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Subject: ***Sapling Solar, LLC – Noise Analysis***
Gustin Township, Alcona County, Michigan

Executive Summary

The purpose of this technical memorandum is to summarize the evaluated noise levels associated with the operational equipment located throughout the proposed Sapling Solar, LLC Solar Site in the Gustin Township of Alcona County, MI. The proposed solar photovoltaic project site is approximately 0.5 mile north of Mikado, approximately 2 miles south of Lincoln, approximately 5.5 miles southwest of Harrisville, and approximately 7.5 miles southeast of Barton City. The site is generally located east of South Hubbard Lake Road, south of M-72, north of East Mikado Glennie Road, and west of South Barlow Road. The proposed solar site will be located on agricultural/undeveloped land with agricultural/undeveloped and rural residential land uses surrounding the project area. The location of the proposed Sapling Solar, LLC Solar Site project is shown in **Figure 1**.

Project Description

The proposed Sapling Solar, LLC Solar Site will be developed on approximately 1,430 acres of agricultural/undeveloped land within the Gustin Township of Alcona County, MI. The solar site will consist of solar arrays and inverters throughout the project area as well as a substation with transformer equipment located in the northern portion of the site.

Existing Conditions

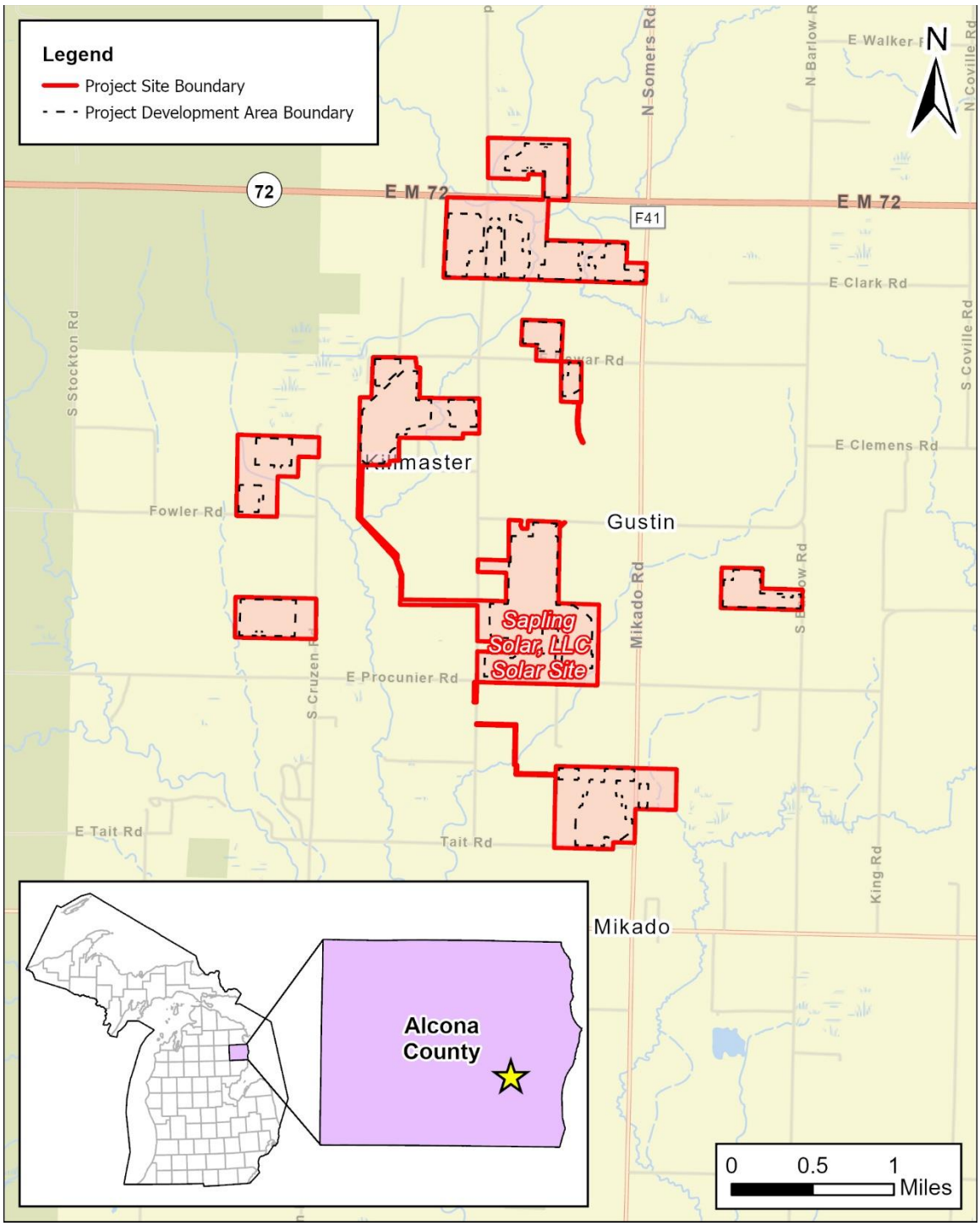
The predominant source of noise in the vicinity of the proposed solar site is anticipated to be traffic noise along nearby roadways, including South Hubbard Lake Road, M-72, East Mikado Glennie Road, and South Barlow Road as well as other rural roads.

