HUSH
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May 21, 2015

Ms. Ching-Fang Chen
Park Development Division
The Maryland-National Capital Park and Planning Commission
9500 Brunett Avenue
Silver Spring, MD 20901

Re: Ovid Hazen Wells Recreational Park
Acoustical Analysis

Ms. Chen:

Hush Acoustics LLC has evaluated noise from a carousel to be relocated to Ovid Hazen Wells Recreational Park in Clarksburg, MD.

1. Design Goals

There are at least three general approaches for evaluating community noise impacts. One is to compare predicted carousel noise levels to the values included in the Montgomery County Noise Ordinance. The second somewhat more conservative approach is to compare carousel noise levels to typical average speech sound levels to assess speech interference. The third and most conservative approach is to compare carousel noise levels to background sound levels to determine if the carousel would be audible. For completeness, all three methods are used in this report.

The carousel operates between 10 am and 7 pm in the summer. The noise ordinance limit is an A-weighted noise level of 65 dBA at neighboring residential zones during the daytime; all hours the carousel will operate are defined as daytime hours by the noise ordinance.

2. Existing Carousel Noise Levels

A site visit was performed at the existing Ovid Hazen Wells Carousel location in the Wheaton Regional Park on April 19, 2015. There are four small Bose CLS-2 speakers at ground level within the carousel, although only one of them was producing sound during our site visit. There are four outdoor "park" speakers with directional horns on the roof of the carousel. There is an equipment rack in the carousel building housing a CD player, amplifier, mixer, and a hand-held microphone. The primary sound sources in the carousel included speakers at ground level at the center of the carousel, speakers on the roof over the carousel, a bell, and children on the carousel. Background sound sources included children playing elsewhere around the carousel, the miniature train horn, aircraft, and birds.

Sound levels were measured around the carousel at distances of approximately 70 and 130 feet from the speakers, in the direction the speaker directional horns were pointed. When possible, the effects of background sound sources were minimized by not measuring when children were playing nearby, when aircraft were close overhead, or when the train whistle was sounded. Sound levels were measured with the sound level meter set on "fast" response. Sound levels were measured for 20 to 60 seconds in each

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location. Sound levels were measured with a hand-held sound level meter, held approximately 5 feet above the ground. Sound levels were measured with two different sound system volume settings. At one volume setting called "low" in this report the mixer's CD channel gain was set for 3 out of 10 and the mixer's master gain was set for 6 out of 10. At the volume setting called "high" in this report the mixer's CD channel gain was set for 7 out of 10 and the mixer's master gain was still set for 6 out of 10. On low, the music sounded like it was just coming out of the speakers at ground level, but on high the music sounded like it was mostly coming out of the rooftop speakers. The music was set on "low" when we arrived; this likely is a fairly typical setting. After completing an initial round of measurements, we asked the park manager to turn the volume up to a level that is representative of the loudest they would normally use.

Sound levels Figure 1 presents the measured maximum noise levels. At a distance of 70 feet from the carousel, the speaker horns on top of the carousel are directing much of the sound past the measurement location, while the distance of 130 feet from the carousel is well within the focal angle of the top speaker horns. This is why sound levels were not that different between the two locations. Also note that at a distance of 130 feet the bell was rung while measuring with the volume on low but not with the volume on high; this shows up in Figure 1 as a relatively high sound level for the dashed orange line in some frequency bands (e.g., 5,000 and 6,300 Hz) with the volume on low. The dotted orange line is just the bell before the music started at 130 feet away.

