EXHIBIT I

PART 2 of 2

Attachment E. Visual Resource Assessment

Visual Resource Assessment

Exie Solar Project

Green County, Kentucky

Case No. 2025-00151

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1.0 INTRODUCTION

On behalf of Exie Solar, LLC (the Applicant), Environmental Design and Research, Landscape Architecture, Engineering & Environmental Services, D.P.C. (EDR) prepared this *Visual Resource Assessment* (VRA) for the proposed Exie Solar Project (the Project). The Project will consist of the construction and operation of a solar-powered electric generation facility and associated infrastructure (the Facility) in an unincorporated area of Green County, Kentucky. This VRA was prepared to evaluate the compatibility of the Facility with the scenic surroundings, as required by Kentucky Revised Statutes (KRS) 278.708(3)(b). Recognizing these requirements, the purposes of this VRA are as follows:

- Describe the appearance of the visible components of the proposed Facility.
- Define the aesthetic character of the visual study area (VSA).
- Inventory and evaluate existing VSRs and viewer groups within the VSA.
- Evaluate potential Facility visibility within the VSA.
- Identify representative views for visual assessment.
- Illustrate the appearance of the proposed Facility from representative locations (photographic simulations).
- Assess visual impacts associated with the proposed Facility.
- Describe visual mitigation and minimization measures that are proposed or have been considered to reduce potential visibility and visual impacts of the Project.

This VRA was prepared by environmental professionals with education and career experience in the evaluation of visual impact. As described in more detail in subsequent sections, the VRA methodology and content are consistent with policies, procedures, and guidelines contained in established visual impact assessment methodologies developed by the Bureau of Land Management (BLM, 1999), United States (U.S.) Forest Service (USFS, 1995), U.S. Department of Transportation (USDOT, 1981 and 2015), U.S. Army Corps of Engineers (Smardon et al., 1988), and National Park Service (Sullivan et al., 2014 and 2021).

2.0 FACILITY DESCRIPTION

The proposed Project includes development of a solar-powered electric generation facility with a capacity of up to 110 megawatts (MW). The Facility is proposed to be located on approximately 1,340 acres of land (Project Area) currently under lease or purchase option by the Applicant. This area is characterized by rolling terrain, with elevations ranging from approximately 700 feet to 1,025 feet above mean sea level. Land cover is defined predominantly by agricultural land interspersed with woodlots and rural residential development. The Project Area is located approximately 1.5 miles west of the unincorporated community of Exie. The City of Greensburg is approximately 7 miles northeast of the Project Area (Figure 2-1). The Facility layout is illustrated in Figure 2-2.

Figure 2-1. Regional Facility Location

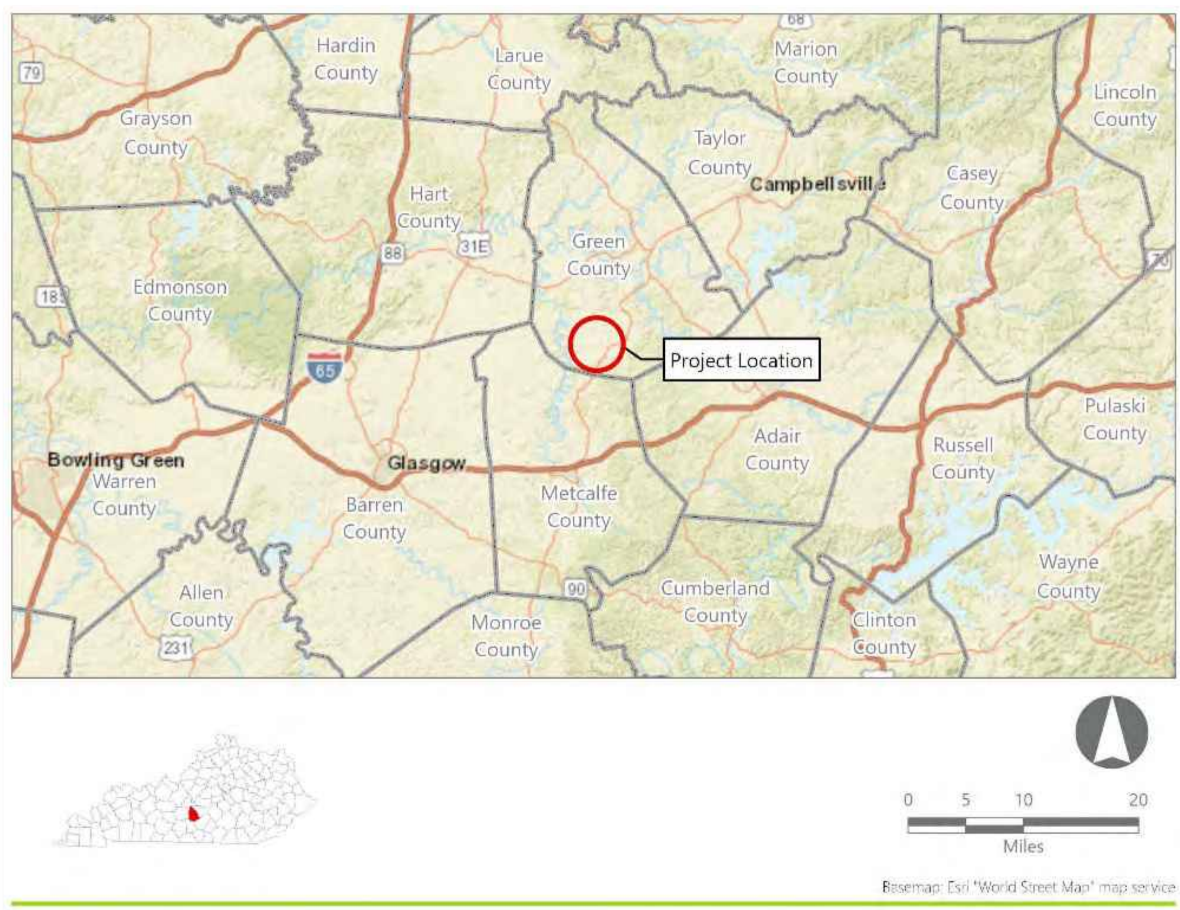
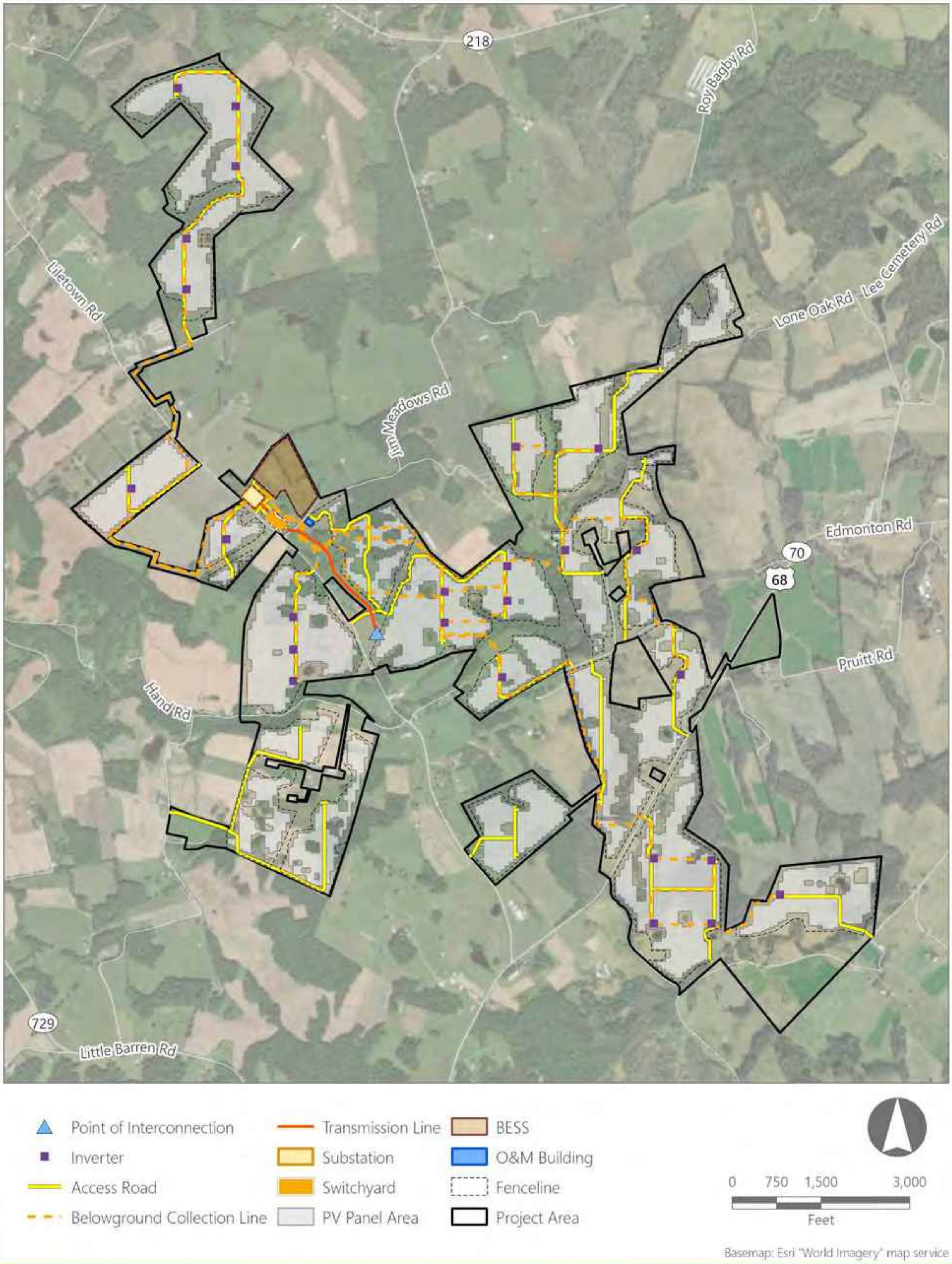


Figure 2-2. Facility Layout



The proposed permanent Facility components will include:

- Rows of photovoltaic (PV) panels mounted on fixed-tilt racking systems;
- Inverters to convert direct current (DC) electricity generated by the PV panels to alternating current (AC) electricity;
- A medium-voltage, belowground electrical collection system to aggregate the AC output from the inverters;
- A collection substation where the facility's electrical output will be combined and increased to the transmission line voltage via step-up transformers;
- A point of interconnection (POI) switchyard and overhead transmission line to transfer the generated electricity to the designated POI;
- A battery energy storage system (BESS);
- Security fencing and gates around the PV panel arrays, collection substation, and POI switchyard;
- Gravel-surfaced access roads;
- An operations and maintenance (O&M) facility.

3.0 EXISTING RESOURCES

The existing scenic and visually sensitive resources in the area surrounding the Project were identified by defining an appropriate visual study area and gathering publicly available data on resources within the study area. These steps are detailed further in this section.

3.1 Definition of Visual Study Area

To determine an appropriate extent of the VSA to be used for the visibility analyses presented in this report (i.e., viewshed analysis, field review, and photosimulations), a preliminary viewshed analysis was completed to determine the geographic extent of potential Project visibility. The preliminary viewshed analysis results suggest that the facility will be entirely screened beyond approximately 1 mile from the Project Area. Additionally, based on observations of operational projects, PV panel arrays become indistinguishable at distances beyond 2 miles due to their low profile, the limits of human visual acuity, and atmospheric haze. Therefore, the Project's VSA has been conservatively defined as the area within a 2-mile radius surrounding the Project Area (Figure 3-1). This VSA was used for all the visual analyses presented herein (i.e., viewshed analysis, field review, and photosimulations).

3.2 Visually Sensitive Resources

EDR conducted a search for resources that could be considered visually sensitive based on the type or intensity of use they receive. A review of publicly available geospatial databases resulted in the identification of 22 VSRs within the VSA. A complete listing of the resources used in the identification of VSRs is included in the References section of this report. The categories of resources considered in this study and number of resources identified in each category are summarized in Table 3-1. The location of these resources is illustrated in Figure 3-1 and in greater detail in the viewshed map included as Attachment A. A list of all VSRs identified within the VSA with additional location information is also included in Attachment A.

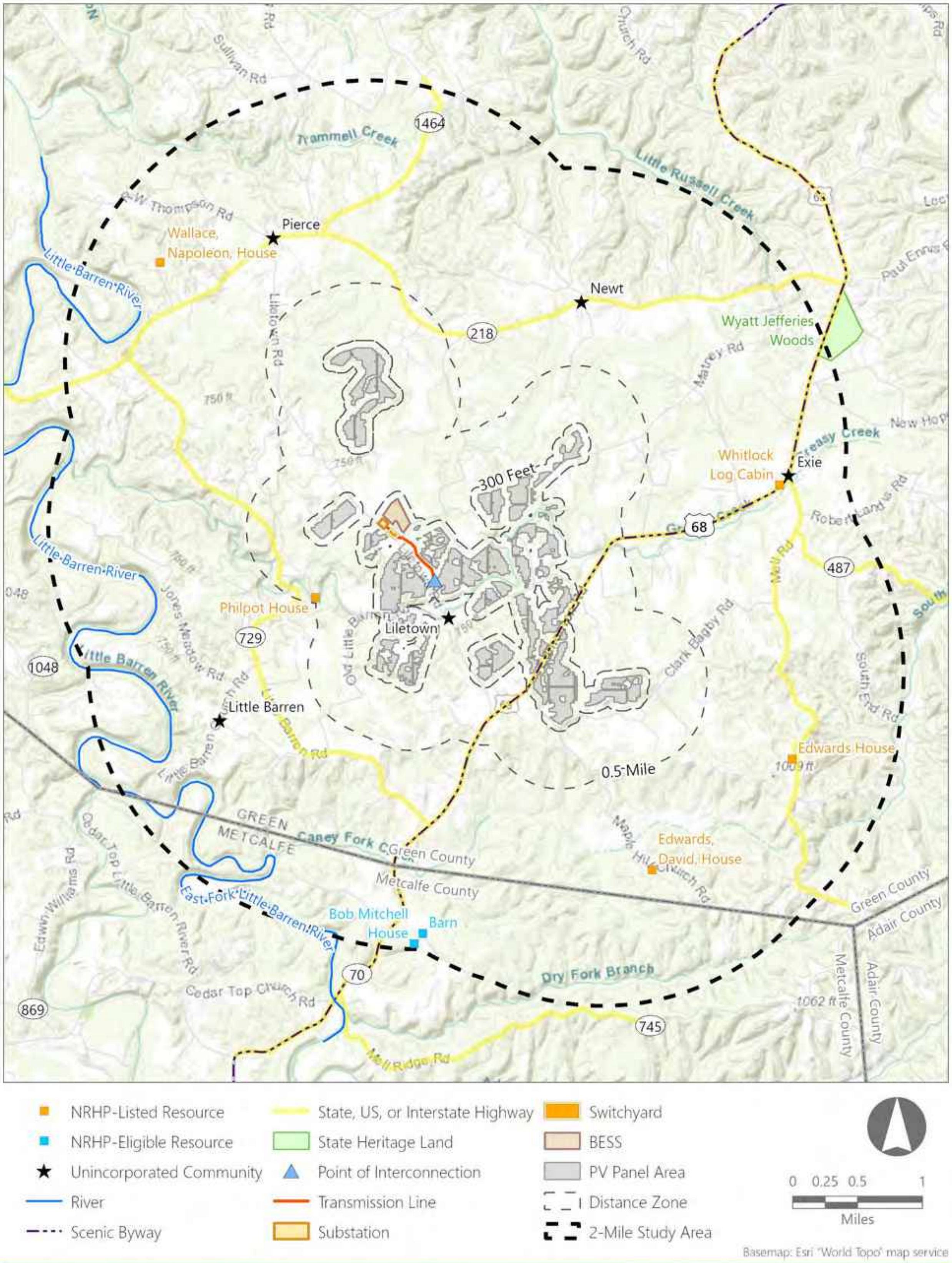
Table 3-1. Summary of Visually Sensitive Resources Identified in the Visual Study Area

Visually Sensitive Resource Category	Number of Resources
Properties of Historic Significance	**7**
National Historic Landmarks (NHL)	0
National or State Historic Sites	0
Properties/Districts Listed on the National Register of Historic Places (NRHP)	5
Properties/Districts Eligible for Listing on the NRHP	2
Designated Scenic Resources	**1**
Rivers Designated as National or State Wild, Scenic, or Recreational	0
Sites, Areas, Lakes, Reservoirs, or Highways Designated or Previously Determined Eligible for Designation as Scenic	1
Other Designated Scenic Resources (Easements, Roads, Districts, Overlooks)	0
Public Lands and Recreational Resources	**3**
National Parks, Recreation Areas, Seashores, and/or Forests	0
National Natural Landmarks	0
National Wildlife Refuges	0
National Heritage Areas	0
State Parks	0
State Nature Preserves	0
State Natural Areas	0

Table 3-1. Summary of Visually Sensitive Resources Identified in the Visual Study Area

Visually Sensitive Resource Category	Number of Resources
Wildlife Management Areas	0
State Forests	0
State Fishing/Waterway Access Sites	0
State Heritage Lands	1
State and Federal Trails	0
Snowmobile/ATV Trails	0
Bike Trails/Routes	0
Other Trails	0
Local Parks and Recreation Areas	0
Publicly Accessible Conservation Lands/Easements	0
Rivers	2
Named Lakes, Ponds, and Reservoirs	0
High-Use Public Areas	**11**
State, U.S., and Interstate Highways	6
Schools	0
Cities and Villages	0
Unincorporated Communities	5
Total Number of VSRs in the VSA	**22**

Figure 3-1. Map of Visually Sensitive Resources



4.0 VISUAL IMPACT ASSESSMENT METHODOLOGY

The specific techniques used to assess potential Facility visibility and visual impacts are described in the following sub-sections.

4.1 Facility Visibility Methodology

A desktop viewshed analysis and field review was undertaken to identify locations within the VSA where there is potential for the proposed PV panels, interconnection facility (substation, switchyard, and BESS), and transmission line to be seen from ground-level vantage points, as described further below.

4.1.1 Viewshed Analysis

Due to the differences in height, form, and scale, separate viewshed analyses were conducted for the PV panels, interconnection facility, and transmission line.

PV Panel Viewshed Analysis

A digital surface model (DSM) viewshed analysis was conducted to identify areas where the proposed PV panels may be visible. This viewshed analysis was based upon the height of the PV panels in their most upright position and therefore represents the greatest possible extent of potential PV panel visibility.

The DSM is a representation of topography as well as natural and built features on the land (e.g., structures, trees, powerlines). By comparison, a digital elevation model (DEM) is a representation of a bare earth topographic surface only. Because it is based on bare earth topography only, a DEM viewshed analysis does not accurately represent areas of potential Facility visibility because it does not consider the screening effects of existing vegetation or structures. Therefore, only a DSM viewshed analysis, which considers the height and location of all surface features, was conducted. The DSM viewshed analysis, which was prepared for the purposes of this VRA, used the following data and parameters:

- A 5-foot resolution DSM derived from the Kentucky Aerial Photography & Elevation Data Program 2014 and 2017 lidar data;
- Sample points representing the proposed PV panels, spaced approximately 300 feet apart in a grid pattern throughout all proposed PV panel areas;
- A maximum height of 12 feet applied to each of the PV panel sample points;
- An assumed eye-level viewer height of 6 feet;
- Esri ArcGIS Pro® software with the Spatial Analyst extension.

To avoid misleading results, some modifications to the DSM were made prior to conducting the viewshed analyses. Existing overhead transmission lines and roadside utility lines are generally misrepresented in the DSM as solid structures that extend from the top of these lines to the ground surface and therefore will be incorrectly interpreted as solid features with the potential to screen views. In order to correct this inaccuracy, all above-ground surface features within transmission line and road corridors (defined as areas within 50 feet of transmission line and state, U.S., and interstate highway centerlines, and areas within 30 feet of local road centerlines) were removed using bare earth (DEM) elevation values within these corridors. A number of hedgerows located in the Project vicinity were cleared from the DSM as well. While these hedgerows will provide some degree of screening of the Facility components and are anticipated to remain in place, their presence in the DSM would have caused the viewshed results to inaccurately indicate complete screening of potential visibility by these hedgerows. It is important to note that this removal of surface features within road and transmission corridors may also eliminate legitimate screening features that occur in these areas, potentially resulting in an overstatement of proposed PV panel visibility within and adjacent to road and transmission line corridors. All vegetation within the Facility's limit of disturbance was also removed and replaced with bare earth elevation values to account for proposed clearing.

Once the viewshed analyses were complete, PV panel visibility was set to zero in locations where existing surface features exceed the bare earth elevation value by 6 feet or more, indicating the presence of vegetation or structures that exceed the assumed viewer height. This was done for two reasons: 1) in locations where trees or structures are present in the DSM, the viewshed results would reflect visibility from treetops or building roofs, which is not the intent of this analysis, and 2) to reflect the fact that the PV panels will generally be screened from view at ground-level vantage points within buildings or areas of vegetation that exceed viewer height.

Because it accounts for screening provided by topography, vegetation, and structures, DSM viewshed analysis is the best available representation of potential visibility of the proposed PV panels. However, because certain characteristics of the Facility and the VSA that may serve to limit visibility (e.g., color, atmospheric/weather conditions, distance from the viewer) are not taken into consideration in the analysis, being located in an area indicated to have potential PV panel visibility does not necessarily equate to actual Facility visibility, nor does it indicate that adverse visual impacts will occur within these geographic locations. There is also the possibility of the DSM overstating screening, and therefore underestimating actual visibility, in locations where views are available through trees during the dormant season. However, such views will typically be significantly screened by bare tree branches and trunks.

Interconnection Facility Viewshed Analysis

A separate DSM viewshed analysis was conducted to identify areas where the proposed interconnection facility may be visible. This viewshed analysis was prepared using sample points representing the bounding dimensions of the proposed interconnection facility. These sample points were assigned heights of 80 feet to represent the maximum height of the tallest substation component, the lightning mast, and 10 feet within the BESS area. All other data sources and assumptions used in this viewshed analysis are as described above for the PV panel viewshed analysis.

Transmission Line Viewshed Analysis

A separate DSM viewshed analysis was conducted to identify areas where the proposed transmission line may be visible. This viewshed analysis was prepared using sample points representing along the proposed transmission line route. These sample points were assigned heights of 100 feet to represent the maximum height of the transmission line structures. All other data sources and assumptions used in this viewshed analysis are as described above for the PV panel viewshed analysis.

4.1.2 Field Review

EDR personnel conducted field review within the VSA and surrounding area on February 27-28, 2025. During field review, EDR staff members traveled public roads and visited public vantage points throughout the VSA to confirm the results of the viewshed analysis and obtain photographs to document existing visual character and representative views for subsequent development of photosimulations. The determination of potential Facility visibility was based on the proposed locations and dimensions of Facility components, viewshed analysis results, and prominent landscape features near within or near the Project Area that served as location and scale references. To assist with viewer orientation and determination of potential Facility visibility in the field, global positioning system (GPS) units were combined with mapping in the Esri ArcGIS Field Maps® mobile application. The field mapping included Facility components, VSR locations, viewshed analysis results, a topographic and aerial base map, and the current viewer location. At each viewpoint, the GPS unit was used to document the location, time, and observations regarding potential Facility visibility.

Field review resulted in documentation of potential Facility visibility from 64 representative viewpoints within the VSA. At each viewpoint, multiple photographs were taken to capture the full extent of the Facility and the surrounding landscape context. These photographs were taken using a digital SLR camera with a lens setting of 18 and 33 mm (equivalent to settings at 27 and 50 mm on a standard 35 mm full frame camera). Viewpoint locations were recorded using a camera-integrated global positioning system (GPS) unit, and all field notes, GPS points, focal length parameters, times, and dates were documented electronically. A complete map of viewpoint locations and representative photographs from each viewpoint are included in Attachment B. The photographs for each viewpoint include a panorama composition illustrating the view context and a single-frame photograph illustrating the most open, unobstructed view available toward the proposed Facility.

4.2 Facility Visual Impact Methodology

EDR examined the potential visual impact associated with the proposed Facility from VSRs within the VSA. This assessment involved determining whether there is potential visibility of the Facility from each of the identified VSRs, based on the viewshed analysis described in Section 4.1.1. In addition, EDR prepared photographic simulations of the proposed Facility from representative viewpoints. These photosimulations illustrate the appearance of the operational Facility. Visual impact assessment procedures are summarized in the subsections below.

4.2.1 Viewpoint Selection

Based on the outcome of EDR's VSR research and field review, a total of two viewpoints were identified as candidates for development of photosimulations. Additional information regarding each viewpoint is included on the context sheet for each photosimulation in Attachment C. These candidate viewpoints were selected based upon one or more of the following criteria:

- They could provide open views of the PV panel areas or other Facility components.
- They could illustrate views from significant locations including VSRs where open views will be available at locations with a high degree of visual exposure, such as more highly travelled roadways where open views will be available.

4.2.2 Photosimulations

To show anticipated visual changes associated with the proposed Facility, three-dimensional (3D) modeling software was used to create realistic photographic simulations of the proposed Facility from each of the views. The photosimulations were developed by using Autodesk 3ds Max Design® to create a simulated perspective (3D camera view) to match the location, bearing, and focal length of each existing conditions photograph. A 3D model of the lidar data (point cloud) used to generate the DSM was created to represent existing landscape features such as roads, buildings, terrain, and vegetation. The 3D camera's orientation, location, roll (tilt), and focal length were then adjusted to match the modeled landscape features in the lidar data with the corresponding landscape features in the photograph. This process ensures that any elements introduced to the model space (e.g., the PV panel areas) will be shown in proper proportion, perspective, and relation to the existing landscape features in the view. Consequently, the alignment, elevations, dimensions, and locations of the proposed Facility structures in the photosimulations will be accurate.

Computer models of the proposed PV panels and racking system, inverters, and access roads were prepared based on layout information and specifications provided by the Applicant. The modeled Facility components were imported into the landscape model space described above and set at the proper geographic location. With the proposed Facility in place, a daylight system was created based on the date, time, and location of each photograph in order to accurately represent light reflection, highlights, color casting, and shadows. The Facility was then rendered and superimposed over the existing photograph in Adobe Photoshop®. Using lidar data and the proposed limits of disturbance as guides, portions of the Facility that would fall behind vegetation, structures, or topography were then masked out and any vegetation that is proposed to be cleared was removed from the photograph. Finally, any shadows cast on the ground by the proposed structures were rendered.

Proposed mitigation plantings were also incorporated into the photosimulations where they would be visible. To model the proposed mitigation, EDR prepared 3D models of each of the proposed plant species, representing the plants during leaf-on conditions and reflecting their size at five to seven years of plant growth, based on the installation size specified in the conceptual planting plan and region-specific species growth rates. The 3D plant models were then placed into the landscape model space in the general arrangement specified in the conceptual planting plan, rendered, and superimposed using the same process described above. The five-to-seven-year range of plant growth was selected for this study to illustrate the plantings at their established size and intended screening effectiveness. The projections of plant growth are based on documented annual growth rates of the selected species multiplied by five. This is stated as a five-to-seven-year period to account for potential reduced growth during plant establishment and drought years. It should be noted that many factors may influence the success of living plant material. The photosimulations assume successful growth resulting from healthy nursery stock that was established following specific planting instructions and required care of the installed materials. Documentation of the requirements should be included in late-stage construction documentation completed by a licensed landscape architect.

A graphic illustration of the photosimulation process is included in Figure 4-1. The photosimulations, along with existing view photographs and additional contextual information for each viewpoint, are included in Attachment C.

Figure 4-1. Photosimulation Methodology

1 | PHOTO SELECTION

Photographs are selected to represent the most open, unobstructed line-of-sight toward the Facility from the viewpoints selected for the development of photosimulations.

2 | CAMERA POSITIONING AND ALIGNMENT

A georeferenced model is created using GPS data collected in the field and lidar data. These data are used to accurately align a camera view to the existing topography, vegetation, and structures that are visible in the photograph using 3D modeling software.

3 | FACILITY MODEL CREATION

A model of the Facility is created based on plans and specifications for the various Facility components. The proposed exterior color/finish of the Facility components is then added, and the components are placed in the correct geographic position within the georeferenced model.

4 | ENVIRONMENT SYSTEM

An environmental system is set up with the appropriate sun angle based upon the specific date, time, and location (latitude and longitude) at which each photo was taken.

5 | MITIGATION MODEL CREATION

Mitigation plantings are modeled and placed at the locations specified in the landscape mitigation plan. Plants are sized based upon anticipated installation size and following 5-7 years of growth post-installation.

6 | SIMULATION RENDERING AND PHOTO EDITING

The 3D model of the Facility and plantings are then rendered and superimposed over the photograph in Adobe Photoshop. Portions of the Facility that fall behind vegetation, structures, and topography are masked out.

5.0 VISUAL RESOURCE ASSESSMENT RESULTS

5.1 Facility Visibility Results

The results of the analysis of Facility visibility were used to identify locations within the VSA where there is potential for the proposed Facility to be seen from ground-level vantage points, including potential visibility from each VSR within the VSA.

5.1.1 PV Panel Viewshed Analysis Results

The PV panel DSM viewshed analysis indicates that the PV panels will potentially be visible from approximately 12.6% (4.6 square miles) of the VSA (i.e., the PV panels would be entirely screened from approximately 87.4% [31.8 square miles] of the VSA). The limited extent of potential PV panel visibility is due to the low profile of the panels and screening provided by woodlots in the surrounding area. As indicated in Figure 5-1, potential visibility is concentrated in agricultural fields, rural residential areas, and along roadway corridors where there is little or no forest areas or other landscape features that screen views. The greatest potential for PV panel visibility occurs within the Project Area itself and within 0.5 miles of the Project Area boundary (Figure 5-2). Beyond 0.5 miles of the Project Area, visibility is limited to narrow bands in large agricultural fields sloping toward the Project. As discussed in Section 5.1.4, actual visibility may be more limited than indicated by the viewshed analysis due to the removal of existing roadside screening features in the viewshed analysis and the effects of distance.

Figure 5-1. PV Panel DSM Viewshed Analysis

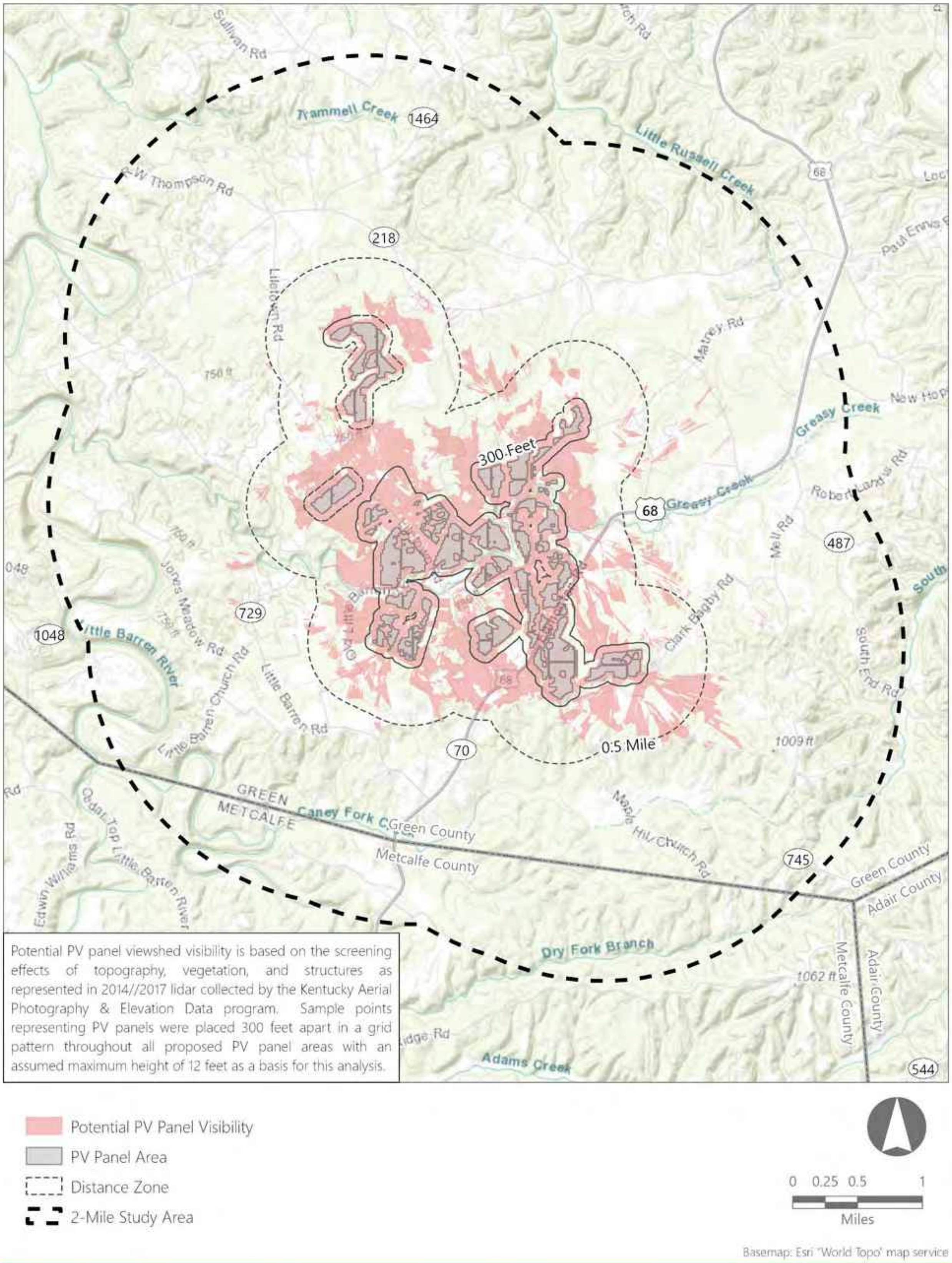
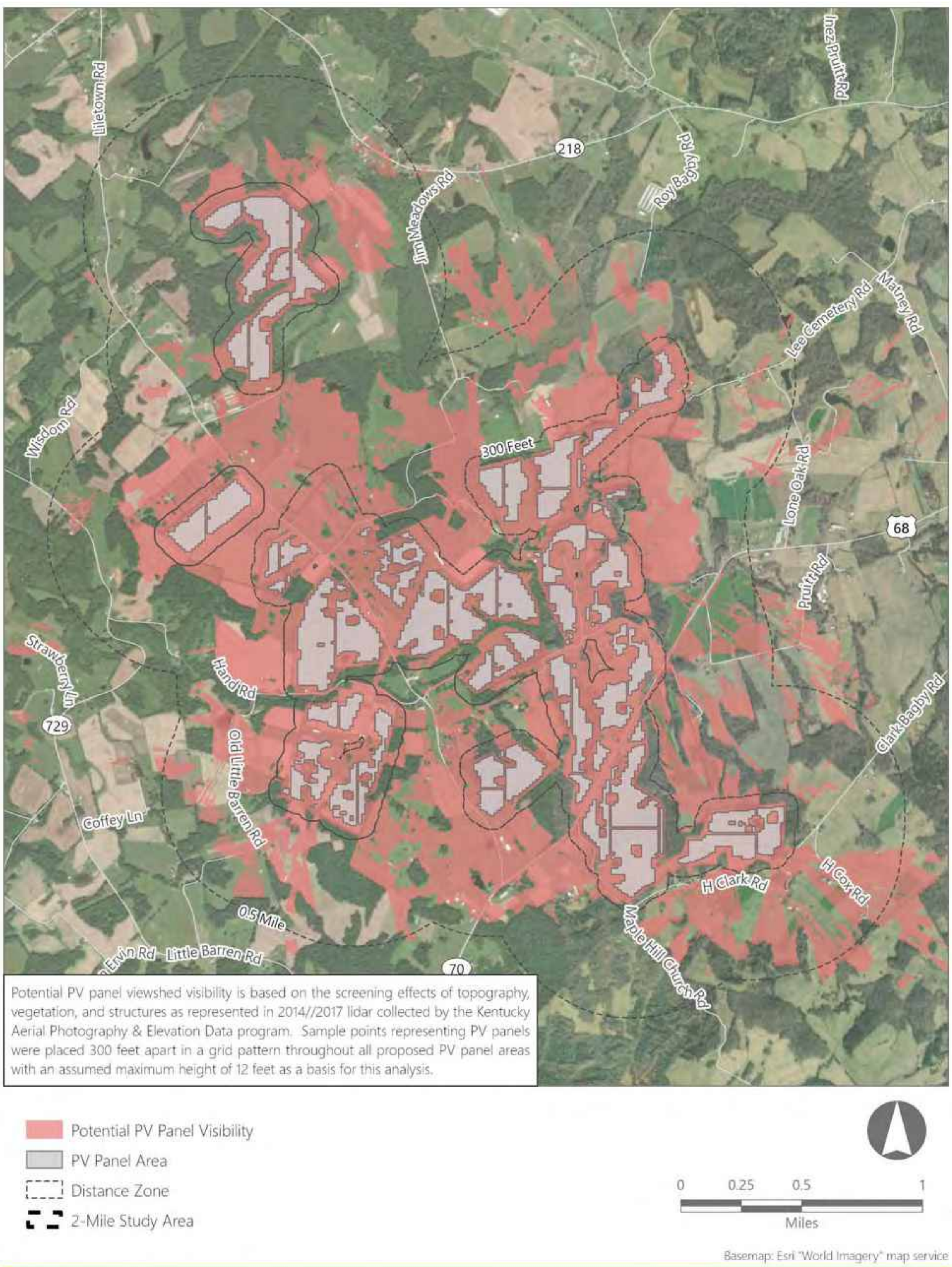


Figure 5-2. PV Panel DSM Viewshed Analysis Foreground Detail



5.1.2 Interconnection Facility Viewshed Analysis Results

As described in Section 4.1.1, a separate DSM viewshed analysis was conducted to determine the geographic extent of visibility of the proposed interconnection facility components, which include the substation, switchyard, and BESS area. Potential visibility of the proposed interconnection facility is illustrated in Figure 5-3. Viewshed analysis results indicate that a portion of the interconnection facility could be visible from approximately 4.0% (1.5 square miles) of the VSA (i.e., the interconnection facility would be entirely screened from approximately 96% of the study area [34.9 square miles]). The limited extent of interconnection visibility is primarily due to the screening provided by woodlots in the surrounding area. The largest areas of contiguous visibility are concentrated in agricultural fields and rural residential yards within 0.5 miles of the interconnection facility. Much of this visibility occurs within the Project Area itself. Beyond 0.5 miles, visibility of the interconnection facility is generally limited to narrow bands within large fields that slope toward the Facility. However, in the eastern portion of the VSA, there are a few more substantial contiguous areas of visibility between 0.5 and 2 miles from the Project. This part of the VSA is relatively free of screening features because it has been mostly developed for agriculture. Additionally, visibility of the interconnection facility extends farther than that of the PV panels due to the greater height of the substation/switchyard structures, which are assigned heights of 80 feet, compared to the 12-foot maximum height of the PV panels. As discussed in Section 5.1.4, actual visibility may be more limited than indicated by the viewshed analysis due to viewing distance, screening by intervening vegetation or topography, as well as the narrow profile of the upper components of the interconnection facility.

5.1.3 Transmission Line Viewshed Analysis Results

As described in Section 4.1.1, a separate DSM viewshed analysis was conducted to determine the geographic extent of visibility of the proposed transmission line. Potential visibility of the proposed transmission line is illustrated in Figure 5-4. Viewshed analysis results indicate that a portion of the transmission line could be visible from approximately 6.4% (2.3 square miles) of the VSA (i.e., the transmission line would be entirely screened from approximately 93.6% of the study area. As discussed in Section 5.1.4, actual visibility may be more limited than indicated by the viewshed analysis due to the removal of existing roadside screening features in the viewshed analysis and the effects of distance.

Figure 5-3. Interconnection Facility DSM Viewshed Analysis

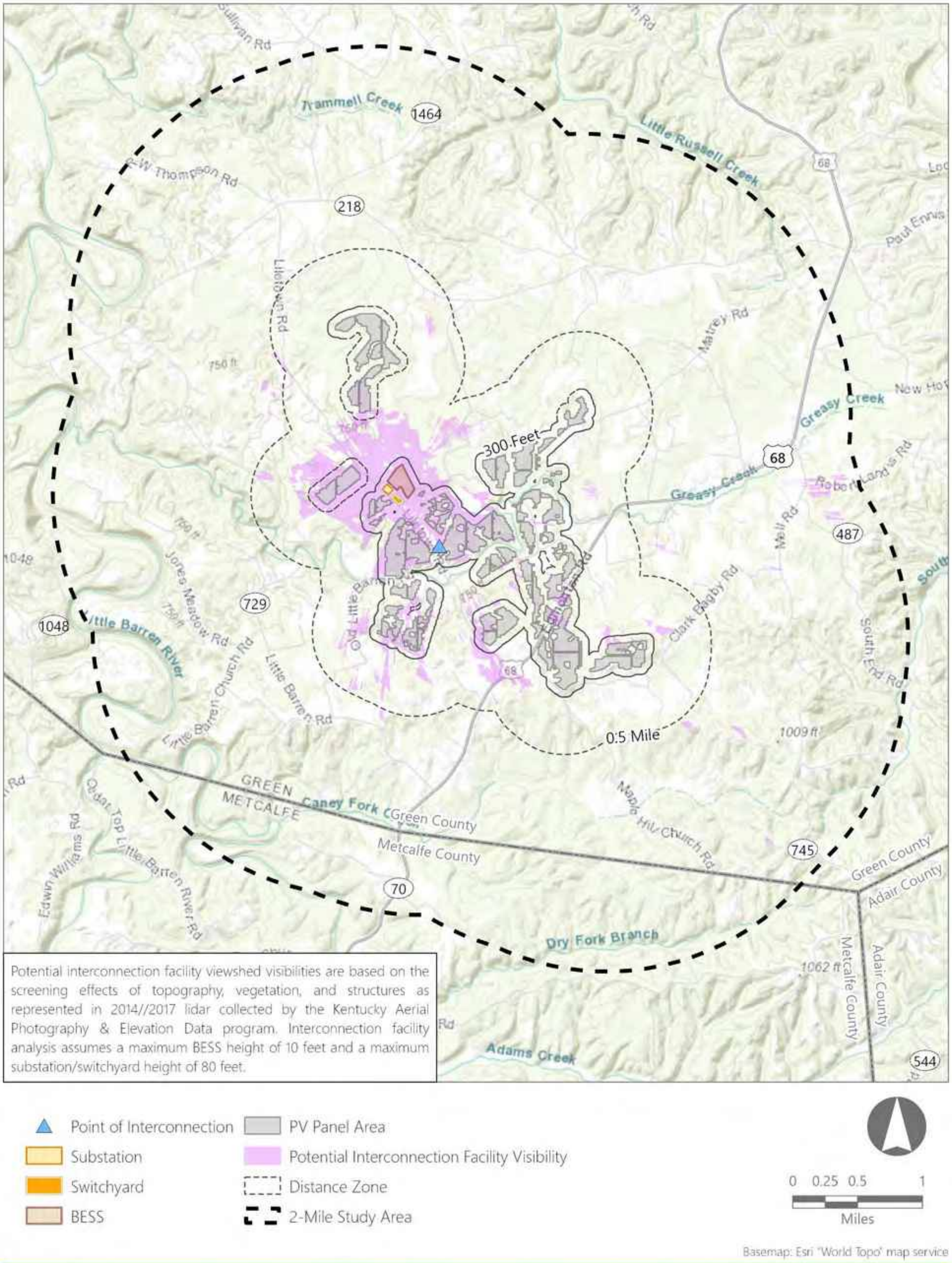
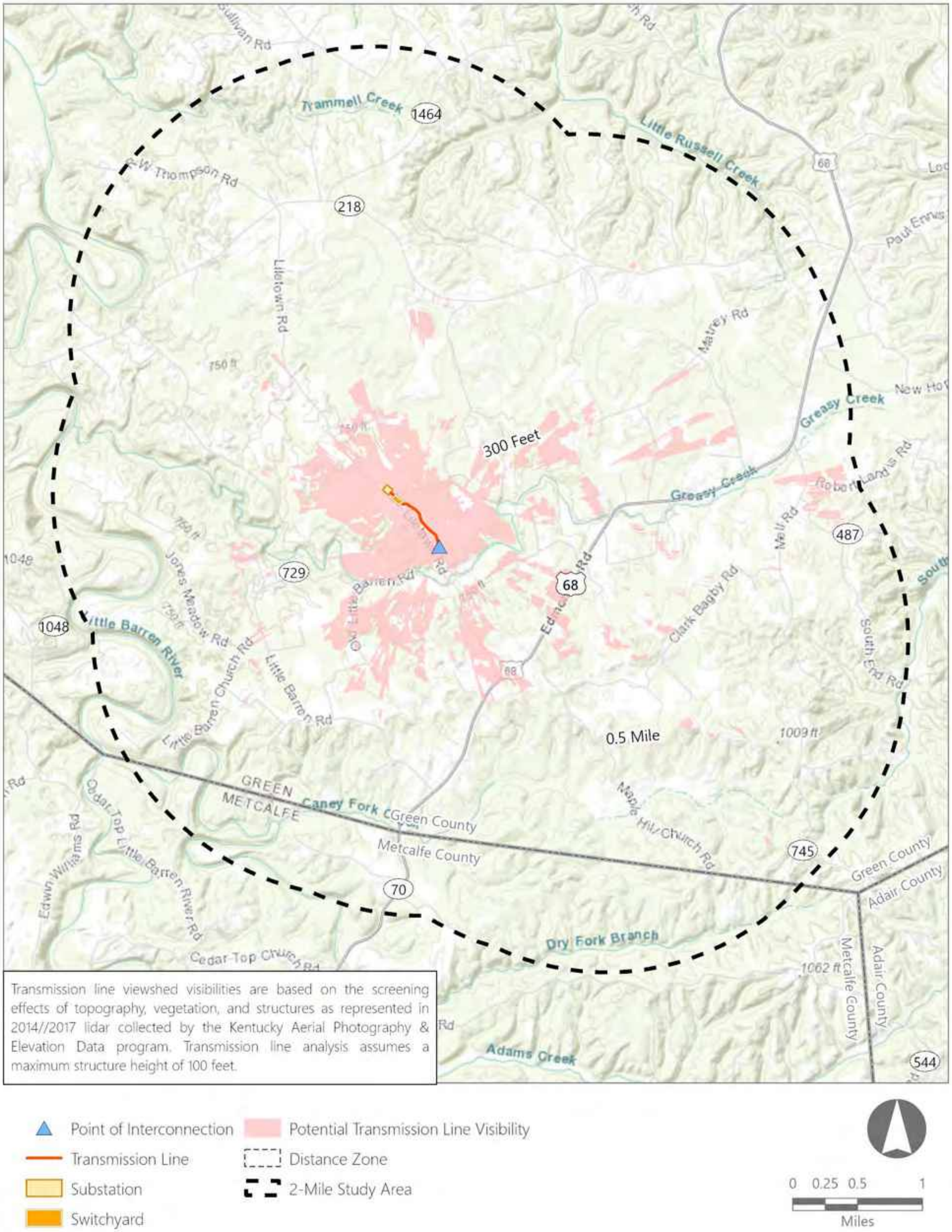


Figure 5-4. Transmission Line Facility DSM Viewshed Analysis



5.1.4 Field Review Results

As discussed in Section 4.1.2, field verification of potential Facility visibility was conducted by experienced field teams that were provided with digital mapping indicating their position relative to the Project Area and geographic areas of potential Facility visibility, as determined by the viewshed analysis. Field review was conducted during leaf-off conditions in February 2025 when existing vegetation was dormant, and screening was at its most limited. Field review resulted in the documentation of views from 64 viewpoint locations. All photographs referenced in this summary can be found in the Attachment B.

During field review, it was confirmed that large, contiguous areas agricultural land within 300 feet of the Project generally provided the most open views. This viewing condition was documented at Viewpoints 4, 5, 10-12, 17, 21, 23, 24, 26-33, 43-46, 52, and 60. In some hillier areas, topographic changes within/surrounding the Project would limit potential visibility to smaller portions of the PV arrays and interconnection facility. Additionally, it was observed that vegetation or existing structures could provide partial screening or softening of Project components in some areas.

From agricultural areas between 300 feet and 0.5 miles of the Project, it was observed that open views toward the Project Area were more limited due to screening by intervening structures, vegetation, and rolling topography. From most of these locations, it was observed that the Project Area was substantially screened and only a portion of the Project components would be visible, where they would appear as fragmented background features. This viewing condition was documented at Viewpoints 6, 7, 13, 14, 16, 18-20, 22, 36, 40-42, 54, 57-59, and 61. Due to viewing distance and the limited extent of visibility, the Facility would likely appear subordinate to other more proximate landscape features and focal points. This is especially true for the PV panels due to their low profile.

Field review confirmed that visibility of the Project Area significantly diminishes beyond 0.5 miles. It was observed that intervening structures, vegetation, and rolling topography dominate the view and would effectively screen PV panels from these more distant locations. Where visible, the panels would appear as nearly imperceptible background features. This viewing condition was observed at Viewpoints 1-3, 8, 9, 15, 25, 34, 35, 38, 39, 47-51, 55, 56, and 62-64. Viewpoint 53, however, confirmed that taller Project components (i.e., the interconnection facility) may be visible within agricultural areas in the eastern VSA which offer longer-distance views toward the Project Area. However, hedgerows, farm structures, and rolling hills would screen the lower portions of the interconnection facility in this area, and the upper portions of these components would appear as thin and delicate, likely overshadowed by closer foreground features.

5.2 Facility Visual Impact Results

To evaluate the anticipated visual impact associated with the proposed Facility, EDR evaluated visibility of the Facility from VSRs within the VSA. In addition, photosimulations showing the appearance of the Facility from high-traffic areas with open views were produced. The results of this evaluation are presented below.

5.2.1 Potential Visibility from Visually Sensitive Resources

A total of 22 VSRs were identified within the VSA, and the viewshed results indicate that 10 of these resources have potential visibility of the PV panels, transmission line, and/or interconnection facility, as summarized in Table 5-1.

Table 5-1. Identified Visually Sensitive Resources with Potential Facility Visibility

Visually Sensitive Resource Category	Number of Resources	Number of Resources with Potential Facility Visibility
Properties of Historic Significance	**Total: 7**	**Total: 1**
Properties/Districts Listed on the NRHP	5	1
Properties/Districts Eligible for Listing on the NRHP	2	0
Designated Scenic Resources	**Total: 1**	**Total: 1**
Sites, Areas, Lakes, Reservoirs or Highways Designated or Previously Determined Eligible for Designation as Scenic	1	1
Public Lands and Recreational Resources	**Total: 3**	**Total: 0**
State Heritage Lands	1	0
Rivers	2	0
High-Use Public Areas	**Total: 11**	**Total: 8**
State, U.S., and Interstate Highways	6	5
Unincorporated Communities	5	3
Total	**Total: 22**	**Total: 10**

Attachment A includes figures with the identified VSRs overlaid with the viewshed results and viewpoint locations, as well as a list of all VSRs within the VSA, with additional information on potential PV panel, transmission line, and interconnection facility visibility.

EDR evaluated the Facility's potential visual effect on each of the 10 VSRs with potential PV panel, transmission line, or interconnection facility visibility within the VSA, based on the results of the viewshed analysis and field review. Other factors that were considered in this evaluation include the viewer's likely sensitivity to changes in the visual environment at each resource and the amount and type of use it receives. Table 5-2 identifies VSRs with potential visibility by resource name, the geographic extent of potential Facility visibility within each VSR as a percentage of its total area within the VSA, and potential visual effect.

Table 5-2. Visibility from Visually Sensitive Resources

Visually Sensitive Resource	% of VSR Area with Visibility	Summary of Potential Visual Effect
Philpot House	0.3%	Minor
US 68 Scenic Byway/US-68	24.6%	Moderate
KY-218	2.9%	Minor
KY-487	11.9%	Negligible
KY-729	3.1%	Minor
KY-745	0.6%	Minor
Liletown	51.5%	Moderate
Little Barren	0.4%	Negligible
Newt	0.2%	Minor

Visual impacts are anticipated to be highest for resources within the foreground distance with a high percent of proposed Facility visibility. Portions of the unincorporated community of Liletown, as well as the scenic byway, US-68 Scenic Byway, are anticipated to experience moderate visual impacts as a result of the Project. These resources will experience use by local residents and through travelers, but visual effects are anticipated to be limited due to significantly lower visitation compared to other resources and lack of recreational amenities. The US-68 Scenic Byway will also experience use by tourists. However, based on the viewshed, views will be intermittent and only along the portion of the scenic byway that traverses the southeastern portion of the Facility.

Resources within approximately 0.5 miles to 1.0 mile of the Facility may experience minor visual effects. These resources include the Philpot House, KY-218, KY-729, KY-745, and unincorporated community of Newt. These resources will experience use by local residents and through travelers. At this distance, individual objects in the landscape begin to merge together, therefore visual effects are anticipated to be limited due to distance from the Facility and intervening topography and vegetation.

For all other VSRs with potential visibility, which includes KY-487 and the unincorporated community of Little Barren, visual effects of the Facility are expected to be more limited due to a lower percentage of PV panel visibility in terms of geographic area and/or where visibility is limited to beyond 1 mile within the background distance. Therefore, viewer/user groups will likely not experience significant views of the Facility or be able to discern Project components.

5.2.2 Photosimulation Results

The photosimulations created at views from representative high-traffic areas with open views of the Facility illustrated the appearance of the Facility from the nearest public vantage points at which the Facility is anticipated to be visible, at viewpoints 11 and 46. Separate photosimulations illustrating the proposed visual mitigation landscaping are provided and demonstrate the potential effectiveness of the landscaping in moderating views of the Facility. Full-sized images of the photosimulations are presented in Appendix C.

6.0 CONCLUSIONS

The Project has been sited in an area with few existing scenic or otherwise visually sensitive resources, and the surrounding terrain limits views of the Facility from beyond the Project Area and foreground distances. As a result, the potential visibility and visual impact of the proposed Facility has been minimized, and the Applicant has proposed additional measures to further mitigate impacts.

6.1 Visibility and Visual Impact Conclusions

The viewshed analysis indicates that PV panel visibility would be limited to 12.6% of the VSA, the interconnection facility could be visible from approximately 4.0% of the VSA, and the transmission line could be visible from approximately 6.4% of the VSA. Based on these results, the vast majority of areas within the VSA would not experience visibility of the Facility and therefore would not experience any visual impacts. In addition, the area of potential visibility diminishes quickly with increased distance from the Facility, as demonstrated by the Facility viewshed figures in Section 5.1.

Of the 22 VSRs identified within the VSA, the viewshed results indicate that only 10 have potential visibility of the Facility. The anticipated visual effect on all but two of these resources is negligible or minor, with the other two evaluated as moderate. Proposed mitigation will further limit visual impacts to these resources, as illustrated in the photosimulations.

6.2 Mitigation of Visual Impacts

Mitigation measures that have been incorporated into the Facility to reduce potential visibility and visual impacts of the Project include:

Facility Equipment

Solar energy generation technology and equipment are fairly standard and do not offer variations in design or materials that would significantly decrease the visibility or visual impact of the Project. Alternate panel colors do not exist, and there is minimal flexibility in the use of alternative design and materials for the racking system. The PV panel configuration proposed for the Project is a "one-in-portrait" configuration, meaning that a single row of panels is fixed on the racking system in portrait orientation. This configuration is advantageous because it results in a low profile compared to other common configurations, such as two-in-portrait.

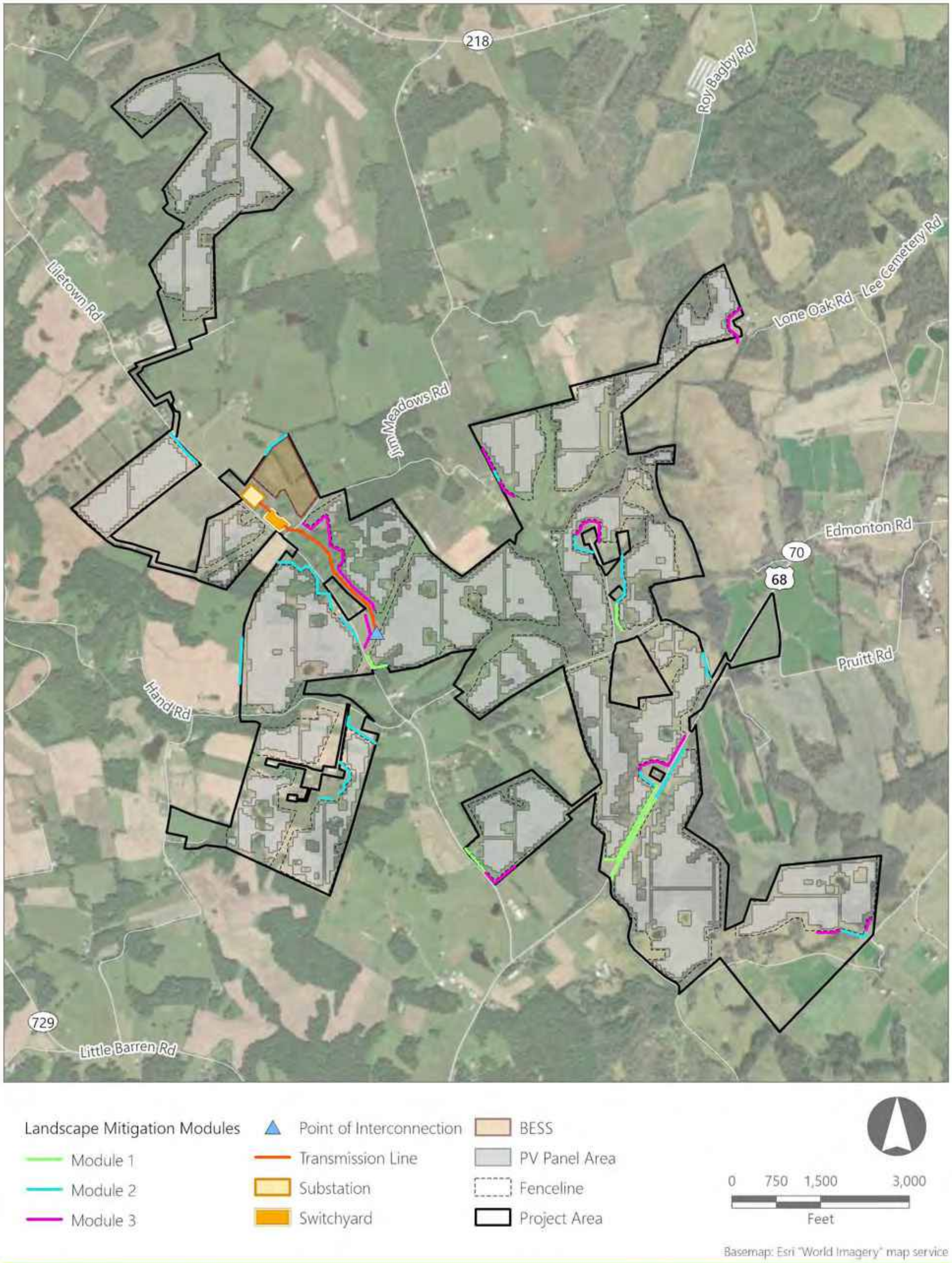
Perimeter Fencing

The Applicant is proposing the use of agricultural style fencing in lieu of galvanized chain-link fence for the perimeter fencing around the PV arrays. This choice of material for the Facility fencing has a considerable mitigating effect on visual impact and helps the Facility to blend with the surrounding agricultural setting.

Vegetative Mitigation

The Applicant has completed a *Conceptual Visual Mitigation Report,* which includes proposed visual mitigation along the Facility fence line in areas of visual sensitivity (Figure 6-1). As discussed in Section 5.2.2, the photosimulations demonstrate that the proposed mitigation plantings effectively reduce the potential visual impacts associated with the Facility. In addition, the protection and management of the existing and proposed site vegetation will further minimize views of the Facility and will help maintain healthy native vegetation in the Project Area.

Figure 6-1. Visual Mitigation Landscaping



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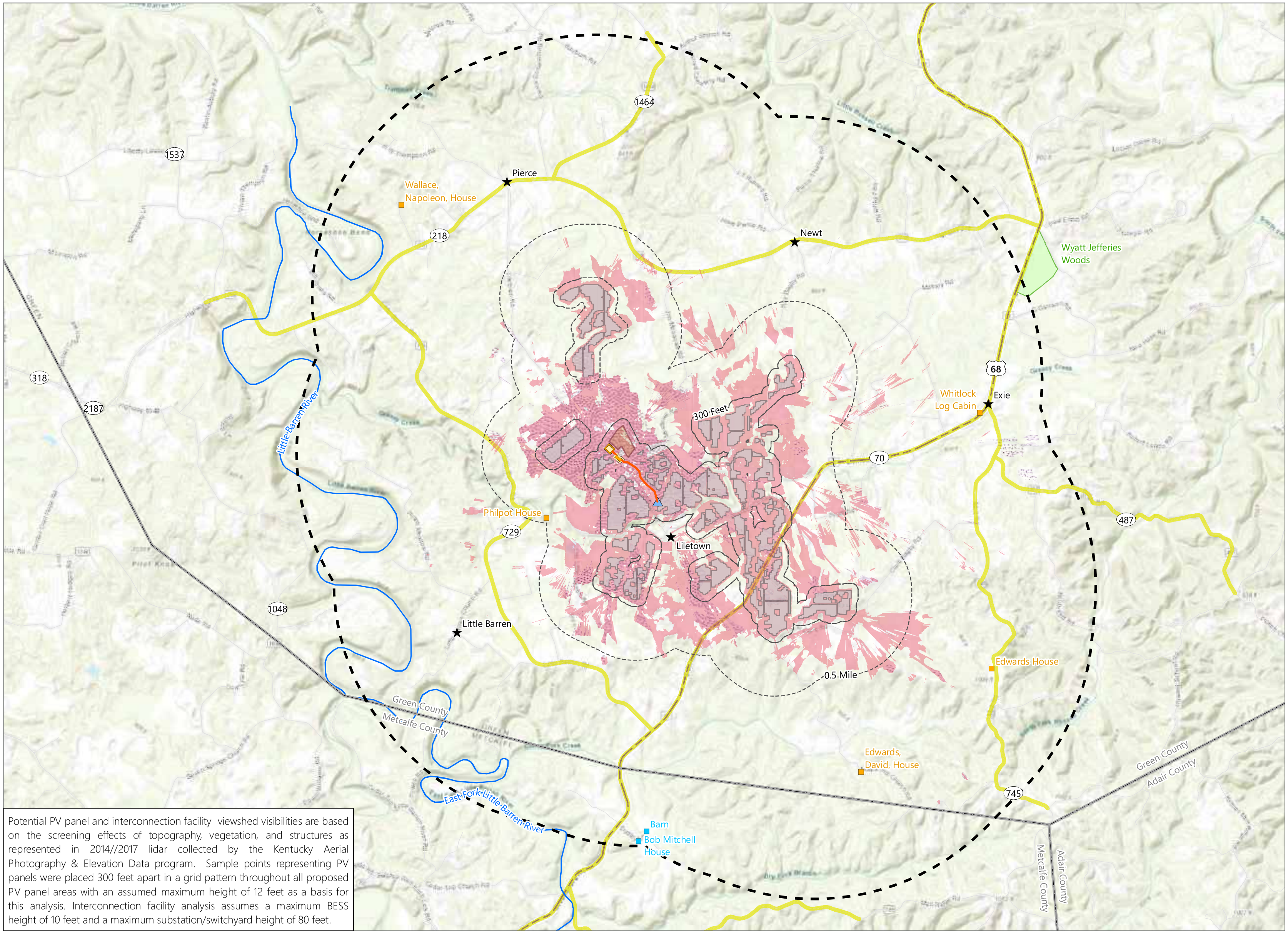
Attachment A. Visually Sensitive Resource Visibility Analysis

Attachment A. Visually Sensitive Resources and Interconnection Facility and PV Panel Viewshed Results



Exie Solar Project

Green County, Kentucky

Visual Resource Assessment

- NRHP-Listed Resource
- NRHP-Eligible Resource
- Unincorporated Community
- River
- State, US, or Interstate Highway
- Scenic Byway
- State Heritage Land
- Potential Interconnection Facility Visibility
- Potential PV Panel Visibility

Project Components

- Point of Interconnection
- Overhead Transmission Line
- Substation
- Switchyard
- BESS
- PV Panel Area
- Distance Zone
- 2-Mile Study Area

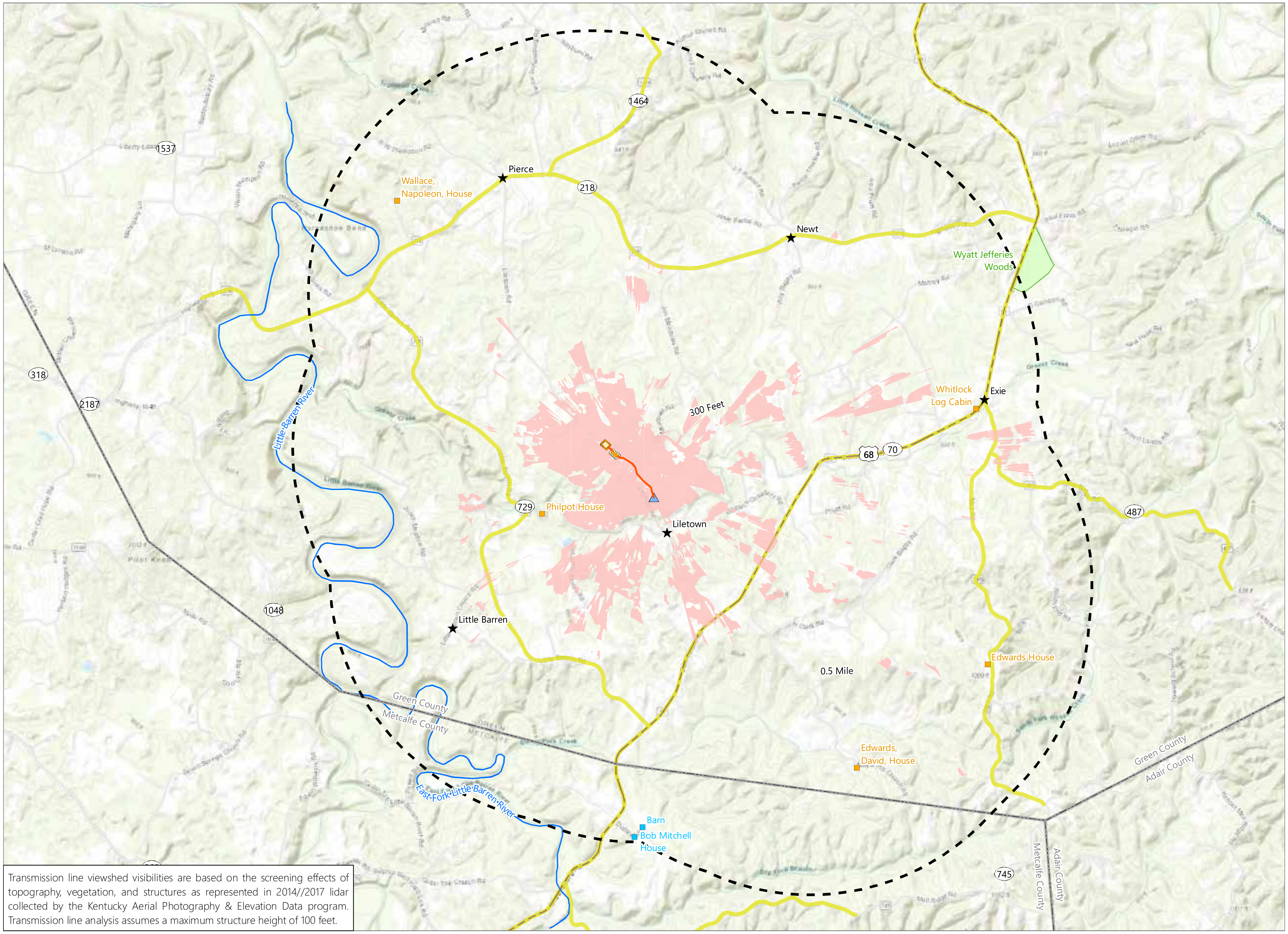
0 0.25 0.5 1
Miles

Prepared July 25, 2025
Basemap: Esri "World Topo" map service

EDR

Potential PV panel and interconnection facility viewshed visibilities are based on the screening effects of topography, vegetation, and structures as represented in 2014//2017 lidar collected by the Kentucky Aerial Photography & Elevation Data program. Sample points representing PV panels were placed 300 feet apart in a grid pattern throughout all proposed PV panel areas with an assumed maximum height of 12 feet as a basis for this analysis. Interconnection facility analysis assumes a maximum BESS height of 10 feet and a maximum substation/switchyard height of 80 feet.

Attachment A. Visually Sensitive Resources and Transmission Line Viewshed Results



Transmission line viewshed visibilities are based on the screening effects of topography, vegetation, and structures as represented in 2014//2017 lidar collected by the Kentucky Aerial Photography & Elevation Data program. Transmission line analysis assumes a maximum structure height of 100 feet.

Exie Solar Project

Green County, Kentucky

Visual Resource Assessment

- NRHP-Listed Resource
- NRHP-Eligible Resource
- Unincorporated Community
- River
- State, US, or Interstate Highway
- Scenic Byway
- State Heritage Land
- Potential Transmission Line Visibility

Project Components

- Point of Interconnection
- Overhead Transmission Line
- Substation
- Switchyard
- 2-Mile Study Area

0 0.25 0.5 1
Miles

Prepared July 25, 2025
Basemap: Esri "World Topo" map service

EDR

Attachment A: Visually Sensitive Resource Table

Visually Sensitive Resource	Location	Representative Viewpoint Number[1]	Distance to Nearest Facility Component[2] (miles)	DSM Viewshed Results Visible (+) Not Visible (-)				
				PV Panels[3]			Overhead Gen-Tie Facility	Interconnection Facility
	County			Foreground	Middle Ground	Background		
Properties of Historic Significance								
National Historic Landmarks (NHL)[4]								
None Identified								
National/State Historic Sites								
None Identified								
Properties/Districts Listed on the National Register of Historic Places (NRHP)								
Edwards House	Green		1.2	•	•	-	-	-
Edwards, David, House	Green	9	1.2	•	•	-	-	-
Philpot House	Green		0.4	•	+	-	-	+
Wallace, Napoleon, House	Green		1.5	•	•	-	-	-
Whitlock Log Cabin	Green		1.5	•	•	-	-	-
Properties/Districts Eligible for Listing on the NRHP								
Barn	Metcalfe		1.9	•	•	-	-	-
Bob Mitchell House	Metcalfe		1.9	•	•	-	-	-
Designated Scenic Resources								
Rivers Designated as National or State Wild, Scenic or Recreational								
None Identified								
Sites, Areas, Lakes, Reservoirs or Highways Designated or Previously Determined Eligible for Designation as Scenic								
US 68 Scenic Byway	Green, Metcalfe	1-3, 10-16, 25, 31, 33, 62	0.0	+	+	+	+	+
Other Designated Scenic Resources (Easements, Roads, Districts, and Overlooks)								
None Identified								
Public Lands and Recreational Resources								
National Parks, Recreation Areas, Seashores, and/or Forests								
None Identified								
National Natural Landmarks								
None Identified								
National Wildlife Refuges								

Attachment A: Visually Sensitive Resource Table

Visually Sensitive Resource	Location	Representative Viewpoint Number[1]	Distance to Nearest Facility Component[2] (miles)	DSM Viewshed Results Visible (+) Not Visible (-)				
				PV Panels[3]			Overhead Gen-Tie Facility	Interconnection Facility
	County			Foreground	Middle Ground	Background		
None Identified								
Heritage Areas								
None Identified								
State Parks								
None Identified								
State Nature Preserves								
None Identified								
State Natural Areas								
None Identified								
Wildlife Management Areas								
None Identified								
State Forests								
None Identified								
State Fishing/Waterway Access Sites								
None Identified								
State Heritage Land								
Wyatt Jefferies Woods Park	Green	25	1.9			-	-	-
Trails[5]								
State and Federal Trails								
None Identified								
Snowmobile/ATV Trails								
None Identified								
Bike Trails/Routes								
None Identified								
Other Trails								
None Identified								
Local Parks and Recreation Areas								
None Identified								
Publicly Accessible Conservation Lands/Easements								
None Identified								

Attachment A: Visually Sensitive Resource Table

Visually Sensitive Resource	Location	Representative Viewpoint Number[1]	Distance to Nearest Facility Component[2] (miles)	DSM Viewshed Results Visible (+) Not Visible (-)				
				PV Panels[3]			Overhead Gen-Tie Facility	Interconnection Facility
	County			Foreground	Middle Ground	Background		
Rivers								
East Fork Little Barren River	Green, Metcalfe		1.5	•	•	-	-	-
Little Barren River	Green, Metcalfe		1.3	•	•	-	-	-
Named Lakes, Ponds, and Reservoirs								
None Identified								
High-Use Public Areas								
State, US, and Interstate Highways								
KY-1464	Green		0.9	•	•	-	-	-
KY-218	Green	39, 54, 55, 63, 64	0.4	•	+	+	+	+
KY-487	Green	53	1.6	•	•	-	+	+
KY-729	Green	34-38, 62, 63	0.3	•	+	-	+	+
KY-745	Green, Metcalfe	51	1.0	•	•	+	+	+
US-68	Green, Metcalfe	1-3, 10-16, 25, 31, 33, 62	0.0	+	+	+	+	+
Schools								
None Identified								
Cities, Villages, Unincorporated Communities								
Cities and Villages								
None Identified								
Unincorporated Communities								
Exie	Green	2	1.4	•	•	-	-	-
Liletown	Green	19, 20	0.0	+	+	•	+	+
Little Barren	Green		1.1	•	•	-	-	+
Newt	Green		0.8	•	•	-	-	+
Pierce	Green	39	0.8	•	•	-	-	-

1 Identified viewpoints are within 150 feet of the visually sensitive resource boundary. If no viewpoint number is indicated, no photos were obtained near this resource during fieldwork.

