APPENDIX B

SOLAR GLARE HAZARD ANALYSIS
SEVILLE 4 SOLAR PROJECT
IMPERIAL COUNTY, CA

SOLAR GLARE HAZARD ANALYSIS

SEVILLE 4 SOLAR PROJECT
ENVIRONMENTALLY SENSITIVE AVOIDANCE ALTERNATIVE
IMPERIAL COUNTY, CALIFORNIA

EMA Report No. 2375-03R
April 2018

Prepared for:

Titan Solar II LLC
604 Sutter, Suite 250
Folsom, CA 95630

ENVIRONMENTAL MANAGEMENT ASSOCIATES

SOLAR GLARE HAZARD ANALYSIS

SEVILLE 4 SOLAR PROJECT
ENVIRONMENTALLY SENSITIVE AVOIDANCE ALTERNATIVE
IMPERIAL COUNTY, CALIFORNIA

EMA Report No. 2375-04
April 2018

Prepared for:

Titan Solar II LLC
604 Sutter, Suite 250
Folsom, CA 95630

LIMITATIONS

This report was prepared by Environmental Management Associates, Inc. (EMA) in conformance with the scope of work prescribed by our client. The work has been conducted in an objective and unbiased manner and in accordance with generally accepted professional practice for this type of work. No other warranty, either expressed or implied, is made as to the findings, recommendations, specifications, or opinions expressed herein.

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Principal

SOLAR GLARE HAZARD ANALYSIS

SEVILLE 4 SOLAR PROJECT
ENVIRONMENTALLY SENSITIVE AVOIDANCE ALTERNATIVE
IMPERIAL COUNTY, CALIFORNIA

TABLE OF CONTENTS

Page

LIMITATIONS i

LIST OF TABLES ii

LIST OF FIGURES iii

LIST OF APPENDICES iii

1. INTRODUCTION AND PROJECT DESCRIPTION 1

2. ASSESSMENT METHODOLOGY 3
   - 2.1 Solar Glare Hazard Analysis Tool (SGHAT) 3
   - 2.2 Key Observation Points 3
   - 2.3 SGHAT Modeling Parameters 5
   - 2.4 Observation Point Parameters 5

3. SGHAT MODEL OUTPUTS 6
   - 3.1 Determination of Ocular Impact 6
   - 3.2 Other SGHAT Graphs 6

4. RESULTS 8
   - 4.1 HSAT Modeling Results 8
   - 4.2 Fixed-Frame Modeling Results 8
   - 4.3 Assessment 9

LIST OF TABLES

Page

Table 1: Description of Selected KOPs 4

TABLE OF CONTENTS
(continued)

LIST OF FIGURES

Page

Figure 1: Location Map of the Project Site and Surrounding Area 9
Figure 2: KOPs – Occupied Residential and Commercial Buildings 10
Figure 3: KOPs – Roads and OWSVRA Points 11
Figure 4: KOPs – IID "R" Transmission Line Road 12
Figure 5: KOPs – Airports 13
Figure 6: Seville 4 Alternative Project Fixed-Frame Array 14
Figure 7: Annual Log-Log Ocular Hazard Plot as a Function of Retinal Irradiance and Subtended Source Angle 15
Figure 8: Example Annual Log-Log Ocular Hazard Plot 16
Figure 9: Example Annual Predicted Glare Occurrence Graph 17
Figure 10: Example Daily Duration of Glare Graph 18
Figure 11: Example Glare Reflections on PV Footprint 19

LIST OF APPENDICES

APPENDIX A: SGHAT MODELING PARAMETERS AND VALUES
APPENDIX B: FIXED-FRAME MODELING (BOTTOM) - RESIDENCE AND COMMERCIAL BUILDING KOPS
APPENDIX C: FIXED-FRAME MODELING (BOTTOM) - ROAD AND OWSVRA KOPS
APPENDIX D: FIXED-FRAME MODELING (BOTTOM) - IID "R" TRANSMISSION LINE ROAD KOPS
APPENDIX E: FIXED-FRAME MODELING (BOTTOM) - AIRPORT KOPS
APPENDIX F: FIXED-FRAME MODELING (TOP) - RESIDENCE AND COMMERCIAL BUILDING KOPS
APPENDIX G: FIXED-FRAME MODELING (TOP) - ROAD AND OWSVRA KOPS
APPENDIX H: FIXED-FRAME MODELING (TOP) - IID "R" TRANSMISSION LINE ROAD KOPS
APPENDIX I: FIXED-FRAME MODELING (TOP) - AIRPORT KOPS

SOLAR GLARE HAZARD ASSESSMENT

SEVILLE 4 SOLAR PROJECT
ENVIRONMENTALLY SENSITIVE AVOIDANCE ALTERNATIVE
IMPERIAL COUNTY, CALIFORNIA

1. INTRODUCTION AND PROJECT DESCRIPTION

Glare is the continuous source of excessive brightness,[a] including the reflection of the sun off any reflective surface, such as windows, calm water or solar panels. The purpose of this glare assessment is to determine the potential impact of glare of the sun from the proposed Seville 4 Solar Project solar panels on residences, motorists and aircraft approaching regional airports. This assessment will use a web-based interactive tool developed by Sandia National Laboratories that provides a quantified assessment of when and where glare will occur throughout the year for the proposed solar installation and the potential effects on the human eye at locations where glare occurs.