Other sources of noise likely include ambient environmental noise, which includes wind, birds chirping, insects, household appliances, landscaping equipment, etc. Also, it is assumed that agricultural equipment contributes to the existing noise environment during the planting and growing seasons.

Noise Regulations

The Sapling Solar, LLC Solar Site is within Gustin Township, MI. Part 8, Section 226 of Public Act 233 enacted by the State of Michigan states that a solar energy facility should not “generate a maximum sound in excess of 55 average hourly decibels as modeled at the nearest outer wall of the nearest dwelling located on an adjacent nonparticipating property.” Therefore, a threshold of 55 dB(A) was used as an operational sound level limit for the Sapling Solar, LLC Solar Site.

Figure 1: Site Location and Vicinity



Characteristics of Noise

Noise is generally defined as unwanted sound. It is emitted from many natural and man-made sources. Sound pressure levels are usually measured and expressed in decibels (dB). The decibel scale is logarithmic and expresses the ratio of the sound pressure unit being measured to a standard reference level. Most sounds occurring in the environment do not consist of a single frequency, but rather a broad band of differing frequencies. The intensities of each frequency add together to generate sound. Because the human ear does not respond to all frequencies equally, the method commonly used to quantify environmental noise consists of evaluating all of the frequencies of a sound according to a weighting system. It has been found that the A-weighted decibel [dB(A)] filter on a sound level meter, which includes circuits to differentially measure selected audible frequencies, best approximates the frequency response of the human ear.

The degree of disturbance from exposure to unwanted sound – noise – depends upon three factors:

1. The amount, nature, and duration of the intruding noise
2. The relationship between the intruding noise and the existing sound environment; and
3. The situation in which the disturbing noise is heard