2 Distance to nearest major Facility component is measured from the closest location within the resource boundary.

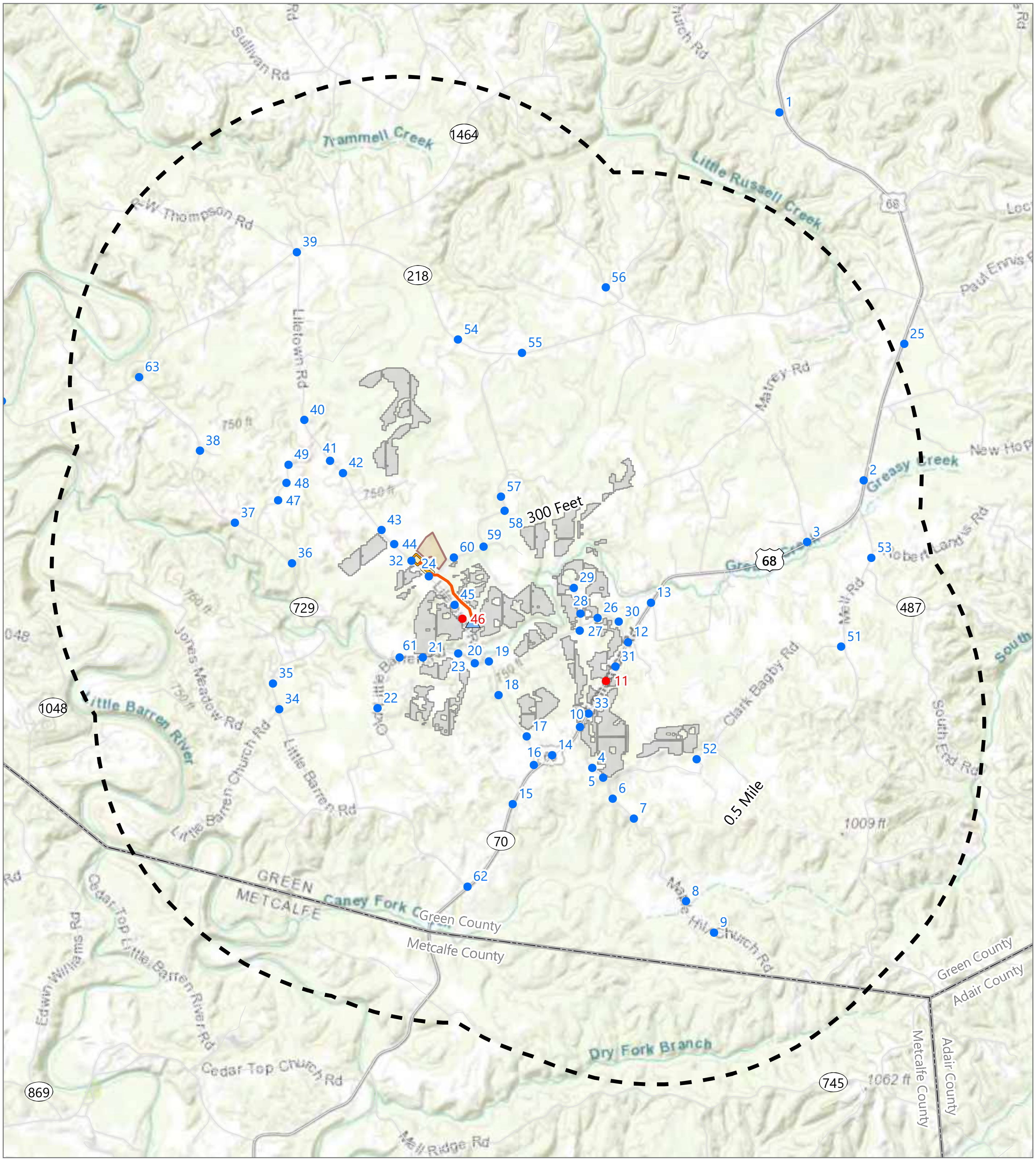
3 Potential PV panel visibility is broken down by the distance zone area within each resource boundary. If a distance zone column includes a grey dot, the resource does not fall within this distance zone.

4 National Historic Landmarks (NHLs) are also S/NRHP-Listed. However, these resources are only included in the NHL category to avoid duplication.

5 State trails that occur within state lands are not identified individually, and are evaluated as part of the overall resource.

Attachment B. Viewpoint Location Map & Viewpoint Photolog

Attachment B. Viewpoint Photolog



Exie Solar Project

Green County, Kentucky

Visual Resource Assessment

- Viewpoint Location
- Simulation Viewpoint
- Point of Interconnection
- Transmission Line
- Substation
- Switchyard
- BESS
- PV Panel Area
- 2-Mile Study Area

0 0.25 0.5 1
Miles

EDR

Prepared July 25, 2025
Basemap: Esri "World Topo" map service

Viewpoint 1 | Panorama
Panorama composition panning east to west

View looking southwest from Mount Lebanon Church Road in Green County

Visually Sensitive Resource(s):
US 68 Scenic Byway, U.S. Route 68

Coordinates:
37.20031°N, 85.54585°W

Elevation:
814 feet

Viewpoint 1 | Single Frame

Viewpoint 2 | Panorama
Panorama composition panning north to southwest

View looking southwest from U.S. Route 68 in Green County

Visually Sensitive Resource(s):
US 68 Scenic Byway, U.S. Route 68, Exie

Coordinates:
37.16254°N, 85.53515°W

Elevation:
807 feet

Viewpoint 2 | Single Frame

Viewpoint 3 | Panorama

Panorama composition panning southwest to north

Viewpoint 3 | Single Frame

View looking northwest from Intersection of Matney Road and U.S. Route 68 in Green County

Visually Sensitive Resource(s):
US 68 Scenic Byway, U.S. Route 68

Coordinates:
37.15621°N, 85.54243°W

Elevation:
787 feet

Viewpoint 4 | Panorama

Panorama composition panning north to south

View looking east from Maple Hill Church Road in Green County

Visually Sensitive Resource(s):
None Identified

Coordinates:
37.13309°N, 85.57001°W

Elevation:
850 feet

Viewpoint 4 | Single Frame

Viewpoint 5 | Panorama
Panorama composition panning northwest to southeast

View looking north from Maple Hill Church Road in Green County

Visually Sensitive Resource(s):
None Identified

Coordinates:
37.13208°N, 85.56859°W

Elevation:
871 feet

Viewpoint 5 | Single Frame

Viewpoint 6 | Panorama

Panorama composition panning north to south

Viewpoint 6 | Single Frame

View looking northeast from Maple Hill Church Road in Green County

Visually Sensitive Resource(s):
None Identified

Coordinates:
37.12991°N, 85.56739°W

Elevation:
860 feet

Viewpoint 7 | Panorama
Panorama composition panning north to south

View looking northeast from Maple Hill Church Road in Green County

Visually Sensitive Resource(s):
None Identified

Coordinates:
37.12787°N, 85.56469°W

Elevation:
832 feet

Viewpoint 7 | Single Frame

Viewpoint 8 | Panorama

Panorama composition panning west to east

Viewpoint 8 | Single Frame

View looking north from Maple Hill Church Road in Green County

Visually Sensitive Resource(s):
None Identified

Coordinates:
37.11936°N, 85.55803°W

Elevation:
732 feet

Viewpoint 9 | Panorama

Panorama composition panning southwest to northeast

Viewpoint 9 | Single Frame

View looking north from Maple Hill Church Road in Green County

Visually Sensitive Resource(s):
EdwaRoads, David, House

Coordinates:
37.11615°N, 85.55445°W

Elevation:
765 feet

Viewpoint 10 | Panorama

Panorama composition panning north to south

View looking east from U.S. Route 68 in Green County

Visually Sensitive Resource(s):
US 68 Scenic Byway, U.S. Route 68

Coordinates:
37.13728°N, 85.57157°W

Elevation:
865 feet

Viewpoint 10 | Single Frame

Viewpoint 11 | Panorama

Panorama composition panning west to northeast

Viewpoint 11 | Single Frame

View looking northwest from U.S. Route 68 in Green County

Visually Sensitive Resource(s):
US 68 Scenic Byway, U.S. Route 69

Coordinates:
37.14206°N, 85.56823°W

Elevation:
812 feet

Viewpoint 12 | Panorama

Panorama composition panning south to northeast

Viewpoint 12 | Single Frame

View looking west from intersection of Whitlock Cemetery Road, U.S. Route 68, and D Atwood Road in Green County

Visually Sensitive Resource(s):
US 68 Scenic Byway, U.S. Route 70

Coordinates:
37.14598°N, 85.56540°W

Elevation:
763 feet

Viewpoint 13 | Panorama

Panorama composition panning east to west

Viewpoint 13 | Single Frame

View looking south from U.S. Route 68 in Green County

Visually Sensitive Resource(s):
US 68 Scenic Byway, U.S. Route 71

Coordinates:
37.15002°N, 85.56246°W

Elevation:
752 feet

Viewpoint 14 | Panorama
Panorama composition panning west to northeast

View looking northwest from U.S. Route 68 in Green County

Visually Sensitive Resource(s):
US 68 Scenic Byway, U.S. Route 72

Coordinates:
37.13440°N, 85.57515°W

Elevation:
815 feet

Viewpoint 14 | Single Frame

Viewpoint 15 | Panorama

Panorama composition panning southwest to east

Viewpoint 15 | Single Frame

View looking north from U.S. Route 68 in Green County

Visually Sensitive Resource(s):
US 68 Scenic Byway, U.S. Route 73

Coordinates:
37.12940°N, 85.58020°W

Elevation:
815 feet

Viewpoint 16 | Panorama
Panorama composition panning west to east

Viewpoint 16 | Single Frame

View looking north from Liletown Road in Green County

Visually Sensitive Resource(s):
US 68 Scenic Byway, U.S. Route 74

Coordinates:
37.13337°N, 85.57747°W

Elevation:
825 feet

Viewpoint 17 | Panorama

Panorama composition panning west to east

Viewpoint 17 | Single Frame

View looking north from Liletown Road in Green County

Visually Sensitive Resource(s):
None Identified

Coordinates:
37.13632°N, 85.57839°W

Elevation:
796 feet

Viewpoint 18 | Panorama

Panorama composition panning northeast to southwest

Viewpoint 18 | Single Frame

View looking southeast from Liletown Road in Green County

Visually Sensitive Resource(s):
None Identified

Coordinates:
37.14057°N, 85.58199°W

Elevation:
760 feet

Viewpoint 19 | Panorama
Panorama composition panning north to south

Viewpoint 19 | Single Frame

View looking northeast from intersection of Luther Drive and Liletown Road in Green County

Visually Sensitive Resource(s):
Liletown

Coordinates:
37.14402°N, 85.58322°W

Elevation:
717 feet

Viewpoint 20 | Panorama
Panorama composition panning southwest to east

Viewpoint 20 | Single Frame

View looking north from Old Little Barren Road in Green County

Visually Sensitive Resource(s):
Liletown

Coordinates:
37.14385°N, 85.58504°W

Elevation:
716 feet

Viewpoint 21 | Panorama

Panorama composition panning west to east

Viewpoint 21 | Single Frame

View looking north from Old Little Barren Road in Green County

Visually Sensitive Resource(s):
None Identified

Coordinates:
37.14443°N, 85.59168°W

Elevation:
726 feet

Viewpoint 22 | Panorama

Panorama composition panning northwest to southeast

Viewpoint 22 | Single Frame

View looking east from Old Little Barren Road in Green County

Visually Sensitive Resource(s):
None Identified

Coordinates:
37.13924°N, 85.59750°W

Elevation:
780 feet

Viewpoint 23 | Panorama
Panorama composition panning southeast to northwest

Viewpoint 23 | Single Frame

View looking southwest from Old Little Barren Road in Green County

Visually Sensitive Resource(s):
None Identified

Coordinates:
37.14483°N, 85.58713°W

Elevation:
709 feet

Viewpoint 24 | Panorama

Panorama composition panning south to north

Viewpoint 24 | Single Frame

View looking west from Liletown Road in Green County

Visually Sensitive Resource(s):
None Identified

Coordinates:
37.15278°N, 85.59090°W

Elevation:
768 feet

Viewpoint 25 | Panorama
Panorama composition panning south to north

Viewpoint 25 | Single Frame

View looking southwest from U.S. Route 68 in Green County

Visually Sensitive Resource(s):
US 68 Scenic Byway, Wyatt Jefferies Woods Park, U.S. Route 68

Coordinates:
37.17652°N, 85.52993°W

Elevation:
836 feet

Viewpoint 26 | Panorama

Panorama composition panning southwest to northeast

View looking northwest from Whitlock Cemetery Road in Green County

Visually Sensitive Resource(s):
None Identified

Coordinates:
37.14847°N, 85.56929°W

Elevation:
778 feet

Viewpoint 26 | Single Frame

Viewpoint 27 | Panorama

Panorama composition panning northeast to west

Viewpoint 27 | Single Frame

View looking southwest from Whitlock Cemetery Road in Green County

Visually Sensitive Resource(s):
None Identified

Coordinates:
37.14717°N, 85.57156°W

Elevation:
778 feet

Viewpoint 28 | Panorama

Panorama composition panning west to east

View looking northwest from G Thompson Road in Green County

Visually Sensitive Resource(s):
None Identified

Coordinates:
37.14891°N, 85.57148°W

Elevation:
781 feet

Viewpoint 28 | Single Frame

Viewpoint 29 | Panorama
Panorama composition panning southeast to southwest

Viewpoint 29 | Single Frame

View looking south from G Thompson Road in Green County

Visually Sensitive Resource(s):
None Identified

Coordinates:
37.15158°N, 85.57233°W

Elevation:
781 feet

Viewpoint 30 | Panorama
Panorama composition panning south to west

Viewpoint 30 | Single Frame

View looking southwest from Whitlock Cemetery Road in Green County

Visually Sensitive Resource(s):
None Identified

Coordinates:
37.14809°N, 85.56658°W

Elevation:
766 feet

Viewpoint 31 | Panorama

Panorama composition southeast panning to northwest

Viewpoint 31 | Single Frame

View looking southwest from U.S. Route 68 in Green County

Visually Sensitive Resource(s):
US 68 Scenic Byway, U.S. Route 68

Coordinates:
37.14348°N, 85.56700°W

Elevation:
780 feet

Viewpoint 32 | Panorama

Panorama composition panning east to west

Viewpoint 32 | Single Frame

View looking southeast from Liletown Road in Green County

Visually Sensitive Resource(s):
None Identified

Coordinates:
37.15438°N, 85.59313°W

Elevation:
774 feet

Viewpoint 33 | Panorama

Panorama composition panning northeast to southwest

View looking southeast from U.S. Route 68 in Green County

Visually Sensitive Resource(s):
US 68 Scenic Byway, U.S. Route 68

Coordinates:
37.13866°N, 85.57046°W

Elevation:
831 feet

Viewpoint 33 | Single Frame

Viewpoint 34 | Panorama

Panorama composition panning north to south

Viewpoint 34 | Single Frame

View looking east from intersection of Little Barren Church Road and Kentucky Route 729 in Green County

Visually Sensitive Resource(s):
Kentucky Route 729

Coordinates:
37.13916°N, 85.61010°W

Elevation:
752 feet

Viewpoint 35 | Panorama

Panorama composition panning north to south

Viewpoint 35 | Single Frame

View looking east from Kentucky Route 729 in Green County

Visually Sensitive Resource(s):
Kentucky Route 729

Coordinates:
37.14181°N, 85.61088°W

Elevation:
735 feet

Viewpoint 36 | Panorama

Panorama composition panning northwest to south

View looking north from Kentucky Route 729 in Green County

Visually Sensitive Resource(s):
Kentucky Route 729

Coordinates:
37.15415°N, 85.60843°W

Elevation:
797 feet

Viewpoint 36 | Single Frame

Viewpoint 37 | Panorama

Panorama composition panning northwest to southeast

Viewpoint 37 | Single Frame

View looking north from Kentucky Route 729 in Green County

Visually Sensitive Resource(s):
Kentucky Route 729

Coordinates:
37.15829°N, 85.61573°W

Elevation:
708 feet

Viewpoint 38 | Panorama

Panorama composition panning north to south

Viewpoint 38 | Single Frame

View looking southeast from Kentucky Route 729 in Green County

Visually Sensitive Resource(s):
Kentucky Route 729

Coordinates:
37.16568°N, 85.62022°W

Elevation:
719 feet

Viewpoint 39 | Panorama

Panorama composition panning northeast to southwest

Viewpoint 39 | Single Frame

View looking southeast from Liletown Road in Green County

Visually Sensitive Resource(s):
Kentucky Route 218, Pierce

Coordinates:
37.18604°N, 85.60776°W

Elevation:
811 feet

Viewpoint 40 | Panorama

Panorama composition panning southeast to northwest

View looking south from Liletown Road in Green County

Visually Sensitive Resource(s):
None Identified

Coordinates:
37.16883°N, 85.60683°W

Elevation:
762 feet

Viewpoint 40 | Single Frame

Viewpoint 41 | Panorama

Panorama composition panning north to southwest

Viewpoint 41 | Single Frame

View looking east from Liletown Road in Green County

Visually Sensitive Resource(s):
None Identified

Coordinates:
37.16463°N, 85.60353°W

Elevation:
744 feet

Viewpoint 42 | Panorama

Panorama composition panning southeast to northwest

Viewpoint 42 | Single Frame

View looking west from Liletown Road in Green County

Visually Sensitive Resource(s):
None Identified

Coordinates:
37.16339°N, 85.60188°W

Elevation:
752 feet

Viewpoint 43 | Panorama

Panorama composition panning southeast to southwest

View looking south from Liletown Road in Green County

Visually Sensitive Resource(s):
None Identified

Coordinates:
37.15751°N, 85.59695°W

Elevation:
772 feet

Viewpoint 43 | Single Frame

Viewpoint 44 | Panorama

Panorama composition panning southwest to north

View looking west from Liletown Road in Green County

Visually Sensitive Resource(s):
None Identified

Coordinates:
37.15610°N, 85.59533°W

Elevation:
787 feet

Viewpoint 44 | Single Frame

Viewpoint 45 | Panorama

Panorama composition panning northeast to southwest

Viewpoint 45 | Single Frame

View looking south from Liletown Road in Green County

Visually Sensitive Resource(s):
None Identified

Coordinates:
37.14984°N, 85.58761°W

Elevation:
784 feet

Viewpoint 46 | Panorama

Panorama composition panning southeast to northwest

Viewpoint 46 | Single Frame

View looking southwest from Liletown Road in Green County

Visually Sensitive Resource(s):
None Identified

Coordinates:
37.14841°N, 85.58661°W

Elevation:
781 feet

Viewpoint 47 | Panorama

Panorama composition panning northwest to south

View looking northeast from Wisdom Road in Green County

Visually Sensitive Resource(s):
None Identified

Coordinates:
37.16059°N, 85.61021°W

Elevation:
757 feet

Viewpoint 47 | Single Frame

Viewpoint 48 | Panorama
Panorama composition panning northeast to southwest

Viewpoint 48 | Single Frame

View looking southeast from Wisdom Road in Green County

Visually Sensitive Resource(s):
None Identified

Coordinates:
37.16238°N, 85.60912°W

Elevation:
764 feet

Viewpoint 49 | Panorama

Panorama composition panning northeast to southwest

Viewpoint 49 | Single Frame

View looking south from Wisdom Road in Green County

Visually Sensitive Resource(s):
None Identified

Coordinates:
37.16424°N, 85.60885°W

Elevation:
761 feet

Viewpoint 50 | Panorama

Panorama composition panning north to east

Viewpoint 50 | Single Frame

View looking northeast from Kentucky Route 1048 in Green County

Visually Sensitive Resource(s):
Kentucky Route 1048

Coordinates:
37.14698°N, 85.64754°W

Elevation:
911 feet

Viewpoint 51 | Panorama

Panorama composition panning south to north

View looking southwest from Clark Bagby Road in Green County

Visually Sensitive Resource(s):
Kentucky Route 745

Coordinates:
37.14546°N, 85.53808°W

Elevation:
866 feet

Viewpoint 51 | Single Frame

Viewpoint 52 | Panorama

Panorama composition panning south to north

Viewpoint 52 | Single Frame

View looking west from Clark Bagby Road in Green County

Visually Sensitive Resource(s):
None Identified

Coordinates:
37.13395°N, 85.55662°W

Elevation:
834 feet

Viewpoint 53 | Panorama

Panorama composition panning southeast to west

Viewpoint 53 | Single Frame

View looking west from Kentucky Route 487 in Green County

Visually Sensitive Resource(s):
Kentucky Route 487

Coordinates:
37.15457°N, 85.53419°W

Elevation:
830 feet

Viewpoint 54 | Panorama

Panorama composition panning southeast to north

Viewpoint 54 | Single Frame

View looking southwest from Kentucky Route 218 in Green County

Visually Sensitive Resource(s):
Kentucky Route 218

Coordinates:
37.17705°N, 85.58710°W

Elevation:
872 feet

Viewpoint 55 | Panorama

Panorama composition panning east to west

Viewpoint 55 | Single Frame

View looking southeast from Kentucky Route 218 in Green County

Visually Sensitive Resource(s):
Kentucky Route 218

Coordinates:
37.17569°N, 85.57891°W

Elevation:
871 feet

Viewpoint 56 | Panorama
Panorama composition panning northeast to west

View looking south from J T Russell Road in Green County

Visually Sensitive Resource(s):
None Identified

Coordinates:
37.18239°N, 85.56817°W

Elevation:
844 feet

Viewpoint 56 | Single Frame

Viewpoint 57 | Panorama

Panorama composition panning east to southwest

Viewpoint 57 | Single Frame

View looking southeast from Jim Meadows Road in Green County

Visually Sensitive Resource(s):
None Identified

Coordinates:
37.16092°N, 85.58165°W

Elevation:
802 feet

Viewpoint 58 | Panorama

Panorama composition panning northeast to southwest

Viewpoint 58 | Single Frame

View looking southeast from Jim Meadows Road in Green County

Visually Sensitive Resource(s):
None Identified

Coordinates:
37.15947°N, 85.58116°W

Elevation:
798 feet

Viewpoint 59 | Panorama

Panorama composition panning south to west

Viewpoint 59 | Single Frame

View looking south from intersection of Jim Meadows Road and B EdwaRoads Road in Green County

Visually Sensitive Resource(s):
None Identified

Coordinates:
37.15579°N, 85.58387°W

Elevation:
792 feet

Viewpoint 60 | Panorama

Panorama composition panning southwest to northeast

Viewpoint 60 | Single Frame

View looking north from Jim Meadows Road in Green County

Visually Sensitive Resource(s):
None Identified

Coordinates:
37.15472°N, 85.58768°W

Elevation:
784 feet

Viewpoint 61 | Panorama

Panorama composition panning northwest to east

Viewpoint 61 | Single Frame

View looking northeast from Intersection of Wilcoxson Cemetery Road and Old Little Barren Road in Green County

Visually Sensitive Resource(s):
None Identified

Coordinates:
37.14445°N, 85.59467°W

Elevation:
721 feet

Viewpoint 62 | Panorama

Panorama composition panning northwest to southeast

View looking north from U.S. Route 68, Kentucky Route 729 in Green County

Visually Sensitive Resource(s):
US 68 Scenic Byway, Kentucky Route 729, U.S. Route 68

Coordinates:
37.12092°N, 85.58602°W

Elevation:
728 feet

Viewpoint 62 | Single Frame

Viewpoint 63 | Panorama
Panorama composition panning northeast to southwest

View looking southeast from intersection of Kentucky Route 729 and Kentucky Route 218 in Green County

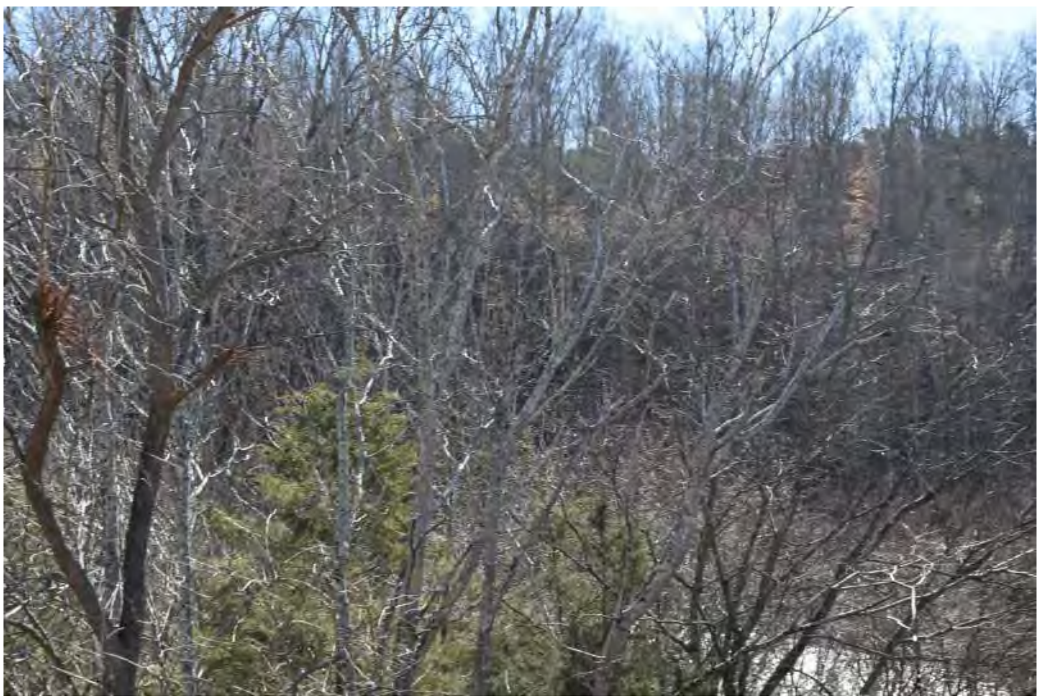
Visually Sensitive Resource(s):
Kentucky Route 729, Kentucky Route 218

Coordinates:
37.17326°N, 85.62797°W

Elevation:
759 feet

Viewpoint 63 | Single Frame

Viewpoint 64 | Panorama
Panorama composition panning east to west



Viewpoint 64 | Single Frame

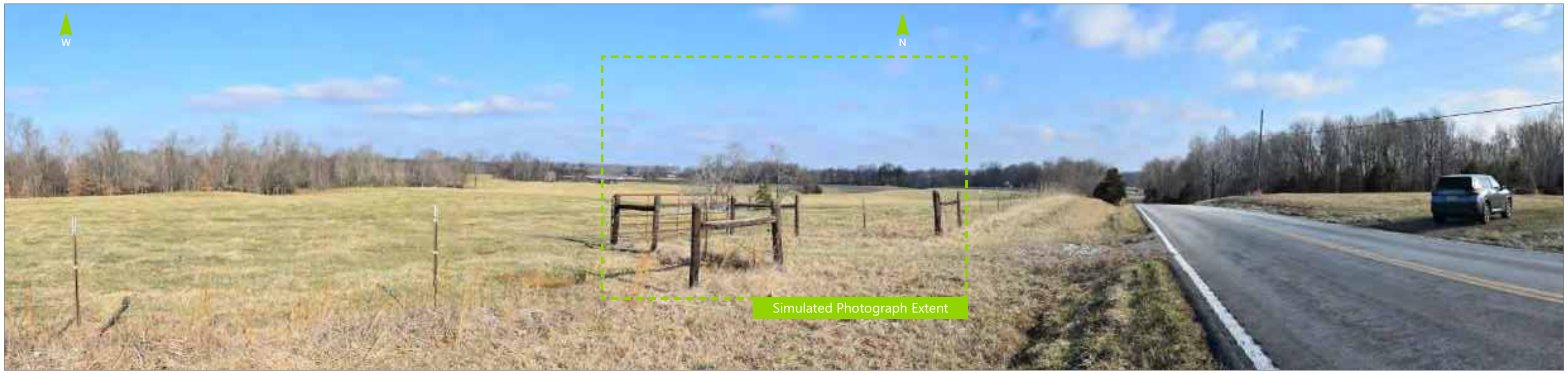
View looking east from Kentucky Route 218 in Green County

Visually Sensitive Resource(s):
Kentucky Route 218

Coordinates:
37.17082°N, 85.64557°W

Elevation:
583 feet

Attachment C. Photosimulations

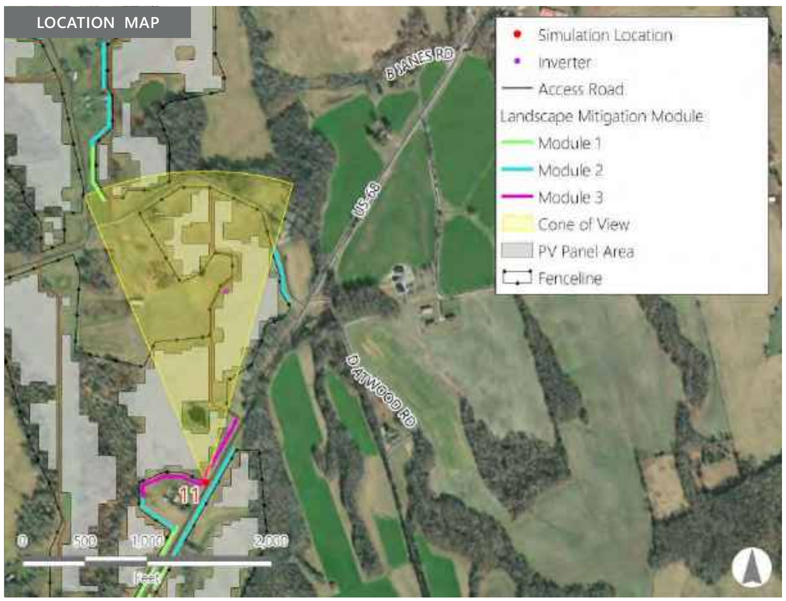


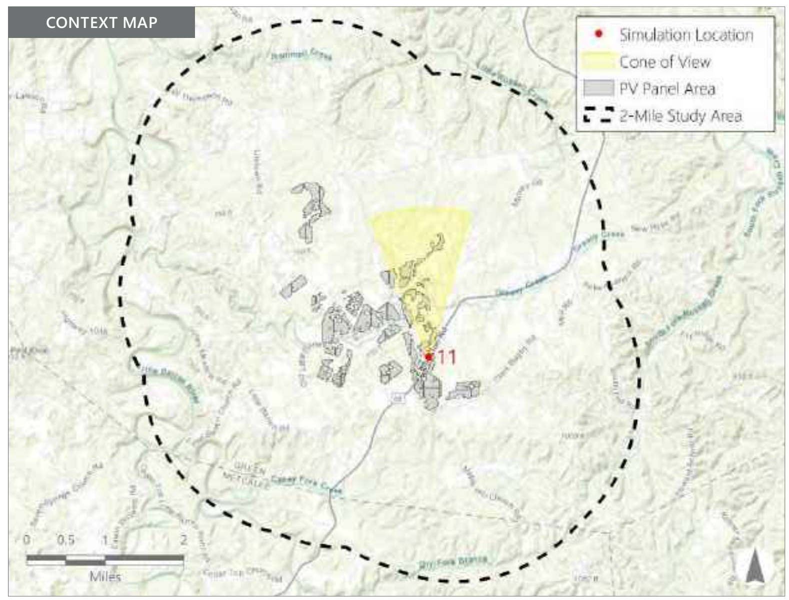
Note: *The image above is a panorama composition panning clockwise from west (left) to northeast (right).*

VIEWPOINT 11
US-68

LOCATION INFORMATION

County: Green
Latitude: 37.14206° N
Longitude: 85.56823° W
Facility Distance:* 113 feet
Distance Zone Represented: Foreground
Viewer/User Group(s): Local Residents, Through-Travelers
Visually Sensitive Resource(s): US 68 Scenic Byway, US 68





PHOTOGRAPH INFORMATION

Date: February 27, 2025
Time: 10:41 AM
Camera: Nikon D7200
Camera Resolution: 27.2 Megapixels
Lens Focal Length (35 mm sensor equivalent): 51 mm
Camera Elevation: 818 feet
Field of View: 39 degrees
Direction of View: North
Printed Size: 10 inches x 15 inches
*Viewing Distance**:* 21 inches

NOTES

**Distance as measured from the viewpoint to the nearest PV panels or Interconnection Facility component within the simulated photograph's field of view*

***The simulation is at the correct perspective when printed on an 11-by-17 sheet at full scale, and viewed approximately 21 inches from the eye of the viewer.*

Note: Printed at actual size, the existing view image is 15 inches wide by 10 inches high. At this size and focal length, the existing view should be viewed from a distance 21 inches from the eye of the viewer.

VIEWPOINT 11

US-68

Exie Solar

Visual Resource Assessment, Attachment C

EDR

0 1 in. 2 in.

This scale is to ensure the simulation images are printed at the intended size.

Note: *Printed at actual size, the resulting simulation image is 15 inches wide by 10 inches high. At this size and focal length, the simulation should be viewed from a distance 21 inches from the eye of the viewer.*

VIEWPOINT 11

US-68

0 1 in. 2 in.

This scale is to ensure the simulation images are printed at the intended size.

Note: *Printed at actual size, the resulting simulation image is 15 inches wide by 10 inches high. At this size and focal length, the simulation should be viewed from a distance 21 inches from the eye of the viewer.*

0 1 in. 2 in.

This scale is to ensure the simulation images are printed at the intended size.

VIEWPOINT 11

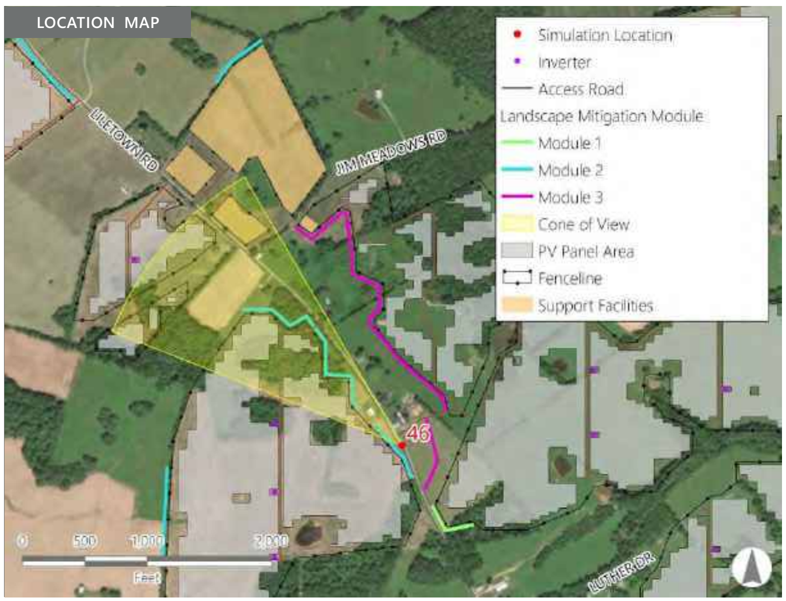
US-68

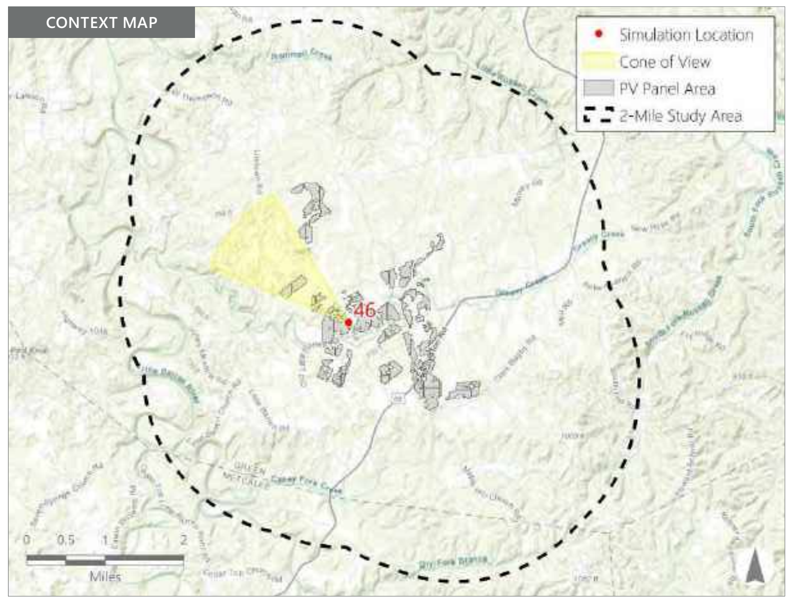
Note: *The image above is a panorama composition panning clockwise from southwest (left) to northeast (right).*

VIEWPOINT 46
Liletown Road

LOCATION INFORMATION

County:	Green
Latitude:	37.14841° N
Longitude:	85.58661° W
Facility Distance:*	102 feet
Distance Zone Represented:	Foreground
Viewer/User Group(s):	Local Residents
Visually Sensitive Resource(s):	None Identified





PHOTOGRAPH INFORMATION

Date:	February 27, 2025
Time:	10:41 AM
Camera:	Nikon D7200
Camera Resolution:	27.2 Megapixels
Lens Focal Length (35 mm sensor equivalent):	51 mm
Camera Elevation:	789 feet
Field of View:	39 degrees
Direction of View:	Northwest
Printed Size:	10 inches x 15 inches
*Viewing Distance**:*	21 inches

NOTES

**Distance as measured from the viewpoint to the nearest PV panels or Interconnection Facility component within the simulated photograph's field of view*

***The simulation is at the correct perspective when printed on an 11-by-17 sheet at full scale, and viewed approximately 21 inches from the eye of the viewer.*

Note: Printed at actual size, the existing view image is 15 inches wide by 10 inches high. At this size and focal length, the existing view should be viewed from a distance 21 inches from the eye of the viewer.

VIEWPOINT 46

Liletown Road

0 1 in. 2 in.

This scale is to ensure the simulation images are printed at the intended size.

Exie Solar

Visual Resource Assessment, Attachment C

EDR

Note: *Printed at actual size, the resulting simulation image is 15 inches wide by 10 inches high. At this size and focal length, the simulation should be viewed from a distance 21 inches from the eye of the viewer.*

0 1 in. 2 in.

This scale is to ensure the simulation images are printed at the intended size.

VIEWPOINT 46
Liletown Road

Exie Solar
Visual Resource Assessment, Attachment C

EDR

PROPOSED VIEW 5-7 YEARS FOLLOWING INSTALLATION

Note: Printed at actual size, the resulting simulation image is 15 inches wide by 10 inches high. At this size and focal length, the simulation should be viewed from a distance 21 inches from the eye of the viewer.

0 1 in. 2 in.

This scale is to ensure the simulation images are printed at the intended size.

VIEWPOINT 46
Liletown Road

Exie Solar
Visual Resource Assessment, Attachment C

EDR

Attachment F. Solar Glare Assessment

Solar Glare Assessment

Exie Solar Project

Green County, Kentucky

Case No. 2025-00151

Prepared for:

Exie Solar, LLC
8400 Normandale Lake Blvd, Suite 1200
Bloomington, MN 55437
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Prepared by:

Environmental Design & Research,
Landscape Architecture, Engineering & Environmental Services, D.P.C.
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July 2025

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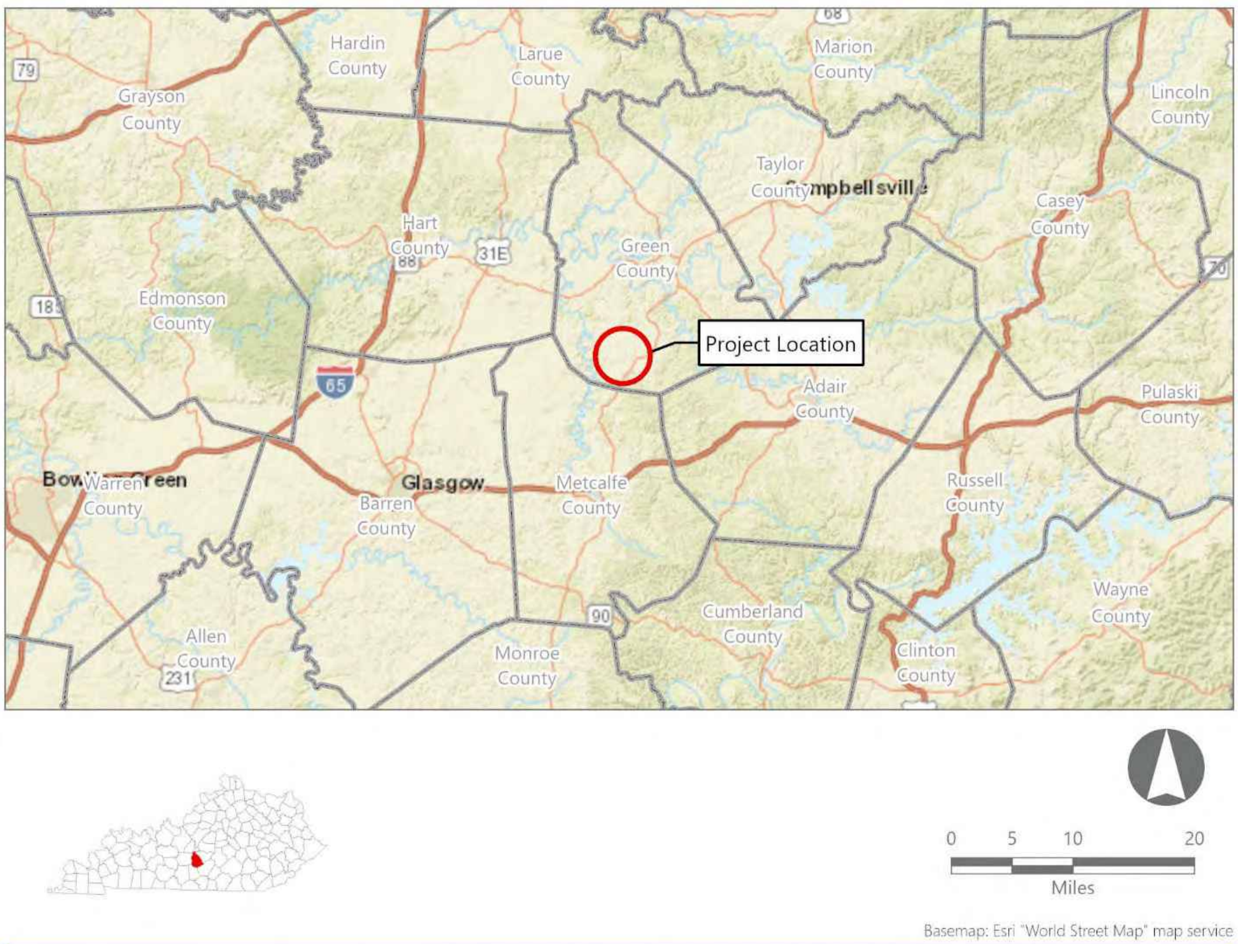
TABLES, FIGURES, & APPENDICES

1.0 INTRODUCTION

On behalf of Exie Solar, LLC (Exie Solar or the Applicant), Environmental Design & Research, Landscape Architecture, Engineering & Environmental Services, D.P.C. (EDR) has prepared this report for the proposed Exie Solar Project (the Facility or Project), located in Green County, Kentucky (Figure 1). The proposed Project is a solar-powered electric generation facility with an up to 110-megawatts alternating current (MW_{AC}) generation capacity. This *Solar Glare Assessment* provides an evaluation of potential glare exposure resulting from the installation of fixed-tilt panels for the Project.

Figure 1. Regional Facility Location

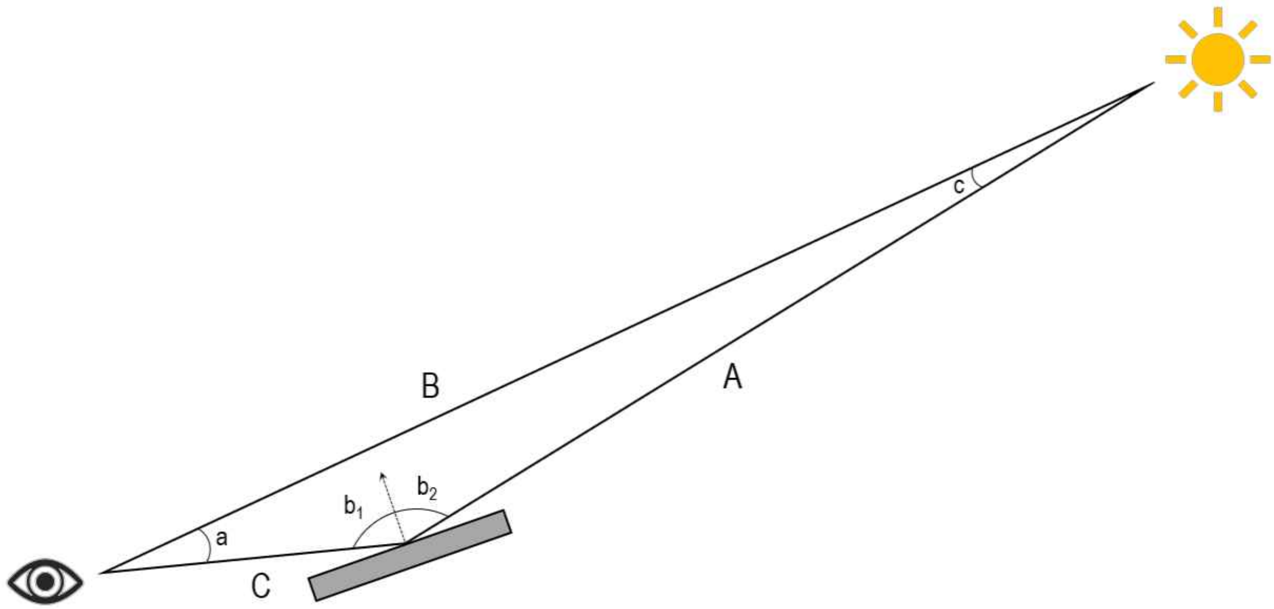


1.1 Definitions

The following terms are used throughout this assessment.

Direct Normal Irradiance (DNI)	The amount of solar radiation received per unit area by a surface that is always held perpendicular (or normal) to the rays that come in a straight line from the direction of the sun at its current position in the sky.
Diffuse Solar Radiation	Solar radiation scattered by molecules and particles in the atmosphere.
Direct Solar Radiation	Solar radiation that has travelled from the sun to the earth's surface in a straight line without scattering. Direct radiation is the component of solar radiation that causes visible glare from flat-plate photovoltaic systems.
Facility	All components of the proposed project, including PV panels and support structures, inverters, transformers, access roads, collection lines, and substation.
Project Area	The parcels of land and easements proposed to host the Facility components.
Glare	A continuous source of bright light.
Glint	A momentary flash of bright light.
Incidence Angle	The angle between the direct component of insolation (i.e., the sun) and a ray perpendicular to the PV panel (angle b_2 in Figure 2). The Incidence Angle is equal to the Reflectance Angle.
Potentially Sensitive Receptors	Non-participating residences or churches within 1,500 feet of the Project Area with the potential to receive glare from the Facility's PV arrays.
PV Panels	Photovoltaic (PV) panels or modules that are fixed to a ground-mounted racking system. On this Facility, a fixed-tilt racking system is proposed.
PV Array	A contiguous group of PV panels which collectively will be enclosed by security fencing and landscape screening plantings, where applicable.
Reflectance Angle	The angle between the reflected component of insolation and a ray perpendicular to the PV panel (angle b_1 in Figure 2 below). The Reflectance Angle is equal to the Incidence Angle.
Retinal Irradiance	The flux of radiant energy per unit area impacting the retina.
Specular Reflection	The mirror-like reflection of waves, such as light, from a surface.

Figure 2. Trigonometric Depiction



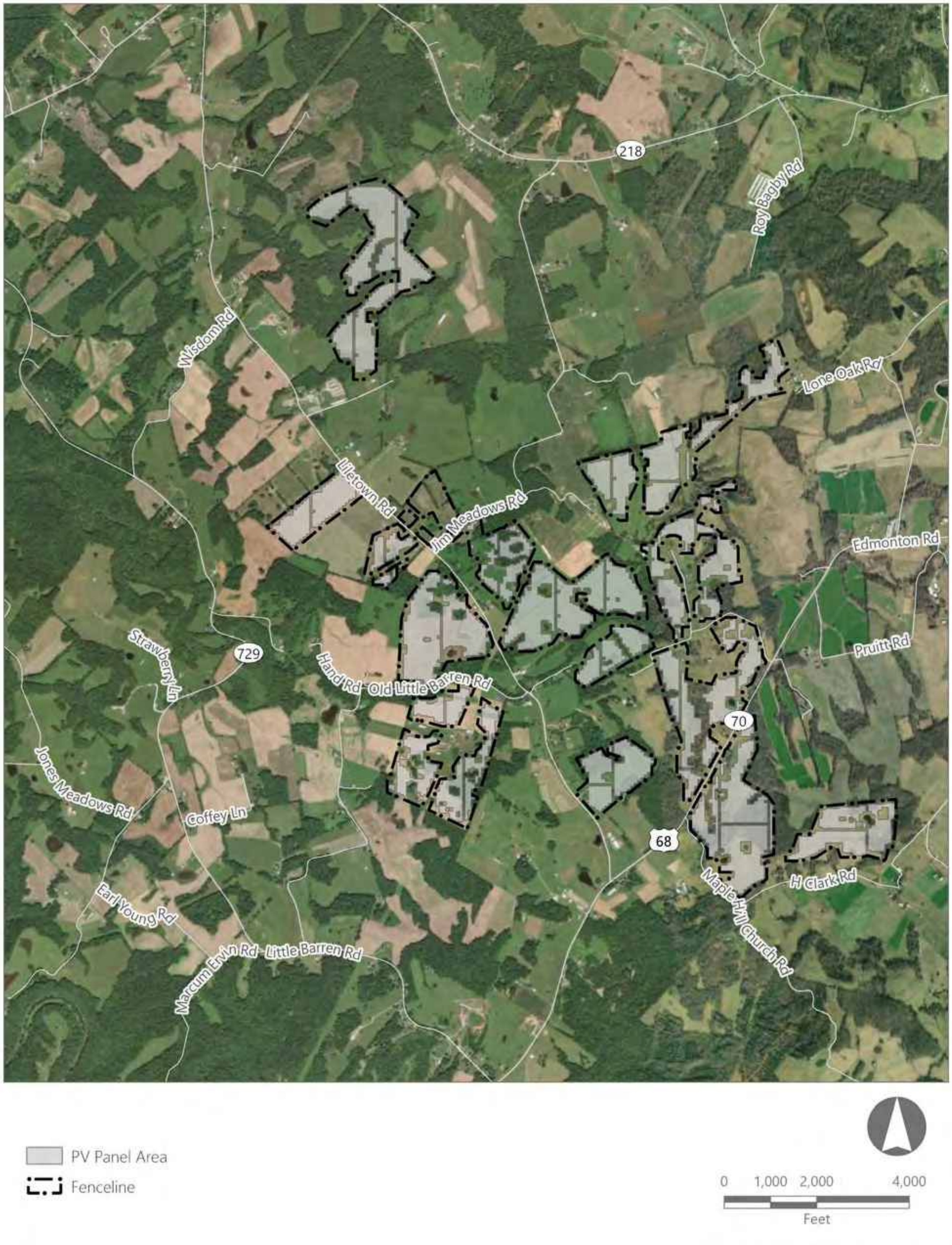
Trigonometric depiction of a receptor, a PV panel, and the sun. Reflectance Angle = b1; Incidence Angle = b2. The distance between the sun and the earth (sides A and B; approximately 91 million miles) is great enough, relative to side C (less than 1,500 feet or 0.28 miles), that angle c is effectively 0°.

1.2 Facility Description

The Facility includes fixed-tilt PV arrays. Fixed-tilt racking designs usually consist of a steel frame that creates a "table" on which the individual PV modules are mounted. The tables are fastened together to create a continuous row. The rows of PV panels will generally follow the existing topography of the Project Area. Rows will be aligned east to west, with the PV panels tilted to the south at an angle of 30 degrees from horizontal. The PV panels are assumed to have a typical maximum height of 12 feet above the ground at their highest point. The extent of solar arrays used in this analysis is shown on Figure 3. If the final footprint of the Project decreases from what is presented in this report, then the potential for glare to be received by nearby receptors may decrease.

The Project is located in Green County, Kentucky, approximately 1.5 miles west of the unincorporated community of Exie and approximately 5 miles east of the unincorporated community of Center. Elevations in the Project Area range from approximately 700 feet above mean sea level (amsl) to 1,025 feet amsl. Land cover within the vicinity of the Facility is dominated by active agriculture, with farms and single-family residences generally located along road frontages.

Figure 3. Facility Layout



1.3 Photovoltaic Systems and Solar Glare

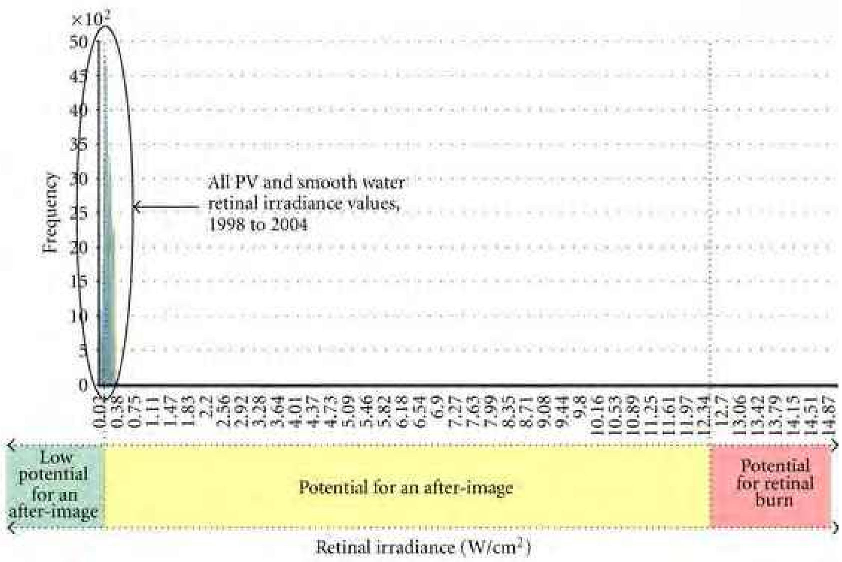
Glare is defined as a continuous source of bright light and differs from glint in its temporal duration. Where glint is a momentary flash of bright light, the effects of glare are generally only realized after 0.15 seconds or more of exposure (Ho et al., 2011; Zehndorfer Engineering, 2019). Both glint and glare are common in the existing environment. The sun and artificial light sources can cause glare or glint either directly (such as from a sunset when driving westbound) or indirectly (such as from the sun's reflection off of a lake or glass window). The potential effects of glare include annoyance and/or nuisance impacts such as distraction, disruption, or temporary avoidance of a view due to the presence of reflected light (Dwyer, 2017; Slana, 2018); safety impacts, such as the potential to disorient road users or pilots (Auffray et al., 2007; Ho et al., 2011; Riley and Olson, 2011); and human health impacts, such as permanent retinal damage (Ho et al., 2009).

Glare that may be produced by a PV array can be separated into two general categories: glare with a potential to cause a temporary after-image (i.e., "yellow glare") and glare with a low potential to produce an after-image (i.e., "green glare"). After-image is when an image continues to appear in the eyes after the exposure has occurred. Green glare is relatively low in intensity and is unlikely to produce an after-image. Yellow glare is similar in intensity to glare received from other sources regularly encountered by motorists (e.g., the rising or setting sun and the reflection of the sun off water features, windows, curtain wall buildings [e.g., buildings whose exterior is all glass], and other smooth surfaces). A third type of glare, red, can be harmful to the eyes. This type of glare is not typically associated with PV solar energy facilities such as the proposed Project.

Although photovoltaic systems are designed to absorb as much of the solar spectrum as possible, PV panels can reflect a proportion of the incoming solar radiation at high incidence angles (Parretta et al., 1999). As a result, under clear sky conditions, fixed-tilt photovoltaic systems, such as the proposed Facility, may produce glare in the early morning and evening when the sun is low on the horizon and there are no obstructions (e.g., topography, vegetation, structures, etc.) limiting the production and receipt of glare.

It is important to note that human health impacts are typically only associated with concentrating solar power plants or other convex reflective surfaces (e.g., convex curtain wall buildings) that concentrate the incoming solar radiation. Flat-plate photovoltaic systems, such as the proposed Facility, are incapable of producing the retinal irradiance levels necessary to result in retinal damage. Figure 4 provides a linear distribution of retinal irradiance showing PV panels and still water. Solar panels generally have a retinal irradiance of 0.23-0.45 W/cm^2, with smooth still water being similar at 0.13-0.38 W/cm^2 and on the bottom end of the retinal irradiance scale for having potential for an after image (Riley and Olson, 2011). In comparison, staring directly at the sun has a retinal irradiance of 8 W/cm^2 (Ho et al., 2011).

Figure 4. Distribution of Retinal Irradiance



Graphic of linear distribution of retinal irradiance from Riley and Olson, 2011.

1.3.1 Modeling Glare

To develop a general estimate of the occurrence, duration, and intensity of glare produced by a PV system and received at a given observation point, the following information is needed:

- Location, size, height, spacing, and orientation, and reflectance of the PV panels;
- Location and height of the observation point;
- Position of the sun;
- Direct Normal Irradiance (DNI);[1] and
- Geospatial characteristics of any topography, vegetation, buildings, or other potential obstructions between the observation point and the PV panels producing glare and between the PV panels and the sun.

ForgeSolar is the only company we are aware of that provides software that allows a user to model glare using the Solar Glare Hazard Analysis Tool (SGHAT). This software, "GlareGauge," is entirely based on the SGHAT model,[2] a conceptual model that was initially developed for use by the Federal Aviation Administration (FAA) in evaluating safety impacts to pilots while landing aircraft (Ho et al., 2015). This tool has since expanded and can be used to identify the potential for a photovoltaic system to produce glare receivable by ground-based receptors (Forge Solar, 2021). However, the application of this tool is limited, as described in Section 1.3.2.

[1] As DNI varies with both the sun position and changing atmospheric conditions, site-specific data with high temporal resolution is needed to accurately estimate glare.

[2] For the purposes of this assessment, the terms "GlareGauge software" and "SGHAT model" are used interchangeably.

1.3.2 SGHAT Model Limitations

The SGHAT model is based on a clear sky and bare earth model that assumes each PV array is a uniform surface. As discussed further below, this model does not consider atmospheric conditions that scatter incoming solar radiation, terrestrial obstructions that block PV panels from receiving direct radiation and/or block an observer from receiving glare, other intense sources of radiation that might mask the effect of glare (i.e., the sun), and other variables that would affect the production and receipt of glare from potentially sensitive receptors. In addition, the model does not allow a user to provide site-specific information on the spacing, size, or characteristics of the PV panels that make up an array.

1.3.2.1 Atmospheric Obstructions

Direct solar radiation is the component of solar radiation that causes visible glare from flat-plate PV systems (Riley and Olson, 2011). Direct radiation is radiation that has travelled from the sun to the earth's surface in a straight line without scattering. In order for PV panels to produce glare, direct solar radiation must strike PV panels at a high incidence angle.[3] Clouds, humidity, and other atmospheric elements scatter and absorb a certain percentage of solar radiation as it travels through the earth's atmosphere, reducing the amount of sunlight that reaches the earth's surface as direct radiation. Under some conditions (e.g., overcast skies), little to no solar radiation reaches the earth's surface without scattering.

The SGHAT model assumes a clear sky with limited radiative scattering. DNI values built into the model represent the maximum values possible for the site, considering the latitude and position of the sun. In the desert southwest, where most of the studies that support the SGHAT model were conducted (e.g., Ho et al., 2011 and Ho, 2013), this assumption is not likely to be problematic. However, in the northeastern United States, where high humidity levels and cloudy or overcast conditions are common, this assumption contributes to an overestimation of glare occurrence, duration, and intensity, as DNI has a direct relationship with glare intensity (Ho et al., 2011).

As an example, the models presented by Ho et al. (2011) were validated at the National Solar Thermal Test Facility located just outside of Albuquerque, NM. The annual percent average of possible sunshine in Albuquerque, NM is 76%, one of the highest values in the nation (NOAA, 2020). In comparison, the annual average percent of possible sunshine in Louisville, Kentucky (located approximately 70 miles north of the Facility) is 55% (NOAA, 2020). Sites such as the Facility that have a high occurrence of cloudy or overcast conditions are expected to have lower glare occurrence, duration, and intensity in the real world as compared to the SGHAT model outputs.

1.3.2.2 Terrestrial Obstructions

Another primary limitation of the SGHAT model is its assumption of a bare earth condition. To produce glare at a given observation point, there must be a clear line-of-sight between the sun and the PV panels, and between the PV panels producing glare and the observer. In the area within and adjacent to the Facility, the topography, vegetation, buildings, and other obstructions significantly limit the visibility of the Facility's solar arrays. Where these terrestrial obstructions do not completely block a receptor's view of the PV arrays,

[3] Specular reflectance is limited at low incidence angles (Parretta et al., 1999).

they often disrupt that view, breaking it into smaller, less contiguous sections. The SGHAT model does not consider these obstructions that currently exist in the landscape.

As noted above, the SGHAT model was designed to meet the FAA's glare analysis requirements (78 FR 63276).[4] In assessing potential glare for pilots and airports, the relevant sensitive receptors (e.g., aircraft and air traffic control towers) are well above the ground surface and terrestrial obstructions are typically limited.[5] In contrast, the proposed Facility is comprised of multiple PV arrays spread out across variable terrain that includes a patchwork of existing vegetative communities (e.g., forests and farmland).

No commercial or municipal airports or air traffic control towers are found within 2 miles of the Project Area. Potentially sensitive receptors are limited to residents and road users, which are located near the ground surface and, in many cases, are lower in elevation than the PV panels. Areas within and adjacent to the Project Area that contain hedgerows located adjacent to the PV panels can substantially reduce the visibility of the Facility from adjacent observation points and shade the panels from direct radiation in the early morning and late evening. Tall trees located adjacent to the PV arrays can significantly affect experienced sunrise and sunset times, which are dependent on the presence and height of an object blocking the horizon.

Considering that glare is almost exclusively produced in the morning and the evening—the times of day when the incidence angle between the sun and the PV panel (angle b_2 in Figure 2) is highest—this is a potentially significant model limitation. As an example, 40-foot trees located 120 feet west of a PV panel would hasten sunset by roughly an hour and a half in mid-summer. Any glare predicted by the SGHAT model from PV panels under these conditions would not actually be present.

As a final point, most PV panels generally have a maximum height of 8-15 feet. At these heights, the panels themselves can act as form of visual screening, preventing a receptor from viewing more than the edges of a PV array, particularly for receptors located at an elevation equal to or less than that of the PV array or in cases where a PV array is located on a slope that grades away from a receptor.[6] This is problematic because, as described above, the SGHAT model assumes that a receptor has full visibility of the PV array. However, in many cases, inter-array panel screening may block most, or all of the glare potentially received by an adjacent residence or roadway. Considering the maximum height of most PV panels and the heights of most ground-based receptors, it is likely that the SGHAT frequently overestimates glare in failing to account for inter-array panel screening.

All of this being said, the SGHAT model is a tool, and in fact may be the only commercially available tool, to assess worst-case predictions of glare from the Project Area and identify locations where the potential incidence of glare may be highest. The number of "hours" of glare output by the model can be used to characterize the potential exposure and identify the potential need for minimization and mitigation.

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[4] Available at: https://www.govinfo.gov/content/pkg/FR-2013-10-23/pdf/2013-24729.pdf

[5] Airports are typically sited in locations with limited topographic relief. In addition, the height of adjacent vegetation is controlled.

[6] In some cases, depending on the topographic and trigonometric relationship between a receptor and the PV array, a receptor located nearly due east or due west of an array may have visibility of one full row of the PV array. However, in the northern hemisphere, such views are unlikely to produce glare with a sun masking angle of more than 10°.

1.3.2.3 Sun-Masking Angle

A variable that is not accounted for in the SGHAT model, but which is important in determining the effect glare may have on a receptor, is the sun-masking angle concept. When the sun is low on the horizon, the sun and PV panels producing glare can be viewed simultaneously by a potential receptor. As the intensity of retinal irradiance produced by the sun is several orders of magnitude greater than what is capable of being produced by flat-plate (i.e., non-concentrating) PV panels (Ho et al., 2011), the sun's intensity can partially or wholly overshadow the glare produced by the PV panels, depending on the angle between the sun and the PV panels, as perceived from the receptor (i.e., angle a in Figure 2). Although there is some ambiguity regarding the angle at which the sun fully masks glare produced by PV panels (Zehndorfer Engineering, 2019), Germany and Austria have established a conservative sun-masking angle standard: glare received by PV panels can be discounted when the sun-masking angle is less than 10° (LAI, 2012; Zehndorfer Engineering, 2019).

1.3.2.4 Additional Considerations

In addition to the limitations described above, the SGHAT model offers no opportunities for a user to modify the characteristics of a PV array to reflect site-specific details regarding the panel dimensions, the spacing between rows of PV panels, or component variation within a PV array (e.g., access road placement). All PV arrays are treated equally as a unified reflective surface; PV arrays with 40 feet of spacing between panels to allow continuing agricultural equipment access are treated the same as tightly packed arrays with less than half the spacing between panels.

All conceptual models are limited in their ability to represent or anticipate real-world phenomena and require correction and validation in order to output accurate data. What is unusual about the SGHAT model, as applied to flat-plate PV systems and ground-based receptors, is the scope of the corrections needed to accurately assess glare receivable by ground-based receptors and—perhaps most importantly—the lack of model validation for this specific application. Ho et al. (2011) validated the accuracy of the model in the desert southwest in predicting the timing and duration of glare produced by concentrating solar energy facilities, and the model was applied and further validated in other locations in the United States, including the northeast (Ho et al., 2013), but none of these studies assessed the accuracy of the SGHAT model in predicting the occurrence, duration, and intensity of glare received by ground-based receptors, such as year-round residences. Neither the SGHAT Technical Reference Manual (Ho et al., 2015) or the studies cited on ForgeSolar's website provide any further information indicating that the GlareGauge software has been validated for this specific application.

The SGHAT model used by ForgeSolar appears to be the only software tool available to conduct a solar glare assessment. However, for flat-plate photovoltaic systems sited in areas with atmospheric and terrestrial conditions that are not favorable to the production or receipt of glare, the raw outputs of the SGHAT model may not be representative of potential on-site conditions.

2.0 METHODS

As discussed above, the SGHAT model outputs represent a worst-case scenario that is unlikely to be realized for the majority of ground-based receptors, particularly in locations such as the Project Area where atmospheric and terrestrial obstructions are prevalent. That being said, some of the limitations of the SGHAT model can be partially or wholly corrected through pre- and post-processing.

With the advent of publicly available, lidar-derived, high-resolution digital elevation model (DEM) data, terrestrial obstructions can be modeled at landscape scales. To correct the SGHAT model's bare earth assumption for residences, lidar-derived DEM data can be used in concert with field-based surveys to understand visibility an observation point might have of the PV panels producing glare, and to determine when panels would be shaded by adjacent vegetation and topography. This data could then be used to eliminate potentially sensitive receptors lacking visibility of the PV arrays and modify the user-defined SGHAT model inputs for potentially sensitive receptors with only partial visibility. Additionally, proposed landscape vegetation to be installed for a project can be added into the DEM allowing one to visualize the potential effects visual plantings at maturity may have on screening views of a project.

To account for the SGHAT model's clear sky assumption, publicly available monthly percent average of possible sunshine values can be incorporated into the SGHAT model outputs for residences through post-processing to reflect overcast and cloudy conditions where glare occurrence is limited.[7]

With respect to the sun-masking angle, conservative standards established by other governing bodies could be applied correctly account for this condition for residences.[8] Considering the distance between the sun and the earth[9] and the fact that the incidence angle and the reflectance angle (angles b2 and b1 in Figure 2, respectively) are equivalent, the angle between the sun and the PV panels, as perceived from the receptor (angle a in Figure 2), can be calculated as: 180 – (2 x Incidence Angle). Under the standard established by Germany and Austria, any glare received by a receptor where the incidence angle is over 85° would be determined to have a sun masking angle less than 10°, and therefore that glare could be discounted.[10] As the SGHAT model provides incidence angle information for every minute of modeled glare, model outputs could be post-processed to account for any sun-masking angle standard determined to be relevant by a municipality or developer.

Although some of the limitations of the SGHAT model can be corrected through applying the methods outlined above, several of the model limitations discussed in Section 1.3.2 are more difficult to remedy. As an example, although it is possible to account for obstructions between a residence or road user and the portions of a PV array causing glare, it is much more difficult to account for terrestrial obstructions between the sun and the PV array that limit the production of glare. Sunrise and sunset times change daily and the effect of terrestrial obstructions on the production of glare will be different for each individual PV panel within an array based on the trigonometric relationship between a PV panel and the specific characteristics

[7] Road users travel on a three-dimensional surface at varying velocities. The SGHAT model outputs for these users are not organized in a manner that would allow this post-processing.
[8] The model outputs for road routes are not organized in a manner that would allow this post-processing.
[9] The earth is approximately 91 million miles from the sun during the perihelion.
[10] 180 – (2 x 85°) = 10°

of the obstructions blocking the receipt of direct solar radiation. Although lidar data could be used to derive a better understanding of the effective sunrise and sunset time in a specific location, this information would have to be built into the SGHAT model algorithm for each individual PV panel. The SGHAT model does not have this capacity.