Titan Solar II LLC (Titan) is proposing to develop the Seville 4 Solar Project, a nominal 20-megawatt alternating current (MW_{AC}) solar photovoltaic (PV) energy generation facility located on up to approximately 174 acres of land in west-central Imperial County, California (see Figure 1). The Seville 4 Solar Project would be built on a portion of Lot 8 of Tract Map No. 00988. Two options are being considered for development. The fixed-frame PV array option would disturb approximately 146 acres of land, while the horizontal single-axis tracking (HSAT) PV array option would disturb approximately 174 acres of land.

In its report of August 2017, Environmental Management Associates (EMA) analyzed the glare effects of both the fixed-frame PV array option and the horizontal single-axis tracking PV array option of the Seville 4 Solar Project. Subsequently, an alternative design for the Seville 4 Solar Project (the "Environmentally Sensitive Avoidance Alternative" (Alternative Project)), which would move the eastern boundary of the original Seville 4 Solar Project two hundred feet to the west, has been proposed. This report analyses the glare effects of the fixed-frame PV array of the Alternative Project.[b]

The Alternative Project proposes to utilize either thin film or crystalline solar photovoltaic (PV) technology modules mounted either on fixed frames or horizontal single-axis tracker (HSAT) systems. The fixed frame PV module arrays would be mounted on racks that would be supported by driven piles. The fixed-frame racks would be secured at a fixed tilt of 25° +/- 5º from horizontal facing a southerly direction. Current Alternative Project design would have individual PV modules, each approximately 3.25 feet wide by 6.5 feet long (depending on the specific PV

[a] Clifford K. Ho. Solar Glare Hazard Analysis Tool (SGHAT), Sandia National Laboratories. 2013.
[b] As no glare was predicted at any of the key observation points from the previous modeling of the Project HSAT array option, no modeling of the HSAT array was performed for the Alternative Project.

technology selected), mounted two high on a fixed frame, providing a three-foot ground clearance and resulting in the tops of the panels at a maximum of 8.5 feet above the ground.

If HSAT technology is used, the PV modules would rotate around the north-south HSAT axis so that the PV modules would continue to face the sun as the sun moves across the sky throughout the day. The PV modules would reach their maximum height (up to 13.5 feet above the ground, depending on the final design) at both sunrise and sunset, when the HSAT is rotated to 60° from horizontal to point the modules at the rising or setting sun. At noon, or when stowed during high winds, when the HSAT system is rotated so that the PV modules are horizontal, the maximum height would be about 10.75 feet above the ground, depending on the final design. Current Alternative Project design would have individual HSAT PV modules, each approximately 3 feet wide by 5.5 feet long (depending on the specific PV technology selected), mounted on a frame which is attached to an HSAT system.

2. ASSESSMENT METHODOLOGY

2.1 Solar Glare Hazard Analysis Tool (SGHAT)

The Solar Glare Hazard Analysis Tool (SGHAT), developed by the Sandia National Laboratory for the U.S. Department of Energy, employs an interactive Google map where the user can locate a site, draw an outline of the proposed PV array(s), and specify observer locations or paths. Latitude, longitude, and elevation are automatically recorded through the Google interface, providing necessary information for sun position and vector calculations. Additional information regarding the orientation and tilt of the PV panels, reflectance, environment, and ocular (eye or vision) factors are entered by the user. If glare is found, the tool calculates the retinal irradiance (intensity of the glare) and subtended angle (size/distance) of the glare source to predict potential ocular hazards ranging from temporary after-image to retinal burn. The results are presented in a simple plot that specifies when glare will occur throughout the year, with color codes indicating the potential ocular hazard.[c]

While a useful tool for estimating glare, one important limitation of SGHAT Version 3.0 is that it does not 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.

2.2 Key Observation Points

Key observation points (KOPs) are locations which may be sensitive to glare from the Alternative Project. The same four classes of KOPs were identified for this Alternative Project assessment as the original: residences, roads, trails and airports.

Using Google Earth aerial images, all residences and commercial buildings were identified within 3.75 miles of the outer boundary of the Seville 4 Solar Project, and all were selected for analysis (see Figure 2). One additional residence, located at a distance of 6.75 miles but with a relatively unobstructed line of site to the Seville 4 Solar Project site, was also selected for analysis. Another residence, located approximately nine miles to the east, was selected as the closest residence located to the east of the Seville 4 Solar Project site. Ten road or off-highway trail locations within the Ocotillo Wells State Vehicular Recreation Area (SVRA) to the north of the Seville 4 Solar Project site were also identified for analysis (see Figure 3). Five additional KOP's were established at intervals along the Imperial Irrigation District's (IID's) "R" transmission line, located on the eastern edge of Lot 8 (see Figure 4). Finally, the two airports (Ocotillo Airport (San Diego County) and the Salton Sea Airport) located closest to the Seville 4 Solar Project site were also selected for this assessment (see Figure 5). Table 1 provides a description of each of the selected KOPs.

[c] Clifford K. Ho, Cianan A. Sims and Julius E. Yellowhair. Solar Glare Hazard Analysis Tool (SGHAT) User's Manual v. 2H. Sandia National Laboratories. Last update: 7/22/2015.