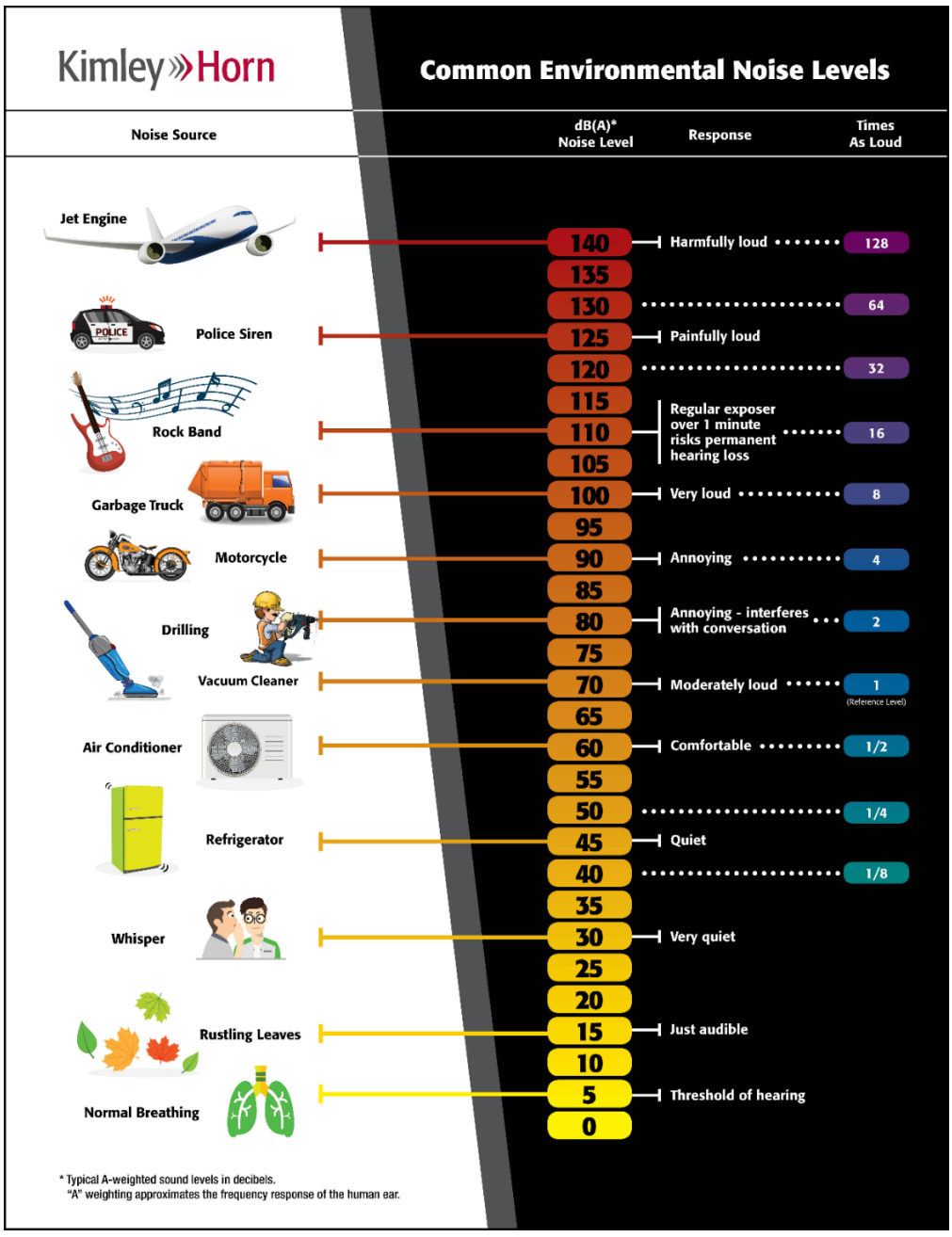
In considering the first of these factors, it is important to note that individuals have varying sensitivity to noise. Loud noises bother some people more than other people, and some individuals become increasingly upset if an unwanted noise persists. The time patterns and durations of noise(s) also affect perception as to whether or not it is offensive. For example, noises that occur during nighttime (sleeping) hours are typically considered to be more offensive than the same noises in the daytime.

With regard to the second factor, individuals tend to judge the annoyance of an unwanted noise in terms of its relationship to noise from other sources (background noise). A car horn blowing at night when background noise levels are low would generally be more objectionable than one blowing in the afternoon when background noise levels are typically higher. The response to noise stimulus is analogous to the response to turning on an interior light. During the daytime an illuminated bulb simply adds to the ambient light, but when eyes are conditioned to the dark of night, a suddenly illuminated bulb can be temporarily blinding.

The third factor – situational noise – is related to the interference of noise with activities of individuals. In a 60 dB(A) environment such as is commonly found in a large business office, normal conversation would be possible, while sleep might be difficult. Loud noises may easily interrupt activities that require a quiet setting for greater mental concentration or rest; however, the same loud noises may not interrupt activities requiring less mental focus or tranquility.