The methods applied by EDR, as outlined in the sections below, are intended to correct some of the limitations of the SGHAT model, where possible. However, even where corrections could be applied, not all model limitations were able to be accounted for. Accordingly, the intent of methods outlined below is to support an overall qualitative, conservative assessment of the Facility's glare exposure.

2.1 Receptors

2.1.1 Pre-Processing

A total of 46 non-participating residences and one church (i.e., receptors) are located within 1,500 feet of the Facility. In addition, there are a number of public roads running through the Facility. No commercial or municipal airports or heliports are located within 2 miles of the Facility. As intervening vegetation and topography (i.e., visual obstructions) are ubiquitous across the Project Area, an initial desktop screening process was conducted using general viewshed modeling, aerial imagery, and the trigonometric relationships between receptors and the PV arrays to identify receptors with the potential to receive solar glare from the Facility.

Using data from the Kentucky Aerial Photography & Elevation Data program, a 5-foot resolution digital surface model (DSM) was created, which included the elevations of buildings, trees, and other objects large enough to be resolved by lidar technology. As part of the development of the DSM, woodlots and hedgerows that may potentially be cleared during construction of the Facility were removed from the resulting DSM to reflect the bare-earth elevation in these locations. The modified DSM was then used as a base layer for a general viewshed model of the Facility. In this viewshed analysis, the height of sensitive receptors was set to 6 feet, and the maximum height of the proposed PV arrays was set to 12 feet.

At the Facility's latitude (37.1° N), and considering the proposed PV panel orientation (180 degrees, i.e., east-west) and tilt (30 degrees south), a receptor must be located due east, due west, east-southeast, or west-southwest of adjacent visible PV arrays in order to receive glare produced by that array. Receptors located north of adjacent PV arrays would not receive glare as fixed-tilt PV arrays that have a 180-degree orientation and a southern tilt are not capable of producing glare that can be received by terrestrial receptors located north of their east-west axis; the view of any receptor located north of the east-west axis will be limited to the back or the side of the PV panels. Receptors located due south, southeast, or southwest of adjacent PV arrays would not receive glare as none of the solar position and receptor location combinations possible at this site would result in incoming solar radiation striking the panels at high incidence angles in a manner that could be received by such receptors. The potential for receptors to receive glare was analyzed further using the methods outlined in Sections 2.1.2, 2.1.3, 2.1.4, and 2.1.5.

2.1.2 Observation Point Viewshed Analysis

An observation point viewshed analysis was completed for each of the receptors. This analysis utilized the DSM and model inputs noted above to identify the visibility each of the receptors that are anticipated to have views of the PV arrays. Figure 5 provides a representative example of the observation point viewshed analysis results for Receptor 57. Considering PV panel orientation and panel visibility within a portion of panels that have the correct position to cause glare receivable at each receptor, 28 of the 47 receptors were identified as not having visibility of the panels or not being in the correct orientation to receive glare. The remaining 18 receptors were further analyzed, as discussed below. Appendix A includes a list of receptors assessed in the SGHAT model.

Figure 5. Example of Observation Viewpoint Analysis

Observation viewpoint analysis results for Receptor 57. The proposed PV panels are shown outlined in dark gray and the results of the viewshed analysis are shown in purple.

2.1.3 SGHAT Modeling

The results of the observation point viewshed analysis and the results of the field verification were used to develop a final geospatial dataset identifying the specific PV panel areas likely to produce glare that is receivable by the potentially affected receptors. This dataset accounts for all terrestrial obstructions known at the time of the field survey that could affect the receipt of glare.[11] Appendix B shows the final geospatial

[11] Lidar-derived viewshed data has the potential to underestimate visibility in the dormant season where the lack of deciduous foliage can improve visibility. However, in this case, leaf-off conditions are largely irrelevant. As indicated in

data for the 18 receptors included in the final modeling. Figure 6 provides an example of the final geospatial data for Receptor 57, as an example.

Figure 6. Example of Final Model Inputs

Final model input data for Receptor 57 (shown in orange). These model input data were developed based on the results of the observation point viewshed analysis (shown in purple, for reference). Proposed PV panels are outlined in dark gray.

This final geospatial dataset was then input into the ForgeSolar modeling software, along with the core assumptions outlined in Table 1 below to produce the SGHAT model outputs. For each of the 18 receptors, a separate ForgeSolar model was run with the discrete panel areas that have Facility visibility.

the results of this assessment (Appendix C), the Facility's potential to produce glare is almost exclusively limited to the late spring, summer, and early fall (i.e., leaf-on conditions).

Table 1. SGHAT Model Inputs

Parameter	Input
Panel Height	12 feet*
Receptor Height	5.4 feet**
Axis Tracking	Fixed
Orientation	180°
Tilt	30° (facing south)
Panel Material	Smooth glass with an anti-reflective coating
Slope Error	6.55 mrad

*The maximum height of the PV panels.
**Average eye height for males in the United States.

2.1.4 Post-Processing

As discussed in Section 1.3, when a receptor views glare from PV panels and glare from the sun in the same general line-of-sight, the sun's significantly greater intensity overshadows (i.e., "masks") the glare produced by the PV panels. To address the masking effect of the sun, a 10-degree sun-masking angle threshold was set and a logical equation was applied to the raw SGHAT model outputs to discount glare received at a sun-masking angle of less than 10 degrees (i.e., an incidence angle greater than 85 degrees).[12]

Percent of possible sunshine is a measurement of the total time that sunshine reaches the earth, expressed as the percent of the possible maximum amount of sunshine, under clear sky conditions, from sunrise to sunset. As discussed in Section 1.3, this variable can be used to correct the clear sky assumption of the SGHAT model and account for climatic conditions that reduce the occurrence, duration, and intensity of glare (e.g., overcast skies, cloud cover, etc.).

The National Weather Service (NWS) typically measures percent of possible sunshine using Marvin sunshine recorders, devices that are sensitive to direct radiation, but which also measure diffuse radiation to some extent (American Meteorological Society, 2020). Direct radiation is the component of solar radiation that causes visible glare from flat-plate photovoltaic systems; diffuse radiation is radiation that has been scattered by molecules in the atmosphere, this type of radiation does not play a central role in producing glare (Riley and Olson, 2011). As Marvin sunshine recorders measure both direct and diffuse radiation, the percent possible sunshine values recorded by the NWS represent a reasonable estimation of the climatic conditions under which glare may be produced.

Monthly average percent possible sunshine records for Louisville, Kentucky from March to September—the months during with the production of glare was modeled to occur—were acquired from the National Oceanic and Atmospheric Administration (NOAA, 2021) (Table 2).

[12] Germany and Austria have established a similar threshold (LAI, 2012; Zehndorfer Engineering, 2019). See Section 1.3 for a further discussion.

Table 2. Monthly Percent of Possible Sunshine Values for Louisville, Kentucky[13]

Month	Percent of Possible Sunshine
March	50
April	55
May	59
June	64
July	66
August	65
September	62

These data were incorporated into the raw SGHAT model outputs directly. For each minute where the SGHAT model predicted glare would be received at a given receptor, a corrective factor was applied specific to the timing of the produced glare. For example, if the raw SGHAT model output data predicted that 10 minutes of glare would be received on July 15, this value would be corrected to an average value of 6.6 minutes to account for the fact that on average, direct incoming solar radiation reaches the earth's surface only 66% of the time in the month of July in the area.

2.2 Public Roadways

The limitations of the SGHAT model are even more difficult to address for road users traveling through the Project Area. In modeling the potential for glare to be received at a residence, the receptor can be assumed to be a relatively static point with known attributes. Road users travel in multiple directions on a three-dimensional surface at differing velocities. Although it would be possible to provide a general correction for climatic variables that affect the production of glare (as described in Section 2.1.5), all other model limitations would be difficult or impossible to address as each point along a travel route would have unique conditions (e.g., visibility, effective sunrise/sunset, inter-array PV panel screening, sun-masking angle, etc.). Although the SGHAT model provides the option to model glare along roadways, considering the limitations discussed in this assessment, the results are not anticipated to be representative of on-site conditions. Accordingly, a qualitative assessment of potential glare exposure was completed for public roadways within and adjacent to the Project Area.

Although portions of roads adjacent to the Facility may have visibility of the Facility PV arrays, an additional consideration that is relevant for roadways is whether glare has the potential to be received within a road user's inner field of view. Pilots and road users have to deal with visual distractions, including glare, on a daily basis. This is typically not an issue unless such distractions are located within the operator's inner field of view, generally +/- 25 degrees for pilots and +/- 15 degrees for road users (Rogers et al., 2015; Zehndorfer et al., 2019). Glare received within a road user's inner field of view is less easily ignored and can more directly affect an operator. The likelihood that glare produced by the Facility's PV arrays would be received within a road user's inner field of view was analyzed qualitatively.

[13] The results of the SGHAT did not identify any glare to occur during the months of October through February.

2.3 Visual Mitigation

As presented in the *Conceptual Visual Mitigation Report* for the Project, to mitigate visual impacts resulting from the Facility, the Applicant is proposing perimeter plantings that will buffer views from adjacent residential non-participating properties, the traveling public, nearby communities, and recreationalists. The *Conceptual Visual Mitigation Report* provides various conceptual planting arrangements with corresponding sample plant schedules, or "modules" proposed for the Project. Three modules have been developed for the Facility for the purpose of visually softening the infrastructure. Planting Module 2 includes robust screening in areas of the highest viewership (proximity to residences) and includes a mix of deciduous and evergreen species planted in a dense arrangement. The approximate mature height of this screening ranges from 10 feet to 50 feet. Planting Module 3 is similar to Planting Module 2 in that it provides a dense planting for stationary adjacent uses, but with a shorter height of approximately 15 feet at maturity. Planting Module 1 is intended for use in areas with more distant or fleeting views of the Facility such as along roadways. This module was not included in the analysis given the more intermittent nature of plantings.

To allow the model to consider the potential effectiveness of the planting modules, the 5-foot resolution DSM, described in section 2.1.1, was modified to include the areas of Planting Modules 2 and 3 at maturity. The modified DSM was then used as a base layer for running a second version of the observation point viewshed analysis. In this viewshed analysis, the height of proposed modules at maturity was set to 15 feet for Planting Module 2 and 12 feet for Planting Module 3. Appendix B shows the final geospatial data for the 18 receptors included in the final modeling and potential screening. Figure 7 provides, as an example, the screening effects of the proposed plantings for Receptor 57.

Figure 7. Example of Landscaping Plan Model Inputs

3.0 RESULTS AND DISCUSSION

3.1 Receptors

In completing the methods outlined in Section 2.0, it was determined that 15 of the 47 receptors located within 1,500 feet of the Project Area had the potential to receive glare produced by the Facility. For the receptors where glare exposure is not anticipated, orientation of views towards the panels, vegetation, and existing structures (e.g., barns and outbuildings) were found to be the most important terrestrial factors in limiting the potential receipt of glare. In most cases, intervening vegetation was often found to obscure or disrupt a receptor's view of potential glare-producing PV panels, as illustrated in Figures 6 and 7.

The post-processed SGHAT model results, which account for terrestrial obstructions between the receptors and the potential glare-producing PV panels, average atmospheric conditions, and the masking effect of the sun, indicate that seven of the 18 receptors within 1,500 feet of the Facility are likely to receive little to no green and/or yellow glare (less than 2 hours a year; Table 3). The average annual duration of yellow glare at the remaining receptors was modeled at 23.9 hours, the average annual duration of green glare modeled to occur at 31.6 hours and combined average annual duration of 55.5 hours per year. The total amount of glare modeled to occur at each of the receptors is equivalent to approximately 0.02% to 3.01% of the approximately 4,454 daylight hours in a given year. At receptors modeled to experience some level of glare, the daily duration would occur for less than 30 minutes (for additional details, see Appendix C). As demonstrated in Table 3, the remaining glare possibly received at these receptors is a combination of green and yellow glare; no glare with the potential to cause eye damage (or red glare) is predicted. Since flat-plate PV panels do not focus reflected sunlight, it is typically not possible for them to cause red glare. No red glare was modeled to occur for this Facility.

Timing and duration of glare vary depending on the position and proximity of each receptor relative to the potential glare-producing PV panels. In general, glare will be received during the summer months before 7:00 a.m. or after 5:00 p.m. Typically, receptors with higher modeled glare levels receive glare somewhat evenly throughout the spring and summer months, whereas receptors with lower modeled glare levels receive glare around either the summer solstice or closer to the vernal and autumnal equinoxes (see Appendix C for further details regarding the raw SGHAT model outputs).

Table 3. Glare Modeling Results

Receptor	Initial Model Run		Post-processing				Glare Modeling Results		
			Sun-Masking Angle Reduction		Percent Possible Sunshine Reduction				
	Green Glare (min)	Yellow Glare (min)	Green Glare (min/ year)	Yellow Glare (min/ year)	Green Glare (min/ year)	Yellow Glare (min/ year)	Green Glare (hrs/ year)	Yellow Glare (hrs/ year)	Total Glare (hrs/ year)
3	492	2,164	0	-1,353	0	-293	0	8.6	8.6
9	509	0	-379	0	-54	0	1.3	0	1.3
10	649	0	-474	0	-69	0	1.8	0	1.8

Receptor	Initial Model Run		Post-processing				Glare Modeling Results		
	Green Glare (min)	Yellow Glare (min)	Sun-Masking Angle Reduction		Percent Possible Sunshine Reduction		Green Glare (hrs/ year)	Yellow Glare (hrs/ year)	Total Glare (hrs/ year)
			Green Glare (min/ year)	Yellow Glare (min/ year)	Green Glare (min/ year)	Yellow Glare (min/ year)			
11	345	229	-305	0	-17	0	0.4	0	0.4
12	1,030	4,321	-650	-1,016	-138	-1,230	4.0	34.6	38.6
13	1,107	529	-420	-264	-274	-107	6.9	2.6	9.5
22	0	0	0	0	0	0	0	0	0
23	7,845	5,755	-1,702	-198	-2,266	-2,076	64.6	58.0	122.6
26	42	0	0	0	0	0	0	0	0
31	3,065	0	-1,433	0	-644	0	16.5	0	16.5
37	2,118	3,138	-300	-154	-683	-1,146	18.9	30.6	49.5
44	11,414	4,714	-2,573	-660	-3,306	-1,552	92.2	41.7	133.9
49	647	2,207	-165	-378	-182	-695	5.0	18.9	23.9
54	4,921	2,483	-770	-392	-1,506	-788	44.1	21.7	65.8
64	0	0	0	0	0	0	0	0	0
65	0	0	0	0	0	0	0	0	0
68	4,086	925	-741	-224	-1,225	-252	35.3	7.5	42.8
78	8,412	4,004	-2,607	-339	-2,180	-1,378	60.4	38.1	98.5

As discussed previously, these estimates represent a worst-case scenario of average conditions. These estimates do not account for terrestrial obstructions between the sun and the PV panels that would prevent the production of glare (i.e., the effects of PV panel shading in the morning and evening) or other model limitations that would further reduce the production and receipt of glare in the real world (e.g., panels in the viewing foreground blocking a receptor's view of glare being produced by panels deeper in the array). In effect, these results assume that (1) each of the receptors has full visibility of the PV array causing glare, (2) no trees or other terrestrial obstructions exist adjacent to the PV arrays that would shade the panels in the morning and evening, and (3) the PV arrays are a single uniform surface with no gaps between panels.

As one or more of these assumptions are incorrect for each of the receptors identified in Table 3 with more than two hours of glare annually, the final results shown in Table 3 are conservative and may exceed real-world values. The glare received by receptors adjacent to the Facility is anticipated to be substantially less than raw SGHAT model output data or the post-processed data.

The vegetative screening proposed throughout the Project site is anticipated to meaningfully contribute to the mitigation of glare impacts. Considering that glare at this site is predicted to occur primarily in the summer, during the leaf-on period, for most receptors, vegetative screening plantings—once established—are likely to be an effective remedy in further mitigating the potential effects of glare. In addition, in the final design of the Facility, the Applicant will retain existing on-site vegetation wherever feasible, particularly along roadways and property lines, to retain the screening benefits of existing vegetation. Appendix B visualizes the areas where vegetative screening could reduce visibility of the Facility and thus potential for glare to occur. Assuming the success of the proposed landscape mitigation plantings, the material will continue to provide additive screening value as the plants mature. For the more densely situated plants in the Residential Screening vegetative screening, this will likely result in near-complete integration of the project into the landscape and the landscape mitigation will appear similar in composition to existing hedgerows and woodlots found throughout the area.

During operations, the Applicant is expected to implement a complaint resolution plan that would require the Applicant to work proactively with residents and stakeholders in the community in responding to concerns with glare, if they should occur. If complaints arise that cannot be resolved, the Applicant can propose additional measures to mitigate potential glare impacts, which may include installing additional vegetative screening plantings, fencing, or other forms of visual screening.

3.2 Public Roadways

As discussed above, road users travel in multiple directions on a three-dimensional surface at differing velocities, making it difficult to assess the potential for one to experience glare. Portions of the following major public roads were identified as having visibility of the Facility's PV arrays in an orientation that may result in the panels being visible: U.S. Route 68, State Route 729, Liletown Road, Wisdom Road, Jim Meadows Road, Little Baren Road, G Thompson Road, Maple Hill Church Road, and Clark Bagby Road.

Although the majority of glare produced by the Facility will be received outside a road user's inner field of view (i.e., +/- 15 degrees), glare may be received within a road user's inner field of view under some conditions along segments of adjacent roads. Along these segments, glare may be received in the morning and the evening, at times of the day when road users are accustomed to coping with glare from the sun and glare produced by other specular bodies (e.g., calm water, curtain wall buildings, large windows, etc.). Views towards portions of panel arrays within the inner field of view will be broken by existing vegetation and buildings and over time the Project's robust vegetation screening plan will further reduce visibility of the Facility.

Visual mitigation measures, such as vegetative screening, are particularly effective in reducing glare impacts for roadways compared to stationary receptors such as residences. Road users typically view the panels from more oblique angles as they travel along the roadway, resulting in a narrower and less direct field of view. In contrast, stationary receptors often have a more perpendicular line of sight to the panels, which increases the potential panel visibility. By strategically placing mitigation features to obstruct indirect views, road users glare impacts are reduced due to the alignment of the viewing angles. Additionally, the effectiveness of these screening measures will continue to improve over time as the planted vegetation matures, further enhancing its ability to block views of the panels.

For all road users, glare is a common and well-studied phenomena (e.g., Auffray et al., 2008; Redweik, 2019). As evidence of this, all vehicles sold in the United States come standard with features intended to help a road user cope with glare received from the sun or other sources (sun visors and shade bands). Furthermore, considering the timing of the glare anticipated and the east-west orientation of the roads where glare could occur, glare within a road user's inner field of view will be produced under conditions where a road user is already actively minimizing glare exposure from the sun in the evening and morning. In consideration of these factors and the Applicant’s planned vegetative mitigation strategy, road users travelling through the Project Area are not anticipated to be exposed to glare in a manner that would impede traffic movements or create safety hazards.

4.0 CONCLUSIONS

Fixed-tilt photovoltaic systems, such as the proposed Facility, can produce glare in the morning and evening when the sun is low on the horizon. The receipt of this glare by potentially sensitive receptors (e.g., residences, churches, and public road users) can be modeled using ForgeSolar’s GlareGauge tool, a commercial software program that is based on the Solar Glare Hazard Analysis Tool (SGHAT) developed by Sandia National Laboratories. However, this tool is a conceptual model with limited accuracy in quantifying potential glare exposure for ground-based receptors in locations such as the Facility where terrestrial and atmospheric obstructions limit the production of glare are common.

In considering the effects of cloud cover, the sun masking angle, and terrestrial obstructions preventing the receipt of glare at receptors, this *Solar Glare Assessment* addresses some of the primary limitations of the SGHAT model. To account for this, a quantitative analysis of glare impact was completed for receptors that have the potential to be impacted by glare. This assessment incorporated the post-processed results of the SGHAT model, where applicable, and found that glare has the potential to be received at 15 receptors. Of those 15 receptors, seven are likely to receive little to no glare (less than 2 hours a year). The potential glare exposure to the remaining receptors is anticipated to be limited in duration, at generally less than 30 minutes per day. Additionally, the SGHAT model does not take into account the magnitude of potential glare from PV arrays in comparison to the existing, naturally occurring glare production from current environmental surfaces near these receptors (i.e. standing water, adjacent picture window glass, vehicle glass, etc.).

Potential glare exposure to roadways may occur along short segments around sunrise and sunset, at similar times of the day that road users are accustomed to dealing with glare exposure from the sun. For both receptors and road users, the Applicant’s visual mitigation plan over time will limit the amount of glare that is receivable by these potentially sensitive receptors. When these proposed measures are considered together with the limited occurrence, duration, and intensity of glare anticipated, the Project’s solar glare exposure is generally anticipated to be minimal.

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APPENDIX A

List of Receptors Assessed in SGHAT Model

Receptor ID	Street Address	City	Latitude	Longitude
3	3745 Liletown Rd	Greensburg	37.13881	-85.57993
9	1019 Old Little Barren Rd	Greensburg	37.13996	-85.59763
10	1980 Old Little Barren Rd	Greensburg	37.14362	-85.58539
11	1000 Lone Oak Rd	Greensburg	37.16229	-85.56345
12	210 G Thompson Rd	Greensburg	37.15100	-85.57184
13	1974 Old Little Barren Rd	Greensburg	37.14389	-85.58593
22	Old Little Barren Rd	Greensburg	37.14155	-85.58741
23	2853 Liletown Rd	Greensburg	37.15026	-85.58779
26	3636 Liletown Rd	Greensburg	37.14010	-85.58311
31	1047 Old Little Barren Rd	Greensburg	37.14036	-85.59766
37	2931 Liletown Rd	Greensburg	37.14945	-85.58706
44	685 B Edwards Rd	Greensburg	37.15534	-85.57876
49	1132 Lone Oak Rd	Greensburg	37.16199	-85.56370
54	9682 Edmonton Rd	Greensburg	37.14165	-85.56906
64	Luther Drive	Greensburg	37.14542	-85.58080
65	1591 Clark Bagby Rd	Greensburg	37.13222	-85.55593
68	2969 Liletown Rd	Greensburg	37.14899	-85.58669
78	2680 Liletown Rd	Greensburg	37.15191	-85.59030

APPENDIX B

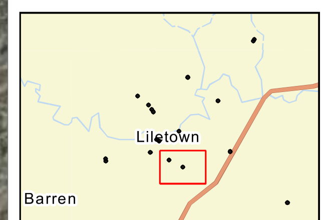
Final Modeling Inputs

Exie Solar Project

Green County, Kentucky

Solar Glare Assessment

- Receptor
- Landscape Mitigation Module
- PV Panel Array*
- Receptor Panel Visibility with Potential for Glare
- Receptor Viewshed
- Receptor Panel Visibility Expected to be Screened by Planting Plan and/or Existing Structures



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Feet

Prepared July 25, 2025

Basemap: KyFromAbove 2024 "Phase 3 - 3in" orthoimagery map service

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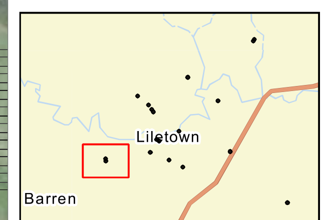

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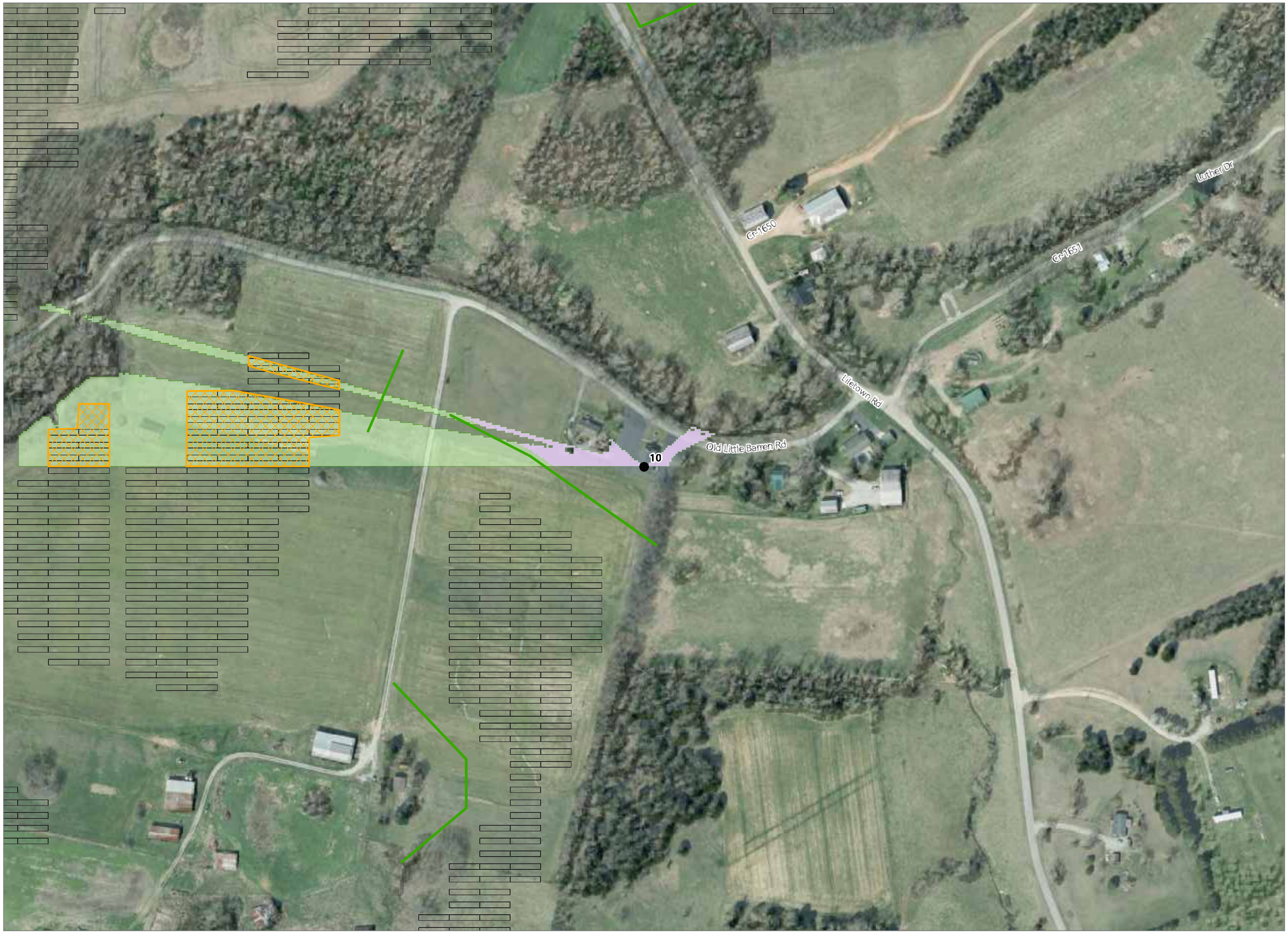

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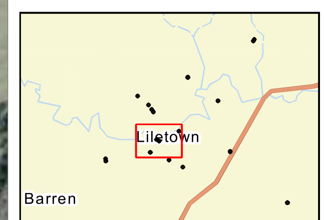

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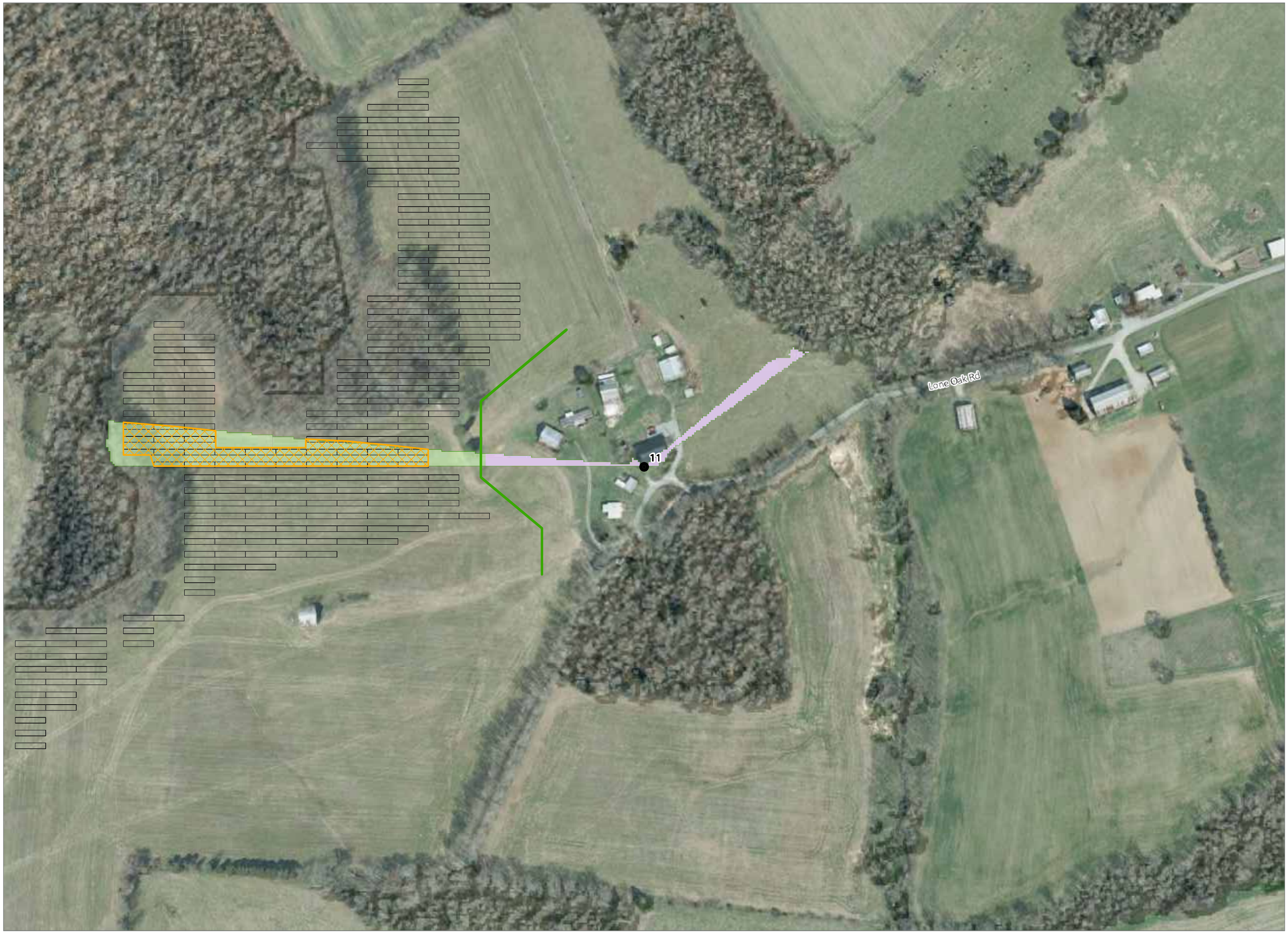

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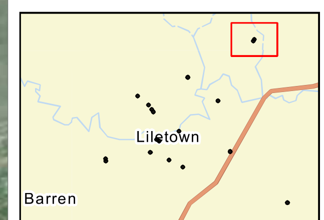

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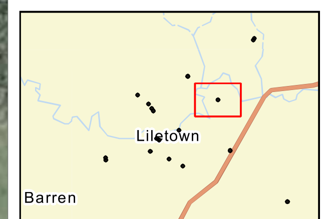

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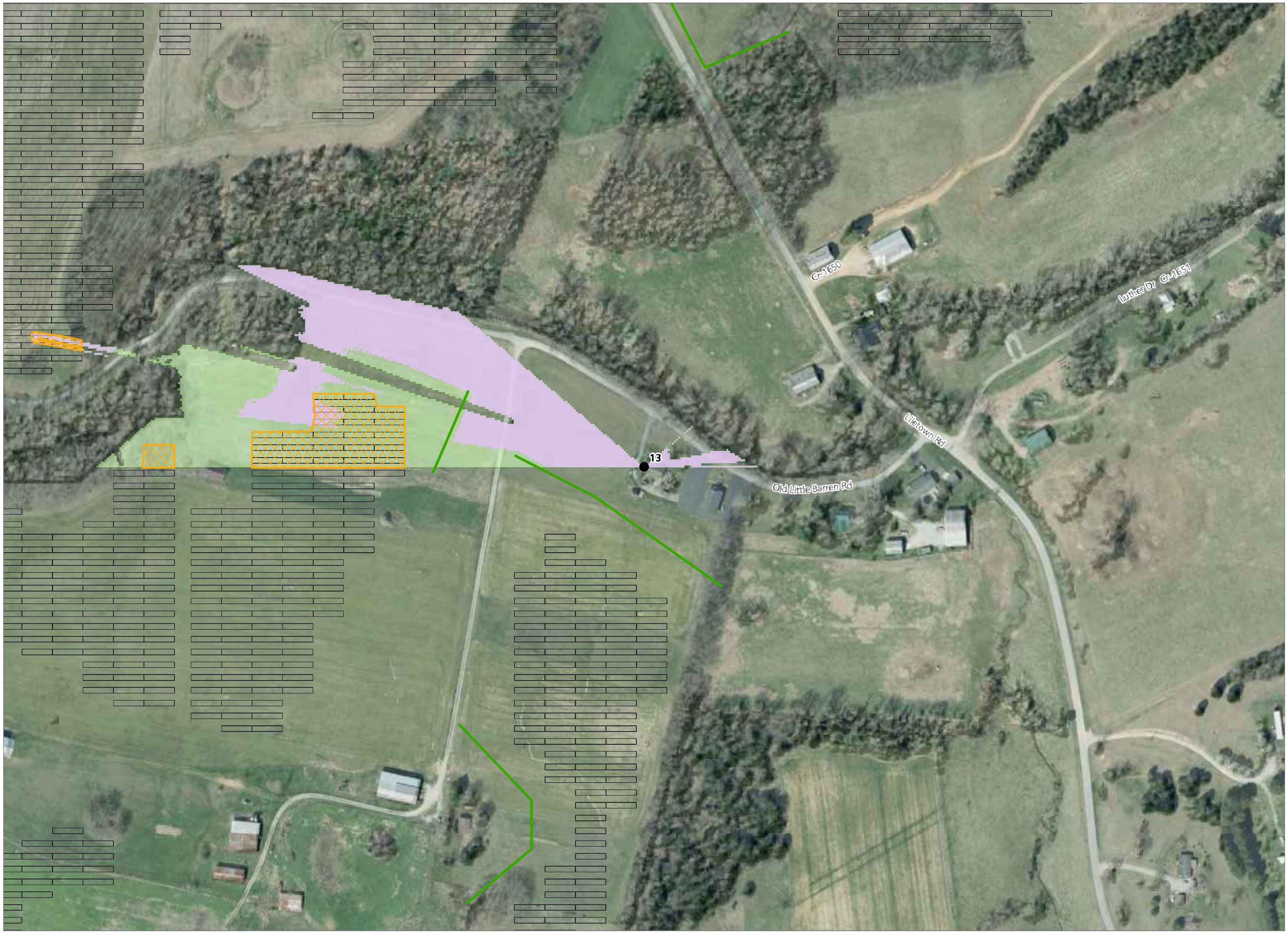

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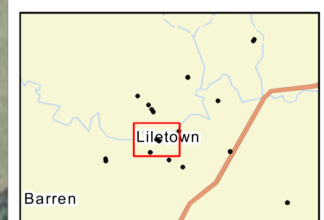

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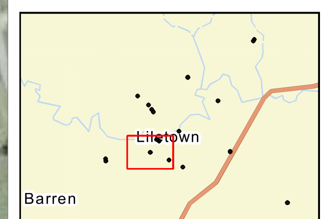

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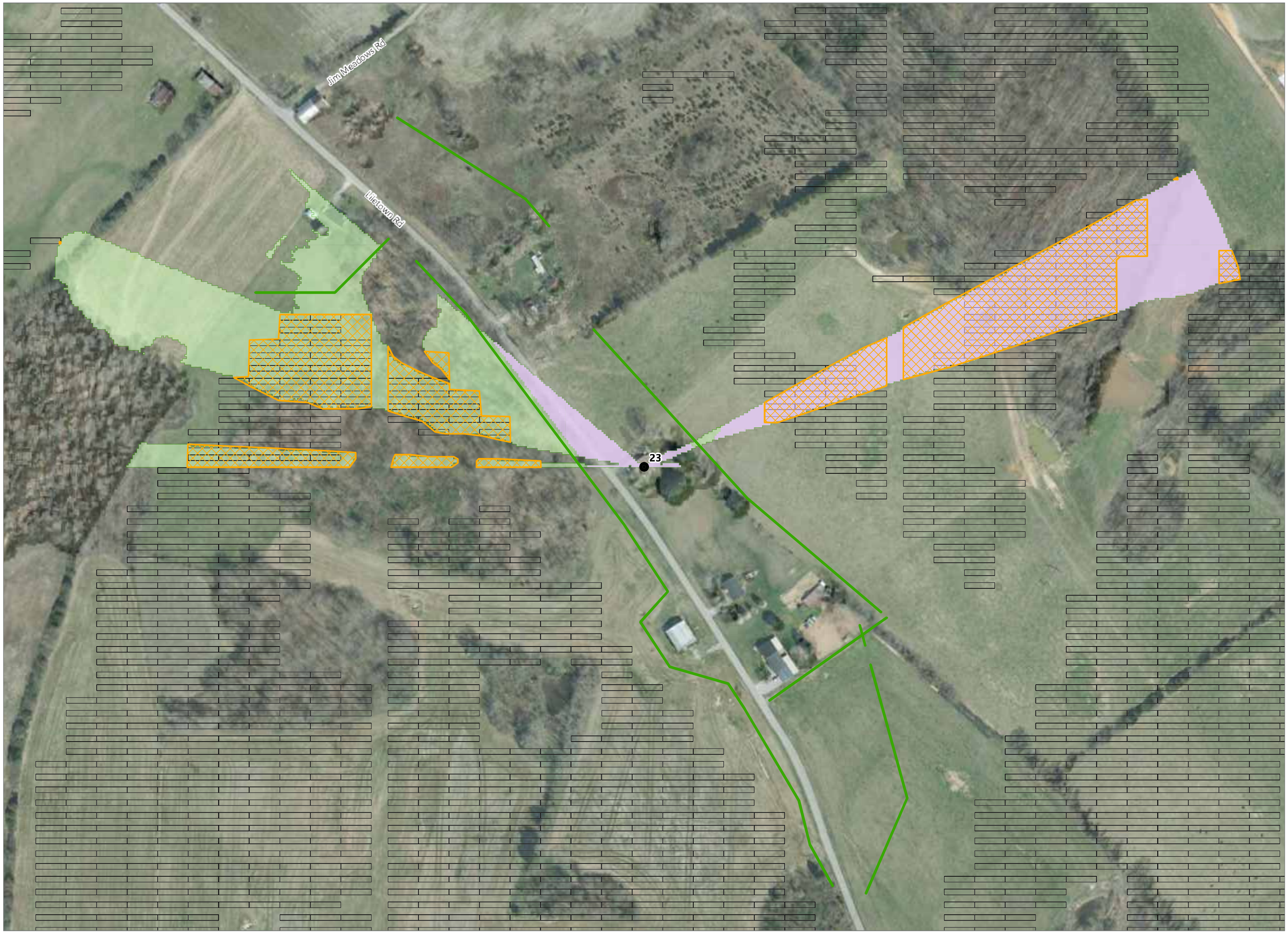

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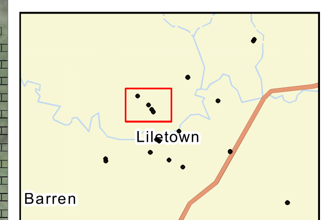

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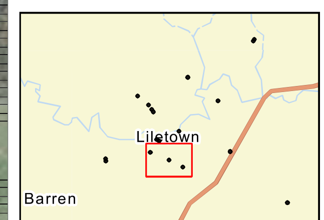

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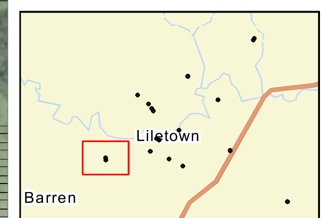

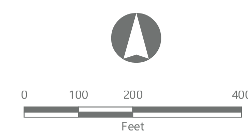

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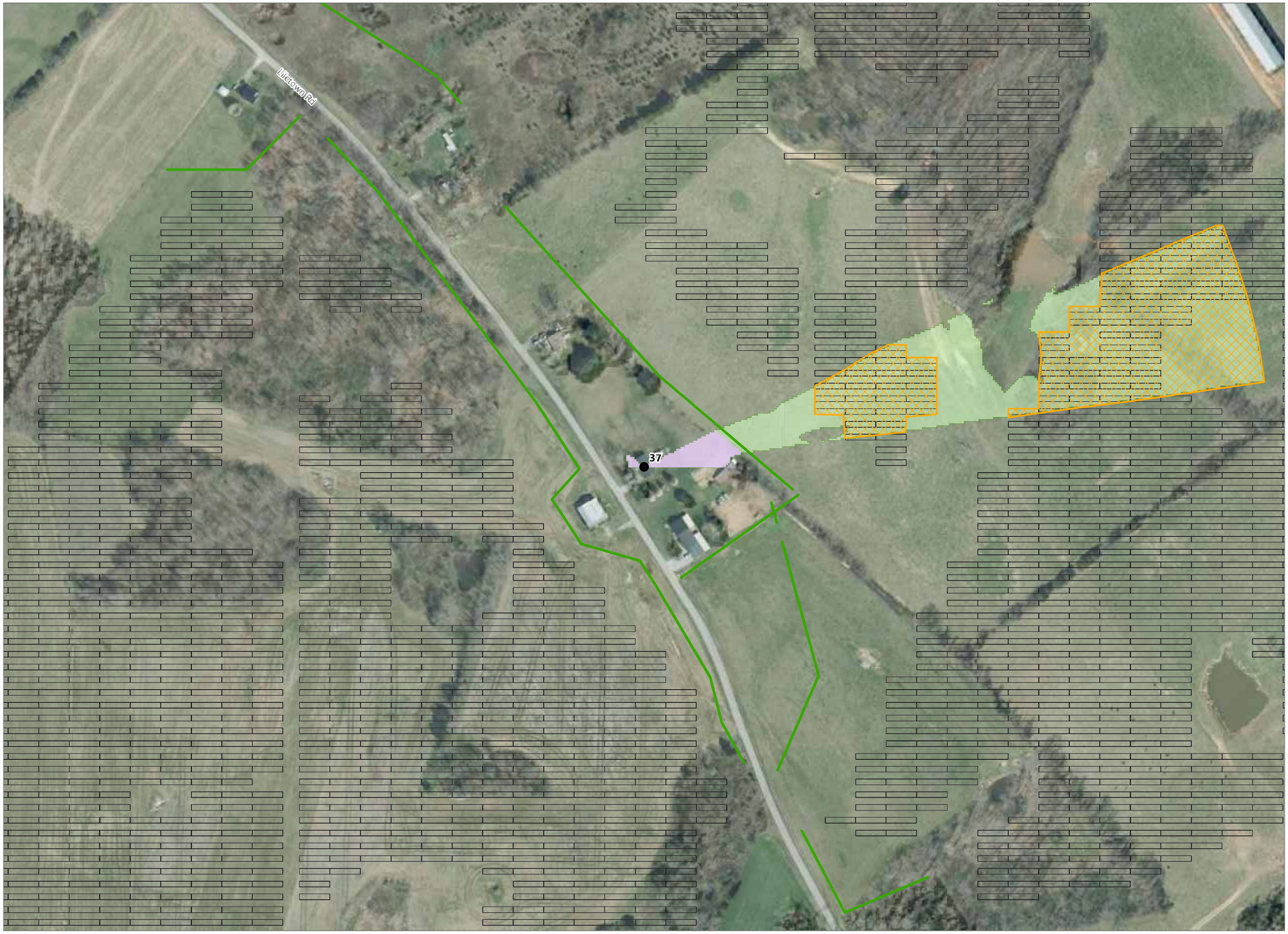

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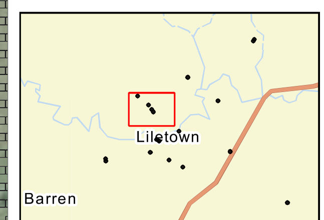

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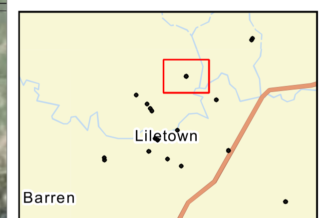

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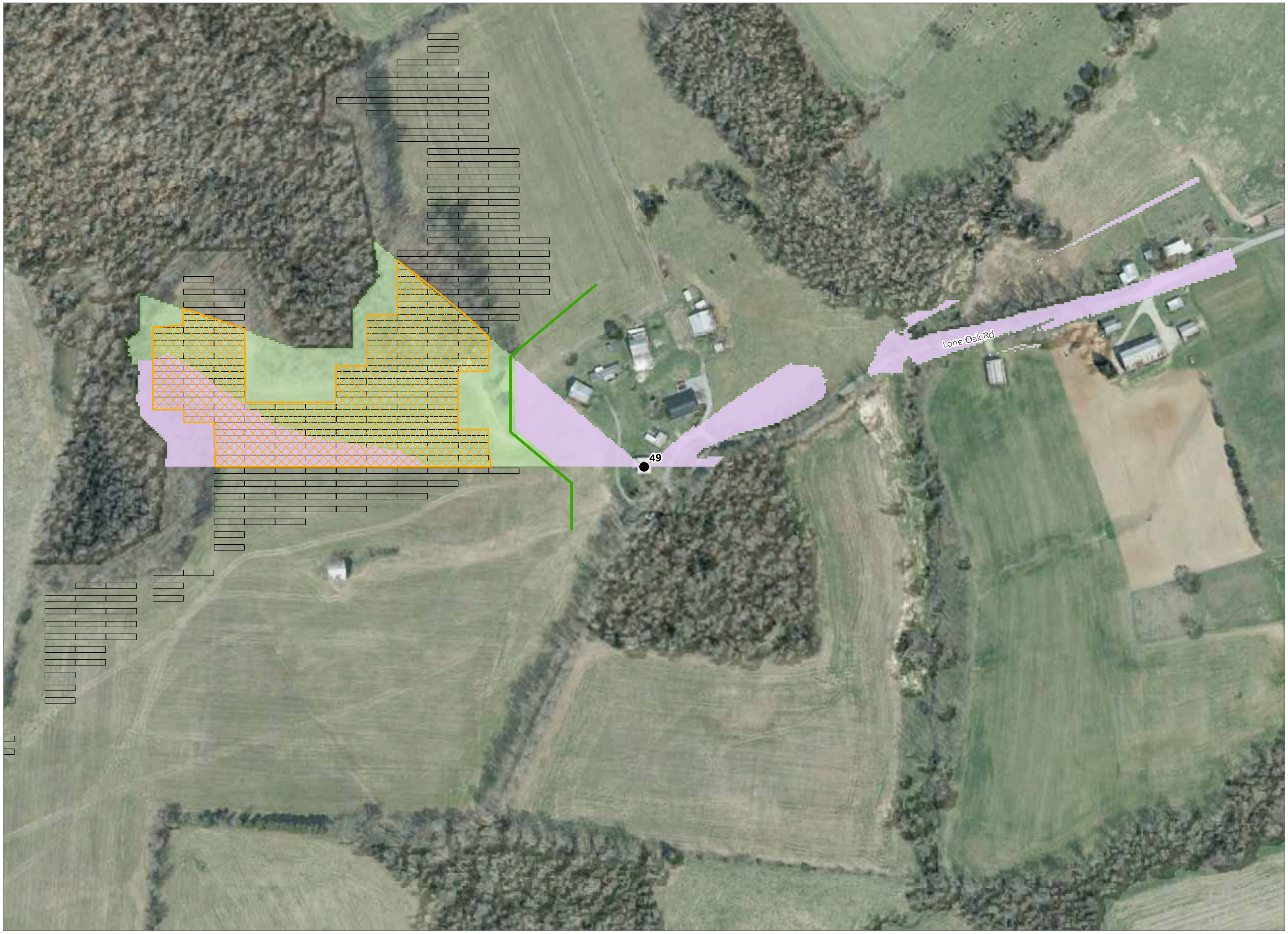

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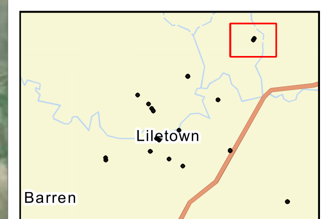

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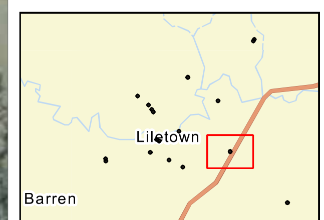

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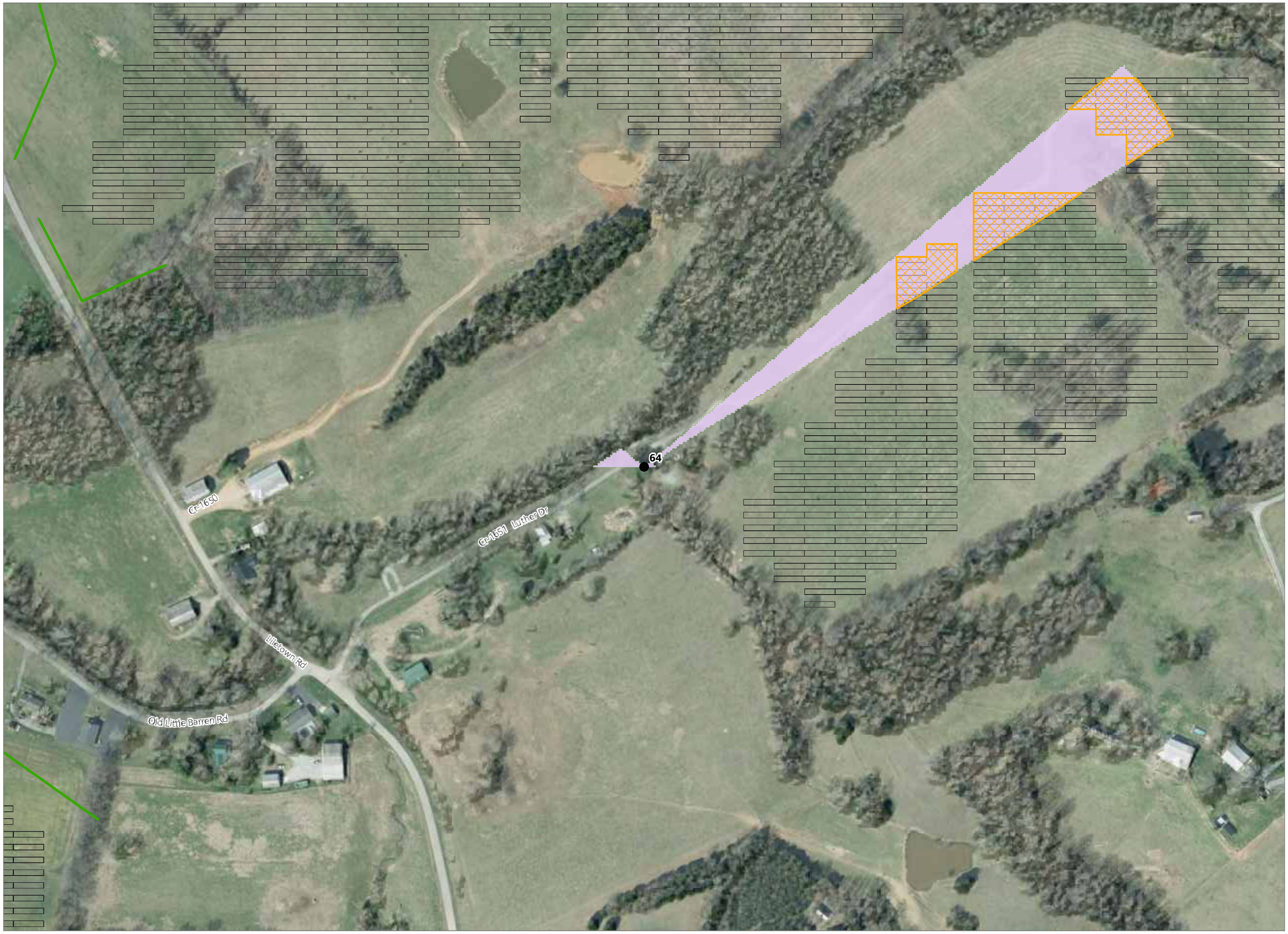

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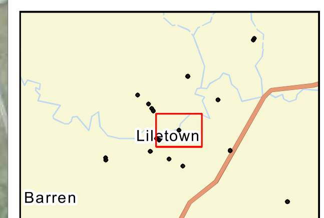
- Receptor Viewshed
- Receptor Panel Visibility Expected to be Screened by Planting Plan and/or Existing Structures



0 100 200 400
Feet

Prepared July 25, 2025
Basemap: KyFromAbove 2024 "Phase 3 - 3in" orthoimagery map service
* The layout evaluated in this analysis uses a slightly larger pv array footprint and represents a conservative assessment on potential for glare to occur from the proposed project.

EDR

Appendix B. Final Modeling Inputs

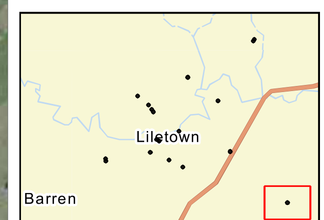
Receptor: 65

Exie Solar Project

Green County, Kentucky

Solar Glare Assessment

- Receptor
- Landscape Mitigation Module
- PV Panel Array*
- Receptor Panel Visibility with Potential for Glare
- Receptor Viewshed
- Receptor Panel Visibility Expected to be Screened by Planting Plan and/or Existing Structures



0 100 200 400
Feet

Prepared July 25, 2025
Basemap: KyFromAbove 2024 "Phase 3 - 3in" orthoimagery map service
* The layout evaluated in this analysis uses a slightly larger pv array footprint and represents a conservative assessment on potential for glare to occur from the proposed project.

EDR

Exie Solar Project

Green County, Kentucky

Solar Glare Assessment

- Receptor
- Landscape Mitigation Module
- PV Panel Array*
- Receptor Panel Visibility with Potential for Glare
- Receptor Viewshed
- Receptor Panel Visibility Expected to be Screened by Planting Plan and/or Existing Structures

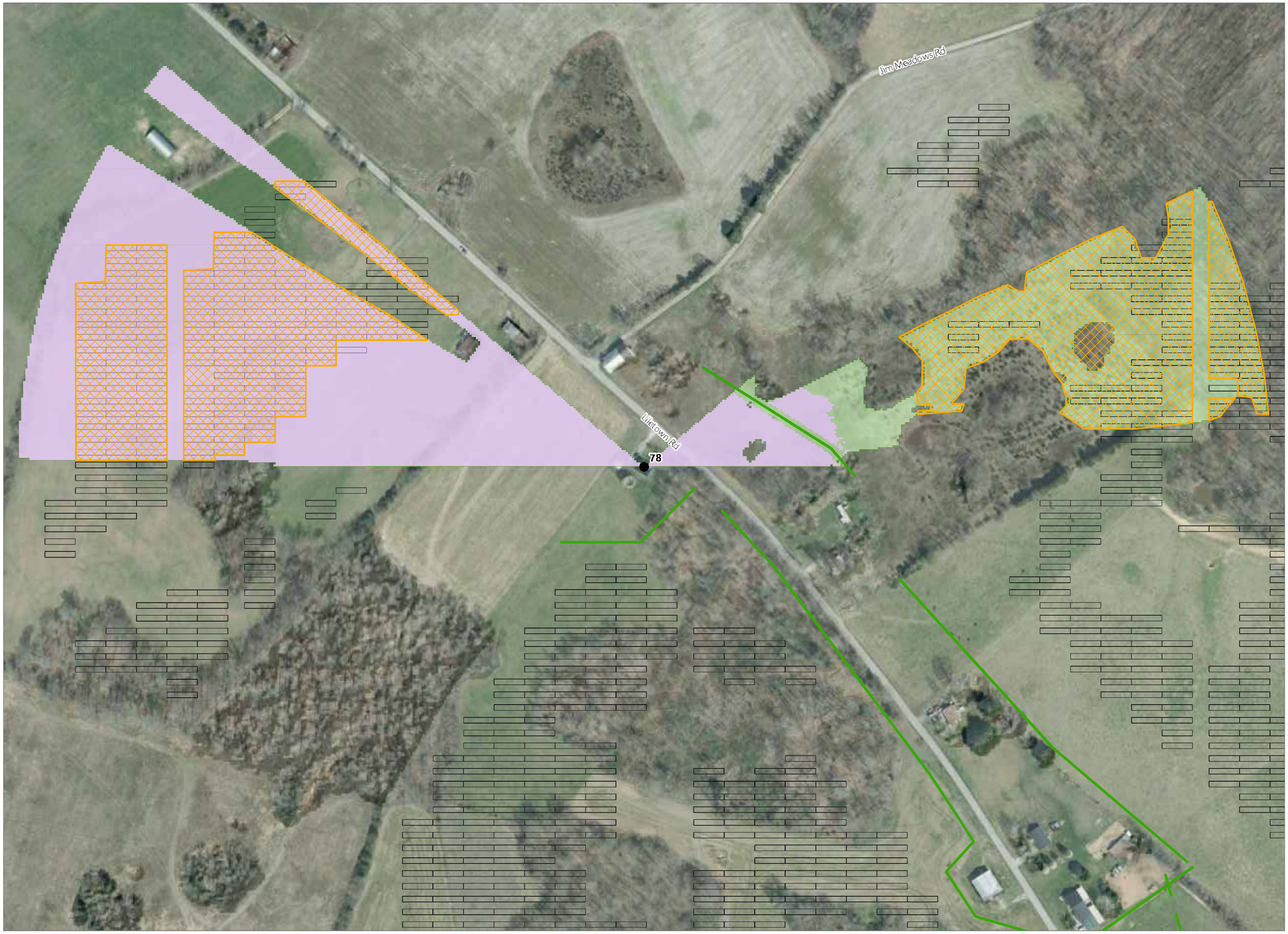
Prepared July 25, 2025

Basemap: KyFromAbove 2024 "Phase 3 - 3in" orthoimagery map service

* The layout evaluated in this analysis uses a slightly larger pv array footprint and represents a conservative assessment on potential for glare to occur from the proposed project.

EDR

Appendix B. Final Modeling Inputs

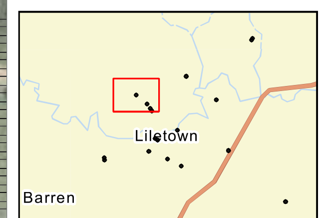


Exie Solar Project

Green County, Kentucky

Solar Glare Assessment

- Receptor
- Landscape Mitigation Module
- PV Panel Array*
- Receptor Panel Visibility with Potential for Glare
- Receptor Viewshed
- Receptor Panel Visibility Expected to be Screened by Planting Plan and/or Existing Structures



0 100 200 400
Feet

Prepared July 25, 2025
Basemap: KyFromAbove 2024 "Phase 3 - 3in" orthoimagery map service
* The layout evaluated in this analysis uses a slightly larger pv array footprint and represents a conservative assessment on potential for glare to occur from the proposed project.

EDR

Appendix C

ForgeSolar Final Glare Modeling Results

FORGESOLAR GLARE ANALYSIS

Project: **Exie Solar**
Site configuration: **3**

Created 21 May, 2025
Updated 21 May, 2025
Time-step 1 minute
Timezone offset UTC-5
Minimum sun altitude 0.0 deg
DNI peaks at 1,000.0 W/m^2
Category 100 MW to 1 GW
Site ID 149792.24968

Ocular transmission coefficient 0.5
Pupil diameter 0.002 m
Eye focal length 0.017 m
Sun subtended angle 9.3 mrad
PV analysis methodology V2

Summary of Results

Glare with potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
3-1	30.0	180.0	492	8.2	2,164	36.1	-

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 3	492	8.2	2,164	36.1

Component Data

PV Arrays

Name: 3-1
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.139779	-85.578158	836.21	12.00	848.21
2	37.139669	-85.577952	838.66	12.00	850.66
3	37.139559	-85.577833	845.49	12.00	857.49
4	37.139463	-85.577764	850.09	12.00	862.09
5	37.139361	-85.577679	851.39	12.00	863.39
6	37.139361	-85.577806	851.56	12.00	863.56
7	37.139336	-85.577839	851.36	12.00	863.36
8	37.139277	-85.577837	851.86	12.00	863.86
9	37.139274	-85.578070	847.50	12.00	859.50
10	37.139173	-85.578100	848.85	12.00	860.85
11	37.139087	-85.578095	848.79	12.00	860.79
12	37.139004	-85.578091	848.32	12.00	860.32
13	37.138980	-85.578058	848.01	12.00	860.01
14	37.138979	-85.577837	850.31	12.00	862.31
15	37.138845	-85.577841	844.38	12.00	856.38
16	37.138845	-85.577869	844.27	12.00	856.27
17	37.138804	-85.577869	842.93	12.00	854.93
18	37.138804	-85.578151	841.16	12.00	853.16
19	37.138804	-85.578381	839.62	12.00	851.62
20	37.138805	-85.578736	831.48	12.00	843.48
21	37.138805	-85.579091	820.34	12.00	832.34
22	37.138981	-85.579090	820.35	12.00	832.35
23	37.139149	-85.579089	815.58	12.00	827.58
24	37.139368	-85.579102	806.61	12.00	818.61
25	37.139492	-85.578913	815.11	12.00	827.11
26	37.139656	-85.578673	833.48	12.00	845.48
27	37.139780	-85.578484	836.53	12.00	848.53
28	37.139903	-85.578312	833.54	12.00	845.54
29	37.139917	-85.578261	833.15	12.00	845.15

Discrete Observation Point Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (ft)	Height (ft)
OP 3	3	37.138806	-85.579934	793.62	5.40

Glare Analysis Results

Summary of Results Glare with potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
3-1	30.0	180.0	492	8.2	2,164	36.1	-

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 3	492	8.2	2,164	36.1

PV: 3-1 potential temporary after-image

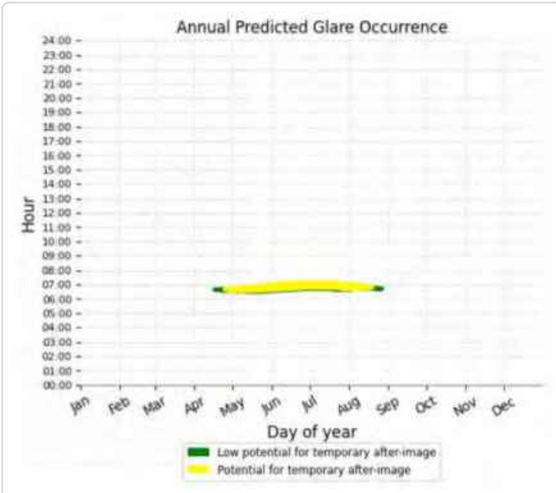
Receptor results ordered by category of glare

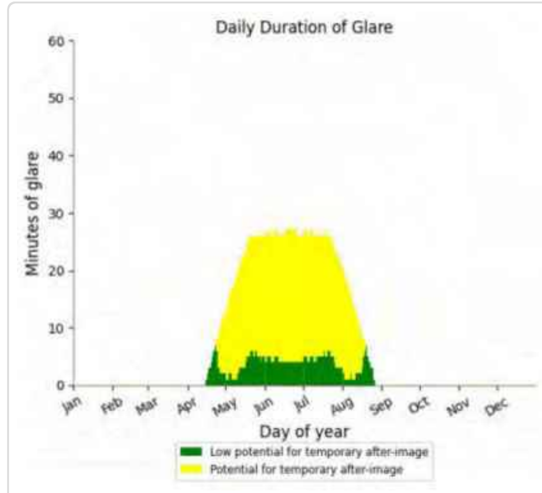
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 3	492	8.2	2,164	36.1

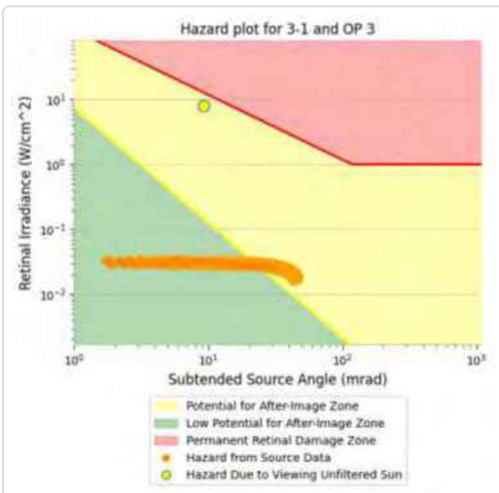
3-1 and OP 3

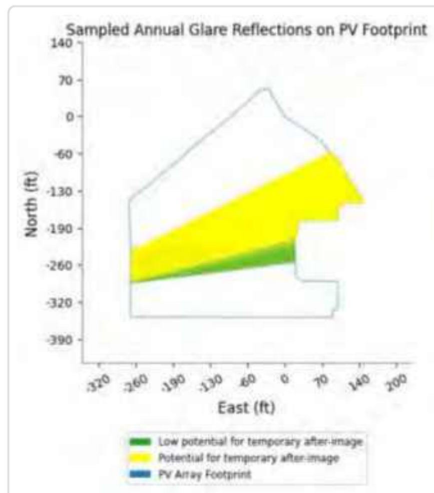
Yellow glare: 2,164 min.

Green glare: 492 min.









Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
The algorithm does not rigorously represent the detailed geometry of a system; detailed features such as gaps between modules, variable height of the PV array, and support structures may impact actual glare results. However, we have validated our models against several systems, including a PV array causing glare to the air-traffic control tower at Manchester-Boston Regional Airport and several sites in Albuquerque, and the tool accurately predicted the occurrence and intensity of glare at different times and days of the year.
Several V1 calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare. This primarily affects V1 analyses of path receptors.
Random number computations are utilized by various steps of the annual hazard analysis algorithm. Predicted minutes of glare can vary between runs as a result. This limitation primarily affects analyses of Observation Point receptors, including ATCTs. Note that the SGHAT/ForgeSolar methodology has always relied on an analytical, qualitative approach to accurately determine the overall hazard (i.e. green vs. yellow) of expected glare on an annual basis.
The analysis does not automatically consider obstacles (either man-made or natural) between the observation points and the prescribed solar installation that may obstruct observed glare, such as trees, hills, buildings, etc.
The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
The variable direct normal irradiance (DNI) feature (if selected) scales the user-prescribed peak DNI using a typical clear-day irradiance profile. This profile has a lower DNI in the mornings and evenings and a maximum at solar noon. The scaling uses a clear-day irradiance profile based on a normalized time relative to sunrise, solar noon, and sunset, which are prescribed by a sun-position algorithm and the latitude and longitude obtained from Google maps. The actual DNI on any given day can be affected by cloud cover, atmospheric attenuation, and other environmental factors.
The ocular hazard predicted by the tool depends on a number of environmental, optical, and human factors, which can be uncertain. We provide input fields and typical ranges of values for these factors so that the user can vary these parameters to see if they have an impact on the results. The speed of SGHAT allows expedited sensitivity and parametric analyses.
The system output calculation is a DNI-based approximation that assumes clear, sunny skies year-round. It should not be used in place of more rigorous modeling methods.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.

Default glare analysis parameters and observer eye characteristics (for reference only):

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

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FORGESOLAR GLARE ANALYSIS

Project: **Exie Solar**
Site configuration: **9**

Created 21 May, 2025
Updated 21 May, 2025
Time-step 1 minute
Timezone offset UTC-5
Minimum sun altitude 0.0 deg
DNI peaks at 1,000.0 W/m^2
Category 100 MW to 1 GW
Site ID 149794.24968

Ocular transmission coefficient 0.5
Pupil diameter 0.002 m
Eye focal length 0.017 m
Sun subtended angle 9.3 mrad
PV analysis methodology V2

Summary of Results Glare with low potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
9-1	30.0	180.0	509	8.5	0	0.0	-

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 9	509	8.5	0	0.0

Component Data

PV Arrays

Name: 9-1
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.140308	-85.593060	741.69	12.00	753.69
2	37.140349	-85.593060	742.16	12.00	754.16
3	37.140377	-85.593060	742.61	12.00	754.61
4	37.140377	-85.593012	740.42	12.00	752.42
5	37.140349	-85.593012	740.33	12.00	752.33
6	37.140308	-85.593046	741.27	12.00	753.27

Discrete Observation Point Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (ft)	Height (ft)
OP 9	9	37.139964	-85.597631	775.43	5.40

Glare Analysis Results

Summary of Results Glare with low potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
9-1	30.0	180.0	509	8.5	0	0.0	-

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 9	509	8.5	0	0.0

PV: 9-1 low potential for temporary after-image

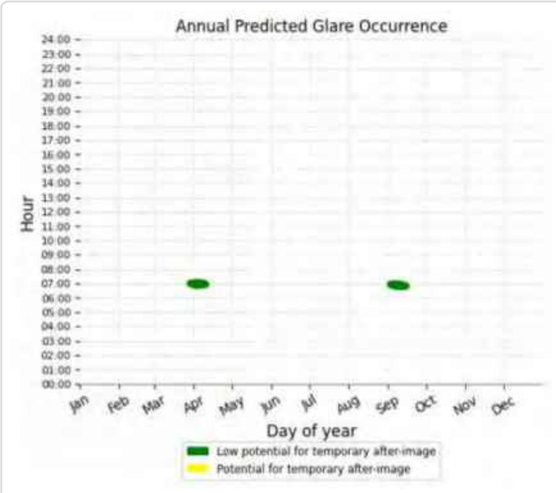
Receptor results ordered by category of glare

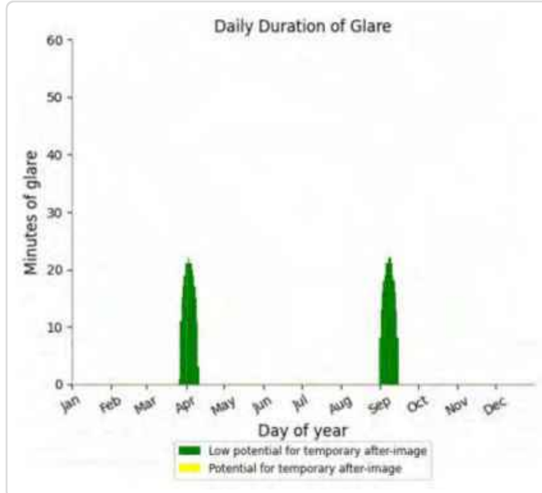
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 9	509	8.5	0	0.0

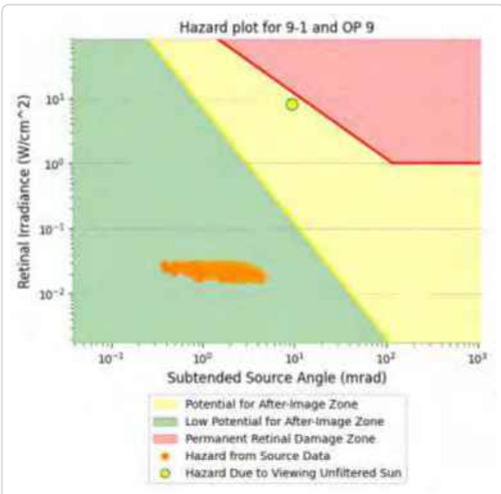
9-1 and OP 9

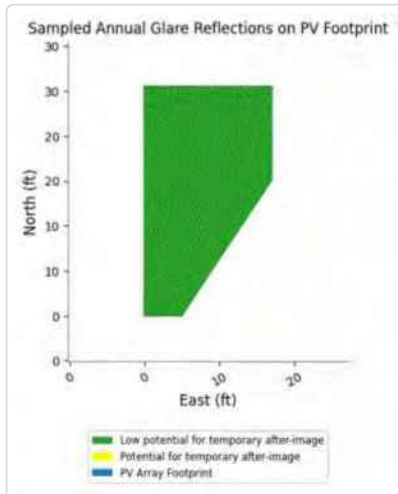
Yellow glare: none

Green glare: 509 min.









Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
The algorithm does not rigorously represent the detailed geometry of a system; detailed features such as gaps between modules, variable height of the PV array, and support structures may impact actual glare results. However, we have validated our models against several systems, including a PV array causing glare to the air-traffic control tower at Manchester-Boston Regional Airport and several sites in Albuquerque, and the tool accurately predicted the occurrence and intensity of glare at different times and days of the year.
Several V1 calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare. This primarily affects V1 analyses of path receptors.
Random number computations are utilized by various steps of the annual hazard analysis algorithm. Predicted minutes of glare can vary between runs as a result. This limitation primarily affects analyses of Observation Point receptors, including ATCTs. Note that the SGHAT/ ForgeSolar methodology has always relied on an analytical, qualitative approach to accurately determine the overall hazard (i.e. green vs. yellow) of expected glare on an annual basis.
The analysis does not automatically consider obstacles (either man-made or natural) between the observation points and the prescribed solar installation that may obstruct observed glare, such as trees, hills, buildings, etc.
The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
The variable direct normal irradiance (DNI) feature (if selected) scales the user-prescribed peak DNI using a typical clear-day irradiance profile. This profile has a lower DNI in the mornings and evenings and a maximum at solar noon. The scaling uses a clear-day irradiance profile based on a normalized time relative to sunrise, solar noon, and sunset, which are prescribed by a sun-position algorithm and the latitude and longitude obtained from Google maps. The actual DNI on any given day can be affected by cloud cover, atmospheric attenuation, and other environmental factors.
The ocular hazard predicted by the tool depends on a number of environmental, optical, and human factors, which can be uncertain. We provide input fields and typical ranges of values for these factors so that the user can vary these parameters to see if they have an impact on the results. The speed of SGHAT allows expedited sensitivity and parametric analyses.
The system output calculation is a DNI-based approximation that assumes clear, sunny skies year-round. It should not be used in place of more rigorous modeling methods.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.

Default glare analysis parameters and observer eye characteristics (for reference only):

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

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FORGESOLAR GLARE ANALYSIS

Project: **Exie Solar**
Site configuration: **10**

Created 21 May, 2025
Updated 21 May, 2025
Time-step 1 minute
Timezone offset UTC-5
Minimum sun altitude 0.0 deg
DNI peaks at 1,000.0 W/m^2
Category 100 MW to 1 GW
Site ID 149795.24968

Ocular transmission coefficient 0.5
Pupil diameter 0.002 m
Eye focal length 0.017 m
Sun subtended angle 9.3 mrad
PV analysis methodology V2

Summary of Results **Glare with low potential for temporary after-image predicted**

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
10-1	30.0	180.0	474	7.9	0	0.0	-
10-2	30.0	180.0	0	0.0	0	0.0	-
10-3	30.0	180.0	175	2.9	0	0.0	-

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 10	649	10.8	0	0.0

Component Data

PV Arrays

Name: 10-1
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.143627	-85.590048	728.84	12.00	740.84
2	37.143628	-85.590292	730.42	12.00	742.42
3	37.143727	-85.590290	730.48	12.00	742.48
4	37.143871	-85.590289	729.28	12.00	741.28
5	37.143877	-85.590050	730.67	12.00	742.67
6	37.144038	-85.590037	730.30	12.00	742.30
7	37.144038	-85.589788	729.45	12.00	741.45
8	37.143916	-85.589788	731.59	12.00	743.59
9	37.143748	-85.589789	729.60	12.00	741.60
10	37.143627	-85.589789	729.13	12.00	741.13

Name: 10-2
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.144078	-85.588441	723.69	12.00	735.69
2	37.144023	-85.588064	722.85	12.00	734.85
3	37.143995	-85.587895	722.55	12.00	734.55
4	37.143914	-85.587896	725.17	12.00	737.17
5	37.143830	-85.587896	727.26	12.00	739.26
6	37.143815	-85.588144	728.78	12.00	740.78
7	37.143721	-85.588145	729.90	12.00	741.90
8	37.143625	-85.588145	731.01	12.00	743.01
9	37.143625	-85.588493	732.61	12.00	744.61
10	37.143626	-85.588799	735.08	12.00	747.08
11	37.143628	-85.589157	734.63	12.00	746.63
12	37.143785	-85.589153	734.90	12.00	746.90
13	37.143953	-85.589149	732.22	12.00	744.22
14	37.144121	-85.589149	727.87	12.00	739.87
15	37.144123	-85.588940	727.36	12.00	739.36
16	37.144124	-85.588767	725.66	12.00	737.66

Name: 10-3
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.144132	-85.587895	718.24	12.00	730.24
2	37.144160	-85.588046	718.14	12.00	730.14
3	37.144229	-85.588389	718.40	12.00	730.40
4	37.144284	-85.588639	718.55	12.00	730.55
5	37.144353	-85.588644	717.09	12.00	729.09
6	37.144298	-85.588389	716.93	12.00	728.93
7	37.144215	-85.588012	717.03	12.00	729.03
8	37.144187	-85.587895	717.26	12.00	729.26

Discrete Observation Point Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (ft)	Height (ft)
OP 10	10	37.143618	-85.585391	725.67	5.40

Glare Analysis Results

Summary of Results Glare with low potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
10-1	30.0	180.0	474	7.9	0	0.0	-
10-2	30.0	180.0	0	0.0	0	0.0	-
10-3	30.0	180.0	175	2.9	0	0.0	-

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 10	649	10.8	0	0.0

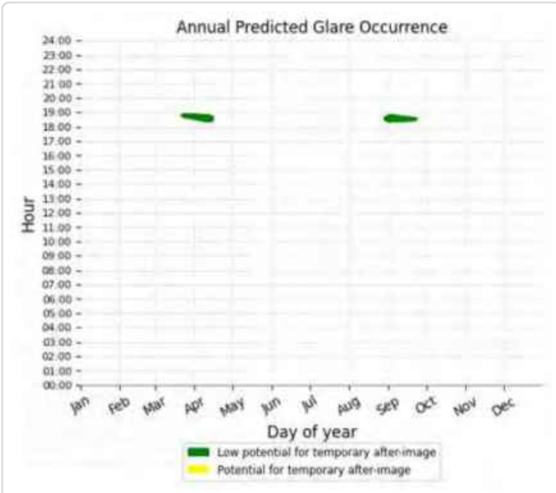
PV: 10-1 low potential for temporary after-image

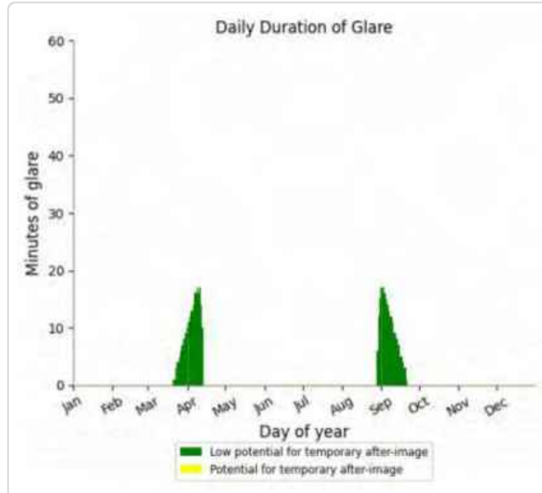
Receptor results ordered by category of glare

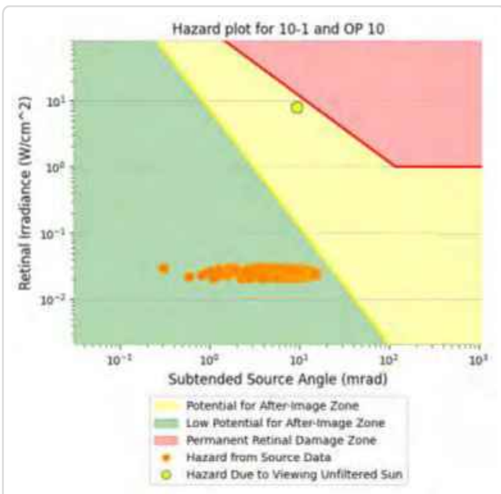
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 10	474	7.9	0	0.0

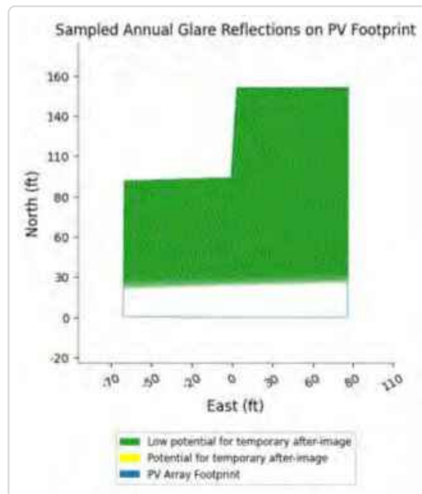
10-1 and OP 10

Yellow glare: none
Green glare: 474 min.









PV: 10-2 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 10	0	0.0	0	0.0

10-2 and OP 10

No glare found

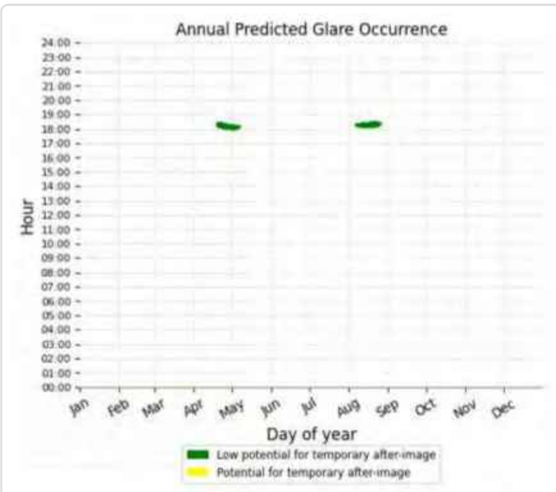
PV: 10-3 low potential for temporary after-image

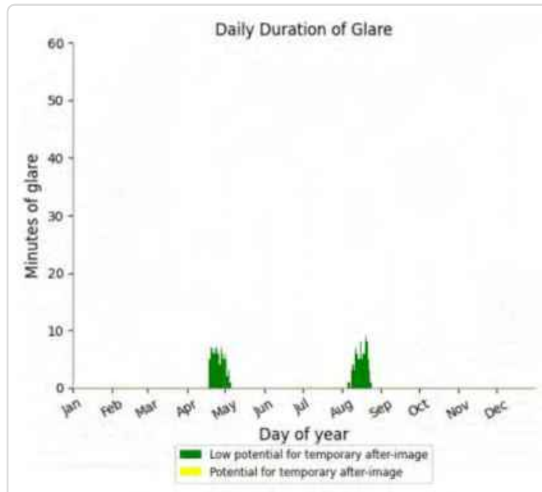
Receptor results ordered by category of glare

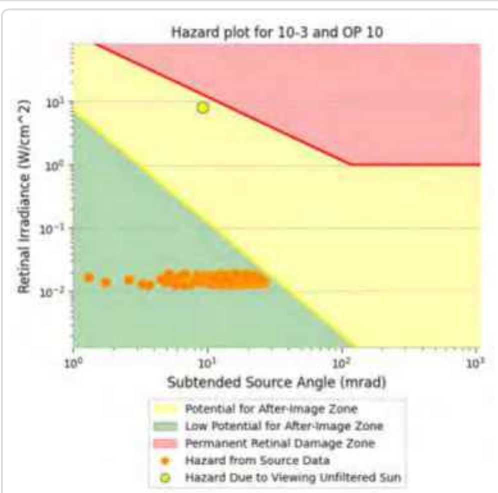
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 10	175	2.9	0	0.0

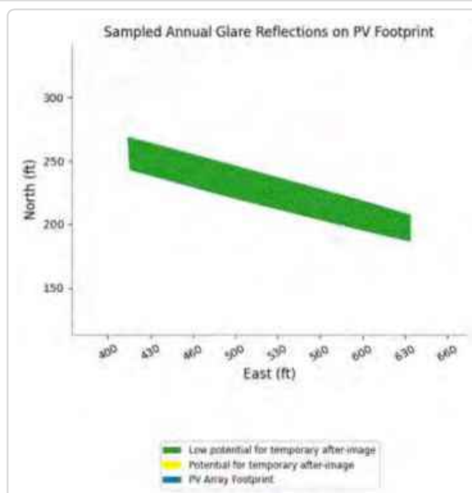
10-3 and OP 10

Yellow glare: none
Green glare: 175 min.









Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
The algorithm does not rigorously represent the detailed geometry of a system; detailed features such as gaps between modules, variable height of the PV array, and support structures may impact actual glare results. However, we have validated our models against several systems, including a PV array causing glare to the air-traffic control tower at Manchester-Boston Regional Airport and several sites in Albuquerque, and the tool accurately predicted the occurrence and intensity of glare at different times and days of the year.
Several V1 calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare. This primarily affects V1 analyses of path receptors.
Random number computations are utilized by various steps of the annual hazard analysis algorithm. Predicted minutes of glare can vary between runs as a result. This limitation primarily affects analyses of Observation Point receptors, including ATCTs. Note that the SGHAT/ ForgeSolar methodology has always relied on an analytical, qualitative approach to accurately determine the overall hazard (i.e. green vs. yellow) of expected glare on an annual basis.
The analysis does not automatically consider obstacles (either man-made or natural) between the observation points and the prescribed solar installation that may obstruct observed glare, such as trees, hills, buildings, etc.
The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
The variable direct normal irradiance (DNI) feature (if selected) scales the user-prescribed peak DNI using a typical clear-day irradiance profile. This profile has a lower DNI in the mornings and evenings and a maximum at solar noon. The scaling uses a clear-day irradiance profile based on a normalized time relative to sunrise, solar noon, and sunset, which are prescribed by a sun-position algorithm and the latitude and longitude obtained from Google maps. The actual DNI on any given day can be affected by cloud cover, atmospheric attenuation, and other environmental factors.
The ocular hazard predicted by the tool depends on a number of environmental, optical, and human factors, which can be uncertain. We provide input fields and typical ranges of values for these factors so that the user can vary these parameters to see if they have an impact on the results. The speed of SGHAT allows expedited sensitivity and parametric analyses.
The system output calculation is a DNI-based approximation that assumes clear, sunny skies year-round. It should not be used in place of more rigorous modeling methods.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.

Default glare analysis parameters and observer eye characteristics (for reference only):

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

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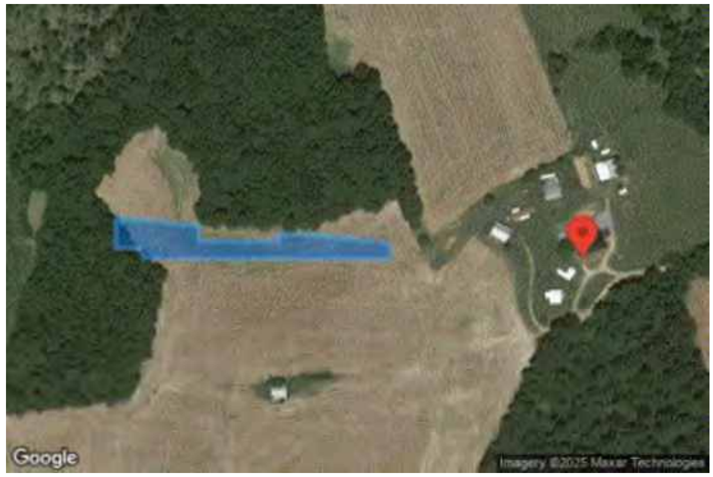
FORGESOLAR GLARE ANALYSIS

Project: **Exie Solar**
Site configuration: **11**

Created 21 May, 2025
Updated 21 May, 2025
Time-step 1 minute
Timezone offset UTC-5
Minimum sun altitude 0.0 deg
DNI peaks at 1,000.0 W/m^2
Category 100 MW to 1 GW
Site ID 149796.24968

Ocular transmission coefficient 0.5
Pupil diameter 0.002 m
Eye focal length 0.017 m
Sun subtended angle 9.3 mrad
PV analysis methodology V2



Summary of Results

Glare with potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
11-1	30.0	180.0	345	5.8	229	3.8	-

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 11	345	5.8	229	3.8

Component Data

PV Arrays

Name: 11-1
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.162420	-85.566978	806.69	12.00	818.69
2	37.162419	-85.566597	803.88	12.00	815.88
3	37.162419	-85.566237	803.35	12.00	815.35
4	37.162475	-85.566235	802.57	12.00	814.57
5	37.162461	-85.565907	802.05	12.00	814.05
6	37.162433	-85.565546	801.94	12.00	813.94
7	37.162405	-85.565230	802.42	12.00	814.42
8	37.162295	-85.565230	803.37	12.00	815.37
9	37.162296	-85.565580	802.25	12.00	814.25
10	37.162296	-85.566011	803.39	12.00	815.39
11	37.162297	-85.566440	804.69	12.00	816.69
12	37.162298	-85.566942	808.05	12.00	820.05
13	37.162299	-85.567485	808.57	12.00	820.57
14	37.162372	-85.567516	808.63	12.00	820.63
15	37.162372	-85.567737	806.45	12.00	818.45
16	37.162494	-85.567736	807.96	12.00	819.96
17	37.162587	-85.567736	808.22	12.00	820.22
18	37.162559	-85.567308	808.62	12.00	820.62
19	37.162531	-85.566979	805.64	12.00	817.64

Discrete Observation Point Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (ft)	Height (ft)
OP 11	11	37.162287	-85.563454	818.97	5.40

Glare Analysis Results

Summary of Results Glare with potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
11-1	30.0	180.0	345	5.8	229	3.8	-

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 11	345	5.8	229	3.8

PV: 11-1 potential temporary after-image

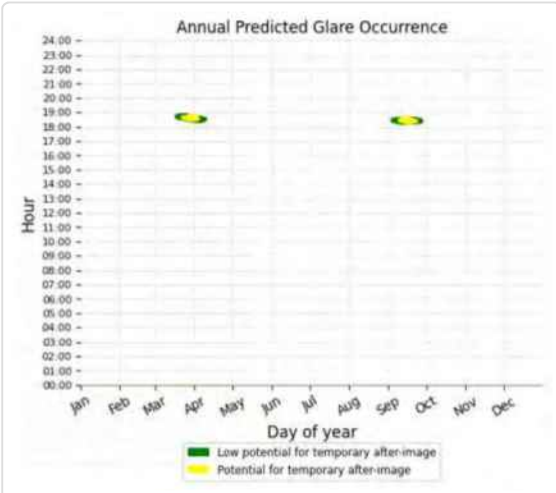
Receptor results ordered by category of glare

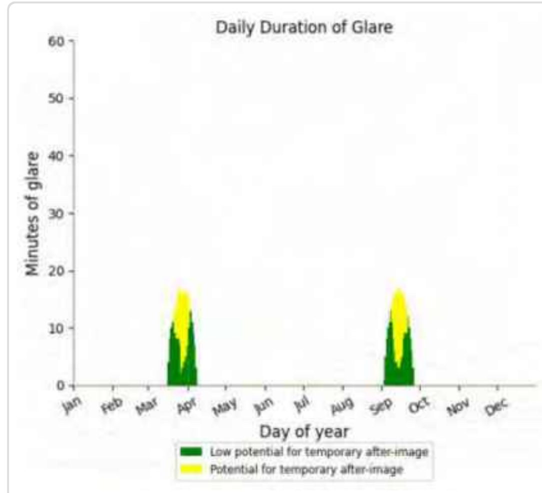
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 11	345	5.8	229	3.8

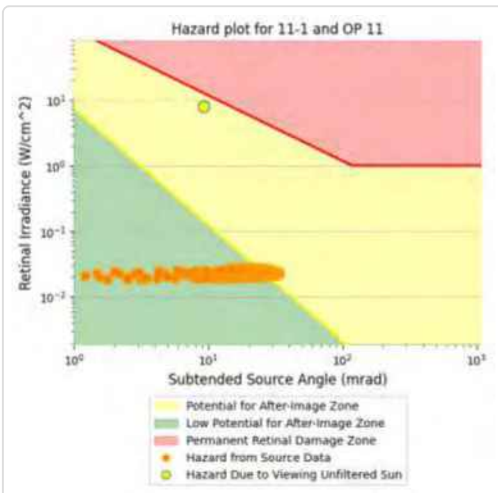
11-1 and OP 11

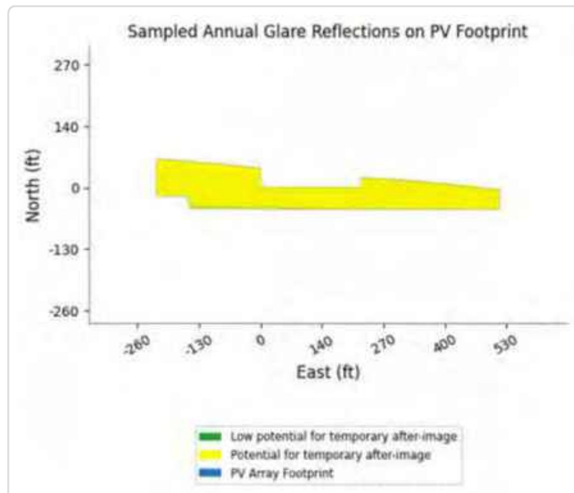
Yellow glare: 229 min.

Green glare: 345 min.









Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
The algorithm does not rigorously represent the detailed geometry of a system; detailed features such as gaps between modules, variable height of the PV array, and support structures may impact actual glare results. However, we have validated our models against several systems, including a PV array causing glare to the air-traffic control tower at Manchester-Boston Regional Airport and several sites in Albuquerque, and the tool accurately predicted the occurrence and intensity of glare at different times and days of the year.
Several V1 calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare. This primarily affects V1 analyses of path receptors.
Random number computations are utilized by various steps of the annual hazard analysis algorithm. Predicted minutes of glare can vary between runs as a result. This limitation primarily affects analyses of Observation Point receptors, including ATCTs. Note that the SGHAT/ ForgeSolar methodology has always relied on an analytical, qualitative approach to accurately determine the overall hazard (i.e. green vs. yellow) of expected glare on an annual basis.
The analysis does not automatically consider obstacles (either man-made or natural) between the observation points and the prescribed solar installation that may obstruct observed glare, such as trees, hills, buildings, etc.
The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
The variable direct normal irradiance (DNI) feature (if selected) scales the user-prescribed peak DNI using a typical clear-day irradiance profile. This profile has a lower DNI in the mornings and evenings and a maximum at solar noon. The scaling uses a clear-day irradiance profile based on a normalized time relative to sunrise, solar noon, and sunset, which are prescribed by a sun-position algorithm and the latitude and longitude obtained from Google maps. The actual DNI on any given day can be affected by cloud cover, atmospheric attenuation, and other environmental factors.
The ocular hazard predicted by the tool depends on a number of environmental, optical, and human factors, which can be uncertain. We provide input fields and typical ranges of values for these factors so that the user can vary these parameters to see if they have an impact on the results. The speed of SGHAT allows expedited sensitivity and parametric analyses.
The system output calculation is a DNI-based approximation that assumes clear, sunny skies year-round. It should not be used in place of more rigorous modeling methods.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.

Default glare analysis parameters and observer eye characteristics (for reference only):

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

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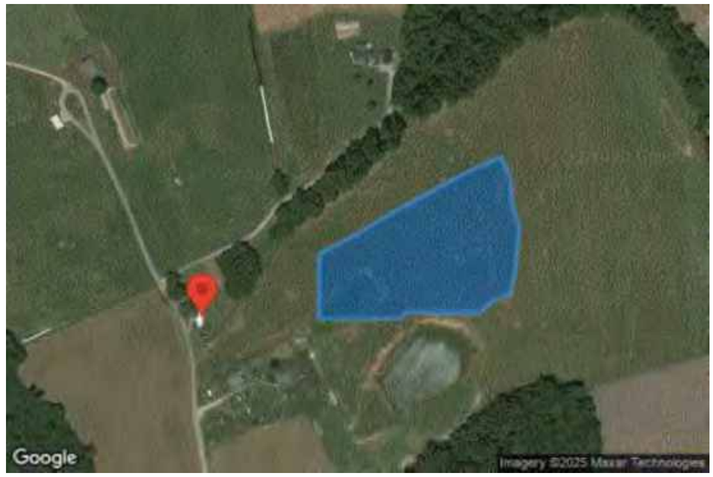
FORGESOLAR GLARE ANALYSIS

Project: **Exie Solar**
Site configuration: **12**

Created 27 May, 2025
Updated 27 May, 2025
Time-step 1 minute
Timezone offset UTC-5
Minimum sun altitude 0.0 deg
DNI peaks at 1,000.0 W/m^2
Category 100 MW to 1 GW
Site ID 150450.24968

Ocular transmission coefficient 0.5
Pupil diameter 0.002 m
Eye focal length 0.017 m
Sun subtended angle 9.3 mrad
PV analysis methodology V2



Summary of Results

Glare with potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
12-1	30.0	180.0	1,030	17.2	4,321	72.0	-

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 12	1,030	17.2	4,321	72.0

Component Data

PV Arrays

Name: 12-1
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.152098	-85.569071	783.13	12.00	795.13
2	37.152015	-85.569020	780.57	12.00	792.57
3	37.151823	-85.569003	776.94	12.00	788.94
4	37.151644	-85.568935	774.76	12.00	786.76
5	37.151534	-85.568953	774.81	12.00	786.81
6	37.151356	-85.568970	775.60	12.00	787.60
7	37.151164	-85.569022	777.09	12.00	789.09
8	37.151109	-85.569194	777.71	12.00	789.71
9	37.151030	-85.569297	778.23	12.00	790.23
10	37.151030	-85.569630	786.73	12.00	798.73
11	37.151030	-85.569991	788.74	12.00	800.74
12	37.150987	-85.570025	788.88	12.00	800.88
13	37.150987	-85.570294	790.13	12.00	802.13
14	37.150987	-85.570510	788.81	12.00	800.81
15	37.150988	-85.570774	788.99	12.00	800.99
16	37.151116	-85.570773	786.96	12.00	798.96
17	37.151284	-85.570773	783.02	12.00	795.02
18	37.151455	-85.570771	776.24	12.00	788.24
19	37.151605	-85.570428	779.20	12.00	791.20
20	37.151797	-85.570016	789.59	12.00	801.59
21	37.151947	-85.569672	794.14	12.00	806.14
22	37.152084	-85.569346	795.04	12.00	807.04
23	37.152166	-85.569106	784.31	12.00	796.31

Discrete Observation Point Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (ft)	Height (ft)
OP 12	12	37.150996	-85.571840	784.06	5.40

Glare Analysis Results

Summary of Results Glare with potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
12-1	30.0	180.0	1,030	17.2	4,321	72.0	-

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 12	1,030	17.2	4,321	72.0

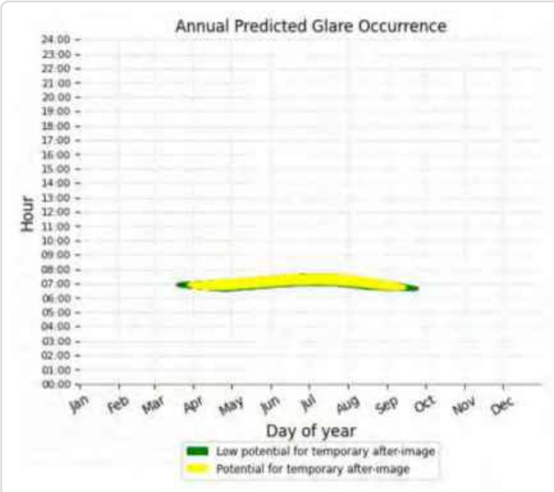
PV: 12-1 potential temporary after-image

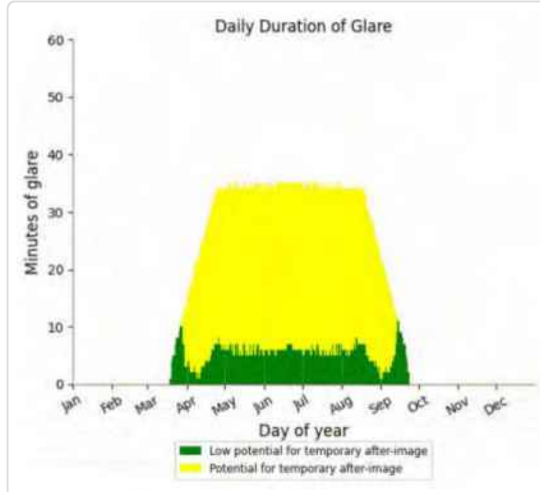
Receptor results ordered by category of glare

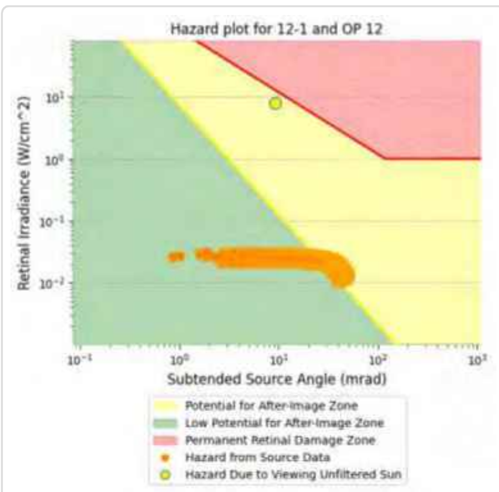
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 12	1,030	17.2	4,321	72.0

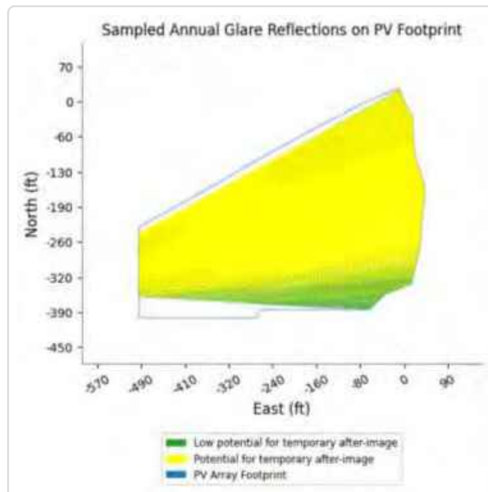
12-1 and OP 12

Yellow glare: 4,321 min.
Green glare: 1,030 min.









Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
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The analysis does not automatically consider obstacles (either man-made or natural) between the observation points and the prescribed solar installation that may obstruct observed glare, such as trees, hills, buildings, etc.
The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
The variable direct normal irradiance (DNI) feature (if selected) scales the user-prescribed peak DNI using a typical clear-day irradiance profile. This profile has a lower DNI in the mornings and evenings and a maximum at solar noon. The scaling uses a clear-day irradiance profile based on a normalized time relative to sunrise, solar noon, and sunset, which are prescribed by a sun-position algorithm and the latitude and longitude obtained from Google maps. The actual DNI on any given day can be affected by cloud cover, atmospheric attenuation, and other environmental factors.
The ocular hazard predicted by the tool depends on a number of environmental, optical, and human factors, which can be uncertain. We provide input fields and typical ranges of values for these factors so that the user can vary these parameters to see if they have an impact on the results. The speed of SGHAT allows expedited sensitivity and parametric analyses.
The system output calculation is a DNI-based approximation that assumes clear, sunny skies year-round. It should not be used in place of more rigorous modeling methods.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.

Default glare analysis parameters and observer eye characteristics (for reference only):

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

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FORGESOLAR GLARE ANALYSIS

Project: **Exie Solar**
Site configuration: **13**

Created 21 May, 2025
Updated 21 May, 2025
Time-step 1 minute
Timezone offset UTC-5
Minimum sun altitude 0.0 deg
DNI peaks at 1,000.0 W/m^2
Category 100 MW to 1 GW
Site ID 149797.24968

Ocular transmission coefficient 0.5
Pupil diameter 0.002 m
Eye focal length 0.017 m
Sun subtended angle 9.3 mrad
PV analysis methodology V2

Summary of Results

Glare with potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
13-1	30.0	180.0	181	3.0	0	0.0	-
13-2	30.0	180.0	513	8.6	529	8.8	-
13-3	30.0	180.0	413	6.9	0	0.0	-

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 13	1,107	18.4	529	8.8

Component Data

PV Arrays

Name: 13-1
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.143888	-85.589925	730.80	12.00	742.80
2	37.143888	-85.590049	730.99	12.00	742.99
3	37.143975	-85.590042	728.53	12.00	740.53
4	37.144038	-85.590037	730.30	12.00	742.30
5	37.144038	-85.589925	730.37	12.00	742.37
6	37.144038	-85.589788	729.45	12.00	741.45
7	37.143970	-85.589788	731.55	12.00	743.55
8	37.143888	-85.589788	731.29	12.00	743.29

Name: 13-2
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.143886	-85.588287	727.44	12.00	739.44
2	37.143886	-85.588538	731.40	12.00	743.40
3	37.143886	-85.588800	734.58	12.00	746.58
4	37.143887	-85.589152	733.14	12.00	745.14
5	37.143999	-85.589151	731.31	12.00	743.31
6	37.144121	-85.589149	727.87	12.00	739.87
7	37.144124	-85.588767	725.66	12.00	737.66
8	37.144125	-85.588664	724.49	12.00	736.49
9	37.144225	-85.588634	720.06	12.00	732.06
10	37.144284	-85.588639	718.55	12.00	730.55
11	37.144335	-85.588646	717.31	12.00	729.31
12	37.144373	-85.588646	716.88	12.00	728.88
13	37.144372	-85.588146	716.19	12.00	728.19
14	37.144290	-85.588122	716.83	12.00	728.83
15	37.144288	-85.587895	716.42	12.00	728.42
16	37.144187	-85.587895	717.26	12.00	729.26
17	37.144132	-85.587895	718.24	12.00	730.24
18	37.143995	-85.587895	722.55	12.00	734.55
19	37.143885	-85.587896	725.96	12.00	737.96

Name: 13-3
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.144727	-85.590961	730.12	12.00	742.12
2	37.144768	-85.590961	731.52	12.00	743.52
3	37.144782	-85.590944	731.74	12.00	743.74
4	37.144754	-85.590704	729.93	12.00	741.93
5	37.144727	-85.590550	730.87	12.00	742.87
6	37.144685	-85.590547	728.15	12.00	740.15
7	37.144699	-85.590670	727.69	12.00	739.69
8	37.144727	-85.590824	726.93	12.00	738.93
9	37.144741	-85.590910	730.01	12.00	742.01
10	37.144727	-85.590910	729.81	12.00	741.81
11	37.144699	-85.590704	727.01	12.00	739.01
12	37.144672	-85.590546	727.04	12.00	739.04
13	37.144658	-85.590546	725.98	12.00	737.98
14	37.144713	-85.590944	729.75	12.00	741.75

Discrete Observation Point Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (ft)	Height (ft)
OP 13	13	37.143888	-85.585927	725.18	5.40

Glare Analysis Results

Summary of Results Glare with potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
13-1	30.0	180.0	181	3.0	0	0.0	-
13-2	30.0	180.0	513	8.6	529	8.8	-
13-3	30.0	180.0	413	6.9	0	0.0	-

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 13	1,107	18.4	529	8.8

PV: 13-1 low potential for temporary after-image

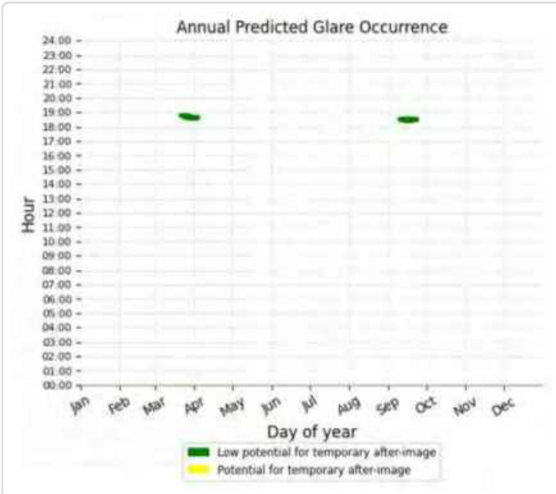
Receptor results ordered by category of glare

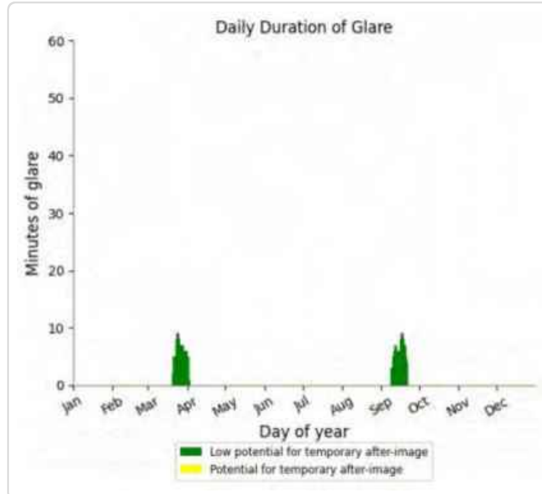
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 13	181	3.0	0	0.0

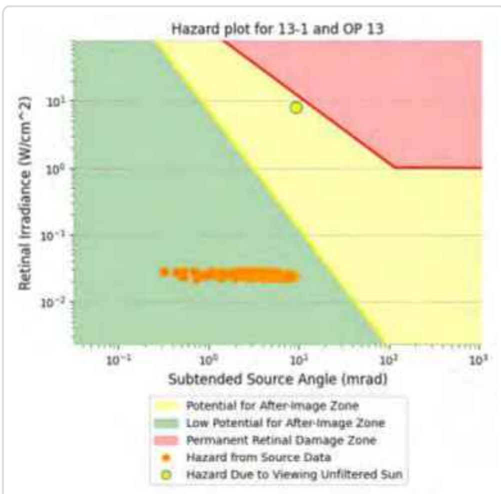
13-1 and OP 13

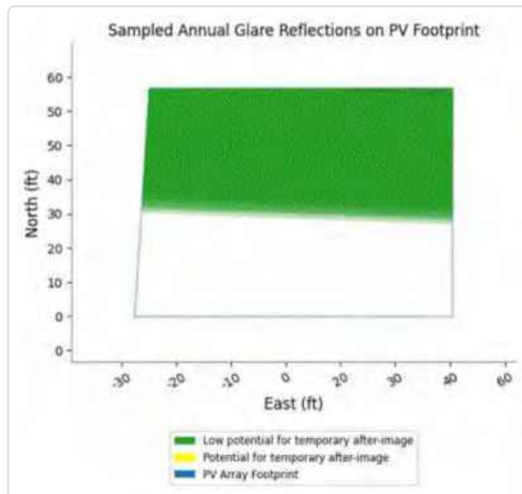
Yellow glare: none

Green glare: 181 min.









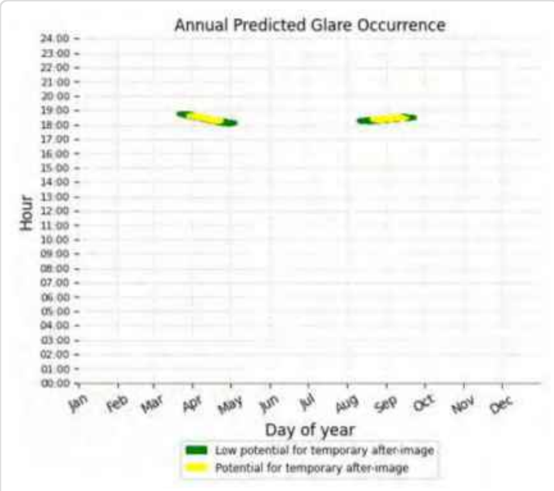
PV: 13-2 potential temporary after-image

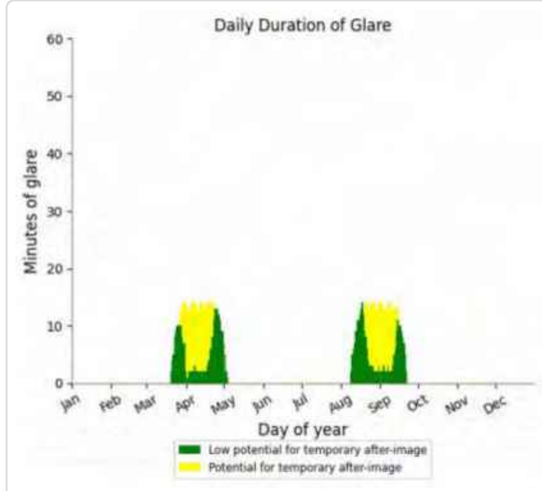
Receptor results ordered by category of glare

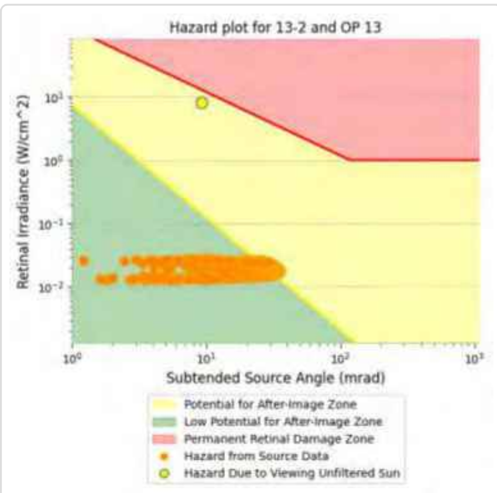
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	**hr**	**min**	**hr**
OP 13	513	8.6	529	8.8

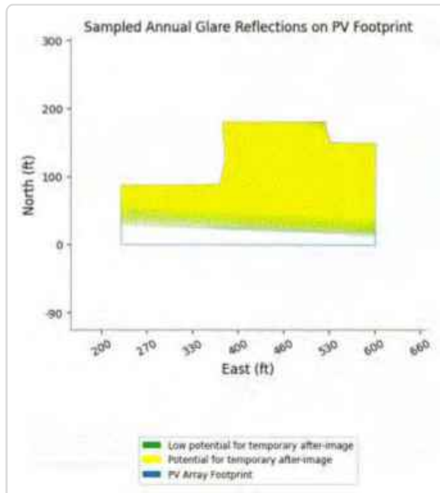
13-2 and OP 13

Yellow glare: 529 min.
Green glare: 513 min.









PV: 13-3 low potential for temporary after-image

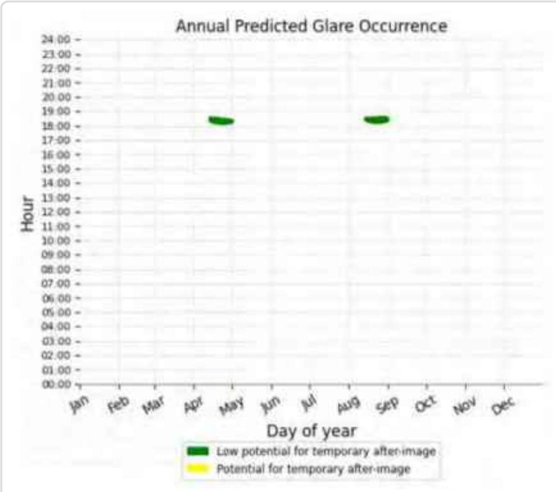
Receptor results ordered by category of glare

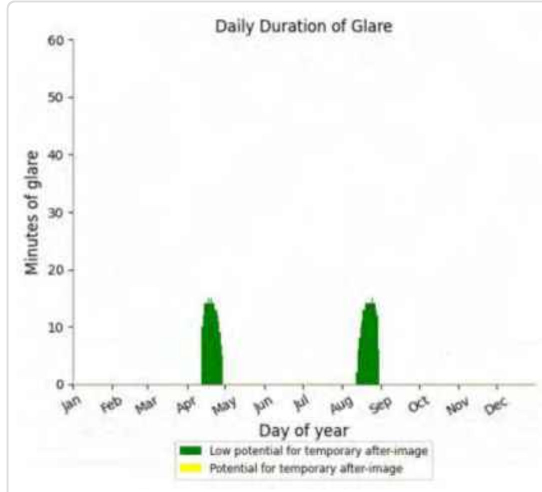
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 13	413	6.9	0	0.0

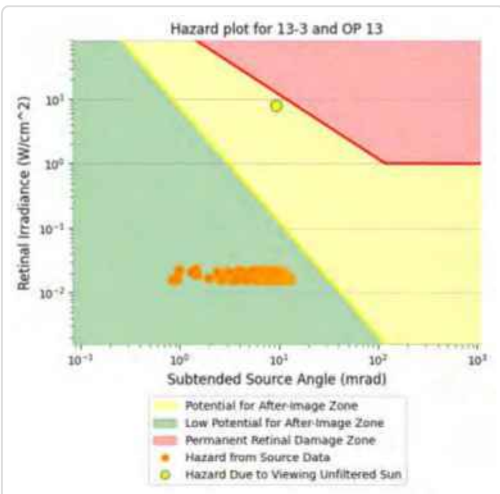
13-3 and OP 13

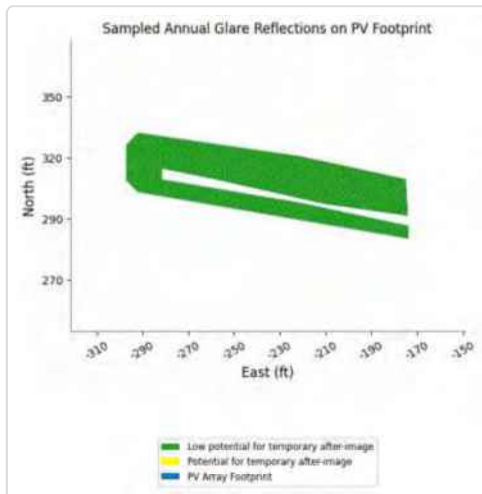
Yellow glare: none

Green glare: 413 min.









Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
The algorithm does not rigorously represent the detailed geometry of a system; detailed features such as gaps between modules, variable height of the PV array, and support structures may impact actual glare results. However, we have validated our models against several systems, including a PV array causing glare to the air-traffic control tower at Manchester-Boston Regional Airport and several sites in Albuquerque, and the tool accurately predicted the occurrence and intensity of glare at different times and days of the year.
Several V1 calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare. This primarily affects V1 analyses of path receptors.
Random number computations are utilized by various steps of the annual hazard analysis algorithm. Predicted minutes of glare can vary between runs as a result. This limitation primarily affects analyses of Observation Point receptors, including ATCTs. Note that the SGHAT/ForgeSolar methodology has always relied on an analytical, qualitative approach to accurately determine the overall hazard (i.e. green vs. yellow) of expected glare on an annual basis.
The analysis does not automatically consider obstacles (either man-made or natural) between the observation points and the prescribed solar installation that may obstruct observed glare, such as trees, hills, buildings, etc.
The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
The variable direct normal irradiance (DNI) feature (if selected) scales the user-prescribed peak DNI using a typical clear-day irradiance profile. This profile has a lower DNI in the mornings and evenings and a maximum at solar noon. The scaling uses a clear-day irradiance profile based on a normalized time relative to sunrise, solar noon, and sunset, which are prescribed by a sun-position algorithm and the latitude and longitude obtained from Google maps. The actual DNI on any given day can be affected by cloud cover, atmospheric attenuation, and other environmental factors.
The ocular hazard predicted by the tool depends on a number of environmental, optical, and human factors, which can be uncertain. We provide input fields and typical ranges of values for these factors so that the user can vary these parameters to see if they have an impact on the results. The speed of SGHAT allows expedited sensitivity and parametric analyses.
The system output calculation is a DNI-based approximation that assumes clear, sunny skies year-round. It should not be used in place of more rigorous modeling methods.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.

Default glare analysis parameters and observer eye characteristics (for reference only):

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

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FORGESOLAR GLARE ANALYSIS

Project: **Exie Solar**
Site configuration: **22**

Created 21 May, 2025
Updated 21 May, 2025
Time-step 1 minute
Timezone offset UTC-5
Minimum sun altitude 0.0 deg
DNI peaks at 1,000.0 W/m^2
Category 100 MW to 1 GW
Site ID 149798.24968

Ocular transmission coefficient 0.5
Pupil diameter 0.002 m
Eye focal length 0.017 m
Sun subtended angle 9.3 mrad
PV analysis methodology V2

Summary of Results No glare predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
22-1	30.0	180.0	0	0.0	0	0.0	-

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 22	0	0.0	0	0.0

Component Data

PV Arrays

Name: 22-1
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.141989	-85.586754	750.02	12.00	762.02
2	37.142126	-85.586558	748.45	12.00	760.45
3	37.142235	-85.586404	746.49	12.00	758.49
4	37.142386	-85.586180	747.33	12.00	759.33
5	37.142537	-85.585940	743.63	12.00	755.63
6	37.142674	-85.585741	735.67	12.00	747.67
7	37.142605	-85.585742	737.29	12.00	749.29
8	37.142495	-85.585906	744.31	12.00	756.31
9	37.142345	-85.586129	748.29	12.00	760.29
10	37.142194	-85.586369	747.15	12.00	759.15
11	37.142098	-85.586524	748.77	12.00	760.77
12	37.141961	-85.586753	750.41	12.00	762.41

Discrete Observation Point Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (ft)	Height (ft)
OP 22	22	37.141552	-85.587409	752.55	5.40

Glare Analysis Results

Summary of Results No glare predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
22-1	30.0	180.0	0	0.0	0	0.0	-

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 22	0	0.0	0	0.0

PV: 22-1 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 22	0	0.0	0	0.0

22-1 and OP 22

No glare found

Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
The algorithm does not rigorously represent the detailed geometry of a system; detailed features such as gaps between modules, variable height of the PV array, and support structures may impact actual glare results. However, we have validated our models against several systems, including a PV array causing glare to the air-traffic control tower at Manchester-Boston Regional Airport and several sites in Albuquerque, and the tool accurately predicted the occurrence and intensity of glare at different times and days of the year.
Several V1 calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare. This primarily affects V1 analyses of path receptors.
Random number computations are utilized by various steps of the annual hazard analysis algorithm. Predicted minutes of glare can vary between runs as a result. This limitation primarily affects analyses of Observation Point receptors, including ATCTs. Note that the SGHAT/ForgeSolar methodology has always relied on an analytical, qualitative approach to accurately determine the overall hazard (i.e. green vs. yellow) of expected glare on an annual basis.
The analysis does not automatically consider obstacles (either man-made or natural) between the observation points and the prescribed solar installation that may obstruct observed glare, such as trees, hills, buildings, etc.
The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
The variable direct normal irradiance (DNI) feature (if selected) scales the user-prescribed peak DNI using a typical clear-day irradiance profile. This profile has a lower DNI in the mornings and evenings and a maximum at solar noon. The scaling uses a clear-day irradiance profile based on a normalized time relative to sunrise, solar noon, and sunset, which are prescribed by a sun-position algorithm and the latitude and longitude obtained from Google maps. The actual DNI on any given day can be affected by cloud cover, atmospheric attenuation, and other environmental factors.
The ocular hazard predicted by the tool depends on a number of environmental, optical, and human factors, which can be uncertain. We provide input fields and typical ranges of values for these factors so that the user can vary these parameters to see if they have an impact on the results. The speed of SGHAT allows expedited sensitivity and parametric analyses.
The system output calculation is a DNI-based approximation that assumes clear, sunny skies year-round. It should not be used in place of more rigorous modeling methods.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.

Default glare analysis parameters and observer eye characteristics (for reference only):

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

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FORGESOLAR GLARE ANALYSIS

Project: **Exie Solar**
Site configuration: **23**

Created 21 May, 2025
Updated 21 May, 2025
Time-step 1 minute
Timezone offset UTC-5
Minimum sun altitude 0.0 deg
DNI peaks at 1,000.0 W/m^2
Category 100 MW to 1 GW
Site ID 149799.24968

Ocular transmission coefficient 0.5
Pupil diameter 0.002 m
Eye focal length 0.017 m
Sun subtended angle 9.3 mrad
PV analysis methodology V2

Summary of Results

Glare with potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
23-1	30.0	180.0	667	11.1	40	0.7	-
23-10	30.0	180.0	873	14.6	2,031	33.9	-
23-11	30.0	180.0	0	0.0	0	0.0	-
23-2	30.0	180.0	0	0.0	0	0.0	-
23-3	30.0	180.0	603	10.1	13	0.2	-
23-4	30.0	180.0	1,394	23.2	0	0.0	-
23-5	30.0	180.0	1,279	21.3	1,409	23.5	-
23-6	30.0	180.0	248	4.1	944	15.7	-
23-7	30.0	180.0	875	14.6	1,318	22.0	-
23-8	30.0	180.0	1,162	19.4	0	0.0	-
23-9	30.0	180.0	744	12.4	0	0.0	-

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 23	7,845	130.8	5,755	95.9

Component Data

PV Arrays

Name: 23-1
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.150258	-85.588637	779.59	12.00	791.59
2	37.150259	-85.589166	767.27	12.00	779.27
3	37.150300	-85.589166	767.01	12.00	779.01
4	37.150314	-85.589148	767.87	12.00	779.87
5	37.150314	-85.588994	776.01	12.00	788.01
6	37.150300	-85.588639	782.19	12.00	794.19

Name: 23-10
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.151174	-85.585655	761.96	12.00	773.96
2	37.151339	-85.585286	766.02	12.00	778.02
3	37.151517	-85.584874	779.94	12.00	791.94
4	37.151681	-85.584496	776.71	12.00	788.71
5	37.151872	-85.584050	781.67	12.00	793.67
6	37.152009	-85.583740	789.49	12.00	801.49
7	37.152013	-85.583646	790.91	12.00	802.91
8	37.151807	-85.583647	789.84	12.00	801.84
9	37.151639	-85.583647	785.68	12.00	797.68
10	37.151639	-85.583868	785.74	12.00	797.74
11	37.151614	-85.583901	785.21	12.00	797.21
12	37.151268	-85.583899	773.88	12.00	785.88
13	37.151172	-85.584291	770.91	12.00	782.91
14	37.151063	-85.584686	774.48	12.00	786.48
15	37.150913	-85.585270	774.95	12.00	786.95
16	37.150831	-85.585656	763.31	12.00	775.31

Name: 23-11
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.152143	-85.583431	791.30	12.00	803.30
2	37.152160	-85.583397	791.25	12.00	803.25
3	37.152143	-85.583395	791.52	12.00	803.52

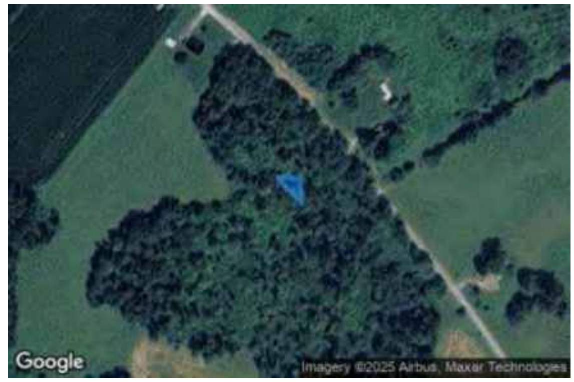
Name: 23-2
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.150314	-85.589320	766.26	12.00	778.26
2	37.150287	-85.589320	765.40	12.00	777.40
3	37.150259	-85.589371	765.08	12.00	777.08
4	37.150260	-85.589610	772.87	12.00	784.87
5	37.150260	-85.589869	760.76	12.00	772.76
6	37.150315	-85.589852	760.19	12.00	772.19
7	37.150342	-85.589835	761.50	12.00	773.50
8	37.150342	-85.589714	770.38	12.00	782.38
9	37.150328	-85.589552	775.67	12.00	787.67
10	37.150328	-85.589354	768.08	12.00	780.08

Name: 23-3
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.150315	-85.590161	757.04	12.00	769.04
2	37.150260	-85.590212	757.99	12.00	769.99
3	37.150261	-85.590695	766.30	12.00	778.30
4	37.150262	-85.591070	772.64	12.00	784.64
5	37.150262	-85.591546	775.41	12.00	787.41
6	37.150413	-85.591539	774.27	12.00	786.27
7	37.150399	-85.591155	775.87	12.00	787.87
8	37.150385	-85.590795	767.17	12.00	779.17
9	37.150371	-85.590435	770.43	12.00	782.43
10	37.150357	-85.590160	758.63	12.00	770.63

Name: 23-4
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material



Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.151013	-85.589393	782.73	12.00	794.73
2	37.150937	-85.589391	780.17	12.00	792.17
3	37.150836	-85.589388	776.98	12.00	788.98
4	37.150905	-85.589456	776.17	12.00	788.17
5	37.150946	-85.589524	775.90	12.00	787.90
6	37.151022	-85.589593	775.71	12.00	787.71

Name: 23-5
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.150947	-85.589782	774.80	12.00	786.80
2	37.150891	-85.589642	773.34	12.00	785.34
3	37.150850	-85.589525	773.13	12.00	785.13
4	37.150809	-85.589387	776.35	12.00	788.35
5	37.150771	-85.589386	776.18	12.00	788.18
6	37.150767	-85.589288	780.04	12.00	792.04
7	37.150760	-85.589142	784.18	12.00	796.18
8	37.150666	-85.589132	783.21	12.00	795.21
9	37.150596	-85.589125	783.24	12.00	795.24
10	37.150592	-85.588891	786.23	12.00	798.23
11	37.150508	-85.588889	783.70	12.00	795.70
12	37.150423	-85.588887	779.73	12.00	791.73
13	37.150437	-85.588977	778.54	12.00	790.54
14	37.150465	-85.589114	777.92	12.00	789.92
15	37.150479	-85.589265	779.11	12.00	791.11
16	37.150479	-85.589422	779.82	12.00	791.82
17	37.150493	-85.589508	779.58	12.00	791.58
18	37.150562	-85.589611	777.02	12.00	789.02
19	37.150589	-85.589731	776.62	12.00	788.62
20	37.150631	-85.589894	775.51	12.00	787.51
21	37.150761	-85.589894	779.43	12.00	791.43
22	37.150891	-85.589893	777.41	12.00	789.41
23	37.151057	-85.589893	775.47	12.00	787.47
24	37.150988	-85.589850	775.47	12.00	787.47

Name: 23-6
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.150681	-85.586796	774.08	12.00	786.08
2	37.150805	-85.586522	775.12	12.00	787.12
3	37.150928	-85.586248	770.57	12.00	782.57
4	37.151037	-85.585990	768.69	12.00	780.69
5	37.151106	-85.585792	763.20	12.00	775.20
6	37.150790	-85.585793	768.95	12.00	780.95
7	37.150735	-85.585991	768.76	12.00	780.76
8	37.150640	-85.586351	768.50	12.00	780.50
9	37.150548	-85.586695	774.90	12.00	786.90
10	37.150551	-85.586796	772.68	12.00	784.68

Name: 23-7
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.151060	-85.590030	778.88	12.00	790.88
2	37.150845	-85.590031	780.49	12.00	792.49
3	37.150658	-85.590031	775.93	12.00	787.93
4	37.150645	-85.590143	776.44	12.00	788.44
5	37.150645	-85.590434	778.06	12.00	790.06
6	37.150687	-85.590554	776.89	12.00	788.89
7	37.150701	-85.590795	777.93	12.00	789.93
8	37.150783	-85.591000	775.43	12.00	787.43
9	37.150852	-85.591163	772.72	12.00	784.72
10	37.150857	-85.591040	774.23	12.00	786.23
11	37.150977	-85.591037	773.94	12.00	785.94
12	37.151099	-85.591033	772.73	12.00	784.73
13	37.151106	-85.590794	774.55	12.00	786.55
14	37.151267	-85.590781	773.53	12.00	785.53
15	37.151266	-85.590505	775.95	12.00	787.95
16	37.151266	-85.590281	777.51	12.00	789.51
17	37.151266	-85.590030	774.31	12.00	786.31

Name: 23-8
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.151569	-85.582901	783.72	12.00	795.72
2	37.151486	-85.582884	780.12	12.00	792.12
3	37.151459	-85.583058	777.11	12.00	789.11
4	37.151562	-85.583058	784.37	12.00	796.37
5	37.151676	-85.583058	786.37	12.00	798.37
6	37.151676	-85.582952	786.22	12.00	798.22

Name: 23-9
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.151734	-85.592594	757.93	12.00	769.93
2	37.151747	-85.592594	757.79	12.00	769.79
3	37.151747	-85.592583	758.16	12.00	770.16
4	37.151734	-85.592583	758.31	12.00	770.31

Discrete Observation Point Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (ft)	Height (ft)
OP 23	23	37.150259	-85.587789	785.95	5.40

Glare Analysis Results

Summary of Results Glare with potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
23-1	30.0	180.0	667	11.1	40	0.7	-
23-10	30.0	180.0	873	14.6	2,031	33.9	-
23-11	30.0	180.0	0	0.0	0	0.0	-
23-2	30.0	180.0	0	0.0	0	0.0	-
23-3	30.0	180.0	603	10.1	13	0.2	-
23-4	30.0	180.0	1,394	23.2	0	0.0	-
23-5	30.0	180.0	1,279	21.3	1,409	23.5	-
23-6	30.0	180.0	248	4.1	944	15.7	-
23-7	30.0	180.0	875	14.6	1,318	22.0	-
23-8	30.0	180.0	1,162	19.4	0	0.0	-
23-9	30.0	180.0	744	12.4	0	0.0	-

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 23	7,845	130.8	5,755	95.9

PV: 23-1 potential temporary after-image

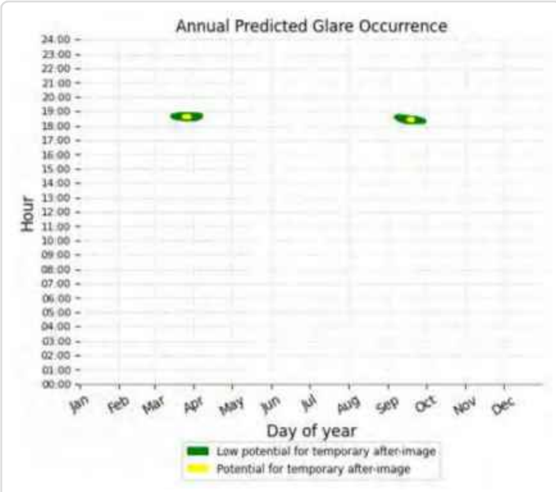
Receptor results ordered by category of glare

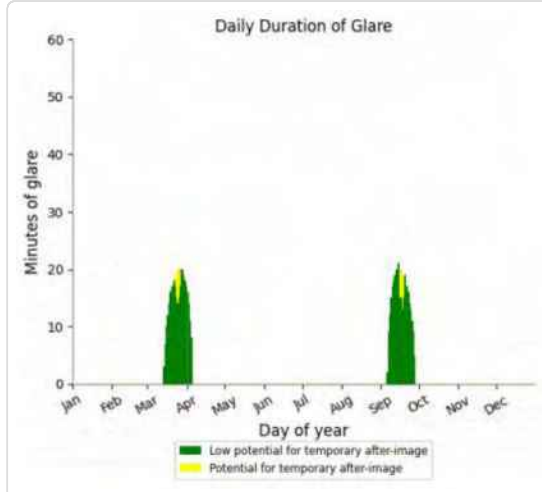
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 23	667	11.1	40	0.7

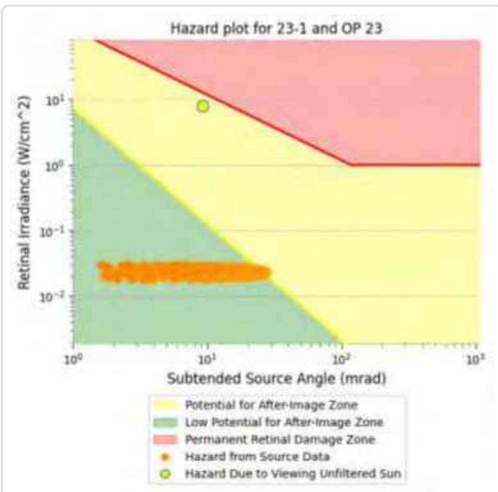
23-1 and OP 23

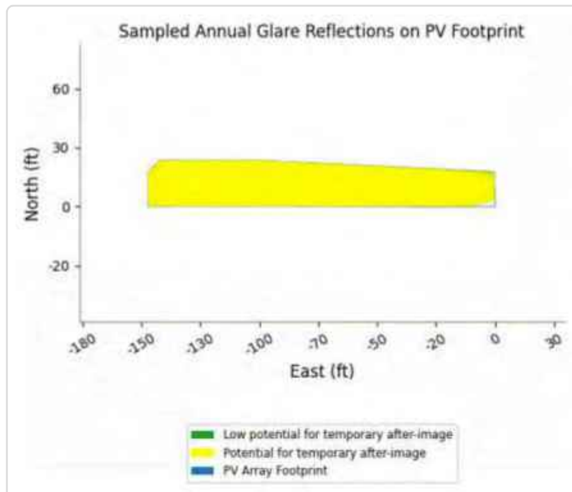
Yellow glare: 40 min.

Green glare: 667 min.









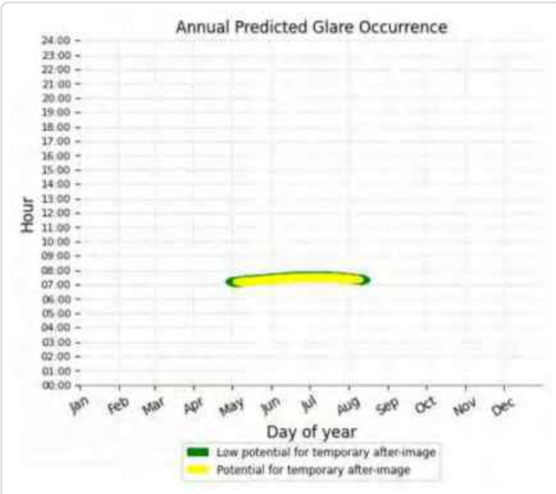
PV: 23-10 potential temporary after-image

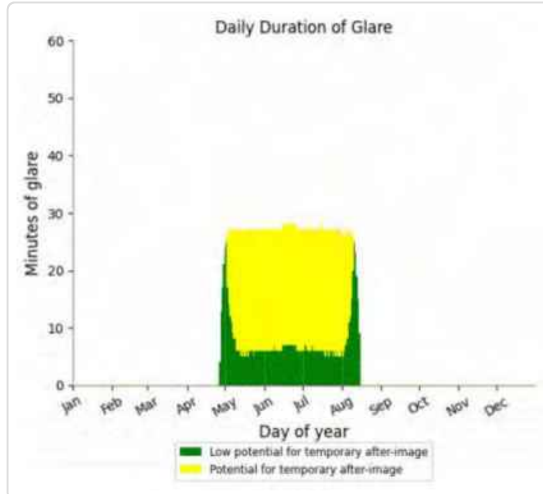
Receptor results ordered by category of glare

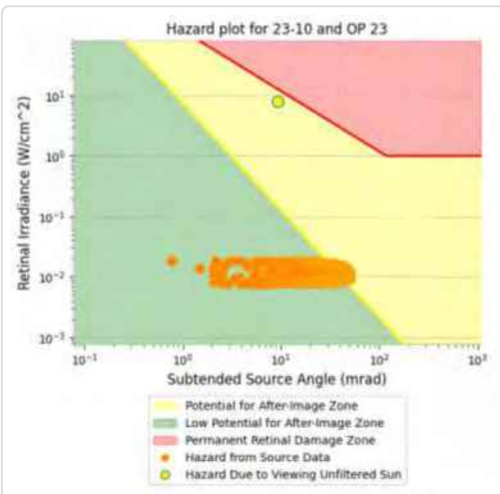
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 23	873	14.6	2,031	33.9

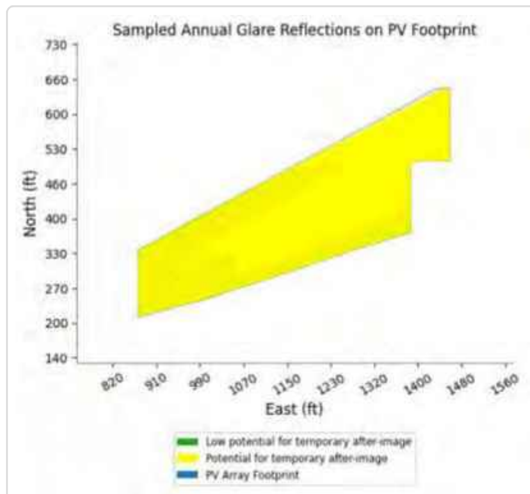
23-10 and OP 23

Yellow glare: 2,031 min.
Green glare: 873 min.









PV: 23-11 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 23	0	0.0	0	0.0

23-11 and OP 23

No glare found

PV: 23-2 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	**hr**	**min**	**hr**
OP 23	0	0.0	0	0.0

23-2 and OP 23

No glare found

PV: 23-3 potential temporary after-image

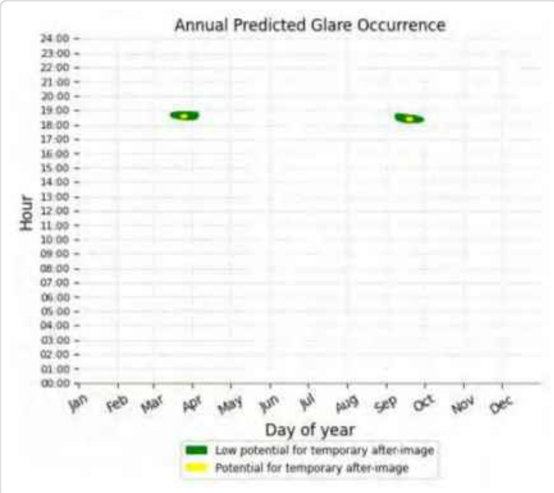
Receptor results ordered by category of glare

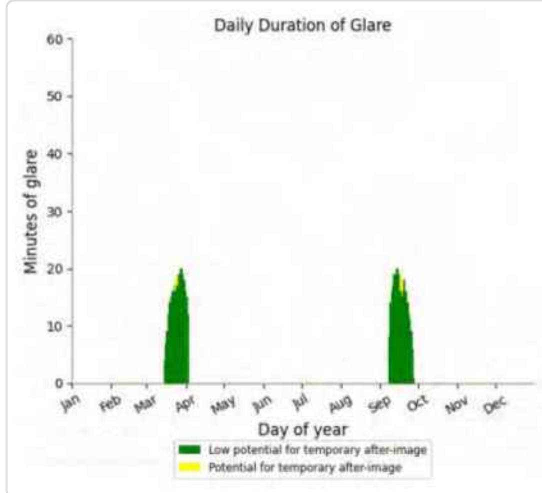
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	**hr**	**min**	**hr**
OP 23	603	10.1	13	0.2

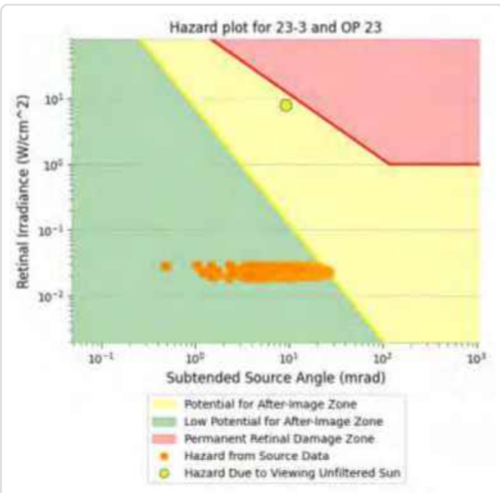
23-3 and OP 23

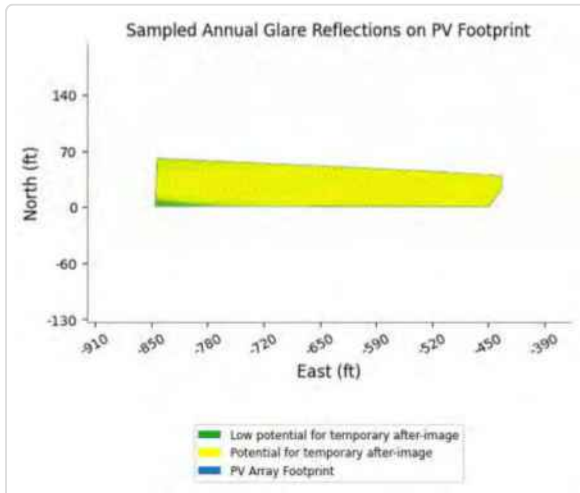
Yellow glare: 13 min.

