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**Subject:           *Douglas Family Butterfly Garden and Solar Farm LLC – Sound Study  
Kane County, Illinois***

### **Executive Summary**

The purpose of this technical memorandum is to summarize the evaluated sound levels associated with the operational equipment to be located throughout the proposed Douglas Family Butterfly Garden and Solar Farm LLC solar site in Kane County, IL. The proposed solar photovoltaic project site is located approximately 1 mile northeast of Sugar Grove, approximately 1.5 miles northwest of Aurora, approximately 3 miles southwest of Batavia, and approximately 3 miles southeast of Elburn. The site is generally located south/west of Norris Road, north of Healey Road/County Road 15 and I-88, and east of Bliss Road/County Road 78. The solar site will be located on agricultural land with residential land uses east of the project site. Additionally, the Aurora Municipal Airport is located approximately 3.5 miles southwest of the site. The location of the proposed Douglas Family Butterfly Garden and Solar Farm LLC solar site is shown in **Figure 1**.

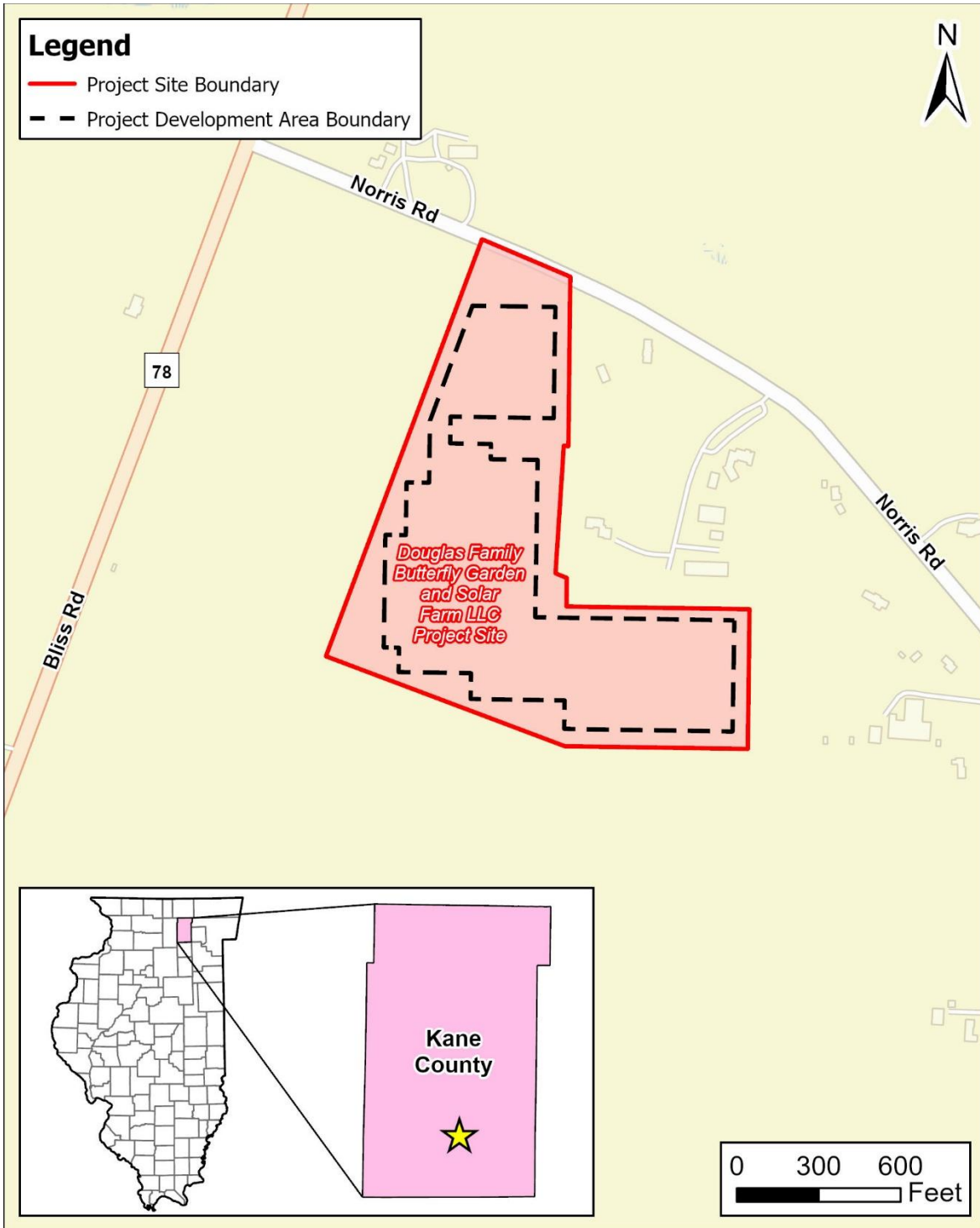
### *Analysis Findings*

- *The solar photovoltaic project will be located on agricultural land with residential properties east of the project site and an airport to the southwest. The Illinois Pollution Control Board (IPCB) noise regulations are based on allowable octave band sound pressure levels