Public Health and Safety Review of the Bluegrass Creek Solar and Storage Project

Prepared for:

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OLLSON
Environmental Health Management

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1 Introduction

Bluegrass Creek Solar LLC has retained Dr. Christopher Ollson, Ph.D., of Ollson Environmental Health Management (OEHM) to review the Application, project layout, and design of the Bluegrass Creek Solar Project to ensure that it is sited in a manner that will protect the public health, safety and welfare of local residents.

Dr. Ollson has extensive experience evaluating potential public health and safety considerations during the siting of commercial solar and energy storage projects. He has a doctorate in Environmental Health Sciences, over 25 years of experience in international consulting and is an Adjunct Professor at the University of Toronto. Dr. Ollson is considered one of North America's foremost experts in proper siting of renewable energy projects to ensure the protection of public health and safety.

2 Project Background

The Bluegrass Creek Solar project (the Project) is proposed to be a 100 megawatt (MW ac) solar energy system coupled with an approximately 21 MW ac, 4-hour duration, Battery Energy Storage System (BESS). The Project will be located in Scott Township, within Vanderburgh County, Indiana. The Project will occupy approximately 600 acres within the perimeter fence on a 1,000-acre site in Scott Township, bounded by I-69 and near the Vanderburgh Industrial Park.

The Project solar facility will consist of photovoltaic (PV) solar modules (panels), racking system (trackers), inverters, medium-voltage transformers, underground cables connecting to the substation and an overhead transmission line to the Point of Interconnection with the grid. The preliminary design for the BESS includes 24 BESS containers and 6 BESS medium-voltage transformers. A single substation having a 125 MVA main power transformer will accommodate power flows from both the solar system and the BESS.

Commercial-scale solar projects have been operating for decades, primarily in the Southwestern states. In recent years there has been an increase in the development in commercial-scale solar and BESS projects across the Midwestern United States, including in Indiana. This has led to potential concerns around public health and safety for those living in proximity to solar projects during the permitting stage.

These concerns typically include those surrounding sound, glint/glare, electromagnetic fields (EMF), and leaching of metals/chemicals from solar panels and impact to soil and groundwater. The internet contains a significant amount of misinformation on these issues and OEHM recommends that the Board of Zoning Appeals (BZA) consider credible sources of scientific information; such as, government agency reports, academic reports and studies found within the peer-reviewed published scientific journals when considering any updates to their solar regulations.

OEHM has reviewed the Vanderburgh County Zoning Ordinance Chapter 17.13.050 Commercial Solar Energy Generating Facilities, Large-Scale. OEHM's review of the Application determined that the project meets or exceeds the ordinance requirements. In addition, OEHM understands that the Project has proposed a number of conditions of approval of the special use permit to the BZA. This report provides additional details about how the project will ensure the protection of community health and safety.

3 Public Health and Safety Considerations

The following sections provide an overview of common concerns and how the Project will ensure the public health and safety of Vanderburgh County residents.

3.1 Electromagnetic Fields

Electric and magnetic fields (EMF) are invisible lines of force that surround any electrical device or generating equipment. Power lines, solar panels, electrical wiring, and home electrical equipment all produce EMF. The electric fields and magnetic fields are very different in nature and are measured in different scientific units (Figure 1).

- electric fields increase as the voltage on the line increases and are measured in volts per meter (V/m).
- magnetic fields result from the flow of current through the line and increase as the current does and are measured in units of milliGauss (mG) or Tesla (T).

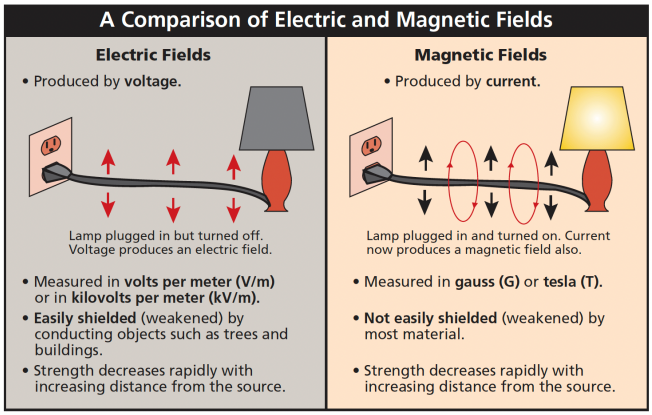


Figure 1. Depiction of electric and magnetic fields as they relate to a household lamp (NIEHS, 2002).