Green glare: 603 min.









PV: 23-4 low potential for temporary after-image

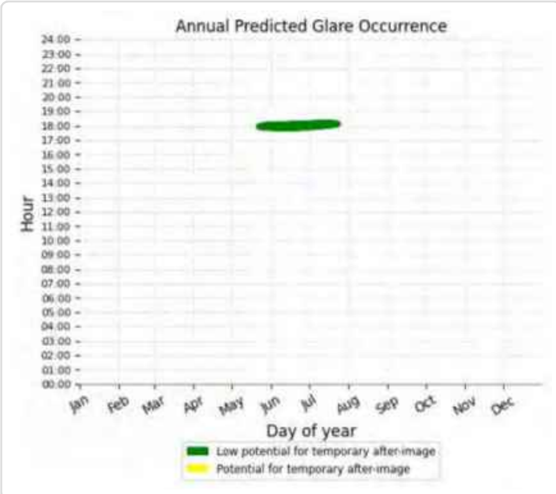
Receptor results ordered by category of glare

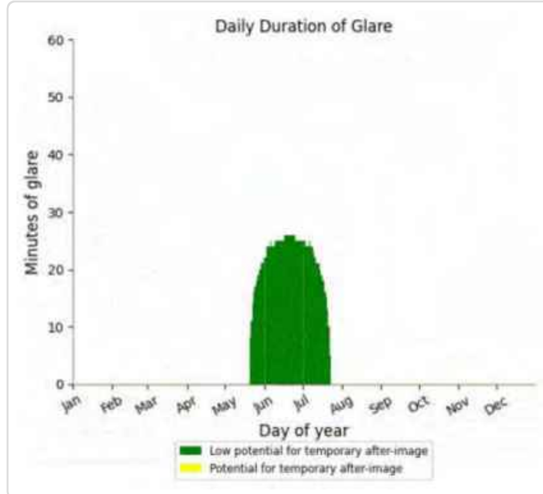
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 23	1,394	23.2	0	0.0

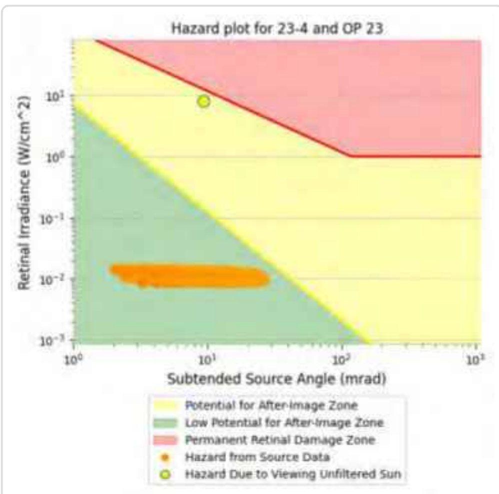
23-4 and OP 23

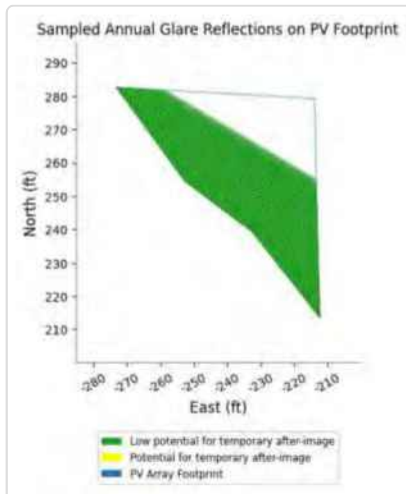
Yellow glare: none

Green glare: 1,394 min.









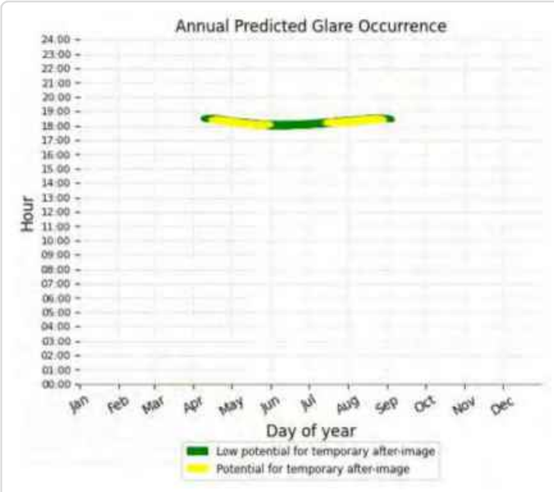
PV: 23-5 potential temporary after-image

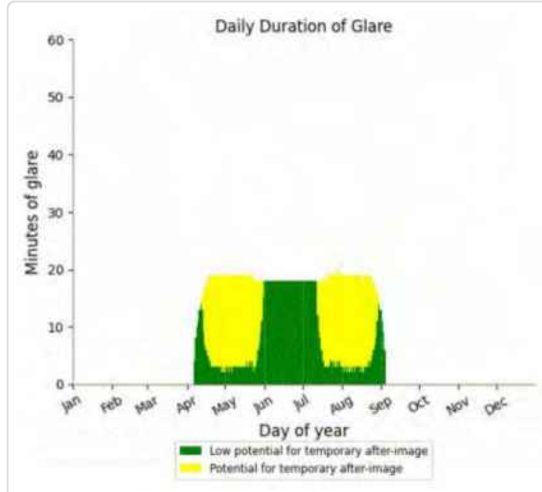
Receptor results ordered by category of glare

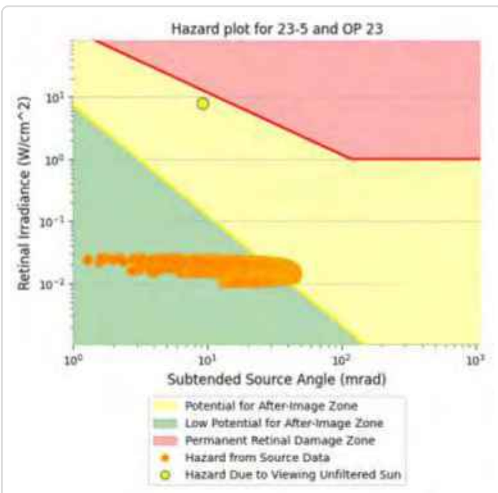
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	**hr**	**min**	**hr**
OP 23	1,279	21.3	1,409	23.5

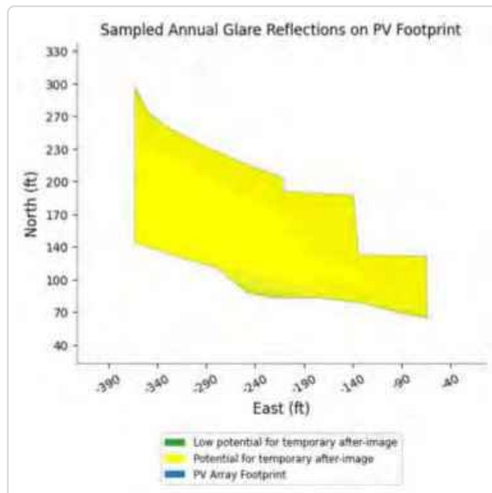
23-5 and OP 23

Yellow glare: 1,409 min.
Green glare: 1,279 min.









PV: 23-6 potential temporary after-image

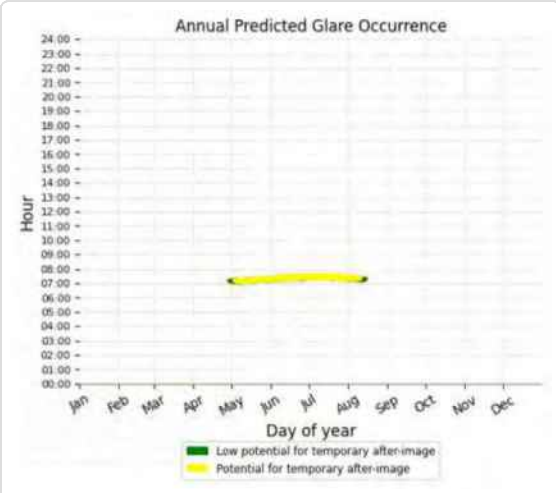
Receptor results ordered by category of glare

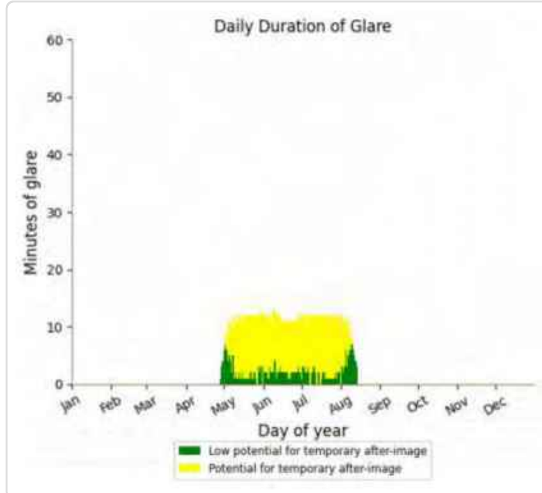
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 23	248	4.1	944	15.7

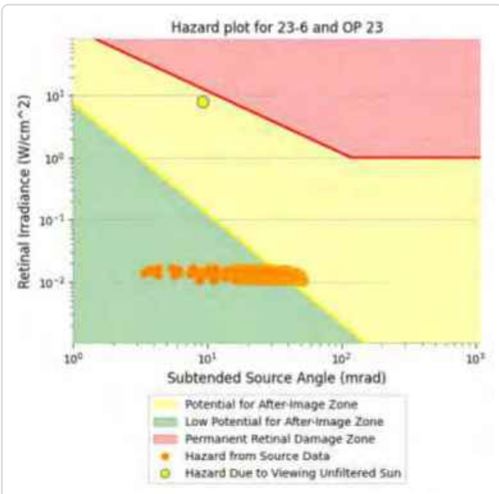
23-6 and OP 23

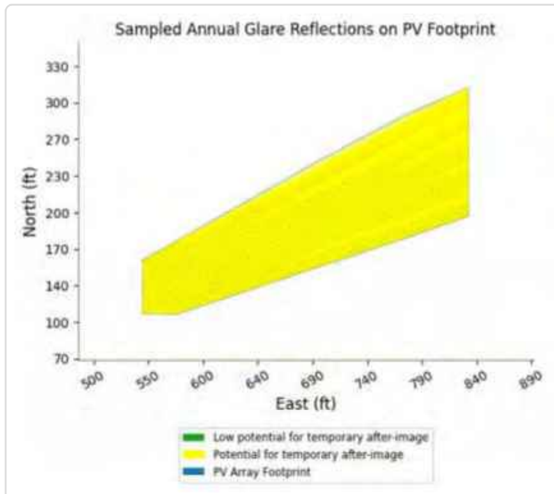
Yellow glare: 944 min.

Green glare: 248 min.









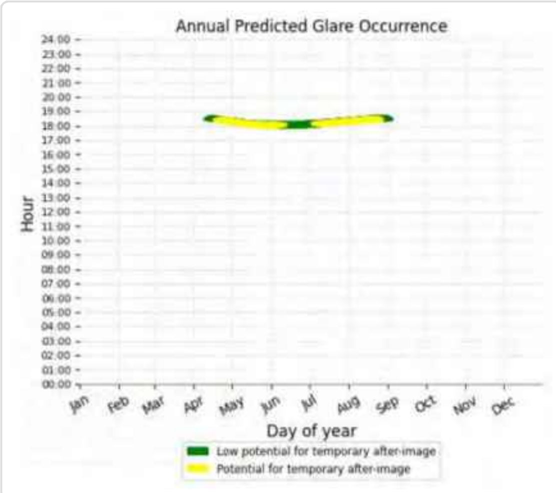
PV: 23-7 potential temporary after-image

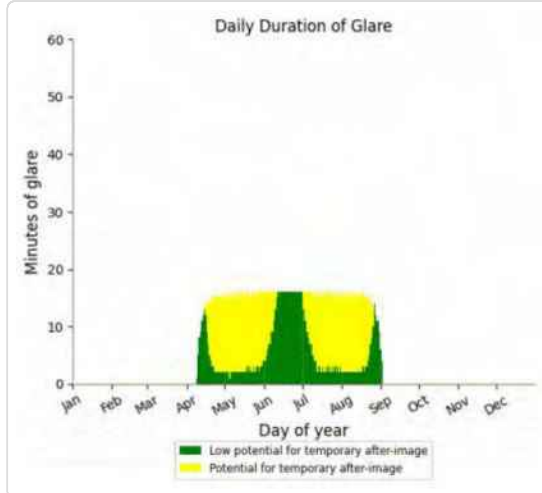
Receptor results ordered by category of glare

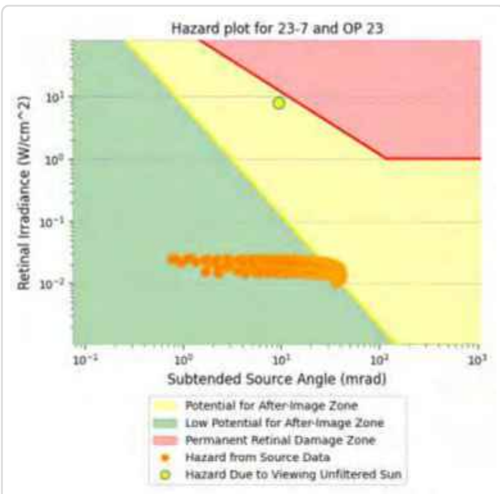
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 23	875	14.6	1,318	22.0

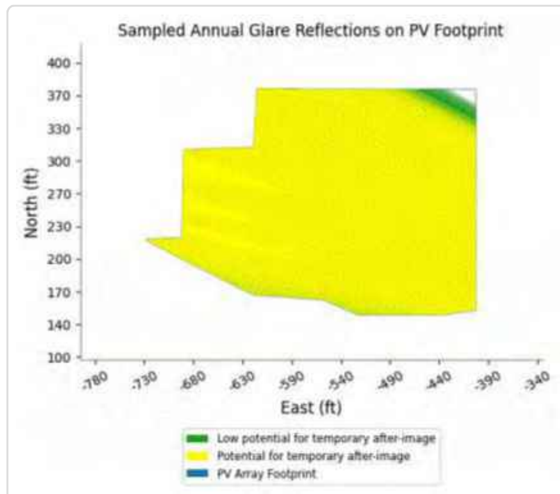
23-7 and OP 23

Yellow glare: 1,318 min.
Green glare: 875 min.









PV: 23-8 low potential for temporary after-image

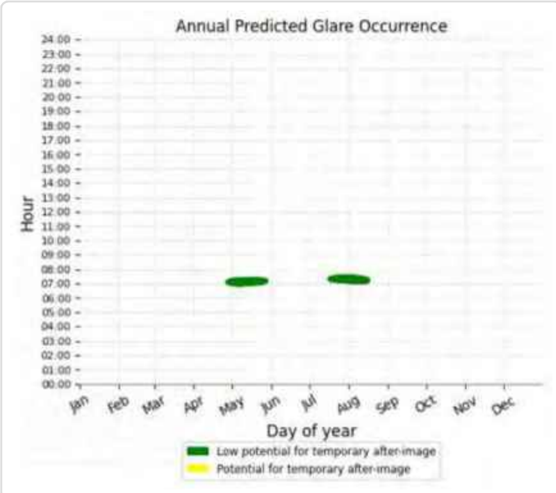
Receptor results ordered by category of glare

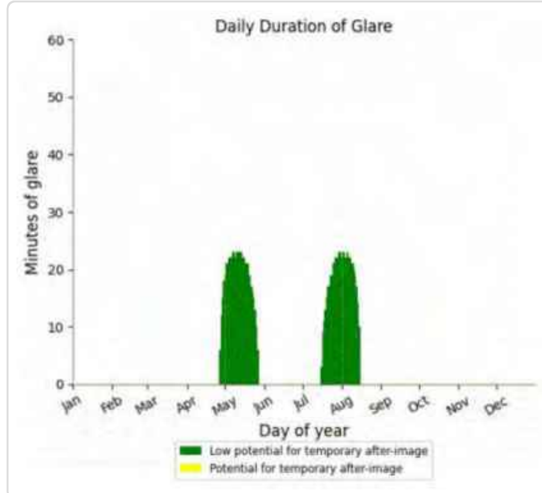
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 23	1,162	19.4	0	0.0

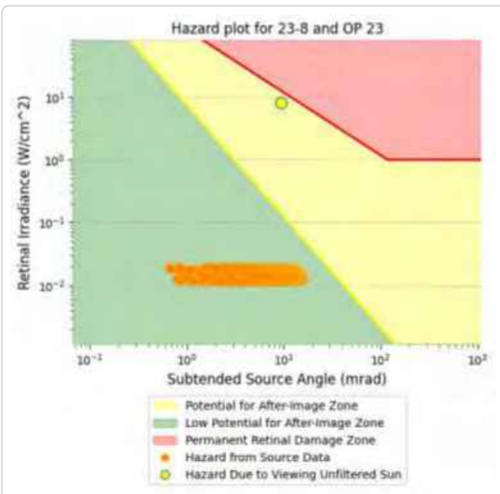
23-8 and OP 23

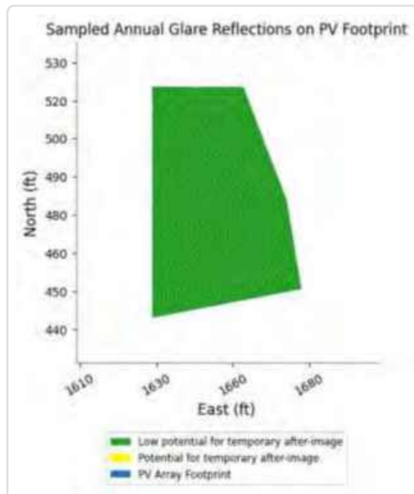
Yellow glare: none

Green glare: 1,162 min.









PV: 23-9 low potential for temporary after-image

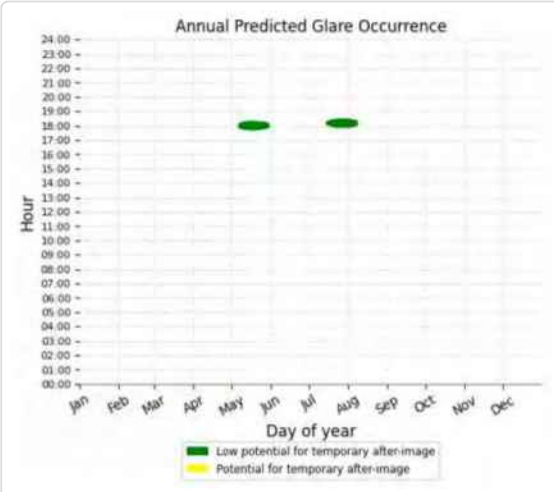
Receptor results ordered by category of glare

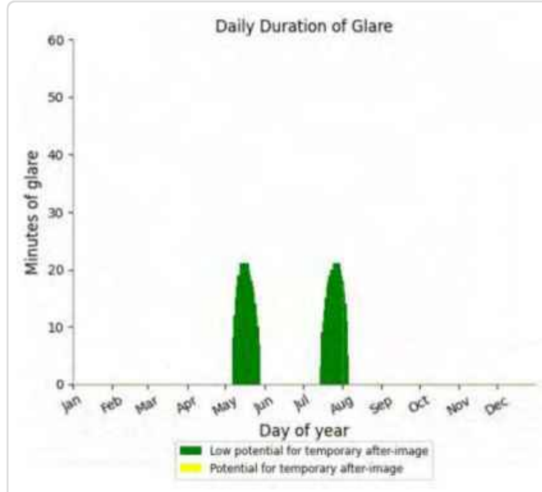
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 23	744	12.4	0	0.0

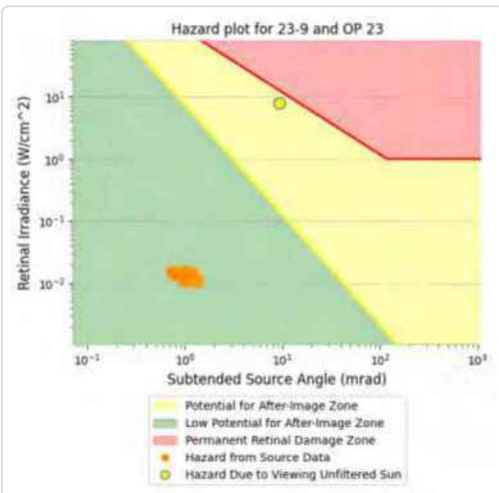
23-9 and OP 23

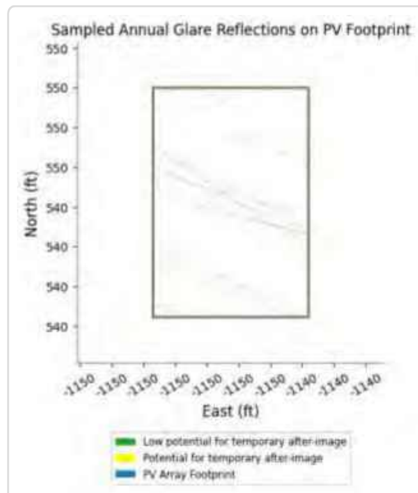
Yellow glare: none

Green glare: 744 min.









Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
The algorithm does not rigorously represent the detailed geometry of a system; detailed features such as gaps between modules, variable height of the PV array, and support structures may impact actual glare results. However, we have validated our models against several systems, including a PV array causing glare to the air-traffic control tower at Manchester-Boston Regional Airport and several sites in Albuquerque, and the tool accurately predicted the occurrence and intensity of glare at different times and days of the year.
Several V1 calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare. This primarily affects V1 analyses of path receptors.
Random number computations are utilized by various steps of the annual hazard analysis algorithm. Predicted minutes of glare can vary between runs as a result. This limitation primarily affects analyses of Observation Point receptors, including ATCTs. Note that the SGHAT/ForgeSolar methodology has always relied on an analytical, qualitative approach to accurately determine the overall hazard (i.e. green vs. yellow) of expected glare on an annual basis.
The analysis does not automatically consider obstacles (either man-made or natural) between the observation points and the prescribed solar installation that may obstruct observed glare, such as trees, hills, buildings, etc.
The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
The variable direct normal irradiance (DNI) feature (if selected) scales the user-prescribed peak DNI using a typical clear-day irradiance profile. This profile has a lower DNI in the mornings and evenings and a maximum at solar noon. The scaling uses a clear-day irradiance profile based on a normalized time relative to sunrise, solar noon, and sunset, which are prescribed by a sun-position algorithm and the latitude and longitude obtained from Google maps. The actual DNI on any given day can be affected by cloud cover, atmospheric attenuation, and other environmental factors.
The ocular hazard predicted by the tool depends on a number of environmental, optical, and human factors, which can be uncertain. We provide input fields and typical ranges of values for these factors so that the user can vary these parameters to see if they have an impact on the results. The speed of SGHAT allows expedited sensitivity and parametric analyses.
The system output calculation is a DNI-based approximation that assumes clear, sunny skies year-round. It should not be used in place of more rigorous modeling methods.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.

Default glare analysis parameters and observer eye characteristics (for reference only):

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

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FORGESOLAR GLARE ANALYSIS

Project: **Exie Solar**
Site configuration: **26**

Created 21 May, 2025
Updated 21 May, 2025
Time-step 1 minute
Timezone offset UTC-5
Minimum sun altitude 0.0 deg
DNI peaks at 1,000.0 W/m^2
Category 100 MW to 1 GW
Site ID 149800.24968

Ocular transmission coefficient 0.5
Pupil diameter 0.002 m
Eye focal length 0.017 m
Sun subtended angle 9.3 mrad
PV analysis methodology V2

Summary of Results

Glare with low potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
26-1	30.0	180.0	42	0.7	0	0.0	-

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 26	42	0.7	0	0.0

Component Data

PV Arrays

Name: 26-1
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.140191	-85.578071	815.82	12.00	827.82
2	37.140095	-85.578003	818.16	12.00	830.16
3	37.140095	-85.578501	825.99	12.00	837.99
4	37.140096	-85.579168	819.83	12.00	831.83
5	37.140097	-85.579590	815.71	12.00	827.71
6	37.140158	-85.579590	815.86	12.00	827.86
7	37.140158	-85.579370	817.23	12.00	829.23
8	37.140242	-85.579339	814.65	12.00	826.65
9	37.140275	-85.579102	810.89	12.00	822.89
10	37.140288	-85.578792	815.16	12.00	827.16
11	37.140301	-85.578483	816.78	12.00	828.78
12	37.140301	-85.578208	814.33	12.00	826.33

Discrete Observation Point Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (ft)	Height (ft)
OP 26	26	37.140100	-85.583112	781.91	5.40

Glare Analysis Results

Summary of Results Glare with low potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
26-1	30.0	180.0	42	0.7	0	0.0	-

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 26	42	0.7	0	0.0

PV: 26-1 low potential for temporary after-image

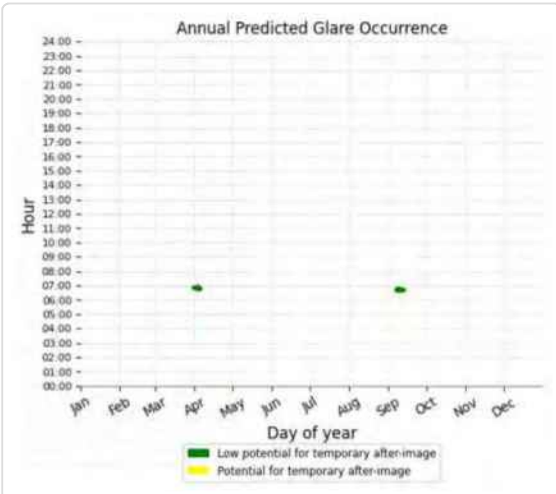
Receptor results ordered by category of glare

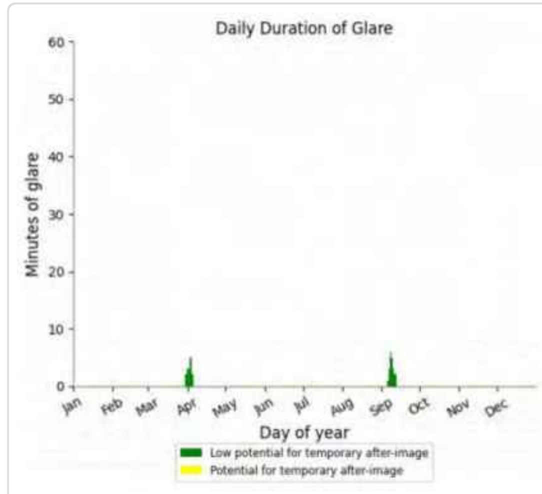
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 26	42	0.7	0	0.0

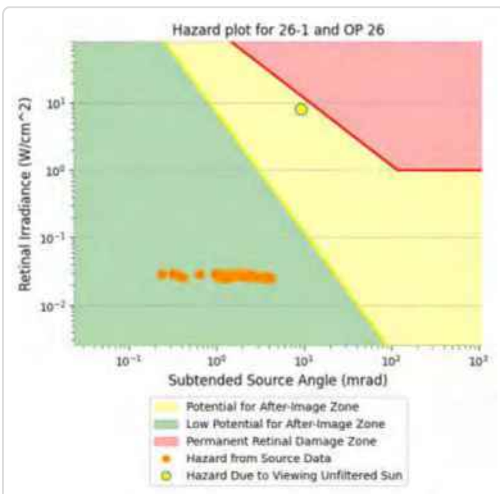
26-1 and OP 26

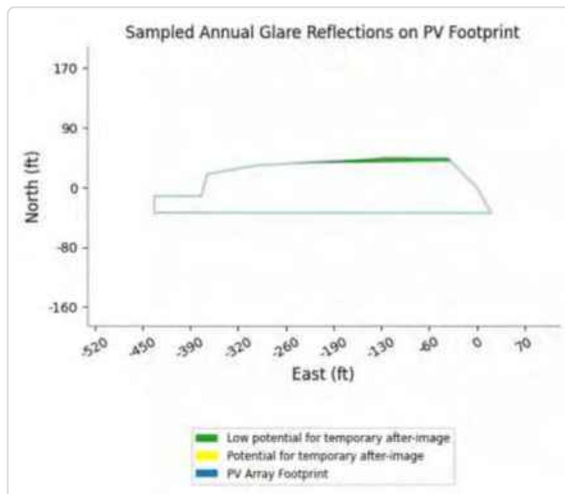
Yellow glare: none

Green glare: 42 min.









Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
The algorithm does not rigorously represent the detailed geometry of a system; detailed features such as gaps between modules, variable height of the PV array, and support structures may impact actual glare results. However, we have validated our models against several systems, including a PV array causing glare to the air-traffic control tower at Manchester-Boston Regional Airport and several sites in Albuquerque, and the tool accurately predicted the occurrence and intensity of glare at different times and days of the year.
Several V1 calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare. This primarily affects V1 analyses of path receptors.
Random number computations are utilized by various steps of the annual hazard analysis algorithm. Predicted minutes of glare can vary between runs as a result. This limitation primarily affects analyses of Observation Point receptors, including ATCTs. Note that the SGHAT/ForgeSolar methodology has always relied on an analytical, qualitative approach to accurately determine the overall hazard (i.e. green vs. yellow) of expected glare on an annual basis.
The analysis does not automatically consider obstacles (either man-made or natural) between the observation points and the prescribed solar installation that may obstruct observed glare, such as trees, hills, buildings, etc.
The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
The variable direct normal irradiance (DNI) feature (if selected) scales the user-prescribed peak DNI using a typical clear-day irradiance profile. This profile has a lower DNI in the mornings and evenings and a maximum at solar noon. The scaling uses a clear-day irradiance profile based on a normalized time relative to sunrise, solar noon, and sunset, which are prescribed by a sun-position algorithm and the latitude and longitude obtained from Google maps. The actual DNI on any given day can be affected by cloud cover, atmospheric attenuation, and other environmental factors.
The ocular hazard predicted by the tool depends on a number of environmental, optical, and human factors, which can be uncertain. We provide input fields and typical ranges of values for these factors so that the user can vary these parameters to see if they have an impact on the results. The speed of SGHAT allows expedited sensitivity and parametric analyses.
The system output calculation is a DNI-based approximation that assumes clear, sunny skies year-round. It should not be used in place of more rigorous modeling methods.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.

Default glare analysis parameters and observer eye characteristics (for reference only):

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

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FORGESOLAR GLARE ANALYSIS

Project: **Exie Solar**
Site configuration: **31**

Created 21 May, 2025
Updated 21 May, 2025
Time-step 1 minute
Timezone offset UTC-5
Minimum sun altitude 0.0 deg
DNI peaks at 1,000.0 W/m^2
Category 100 MW to 1 GW
Site ID 149801.24968

Ocular transmission coefficient 0.5
Pupil diameter 0.002 m
Eye focal length 0.017 m
Sun subtended angle 9.3 mrad
PV analysis methodology V2

Summary of Results Glare with low potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
31-1	30.0	180.0	540	9.0	0	0.0	-
31-2	30.0	180.0	751	12.5	0	0.0	-
31-3	30.0	180.0	1,016	16.9	0	0.0	-
31-4	30.0	180.0	758	12.6	0	0.0	-

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 31	3,065	51.1	0	0.0

Component Data

PV Arrays

Name: 31-1
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.140431	-85.592960	737.73	12.00	749.73
2	37.140431	-85.592943	736.98	12.00	748.98
3	37.140418	-85.592943	737.18	12.00	749.18
4	37.140418	-85.592960	737.89	12.00	749.89
5	37.140363	-85.592961	738.43	12.00	750.43
6	37.140349	-85.592978	739.05	12.00	751.05
7	37.140349	-85.593060	742.16	12.00	754.16
8	37.140429	-85.593059	742.97	12.00	754.97
9	37.140496	-85.593059	741.64	12.00	753.64
10	37.140583	-85.593058	737.45	12.00	749.45
11	37.140541	-85.592994	736.76	12.00	748.76
12	37.140486	-85.592960	736.71	12.00	748.71

Name: 31-2
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.140747	-85.592548	734.60	12.00	746.60
2	37.140747	-85.592531	734.79	12.00	746.79
3	37.140667	-85.592531	734.43	12.00	746.43
4	37.140568	-85.592531	735.02	12.00	747.02
5	37.140568	-85.592514	735.18	12.00	747.18
6	37.140467	-85.592514	736.65	12.00	748.65
7	37.140348	-85.592515	737.06	12.00	749.06
8	37.140348	-85.592566	736.40	12.00	748.40
9	37.140391	-85.592611	736.05	12.00	748.05
10	37.140431	-85.592652	735.22	12.00	747.22
11	37.140472	-85.592652	735.18	12.00	747.18
12	37.140472	-85.592634	735.41	12.00	747.41
13	37.140500	-85.592634	735.16	12.00	747.16
14	37.140500	-85.592651	734.92	12.00	746.92
15	37.140555	-85.592651	734.54	12.00	746.54
16	37.140623	-85.592565	734.30	12.00	746.30
17	37.140678	-85.592565	733.97	12.00	745.97
18	37.140678	-85.592617	733.13	12.00	745.13
19	37.140761	-85.592720	732.97	12.00	744.97
20	37.140761	-85.592925	734.00	12.00	746.00
21	37.140720	-85.593011	734.89	12.00	746.89
22	37.140651	-85.593058	736.44	12.00	748.44
23	37.140789	-85.593057	737.27	12.00	749.27
24	37.140802	-85.592960	735.63	12.00	747.63
25	37.140829	-85.592668	734.08	12.00	746.08
26	37.140829	-85.592548	734.73	12.00	746.73

Name: 31-3
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.141324	-85.592650	734.96	12.00	746.96
2	37.141049	-85.592582	734.68	12.00	746.68
3	37.140857	-85.592548	734.66	12.00	746.66
4	37.140829	-85.592737	734.05	12.00	746.05
5	37.140816	-85.592874	734.51	12.00	746.51
6	37.140802	-85.593057	737.69	12.00	749.69
7	37.140849	-85.593057	738.44	12.00	750.44
8	37.140849	-85.592836	734.72	12.00	746.72
9	37.140874	-85.592803	734.49	12.00	746.49
10	37.141017	-85.592803	735.21	12.00	747.21
11	37.141269	-85.592804	737.49	12.00	749.49
12	37.141447	-85.592804	738.94	12.00	750.94
13	37.141475	-85.592701	736.19	12.00	748.19

Name: 31-4
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.141571	-85.592735	738.01	12.00	750.01
2	37.141502	-85.592735	737.22	12.00	749.22
3	37.141489	-85.592804	739.39	12.00	751.39
4	37.141547	-85.592804	740.05	12.00	752.05
5	37.141605	-85.592804	740.81	12.00	752.81
6	37.141605	-85.592752	738.95	12.00	750.95

Discrete Observation Point Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (ft)	Height (ft)
OP 31	31	37.140357	-85.597662	773.80	5.40

Glare Analysis Results

Summary of Results Glare with low potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
31-1	30.0	180.0	540	9.0	0	0.0	-
31-2	30.0	180.0	751	12.5	0	0.0	-
31-3	30.0	180.0	1,016	16.9	0	0.0	-
31-4	30.0	180.0	758	12.6	0	0.0	-

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 31	3,065	51.1	0	0.0

PV: 31-1 low potential for temporary after-image

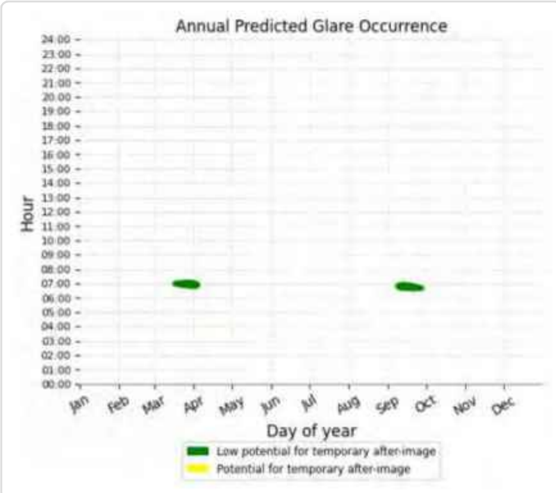
Receptor results ordered by category of glare

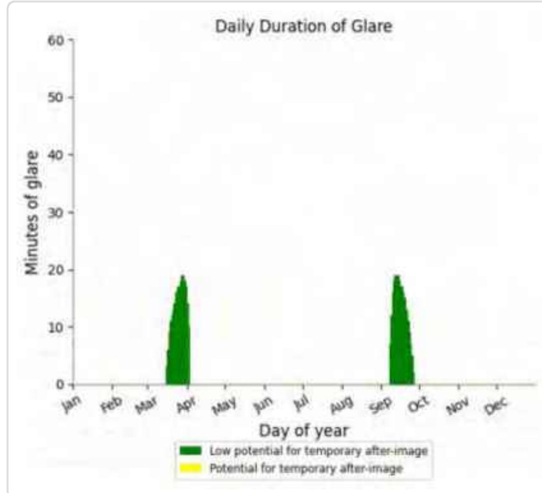
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 31	540	9.0	0	0.0

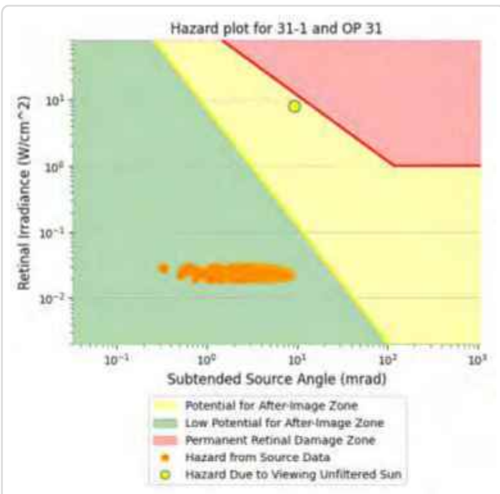
31-1 and OP 31

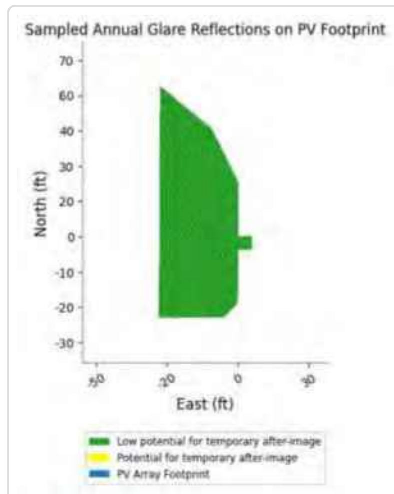
Yellow glare: none

Green glare: 540 min.









PV: 31-2 low potential for temporary after-image

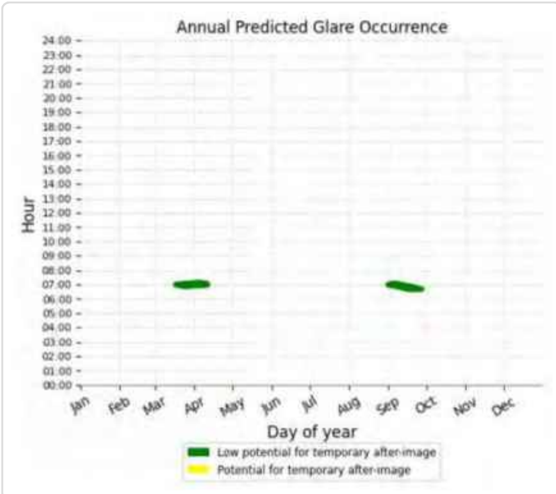
Receptor results ordered by category of glare

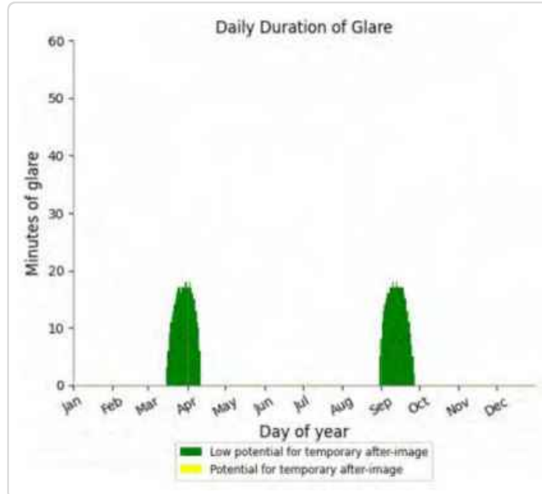
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 31	751	12.5	0	0.0

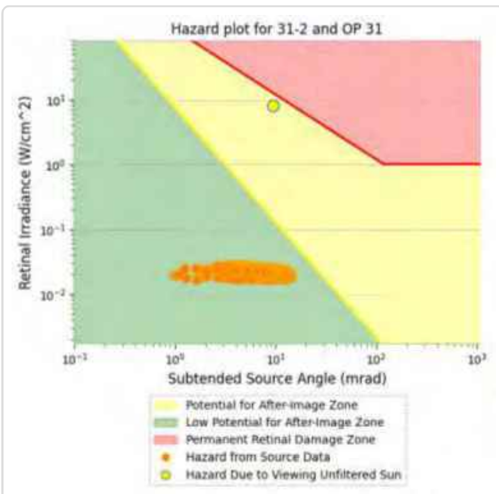
31-2 and OP 31

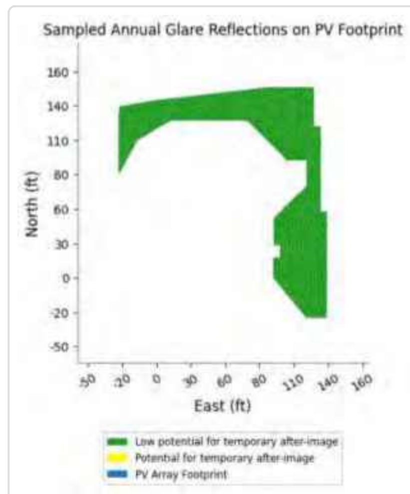
Yellow glare: none

Green glare: 751 min.









PV: 31-3 low potential for temporary after-image

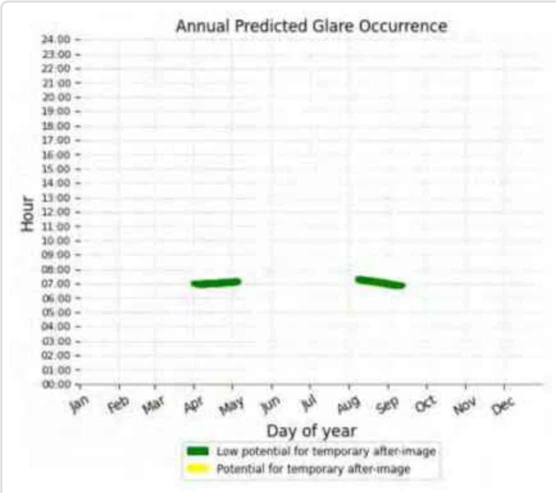
Receptor results ordered by category of glare

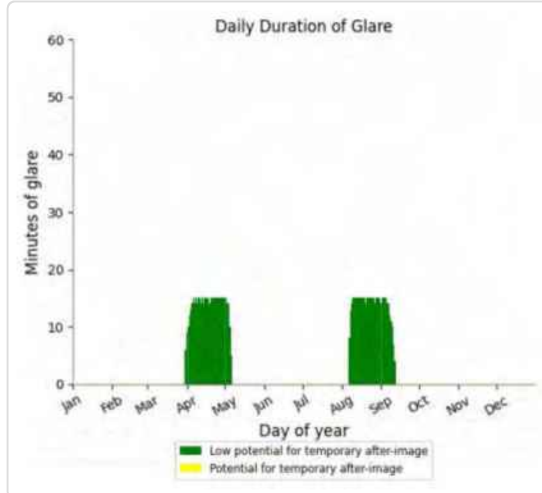
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 31	1,016	16.9	0	0.0

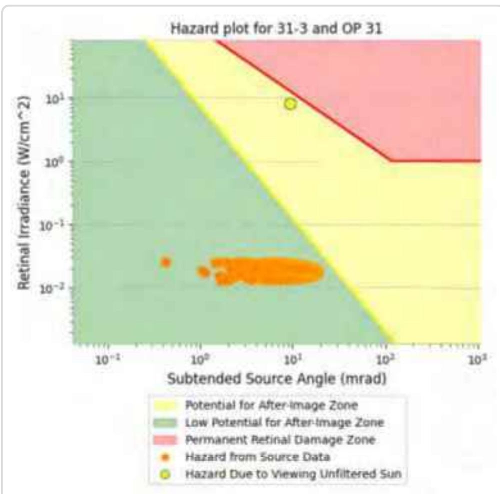
31-3 and OP 31

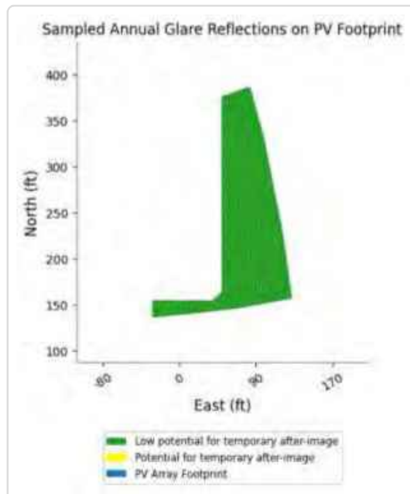
Yellow glare: none

Green glare: 1,016 min.









PV: 31-4 low potential for temporary after-image

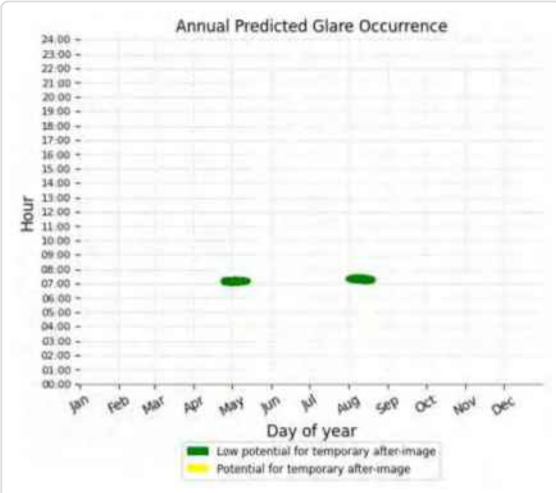
Receptor results ordered by category of glare

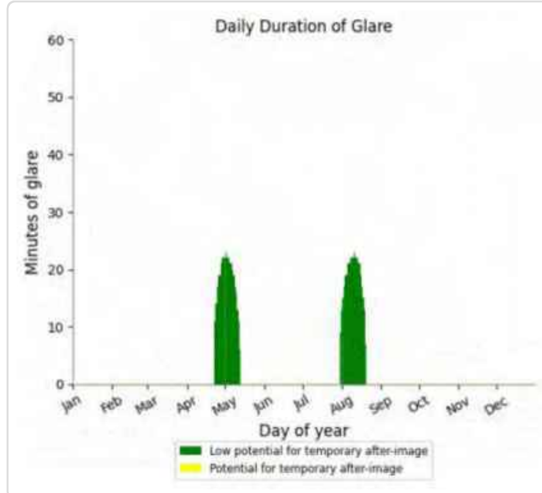
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 31	758	12.6	0	0.0

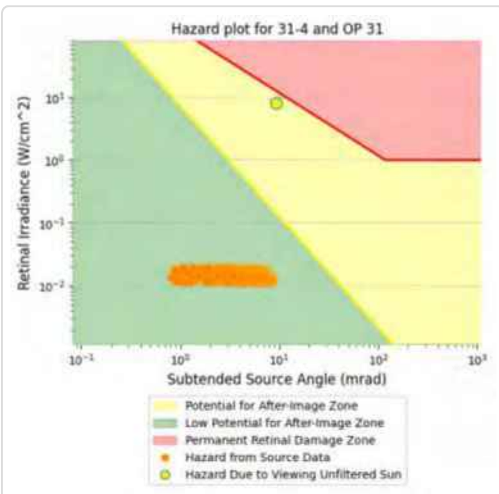
31-4 and OP 31

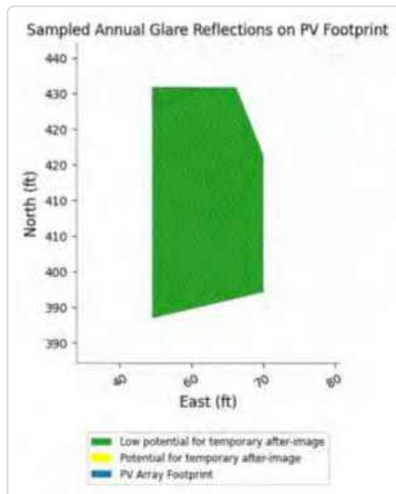
Yellow glare: none

Green glare: 758 min.









Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
The algorithm does not rigorously represent the detailed geometry of a system; detailed features such as gaps between modules, variable height of the PV array, and support structures may impact actual glare results. However, we have validated our models against several systems, including a PV array causing glare to the air-traffic control tower at Manchester-Boston Regional Airport and several sites in Albuquerque, and the tool accurately predicted the occurrence and intensity of glare at different times and days of the year.
Several V1 calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare. This primarily affects V1 analyses of path receptors.
Random number computations are utilized by various steps of the annual hazard analysis algorithm. Predicted minutes of glare can vary between runs as a result. This limitation primarily affects analyses of Observation Point receptors, including ATCTs. Note that the SGHAT/ForgeSolar methodology has always relied on an analytical, qualitative approach to accurately determine the overall hazard (i.e. green vs. yellow) of expected glare on an annual basis.
The analysis does not automatically consider obstacles (either man-made or natural) between the observation points and the prescribed solar installation that may obstruct observed glare, such as trees, hills, buildings, etc.
The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
The variable direct normal irradiance (DNI) feature (if selected) scales the user-prescribed peak DNI using a typical clear-day irradiance profile. This profile has a lower DNI in the mornings and evenings and a maximum at solar noon. The scaling uses a clear-day irradiance profile based on a normalized time relative to sunrise, solar noon, and sunset, which are prescribed by a sun-position algorithm and the latitude and longitude obtained from Google maps. The actual DNI on any given day can be affected by cloud cover, atmospheric attenuation, and other environmental factors.
The ocular hazard predicted by the tool depends on a number of environmental, optical, and human factors, which can be uncertain. We provide input fields and typical ranges of values for these factors so that the user can vary these parameters to see if they have an impact on the results. The speed of SGHAT allows expedited sensitivity and parametric analyses.
The system output calculation is a DNI-based approximation that assumes clear, sunny skies year-round. It should not be used in place of more rigorous modeling methods.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.

Default glare analysis parameters and observer eye characteristics (for reference only):

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

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FORGESOLAR GLARE ANALYSIS

Project: **Exie Solar**
Site configuration: **37**

Created 21 May, 2025
Updated 21 May, 2025
Time-step 1 minute
Timezone offset UTC-5
Minimum sun altitude 0.0 deg
DNI peaks at 1,000.0 W/m^2
Category 100 MW to 1 GW
Site ID 149802.24968

Ocular transmission coefficient 0.5
Pupil diameter 0.002 m
Eye focal length 0.017 m
Sun subtended angle 9.3 mrad
PV analysis methodology V2

Summary of Results

Glare with potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
37-1	30.0	180.0	1,042	17.4	1,933	32.2	-
37-2	30.0	180.0	1,076	17.9	1,205	20.1	-

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 37	2,118	35.3	3,138	52.3

Component Data

PV Arrays

Name: 37-1
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.149676	-85.584912	779.63	12.00	791.63
2	37.149659	-85.585123	779.16	12.00	791.16
3	37.149636	-85.585409	773.34	12.00	785.34
4	37.149704	-85.585416	773.02	12.00	785.02
5	37.149789	-85.585425	773.25	12.00	785.25
6	37.149793	-85.585658	769.81	12.00	781.81
7	37.149877	-85.585658	768.98	12.00	780.98
8	37.149980	-85.585658	768.40	12.00	780.40
9	37.150089	-85.585409	773.22	12.00	785.22
10	37.150185	-85.585220	779.01	12.00	791.01
11	37.150253	-85.585048	780.85	12.00	792.85
12	37.150250	-85.584906	778.25	12.00	790.25
13	37.150166	-85.584904	778.69	12.00	790.69
14	37.150166	-85.584655	771.49	12.00	783.49
15	37.150044	-85.584655	776.34	12.00	788.34
16	37.149914	-85.584655	778.72	12.00	790.72
17	37.149792	-85.584655	779.41	12.00	791.41
18	37.149777	-85.584904	780.91	12.00	792.91

Name: 37-2
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.150771	-85.582182	772.09	12.00	784.09
2	37.150551	-85.582097	769.55	12.00	781.55
3	37.150277	-85.582011	767.52	12.00	779.52
4	37.150002	-85.581961	767.75	12.00	779.75
5	37.149948	-85.582441	770.26	12.00	782.26
6	37.149880	-85.583025	779.53	12.00	791.53
7	37.149826	-85.583574	771.87	12.00	783.87
8	37.149771	-85.584068	769.97	12.00	781.97
9	37.149829	-85.584066	768.52	12.00	780.52
10	37.149828	-85.583817	768.36	12.00	780.36
11	37.150018	-85.583815	762.75	12.00	774.75
12	37.150155	-85.583796	762.17	12.00	774.17
13	37.150333	-85.583814	761.00	12.00	773.00
14	37.150332	-85.583565	767.57	12.00	779.57
15	37.150500	-85.583563	766.67	12.00	778.67
16	37.150500	-85.583314	773.28	12.00	785.28
17	37.150608	-85.583305	772.98	12.00	784.98
18	37.150718	-85.583297	769.26	12.00	781.26
19	37.150814	-85.583005	768.87	12.00	780.87
20	37.150923	-85.582679	770.77	12.00	782.77
21	37.151032	-85.582353	771.54	12.00	783.54
22	37.151032	-85.582301	771.16	12.00	783.16

Discrete Observation Point Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (ft)	Height (ft)
OP 37	37	37.149450	-85.587063	790.19	5.40

Glare Analysis Results

Summary of Results Glare with potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
37-1	30.0	180.0	1,042	17.4	1,933	32.2	-
37-2	30.0	180.0	1,076	17.9	1,205	20.1	-

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 37	2,118	35.3	3,138	52.3

PV: 37-1 potential temporary after-image

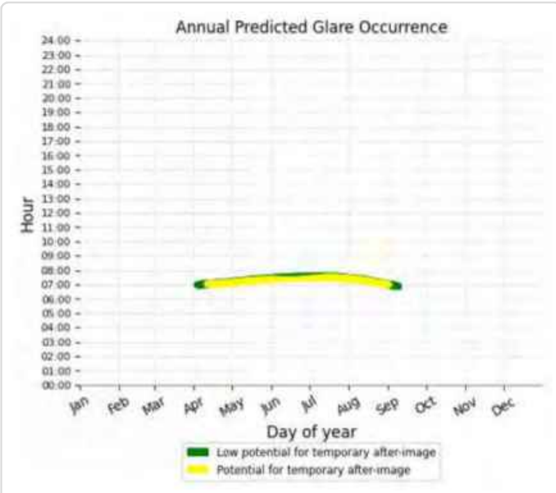
Receptor results ordered by category of glare

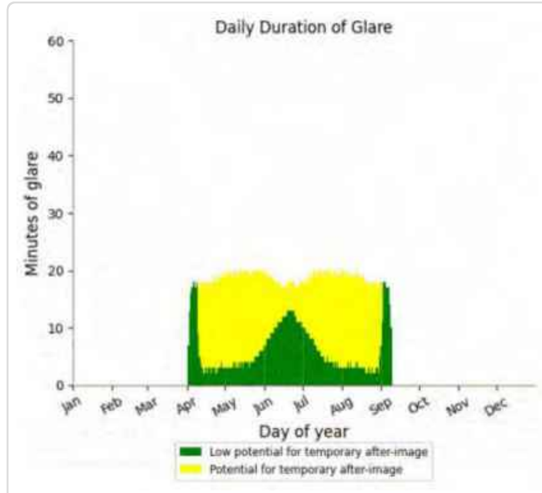
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 37	1,042	17.4	1,933	32.2

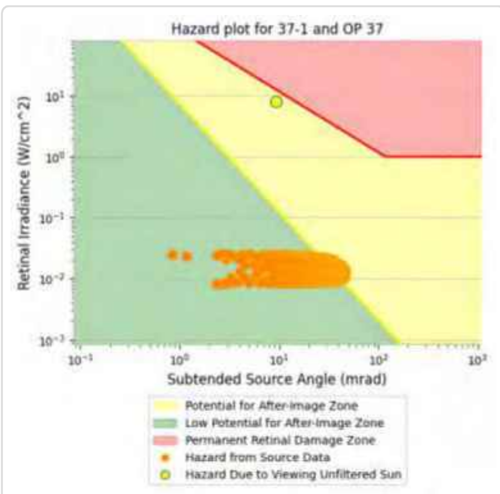
37-1 and OP 37

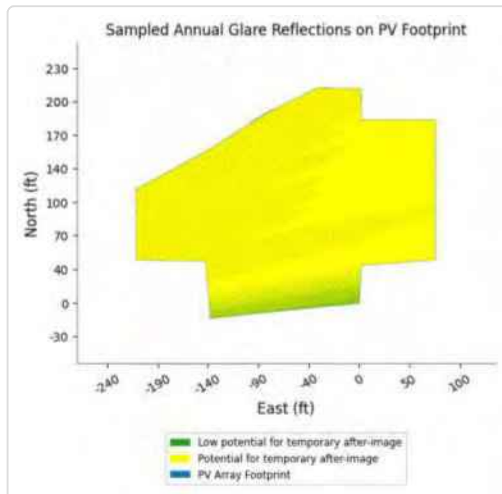
Yellow glare: 1,933 min.

Green glare: 1,042 min.









PV: 37-2 potential temporary after-image

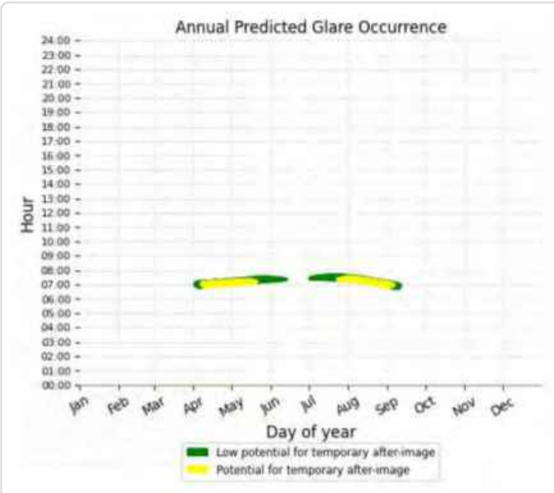
Receptor results ordered by category of glare

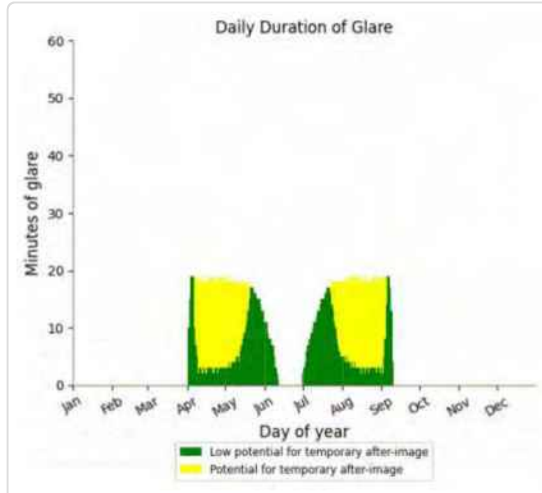
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 37	1,076	17.9	1,205	20.1

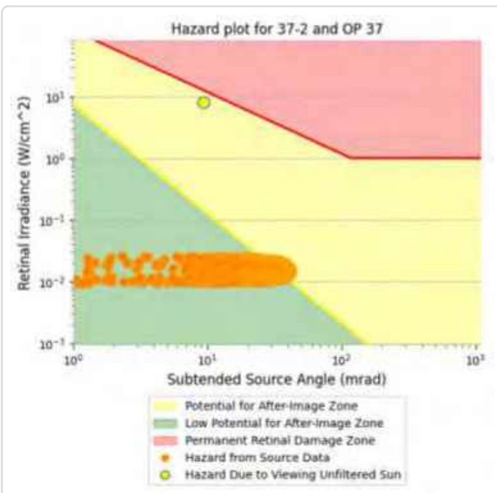
37-2 and OP 37

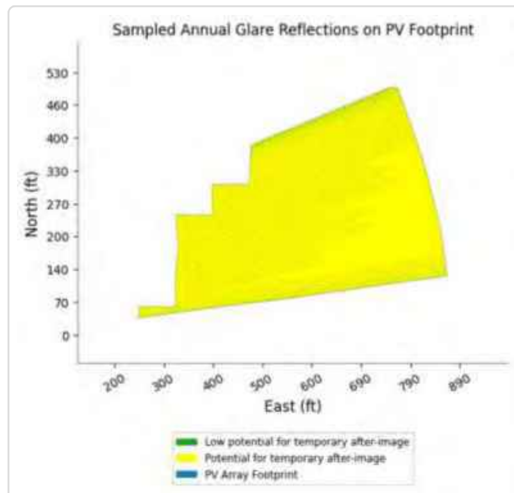
Yellow glare: 1,205 min.

Green glare: 1,076 min.









Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
The algorithm does not rigorously represent the detailed geometry of a system; detailed features such as gaps between modules, variable height of the PV array, and support structures may impact actual glare results. However, we have validated our models against several systems, including a PV array causing glare to the air-traffic control tower at Manchester-Boston Regional Airport and several sites in Albuquerque, and the tool accurately predicted the occurrence and intensity of glare at different times and days of the year.
Several V1 calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare. This primarily affects V1 analyses of path receptors.
Random number computations are utilized by various steps of the annual hazard analysis algorithm. Predicted minutes of glare can vary between runs as a result. This limitation primarily affects analyses of Observation Point receptors, including ATCTs. Note that the SGHAT/ ForgeSolar methodology has always relied on an analytical, qualitative approach to accurately determine the overall hazard (i.e. green vs. yellow) of expected glare on an annual basis.
The analysis does not automatically consider obstacles (either man-made or natural) between the observation points and the prescribed solar installation that may obstruct observed glare, such as trees, hills, buildings, etc.
The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
The variable direct normal irradiance (DNI) feature (if selected) scales the user-prescribed peak DNI using a typical clear-day irradiance profile. This profile has a lower DNI in the mornings and evenings and a maximum at solar noon. The scaling uses a clear-day irradiance profile based on a normalized time relative to sunrise, solar noon, and sunset, which are prescribed by a sun-position algorithm and the latitude and longitude obtained from Google maps. The actual DNI on any given day can be affected by cloud cover, atmospheric attenuation, and other environmental factors.
The ocular hazard predicted by the tool depends on a number of environmental, optical, and human factors, which can be uncertain. We provide input fields and typical ranges of values for these factors so that the user can vary these parameters to see if they have an impact on the results. The speed of SGHAT allows expedited sensitivity and parametric analyses.
The system output calculation is a DNI-based approximation that assumes clear, sunny skies year-round. It should not be used in place of more rigorous modeling methods.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.