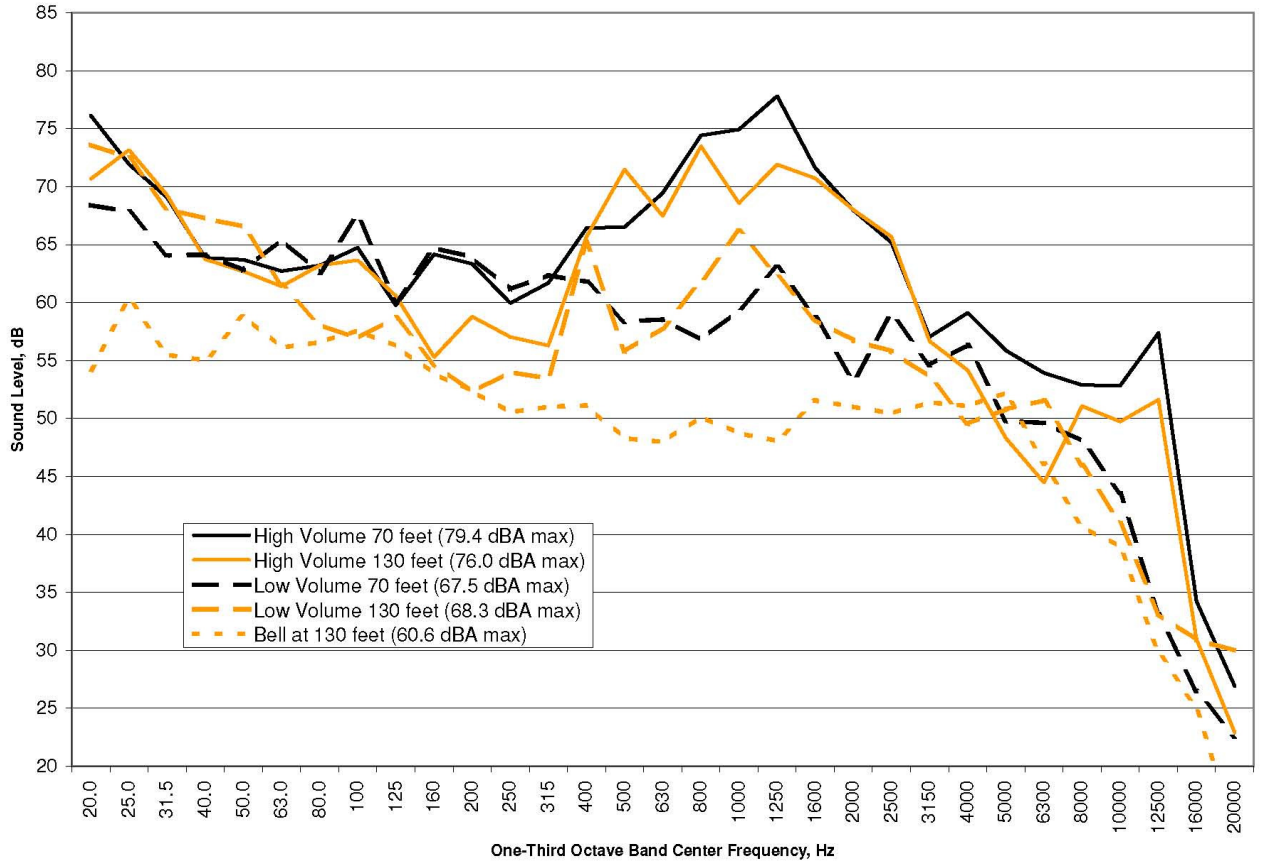

Figure 1. Measured Maximum Carousel Sound Spectra

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3. Proposed Carousel Location Sound Levels

It has been proposed to relocate the Ovid Hazen Wells Carousel to Ovid Hazen Wells Park in Clarksburg, MD. The proposed carousel location is approximately 740 feet from the nearest residences to the southwest and approximately 1,430 feet from the nearest residence to the north.

In order to evaluate the impact of sound from this carousel on the surrounding communities, ambient sound levels were measured in and near the park. A site visit was performed on Friday May 1, 2015. Sound level meters were installed in the locations indicated M1 and M2 in Figure 2. This figure also shows the proposed location of the carousel. The meters were programmed to log the average, maximum, and minimum sound level each minute, to log statistical sound levels (e.g., the sound level exceeded 1, 5, 10, 50, 66, and 90% of the time) each hour, and to create audio files each tile a very loud sound occurred. The meter cases were chained to trees and the microphones were attached to poles approximately 15 to 20 feet above the ground to represent sound levels at the top floor of houses (sound levels are normally higher at upper floors since they are farther from the sound-absorbing ground). Location M1 was near the park entrance northeast of Skylark Road across from Sycamore Farm Drive at approximately the same distance from Skylark Road as are the existing single-family detached houses along the southwest side of Skylark Road. This location was selected to represent ambient sound levels in the residential community to the southwest of the proposed carousel location. The main sound sources at location M1 are traffic on Skylark Road and on weekends also activities in the park. Location M2 was along the edge of the farm abutting the single-family detached housing community along Kigger Jack Lane across from Tregoning Drive. This is a very quiet location which was selected to represent ambient sound levels in the community to the north of the proposed carousel location. The sound level meters were retrieved on Tuesday May 12, 2015.