that vary depending on the category of land the noise is generated from and the category of land the noise is received at. It is to be noted that there are no established maximum octave band sound pressure levels for noise emissions from Class C properties (i.e., agricultural uses) to Class C properties. Modeled operational octave band sound pressure levels at surrounding Class A properties (i.e., residences) are anticipated to remain below the octave band limits established by IPCB during daytime hours; therefore, noise mitigation is not recommended at this time.*

### **Project Description**

The proposed Douglas Family Butterfly Garden and Solar Farm LLC site will be developed on approximately 20 acres out of nearly 31 acres of agricultural land in an unincorporated portion of Kane County, IL. The solar site will consist of solar arrays throughout the project area with forty (40) string inverters located on two (2) equipment pads, with twenty (20) inverters on each equipment pad, towards the northern portion of the 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

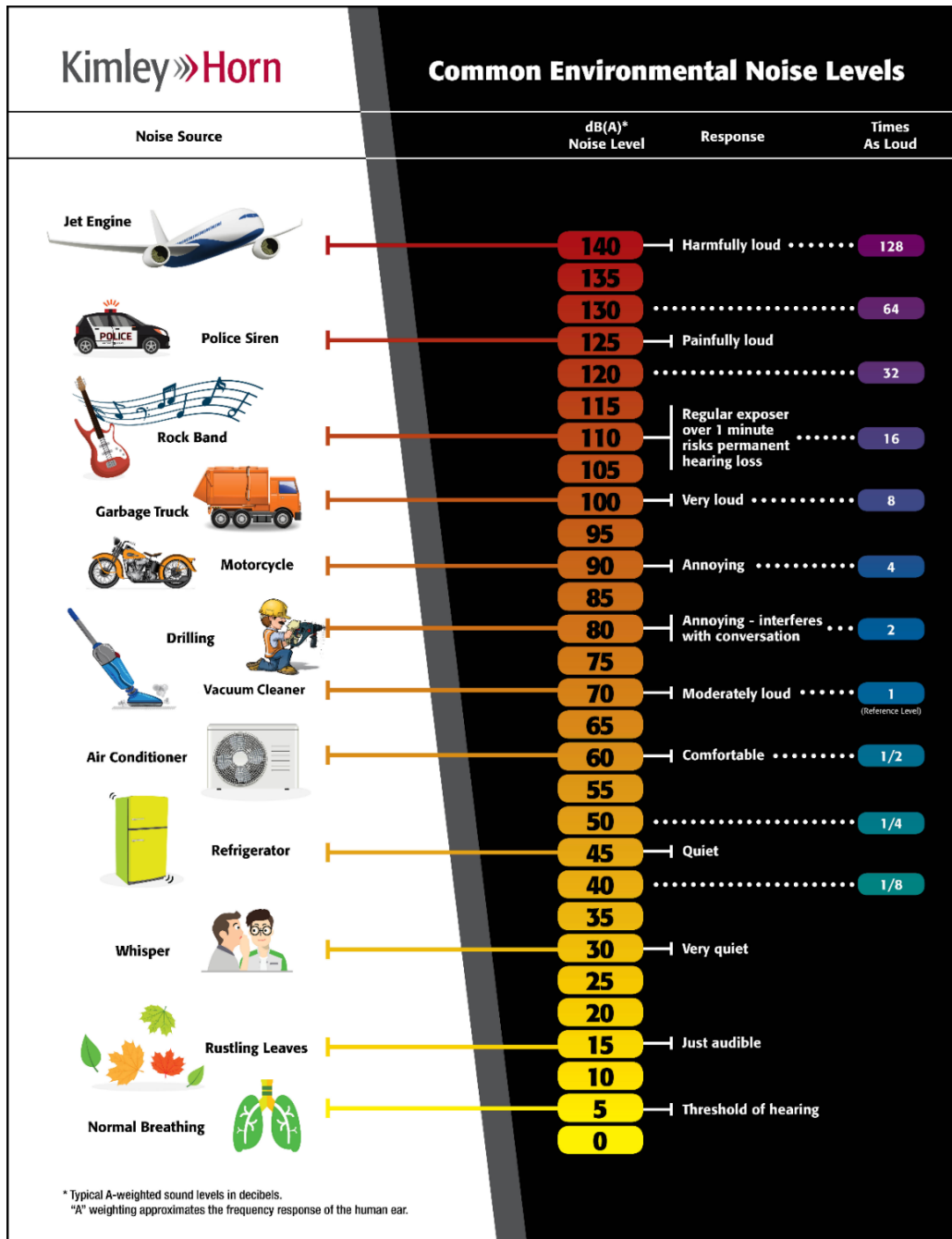
In considering the first of these factors, it is important to note that individuals have varying sensitivity to noise. Loud noises bother some people more than other people, and some individuals become increasingly upset if an unwanted noise persists. The time patterns and durations of noise(s) also 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.