Default glare analysis parameters and observer eye characteristics (for reference only):

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

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FORGESOLAR GLARE ANALYSIS

Project: **Exie Solar**
Site configuration: **44**

Created 21 May, 2025
Updated 21 May, 2025
Time-step 1 minute
Timezone offset UTC-5
Minimum sun altitude 0.0 deg
DNI peaks at 1,000.0 W/m^2
Category 100 MW to 1 GW
Site ID 149804.24968

Ocular transmission coefficient 0.5
Pupil diameter 0.002 m
Eye focal length 0.017 m
Sun subtended angle 9.3 mrad
PV analysis methodology V2

Summary of Results

Glare with potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
44-1	30.0	180.0	584	9.7	0	0.0	-
44-10	30.0	180.0	711	11.8	0	0.0	-
44-11	30.0	180.0	1,846	30.8	0	0.0	-
44-12	30.0	180.0	1,358	22.6	0	0.0	-
44-13	30.0	180.0	85	1.4	0	0.0	-
44-14	30.0	180.0	0	0.0	0	0.0	-
44-2	30.0	180.0	754	12.6	0	0.0	-
44-3	30.0	180.0	614	10.2	0	0.0	-
44-4	30.0	180.0	269	4.5	0	0.0	-
44-5	30.0	180.0	1,904	31.7	1,689	28.1	-
44-6	30.0	180.0	364	6.1	0	0.0	-
44-7	30.0	180.0	2,486	41.4	3,025	50.4	-
44-8	30.0	180.0	0	0.0	0	0.0	-
44-9	30.0	180.0	439	7.3	0	0.0	-

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 44	11,414	190.2	4,714	78.6

Component Data

PV Arrays

Name: 44-1
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.155485	-85.574804	737.81	12.00	749.81
2	37.155498	-85.574468	745.33	12.00	757.33
3	37.155511	-85.574090	750.36	12.00	762.36
4	37.155524	-85.573610	748.46	12.00	760.46
5	37.155332	-85.573610	748.40	12.00	760.40
6	37.155332	-85.574071	749.70	12.00	761.70
7	37.155333	-85.574476	745.30	12.00	757.30
8	37.155333	-85.574804	741.29	12.00	753.29

Name: 44-10
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.156829	-85.573950	760.22	12.00	772.22
2	37.156774	-85.573933	758.99	12.00	770.99
3	37.156760	-85.573950	759.05	12.00	771.05
4	37.156733	-85.574053	758.77	12.00	770.77
5	37.156692	-85.574191	759.42	12.00	771.42
6	37.156668	-85.574277	759.76	12.00	771.76
7	37.156668	-85.574409	759.29	12.00	771.29
8	37.156668	-85.574534	756.94	12.00	768.94
9	37.156679	-85.574534	756.96	12.00	768.96
10	37.156734	-85.574362	760.68	12.00	772.68
11	37.156788	-85.574190	760.98	12.00	772.98
12	37.156843	-85.574019	761.42	12.00	773.42
13	37.156843	-85.573967	760.83	12.00	772.83

Name: 44-11
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.157063	-85.574070	768.23	12.00	780.23
2	37.156994	-85.574035	766.27	12.00	778.27
3	37.156898	-85.574001	763.00	12.00	775.00
4	37.156843	-85.574190	762.20	12.00	774.20
5	37.156788	-85.574362	760.98	12.00	772.98
6	37.156734	-85.574550	755.76	12.00	767.76
7	37.156807	-85.574549	754.79	12.00	766.79
8	37.156871	-85.574549	755.47	12.00	767.47
9	37.156926	-85.574430	761.35	12.00	773.35
10	37.156953	-85.574344	763.92	12.00	775.92
11	37.156994	-85.574293	765.88	12.00	777.88
12	37.157063	-85.574121	768.56	12.00	780.56

Name: 44-12
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.157104	-85.574241	769.04	12.00	781.04
2	37.157118	-85.574241	769.31	12.00	781.31
3	37.157118	-85.574310	768.02	12.00	780.02
4	37.157077	-85.574430	763.38	12.00	775.38
5	37.157036	-85.574549	758.21	12.00	770.21
6	37.157069	-85.574549	758.32	12.00	770.32
7	37.157077	-85.574562	757.79	12.00	769.79
8	37.157132	-85.574447	763.65	12.00	775.65
9	37.157187	-85.574327	769.12	12.00	781.12
10	37.157214	-85.574258	771.34	12.00	783.34
11	37.157228	-85.574224	771.90	12.00	783.90
12	37.157228	-85.574172	771.83	12.00	783.83
13	37.157200	-85.574155	771.27	12.00	783.27
14	37.157145	-85.574121	770.29	12.00	782.29
15	37.157090	-85.574104	769.25	12.00	781.25
16	37.157049	-85.574207	768.26	12.00	780.26
17	37.157022	-85.574276	766.76	12.00	778.76
18	37.157022	-85.574310	766.29	12.00	778.29
19	37.156994	-85.574344	764.97	12.00	776.97
20	37.156981	-85.574413	762.72	12.00	774.72
21	37.156940	-85.574516	758.28	12.00	770.28
22	37.156981	-85.574533	758.21	12.00	770.21
23	37.157008	-85.574464	761.99	12.00	773.99
24	37.157063	-85.574361	765.27	12.00	777.27
25	37.157091	-85.574310	767.40	12.00	779.40

Name: 44-13
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.157297	-85.574309	771.57	12.00	783.57
2	37.157310	-85.574326	771.44	12.00	783.44
3	37.157228	-85.574481	764.75	12.00	776.75
4	37.157132	-85.574721	750.33	12.00	762.33
5	37.157132	-85.574773	745.52	12.00	757.52
6	37.157146	-85.574773	746.57	12.00	758.57
7	37.157297	-85.574464	767.46	12.00	779.46
8	37.157311	-85.574481	767.39	12.00	779.39
9	37.157256	-85.574584	763.18	12.00	775.18
10	37.157201	-85.574738	752.62	12.00	764.62
11	37.157242	-85.574738	753.96	12.00	765.96
12	37.157229	-85.574790	747.21	12.00	759.21
13	37.157284	-85.574790	749.41	12.00	761.41
14	37.157352	-85.574669	759.93	12.00	771.93
15	37.157434	-85.574549	765.20	12.00	777.20
16	37.157516	-85.574429	768.64	12.00	780.64
17	37.157530	-85.574395	769.60	12.00	781.60
18	37.157448	-85.574326	772.63	12.00	784.63
19	37.157379	-85.574275	773.37	12.00	785.37
20	37.157296	-85.574223	772.95	12.00	784.95
21	37.157269	-85.574275	771.80	12.00	783.80
22	37.157242	-85.574361	769.23	12.00	781.23
23	37.157214	-85.574430	766.19	12.00	778.19
24	37.157228	-85.574447	765.96	12.00	777.96
25	37.157255	-85.574395	768.63	12.00	780.63

Name: 44-14
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.157475	-85.574532	765.02	12.00	777.02
2	37.157434	-85.574635	760.38	12.00	772.38
3	37.157380	-85.574772	750.43	12.00	762.43
4	37.157462	-85.574755	750.58	12.00	762.58
5	37.157558	-85.574703	751.15	12.00	763.15
6	37.157695	-85.574651	752.66	12.00	764.66
7	37.157736	-85.574600	757.69	12.00	769.69
8	37.157736	-85.574566	760.13	12.00	772.13
9	37.157681	-85.574514	762.41	12.00	774.41
10	37.157626	-85.574463	765.96	12.00	777.96
11	37.157558	-85.574412	768.71	12.00	780.71
12	37.157536	-85.574412	768.93	12.00	780.93

Name: 44-2
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.155639	-85.573617	748.66	12.00	760.66
2	37.155551	-85.573610	748.51	12.00	760.51
3	37.155539	-85.574246	748.96	12.00	760.96
4	37.155539	-85.574519	744.69	12.00	756.69
5	37.155539	-85.574803	738.74	12.00	750.74
6	37.155649	-85.574803	740.91	12.00	752.91
7	37.155690	-85.574433	746.80	12.00	758.80
8	37.155717	-85.574090	751.63	12.00	763.63
9	37.155744	-85.573627	748.51	12.00	760.51

Name: 44-3
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.155840	-85.573644	748.28	12.00	760.28
2	37.155799	-85.573952	750.65	12.00	762.65
3	37.155772	-85.574227	751.54	12.00	763.54
4	37.155759	-85.574433	747.43	12.00	759.43
5	37.155732	-85.574803	741.97	12.00	753.97
6	37.155772	-85.574803	741.80	12.00	753.80
7	37.155814	-85.574803	742.03	12.00	754.03
8	37.155841	-85.574587	745.45	12.00	757.45
9	37.155896	-85.574295	751.01	12.00	763.01
10	37.155937	-85.574004	749.30	12.00	761.30
11	37.155963	-85.573660	747.64	12.00	759.64

Name: 44-4
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.155951	-85.574192	750.11	12.00	762.11
2	37.156005	-85.573780	746.93	12.00	758.93
3	37.156005	-85.573677	746.85	12.00	758.85
4	37.155991	-85.573677	747.12	12.00	759.12
5	37.155964	-85.573883	747.63	12.00	759.63
6	37.155937	-85.574107	750.18	12.00	762.18
7	37.155896	-85.574415	749.27	12.00	761.27
8	37.155910	-85.574467	748.39	12.00	760.39

Name: 44-5
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.155952	-85.576008	752.66	12.00	764.66
2	37.155784	-85.576008	749.34	12.00	761.34
3	37.155662	-85.576008	745.19	12.00	757.19
4	37.155662	-85.576259	756.23	12.00	768.23
5	37.155349	-85.576263	747.13	12.00	759.13
6	37.155336	-85.576287	748.22	12.00	760.22
7	37.155336	-85.576619	761.42	12.00	773.42
8	37.155337	-85.576943	767.74	12.00	779.74
9	37.155337	-85.577263	769.08	12.00	781.08
10	37.155580	-85.577262	765.15	12.00	777.15
11	37.155786	-85.577262	767.28	12.00	779.28
12	37.155996	-85.577261	765.68	12.00	777.68
13	37.155955	-85.577109	762.49	12.00	774.49
14	37.155886	-85.576989	759.29	12.00	771.29
15	37.155858	-85.576903	757.14	12.00	769.14
16	37.155776	-85.576886	756.36	12.00	768.36
17	37.155776	-85.576766	754.57	12.00	766.57
18	37.155872	-85.576612	753.18	12.00	765.18
19	37.155954	-85.576577	753.02	12.00	765.02
20	37.156064	-85.576405	753.06	12.00	765.06
21	37.156091	-85.576302	751.72	12.00	763.72
22	37.156091	-85.576011	747.03	12.00	759.03

Name: 44-6
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.155992	-85.574690	746.18	12.00	758.18
2	37.156033	-85.574432	750.36	12.00	762.36
3	37.156088	-85.574089	748.19	12.00	760.19
4	37.156142	-85.573711	745.58	12.00	757.58
5	37.156128	-85.573711	745.62	12.00	757.62
6	37.156074	-85.574003	747.53	12.00	759.53
7	37.156006	-85.574432	749.94	12.00	761.94
8	37.155979	-85.574655	746.74	12.00	758.74

Name: 44-7
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.156093	-85.577469	770.52	12.00	782.52
2	37.156024	-85.577398	768.47	12.00	780.47
3	37.155832	-85.577399	770.50	12.00	782.50
4	37.155580	-85.577399	768.00	12.00	780.00
5	37.155337	-85.577400	767.59	12.00	779.59
6	37.155338	-85.577650	771.26	12.00	783.26
7	37.155489	-85.577661	775.45	12.00	787.45
8	37.155497	-85.577900	778.71	12.00	790.71
9	37.155665	-85.577903	781.10	12.00	793.10
10	37.155822	-85.577907	783.08	12.00	795.08
11	37.155828	-85.578036	785.58	12.00	797.58
12	37.155833	-85.578036	785.66	12.00	797.66
13	37.155915	-85.577916	784.60	12.00	796.60
14	37.156011	-85.577761	780.32	12.00	792.32
15	37.156120	-85.577606	774.53	12.00	786.53
16	37.156175	-85.577503	772.47	12.00	784.47
17	37.156175	-85.577486	772.01	12.00	784.01

Name: 44-8
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.156156	-85.574140	749.12	12.00	761.12
2	37.156129	-85.574278	750.40	12.00	762.40
3	37.156102	-85.574432	750.90	12.00	762.90
4	37.156116	-85.574449	750.90	12.00	762.90
5	37.156157	-85.574312	750.84	12.00	762.84
6	37.156170	-85.574140	749.22	12.00	761.22

Name: 44-9
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.156747	-85.573916	758.11	12.00	770.11
2	37.156610	-85.574362	758.32	12.00	770.32
3	37.156624	-85.574397	758.81	12.00	770.81
4	37.156760	-85.573933	758.77	12.00	770.77

Discrete Observation Point Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (ft)	Height (ft)
OP 44	44	37.155340	-85.578756	783.77	5.40

Glare Analysis Results

Summary of Results Glare with potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
44-1	30.0	180.0	584	9.7	0	0.0	-
44-10	30.0	180.0	711	11.8	0	0.0	-
44-11	30.0	180.0	1,846	30.8	0	0.0	-
44-12	30.0	180.0	1,358	22.6	0	0.0	-
44-13	30.0	180.0	85	1.4	0	0.0	-
44-14	30.0	180.0	0	0.0	0	0.0	-
44-2	30.0	180.0	754	12.6	0	0.0	-
44-3	30.0	180.0	614	10.2	0	0.0	-
44-4	30.0	180.0	269	4.5	0	0.0	-
44-5	30.0	180.0	1,904	31.7	1,689	28.1	-
44-6	30.0	180.0	364	6.1	0	0.0	-
44-7	30.0	180.0	2,486	41.4	3,025	50.4	-
44-8	30.0	180.0	0	0.0	0	0.0	-
44-9	30.0	180.0	439	7.3	0	0.0	-

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 44	11,414	190.2	4,714	78.6

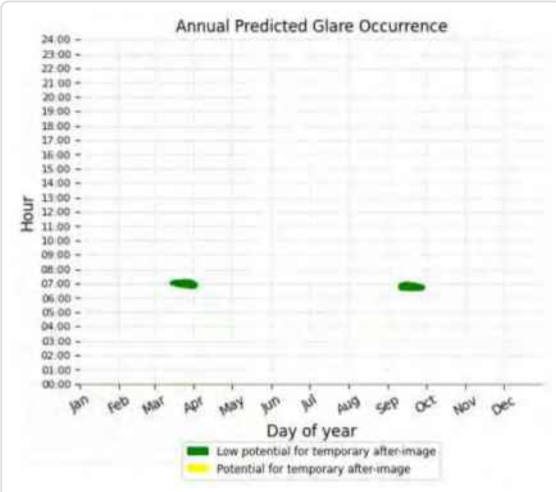
PV: 44-1 low potential for temporary after-image

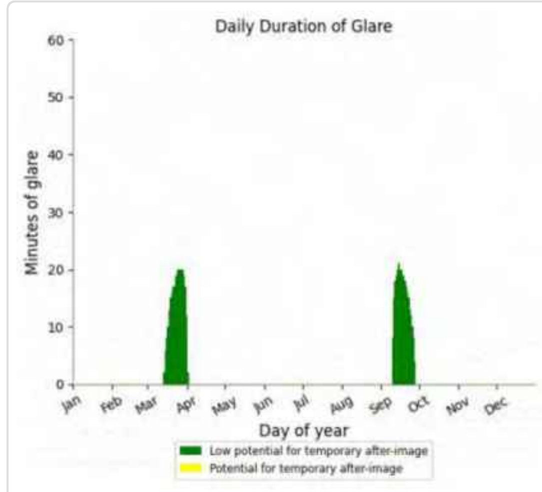
Receptor results ordered by category of glare

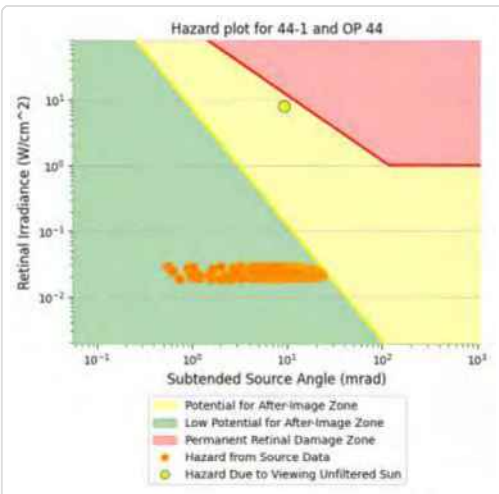
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 44	584	9.7	0	0.0

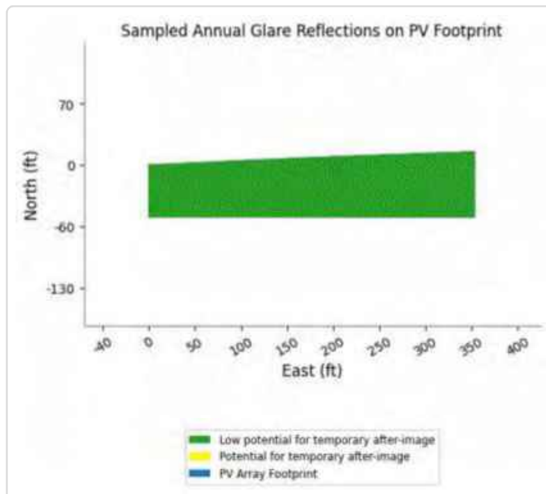
44-1 and OP 44

Yellow glare: none
Green glare: 584 min.









PV: 44-10 low potential for temporary after-image

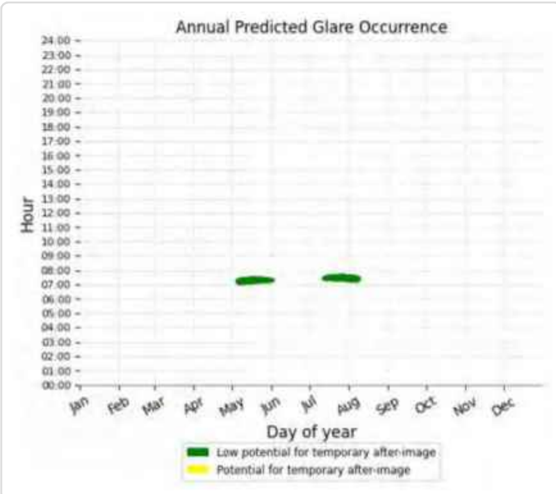
Receptor results ordered by category of glare

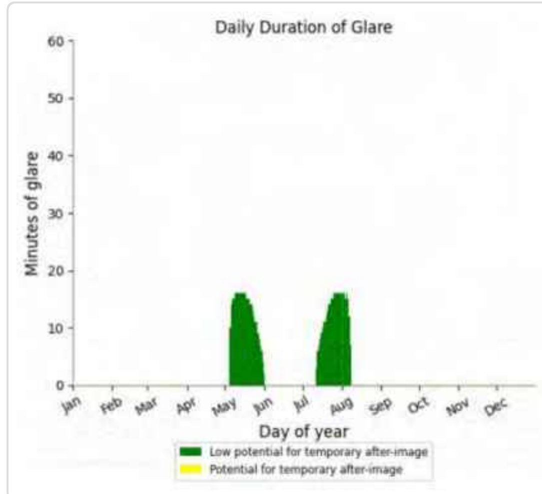
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 44	711	11.8	0	0.0

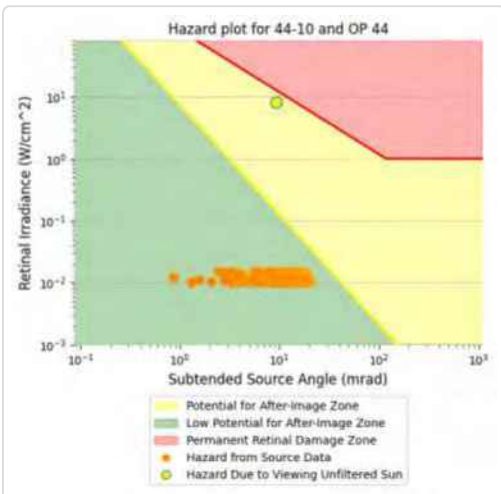
44-10 and OP 44

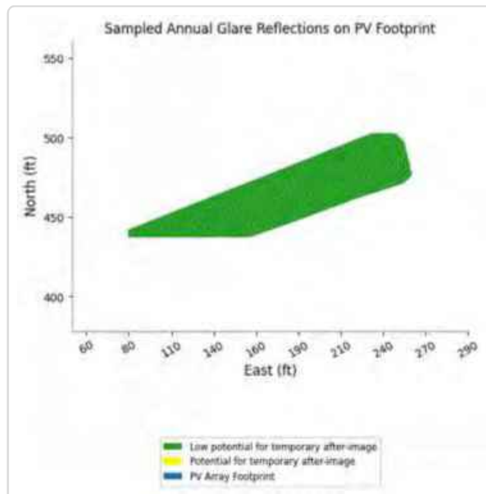
Yellow glare: none

Green glare: 711 min.









PV: 44-11 low potential for temporary after-image

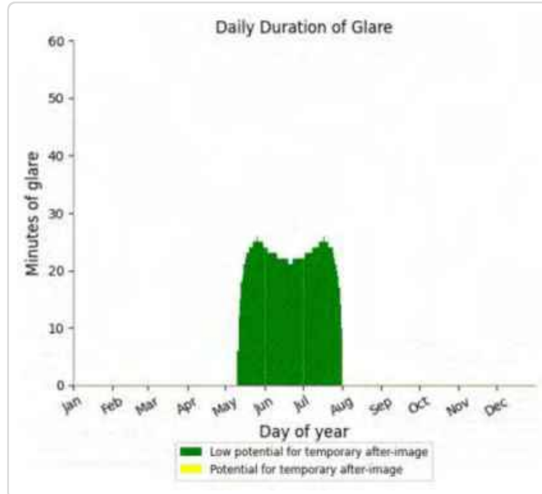
Receptor results ordered by category of glare

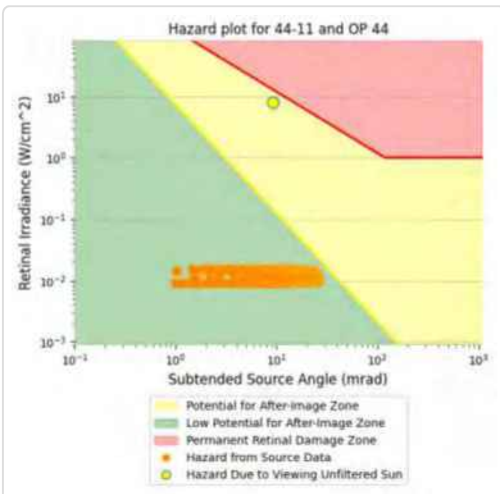
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 44	1,846	30.8	0	0.0

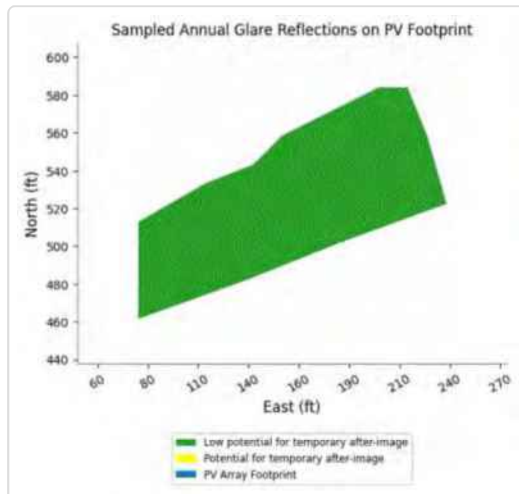
44-11 and OP 44

Yellow glare: none

Green glare: 1,846 min.







PV: 44-12 low potential for temporary after-image

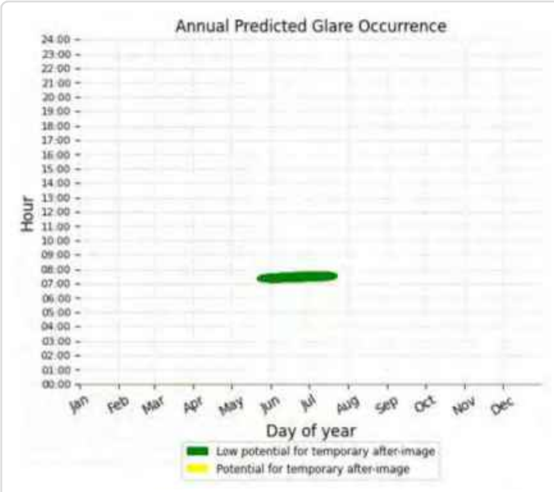
Receptor results ordered by category of glare

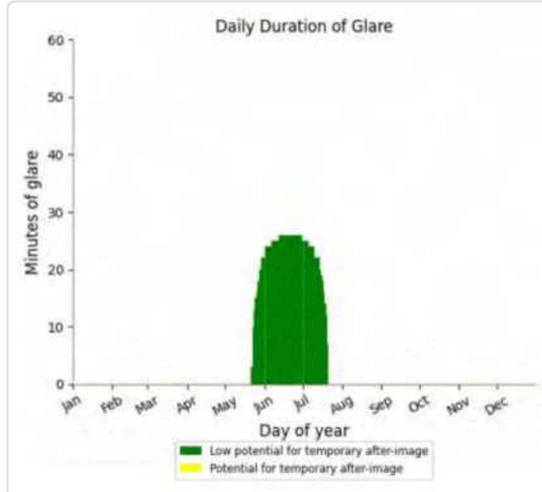
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 44	1,358	22.6	0	0.0

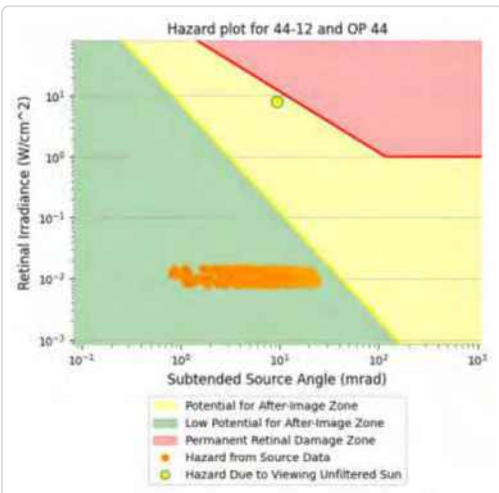
44-12 and OP 44

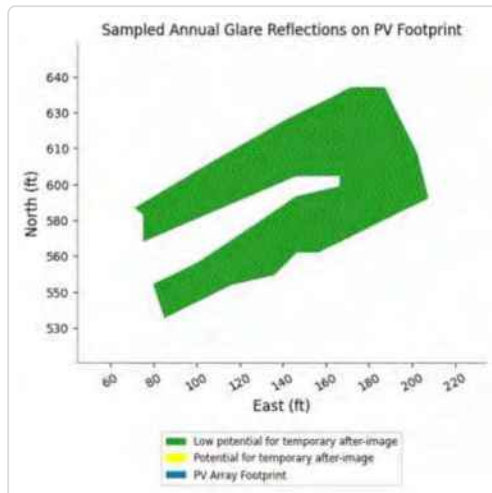
Yellow glare: none

Green glare: 1,358 min.









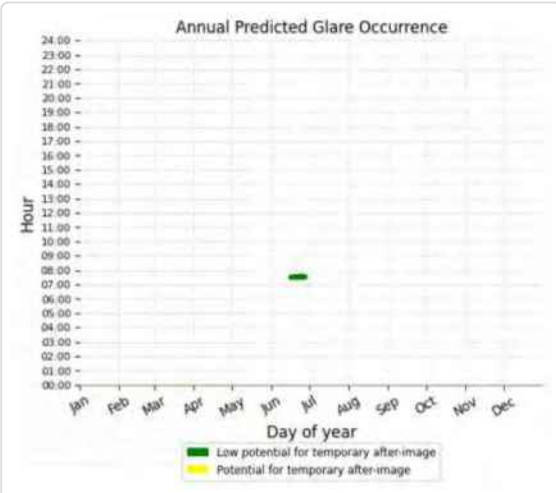
PV: 44-13 low potential for temporary after-image

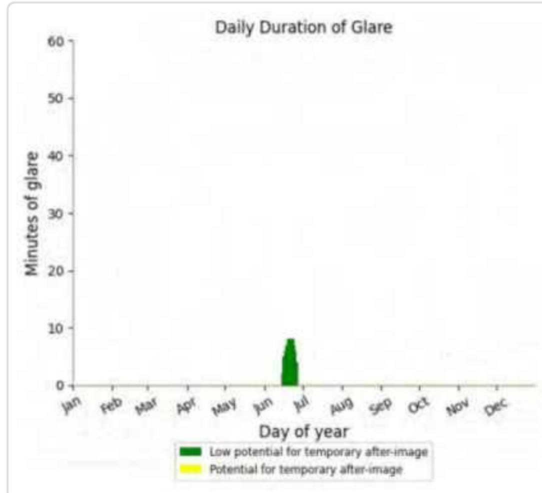
Receptor results ordered by category of glare

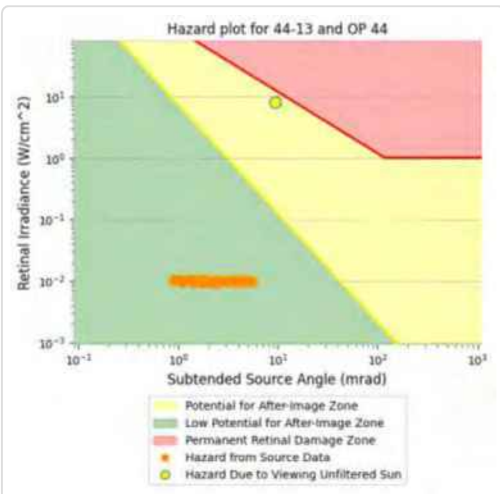
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 44	85	1.4	0	0.0

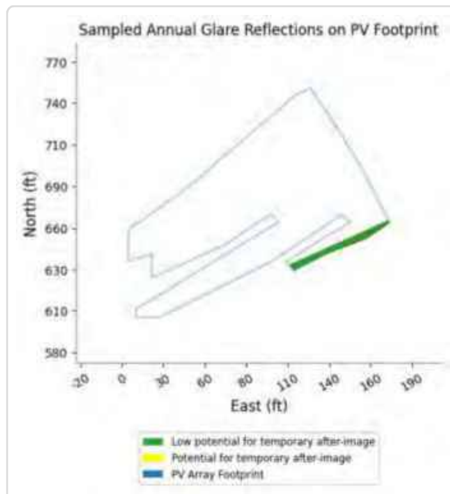
44-13 and OP 44

Yellow glare: none
Green glare: 85 min.









PV: 44-14 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 44	0	0.0	0	0.0

44-14 and OP 44

No glare found

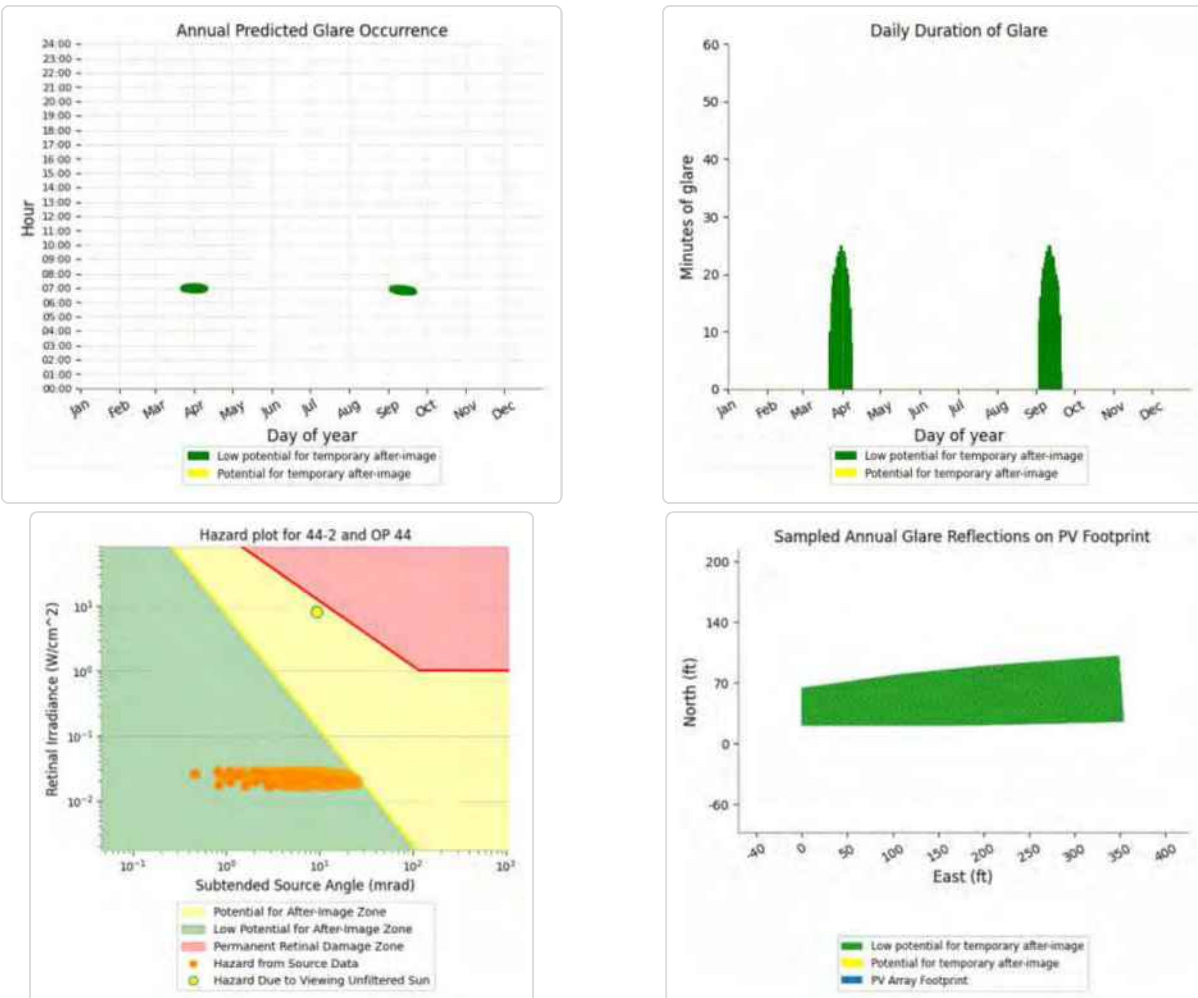
PV: 44-2 low potential for temporary after-image

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 44	754	12.6	0	0.0

44-2 and OP 44

Yellow glare: none
Green glare: 754 min.



PV: 44-3 low potential for temporary after-image

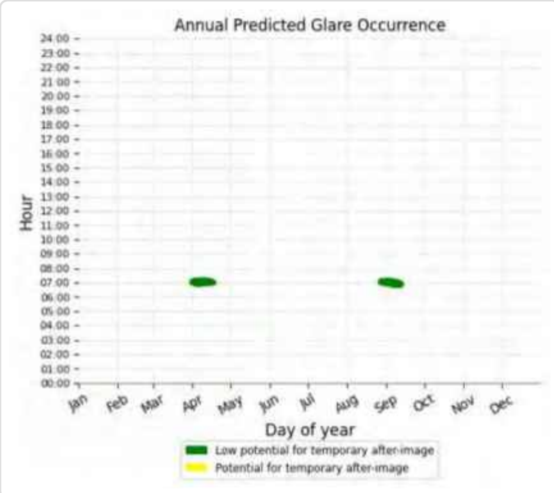
Receptor results ordered by category of glare

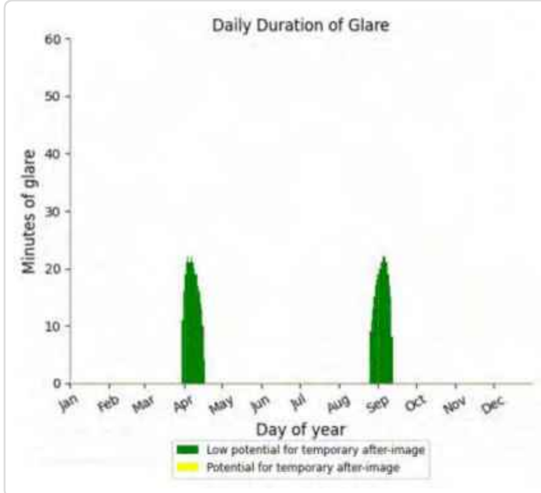
OP 44	614	10.2	0	0.0

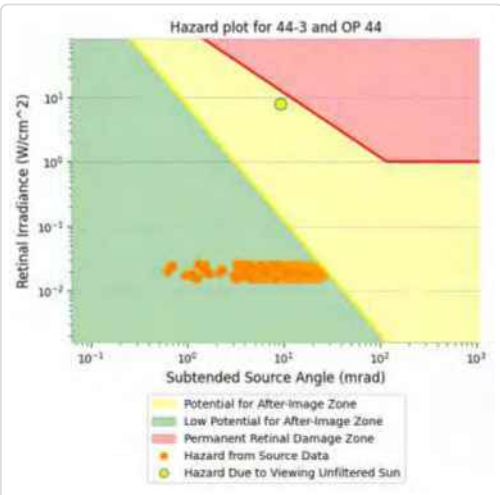
44-3 and OP 44

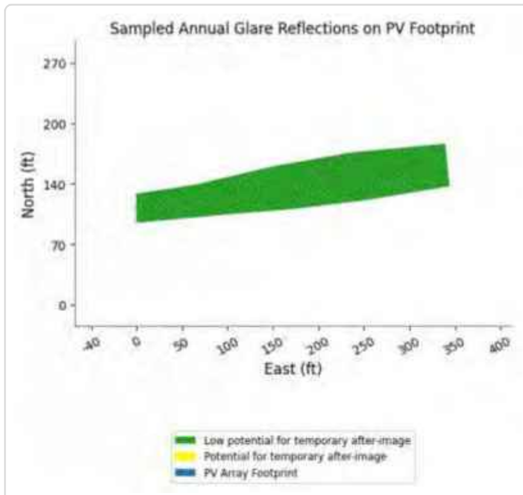
Yellow glare: none

Green glare: 614 min.









PV: 44-4 low potential for temporary after-image

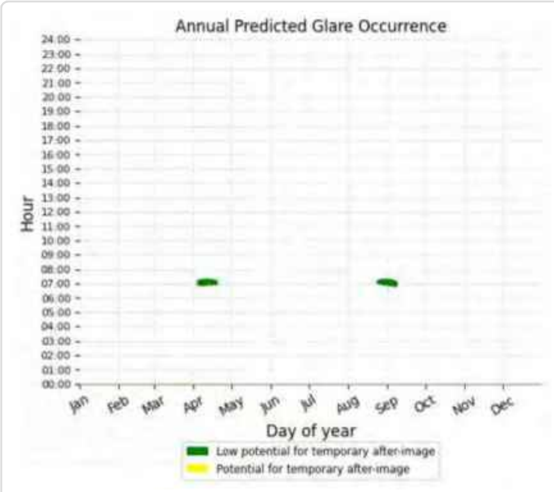
Receptor results ordered by category of glare

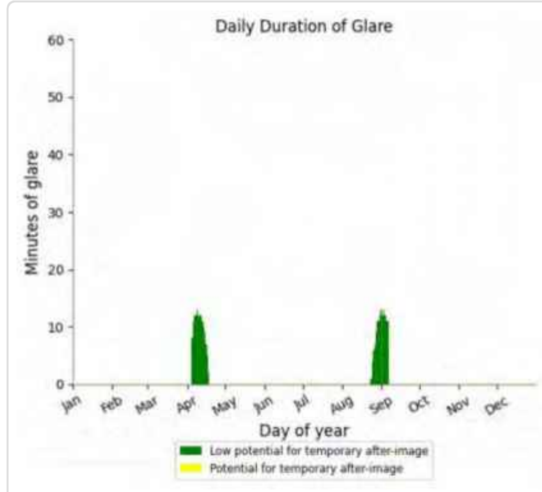
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 44	269	4.5	0	0.0

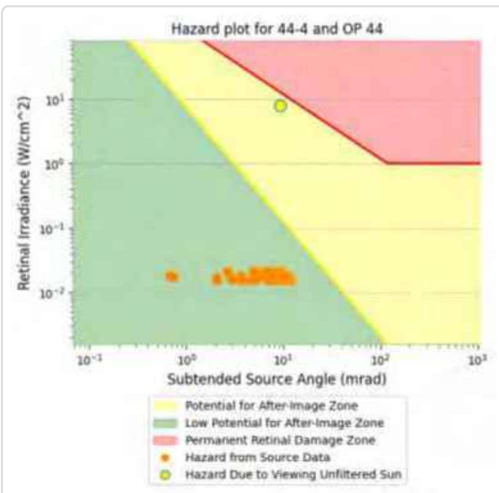
44-4 and OP 44

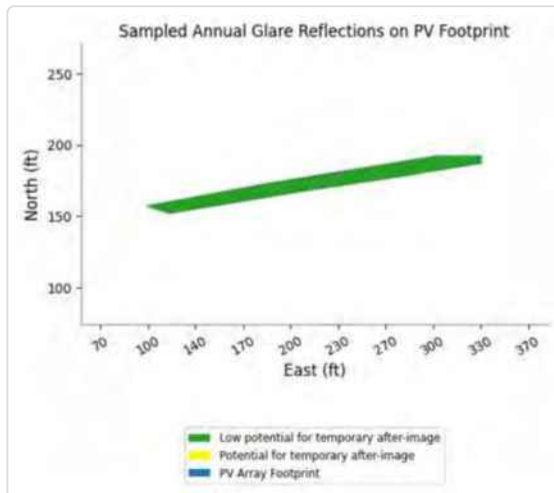
Yellow glare: none

Green glare: 269 min.









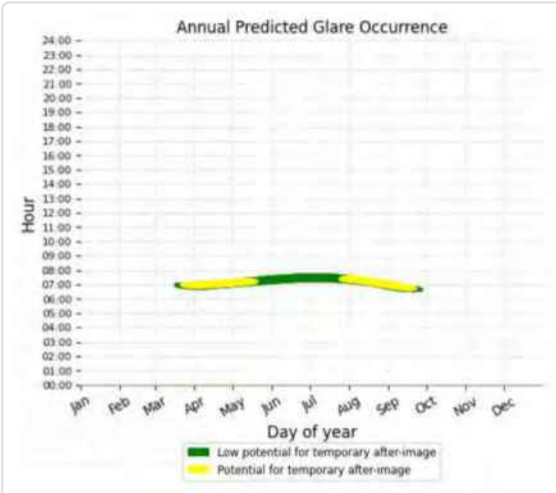
PV: 44-5 potential temporary after-image

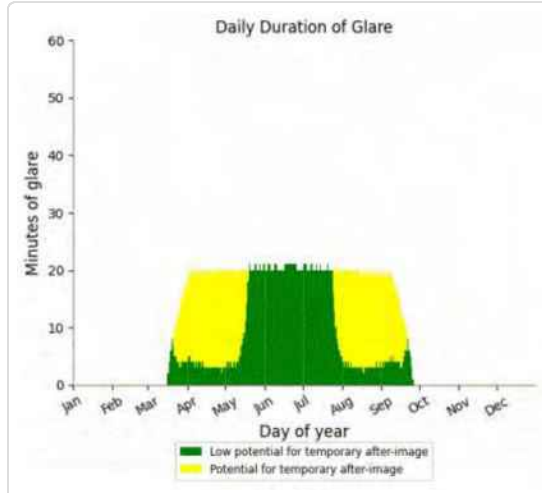
Receptor results ordered by category of glare

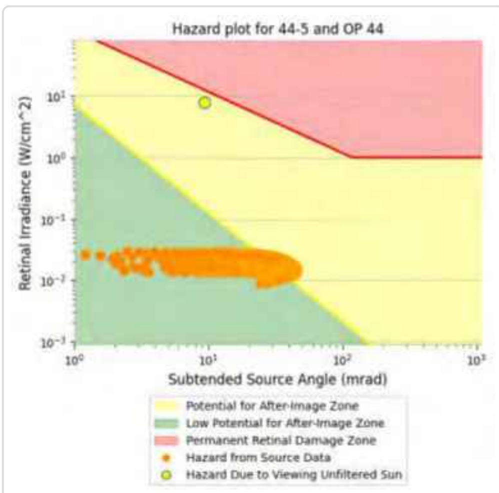
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 44	1,904	31.7	1,689	28.1

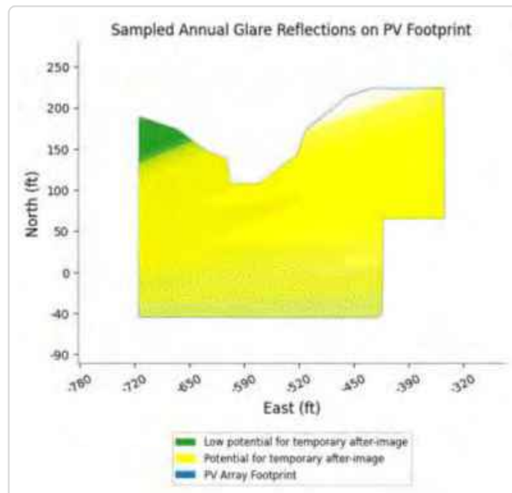
44-5 and OP 44

Yellow glare: 1,689 min.
Green glare: 1,904 min.









PV: 44-6 low potential for temporary after-image

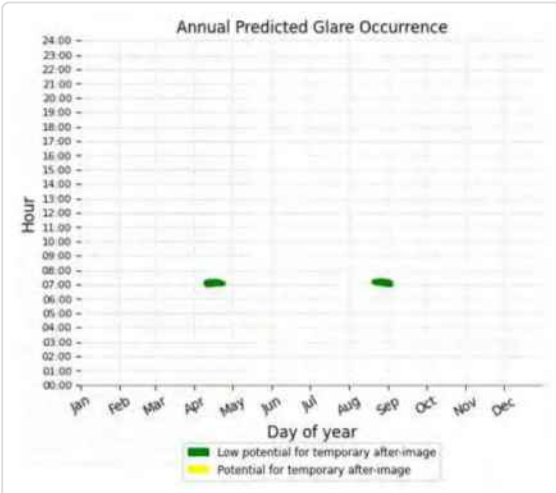
Receptor results ordered by category of glare

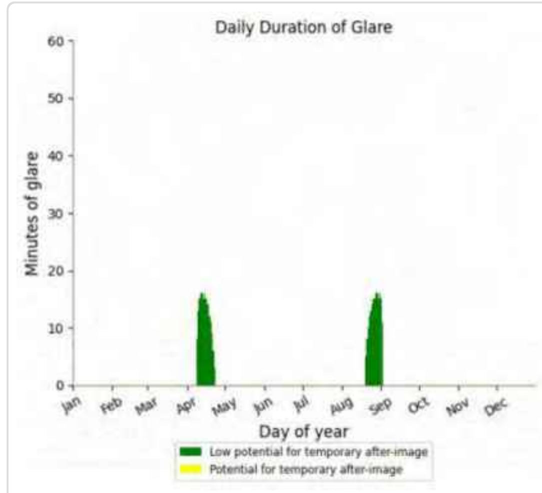
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 44	364	6.1	0	0.0

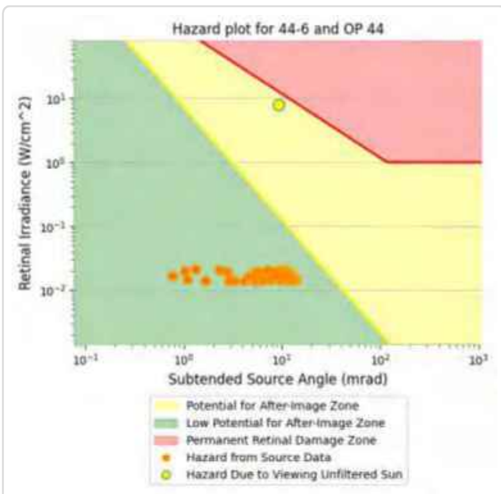
44-6 and OP 44

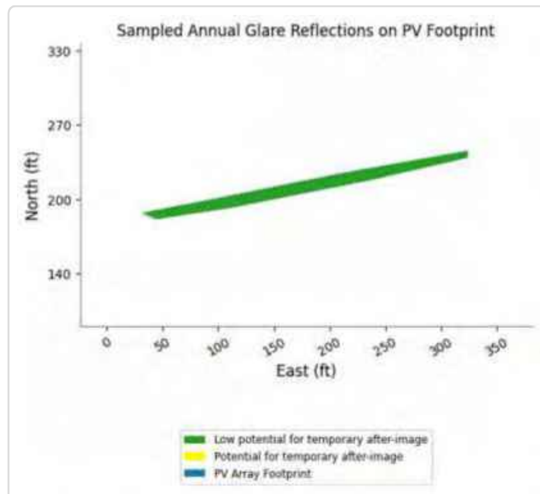
Yellow glare: none

Green glare: 364 min.









PV: 44-7 potential temporary after-image

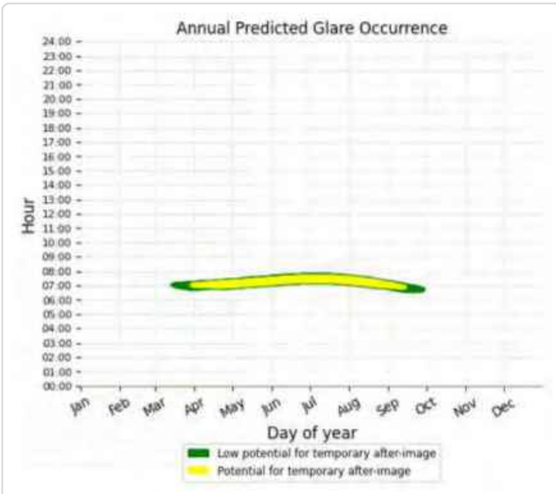
Receptor results ordered by category of glare

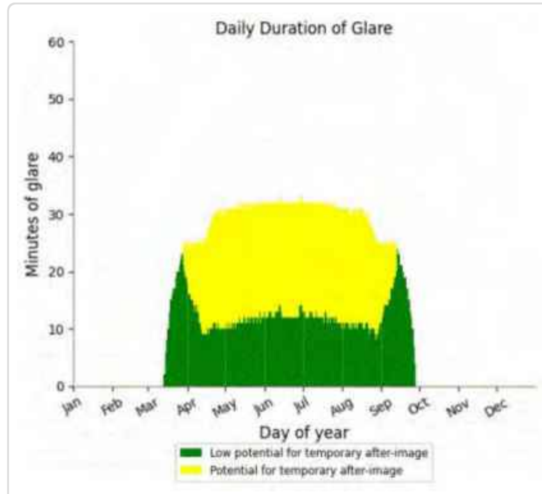
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 44	2,486	41.4	3,025	50.4

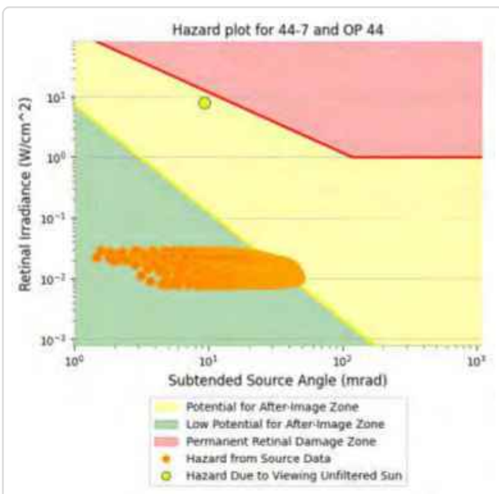
44-7 and OP 44

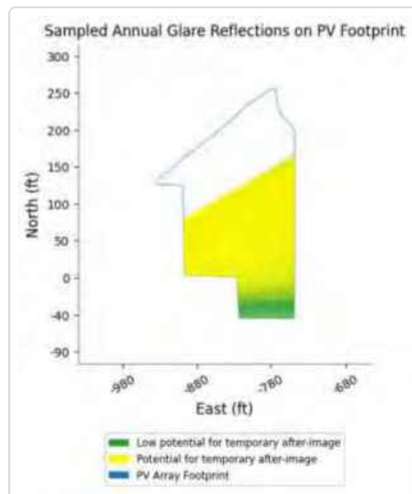
Yellow glare: 3,025 min.

Green glare: 2,486 min.









PV: 44-8 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 44	0	0.0	0	0.0

44-8 and OP 44

No glare found

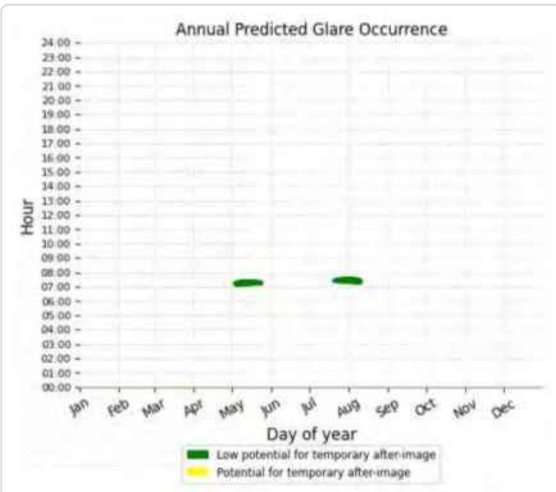
PV: 44-9 low potential for temporary after-image

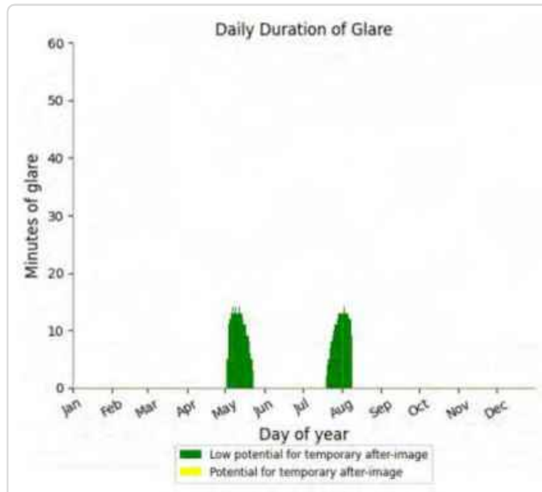
Receptor results ordered by category of glare

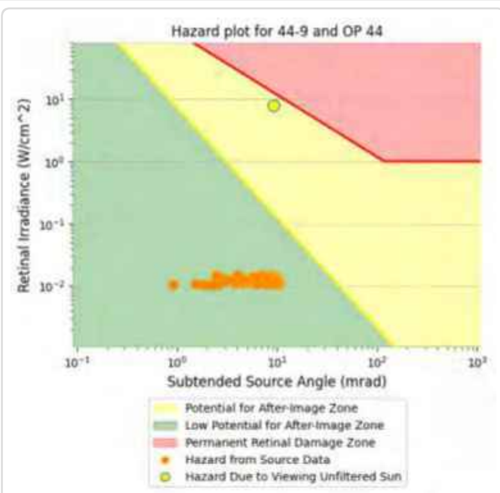
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 44	439	7.3	0	0.0

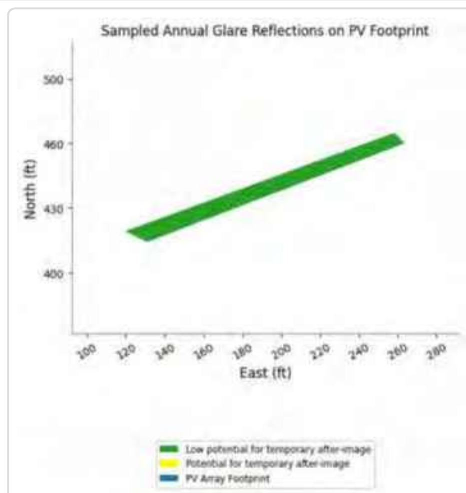
44-9 and OP 44

Yellow glare: none
Green glare: 439 min.









Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
The algorithm does not rigorously represent the detailed geometry of a system; detailed features such as gaps between modules, variable height of the PV array, and support structures may impact actual glare results. However, we have validated our models against several systems, including a PV array causing glare to the air-traffic control tower at Manchester-Boston Regional Airport and several sites in Albuquerque, and the tool accurately predicted the occurrence and intensity of glare at different times and days of the year.
Several V1 calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare. This primarily affects V1 analyses of path receptors.
Random number computations are utilized by various steps of the annual hazard analysis algorithm. Predicted minutes of glare can vary between runs as a result. This limitation primarily affects analyses of Observation Point receptors, including ATCTs. Note that the SGHAT/ForgeSolar methodology has always relied on an analytical, qualitative approach to accurately determine the overall hazard (i.e. green vs. yellow) of expected glare on an annual basis.
The analysis does not automatically consider obstacles (either man-made or natural) between the observation points and the prescribed solar installation that may obstruct observed glare, such as trees, hills, buildings, etc.
The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
The variable direct normal irradiance (DNI) feature (if selected) scales the user-prescribed peak DNI using a typical clear-day irradiance profile. This profile has a lower DNI in the mornings and evenings and a maximum at solar noon. The scaling uses a clear-day irradiance profile based on a normalized time relative to sunrise, solar noon, and sunset, which are prescribed by a sun-position algorithm and the latitude and longitude obtained from Google maps. The actual DNI on any given day can be affected by cloud cover, atmospheric attenuation, and other environmental factors.
The ocular hazard predicted by the tool depends on a number of environmental, optical, and human factors, which can be uncertain. We provide input fields and typical ranges of values for these factors so that the user can vary these parameters to see if they have an impact on the results. The speed of SGHAT allows expedited sensitivity and parametric analyses.
The system output calculation is a DNI-based approximation that assumes clear, sunny skies year-round. It should not be used in place of more rigorous modeling methods.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.

Default glare analysis parameters and observer eye characteristics (for reference only):

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

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FORGESOLAR GLARE ANALYSIS

Project: **Exie Solar**
Site configuration: **49**

Created 21 May, 2025
Updated 21 May, 2025
Time-step 1 minute
Timezone offset UTC-5
Minimum sun altitude 0.0 deg
DNI peaks at 1,000.0 W/m^2
Category 100 MW to 1 GW
Site ID 149803.24968

Ocular transmission coefficient 0.5
Pupil diameter 0.002 m
Eye focal length 0.017 m
Sun subtended angle 9.3 mrad
PV analysis methodology V2

Summary of Results Glare with potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
49-1	30.0	180.0	647	10.8	2,207	36.8	-

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 49	647	10.8	2,207	36.8

Component Data

PV Arrays

Name: 49-1
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.163188	-85.565459	800.43	12.00	812.43
2	37.162982	-85.565150	803.45	12.00	815.45
3	37.162844	-85.564973	804.09	12.00	816.09
4	37.162742	-85.564974	804.54	12.00	816.54
5	37.162620	-85.564976	805.18	12.00	817.18
6	37.162621	-85.565225	801.59	12.00	813.59
7	37.162431	-85.565226	802.35	12.00	814.35
8	37.162238	-85.565226	803.56	12.00	815.56
9	37.162238	-85.564977	806.44	12.00	818.44
10	37.162116	-85.564977	805.20	12.00	817.20
11	37.161993	-85.564957	803.62	12.00	815.62
12	37.161994	-85.565537	807.38	12.00	819.38
13	37.161995	-85.566218	811.56	12.00	823.56
14	37.161995	-85.566683	812.79	12.00	824.79
15	37.161996	-85.567226	810.51	12.00	822.51
16	37.162120	-85.567230	810.30	12.00	822.30
17	37.162287	-85.567235	809.99	12.00	821.99
18	37.162288	-85.567486	808.69	12.00	820.69
19	37.162372	-85.567486	808.81	12.00	820.81
20	37.162372	-85.567737	806.45	12.00	818.45
21	37.162578	-85.567736	808.13	12.00	820.13
22	37.162746	-85.567736	809.08	12.00	821.08
23	37.162914	-85.567735	808.05	12.00	820.05
24	37.162929	-85.567487	807.27	12.00	819.27
25	37.163040	-85.567486	806.21	12.00	818.21
26	37.162969	-85.567227	803.68	12.00	815.68
27	37.162902	-85.566981	802.65	12.00	814.65
28	37.162739	-85.566980	803.48	12.00	815.48
29	37.162597	-85.566979	804.89	12.00	816.89
30	37.162420	-85.566978	806.69	12.00	818.69
31	37.162419	-85.566597	803.88	12.00	815.88
32	37.162419	-85.566237	803.35	12.00	815.35
33	37.162514	-85.566234	801.76	12.00	813.76
34	37.162660	-85.566229	800.78	12.00	812.78
35	37.162660	-85.565978	800.64	12.00	812.64
36	37.162828	-85.565978	800.16	12.00	812.16
37	37.162996	-85.565978	800.01	12.00	812.01
38	37.162995	-85.565726	800.06	12.00	812.06
39	37.163163	-85.565726	799.84	12.00	811.84
40	37.163353	-85.565725	800.30	12.00	812.30

Discrete Observation Point Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (ft)	Height (ft)
OP 49	49	37.161990	-85.563699	818.07	5.40

Glare Analysis Results

Summary of Results Glare with potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
49-1	30.0	180.0	647	10.8	2,207	36.8	-

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 49	647	10.8	2,207	36.8

PV: 49-1 potential temporary after-image

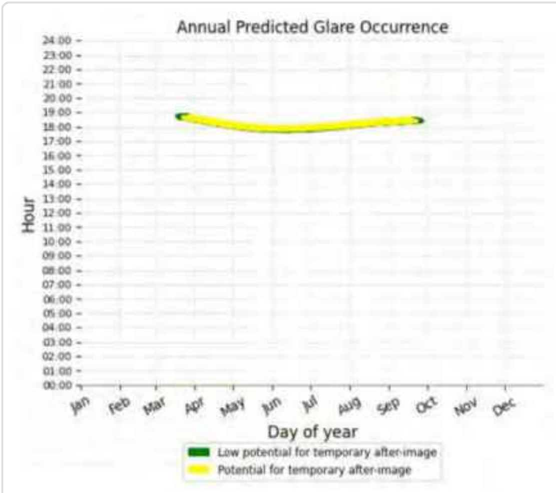
Receptor results ordered by category of glare

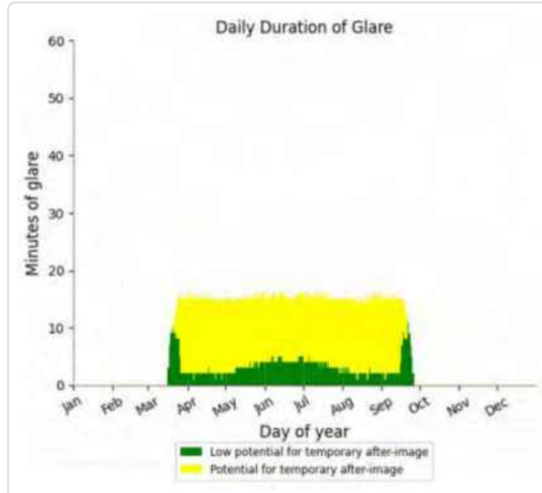
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 49	647	10.8	2,207	36.8

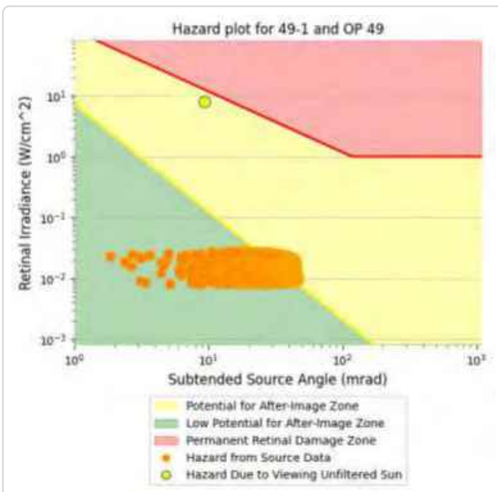
49-1 and OP 49

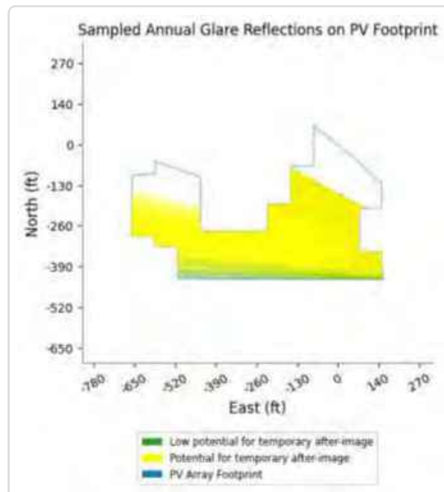
Yellow glare: 2,207 min.

Green glare: 647 min.









Assumptions

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"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
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The system output calculation is a DNI-based approximation that assumes clear, sunny skies year-round. It should not be used in place of more rigorous modeling methods.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.

Default glare analysis parameters and observer eye characteristics (for reference only):

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

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FORGESOLAR GLARE ANALYSIS

Project: **Exie Solar**
Site configuration: **54**

Created 21 May, 2025
Updated 21 May, 2025
Time-step 1 minute
Timezone offset UTC-5
Minimum sun altitude 0.0 deg
DNI peaks at 1,000.0 W/m^2
Category 100 MW to 1 GW
Site ID 149925.24968

Ocular transmission coefficient 0.5
Pupil diameter 0.002 m
Eye focal length 0.017 m
Sun subtended angle 9.3 mrad
PV analysis methodology V2

Summary of Results Glare with potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
54-1	30.0	180.0	121	2.0	0	0.0	-
54-2	30.0	180.0	2,282	38.0	2,483	41.4	-
54-3	30.0	180.0	0	0.0	0	0.0	-
54-4	30.0	180.0	792	13.2	0	0.0	-
54-5	30.0	180.0	821	13.7	0	0.0	-
54-6	30.0	180.0	905	15.1	0	0.0	-

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 54	4,921	82.0	2,483	41.4

Component Data

PV Arrays

Name: 54-1
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.142123	-85.569889	796.60	12.00	808.60
2	37.142123	-85.570023	791.89	12.00	803.89
3	37.142123	-85.570138	787.78	12.00	799.78
4	37.142254	-85.570138	786.98	12.00	798.98
5	37.142376	-85.570137	785.44	12.00	797.44
6	37.142280	-85.569987	791.09	12.00	803.09
7	37.142197	-85.569872	796.73	12.00	808.73

Name: 54-2
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.141645	-85.567623	802.42	12.00	814.42
2	37.141645	-85.567782	804.50	12.00	816.50
3	37.141783	-85.567782	806.81	12.00	818.81
4	37.141905	-85.567782	809.50	12.00	821.50
5	37.141905	-85.567532	806.07	12.00	818.07
6	37.142073	-85.567530	809.38	12.00	821.38
7	37.142203	-85.567530	811.28	12.00	823.28
8	37.142325	-85.567530	812.34	12.00	824.34
9	37.142325	-85.567421	811.08	12.00	823.08
10	37.142325	-85.567280	808.31	12.00	820.31
11	37.142371	-85.567278	808.65	12.00	820.65
12	37.142413	-85.567276	808.62	12.00	820.62
13	37.142440	-85.567190	805.19	12.00	817.19
14	37.142468	-85.567053	799.66	12.00	811.66
15	37.142358	-85.567071	799.67	12.00	811.67
16	37.142179	-85.567071	799.93	12.00	811.93
17	37.141960	-85.567174	800.81	12.00	812.81
18	37.141836	-85.567295	801.06	12.00	813.06
19	37.141823	-85.567381	801.41	12.00	813.41
20	37.141699	-85.567381	800.82	12.00	812.82
21	37.141644	-85.567433	801.03	12.00	813.03

Name: 54-3
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.142550	-85.567173	805.86	12.00	817.86
2	37.142550	-85.567139	804.79	12.00	816.79
3	37.142564	-85.567053	801.51	12.00	813.51
4	37.142550	-85.567053	801.20	12.00	813.20
5	37.142468	-85.567190	805.86	12.00	817.86
6	37.142427	-85.567276	808.65	12.00	820.65
7	37.142427	-85.567280	808.72	12.00	820.72
8	37.142513	-85.567279	808.43	12.00	820.43
9	37.142577	-85.567279	807.86	12.00	819.86
10	37.142661	-85.567278	806.52	12.00	818.52
11	37.142661	-85.567160	805.02	12.00	817.02
12	37.142660	-85.567028	801.69	12.00	813.69
13	37.142660	-85.567028	801.68	12.00	813.68
14	37.142605	-85.567087	803.61	12.00	815.61
15	37.142564	-85.567173	805.79	12.00	817.79

Name: 54-4
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.143260	-85.572970	774.58	12.00	786.58
2	37.143260	-85.573004	777.90	12.00	789.90
3	37.143273	-85.573038	778.79	12.00	790.79
4	37.143301	-85.573086	777.69	12.00	789.69
5	37.143356	-85.573085	773.58	12.00	785.58
6	37.143328	-85.573021	773.40	12.00	785.40
7	37.143273	-85.572969	774.10	12.00	786.10

Name: 54-5
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.142919	-85.571191	780.59	12.00	792.59
2	37.142751	-85.571196	783.54	12.00	795.54
3	37.142593	-85.571189	787.78	12.00	799.78
4	37.142587	-85.570911	785.88	12.00	797.88
5	37.142582	-85.570694	783.33	12.00	795.33
6	37.142460	-85.570695	788.42	12.00	800.42
7	37.142322	-85.570695	794.02	12.00	806.02
8	37.142433	-85.570999	795.06	12.00	807.06
9	37.142626	-85.571461	790.80	12.00	802.80
10	37.142777	-85.571856	795.12	12.00	807.12
11	37.142929	-85.572198	787.03	12.00	799.03
12	37.143256	-85.572197	783.87	12.00	795.87
13	37.143471	-85.572197	781.43	12.00	793.43
14	37.143753	-85.572196	779.10	12.00	791.10
15	37.143753	-85.572162	779.89	12.00	791.89
16	37.143615	-85.571957	786.39	12.00	798.39
17	37.143464	-85.571734	787.27	12.00	799.27
18	37.143216	-85.571374	780.50	12.00	792.50
19	37.143092	-85.571193	778.81	12.00	790.81

Name: 54-6
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.144069	-85.572659	767.34	12.00	779.34
2	37.144069	-85.572727	765.95	12.00	777.95
3	37.144056	-85.572830	767.16	12.00	779.16
4	37.144029	-85.572933	767.92	12.00	779.92
5	37.143960	-85.572951	767.57	12.00	779.57
6	37.143987	-85.572796	767.80	12.00	779.80
7	37.143918	-85.572796	767.99	12.00	779.99
8	37.143918	-85.572625	770.41	12.00	782.41
9	37.144042	-85.572625	767.84	12.00	779.84
10	37.144042	-85.572590	770.09	12.00	782.09
11	37.143959	-85.572470	780.39	12.00	792.39
12	37.143863	-85.572333	780.08	12.00	792.08
13	37.142984	-85.572335	781.54	12.00	793.54
14	37.143011	-85.572387	779.30	12.00	791.30
15	37.143231	-85.572386	777.38	12.00	789.38
16	37.143424	-85.572437	775.75	12.00	787.75
17	37.143589	-85.572608	772.52	12.00	784.52
18	37.143712	-85.572763	770.82	12.00	782.82
19	37.143740	-85.573084	770.52	12.00	782.52
20	37.143808	-85.573086	770.21	12.00	782.21
21	37.143809	-85.573336	770.90	12.00	782.90
22	37.143947	-85.573335	770.49	12.00	782.49
23	37.143974	-85.573328	770.35	12.00	782.35
24	37.144084	-85.573225	773.88	12.00	785.88
25	37.144194	-85.573122	784.18	12.00	796.18
26	37.144303	-85.573001	795.80	12.00	807.80
27	37.144303	-85.572984	796.07	12.00	808.07

Discrete Observation Point Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (ft)	Height (ft)
OP 54	54	37.141652	-85.569064	809.68	5.40

Glare Analysis Results

Summary of Results Glare with potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
54-1	30.0	180.0	121	2.0	0	0.0	-
54-2	30.0	180.0	2,282	38.0	2,483	41.4	-
54-3	30.0	180.0	0	0.0	0	0.0	-
54-4	30.0	180.0	792	13.2	0	0.0	-
54-5	30.0	180.0	821	13.7	0	0.0	-
54-6	30.0	180.0	905	15.1	0	0.0	-

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 54	4,921	82.0	2,483	41.4

PV: 54-1 low potential for temporary after-image

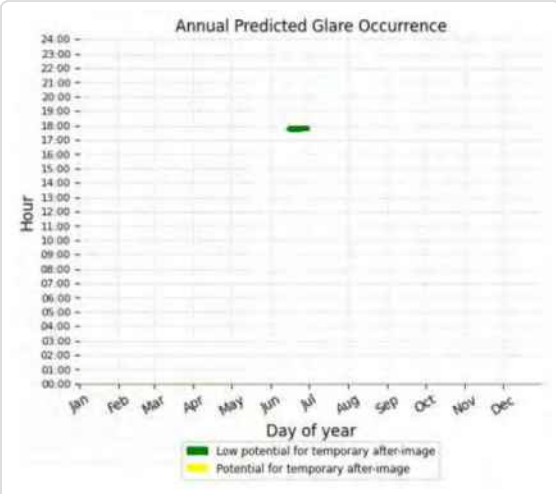
Receptor results ordered by category of glare

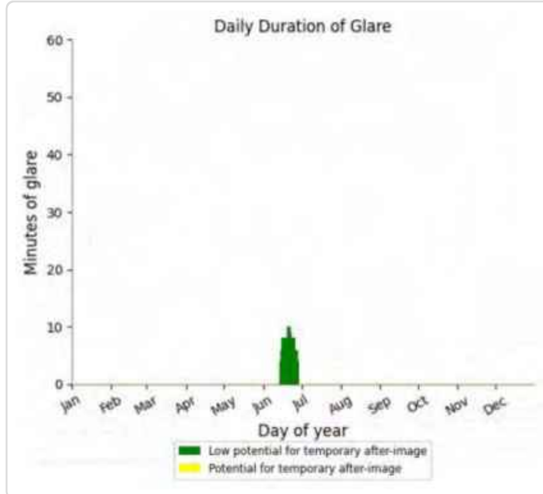
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 54	121	2.0	0	0.0

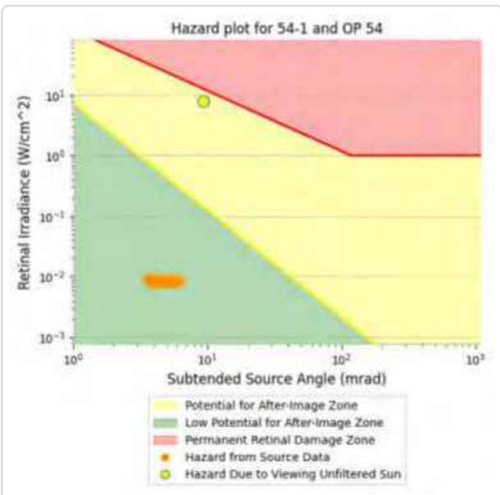
54-1 and OP 54

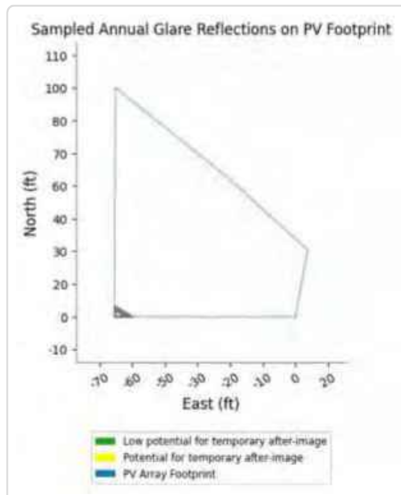
Yellow glare: none

Green glare: 121 min.









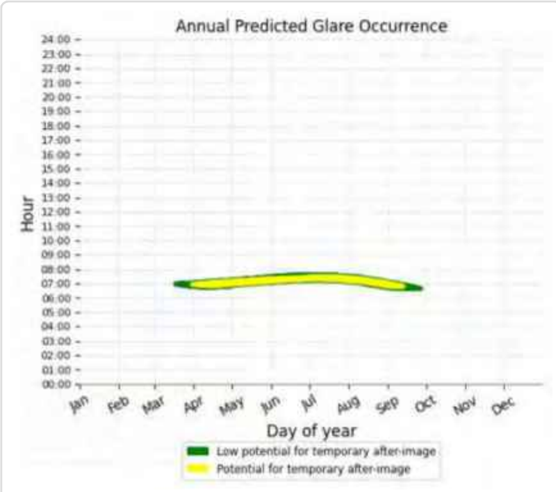
PV: 54-2 potential temporary after-image

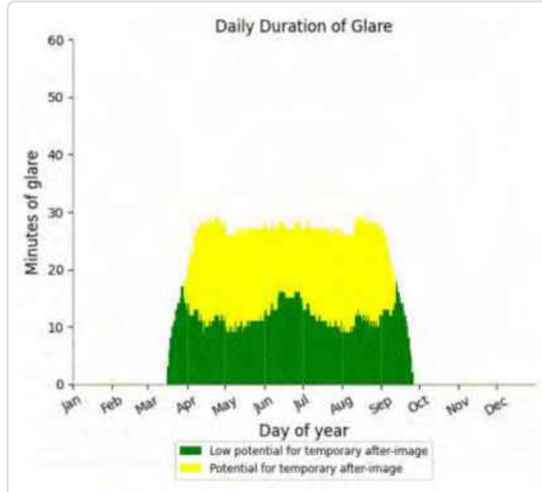
Receptor results ordered by category of glare

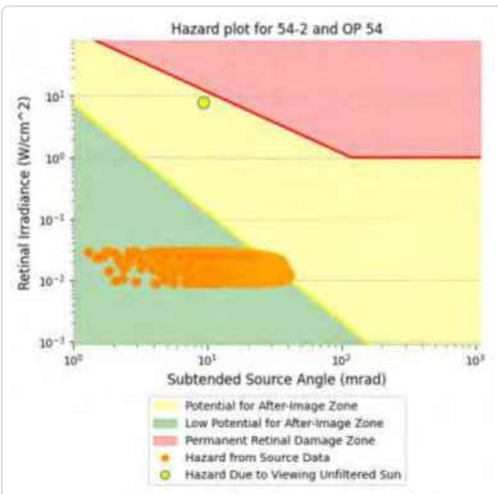
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 54	2,282	38.0	2,483	41.4

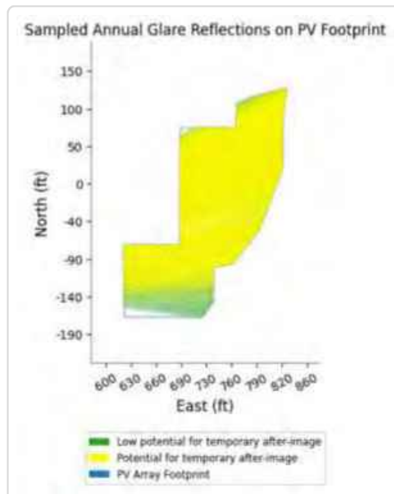
54-2 and OP 54

Yellow glare: 2,483 min.
Green glare: 2,282 min.