Table 1: Description of Selected KOPs

Figure 2: KOPs – Occupied Residential and Commercial Buildings			
Number	Description	Latitude (deg)	Longitude (deg)
1	Blu Inn Café	33.125270	-116.044420
2	Blu Inn RV Park	33.123450	-116.040750
3	Residence #1	33.121760	-116.031770
4	Residence #2, #3 & #5	33.122910	-116.052040
5	Residence #4	33.112370	-116.041880
6	Residence #7	33.105510	-116.040630
7	Residence #8	33.108380	-116.038420
8	Residence #9	33.084850	-116.104720
9	Residence #10	33.116980	-115.826883
Figure 3: KOPs – Roads and OWSVRA Points			
Number	Description	Latitude (deg)	Longitude (deg)
1	Highway 78 - NE	33.125550	-115.983140
2	Highway 78 - N	33.125760	-116.003740
3	Highway 78 - NW	33.125840	-116.024850
4	OWSVRA - County Line Rd. Bluff	33.137910	-116.081620
5	OWSVRA - County Line Rd. Hill	33.148220	-116.086330
6	OWSVRA - South of Oil Well Wash	33.148910	-115.934340
7	OWSVRA - San Felipe Wash	33.137630	-116.048990
8	OWSVRA - Tarantula Wash	33.143680	-116.013550
9	OWSVRA - Pole Line Road	33.145280	-115.972800
10	OWSVRA - Gas Dome Trail	33.155050	-115.943440
Figure 4: KOPs – IID "R" Transmission Line Road			
Number	Description	Latitude (deg)	Longitude (deg)
1	IID T-Line Road #1	33.107402	-115.978259
2	IID T-Line Road #2	33.104716	-115.978387
3	IID T-Line Road #3	33.100159	-115.978204
4	IID T-Line Road #4	33.095468	-115.978130
5	IID T-Line Road #5	33.092824	-115.977989
Figure 5: KOPs – Airports			
	Description	Latitude (deg)	Longitude (deg)
	Salton Sea Airport	33.2411944	-115.9525833
	Ocotillo Airport	33.1477778	-116.1315833

2.3 SGHAT Modeling Parameters

Attachment A provides a description of each of the SGHAT modeling parameters and the values used for this assessment. A summary of these modeling parameters follows.

Site configuration parameters (e.g., solar angle and irradiance and ocular values) used the model default values.

PV array parameters were input for modeling both fixed-tilt arrays. The orientation of the fixed-tilt panels was set at 180º from true north, while the tilt of the fixed-tilt solar panels was set at 25º (centered on the proposed 25º +/- º5 range of tilt).

The module surface material "Smooth Glass with Anti Reflection Coating" was selected. In addition, the "Correlate slope error to module surface type" question was selected, which sets the slope error value, based on the selected module surface material. Finally, the "Reflectivity varies with incidence angle" function was checked, which determines the reflectivity of the modules at each time step as a function of module surface material and incidence angle between the panel normal and sun position.

The latitude, longitude and ground elevation for each array vertex is automatically recorded through the SGHAT-Google interface. Array models were constructed for the Alternative Project fixed-frame option (Figure 6). The array vertex parameters require either the height of the array above the ground or the total elevation (the sum of the ground elevation and height above ground). Because the fixed frame panels have a maximum height of 3 feet above the ground and a maximum of 8.5 feet above the ground, glare analyses at both these heights above ground were modeled.

Aircraft flight path parameters required for the assessment of the two airports include the true direction (angle) of each runway, the threshold crossing height (using the default number of 3º), the glide slope (using the default value of 3º); pilot visibility from cockpit/maximum downward viewing angle (defaults to 30º); and the azimuthal viewing angle (defaults to 180°).

2.4 Observation Point Parameters

The latitude, longitude and ground elevation for each of the Key Observation Points (KOPs) is automatically recorded through the SGHAT-Google interface. The observation point parameters also require either the height of the observation point above the ground or the total elevation (the sum of the ground elevation and height above ground). A height of 5 feet of ground level was used for the residence and vehicle observation points.

3. SGHAT MODEL OUTPUTS

3.1 Determination of Ocular Impact

SGHAT determines the potential ocular impact through calculation of the direct normal irradiance, PV module reflectance, size and orientation of the array, optical properties of the PV module, and ocular parameters. These values are then used to determine the retinal irradiance and subtended source angle used in an annual log-log "ocular hazard" plot (see Figure 7).

The subtended source angle represents the size of the glare viewed by an observer, while the retinal irradiance determines the amount of energy impacting the retina of the observer. Larger source angles can result in glare of high intensity, even if the retinal irradiance is low.

The ocular impact of viewed glare has been classified into three levels based on the retinal irradiance and subtended source angle: low potential for after-image, potential for after-image, and potential for permanent eye damage. Figure 7 is a log-log plot which illustrates these three areas of glare intensity[d]:

The impact potential for after-images (in the green and yellow areas in Figure 7) varies broadly, from minor distractions to after-images to flash blindness to potentially permanent eye damage. At the high end of the yellow band, directly viewing the sun could lead to permanent eye damage (see Figure 7 – directly looking at the sun has a high retinal radiance with a relatively low subtended source angle). Examples of after-images (in the yellow band) include the eye's reaction to a flash bulb or a light being turned on in a dark room. At its lowest point, plotted points with a low potential for after-images are just that; the potential for after-images is low.

As shown in the example annual log-log ocular hazard plot (Figure 8), glare with only a low potential for after-image is predicted to be visible from the prescribed observation point.