**Local Regulations**

The Douglas Family Butterfly Garden and Solar Farm LLC solar site is located in an unincorporated portion of Kane County, IL. Chapter 25, Article V, Section 25-5-4-9 of the Kane County, IL Code of Ordinance states that “Noise levels from Commercial Solar Energy Facilities shall be in compliance with applicable Illinois Pollution Control Board (IPCB) regulations.”

The IPCB noise regulations are based on allowable octave band sound pressure levels during daytime and nighttime hours. The site will be located on Class C (i.e., agricultural use) land with Class A (i.e., residential use) and Class C land surrounding the site. It is to be noted that there are no established maximum octave band sound pressure levels for noise emissions from Class C to Class C land uses.

According to Title 35 (Environmental Protection), Subtitle H (Noise), Chapter I (Pollution Control Board), Part 901 (Sound Emission Standards and Limitations for Property Line-Noise Sources), a facility operating in an agricultural field (Class C Land) cannot cause an exceedance of sound levels at any point within a residential land use (Class A Land) during daytime hours as shown in **Table 1**.

**Table 1: Maximum Allowable Sound Emitted to Class A Land During Daytime Hours**

Octave Band Center Frequency (Hertz)	Allowable Octave Band Sound Pressure Levels (dB) of Sound Emitted to any Receiving Class A Land from		
	Class C Land	Class B Land	Class A Land
31.5	75	72	72
63	74	71	71
125	69	65	65
250	64	57	57
500	58	51	51
1000	52	45	45
2000	47	39	39
4000	43	34	34
8000	40	32	32

It should be noted that the Douglas Family Butterfly Garden and Solar Farm LLC solar site will not be operational during nighttime hours; therefore, only the daytime IPCB octave band sound pressure limits were applicable for this site.

**Noise Analysis**

Sound levels from the proposed Douglas Family Butterfly Garden and Solar Farm 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 inverter equipment is anticipated to be the main source 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 Norris Road, Healey Road/County Road 15, I-88, Bliss Road/County Road 78, and other rural roadways are anticipated to contribute to the ambient noise environment throughout the entire day. Additionally, noise from the Aurora Municipal Airport to the southwest is anticipated to contribute to the existing ambient noise environment but was not modeled in this analysis.

*Inverters*

Photovoltaic (PV) inverter equipment can generate steady, unvarying noise that may create issues when located near noise-sensitive uses. It was assumed that forty (40) string inverters would be located on two (2) equipment pads, with twenty (20) string inverters on each equipment pad, in the northern portion of the proposed solar site. Based on noise emission levels for CPS SCH100/125KTL-DO/US-600 string inverter equipment, a reference sound level of approximately 65 dB(A) at 1 meter (i.e., 3 feet) for a string inverter was used. **Table 2** shows the octave band emission levels for the CPS SCH100/125KTL-DO/US-600 string inverter used for reference. The sound emissions from the operation of the string inverters were calculated using SoundPLAN.

**Table 2: Sound Emissions for String Inverter**

Octave Band Center Frequency	31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1k Hz	2k Hz	4k Hz	8k Hz
Frequency Sound Level	28	46	65	70	72	72	71	72	63

Sound generated by the string inverters is not anticipated to significantly contribute to the existing environmental sound levels surrounding the site. Also, sound generated by the string inverters is expected to be mitigated by providing sufficient offsets between the string 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 string inverters.