While analyzing the sound level data it was determined that the meter at location M1 had a microphone cable malfunction and did not collect valid data for approximately the first 20 hours of the survey through 10:30 am on Saturday May 2, 2015. Also, audio files were created when children yelled into the microphone and jostled the meter case at location M1 between 12:58 and 1:01 pm on Saturday May 2, 2015. Sound level data were disregarded before 10:30 am on May 2, 2015, and sound level data were interpolated between 12:58 and 1:01 pm on May 2, 2015.

At location M2 only two audio files were created and both were due to birds chirping close to the microphone.

Figure 3 presents measured five-minute average sound levels. It can be seen that the sound level is generally much higher at location M1 (since it is closer to a road) than at location M2.

The carousel operates between 10 am and 7 pm in the summer. For this reason, we are focused on sound levels during this time period, and not overnight. The sound level exceeded 50, 66, and 90% of the time (the L_{50}, L_{66}, and L_{90}) were output by the sound level meter each hour for each location. The average values were calculated for the 10 am to 7 pm time period for each location and are presented in Figure 4. The A-weighted values are included in the legend. The audibility-based approach is far more conservative than simply using the noise ordinance provisions. One way to understand this statement is

that with an audibility criterion one is comparing carousel noise levels to the L_{50}, L_{66}, and L_{90} values in Figure 4, which include an A-weighted value of 37.4 dBA at location M2. Comparing to a value of 37.4 dBA is far more conservative than comparing to the noise ordinance limit of an A-weighted sound level of 65 dBA.

Figure 2. Sound Level Meter Locations

4. Predicted Noise Levels due to Carousel in Community

The noise generated by the carousel is presented in Figure 1 above. Sound levels were extrapolated for distance based on the highest values measured at a distance of 130 feet in each frequency band. The computer program Sound Propagation Model SPM9613 was used to estimate how much sound levels drop with distance. At long distances, atmospheric conditions such as wind speed and direction dramatically affect sound propagation. This computer program factors in distance as well as a modest downwind condition, to provide a moderately conservative estimate. Despite wind being considered in this way, there will still be atmospheric conditions which would increase sound levels beyond those predicted in this report at times, and of course would also reduce sound levels significantly at times. Sound levels were predicted for second story locations; this is conservative since it diminishes attenuation of sound by the ground and also barrier attenuation by any proposed noise walls. For simplicity, we did not factor in ground elevation in this analysis.