3.2 Other SGHAT Graphs

In addition to producing the annual log-log ocular hazard plot, SGHAT produces the following additional graphs (using the same three divisions of glare intensity (green, yellow and red)):

<u>Annual Predicted Glare Occurrence:</u>

The Annual Predicted Glare Occurrence graph (see example in Figure 9) shows when glare can occur (as viewed from the prescribed observation point) throughout the year. The graph plots the days of the year vs the hours of the day, with the color of the dots (green, yellow or red) indicating the potential ocular hazard. As shown in Figure 9, glare in this example is predicted to be visible from the prescribed observation point during the late afternoon from mid-March to mid-September. The green color of the plotted points indicates that the glare in this particular example has a low potential to cause a temporary after-image.

[d] Clifford K. Ho, Cianan A. Sims, Julius Yellowhair, and Evan Bush, Solar Glare Hazard Analysis Tool (SGHAT) Technical Reference Manual. Sandia National Laboratories. March 2015

Daily Duration of Glare:

The Daily Duration of Glare graph (see example in Figure 10) shows the daily duration of glare (as viewed from the prescribed observation point) throughout the year. The graph plots the days of the year vs the duration of glare, with the color of the dots (green, yellow or red) indicating the potential ocular hazard. As shown in Figure 10, glare in this example is still predicted to be visible from the prescribed observation point from mid-March to mid-September, with daily durations not exceeding 10 minutes per day. The green color of the plotted points again indicates that the glare in this particular example has a low potential to cause a temporary after-image.

Glare Reflections on PV Footprint [Aggregate]:

The Glare Reflections on PV Footprint [Aggregate] (see example in Figure 11) plot illustrates the aggregated location(s) of the glare spots for times when glare is predicted. For a given minute of glare, the receptor will see a visible sun reflection, or glare spot, on one or more modules in the PV array. This plot gathers the locations of each glare spot and displays them on the array footprint. This can help to identify which section(s) of the array are generating glare.

4. RESULTS

4.1 HSAT Modeling Results

As stated above, since no glare was predicted at any of the KOPs from the HSAT array in the modeling of glare from the Seville 4 Solar Project, no modeling of glare was performed for the Alternative Project HSAT array layout.

4.2 Fixed-Frame Modeling Results

Modeling results for the bottom of the fixed-frame array are provided in APPENDIX B through APPENDIX E. Modeling results for the top of the fixed-frame array are provided in APPENDIX F through APPENDIX I.

No glare was predicted from either the bottom (see APPENDIX C and APPENDIX E) or the top (see APPENDIX G and APPENDIX I) of the fixed-frame array to any of the commercial building, highway, OWSVRA trail or airport KOPs.

Glare was predicted at two residences. The modeling of KOP #6 (Residence 7) predicted that this KOP would receive annually a total of only 6 minutes of "green" glare and 1 minute of "yellow" glare from the bottom of the fixed-frame array (see APPENDIX B) and 3 minutes of "green" glare and 1 minute of "yellow" glare from the top of the fixed-frame array (see APPENDIX F) in the early morning of mid-March or mid-September. The modeling of KOP #8 (Residence 9) predicted that this KOP would receive annually 18 minutes of "green" glare from the bottom of the fixed-frame array (see APPENDIX B) and 18 minutes of "green" glare from the top of the fixed-frame array (see APPENDIX F) in the early morning of Spring or Fall.

Substantial glare was predicted from both the bottom and the top of the fixed-frame array by the Seville 4 Solar Project modeling of KOP #3 on the IID's "R" transmission line road. However, by constructing the fixed-frame array 200 feet west of the existing transmission line and its accompanying road, the Alternative Project reduces predicted "yellow" glare by nearly 70%. SGHAT predicted that Alternative Project KOP #3 would receive annually 5,570 minutes of "yellow" glare (down from the Project's 17,937 minutes) from the bottom of the fixed-frame array and 4,271 minutes of "yellow" glare (down from the Project's 13,709 minutes) from the top of the fixed-frame array in the late afternoon from early March through early October, with the daily duration of glare of less than 30 minutes (see APPENDIX D and APPENDIX H). The intensity of this potential for after-image glare is generally low, near the bottom range of retinal irradiance. SGHAT also predicted that Alternative Project KOP #3 would receive annually 82 minutes of "green" glare from the both the bottom and top of the fixed-frame array.

The predicted glare at the adjacent KOPs (KOP #2 and KOP #4 on the IID's "R" transmission line road) is significantly less than that at KOP #3 (less than 80 minutes annually of "yellow" glare and 6 minutes or less of "green" glare), and comparable to that predicted from the Seville 4 Solar Project analysis [see APPENDIX D and APPENDIX H]. No glare was predicted at either KOP #1 or KOP #5 on the IID "R" Transmission Line Road.

4.3 Assessment

In reviewing the results of the SGHAT modeling, it is important to note that while a useful tool for estimating glare, one important limitation of SGHAT Version 3.0 is that it does not 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.