The potential health considerations involve the strength of the magnetic fields. Given that we are surrounded by magnetic fields in our everyday lives it is important to put these levels into perspective. The typical level of magnetic fields in our homes averages 1-4 mG. However, our exposure increases as we are closer to electrical equipment. Table 1 provides a list of common household appliances and their associated magnetic fields.

Table 1. Typical AC Time Varying Magnetic Fields (mG) Surrounding Common Appliances and Beneath a 69 kV AC transmission line (NIEHS, 2002)

Appliance	Time Varying Magnetic Field (mG)		
	6" from source	1' from source	2' from source
Microwave	100 – 300	1 – 200	1 – 30
Dishwasher	10-100	6 – 30	2 – 7
Refrigerator	2 – 40	2 – 20	1 – 10
Vacuum Cleaner	100 – 700	20 – 200	4 – 50
Hair Dryer	1 – 700	1 – 70	1 – 10
69 kV AC Transmission Line	29.7	--	--

There are no Federal or State health-based exposure guidelines for EMF for the general public. Two international expert groups—the Institute of Electrical and Electronics Engineers ("IEEE") and the International Commission on Non-Ionizing Radiation Protection ("ICNIRP")—have issued EMF exposure guidelines. Both groups of experts have concluded that no adverse health effects occur at EMF levels below their exposure guidelines for the general public. For AC time varying magnetic

fields, the IEEE exposure guideline is 9,040 mG, and for ICNIRP the exposure guideline is 2,000 mG.

For the Bluegrass Creek Solar project, the solar PV panels themselves are a source of very weak direct current (DC) magnetic fields. The same is true of the batteries in the BESS facility. DC magnetic fields are very different than the alternating currents (AC) produced by the other electrical equipment. DC magnetic fields are the same as those produced by the magnetic field of the earth's crust. The level of DC magnetic fields from the solar panels and BESS containers would in fact be at a lower level than natural background levels. Therefore, it does not pose a risk to public health.

The solar power from the panels and the BESS batteries power is converted from DC electricity to AC electricity at the inverters. Then the electricity from both is carried by the underground cables to the substation. From the Project substation there will be a 1,000 ft 69 KV line that will interconnect the power to the grid at the Elliot Substation. There will be will AC magnetic fields generated in close proximity to the inverters, along the collector lines, the substation and the overhead transmission line. However, the magnetic fields will be weak and typically less than 30 mG, even if you were standing beneath the transmission line section.

Overall, the level of EMF at the Bluegrass Creek Project will be within background levels expected in a home (<4 mG) at the fence line of the facility. They were certainly be less than the health-based guideline of the ICNIRP of 2,000 mG. Ultimately, exposure to EMF from solar panels and associated transmission lines does not cause health impacts. The Project's voluntary 300-foot setbacks from non-participating residences exceed the county ordinance's 250-foot requirement, further reducing EMF exposure at neighboring properties to below natural background levels.

Based on approximately 25,000 articles published over the past 40 years, none of the U.S. or international medical organizations has found that exposure to power frequency EMF causes, or contributes, to cancer or any other disease or illness. These reviews generally conclude that, while some epidemiology studies report a weak association with childhood leukemia, controlled laboratory studies do not support that association and the scientific studies overall have not demonstrated that EMF causes or contributes to any type of cancer or other disease.

This is an issue that has been studied by researchers with the American Cancer Society.

"*As the nation begins to think green and look for sustainable energy sources, there is growing interest in solar energy. While research continues to evaluate newer panel technologies, solar panels have not been shown to cause cancer.*" – Karen Winkfield, MD, PhD, board-certified radiation oncologist and Ingram Professor of Cancer Research at the Vanderbilt-Ingram Cancer Center and 2022 **Cancer.Net Associate Editor for Radiation Oncology & Health Equity**

3.2 Sound

The Bluegrass Creek Solar and Storage project will be a source of sound to the surrounding environment. The Vanderburgh County solar ordinance does not contain any restrictions on sound from solar projects. To ensure that the Project would not cause undue nuisance to the neighbors the Project commissioned RSG to conduct a Project-specific noise assessment of both the BESS and solar noise sources.