As shown in **Figure 2**, most individuals are exposed to fairly high noise levels from many sources on a regular basis. To perceive sounds of greatly varying pressure levels, human hearing has a non-linear sensitivity to sound pressure exposure. Doubling the sound pressure results in a three decibel change in the noise level; however, variations of three decibels [3 dB(A)] or less are commonly considered “barely perceptible” to normal human hearing. A five decibel [5 dB(A)] change is more readily noticeable. A ten-fold increase in the sound pressure level correlates to a 10 decibel [10 dB(A)] noise level increase; however, it is judged by most people as only sounding “twice as loud”.

Figure 2: Common Noise Levels



Over time, individuals tend to accept the noises that intrude into their lives on a regular basis. However, exposure to prolonged and/or extremely loud noise(s) can prevent use of exterior and interior spaces and has been theorized to pose health risks.

Noise Analysis

Noise levels from the proposed Sapling Solar, LLC Solar Site were evaluated using SoundPLAN. This program computes predicted sound levels at noise-sensitive areas through a series of adjustments to reference sound levels. SoundPLAN also accounts for topography, groundcover type, and intervening structures. Sound levels generated from the inverters and substation are anticipated to be the dominant sources of sound from the proposed solar photovoltaic project site.

It should be noted that noise from surrounding roadways was not modeled in this analysis although South Hubbard Lake Road, M-72, East Mikado Glennie Road, South Barlow Road, and other rural roadways are anticipated to contribute to the ambient noise environment throughout the entire day.

Inverters

Photovoltaic (PV) inverter equipment generates steady, unvarying noise that can create issues when located near noise-sensitive uses. It was assumed that fifty-two (52) PV inverters would be distributed throughout the solar site. Based on typical noise emission levels for the SMA Sunny Central inverter equipment, which is similar to the SMA MV Power Station proposed for the site, a reference sound level of 65 dB(A) at 10 meters for each PV inverter was used. The noise from the operation of the PV inverter equipment was calculated at the closest noise-sensitive receptors surrounding the project area using SoundPLAN.

Sound generated by the inverters is not anticipated to significantly contribute to the existing environmental noise levels surrounding the site. Also, sound generated by the inverters is expected to be mitigated by providing sufficient offsets between the inverters and surrounding noise-sensitive land uses as well as by the physical presence of the solar arrays, which are anticipated to shield and disperse some of the sound generated by the inverters.

Transformers

Transformers also generate steady, unvarying sound that can create issues when located near noise-sensitive areas. It was assumed that transformers would be located at the proposed substation in the northern portion of the project development area. A reference sound level for a transformer of approximately 75 dB(A) at 1 meter was used. The sound from the simultaneous operation of the transformers was calculated at noise-sensitive receptors in the area near the proposed substation.