No glare was predicted from either the bottom or the top of the fixed-frame array to any of the commercial building, highway, OWSVRA trail or airport KOPs. Glare was predicted at only two residences. The modeling of KOP #6 (Residence 7) predicted that this KOP would receive annually a total of only 6 minutes of “green” glare and 1 minute of “yellow” glare from the bottom of the fixed-frame array and 3 minutes of “green” glare and 1 minute of “yellow” glare from the top of the fixed-frame array. The modeling of KOP #8 (Residence 9) predicted that this KOP would receive annually 18 minutes of “green” glare from the bottom of the fixed-frame array and 18 minutes of “green” glare from the top of the fixed-frame array. Although these estimates of glare to the residences from the Alternative Project are greater than that of the Seville 4 Solar Project, the increases are *de minimis* and do not warrant mitigation.

Exposure to predicted glare depends upon the type of glare receptor. Fixed receptors (occupied residences and commercial buildings and airports) are exposed to the predicted glare during the full, predicted time of the glare. Mobile receptors (roads and trails), however, move through the area of predicted glare, and are exposed to the predicted glare only during the time the mobile receptor is within the zone of that predicted glare. Thus, although the SGHAT model predicts that KOP #3 on the IID’s “R” transmission line road would receive annually nearly 5,600 minutes of "yellow" glare from the bottom of the fixed-frame array, a vehicle traveling at 20 miles per hour on the “R” transmission line road would spend less than 30 seconds in the predicted yellow glare area immediately adjacent to the solar array, and less than two minutes on the road before the source of the solar array glare is passed. Vehicles moving along the “R” transmission line are traveling generally perpendicular to the proposed solar array, and not driving toward it, so the glare is peripheral. There are also no facilities along the IID “R” transmission line road that would attract or keep travelers to the areas of predicted “yellow” glare. Based on this assessment, the impact of glare from the proposed Seville 4 Solar Project is less than significant.