In the absence of a county noise ordinance RSG recommended that the Project be designed to a 45 dBA L_{eq} standard for each of the homes that were uninvolved (non-participating) in the Project. They reference a general World Health Organization (WHO) standard to support their criteria.

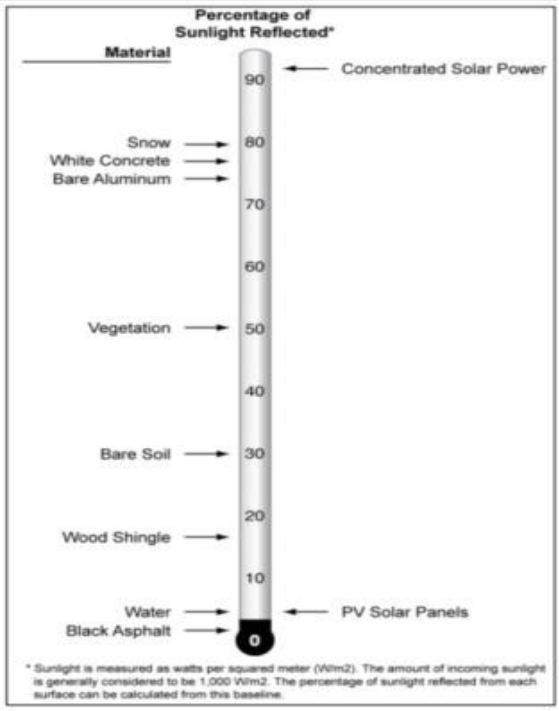
OEHM agrees that adherence to a 45 dBA L_{eq} standard at the exterior of uninvolved homes in the area is the correct metric for ensuring the protection of public health and unimpeded use of their

property. This standard has also been adopted in state regulations for solar projects (e.g., New York, North Dakota, Wisconsin) and is closely aligned with others (e.g., Illinois, South Dakota, and Minnesota). The 45 dBA sound standard at night is, first and foremost, meant to protect individuals' ability to sleep. At this level it has been demonstrated that even with the windows open in the summertime that nearby residents will not be adversely impacted. During the daytime this level ensures that the general quality of life and use of their property will not be impaired by an intrusive level of noise. Given that it is a solar project is anticipated to generate less noise during nighttime hours.

According to the Project noise report there are 558 homes located within 1.5 miles of Project infrastructure. All of the uninvolved homes had modeled sound levels <45 dBA. This will ensure the Project noise does not impact the health or welfare of the local residents.

3.3 Glare from Solar Panels

As with any reflective surface glare can occur off of solar panels when they are perfectly oriented in a position that reflects the sun onto roadways or adjacent properties. However, solar panels are already designed and manufactured to reduce glare using anti-reflective glass and reflect only approximately 2% of incoming light.



It is important to note that any glare from solar panels from the Project would be less than that from sunlight on water, windows and even windshields or rear windows in cars. We all experience this type of glare while driving our vehicles every day. Regardless, if undue glare is predicted for neighboring properties there are several mitigation measures that can be incorporated into the solar project design.

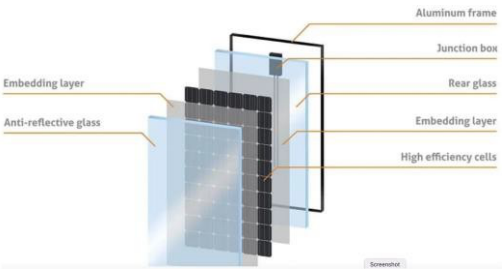
The Vanderburgh County Ordinance does have provisions for glare they "*do not cause glare onto adjacent properties or into the right-of-way where it could present a safety hazard for street traffic.*"

To that end the Project commissioned Capitol Airspace Group to conduct a Glint and Glare Analysis report for the project. The conducted analysis for the Evansville Regional Airport flight approaches and the air traffic control tower (ATCT), the solar adjacent roadways and homes. The results indicated that no glare would affect flight paths or the ACTC. It also determined that there would not be any glare that would impact local vehicle traffic. There was minor glare predicted for a single participating project residence. It is not anticipated that the glare would be significant on the residence but mitigation measures such as adjusting the resting angle of the panels. Therefore, glare from the solar panels of the Project is not expected to cause a nuisance or public safety issue in the County.

3.4 Leaching of Materials from Solar Panels

There is considerable misinformation on the internet about the potential for operating solar panels to impact soil and groundwater. It is true that solar panels contain trace amounts of heavy metals and chemicals.