PV: 54-3 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 54	0	0.0	0	0.0

54-3 and OP 54

No glare found

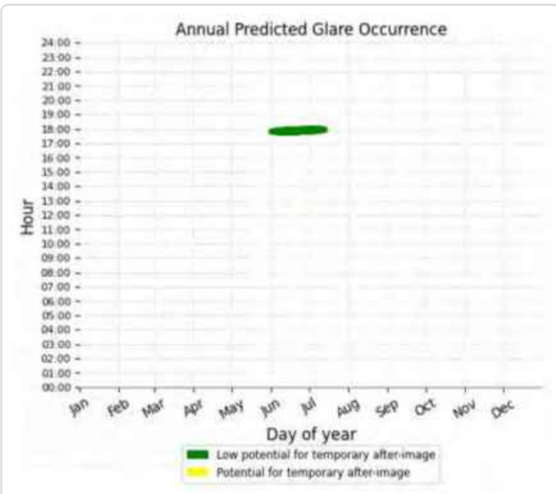
PV: 54-4 low potential for temporary after-image

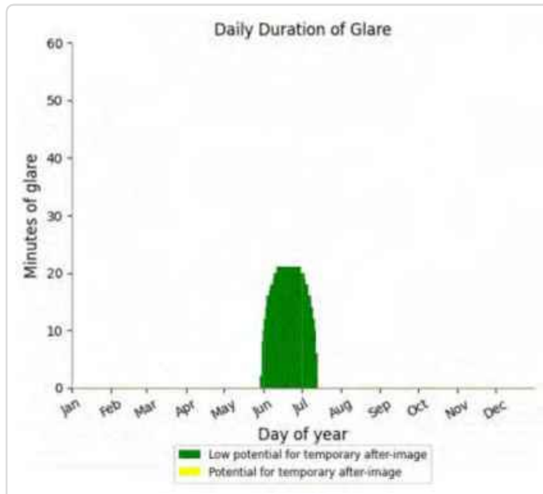
Receptor results ordered by category of glare

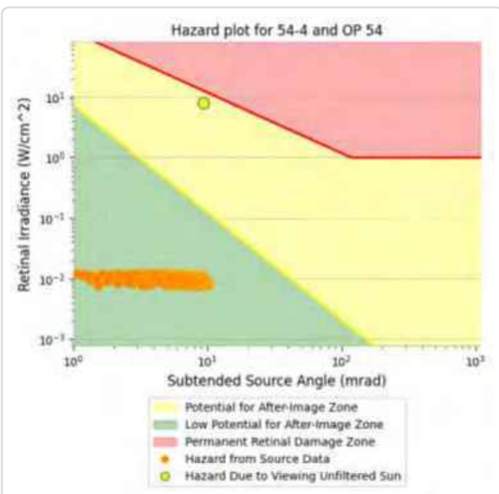
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 54	792	13.2	0	0.0

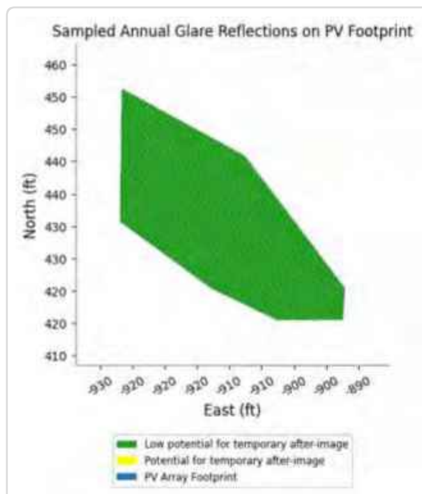
54-4 and OP 54

Yellow glare: none
Green glare: 792 min.









PV: 54-5 low potential for temporary after-image

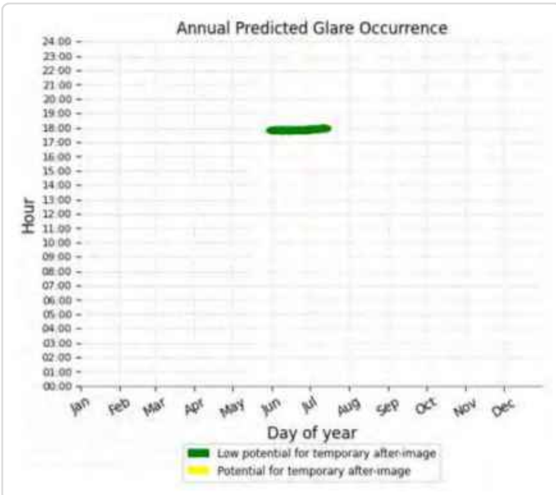
Receptor results ordered by category of glare

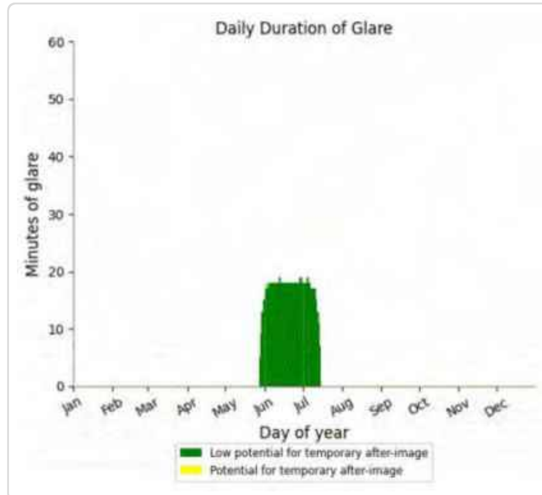
OP 54	821	13.7	0	0.0

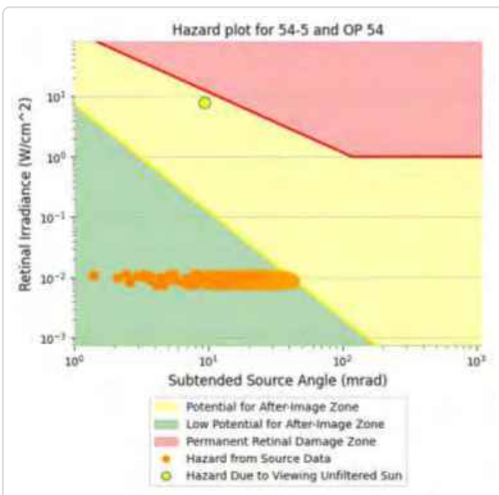
54-5 and OP 54

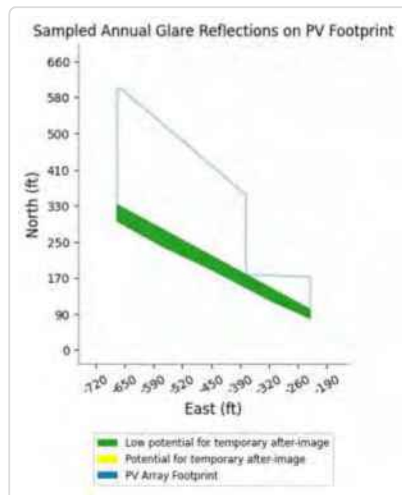
Yellow glare: none

Green glare: 821 min.









PV: 54-6 low potential for temporary after-image

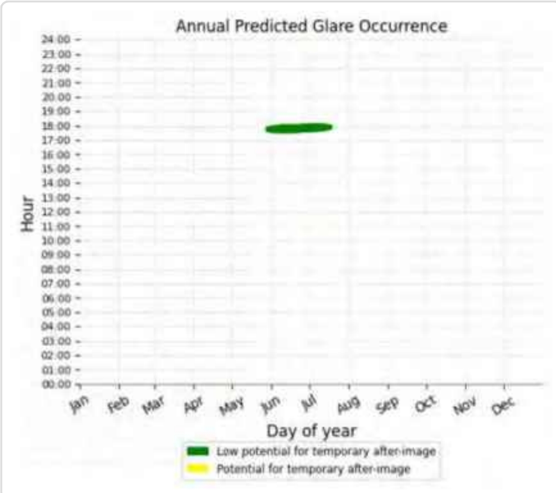
Receptor results ordered by category of glare

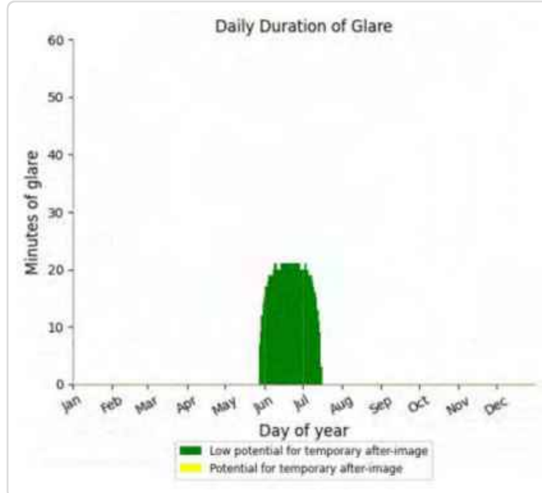
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 54	905	15.1	0	0.0

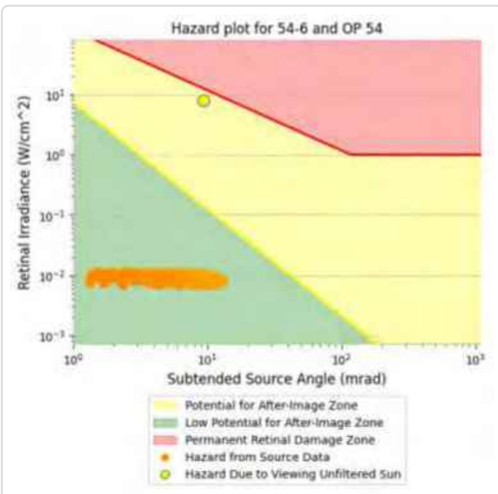
54-6 and OP 54

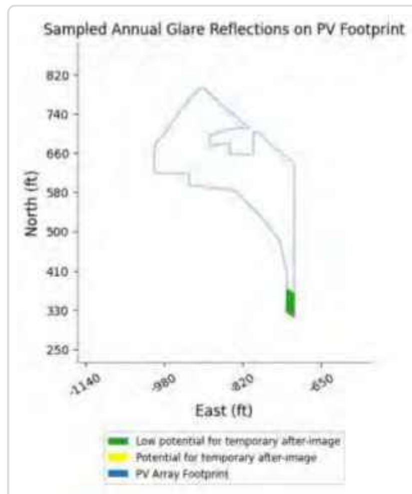
Yellow glare: none

Green glare: 905 min.









Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
The algorithm does not rigorously represent the detailed geometry of a system; detailed features such as gaps between modules, variable height of the PV array, and support structures may impact actual glare results. However, we have validated our models against several systems, including a PV array causing glare to the air-traffic control tower at Manchester-Boston Regional Airport and several sites in Albuquerque, and the tool accurately predicted the occurrence and intensity of glare at different times and days of the year.
Several V1 calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare. This primarily affects V1 analyses of path receptors.
Random number computations are utilized by various steps of the annual hazard analysis algorithm. Predicted minutes of glare can vary between runs as a result. This limitation primarily affects analyses of Observation Point receptors, including ATCTs. Note that the SGHAT/ ForgeSolar methodology has always relied on an analytical, qualitative approach to accurately determine the overall hazard (i.e. green vs. yellow) of expected glare on an annual basis.
The analysis does not automatically consider obstacles (either man-made or natural) between the observation points and the prescribed solar installation that may obstruct observed glare, such as trees, hills, buildings, etc.
The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
The variable direct normal irradiance (DNI) feature (if selected) scales the user-prescribed peak DNI using a typical clear-day irradiance profile. This profile has a lower DNI in the mornings and evenings and a maximum at solar noon. The scaling uses a clear-day irradiance profile based on a normalized time relative to sunrise, solar noon, and sunset, which are prescribed by a sun-position algorithm and the latitude and longitude obtained from Google maps. The actual DNI on any given day can be affected by cloud cover, atmospheric attenuation, and other environmental factors.
The ocular hazard predicted by the tool depends on a number of environmental, optical, and human factors, which can be uncertain. We provide input fields and typical ranges of values for these factors so that the user can vary these parameters to see if they have an impact on the results. The speed of SGHAT allows expedited sensitivity and parametric analyses.
The system output calculation is a DNI-based approximation that assumes clear, sunny skies year-round. It should not be used in place of more rigorous modeling methods.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.

Default glare analysis parameters and observer eye characteristics (for reference only):

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

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FORGESOLAR GLARE ANALYSIS

Project: **Exie Solar**
Site configuration: **64**

Created 21 May, 2025
Updated 21 May, 2025
Time-step 1 minute
Timezone offset UTC-5
Minimum sun altitude 0.0 deg
DNI peaks at 1,000.0 W/m^2
Category 100 MW to 1 GW
Site ID 149929.24968

Ocular transmission coefficient 0.5
Pupil diameter 0.002 m
Eye focal length 0.017 m
Sun subtended angle 9.3 mrad
PV analysis methodology V2

Summary of Results No glare predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
64-1	30.0	180.0	0	0.0	0	0.0	-
64-2	30.0	180.0	0	0.0	0	0.0	-
64-3	30.0	180.0	0	0.0	0	0.0	-

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 64	0	0.0	0	0.0

Component Data

PV Arrays

Name: 64-1
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.146628	-85.578719	719.45	12.00	731.45
2	37.146796	-85.578722	718.38	12.00	730.38
3	37.146795	-85.578471	719.75	12.00	731.75
4	37.146879	-85.578471	719.29	12.00	731.29
5	37.146879	-85.578221	720.66	12.00	732.66
6	37.146795	-85.578221	721.36	12.00	733.36
7	37.146701	-85.578222	721.61	12.00	733.61
8	37.146632	-85.578348	721.33	12.00	733.33
9	37.146536	-85.578537	721.25	12.00	733.25
10	37.146454	-85.578715	720.56	12.00	732.56

Name: 64-2
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.146948	-85.578084	721.17	12.00	733.17
2	37.147066	-85.578084	720.85	12.00	732.85
3	37.147215	-85.578083	720.36	12.00	732.36
4	37.147215	-85.577794	722.05	12.00	734.05
5	37.147214	-85.577456	724.71	12.00	736.71
6	37.147214	-85.577198	727.54	12.00	739.54
7	37.147111	-85.577387	726.43	12.00	738.43
8	37.147015	-85.577576	724.81	12.00	736.81
9	37.146865	-85.577885	724.62	12.00	736.62
10	37.146769	-85.578084	723.59	12.00	735.59

Name: 64-3
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.147866	-85.576647	723.66	12.00	735.66
2	37.147728	-85.576527	725.37	12.00	737.37
3	37.147591	-85.576442	727.54	12.00	739.54
4	37.147508	-85.576614	727.35	12.00	739.35
5	37.147399	-85.576827	728.25	12.00	740.25
6	37.147490	-85.576827	726.59	12.00	738.59
7	37.147595	-85.576827	725.19	12.00	737.19
8	37.147596	-85.576941	724.39	12.00	736.39
9	37.147596	-85.577078	724.43	12.00	736.43
10	37.147680	-85.577078	721.51	12.00	733.51
11	37.147764	-85.577078	720.39	12.00	732.39
12	37.147763	-85.577299	720.27	12.00	732.27
13	37.147825	-85.577213	719.52	12.00	731.52
14	37.147907	-85.577093	718.98	12.00	730.98
15	37.147970	-85.576990	718.89	12.00	730.89
16	37.147970	-85.576880	719.08	12.00	731.08
17	37.147969	-85.576750	719.78	12.00	731.78

Discrete Observation Point Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (ft)	Height (ft)
OP 64	64	37.145416	-85.580798	718.01	5.40

Glare Analysis Results

Summary of Results No glare predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
64-1	30.0	180.0	0	0.0	0	0.0	-
64-2	30.0	180.0	0	0.0	0	0.0	-
64-3	30.0	180.0	0	0.0	0	0.0	-

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 64	0	0.0	0	0.0

PV: 64-1 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 64	0	0.0	0	0.0

64-1 and OP 64

No glare found

PV: 64-2 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 64	0	0.0	0	0.0

64-2 and OP 64

No glare found

PV: 64-3 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 64	0	0.0	0	0.0

64-3 and OP 64

No glare found

Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
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Random number computations are utilized by various steps of the annual hazard analysis algorithm. Predicted minutes of glare can vary between runs as a result. This limitation primarily affects analyses of Observation Point receptors, including ATCTs. Note that the SGHAT/ ForgeSolar methodology has always relied on an analytical, qualitative approach to accurately determine the overall hazard (i.e. green vs. yellow) of expected glare on an annual basis.
The analysis does not automatically consider obstacles (either man-made or natural) between the observation points and the prescribed solar installation that may obstruct observed glare, such as trees, hills, buildings, etc.
The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
The variable direct normal irradiance (DNI) feature (if selected) scales the user-prescribed peak DNI using a typical clear-day irradiance profile. This profile has a lower DNI in the mornings and evenings and a maximum at solar noon. The scaling uses a clear-day irradiance profile based on a normalized time relative to sunrise, solar noon, and sunset, which are prescribed by a sun-position algorithm and the latitude and longitude obtained from Google maps. The actual DNI on any given day can be affected by cloud cover, atmospheric attenuation, and other environmental factors.
The ocular hazard predicted by the tool depends on a number of environmental, optical, and human factors, which can be uncertain. We provide input fields and typical ranges of values for these factors so that the user can vary these parameters to see if they have an impact on the results. The speed of SGHAT allows expedited sensitivity and parametric analyses.
The system output calculation is a DNI-based approximation that assumes clear, sunny skies year-round. It should not be used in place of more rigorous modeling methods.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.

Default glare analysis parameters and observer eye characteristics (for reference only):

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

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FORGESOLAR GLARE ANALYSIS

Project: **Exie Solar**
Site configuration: **65**

Created 21 May, 2025
Updated 23 Jul, 2025
Time-step 1 minute
Timezone offset UTC-5
Minimum sun altitude 0.0 deg
DNI peaks at 1,000.0 W/m^2
Category 100 MW to 1 GW
Site ID 149930.24968

Ocular transmission coefficient 0.5
Pupil diameter 0.002 m
Eye focal length 0.017 m
Sun subtended angle 9.3 mrad
PV analysis methodology V2

Summary of Results No glare predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
65-2	30.0	180.0	0	0.0	0	0.0	-

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 65	0	0.0	0	0.0

Component Data

PV Arrays

Name: 65-2
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.134862	-85.559833	847.39	12.00	859.39
2	37.134724	-85.559628	834.99	12.00	846.99
3	37.134573	-85.559405	839.28	12.00	851.28
4	37.134435	-85.559200	841.54	12.00	853.54
5	37.134284	-85.558977	841.38	12.00	853.38
6	37.134122	-85.558754	835.36	12.00	847.36
7	37.134122	-85.559037	832.18	12.00	844.18
8	37.134122	-85.559246	832.57	12.00	844.57
9	37.134123	-85.559497	828.50	12.00	840.50
10	37.134206	-85.559528	827.37	12.00	839.37
11	37.134207	-85.559750	822.12	12.00	834.12
12	37.134208	-85.560001	820.20	12.00	832.20
13	37.134208	-85.560250	824.32	12.00	836.32
14	37.134290	-85.560274	828.54	12.00	840.54
15	37.134291	-85.560366	829.52	12.00	841.52
16	37.134423	-85.560280	835.84	12.00	847.84
17	37.134588	-85.560143	842.36	12.00	854.36
18	37.134739	-85.560005	847.09	12.00	859.09
19	37.134862	-85.559867	849.37	12.00	861.37

Discrete Observation Point Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (ft)	Height (ft)
OP 65	65	37.132215	-85.555926	830.77	5.40

Glare Analysis Results

Summary of Results No glare predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
65-2	30.0	180.0	0	0.0	0	0.0	-

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 65	0	0.0	0	0.0

PV: 65-2 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 65	0	0.0	0	0.0

65-2 and OP 65

No glare found

Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
The algorithm does not rigorously represent the detailed geometry of a system; detailed features such as gaps between modules, variable height of the PV array, and support structures may impact actual glare results. However, we have validated our models against several systems, including a PV array causing glare to the air-traffic control tower at Manchester-Boston Regional Airport and several sites in Albuquerque, and the tool accurately predicted the occurrence and intensity of glare at different times and days of the year.
Several V1 calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare. This primarily affects V1 analyses of path receptors.
Random number computations are utilized by various steps of the annual hazard analysis algorithm. Predicted minutes of glare can vary between runs as a result. This limitation primarily affects analyses of Observation Point receptors, including ATCTs. Note that the SGHAT/ForgeSolar methodology has always relied on an analytical, qualitative approach to accurately determine the overall hazard (i.e. green vs. yellow) of expected glare on an annual basis.
The analysis does not automatically consider obstacles (either man-made or natural) between the observation points and the prescribed solar installation that may obstruct observed glare, such as trees, hills, buildings, etc.
The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
The variable direct normal irradiance (DNI) feature (if selected) scales the user-prescribed peak DNI using a typical clear-day irradiance profile. This profile has a lower DNI in the mornings and evenings and a maximum at solar noon. The scaling uses a clear-day irradiance profile based on a normalized time relative to sunrise, solar noon, and sunset, which are prescribed by a sun-position algorithm and the latitude and longitude obtained from Google maps. The actual DNI on any given day can be affected by cloud cover, atmospheric attenuation, and other environmental factors.
The ocular hazard predicted by the tool depends on a number of environmental, optical, and human factors, which can be uncertain. We provide input fields and typical ranges of values for these factors so that the user can vary these parameters to see if they have an impact on the results. The speed of SGHAT allows expedited sensitivity and parametric analyses.
The system output calculation is a DNI-based approximation that assumes clear, sunny skies year-round. It should not be used in place of more rigorous modeling methods.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.

Default glare analysis parameters and observer eye characteristics (for reference only):

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

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FORGESOLAR GLARE ANALYSIS

Project: **Exie Solar**
Site configuration: **68**

Created 21 May, 2025
Updated 21 May, 2025
Time-step 1 minute
Timezone offset UTC-5
Minimum sun altitude 0.0 deg
DNI peaks at 1,000.0 W/m^2
Category 100 MW to 1 GW
Site ID 149931.24968

Ocular transmission coefficient 0.5
Pupil diameter 0.002 m
Eye focal length 0.017 m
Sun subtended angle 9.3 mrad
PV analysis methodology V2

Summary of Results

Glare with potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
68-1	30.0	180.0	234	3.9	190	3.2	-
68-2	30.0	180.0	627	10.4	57	0.9	-
68-3	30.0	180.0	1,768	29.5	0	0.0	-
68-4	30.0	180.0	0	0.0	0	0.0	-
68-5	30.0	180.0	456	7.6	490	8.2	-
68-6	30.0	180.0	1,001	16.7	188	3.1	-
68-7	30.0	180.0	0	0.0	0	0.0	-

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 68	4,086	68.1	925	15.4

Component Data

PV Arrays

Name: 68-1
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.149009	-85.588139	766.73	12.00	778.73
2	37.148994	-85.587895	771.21	12.00	783.21
3	37.148995	-85.588456	765.21	12.00	777.21
4	37.148995	-85.588847	763.59	12.00	775.59
5	37.148996	-85.589430	755.53	12.00	767.53
6	37.148997	-85.589897	754.36	12.00	766.36
7	37.149161	-85.589897	755.88	12.00	767.88
8	37.149133	-85.589305	760.29	12.00	772.29
9	37.149105	-85.588722	767.74	12.00	779.74
10	37.149063	-85.588139	767.37	12.00	779.37

Name: 68-2
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.149127	-85.590034	753.97	12.00	765.97
2	37.149127	-85.590285	741.23	12.00	753.23
3	37.148997	-85.590284	752.93	12.00	764.93
4	37.148998	-85.590788	763.65	12.00	775.65
5	37.148998	-85.591290	766.01	12.00	778.01
6	37.148999	-85.591845	767.70	12.00	779.70
7	37.149123	-85.591827	768.44	12.00	780.44
8	37.149288	-85.591827	768.95	12.00	780.95
9	37.149273	-85.591484	768.41	12.00	780.41
10	37.149231	-85.590901	760.37	12.00	772.37
11	37.149190	-85.590472	740.66	12.00	752.66
12	37.149162	-85.590034	753.70	12.00	765.70

Name: 68-3
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.149460	-85.588018	778.56	12.00	790.56
2	37.149461	-85.588018	778.61	12.00	790.61
3	37.149475	-85.588104	780.63	12.00	792.63
4	37.149498	-85.588155	781.61	12.00	793.61
5	37.149498	-85.588037	779.96	12.00	791.96
6	37.149498	-85.587890	778.50	12.00	790.50
7	37.149460	-85.587890	777.39	12.00	789.39

Name: 68-4
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.149910	-85.585169	780.66	12.00	792.66
2	37.149992	-85.585032	780.63	12.00	792.63
3	37.150061	-85.584911	779.32	12.00	791.32
4	37.150166	-85.584705	772.40	12.00	784.40
5	37.150157	-85.584688	772.32	12.00	784.32
6	37.150061	-85.584843	777.99	12.00	789.99
7	37.149965	-85.584997	781.30	12.00	793.30
8	37.149883	-85.585135	781.39	12.00	793.39
9	37.149800	-85.585289	777.65	12.00	789.65
10	37.149814	-85.585306	777.27	12.00	789.27

Name: 68-5
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.149961	-85.588520	777.52	12.00	789.52
2	37.149965	-85.588642	775.94	12.00	787.94
3	37.149895	-85.588642	782.38	12.00	794.38
4	37.149797	-85.588642	784.17	12.00	796.17
5	37.149795	-85.588751	783.48	12.00	795.48
6	37.149794	-85.588875	783.03	12.00	795.03
7	37.149751	-85.588881	782.16	12.00	794.16
8	37.149847	-85.589167	777.98	12.00	789.98
9	37.149930	-85.589389	773.58	12.00	785.58
10	37.150026	-85.589681	771.71	12.00	783.71
11	37.150123	-85.589895	765.49	12.00	777.49
12	37.150164	-85.589895	764.46	12.00	776.46
13	37.150219	-85.589835	765.66	12.00	777.66
14	37.150260	-85.589749	768.64	12.00	780.64
15	37.150328	-85.589749	768.13	12.00	780.13
16	37.150397	-85.589749	769.58	12.00	781.58
17	37.150466	-85.589817	768.02	12.00	780.02
18	37.150535	-85.589894	768.62	12.00	780.62
19	37.150661	-85.589894	777.11	12.00	789.11
20	37.150796	-85.589894	779.76	12.00	791.76
21	37.150796	-85.589868	779.41	12.00	791.41
22	37.150685	-85.589679	775.89	12.00	787.89
23	37.150603	-85.589542	776.21	12.00	788.21
24	37.150479	-85.589302	779.14	12.00	791.14
25	37.150383	-85.589183	769.96	12.00	781.96
26	37.150383	-85.589320	771.17	12.00	783.17
27	37.150314	-85.589423	770.34	12.00	782.34
28	37.150232	-85.589492	769.49	12.00	781.49
29	37.150129	-85.589526	768.92	12.00	780.92
30	37.150067	-85.589458	768.03	12.00	780.03
31	37.150067	-85.589355	770.26	12.00	782.26
32	37.150081	-85.589286	771.92	12.00	783.92
33	37.150149	-85.589183	770.88	12.00	782.88
34	37.150218	-85.589131	771.42	12.00	783.42
35	37.150314	-85.589097	770.30	12.00	782.30
36	37.150328	-85.589063	771.75	12.00	783.75
37	37.150314	-85.589028	774.38	12.00	786.38
38	37.149964	-85.588411	780.95	12.00	792.95

Name: 68-6
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.150808	-85.590031	780.68	12.00	792.68
2	37.150677	-85.590031	776.88	12.00	788.88
3	37.150555	-85.590031	769.24	12.00	781.24
4	37.150555	-85.590252	774.19	12.00	786.19
5	37.150525	-85.590286	773.76	12.00	785.76
6	37.150429	-85.590265	768.68	12.00	780.68
7	37.150428	-85.590212	765.50	12.00	777.50
8	37.150370	-85.590212	763.29	12.00	775.29
9	37.150302	-85.590246	762.09	12.00	774.09
10	37.150261	-85.590281	761.08	12.00	773.08
11	37.150316	-85.590504	770.28	12.00	782.28
12	37.150412	-85.590778	767.71	12.00	779.71
13	37.150495	-85.591035	774.85	12.00	786.85
14	37.150591	-85.591285	773.84	12.00	785.84
15	37.150707	-85.591284	772.81	12.00	784.81
16	37.150847	-85.591284	770.75	12.00	782.75
17	37.150852	-85.591163	772.72	12.00	784.72
18	37.150857	-85.591040	774.23	12.00	786.23
19	37.150959	-85.591037	774.01	12.00	786.01
20	37.151099	-85.591033	772.73	12.00	784.73
21	37.151098	-85.590782	774.76	12.00	786.76
22	37.151267	-85.590781	773.53	12.00	785.53
23	37.151266	-85.590742	773.93	12.00	785.93
24	37.151181	-85.590553	776.02	12.00	788.02
25	37.151071	-85.590348	778.66	12.00	790.66
26	37.150961	-85.590159	780.56	12.00	792.56
27	37.150878	-85.590031	780.36	12.00	792.36

Name: 68-7
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.151102	-85.583142	764.54	12.00	776.54
2	37.151212	-85.582970	769.12	12.00	781.12
3	37.151335	-85.582781	773.92	12.00	785.92
4	37.151458	-85.582575	778.02	12.00	790.02
5	37.151403	-85.582524	776.56	12.00	788.56
6	37.151294	-85.582713	774.67	12.00	786.67
7	37.151170	-85.582936	769.30	12.00	781.30
8	37.151088	-85.583091	766.45	12.00	778.45
9	37.150972	-85.583311	766.17	12.00	778.17
10	37.150992	-85.583311	765.25	12.00	777.25

Discrete Observation Point Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (ft)	Height (ft)
OP 68	68	37.148988	-85.586690	790.52	5.40

Glare Analysis Results

Summary of Results Glare with potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
68-1	30.0	180.0	234	3.9	190	3.2	-
68-2	30.0	180.0	627	10.4	57	0.9	-
68-3	30.0	180.0	1,768	29.5	0	0.0	-
68-4	30.0	180.0	0	0.0	0	0.0	-
68-5	30.0	180.0	456	7.6	490	8.2	-
68-6	30.0	180.0	1,001	16.7	188	3.1	-
68-7	30.0	180.0	0	0.0	0	0.0	-

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 68	4,086	68.1	925	15.4

PV: 68-1 potential temporary after-image

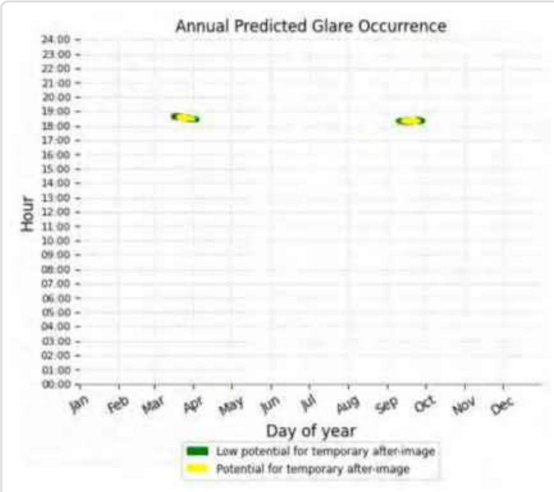
Receptor results ordered by category of glare

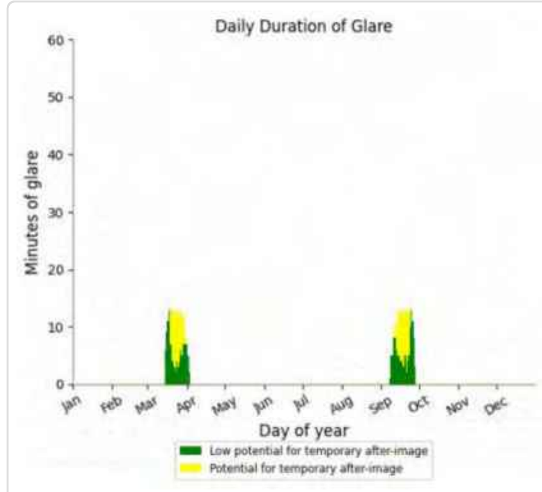
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 68	234	3.9	190	3.2

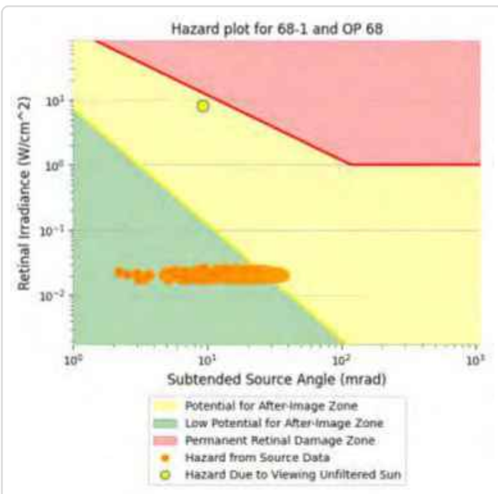
68-1 and OP 68

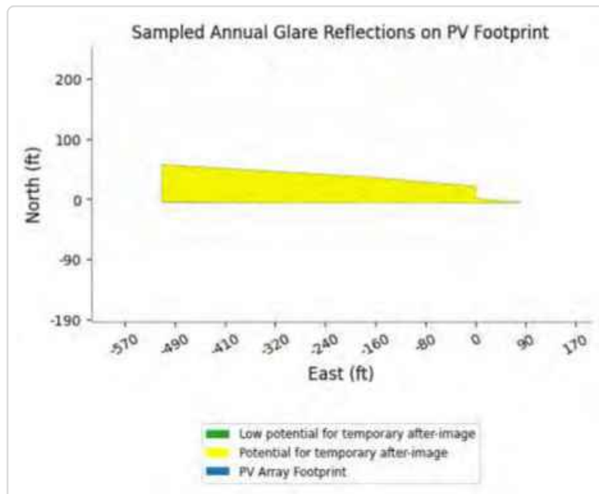
Yellow glare: 190 min.

Green glare: 234 min.









PV: 68-2 potential temporary after-image

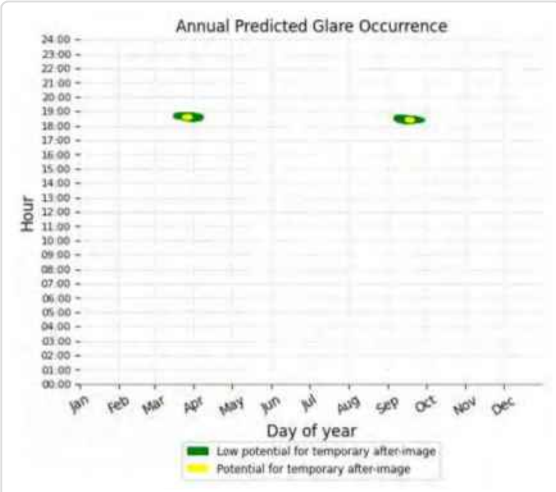
Receptor results ordered by category of glare

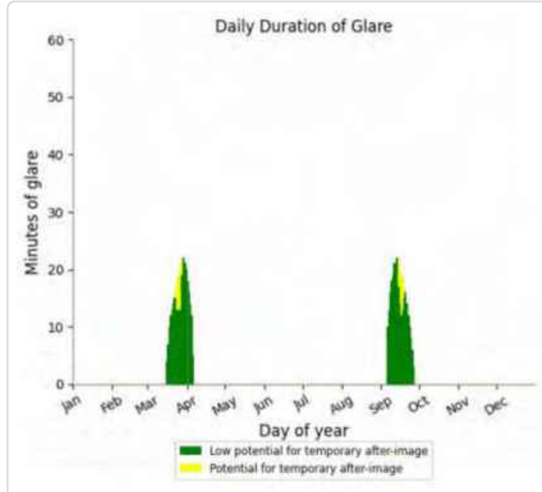
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 68	627	10.4	57	0.9

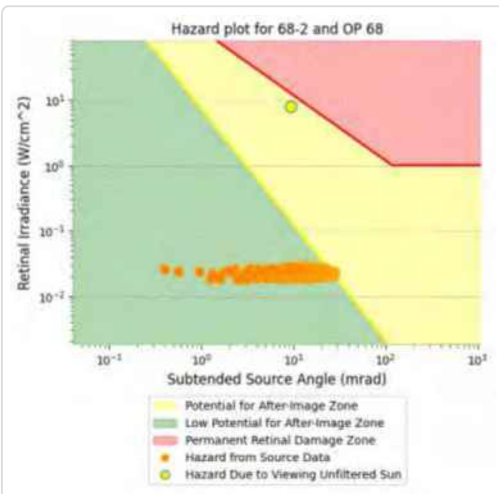
68-2 and OP 68

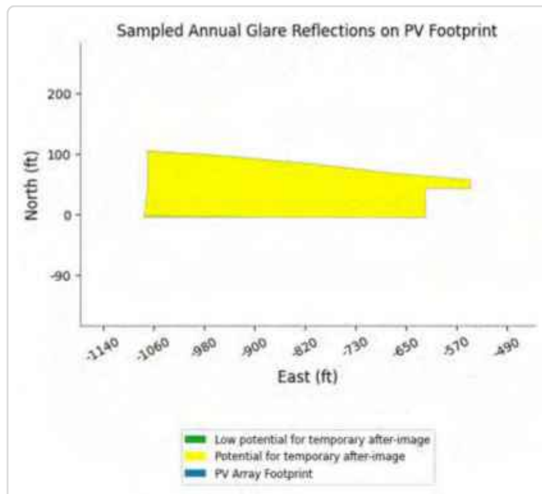
Yellow glare: 57 min.

Green glare: 627 min.









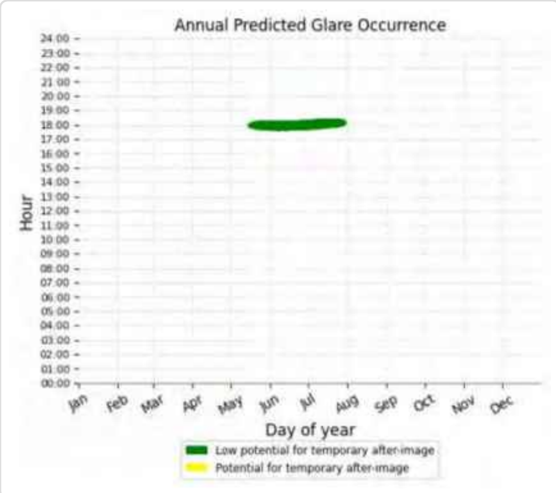
PV: 68-3 low potential for temporary after-image

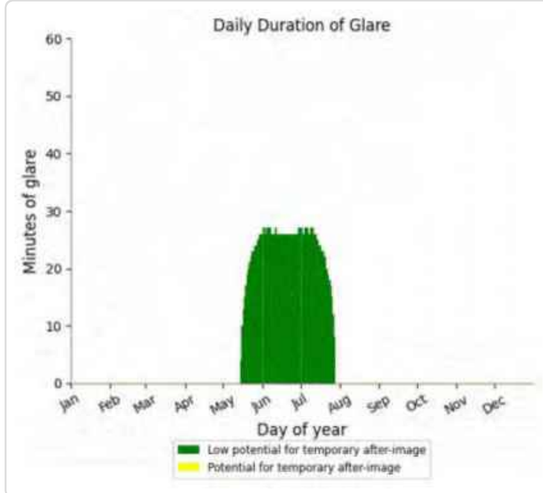
Receptor results ordered by category of glare

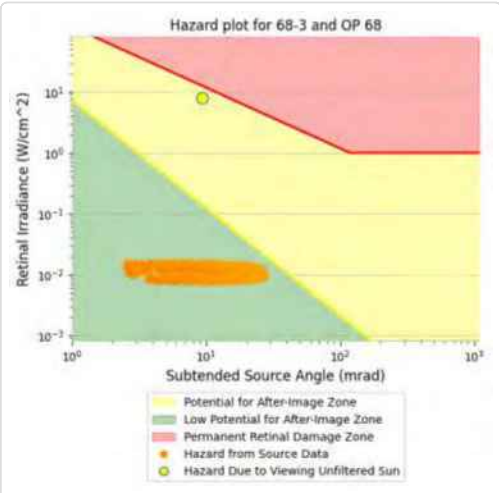
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 68	1,768	29.5	0	0.0

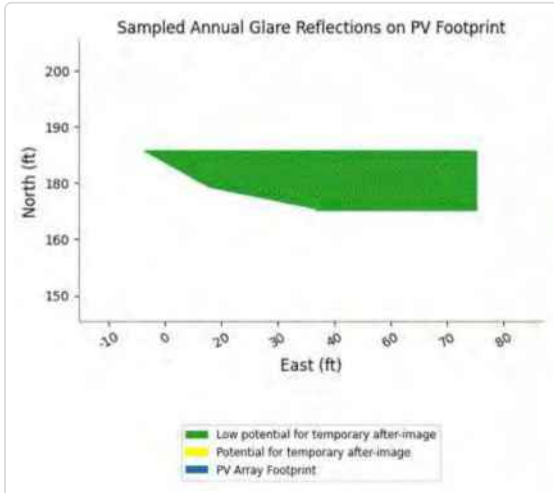
68-3 and OP 68

Yellow glare: none
Green glare: 1,768 min.









PV: 68-4 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 68	0	0.0	0	0.0

68-4 and OP 68

No glare found

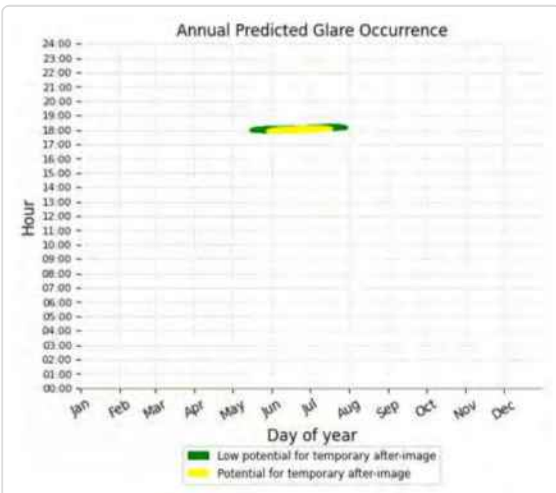
PV: 68-5 potential temporary after-image

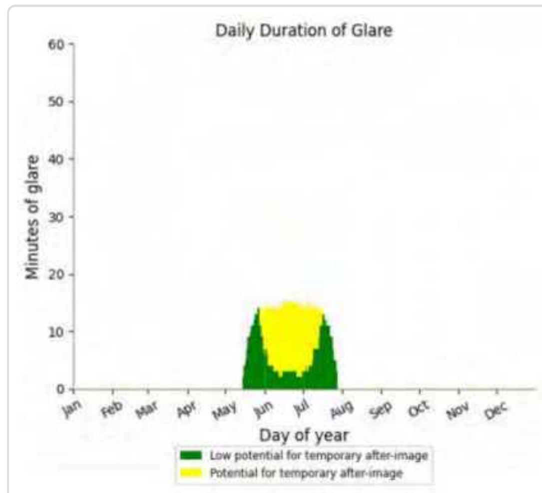
Receptor results ordered by category of glare

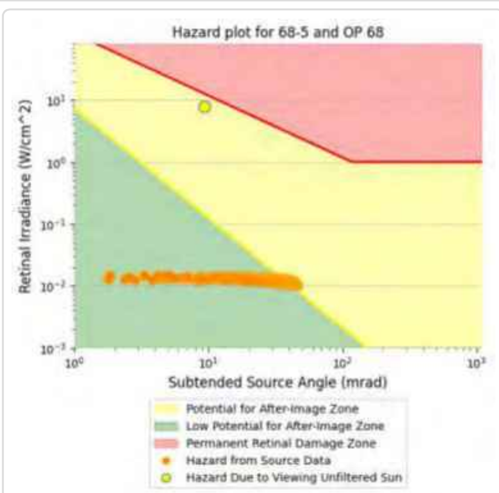
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 68	456	7.6	490	8.2

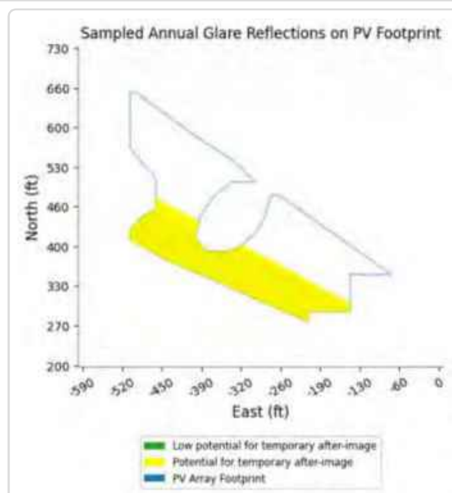
68-5 and OP 68

Yellow glare: 490 min.
Green glare: 456 min.









PV: 68-6 potential temporary after-image

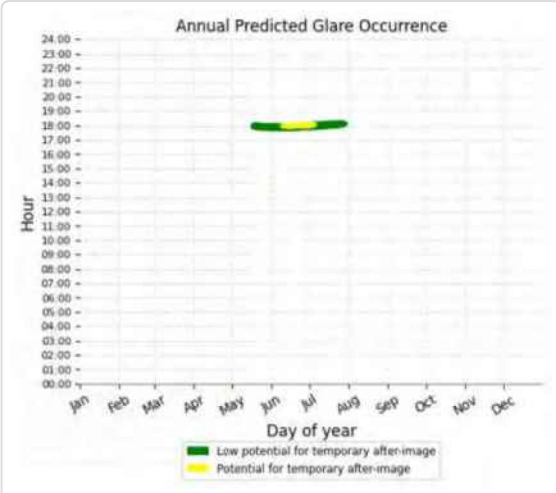
Receptor results ordered by category of glare

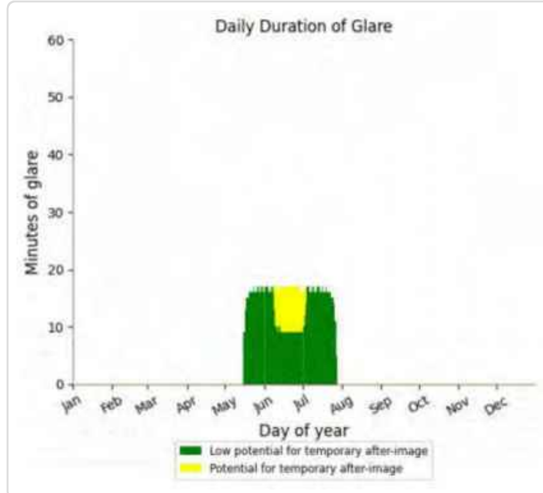
OP 68	1,001	16.7	188	3.1

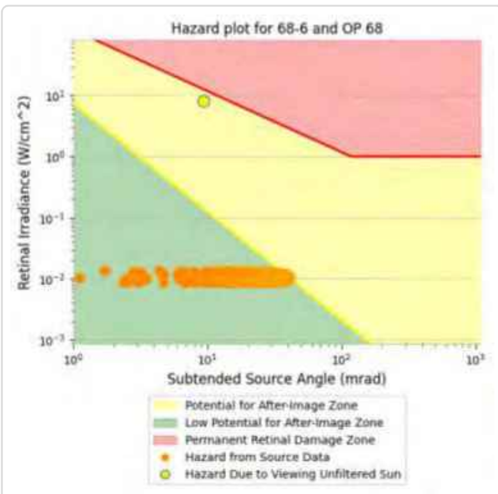
68-6 and OP 68

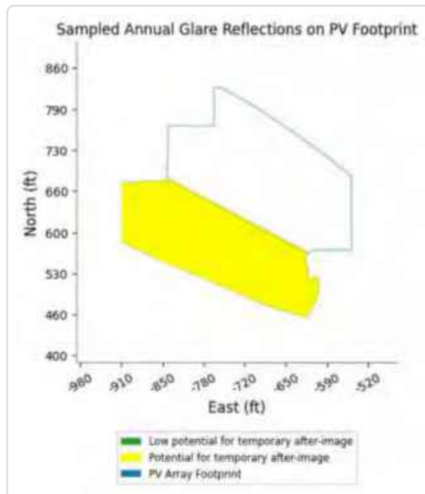
Yellow glare: 188 min.

Green glare: 1,001 min.









PV: 68-7 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 68	0	0.0	0	0.0

68-7 and OP 68

No glare found

Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
The algorithm does not rigorously represent the detailed geometry of a system; detailed features such as gaps between modules, variable height of the PV array, and support structures may impact actual glare results. However, we have validated our models against several systems, including a PV array causing glare to the air-traffic control tower at Manchester-Boston Regional Airport and several sites in Albuquerque, and the tool accurately predicted the occurrence and intensity of glare at different times and days of the year.
Several V1 calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare. This primarily affects V1 analyses of path receptors.
Random number computations are utilized by various steps of the annual hazard analysis algorithm. Predicted minutes of glare can vary between runs as a result. This limitation primarily affects analyses of Observation Point receptors, including ATCTs. Note that the SGHAT/ForgeSolar methodology has always relied on an analytical, qualitative approach to accurately determine the overall hazard (i.e. green vs. yellow) of expected glare on an annual basis.
The analysis does not automatically consider obstacles (either man-made or natural) between the observation points and the prescribed solar installation that may obstruct observed glare, such as trees, hills, buildings, etc.
The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
The variable direct normal irradiance (DNI) feature (if selected) scales the user-prescribed peak DNI using a typical clear-day irradiance profile. This profile has a lower DNI in the mornings and evenings and a maximum at solar noon. The scaling uses a clear-day irradiance profile based on a normalized time relative to sunrise, solar noon, and sunset, which are prescribed by a sun-position algorithm and the latitude and longitude obtained from Google maps. The actual DNI on any given day can be affected by cloud cover, atmospheric attenuation, and other environmental factors.
The ocular hazard predicted by the tool depends on a number of environmental, optical, and human factors, which can be uncertain. We provide input fields and typical ranges of values for these factors so that the user can vary these parameters to see if they have an impact on the results. The speed of SGHAT allows expedited sensitivity and parametric analyses.
The system output calculation is a DNI-based approximation that assumes clear, sunny skies year-round. It should not be used in place of more rigorous modeling methods.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.

Default glare analysis parameters and observer eye characteristics (for reference only):

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

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FORGESOLAR GLARE ANALYSIS

Project: **Exie Solar**
Site configuration: **78**

Created 21 May, 2025
Updated 21 May, 2025
Time-step 1 minute
Timezone offset UTC-5
Minimum sun altitude 0.0 deg
DNI peaks at 1,000.0 W/m^2
Category 100 MW to 1 GW
Site ID 149950.24968

Ocular transmission coefficient 0.5
Pupil diameter 0.002 m
Eye focal length 0.017 m
Sun subtended angle 9.3 mrad
PV analysis methodology V2

Summary of Results

Glare with potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
78-1	30.0	180.0	589	9.8	0	0.0	-
78-2	30.0	180.0	2,472	41.2	323	5.4	-
78-3	30.0	180.0	1,166	19.4	2,674	44.6	-
78-4	30.0	180.0	3,497	58.3	0	0.0	-
78-5	30.0	180.0	688	11.5	1,007	16.8	-
78-6	30.0	180.0	0	0.0	0	0.0	-

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 78	8,412	140.2	4,004	66.7

Component Data

PV Arrays

Name: 78-1
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.152352	-85.585652	782.62	12.00	794.62
2	37.152352	-85.585438	776.20	12.00	788.20
3	37.152286	-85.585507	774.22	12.00	786.22
4	37.152232	-85.585559	774.00	12.00	786.00
5	37.152204	-85.585653	778.75	12.00	790.75

Name: 78-2
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.151955	-85.594613	779.84	12.00	791.84
2	37.151956	-85.594972	785.18	12.00	797.18
3	37.152242	-85.594972	786.59	12.00	798.59
4	37.152532	-85.594973	785.44	12.00	797.44
5	37.152891	-85.594972	775.77	12.00	787.77
6	37.153120	-85.594972	772.41	12.00	784.41
7	37.153130	-85.594728	772.33	12.00	784.33
8	37.153372	-85.594721	772.33	12.00	784.33
9	37.153371	-85.594471	772.81	12.00	784.81
10	37.153371	-85.594221	773.48	12.00	785.48
11	37.153165	-85.594221	773.40	12.00	785.40
12	37.152913	-85.594221	774.86	12.00	786.86
13	37.152577	-85.594222	777.34	12.00	789.34
14	37.152241	-85.594223	775.21	12.00	787.21
15	37.151955	-85.594223	772.34	12.00	784.34

Name: 78-3
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.153286	-85.593191	763.90	12.00	775.90
2	37.153079	-85.592763	762.29	12.00	774.29
3	37.152914	-85.592403	764.18	12.00	776.18
4	37.152742	-85.592077	762.90	12.00	774.90
5	37.152743	-85.592472	760.99	12.00	772.99
6	37.152743	-85.592831	759.82	12.00	771.82
7	37.152575	-85.592831	759.27	12.00	771.27
8	37.152575	-85.593080	762.73	12.00	774.73
9	37.152407	-85.593081	761.27	12.00	773.27
10	37.152239	-85.593083	758.57	12.00	770.57
11	37.152239	-85.593332	767.17	12.00	779.17
12	37.152071	-85.593334	764.06	12.00	776.06
13	37.152072	-85.593585	770.26	12.00	782.26
14	37.151988	-85.593585	767.97	12.00	779.97
15	37.151988	-85.593835	770.60	12.00	782.60
16	37.151954	-85.593822	770.59	12.00	782.59
17	37.151955	-85.594086	771.02	12.00	783.02
18	37.152278	-85.594085	774.02	12.00	786.02
19	37.152614	-85.594084	773.51	12.00	785.51
20	37.152913	-85.594084	773.13	12.00	785.13
21	37.153203	-85.594083	772.40	12.00	784.40
22	37.153213	-85.593839	770.70	12.00	782.70
23	37.153454	-85.593832	773.37	12.00	785.37
24	37.153455	-85.593661	771.44	12.00	783.44
25	37.153454	-85.593519	769.63	12.00	781.63

Name: 78-4
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.153385	-85.585487	770.46	12.00	782.46
2	37.153110	-85.585368	773.38	12.00	785.38
3	37.152794	-85.585266	788.29	12.00	800.29
4	37.152506	-85.585198	785.95	12.00	797.95
5	37.152245	-85.585164	778.96	12.00	790.96
6	37.152248	-85.585260	774.51	12.00	786.51
7	37.152355	-85.585301	776.36	12.00	788.36
8	37.152369	-85.585413	776.32	12.00	788.32
9	37.152478	-85.585419	782.32	12.00	794.32
10	37.152482	-85.585652	786.06	12.00	798.06
11	37.152772	-85.585652	779.47	12.00	791.47
12	37.153108	-85.585651	774.60	12.00	786.60
13	37.153378	-85.585650	774.81	12.00	786.81
14	37.153646	-85.585650	762.16	12.00	774.16
15	37.153646	-85.585624	762.39	12.00	774.39

Name: 78-5
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.153361	-85.585788	772.28	12.00	784.28
2	37.153109	-85.585788	773.25	12.00	785.25
3	37.152772	-85.585789	776.38	12.00	788.38
4	37.152436	-85.585790	785.15	12.00	797.15
5	37.152191	-85.585790	781.90	12.00	793.90
6	37.152150	-85.586262	783.88	12.00	795.88
7	37.152151	-85.586674	772.94	12.00	784.94
8	37.152261	-85.586880	771.41	12.00	783.41
9	37.152302	-85.586828	772.52	12.00	784.52
10	37.152357	-85.586828	771.82	12.00	783.82
11	37.152453	-85.586862	771.01	12.00	783.01
12	37.152522	-85.586930	770.11	12.00	782.11
13	37.152659	-85.587016	768.47	12.00	780.47
14	37.152742	-85.587136	768.51	12.00	780.51
15	37.152742	-85.587290	768.64	12.00	780.64
16	37.152653	-85.587392	767.70	12.00	779.70
17	37.152591	-85.587514	767.99	12.00	779.99
18	37.152550	-85.587651	769.28	12.00	781.28
19	37.152413	-85.587668	769.64	12.00	781.64
20	37.152317	-85.587772	772.56	12.00	784.56
21	37.152317	-85.587669	770.49	12.00	782.49
22	37.152271	-85.587684	770.57	12.00	782.57
23	37.152249	-85.588049	770.88	12.00	782.88
24	37.152271	-85.588048	771.57	12.00	783.57
25	37.152276	-85.587943	771.46	12.00	783.46
26	37.152317	-85.587944	773.27	12.00	785.27
27	37.152317	-85.588048	772.16	12.00	784.16
28	37.152386	-85.588055	770.03	12.00	782.03
29	37.152441	-85.588011	769.20	12.00	781.20
30	37.152606	-85.588011	767.52	12.00	779.52
31	37.152688	-85.588097	764.93	12.00	776.93
32	37.152757	-85.588200	764.64	12.00	776.64
33	37.152853	-85.587976	771.20	12.00	783.20
34	37.152947	-85.587735	774.59	12.00	786.59
35	37.153031	-85.587530	772.32	12.00	784.32
36	37.153099	-85.587307	761.59	12.00	773.59
37	37.153058	-85.587221	762.52	12.00	774.52
38	37.153058	-85.587169	762.92	12.00	774.92
39	37.153181	-85.587152	761.16	12.00	773.16
40	37.153291	-85.586894	772.22	12.00	784.22
41	37.153400	-85.586620	774.99	12.00	786.99
42	37.153482	-85.586362	762.65	12.00	774.65
43	37.153400	-85.586259	762.97	12.00	774.97
44	37.153276	-85.586208	764.75	12.00	776.75
45	37.153276	-85.586088	764.57	12.00	776.57
46	37.153427	-85.585985	764.06	12.00	776.06
47	37.153537	-85.585985	761.99	12.00	773.99
48	37.153633	-85.586002	761.89	12.00	773.89
49	37.153715	-85.585787	764.94	12.00	776.94

Name: 78-6
Axis tracking: Fixed (no rotation)
Tilt: 30.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.153518	-85.592676	760.57	12.00	772.57
2	37.153381	-85.592470	763.31	12.00	775.31
3	37.153106	-85.592076	767.34	12.00	779.34
4	37.152941	-85.591826	766.26	12.00	778.26
5	37.152910	-85.591826	765.95	12.00	777.95
6	37.152907	-85.591922	765.71	12.00	777.71
7	37.153078	-85.592231	766.62	12.00	778.62
8	37.153299	-85.592573	764.08	12.00	776.08
9	37.153491	-85.592899	760.66	12.00	772.66
10	37.153753	-85.593340	771.42	12.00	783.42
11	37.153790	-85.593329	771.88	12.00	783.88
12	37.153790	-85.593087	769.30	12.00	781.30

Discrete Observation Point Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (ft)	Height (ft)
OP 78	78	37.151906	-85.590300	776.40	5.40

Glare Analysis Results

Summary of Results

Glare with potential for temporary after-image predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
78-1	30.0	180.0	589	9.8	0	0.0	-
78-2	30.0	180.0	2,472	41.2	323	5.4	-
78-3	30.0	180.0	1,166	19.4	2,674	44.6	-
78-4	30.0	180.0	3,497	58.3	0	0.0	-
78-5	30.0	180.0	688	11.5	1,007	16.8	-
78-6	30.0	180.0	0	0.0	0	0.0	-

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 78	8,412	140.2	4,004	66.7

PV: 78-1

low potential for temporary after-image

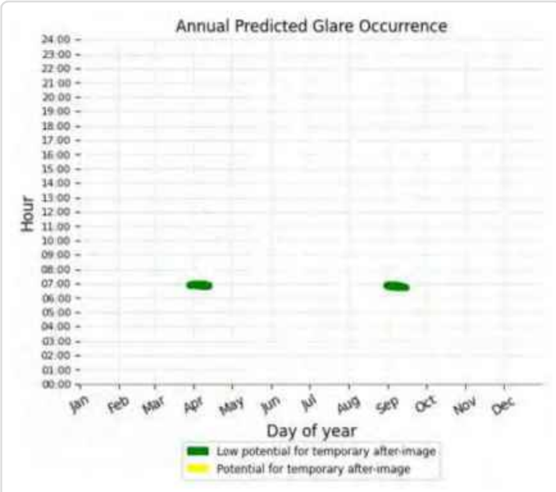
Receptor results ordered by category of glare

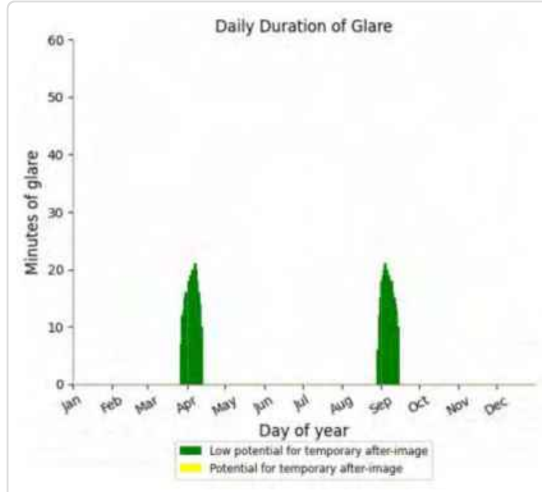
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 78	589	9.8	0	0.0

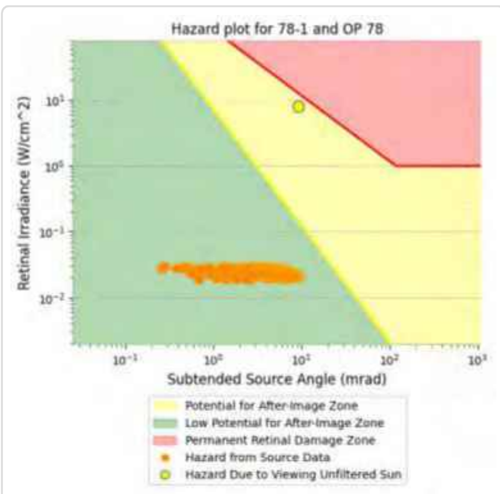
78-1 and OP 78

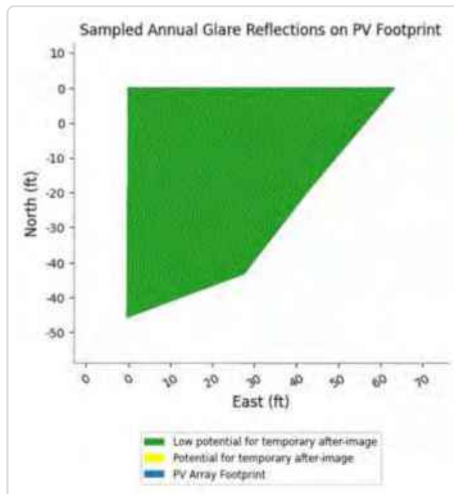
Yellow glare: none

Green glare: 589 min.









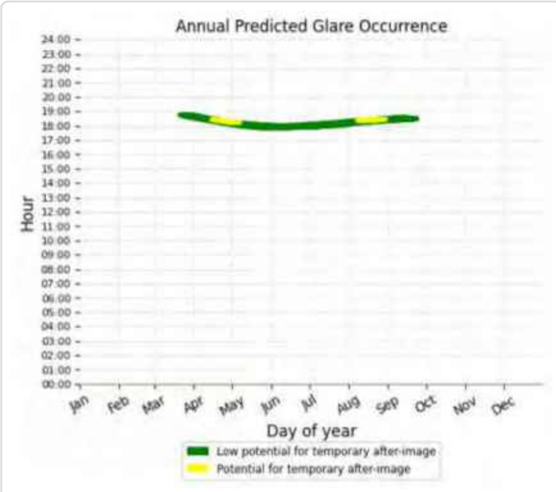
PV: 78-2 potential temporary after-image

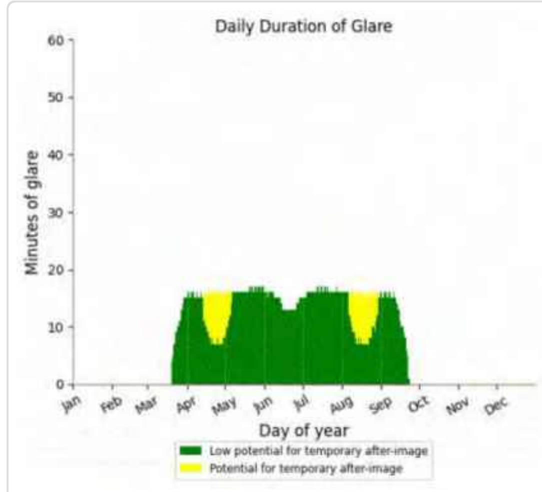
Receptor results ordered by category of glare

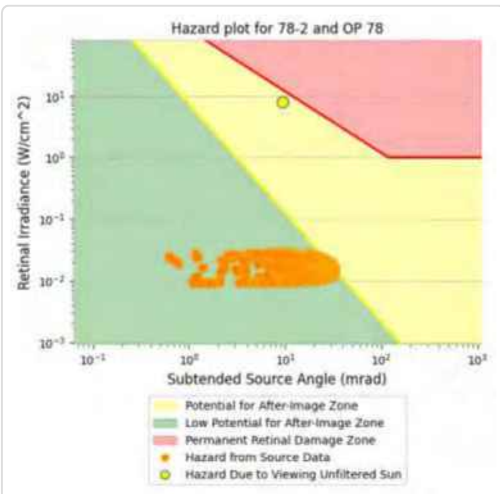
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	**hr**	**min**	**hr**
OP 78	2,472	41.2	323	5.4

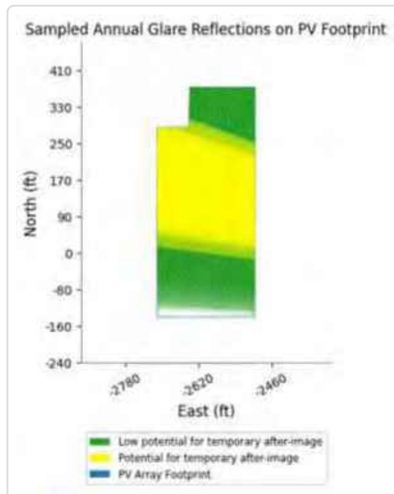
78-2 and OP 78

Yellow glare: 323 min.
Green glare: 2,472 min.









PV: 78-3 potential temporary after-image

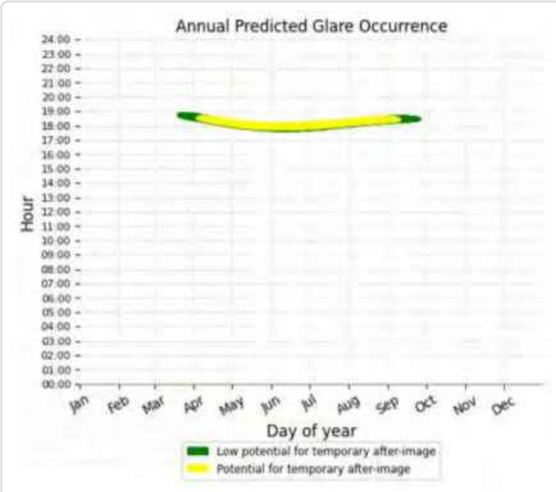
Receptor results ordered by category of glare

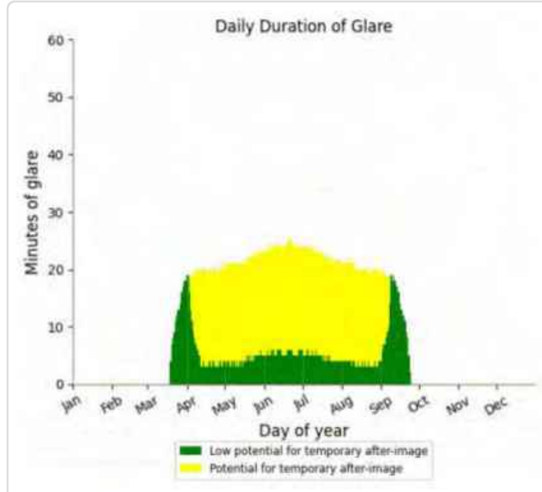
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 78	1,166	19.4	2,674	44.6

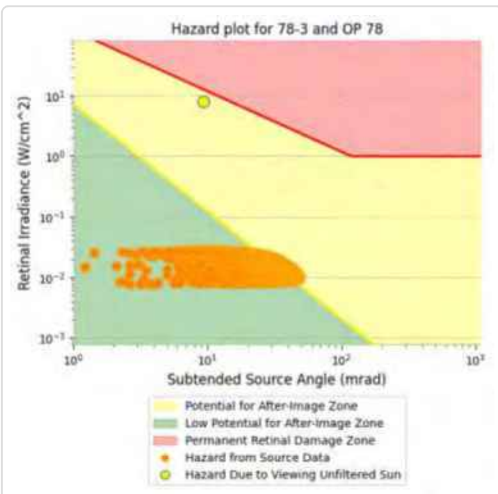
78-3 and OP 78

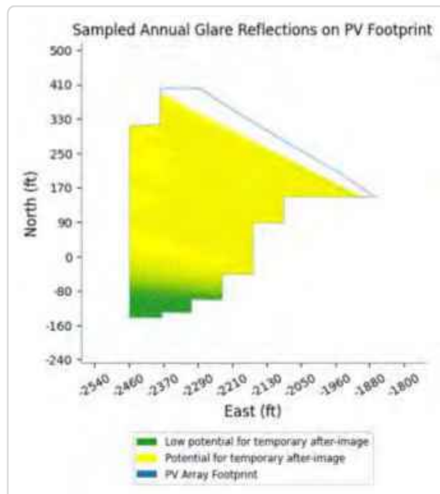
Yellow glare: 2,674 min.

Green glare: 1,166 min.









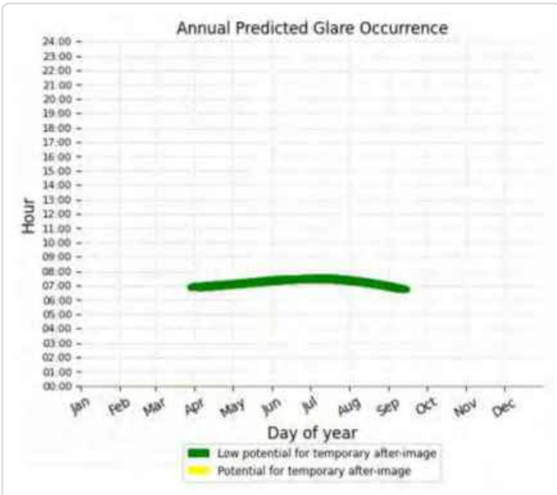
PV: 78-4 low potential for temporary after-image

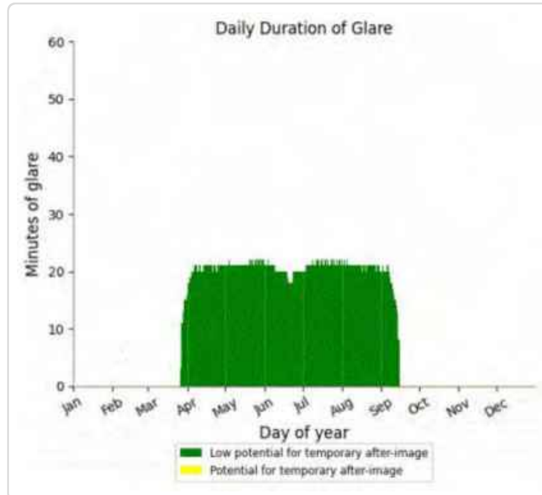
Receptor results ordered by category of glare

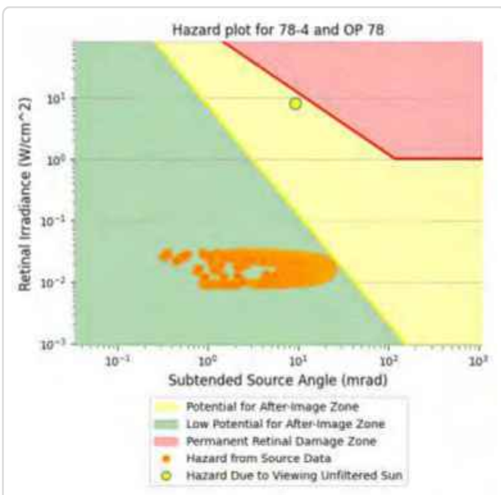
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 78	3,497	58.3	0	0.0

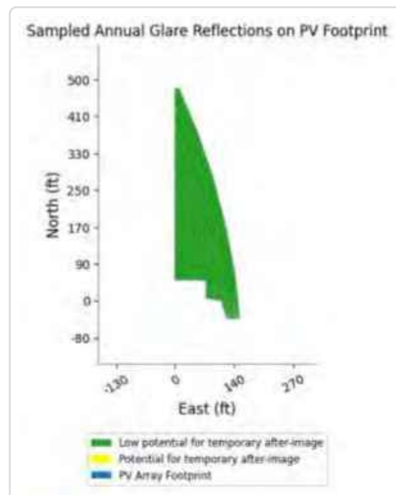
78-4 and OP 78

Yellow glare: none
Green glare: 3,497 min.