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FIGURES

Figure 1: Location Map of the Project Site and Surrounding Area

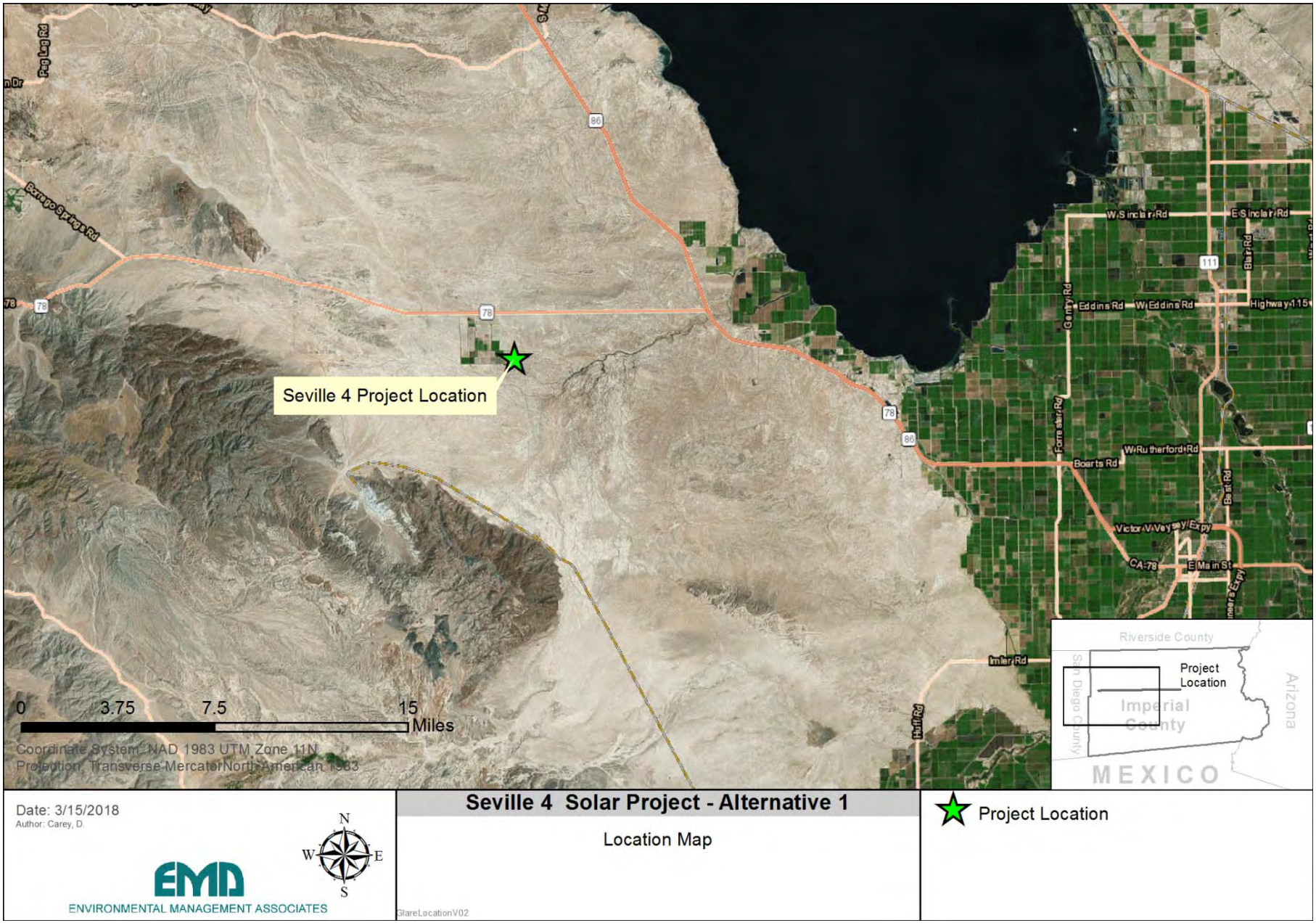