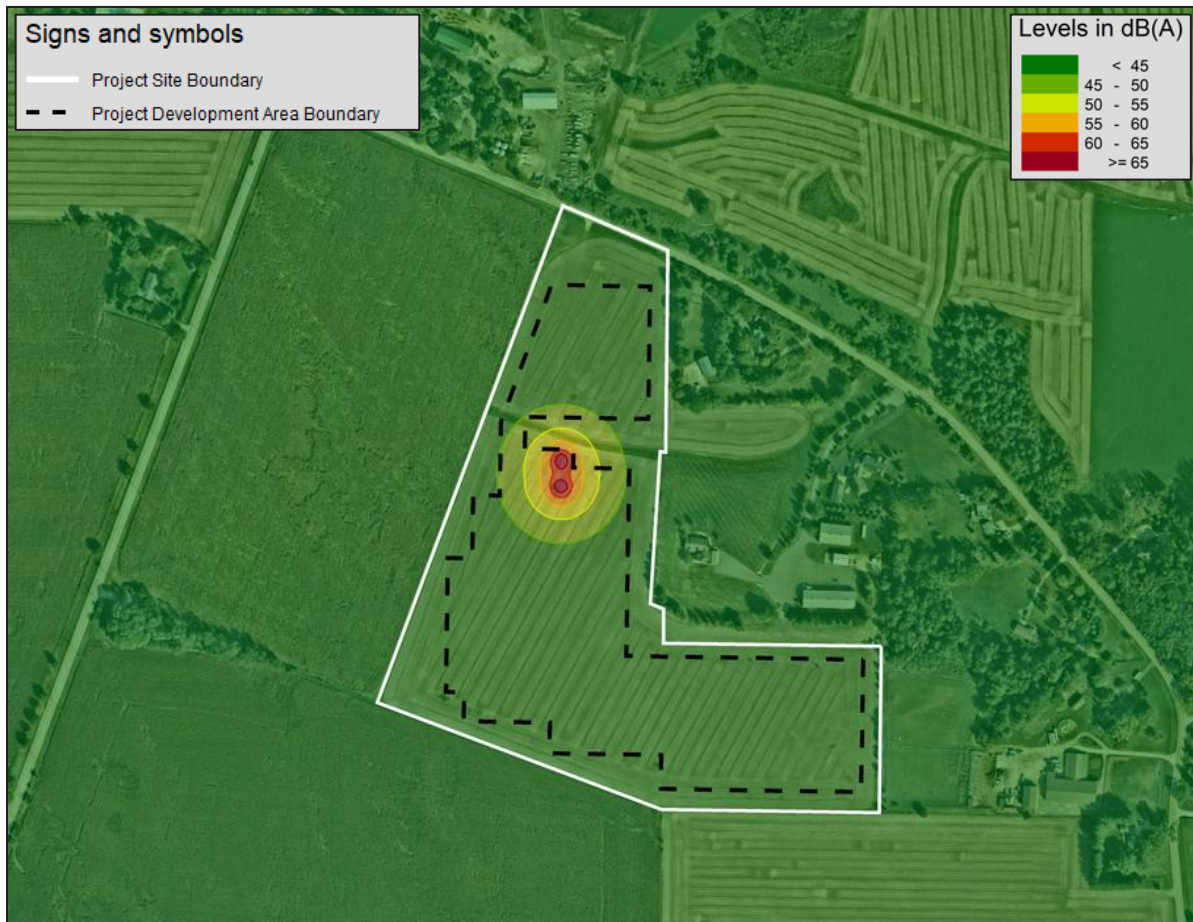
**Results**

The SoundPLAN-predicted maximum octave band noise levels at surrounding Class A land uses during daytime hours are not anticipated to exceed the octave band limits established by IPCB; therefore, noise mitigation measures do not need to be included in the project design at this time. It is to be noted that there are no established maximum octave band sound pressure levels for noise emissions from Class C uses (i.e., agricultural uses) to Class C uses. The maximum predicted octave band emissions at Class A uses are shown in **Table 3**. The anticipated operational sound contours during daytime hours are shown in **Figure 3**.

**Table 3: Predicted Maximum Sound Emissions at Class A Properties**

Octave Band Center Frequency	31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz
Maximum Octave Band SPLs from Inverters	-	13.3	26.4	19.0	23.6	32.2	32.3	30.9	10.5

**Figure 3: Operational Sound Contours**



**Conclusions**

The proposed solar photovoltaic project site is generally located south/west of Norris Road, north of Healey Road/County Road 15 and I-88, and east of Bliss Road/County Road 78. The solar site will be located on agricultural land with residential land uses east the project site. Additionally, the Aurora Municipal Airport is located approximately 3.5 miles southwest of the site.

After modeling and analyzing the anticipated operational sound levels throughout the proposed solar site, it was determined that noise mitigation measures are not needed at this time since the predicted operational sound levels are anticipated to remain below the IPCB permissible octave band sound pressure level limits at Class A land uses during daytime hours. It is to be noted that there are no established maximum octave band sound pressure levels for noise emissions from Class C uses (i.e., agricultural uses) to Class C uses.