\textsuperscript{4} The STC ratings shown are those necessary to maintain interior noise levels at 45 dBA Ldn when using that specific exterior wall construction. When looking at Tables 5 and 6, recall that the maximum noise impact upon 4900 Moorland Lane will be 67 dBA Ldn.

The values included in Table 5 and Table 6 were calculated using one generic room (15 feet x 15 feet, carpeted room with two walls exposed to noise) to demonstrate the concept of varying window/door percentages and the resulting effect on required STC ratings. Values in Table 5 and Table 6 \textbf{should not} be universally applied to outdoor noise impact upon 4900 Moorland Lane; however they can be used to gain a general idea of the window/door STC ratings to be expected based upon the level of noise impact upon a building elevation. Actual STC ratings will depend upon interior room finishes and characteristics, room/building orientation with respect to the noise source, building geometry, etc.

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|c|c|}
\hline
\textbf{Outdoor Noise Impact (dBA Ldn)} & \multicolumn{4}{|c|}{\textbf{Required Window/Door STC Rating Necessary to Maintain Interior Noise Levels Below 45 dBA Ldn (When Using Cementitious or Hardi Panel Exterior Walls)}} \\
\hline
 & 20% & 40% & 60% & 80% \\
\hline
65 & 25 & 25 & 27 & 28 \\
70 & 28 & 30 & 32 & 33 \\
\hline
\end{tabular}
\caption{Hypothetical window/door STC ratings with cementitious or Hardi panel exterior walls.}
\end{table}

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|c|c|}
\hline
\textbf{Outdoor Noise Impact (dBA Ldn)} & \multicolumn{4}{|c|}{\textbf{Required Window/Door STC Rating Necessary to Maintain Interior Noise Levels Below 45 dBA Ldn (When Using Brick/Masonry Exterior Walls)}} \\
\hline
 & 20% & 40% & 60% & 80% \\
\hline
65 & 25 & 25 & 27 & 28 \\
70 & 27 & 30 & 32 & 33 \\
\hline
\end{tabular}
\caption{Hypothetical window/door STC ratings with brick/masonry exterior walls.}
\end{table}

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 always 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.

\textsuperscript{4} STC ratings were calculated assuming exterior walls constructed of one layer of 5/8” interior gypsum board, 2” x 4” wood studs with 3.5” fiberglass batt insulation, one layer of ½” exterior plywood, and the specified exterior wall finish.
In other words, when the glass occupies such a significant portion of the exterior wall, increasing the wall STC rating even drastically will not decrease the interior noise level. Increasing the composite STC rating of the partition must be accomplished by first addressing the “weakest link” in the partition (the glass).

Note that when windows and/or doors occupy a high percentage of the impacted façade, substantially higher window/door STC ratings than those typically used in standard construction (usually around 25 STC) may be required depending upon the noise level impact.
8. **Conclusion**

The proposed 4900 Moorland Lane multifamily building will be exposed to future transportation noise levels above 65 dBA Ldn and up to 67 dBA Ldn. While this represents a slight level of noise impact, compliance with Montgomery County’s residential noise regulations can be achieved through reasonable modifications to proposed building plans.

Future transportation noise levels throughout the rooftop pool and terrace areas will be below 65 dBA Ldn. Additional mitigation for these public outdoor spaces will not be required.

Most of the west elevation, as well as a small portion of the north and south elevations, will be exposed to future transportation noise levels slightly above 65 dBA Ldn. While this is above the recommended outdoor noise level of 65 dBA Ldn, compliance with Montgomery County’s residential 45 dBA Ldn interior noise level requirement can be achieved through reasonable modifications to proposed building construction.

Units with impact above 65 dBA Ldn require further analysis and may require modifications to proposed standard building construction. Depending upon the noise level specific to each impacted unit, modifications may include increased window/door STC ratings. Further analysis is required to determine the exact mitigation designs necessary, which will be established once architectural plans (building elevations, window/door schedule, unit plans) are further developed.

All other residential units, including the entire east elevation, most of the north and south elevations, and a small portion of the west elevation, will not be exposed to future transportation noise levels above 65 dBA Ldn. These residences require no further analysis or modifications to comply with Montgomery County’s residential interior noise regulation.

**Please Note:** The results of this Phase I 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 roadway alignments, projected roadway traffic volumes, and the proposed building layout. 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 interior noise levels to comply with Montgomery County’s noise level requirements for residential development.