Figure 2: KOPs – Occupied Residential and Commercial Buildings

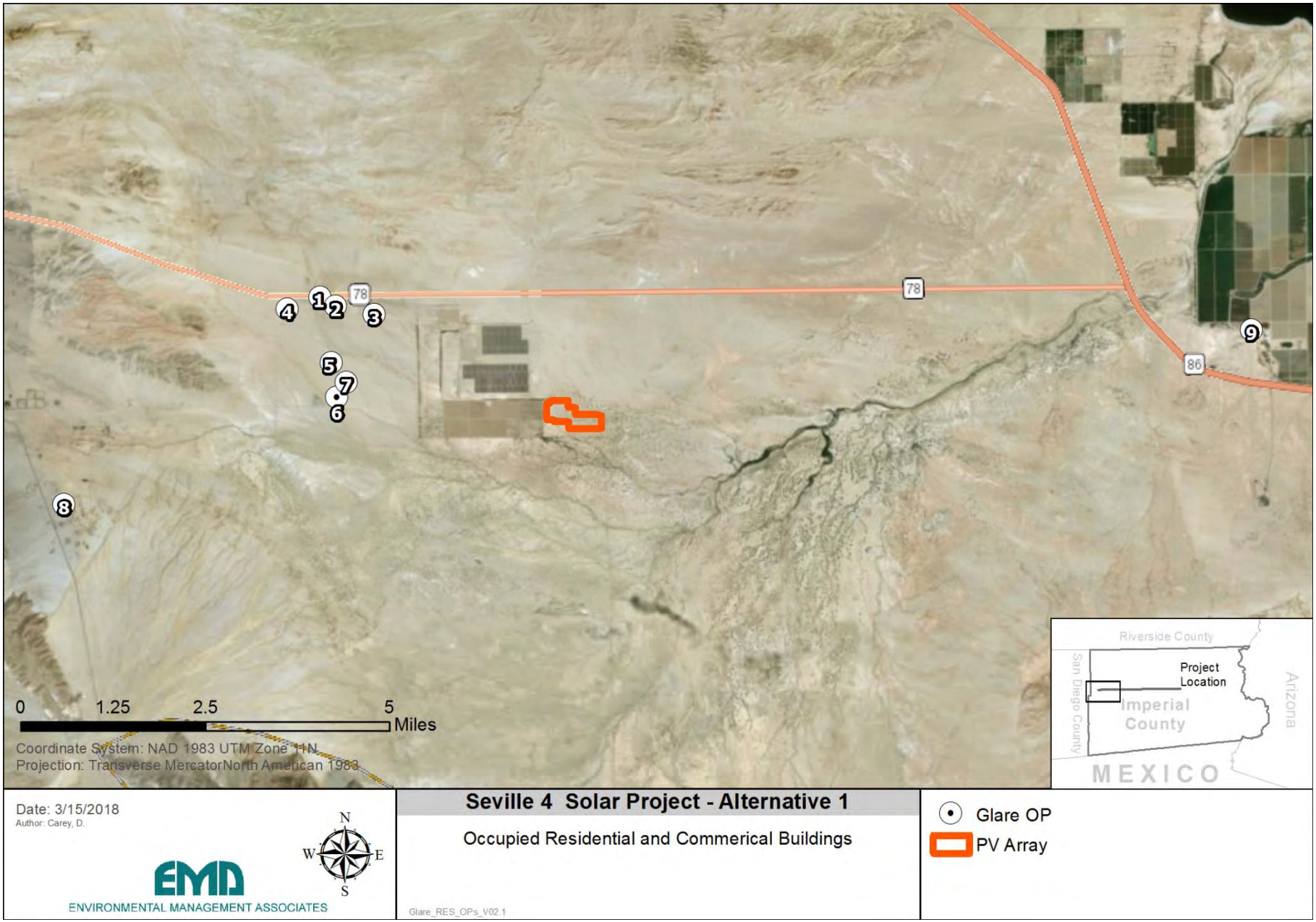


Figure 3: KOPs – Roads and OWSVRA Points

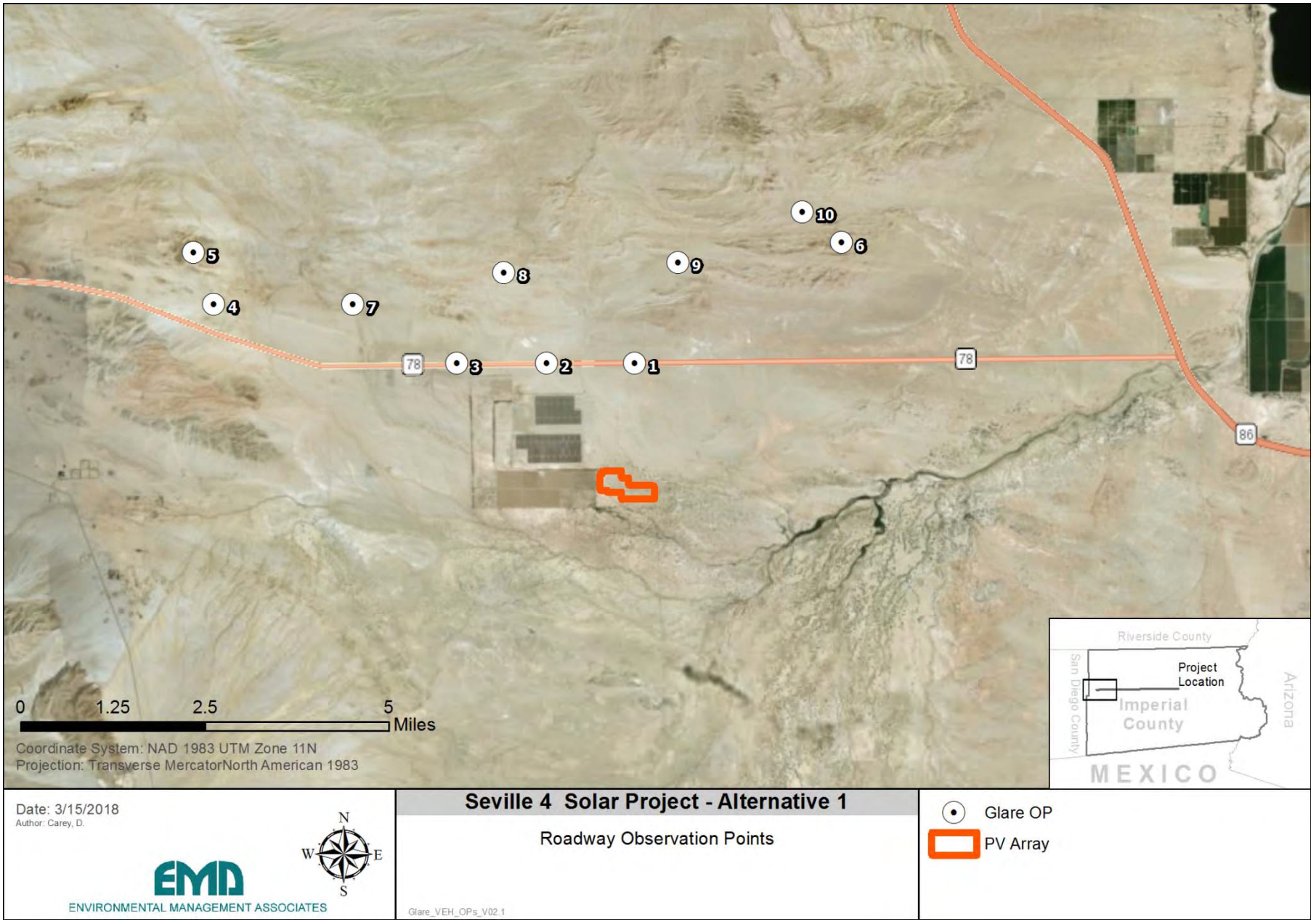


Figure 4: KOPs – IID "R" Transmission Line Road