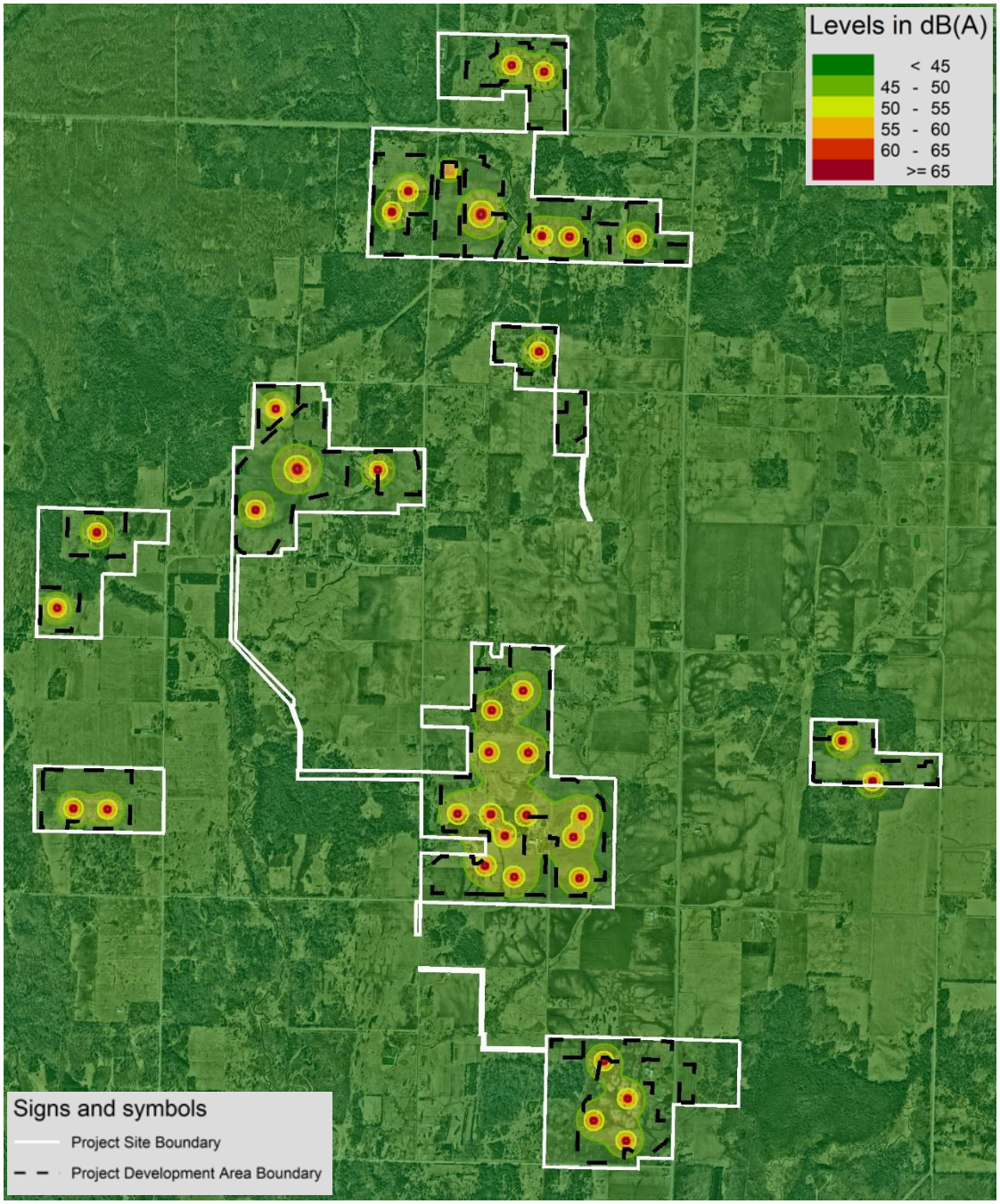
Sound generated by the transformers is not anticipated to significantly contribute to the existing environmental sound levels surrounding the site. Also, sound generated by the transformers is expected to be mitigated by providing sufficient offsets between the transformers and surrounding noise-sensitive land uses.

Results

The SoundPLAN-predicted maximum hourly equivalent operational noise levels at the closest residential land uses surrounding the site are anticipated to be remain near or below approximately 46 dB(A). The anticipated hourly equivalent operational noise contours are shown in **Figure 3**.

Since predicted hourly equivalent operational noise levels are anticipated to remain below 55 dB(A) at the nearest noise-sensitive receptors surrounding the site, noise mitigation measures do not need to be included in the project design at this time.

Figure 3: Operational Sound Contours



Conclusions

The site is approximately 0.5 mile north of Mikado, approximately 2 miles south of Lincoln, approximately 5.5 miles southwest of Harrisville, and approximately 7.5 miles southeast of Barton City. The site is generally located east of South Hubbard Lake Road, south of M-72, north of East Mikado Glennie Road, and west of South Barlow Road. The solar site will be located on agricultural/undeveloped land with agricultural/undeveloped and rural residential land uses surrounding the project area.

After modeling and analyzing the anticipated hourly equivalent operational sound levels throughout the proposed solar site, it was determined that noise mitigation measures are not needed at this time. The predicted hourly equivalent operational noise levels at the closest noise-sensitive receptors surrounding the site are anticipated to remain below the 55 dB(A) sound level limit established by the State of Michigan in Part 8, Section 226 of Public Act 233.