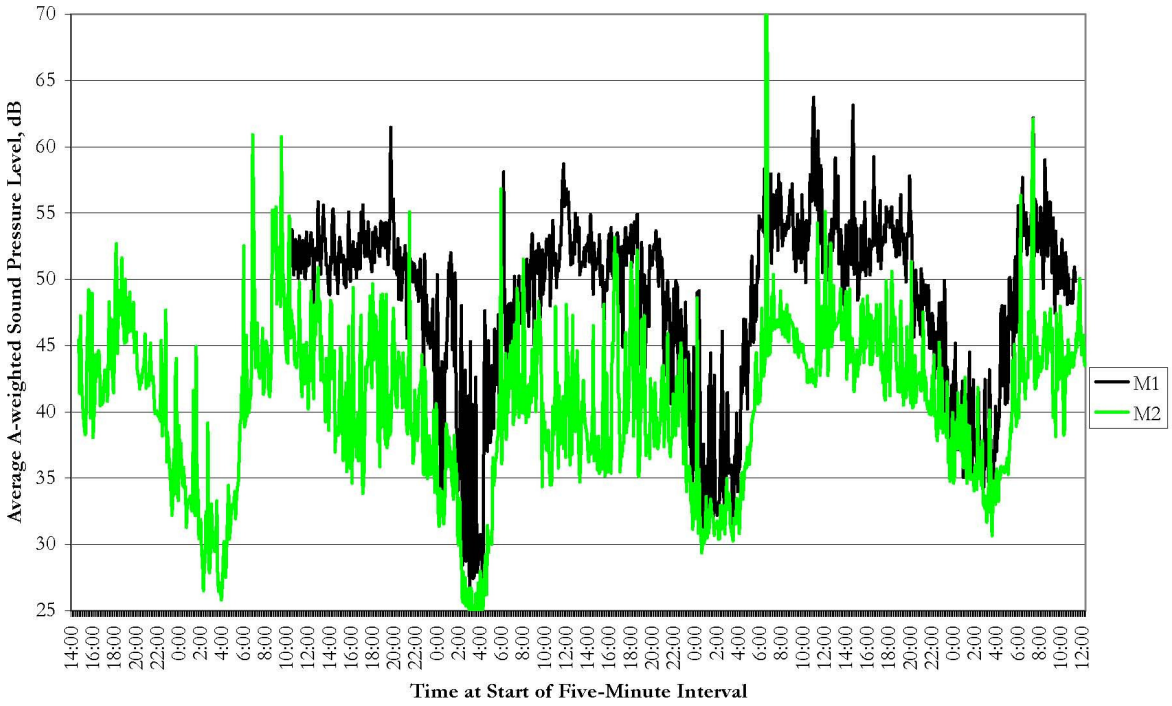

Figure 3. Measured Ambient Sound Levels in Ovid-Hazen Wells Park

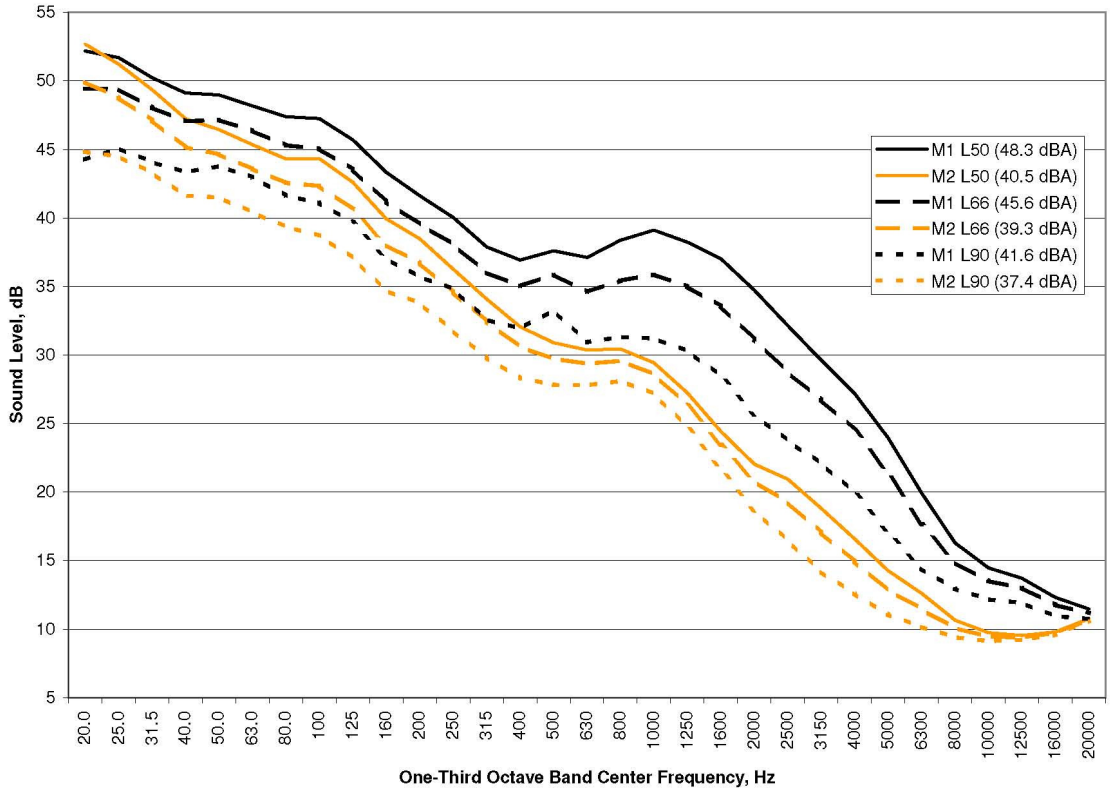

Figure 4. Measured Background Daytime Sound Spectra in Ovid-Hazen Wells Park

Figures 5 and 6 present the resulting predicted carousel noise levels overlaid on top of background sound levels in the community. These figures show that carousel noise levels will exceed ambient sound levels mostly in the middle-frequency range of 400 to 4,000 Hz. Also, the impact is generally similar in each location; although the carousel will be much louder to the southwest near location M1, background sound levels are much lower to the north near location M2.