The solar panels are typically comprised of silicon cells sandwiched between upper and lower layers of plastic and by front and rear sheets of glass, all encased by an aluminum frame. This ensures that the panels are completely encapsulated and protected from the rain, snow and other weather elements.



There are trace concentrations metals (e.g., copper and lead) associated with the panels and soldering of some of the electrical components. Also, for some panels there is trace amounts of per- and polyfluoroalkyl substances (PFAS) in outer as an anti-reflective and self-cleaning coating. Most PFAS identified in solar modules belong to the fluoropolymers category, which is a distinct group of PFAS and is considered a polymer of low concern. There are some solar panels that involve the use of cadmium telluride; however, these types of panels will not be used in the Bluegrass Creek Solar project. It is important to note that under operational conditions there is little to no ability of any of this material to leach or be emitted from the solar panels and impact local soil or groundwater.

The solar panel racks are mounted on poles or piles that will be driven into the ground. There are various types of poles that can be used, one of which is galvanized steel which concerns have been expressed will result in the leaching of zinc that would impact local groundwater and drinking water. Galvanized steel is widely used in numerous construction activities across rural America including in drainage pipes, road barriers, bridges, grain drying bins, silos, fencing and barn construction. Any leaching of zinc from the galvanized steel mounts from a solar project would be negligible and not impact local groundwater. In fact, zinc is an essential element and any level in groundwater used as drinking water would be insignificant compared to health standards.

Although the Project will not impact local soil or groundwater, it is OEHM's understanding that Bluegrass Creek Solar is offering to conduct baseline and decommissioning soil testing to ensure no chemical impact to soil or groundwater, as outlined in the Proposed Conditions.

3.5 Extreme Weather Considerations

It is understood that Vanderburgh County is in an area that experiences high wind, tornado and hail events. Solar projects are typically designed to withstand winds of up to 140 miles per hour (mph). This is factored into the geotechnical studies and design of the steel pile depths to ensure that the Project will remain stable under high wind events.

That said, if there was a direct tornado strike through the path of the solar project there is a potential that the panels could be dislodged. However, this is no different than would occur for another building that would be in the tornado's path. In the event of a tornado strike it would be a physical debris hazard of the panel. There would be no toxic chemical hazard that would leach from the panels.

Solar panels are also designed to withstand hail damage. Those panels that are tested to Underwriters Laboratory (UL) 61730 are rated to withstand hail of 1 to 4 inches in diameter and at velocities of between 50 to 80 mph. The Project will employ ARRAY Technologies' SmartTrack trackers that will be deployed 30 minutes prior to a storm and stow the panels in a direction that would minimize the risk of damage.

There have been solar projects that have indeed experienced widespread damage in extreme hail storms. The large hail size and velocity damaged many panels and rendered the projects unusable until the panels could be replaced. However, as discussed in Section 3.4, even if this was to occur there would be no leaching of chemicals or metals into the soil during the time that it would take to replace damaged panels.

3.6 Heat Island Effect

Cities, towns and commercial areas experience a phenomenon referred to as the heat island effect. This is where built up areas can be significantly warmer than surrounding rural areas, especially at night. This is because urban areas contain large amounts of heat-absorbing material; such as, asphalt, concrete and buildings. This results in urban areas releasing heat and the local air temperature being anywhere between 2 to 20ºF higher than surrounding rural areas.

Questions have been raised about whether solar farms can have a similar impact. A single paper released in 2016 measured a 5 to 7ºF increase in temperature above solar panels in a semiarid dessert environment (Barron-Gafford *et al.,* 2016). Given that this study was conducted in a desert environment it is not representative of conditions in Indiana. The authors detail that vegetative cover, as would be the case in Bluegrass Creek Solar, would mitigate these issues.

In addition, there is no research or practical real-world experience that would suggest that even if there was a minor change in temperatures immediately above the panels that it is impacting the local environmental conditions. Solar projects in rural areas are often located adjacent to agricultural fields or pasture land and have not been reported to impact crop yield or production.

3.7 Electric and Fire Safety

The Project involves numerous electrical components in the solar panels, inverters, transformers, the BESS and the substation equipment. The entire area will be fenced and not accessible by the general public. All equipment will be installed to the highest standards of the National Electrical Code and be verified by a licenced electrical engineer prior to commissioning.