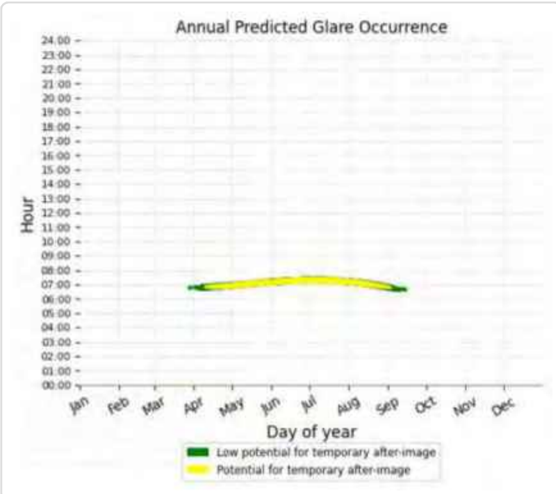
PV: 78-5 potential temporary after-image

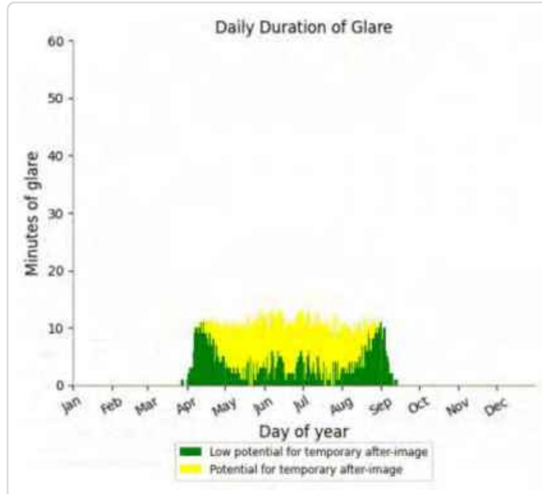
Receptor results ordered by category of glare

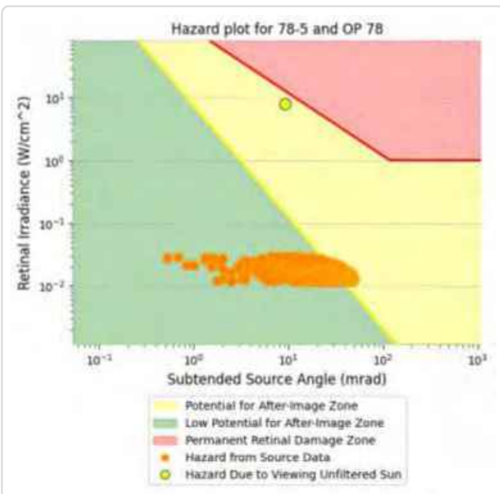
Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 78	688	11.5	1,007	16.8

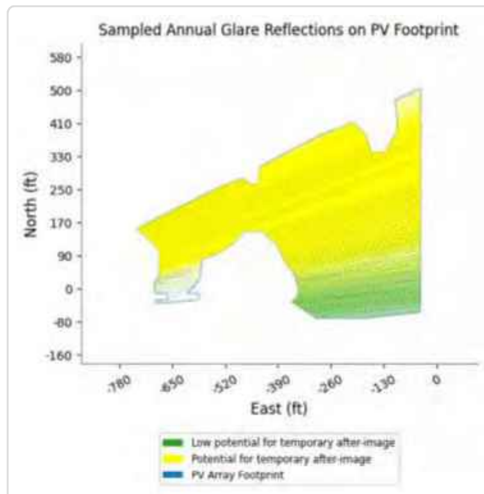
78-5 and OP 78

Yellow glare: 1,007 min.
Green glare: 688 min.









PV: 78-6 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
OP 78	0	0.0	0	0.0

78-6 and OP 78

No glare found

Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
The algorithm does not rigorously represent the detailed geometry of a system; detailed features such as gaps between modules, variable height of the PV array, and support structures may impact actual glare results. However, we have validated our models against several systems, including a PV array causing glare to the air-traffic control tower at Manchester-Boston Regional Airport and several sites in Albuquerque, and the tool accurately predicted the occurrence and intensity of glare at different times and days of the year.
Several V1 calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare. This primarily affects V1 analyses of path receptors.
Random number computations are utilized by various steps of the annual hazard analysis algorithm. Predicted minutes of glare can vary between runs as a result. This limitation primarily affects analyses of Observation Point receptors, including ATCTs. Note that the SGHAT/ ForgeSolar methodology has always relied on an analytical, qualitative approach to accurately determine the overall hazard (i.e. green vs. yellow) of expected glare on an annual basis.
The analysis does not automatically consider obstacles (either man-made or natural) between the observation points and the prescribed solar installation that may obstruct observed glare, such as trees, hills, buildings, etc.
The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
The variable direct normal irradiance (DNI) feature (if selected) scales the user-prescribed peak DNI using a typical clear-day irradiance profile. This profile has a lower DNI in the mornings and evenings and a maximum at solar noon. The scaling uses a clear-day irradiance profile based on a normalized time relative to sunrise, solar noon, and sunset, which are prescribed by a sun-position algorithm and the latitude and longitude obtained from Google maps. The actual DNI on any given day can be affected by cloud cover, atmospheric attenuation, and other environmental factors.
The ocular hazard predicted by the tool depends on a number of environmental, optical, and human factors, which can be uncertain. We provide input fields and typical ranges of values for these factors so that the user can vary these parameters to see if they have an impact on the results. The speed of SGHAT allows expedited sensitivity and parametric analyses.
The system output calculation is a DNI-based approximation that assumes clear, sunny skies year-round. It should not be used in place of more rigorous modeling methods.
Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid based on aggregated research data. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.

Default glare analysis parameters and observer eye characteristics (for reference only):

- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

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Attachment G. Conceptual Visual Mitigation Report

Conceptual Visual Mitigation Report

Exie Solar Project

Green County, Kentucky

Prepared for:

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exiesolar@geronimopower.com

Prepared by:

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July 2025

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1.0 Goals and Objectives

Exie Solar, LLC (the Applicant) is proposing to construct the Exie Solar Project (the Project), an up to 110-megawatt (MW) solar photovoltaic (PV) electric generation facility in Green County, Kentucky. The area leased or purchased for the Project includes 1,340 acres of private land (the Project Area). Environmental Design & Research, Landscape Architecture, Engineering & Environmental Services, D.P.C. (EDR) has developed this *Conceptual Visual Mitigation Report* to address the potential visual impacts resulting from the installation of the Project.

This report includes a conceptual visual mitigation strategy consisting of an example plant species palette, conceptual arrangements of the example plant species in three distinct planting modules, and proposed planting module locations intended to address the varied aesthetic impacts of the Project on adjacent, residential non-participating properties and the traveling public. Preliminary planting and establishment guidelines are included to provide initial planning and guidance on the steps required for successful implementation. Objectives of this report include:

- Provide preliminary recommendations for visual mitigation of potential Project impacts that match the character of the existing landscape, avoiding the use of non-natural forms and features such as berms and privacy fences, which would contrast inappropriately with the Project setting
- Prioritize the use of native plant material which complements the existing vegetation within and adjacent to the Project Area
- Contribute ecological benefits to the Project Area through the creation of habitat areas for local wildlife, including pollinators
- Provide preliminary guidance for the installation, establishment, and long-term care of the proposed plantings

The proposed planting module locations shown in this report have been developed through analysis of facility visibility from non-participating residences, roadways, and other scenic and cultural resources near the Project Area, with the primary goal of reducing potential visual impacts to resources and receptors adjacent to the facility.

2.0 Design Methodology and Plant Selection

Selecting the appropriate visual buffer is dependent on local context. While opaque screening such as uninterrupted fencing or berms may be well suited to some settings, it would not be visually compatible with a rural landscape. Vegetative buffers such as wind breaks and hedgerows, however, have precedent in agricultural and rural landscapes and would not appear out of place in most instances. The use of vegetation for visual impact mitigation mimics the existing hedgerow borders at perimeters of farm fields and along roadways and complements the visual buffers provided by natural vegetation within and surrounding the Project Area.

Existing vegetation within and adjacent to the Project Area consists mainly of expansive agricultural fields used for pastureland and cropland, divided by hedgerows, woodlots, and wooded riparian corridors along creek and stream channels. These existing vegetative stands have informed the plant material selection for the proposed mitigation strategy, which includes deciduous trees predominantly composed of oaks and tulip poplar, evergreen trees including Virginia pine and eastern red cedar, and a variety of lower-growing spreading shrubs and understory trees. This strategy is based on the idea that the success of existing native species in the area indicates that conditions may be suitable for newly installed plants of the same species. Because they are well suited for the site-specific climate, these native species often require less maintenance than introduced species.

Species and growth habit diversity within the plantings can enhance cover, food, breeding, and feeding habitat for a variety of wildlife species. Using a mixture of native flowering species can also improve pollinator habitat and increase biodiversity in a way that complements the existing landscape, which includes large areas dominated by a monoculture of agricultural crops.

Example plant species with representative photographs are included below. Additional species for potential selection are included in the planting module design sheets shown in Section 3.0. A number of sources were used in development of the suggested plant lists, including but not limited to: on-site observation, the USDA PLANTS database (NRCS, 2024), the *Forest Atlas of the United States* (Perry et al., 2022), the listed Exotic Invasive Plants of Kentucky (Kentucky Exotic Pest Plant Council, 2013), and the native plant lists included in the *Kentucky Pollinator Protection Plan* (Kentucky Department of Agriculture, 2019).

Planting Design Strategy

The proposed vegetative visual mitigation is designed with the intent of moderating views of the solar arrays, above ground electrical components, and the associated perimeter fence that may contrast with the existing agricultural landscape, while maintaining the safe and efficient operation of the facility. Depending on the location and distance of resources adjacent to the Project Area, various plant types and densities are proposed to provide an appropriate level of mitigation. For example, mitigation for a residence adjacent to the Project Area with views focused directly into the facility may require a more dense planting module (Figure 2.1) than a local road where only fleeting views of the facility may be available, requiring less plant material to soften the view (Figure 2.2). This report considers three preliminary planting modules that vary in density and plant material and are described in detail in Section 3.0.

Figure 2.1 Example of Dense Visual Mitigation Module

Figure 2.2 Example of Intermittent Visual Mitigation Module

Examples of Potential Plant Materials

American Hornbeam

Sweet Gum

Cucumbertree Magnolia

Tupelo

American Hophornbeam

Virginia Pine

Eastern Red Cedar

Eastern Redbud

Allegheny Serviceberry

Common Witch Hazel

Virginia Sweetspire

Gray Dogwood

Black Chokeberry

Blackhaw Viburnum

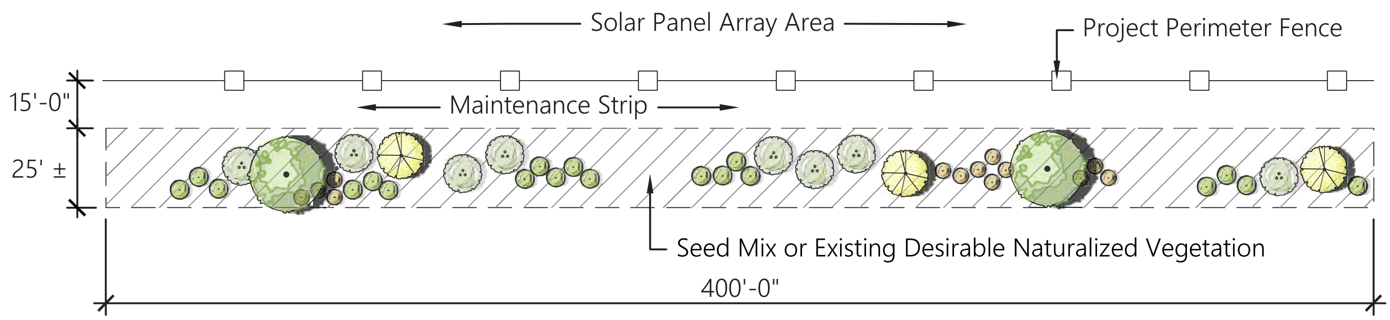
Spicebush

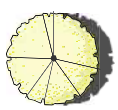
Botanical Name	Common Name	Install Height	5-7 Year Height	Max. Mature Height	Module 1	Module 2	Module 3
Amelenchier laevis	Allegheny Serviceberry	8′	14′	30′	X		X
Aronia melanocarpa	Black Chokeberry	3′	6′	6′	X	X	X
Cercis canadensis	Eastern Redbud	6′	12′	30′	X		X
Carpinus caroliniana	American Hornbeam	10′	16′	35′	X	X	
Cornus racemosa	Gray Dogwood	3′	8′	15′	X	X	X
Hamamelis virginiana	Common Witch Hazel	4′	10′	20′	X	X	X
Itea virginica	Virginia Sweetspire	3′	4′	8′	X	X	
Juniperus virginiana	Eastern Red Cedar	4′	12′	50′		X	X
Lindera benzoin	Spicebush	3′	5′	12′	X	X	X
Liquidambar styraciflua	American Sweetgum	12′	24′	70′		X	
Magnolia acuminata	Cucumbertree	10′	16′	50′	X	X	
Nyssa sylvatica	Tupelo	10′	16′	40′	X	X	
Ostrya virginiana	American	10′	16′	40′	X	X	
Pinus virginiana	Virginia Pine	6′	15′	70′		X	
Viburnum prunifolium	Blackhaw Virbunum	3′	9′	12′	X	X	X

3.0 Planting Modules

Planting Module 1

Module 1 consists of shrubs and trees of varying scale and form. The module is intended to visually break up the horizontal line of the solar array, provide partial screening, and visually integrate with the surrounding landscape in areas with frequent viewers but without prolonged viewer duration, such as along public roadways. The low profile of the selected species allows for partial screening while maintaining long views and open sky over the top of the solar facility. A 15-foot maintenance strip is provided for routine fence inspection and maintenance.

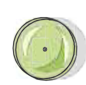




Small Flowering Tree
Aesculus glabra / Ohio Buckeye
Amelanchier laevis / Allegheny Serviceberry
Cercis canadensis / Eastern Redbud
Crataegus crus-galli / Cockspur Hawthorn
Halesia carolina / Silverbell

Large Shrub
Cornus racemosa / Gray Dogwood
Hamamelis virginiana / Common Witch Hazel
Rhus typhina / Staghorn Sumac
Salix discolor / Pussy Willow
Viburnum prunifolium / Blackhaw Viburnum

Medium Deciduous Tree
Carpinus caroliniana / American Hornbeam
Magnolia acuminata / Cucumbertree Magnolia
Nyssa sylvatica / Tupelo
Ostrya virginiana / American Hophornbeam
Oxydendrum arboreum / Sourwood Tree

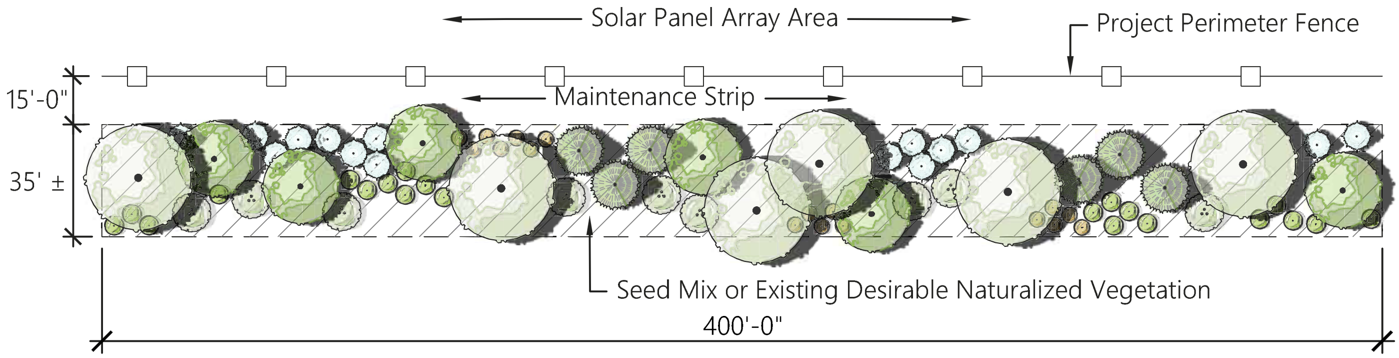


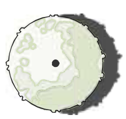
Medium Shrub
Aronia melanocarpa / Black Chokeberry
Corylus americana / American Hazelnut
Kalmia latifolia / Mountain Laurel
Lindera benzoin / Spicebush
Physocarpus opulifolius / Ninebark

1. Suitability of existing vegetation in lieu of seed mix shall be as determined by facility owner.
2. Species identified in planting module graphics are representative of the design intent, subject to availability and site conditions at the time of planting. If species identified in the plant lists shown are not available at the time of installation, substitute with plant species that meet the design intent of the species to be substituted, in coordination with the facility owner and construction manager.
3. Plant species graphic icons represent the average canopy spread of each plant type at maturity, to be used for Exie Solar conceptual planting designs only.

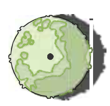
Planting Module 2

Module 2 consists of shade trees, shrubs, and evergreen material to provide screening during winter (leaf-off) and summer (leaf-on) conditions. This module is intended to provide a higher level of screening, particularly where stationary adjacent uses, such as residences, could be impacted by direct views of facility components. This module type will not create a 100% opaque screen, but rather a dynamic vegetative buffer that allows light to pass through and replicates the character and density of existing hedgerows found throughout the area. A 15-foot maintenance strip is provided to accommodate routine fence inspection and maintenance.

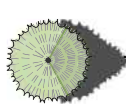




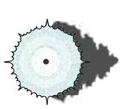
Large Deciduous Tree
Celtis occidentalis / Common Hackberry
Liquidambar styraciflua / Sweet Gum
Liriodendron tulipifera / Tulip Poplar
Quercus alba / White Oak
Quercus muehlenbergii / Chinkapin Oak



Medium Deciduous Tree
Carpinus caroliniana / American Hornbeam
Magnolia acuminata / Cucumbertree Magnolia
Nyssa sylvatica / Tupelo
Ostrya virginiana / American Hophornbeam
Oxydendrum arboreum / Sourwood Tree



Large Evergreen
Abies concolor / White Fir
Picea glauca / White Spruce
Pinus strobus / White Pine
Pinus virginiana / Virginia Pine



Small / Medium Evergreen
Abies balsamea phanerolepis / Canaan Fir
Juniperus virginiana / Eastern Red Cedar
Picea glauca `Densata` / Black Hills Spruce

Large Shrub
Cornus racemosa / Gray Dogwood
Hamamelis virginiana / Common Witch Hazel
Rhus typhina / Staghorn Sumac
Salix discolor / Pussy Willow
Viburnum prunifolium / Blackhaw Viburnum

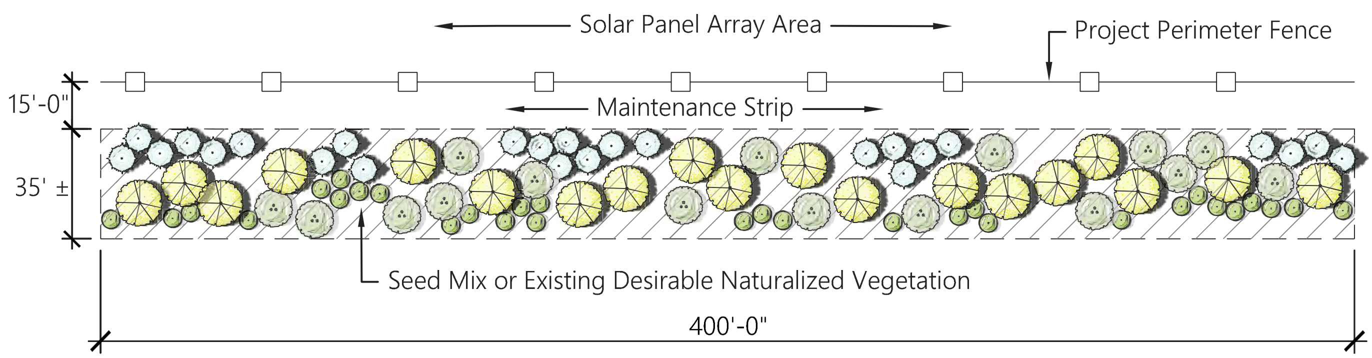
Medium Shrub
Aronia melanocarpa / Black Chokeberry
Corylus americana / American Hazelnut
Kalmia latifolia / Mountain Laurel
Lindera benzoin / Spicebush
Physocarpus opulifolius / Ninebark

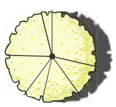
Small Shrub
Itea virginica / Virginia Sweetspire
Rhus aromatica / Fragrant Sumac
Rosa carolina / Carolina Rose

1. Suitability of existing vegetation in lieu of seed mix shall be as determined by facility owner.
2. Species identified in planting module graphics are representative of the design intent, subject to availability and site conditions at the time of planting. If species identified in the plant lists shown are not available at the time of installation, substitute with plant species that meet the design intent of the species to be substituted, in coordination with the facility owner and construction manager.
3. Plant species graphic icons represent the average canopy spread of each plant type at maturity, to be used for Exie Solar conceptual planting designs only.

Planting Module 3

Module 3 consists of small flowering trees, shrubs, and evergreen material to provide screening during winter (leaf-off) and summer (leaf-on) conditions. This module is intended to provide a higher level of screening, particularly where stationary adjacent uses could be impacted by direct views of facility components, while reaching a lower mature height than the species proposed in Module 2, for use in areas where panel shading or overhead obstructions are a constraint. This module type will not create a 100% opaque screen, but rather a dynamic vegetative buffer that allows light to pass through and replicates the character and density of existing hedgerows found throughout the area. A 15-foot maintenance strip is provided to accommodate routine fence inspection and maintenance.



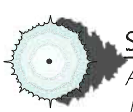


Small Flowering Tree

Aesculus glabra / Ohio Buckeye
Amelanchier laevis / Allegheny Serviceberry
Cercis canadensis / Eastern Redbud
Crataegus crus-galli / Cockspur Hawthorn
Halesia carolina / Silverbell

Large Shrub

Cornus racemosa / Gray Dogwood
Hamamelis virginiana / Common Witch Hazel
Rhus typhina / Staghorn Sumac
Salix discolor / Pussy Willow
Viburnum prunifolium / Blackhaw Viburnum



Small / Medium Evergreen

Abies balsamea phanerolepis / Canaan Fir
Juniperus virginiana / Eastern Red Cedar
Picea glauca \`Densata\` / Black Hills Spruce

Medium Shrub

Aronia melanocarpa / Black Chokeberry
Corylus americana / American Hazelnut
Kalmia latifolia / Mountain Laurel
Lindera benzoin / Spicebush
Physocarpus opulifolius / Ninebark

1. Suitability of existing vegetation in lieu of seed mix shall be as determined by facility owner.
2. Species identified in planting module graphics are representative of the design intent, subject to availability and site conditions at the time of planting. If species identified in the plant lists shown are not available at the time of installation, substitute with plant species that meet the design intent of the species to be substituted, in coordination with the facility owner and construction manager.
3. Plant species graphic icons represent the average canopy spread of each plant type at maturity, to be used for Exie Solar conceptual planting designs only.

4.0 Plant Material Installation, Establishment, and Maintenance

Overview

The plant material proposed in this *Conceptual Visual Mitigation Report* has been selected for its regional compatibility with the existing landscape to lessen the need for prolonged maintenance beyond the period of establishment. Proper installation, establishment, and continued management are critical to the survival and long-term health of the vegetation installed for visual mitigation. The Applicant will review the condition of plant material after initial installation to ensure the intent of the mitigation strategy is successfully implemented.

This *Conceptual Visual Mitigation Report* is intended to support permitting efforts only; therefore, this information has not been developed to the level of detail required for bidding and installation of the mitigation plantings. Prior to implementation of this strategy, EDR recommends that industry-standard construction drawings and specifications be produced by a licensed Landscape Architect. Landscape construction drawings for the contractor should be designed to achieve the visual mitigation goals outlined in this report.

Site Preparation, Plant Delivery, and Staging

To improve plant establishment outcomes, it is essential that site preparation measures are completed prior to plant layout. Planting modules may be indicated in areas previously occupied by a variety of uses including temporary laydown yards, agricultural hedgerows, vegetated right-of-way shoulders, and agricultural crop production. Site preparation measures should be tailored to each planting site in consideration of prior use, current soil nutrient levels, and planting module type. Planting areas should be cleared of existing broadleaf vegetation in the immediate planting area that may compete with or impede visibility of the new plantings. Example site preparation measures include, but are not limited to:

- Decompact soils, particularly if site has been subjected to concentrated mechanical or vehicular use.
- Mow the entire planting area, including applicable maintenance strips.
- Apply herbicides as necessary to control competing vegetation.
- Amend soils with fertilizer, organic matter, and sulfur or lime, according to soil test recommendations. If applying lime, a two-week interval should be reserved from fertilizer application.

Plant installation is recommended to occur immediately following the delivery of plant materials to the site. If this cannot be achieved, a staging area should be established for the sole purpose of plant care and protection until the planting can occur. The staging site should provide shade for all materials and access to irrigation, optimally providing a fine-mist spray to balled-and-burlapped root balls and steady irrigation to containerized plants. If planting is scheduled to occur more than a week following delivery, plants should be heeled in with native site soils and/or mulch.

Installation

Upon completion of the site preparation stage, individual plant locations should be laid out in the field, using stakes to mark the planting locations of larger specimens, for approval prior to installation. Trees and shrubs should be installed according to industry-standard best management practices to promote the establishment and long-term health and vigor of the plants, taking care to perform the following:

1. Install during the dormant season, occurring after leaf-drop in fall and prior to bud-break in spring.
2. Remove containers, wire baskets, burlap, twine, protective wrap, and tags prior to planting.
3. Install trees plumb or straight from all viewpoints.
4. Backfill planting pits with on-site soils, or amended according to the recommendations of a qualified soil testing agency or landscape contractor.
5. Apply mulch to retain moisture and insulate tree roots from extreme temperatures.
6. Stake trees.
7. Seed all disturbed areas outside of the immediate planting areas that are not intended to receive mulch with the selected Project seed mix.
8. Water all new plantings thoroughly.
9. Provide rodent guards at the base of each tree. In areas where deer pressure is noted, an individual wire-mesh tree fence should instead be utilized.

Individual plant installations should be tailored to plant type (e.g., evergreen tree, deciduous tree, or shrub), form (e.g., single-stem or multi-stem), size, and root/container (e.g., balled-and-burlapped, bare root, or container), as illustrated in the typical plant installation details (see Figures 4.1, 4.2 and 4.3).

To aid maintenance and monitoring activities performed during the early establishment period, it is recommended that stakes be positioned at the limits of each planting module area to delineate the maintenance boundaries. Individual woody plant specimens under 36” in height should be marked with flags to bolster plant visibility during inspections and maintenance activities.

Figure 4.1 Typical Deciduous Tree Installation Detail

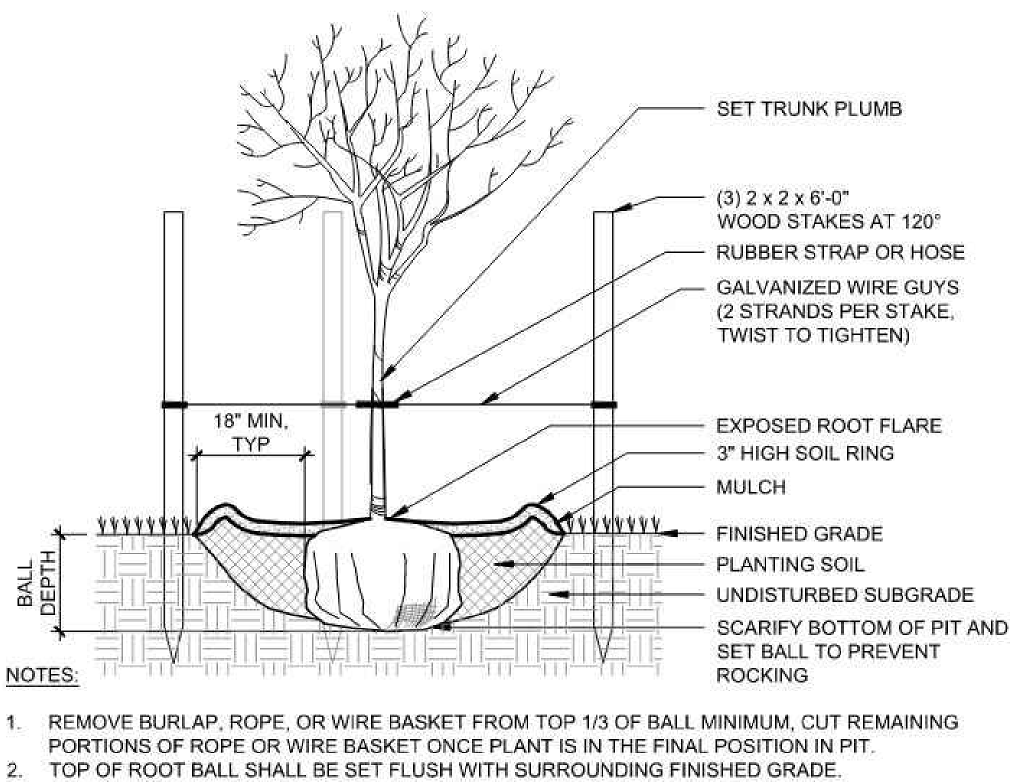
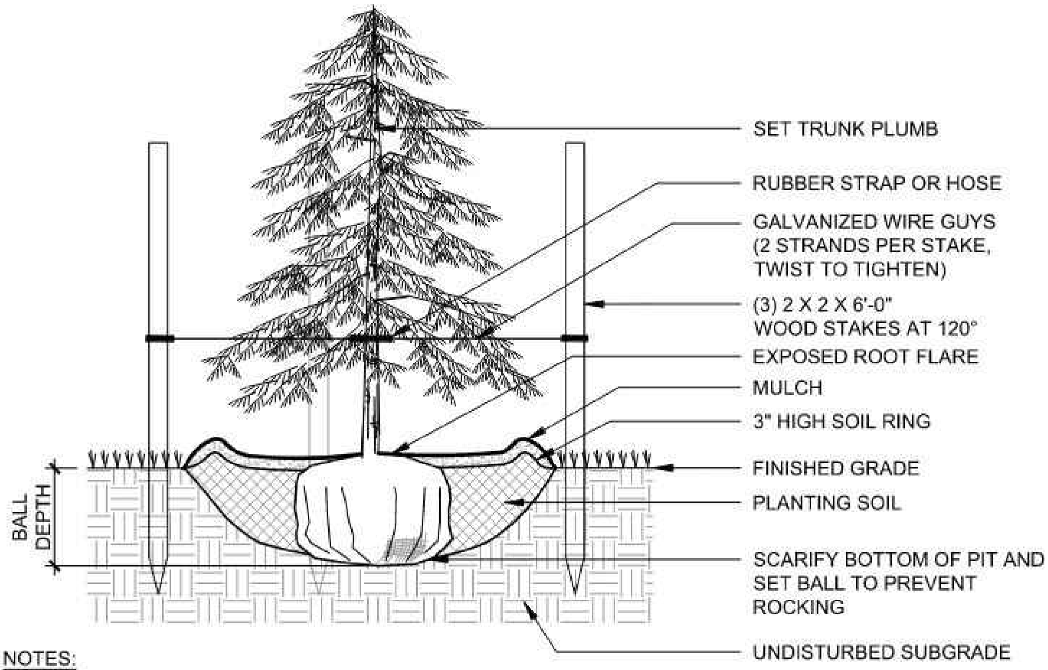


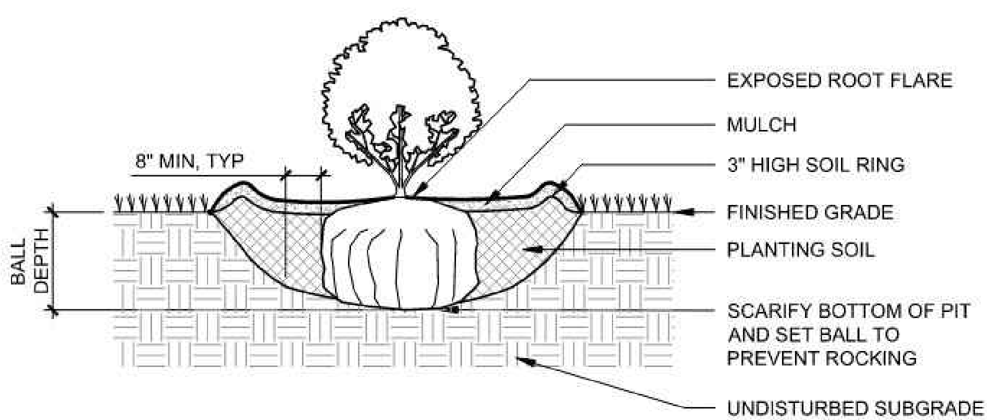
Figure 4.2 Typical Evergreen Tree Installation Detail



NOTES:

1. REMOVE BURLAP, ROPE, OR WIRE BASKET FROM TOP 1/3 OF BALL MINIMUM, CUT REMAINING PORTIONS OF ROPE OR WIRE BASKET ONCE PLANT IS IN THE FINAL POSITION IN PIT.
2. TOP OF ROOT BALL SHALL BE SET FLUSH WITH SURROUNDING FINISHED GRADE.

Figure 4.3 Typical Shrub Installation Detail



NOTES:

1. TOP OF ROOT BALL SHALL BE SET FLUSH WITH SURROUNDING FINISHED GRADE.
2. SET PLANTS PLUMB

Establishment

The plant establishment period is the inital phase following planting where plants must receive targeted support to encourage the developement of a healthy root system. Proper establishment protocols such as irrigation and post-installation monitoring are imperative for the long-term health and surviviability of the plantings. These measures should be performed at regular intervals throughout the establishment period, which typically encompasses the active growing season (typically from early April to early November in central Kentucky) of the first two years following planting.

Irrigation timing and amounts should be tailored to each individual plant or group of plants. In general, it is recommended that woody plants receive irrigation daily for the first two weeks following inital planting, with watering intervals increasing to every three days between weeks three to twelve, and weekly thereafter during the establishment period. Recommended irrigation amounts per plant at each watering are provided as follows:

Plant Size	Gallons
12 to 36 inches height	5
36 inches to 5 feet	7
5 to 8 feet	15
2 to 3 inches caliper	25
3 to 4 inches caliper	30

Irrigation timing and amounts may require adjustment based on current environmental conditions. To accurately determine irrigation needs per plant, probe a soil moisture meter to the depth of each root ball. Irrigate plants measuring 30% moist or less with the amounts indicated in the chart, adjusting for clay soils to prevent over-watering.

Post-installation monitoring can ensure that issues resulting from transplant shock are addressed while they remain treatable, before plant mortality is at risk. Monitor plants at regular intervals throughout the establishment period to inspect for signs of plant stress, which commonly present through the following initial indicators:

- Root suckering
- Bolting branches
- Wilted leaves or branches
- Early leaf drop
- Curled, rolled, or mishapen leaves
- Discolored leaves (e.g., brown edges, overall yellowed appearance, or bleaching)
- Crown or branch dieback

It is recommended that an ISA-certified arborist be engaged to develop a treatment plan if any of the aforementioned issues are observed.

Plant Material Maintenance

To ensure the goals of the final visual mitigation planting plan continue to be met, the visual mitigation plantings must be managed regularly throughout the life of the Project to manage tree health, develop proper form and structure, reduce risk of failure, and provide clearance to facility structures. Following the establishment period, conduct maintenance and inspection on an annual basis, including:

- Inspect for physical damage and signs of pests and disease
- Apply fertilizer as needed
- Prune trees only as necessary under the direction of a certified arborist, remaining consistent with each species' natural growth habit
- Engage an ISA-certified arborist to develop a treatment plan for any noted issues

Replacement Protocol

Trees and shrubs within the visual mitigation plantings are intended to be replaced as needed to maintain the desired plant density and screening effect outlined in Section 3.0. Trees with greater than 50% crown dieback should be evaluated for removal and replacement with the same species or a functionally similar species.

5.0 Preliminary Planting Module Locations

Planting Module Location Methodology

In order to identify adjacent, non-participating receptors with a potential direct line of sight to the Project, EDR conducted a digital surface model (DSM) viewshed analysis, which considers the screening effects of existing topography, structures, and vegetation. For the purposes of this analysis, adjacent, non-participating receptor was defined as a habitable residential structure on a property owned by a person without prior agreements with the Applicant and whose parcel abuts any Project parcel or a road or utility right-of-way that also abuts a Project parcel. Direct line-of-sight is defined as a straight line between the observer and the object being observed, unobstructed by any physical barrier that materially obscures a view of the object being observed.

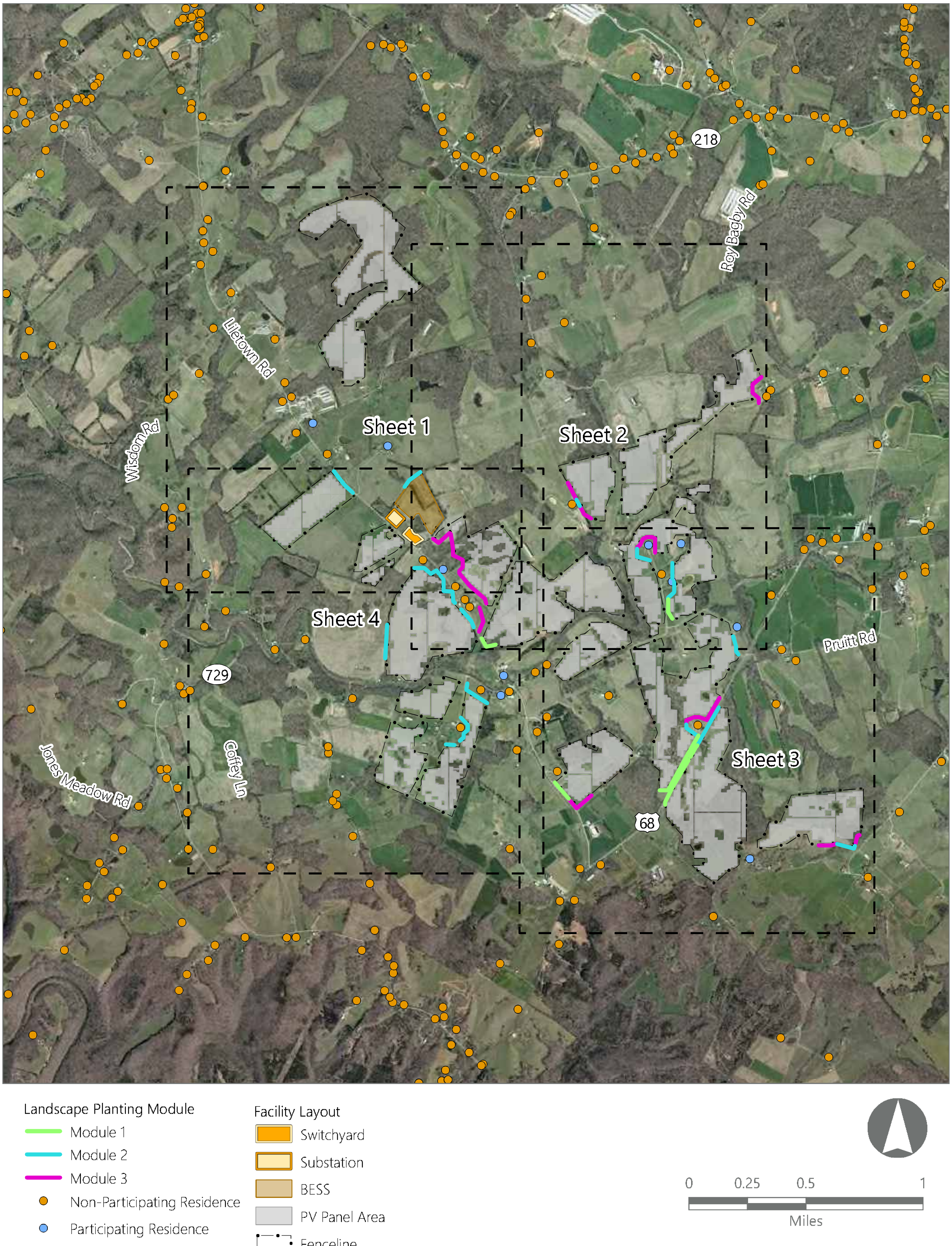
This viewshed analysis was prepared using:

1. A DSM derived from publicly available 2020 lidar data revised to reflect facility-related clearing and to remove adjacent, non-participating receptors (in order to prevent them from obstructing their own visibility)
2. Sample points placed in the approximate center of each adjacent, non-participating receptor
3. A viewer height of 15 feet applied to each sample point to approximate the viewer’s eye level from the second story of the residence
4. A maximum PV array height of 8.5 feet was utilized for the purposes of e viewshed analysis described in this report
5. A viewshed extent limit equal to the distance from the receptor to the nearest PV panel plus 500 feet (varies by receptor)
6. Esri ArcGIS Pro® software with the Spatial Analyst extension

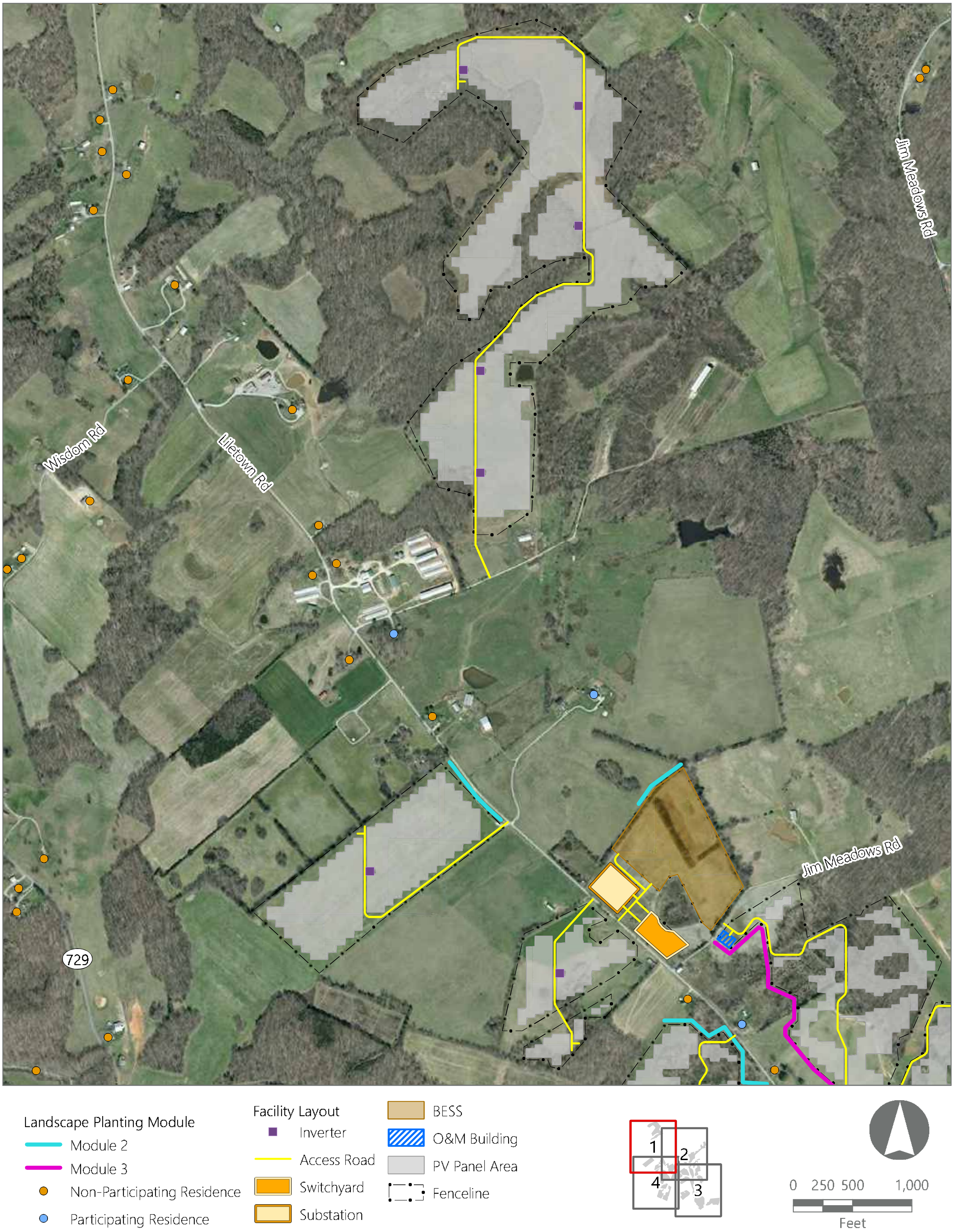
The resulting viewshed indicates areas where the receptor has a direct line-of-sight to areas 8.5 feet above the surrounding ground surface. Therefore, areas where the receptor viewshed overlaps the proposed PV arrays indicate potential receptor visibility of adjacent PV panels. These locations were then evaluated for appropriate placement of mitigation modules.

The preliminary locations for planting modules are illustrated on the following figures.

Planting Module Locations



Basemap: KyFromAbove 2024 "Phase 3 - 3in" orthoimagery map service



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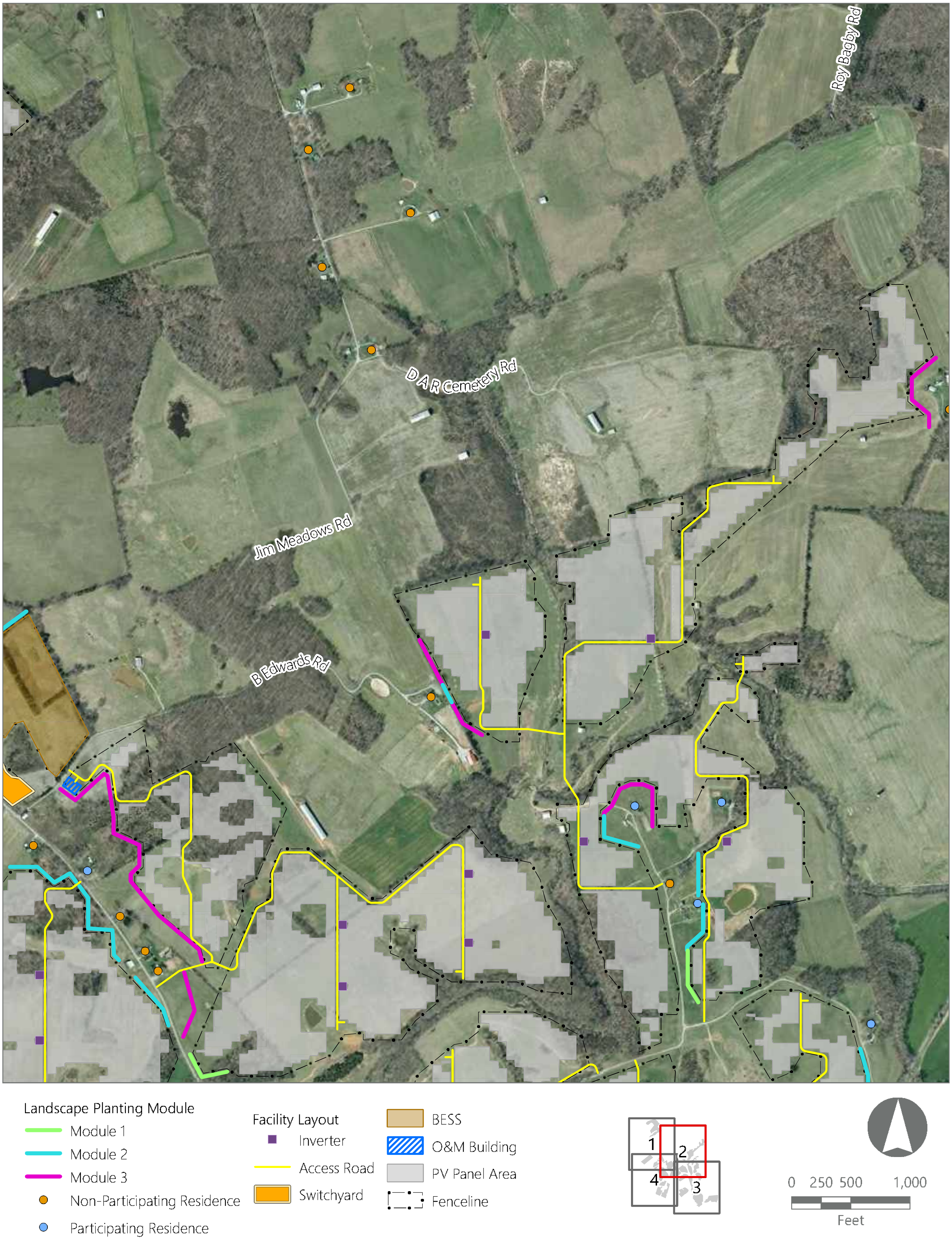
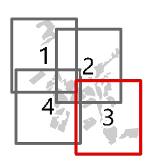
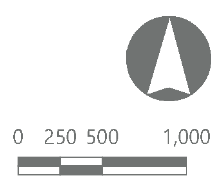


Basemap: KyFromAbove 2024 "Phase 3 - 3in" orthoimagery map service

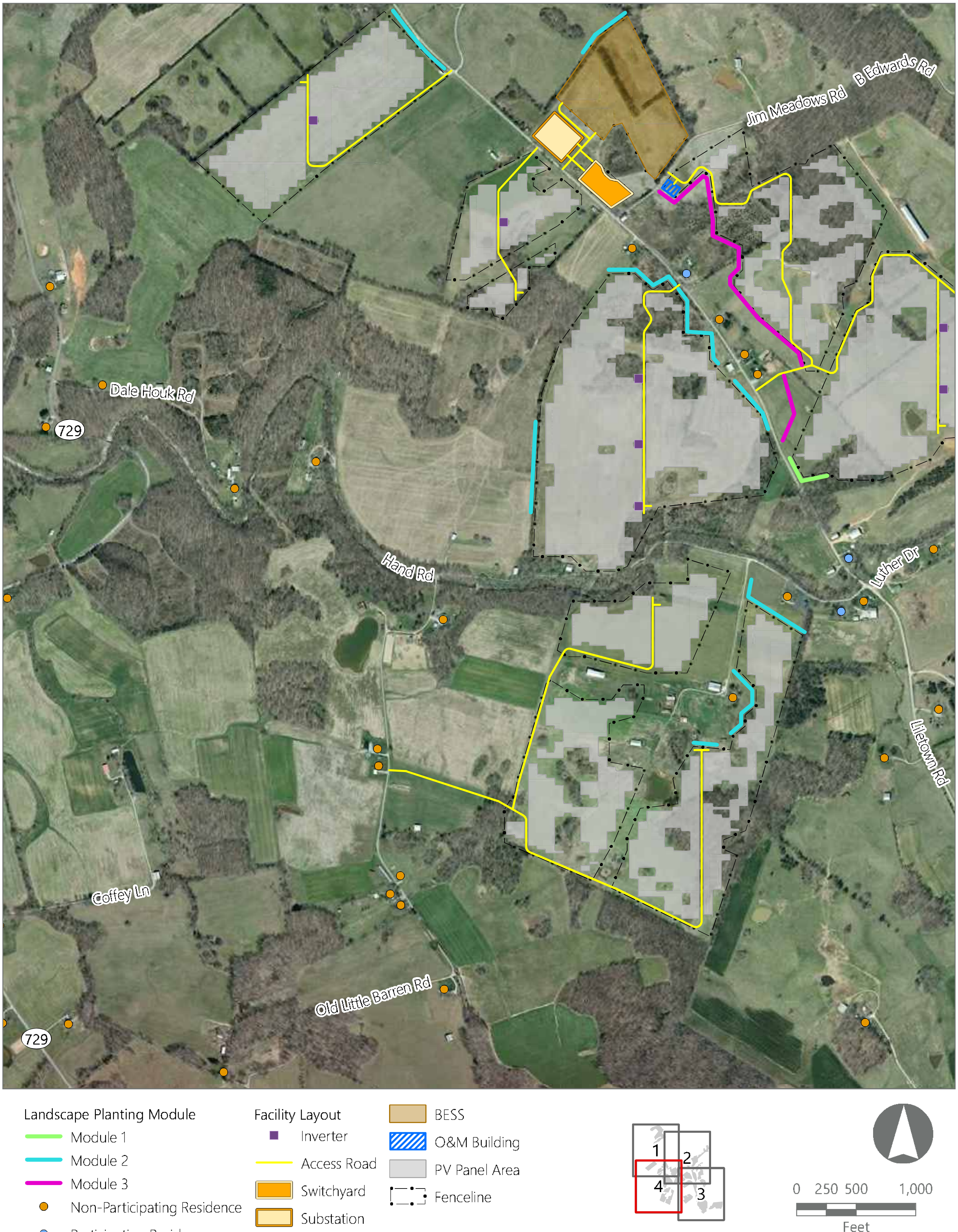
Landscape Planting Module
- Module 1
- Module 2
- Module 3
- Non-Participating Residence
- Participating Residence

Facility Layout
- Inverter
- Access Road
- PV Panel Area
- Fenceline





Basemap: KyFromAbove 2024 "Phase 3 - 3in" orthoimagery map service



Basemap: KyFromAbove 2024 "Phase 3 - 3in" orthoimagery map service

6.0 Conclusion

Mitigation of visual impacts is an important consideration in the development of a solar facility. The Exie Solar Project mitigation strategy proposes measures to reasonably mitigate the potential visual impacts associated with the facility. The three proposed planting modules provide potential visual mitigation options that could be incorporated into the Project. The selection of native plant species further enhances ecological benefits through habitat creation and increased biodiversity. However, circumstances such as inappropriate planting, the presence of utility conflicts, availability/condition of species at the time of procurement, and input from the Project stakeholders (such as adjacent landowners) may require alterations or substitutions to the proposed materials, or result in plant material decline or loss.

7.0 References

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Attachment H. Route Evaluation Study

ROUTE EVALUATION STUDY

Exie Solar Project
Green County, Kentucky

Prepared for:
Environmental Design & Research,
Landscape Architecture, Engineering &
Environmental Services, D.P.C.
5 East Long Street
Columbus, OH 43215

Prepared by:
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Verdantas Project No: 33458

August 2025

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Tables

Appendices

1. Introduction

1.1 Project Description and Purpose

This Route Evaluation Study has been prepared for Environmental Design & Research, Landscape Architecture, Engineering & Environmental Services, D.P.C. (EDR) on behalf of Exie Solar LLC, who is planning development of the Exie Solar Project, a utility-scale solar electric generation facility with a capacity of up to 110-megawatt AC (MW_{AC}). The Exie Solar Project is planned to include solar panels, along with associated infrastructure such as access roads, electrical collection lines and substation/switchyards. The project is located in Green County, Kentucky. The overall Project Area is approximately 1,340 acres. A Vicinity Map is included in Appendix A.

The objective of this study is to support decisions with state and local authorities regarding permitting and road use and maintenance agreements.

For the purpose of this report, the following definitions have been used when describing the project:

- Project Area means all land within a contiguous geographic boundary that contains the facility, associated setbacks, and properties under lease or agreement that contain any components of the facility.
- Facility means the proposed solar energy system and all associated facilities.

1.2 Methodology

The solar panels will be located in groups at various locations in the Project Area and access to the proposed solar panels for construction and operation will be from state, county and, where necessary, new private gravel access roads. Construction of the facility will cause temporary increases in truck traffic on area roadways due to the delivery of materials and equipment.

This evaluation identifies the probable public routes that can be used to construct and operate the facility. It is assumed that vehicle traffic will originate from an Interstate or 4-lane divided State highway. From these routes, 2-lane State highways will be used to travel to the Project Area. State and county roads will be used to access private leased parcels that make up the Project Area.

For purposes of this evaluation, Interstate, 4-lane and 2-lane State highways were not evaluated because it is assumed that these roadways are sufficient to accommodate the construction and operational traffic with respect to load capacity, geometry, and condition. This evaluation was completed using desktop resources only such as digital aerial photographs, Google Earth, etc. A visual evaluation was not completed.

Research for state permits that are necessary for hauling the materials and equipment is also included in this report.

1.3 Vehicle Types

The size and types of vehicles needed to deliver construction equipment, construction materials and facility components include flatbed or tractor-trailer equipment delivery vehicles and multi-axle dump trucks. In addition, typical automobiles and pickup trucks will be used to transport construction staff and other incidental truck trips.

1.4 Design Vehicle Characteristics

Transportation of construction equipment and materials and facility components will be completed using conventional transportation vehicles such as fixed-bed trucks or tractor-semi-trailers (AASHTO WB-67 or smaller). Construction equipment such as excavators, bull dozers, and wheel tractor-scrapers will be transported to the site on fixed-bed or tractor-semi-trailer low-boy vehicles. Multi-axle dump trucks may also be used. For the vast majority of the vehicles, they will be of legal weight and dimensions. Some limited components such as switchgear or transformers for switchyards and substations may require the use of Oversize/Overweight (OSOW) Permits which are described in Section 3.3 of this report.

2. Probable Route Evaluation

2.1 Existing Road Network and Traffic Conditions

Three major roadways are present near the Project Area vicinity: US-68, KY-218, and KY-729 (Appendix A). US-68 is a two-lane road that runs in a northeasterly path along the southeast border of the Project Area. KY-218 is a two-lane road that runs east and west along the north border of the Project Area. KY-729 is a one-and-a-half lane road that runs in a southwesterly direction along the southwest border of the Project Area. The average daily traffic (ADT) is the average number of vehicles traveling in two directions past a specific point or monitoring station in a 24-hour period. Eight ADT monitoring stations are located in the vicinity of the Project Area—three along US-68, two along KY-218, one along KY-729, one along Liletown Road, and one along Old Little Barren Road. The ADT information in the Project Area vicinity is summarized in Table 1 below.

TABLE 1: AVERAGE DAILY TRAFFIC[1]

Station ID	Roadway	County	Milepoints	Average Daily Traffic (average of vehicles / 24 hours)
044691	Old Little Barren Road	Green	1.291-1.835	94
044508	KY-729	Green	0-5.245	117
044690	Liletown Road	Green	0.791-0.991	220
085002	US-68	Metcalfe	17.842-20.016	778
044511	US-68	Green	0-4.576	784
044513	KY-218	Green	1.615-5.045	791
044253	KY-218	Green	5.045-9.523	982
044254	US-68	Green	4.576-6.099	1310

[1] Kentucky Transportation Cabinet (KYTC) Traffic Counts
https://maps.kytc.ky.gov/trafficcounts

3. Potential Impacts to Roadways

The development of a solar electric generating facility has the potential to create transportation impacts because of short-term construction activities. The following sections estimate the traffic for construction vehicles during the project and summarizes permitting and road use agreements.

3.1 Estimated Future Traffic

To deliver the construction equipment, materials and construction workers during the construction of the facility, the probable routes will experience increased construction traffic (trucks, equipment, passenger vehicles carrying workers, etc.). Based on Verdantas' significant background of experience working on solar projects and with solar developers, there will be approximately 17 to 18 vehicles per MW of power. Therefore, there are estimated to be 1,870 to 1,980 vehicles for the project. The estimated number of vehicles is the estimated total for the duration of the project's construction. The construction daily totals will vary depending on the stage of construction and will be dependent on the selected contractor's schedule.

For the vast majority of the vehicles, they will be of legal weight and dimensions. Some limited components such as switchgear or transformers for switchyards and substations may require the use of overweight/oversize vehicles.

A final delivery route has not yet been finalized, but it is likely the Primary Access Route for delivery of facility components to the Project Area will be from the south, originating from Cumberland Parkway, and by way of U.S. Route 68, to KY-218 or KY-729 (see Appendix A). Within the Project Area, county roads and new private gravel access roads will likely be used to deliver equipment and materials.

For the majority of the delivery vehicles that are of legal dimensions, no delays to local traffic should be experienced except where the delivery vehicles may need to travel on narrow roadways (less than 2 lanes in width). However, the delays to local traffic should be minimal due to the low traffic volume in the Project Area. When delivery vehicles are travelling on narrow roadways or when there is an occasional oversized vehicle, traffic control will be utilized to manage local traffic. Because this is an agricultural area, heavier use of roadways by local farmers during planting and harvest seasons will occur.

The Project Area is located within the Green County Public Schools District. The Green County Public City Schools District has four schools: Green County Primary School, Green County Intermediate School, Green County Middle School, and Green County High School. Of the Green County Public Schools District, all four schools are approximately the same distance (~10 miles) from the Project Area. Due to the rural area, many of the students are transported by bus. The number of buses and stops within the Project Area would be limited due to the total number of students and low density of homes.

During operation and maintenance of the facility, there will be very little increase in traffic as solar electric generating facilities typically only require a few permanent operations staff. There will be occasional maintenance vehicles and additional traffic will be negligible.

3.2 Impact on Road Infrastructure

It is probable that degradation of roads in the vicinity of the Project Area may occur as a result of the proposed Project. The increase in localized traffic and the continued entry and exit of heavy trucks or equipment have the potential to result in additional wear on the existing roadway and shoulder of the prospective entrances to the Project site. Potential impacts may also occur along the local roadways where sufficient width for passing motorists cannot be obtained affecting the roadway edges and the shoulder area. Potential impacts to the local roadways may also occur where locations of insufficient subbase are encountered. These areas are typically random and smaller in nature.

3.3 Permits and Agreements

Prior to construction, the contractor will obtain all necessary permits from Kentucky Transportation Cabinet (KYTC) and the County Road Department. County officials will be consulted as necessary to obtain any required driveway permits, crossing permits, or other required approvals. Furthermore, the Project will coordinate with Green County officials as necessary for potential impacts associated with construction activities.

Oversize/Overweight (OSOW) Permits are required when loads exceed legal dimensions or weights. OSOW Permits will be obtained from the Kentucky Transportation Cabinet (KYTC) and in accordance with Kentucky law. Table 2 summarizes the vehicle characteristics without OSOW Permits for State of Kentucky highways.

For construction of the facility, the vast majority of the vehicles will meet current legal dimensions and weights. Therefore, OSOW Permits are only anticipated for a few vehicles that may exceed these criteria such as switchgear or transformers.

TABLE 2: DIMENSIONAL CRITERIA FOR VEHICLES WITHOUT OVERSIZE/OVERWEIGHT PERMITS

Vehicle Characteristic	State Highway Limit
Width of vehicle, inclusive of load	8.5 Feet
Height of vehicle, inclusive of load	13.5 Feet
Length of vehicle, inclusive of load and bumpers	53 Feet
Total Weight of vehicle, inclusive of load	80,000 pounds

Table 2 Notes:

- Length represents semi-tractor-semi-trailer combination.
- Maximum weights are determined by the gross weight of the load and the vehicle, and subject to the axle weights.
- See KYTC Legal Dimensions page:

  https://drive.ky.gov/Motor-Carriers/Overweight-Over-Dimensional/Pages/OWOD-Legal-Dimensions.aspx

4. Anticipated Levels of Fugitive Dust

Land disturbing activities associated with the proposed Project may temporarily contribute to an increase in airborne dust particles, known as fugitive dust per the Kentucky Energy and Environment Cabinet. Fugitive dust is defined as dust that is not emitted from a defined point source, which includes paved, unpaved internal roads and construction sites. Fugitive dust is regulated under Kentucky's state fugitive emissions regulations (401 KAR 63:010).

The primary sources of fugitive dust are expected to be from vehicular traffic on paved and unpaved internal roads, construction activities, and material handling. The anticipated levels of fugitive dust will vary depending on several factors including traffic volume, vehicle speed, road surface conditions, and weather conditions such as wind speed and precipitation. Internal roads to access the site will be gravel, which may result in an increase in airborne dust particles during dry conditions and when internal roadway traffic is heavy during construction.

To address the anticipated levels of fugitive dust, mitigation measures are recommended during construction activities. These include implementing speed limits, barriers, and other traffic control measures; along with the use of water for dust control as authorized under the Kentucky Pollutant Discharge Elimination System as a non-stormwater discharge activity.

5. Impacts to Rail

There are no public rail or bus transit systems in the Project Area.

There are no commercial rail lines in Green County[2]. Consequently, there will be no impact to rail traffic or a rail system during the duration of construction.

[2]Kentucky Transportation Cabinet (KYTC) Railroads
https://transportation.ky.gov/MultimodalFreight/Pages/Railroads.aspx

6. Conclusions

The vast majority of the vehicles transporting construction equipment, materials and workers are expected to meet legal load and dimensional limits. Some limited components such as switchgear or transformers for switchyards and substations may require Oversize/Overweight (OSOW) Permits. OSOW Permits will be obtained from the KYTC and in accordance with Kentucky law. All work will be coordinated and approved by the appropriate regulatory agencies prior to construction.

For the majority of the delivery vehicles that are of legal dimensions, no delays to local traffic should be experienced except where the delivery vehicles may need to travel on narrow roadways. However, the delays to local traffic should be minimal due to the low traffic volume in the Project Area. When delivery vehicles are traveling on narrow roadways or when there is an occasional oversized vehicle, traffic control will be utilized to manage local traffic. Because this is an agricultural area, heavier use of roadways by local farmers during planting and harvest seasons will occur.

U.S. Route 68 to either State Route KY-218 or State Route KY-729 will likely be the Primary Access Route used to approach the project, being the main artery for delivery of facility components. Within the Project Area, county roads and new private gravel access roads will likely be used to deliver equipment and materials.

All roads should be monitored during construction for deterioration to ensure they are safe for local traffic. The volume and/or weight of construction traffic may cause accelerated pavement deterioration or stress on drainage structures that could necessitate temporary repairs. After completion of construction activities, there may be improvements required to return the roadways and drainage structures to pre-construction conditions or better.

To address the anticipated levels of fugitive dust, mitigation measures are recommended during construction activities. These include implementing speed limits, barriers, and other traffic control measures; along with the use of water for dust control as authorized under the Kentucky Pollutant Discharge Elimination System as a non-stormwater discharge activity.

During operation and maintenance of the facility, there will be very little increase in traffic as solar electric generating facilities typically only require a few permanent operations staff. There will be occasional maintenance vehicles and additional traffic will be negligible.

Appendix A

Project Map

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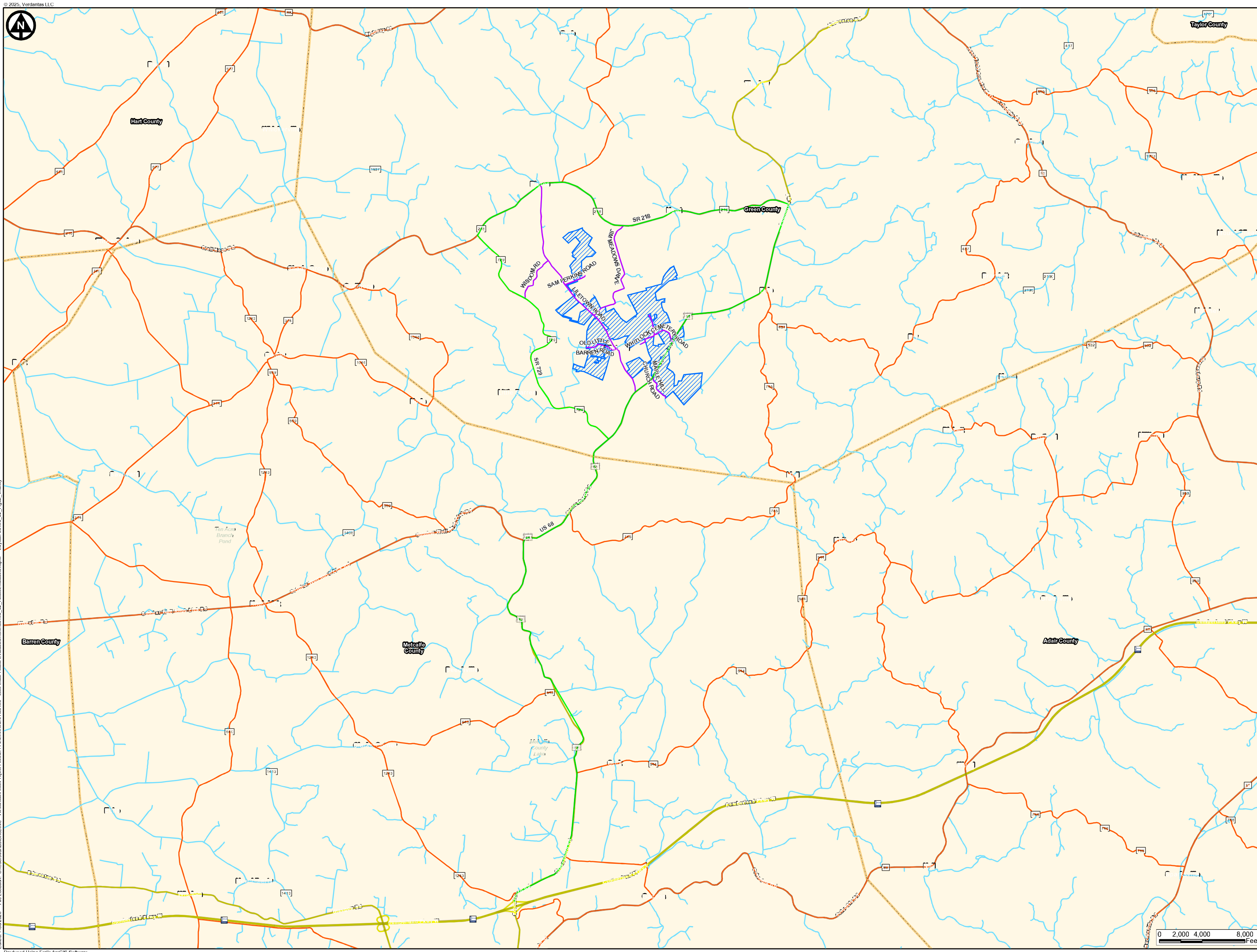

Exie Solar Project Area
County Boundary
Probable Route - County and Local Roads
Primary Access Route - US and State Highways
County Road
State Route
US Route

DISCLAIMER: Verdantas LLC has furnished this map to the Client for its sole and exclusive use as a preliminary planning and screening tool. This map is reproduced from geospatial information compiled from third-party sources which may change over time and are not accurate as to mapping, surveying or engineering standards. Verdantas LLC makes no representation or warranty as to the content, accuracy, timeliness or completeness of any information. In no event will Verdantas LLC, its owners, officers, employees or agents, be liable for damages of any kind arising out of the use of this map by Client or any other party.

Green County, Kentucky

Vicinity Map

Route Evaluation Study
Exie Solar Project

Project Number	33458
Date	August 2025
Author	rartus
Scale	1 in = 4,000 ft
Figure	1

Produced Using Esri's ArcGIS Software