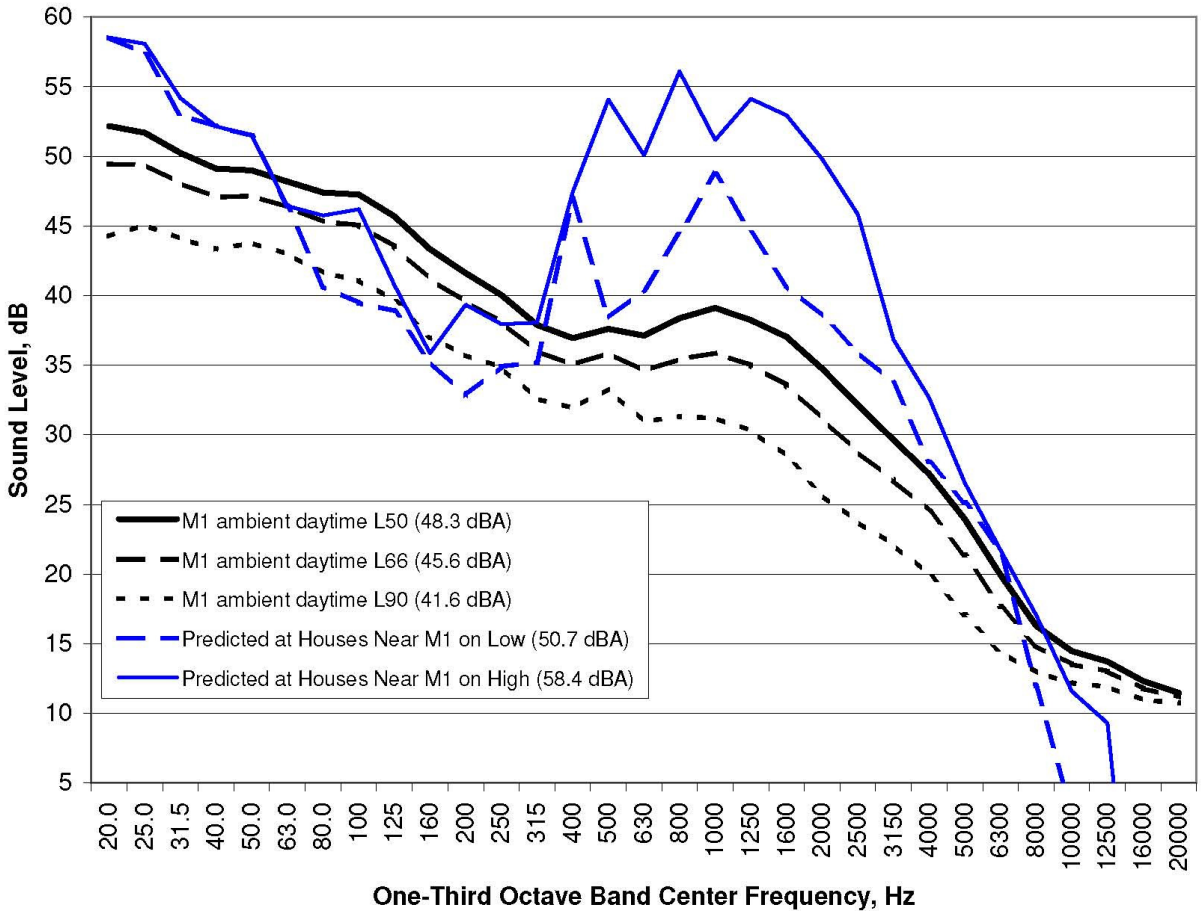

Figure 5. Predicted Carousel Noise Levels at Houses Near M1

Predicted A-weighted noise levels are also listed in the legends of Figures 5 and 6. These show that maximum noise levels from the carousel will be approximately 51 dBA on low volume and 58 dBA on high volume to the southwest, and 44 dBA on low volume and 52 dBA on high volume to the north. These sound levels are all below the noise ordinance limit of 65 dBA. This means that there would not be a noise ordinance violation.