3.7.1 Arc Flash

Arc flash refers to the flash of light and heat that is created when energy is released between a high-voltage live conductor and another conductor or the ground. The electrical components involved in the BESS and the solar inverters and substation could cause an arc flash. An arc flash causes severe burns and can be fatal for people who come into contact with them. All Project personnel coming in contact with electrical equipment will have the proper training and experience to ensure their protection against such events. In the event of a fire, local firefighters and emergency response personnel will be trained to ensure that they don't come into contact with an arc flash.

3.7.2 Fire

Fires in solar and BESS facilities are extremely rare, although they do happen. The Project has committed to preparing a site-specific Emergency Management Plan (EMP) in cooperation with the County and local emergency management services (EMS). The plan will clearly outline emergency response protocols, roles and responsibilities. There is also a commitment to provide training to County staff and EMS prior to commissioning and annually as requested by the County.

The Project commissioned Hiller Fire to provide the Bluegrass Creek Battery Energy Storage Safety Overview and Report. As detailed in the Hiller report fires in BESS systems have become very rare given the recently update code and standards requirements.

In the event of a BESS fire, the Hiller Fire Report recommends allowing the container to self-consume without water application, as air quality results from recent incidents show no hazardous gases beyond health standards at the fenceline.

Air quality results take around six recent BESS fires have indicated that there were no hazardous or toxic levels of gases detected above stringent health standards, even at the fence line. Therefore, no one in surrounding community would be adversely impacted.

With respect to the solar facility, the panels themselves do not initiate a fire. Instead, solar project fires may typically occur as a result of improper or faulty wiring. In the unlikely event of a fire at the solar project it would largely lead to a grass fire. Fire departments have all the equipment they need in the event of such a fire. They are not asked to save any equipment, rather to put out the grass fire and ensure that it does not spread to a neighboring field. Again, in such an event there would be no adverse toxic fumes from the fire that would impact the local residents.

3.8 Setbacks and Fencing

The key to solar and BESS project design is adherence to appropriate setbacks to neighboring properties, homes and roads. These setbacks are not only for public safety but they also ensure that the previously mentioned sound and glare issues are not excessive.

The Vandenburgh County Ordinance requires the following setbacks:

- 50 feet from the common lot line(s) between the two properties, or 250 feet from the principal residential structure, whichever is greater.
- When locating adjacent to a right-of-way for any public road, the solar array shall have a forty (40) foot setback from the right-of-way
- Setbacks for all other property lines shall meet the district setback or be a minimum of ten (10) feet whichever is greater.

However, the Bluegrass Creek Solar and Storage project was designed with a voluntary 300-foot setbacks from residences of non-participating landowners (unless the setback is waived by mutual consent), 50-foot setbacks from the right-of-way of state highways and county/state aid highways, and 40-foot setbacks from other public roads. This voluntary increase in setbacks is more than sufficient to ensure public health and safety is maintained for the local residences. In addition, the perimeter of the property will be full fenced to ensure that trespass into the facility is not feasible.

4 Conclusion on Bluegrass Creek Solar and Storage Project for Protection of Public Health and Safety

OEHM has reviewed the Bluegrass Creek Solar and Storage Project design and layout. The Project meets or exceeds all of the requirements of the Vanderburgh County Ordinances. All of the electrical equipment is designed to meet the National Electrical Code standards and will be verified prior to energization of the facility. Adherence to the codes and standards will reduce the risk of fire occurring at the site.

In addition, the Project conducted a noise impact assessment and voluntarily meets a restrictive 45 dBA sound level at the exterior of uninvolved homes surrounding the facility. The glare analysis showed that there will be no glare on the adjacent roads, that the airport will not be affected and that only minor glare is predicted for one participating project resident that can be mitigated. The Project has also voluntarily increased setbacks to uninvolved homes to at least 300 feet.

Most importantly the project has committed to the development of an Emergency Management Plan with the County EMS officials. It will include training of the local fire department and emergency responders. In the unlikely event of a fire the local residents would not be at undue risk from such an event.

Overall, I believe that the Bluegrass Creek Project has been properly designed and its operation should not impact the public health, safety or welfare of local residents.

Sincerely,

OLLSON ENVIRONMENTAL HEALTH MANAGEMENT

Christopher Ollson, PhD
Senior Environmental Health Scientist

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