The average sound level of speech outdoors in a suburban area at 1 meter away is approximately 55 dBA. When an interfering noise is much quieter than this value there is not much speech interference, but when an interfering noise is much louder than this value there will be significant speech interference. Although the percentage of sentences interfered with would vary with the noise level, a reasonable goal for speech interference is to limit noise levels to approximately 55 dBA. The predicted

noise levels would exceed this goal at locations to the southwest with the volume only on high, and would not exceed this goal to the north. Only 3 dB of reduction would be required to meet the speech interference goal of 55 dBA, although it is generally advisable to aim for at least 5 dB of reduction whenever a noise barrier is planned.

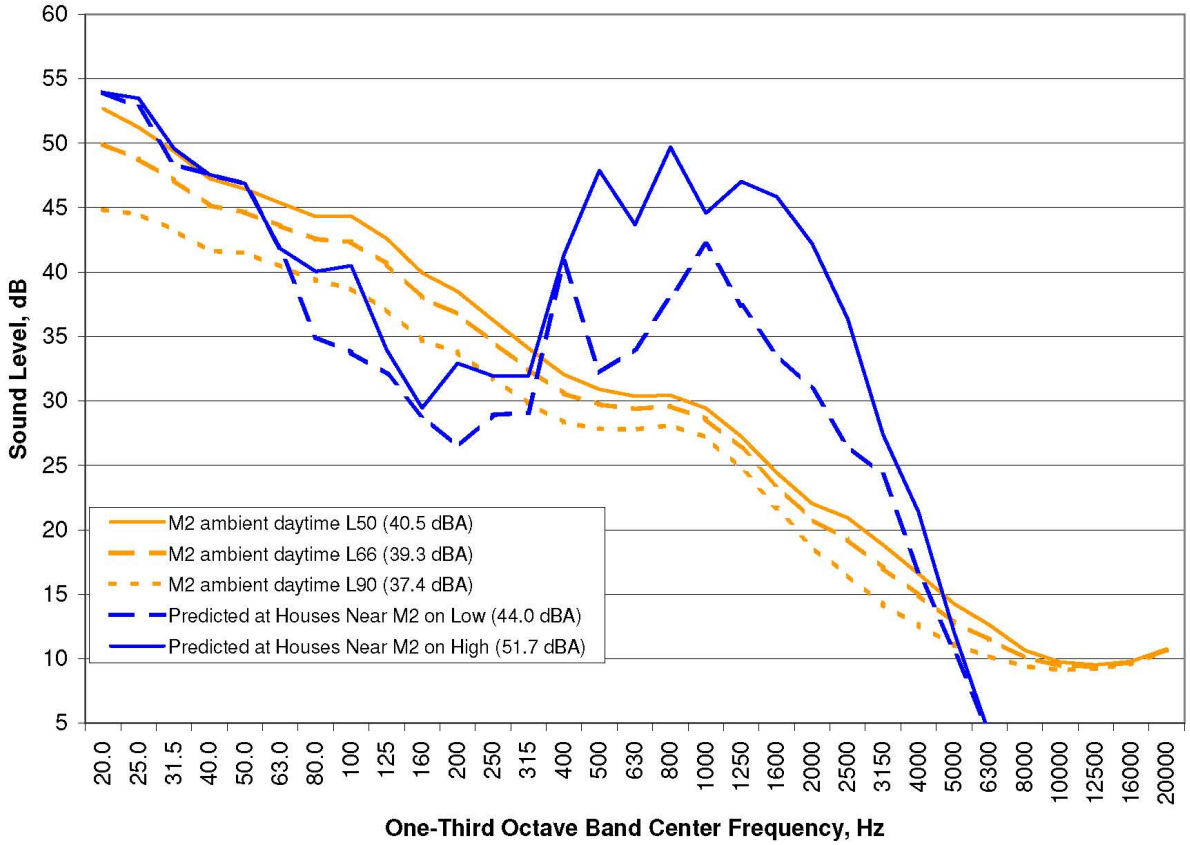

Figure 6. Predicted Carousel Noise Levels at Houses Near M2

It likely is not practical to make the carousel inaudible. Doing so would require not using the high speakers and a fairly tall noise barrier.

5. Noise Mitigation Measures

As noted above, there would not be a noise ordinance violation. However, there would be speech interference to the southwest. Also, maximum carousel noise levels are expected to significantly exceed ambient sound levels much of the time in communities to the southwest as well as the north in frequency bands of 400 to 4,000 Hz regardless of the music volume setting. This means that the carousel would be audible most of the time. For these reasons, it may be reasonable to consider noise mitigation measures.

The only two ways to limit noise levels in the community are to turn the music down and to construct noise barriers of some sort. Noise barriers are the broad category encompassing all solid, heavy

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structures that block the line of sight from the noise source to the listener and could include earthen berms, noise walls, or buildings. This would not include things that are not continuous such as trees, nor would it include things that are not heavy such as tents. The noise barrier would have to be tall enough to block sound from the speakers. In the case of this carousel, the speakers include four on top of the carousel and four at ground levels within the carousel. It is not practical to have a barrier block the speakers on top of the carousel. For this reason, the obvious solution is to remove those speakers, and only use ground-level speakers. The manager at the existing carousel location referred to the high speakers as "park" speakers because they are intended to have announcements reach the entire park. There is no way to prevent noise from speakers traveling long distances when the speakers are specifically designed to project sound long distances.

We used the SPM9613 computer program to predict the effects of noise barriers. There are many variables in such an analysis that make it a fairly crude prediction at this time. The three key variables that it would likely be too soon to predict are: (a) the final speaker height (we used 3 feet high), (b) the distance from the noise barrier to the carousel (we used 50 feet from the speakers), (c) the listener height of interest (we used 22 feet high to represent the top of the second floor of houses), and (d) the ground elevations at the speakers, noise barrier, and listener (we assumed a flat site at this time). Using these assumptions, we predict that a noise barrier would reduce A-weighted carousel noise levels approximately:

- 4 dBA to the southwest and 3 dBA to the north if the barrier were 6 feet tall
- 6 dBA to the southwest and 4 dBA to the north if the barrier were 8 feet tall
- 8 dBA to the southwest and 6 dBA to the north if the barrier were 10 feet tall

If the listener height were 5 feet above the ground instead of 22 feet, the noise wall would provide 1 dB greater reductions.

6. Summary and Recommendations

In summary, if the park only uses the ground-level speakers (not the "park" speakers) played at a low volume, the predicted noise level will not exceed the Montgomery County noise ordinance or our proposed goal for speech interference, and no additional noise mitigation measures would be required.

Specifically, we recommend the following:

- Using the rooftop speakers only for announcements, and using only ground-level speakers for music.
- Have the park manager establish and document the desired sound system volume and develop a protocol of ensuring sound system volumes are consistent.

During the design of the carousel area, it might be possible to plan for noise barrier elements around the carousel. Where such elements are feasible, we would recommend following these guidelines:

- Make the noise barrier at least as tall as a person, and preferably taller.
- Locate the noise barrier as close as possible to the carousel.
- If any other buildings are planned nearby, use them as noise barriers.
- As used at Little Bennet Regional Park, consider using hay bales as noise barriers.

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- Circle as much of the carousel as possible with the noise barrier to block as wide an angle as possible to the communities to the southwest and north. Where breaks are required in the carousel, locate them on sides of the carousel pointing as much away from houses as possible such as toward the southeast or possibly the northwest.
- Consider incorporating clear panels such as glass, Plexiglass, or Lexan in lieu of railings at ground level. Also consider incorporating clear panels extending down from the roof line around the entire building. These likely would be the most cost-effective noise attenuation measures.

If you have any questions, please contact me at 703/534.2790 or Gary@HushAcoustics.com.

Sincerely,

Gary Ehrlich, P.E.
Principal