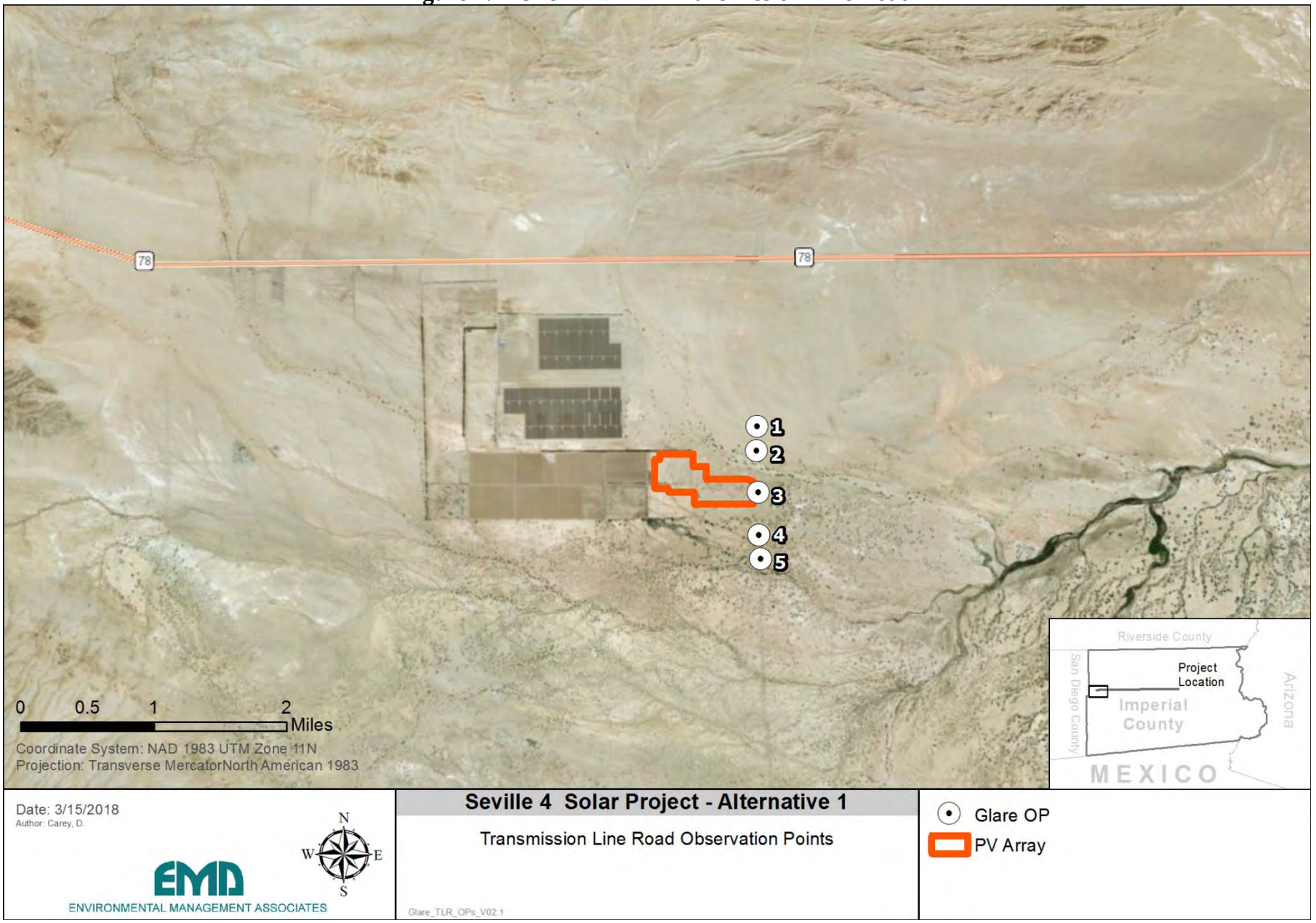


Figure 5: KOPs – Airports

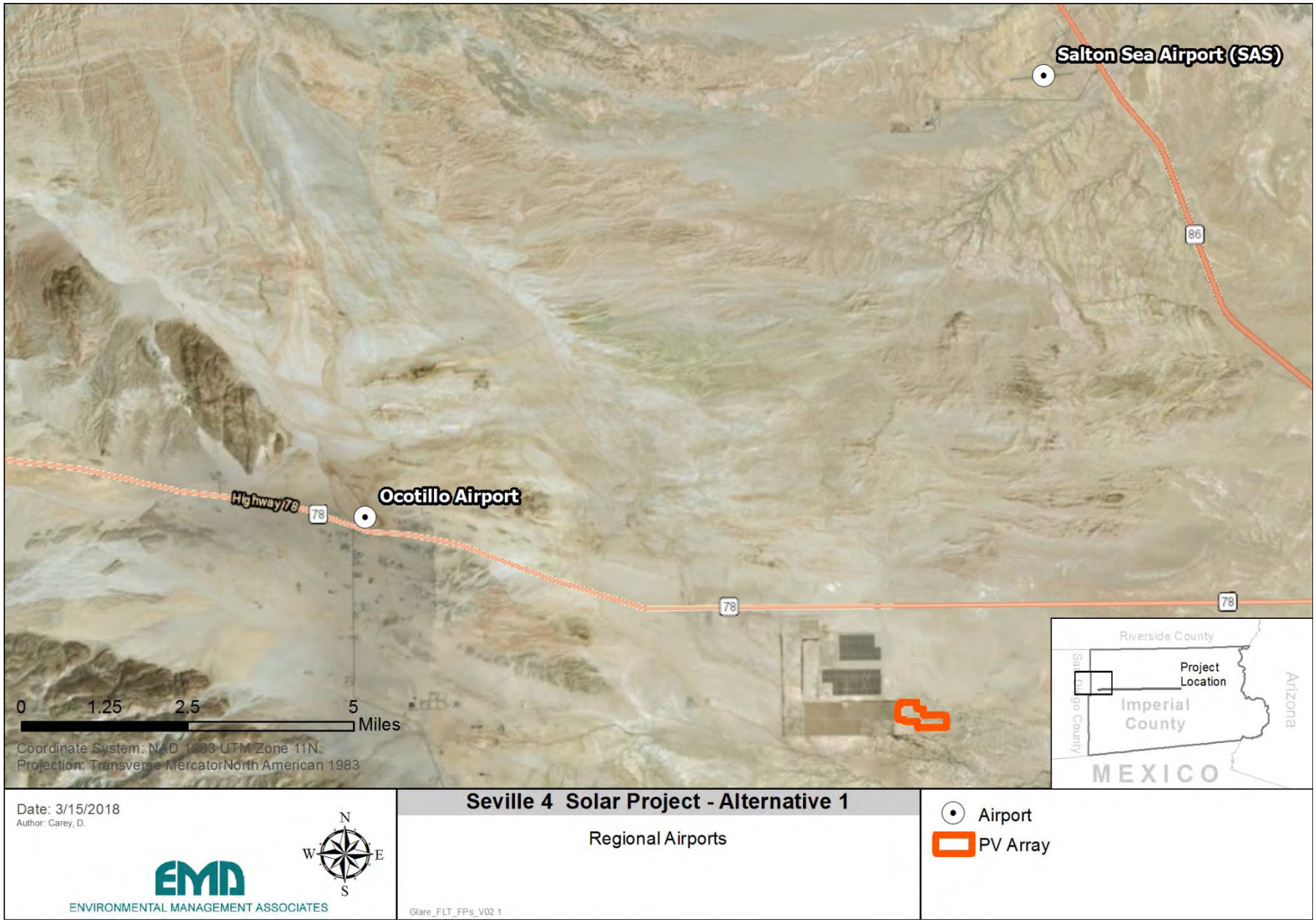


Figure 6: Seville 4 Alternative Project Fixed-Frame Array

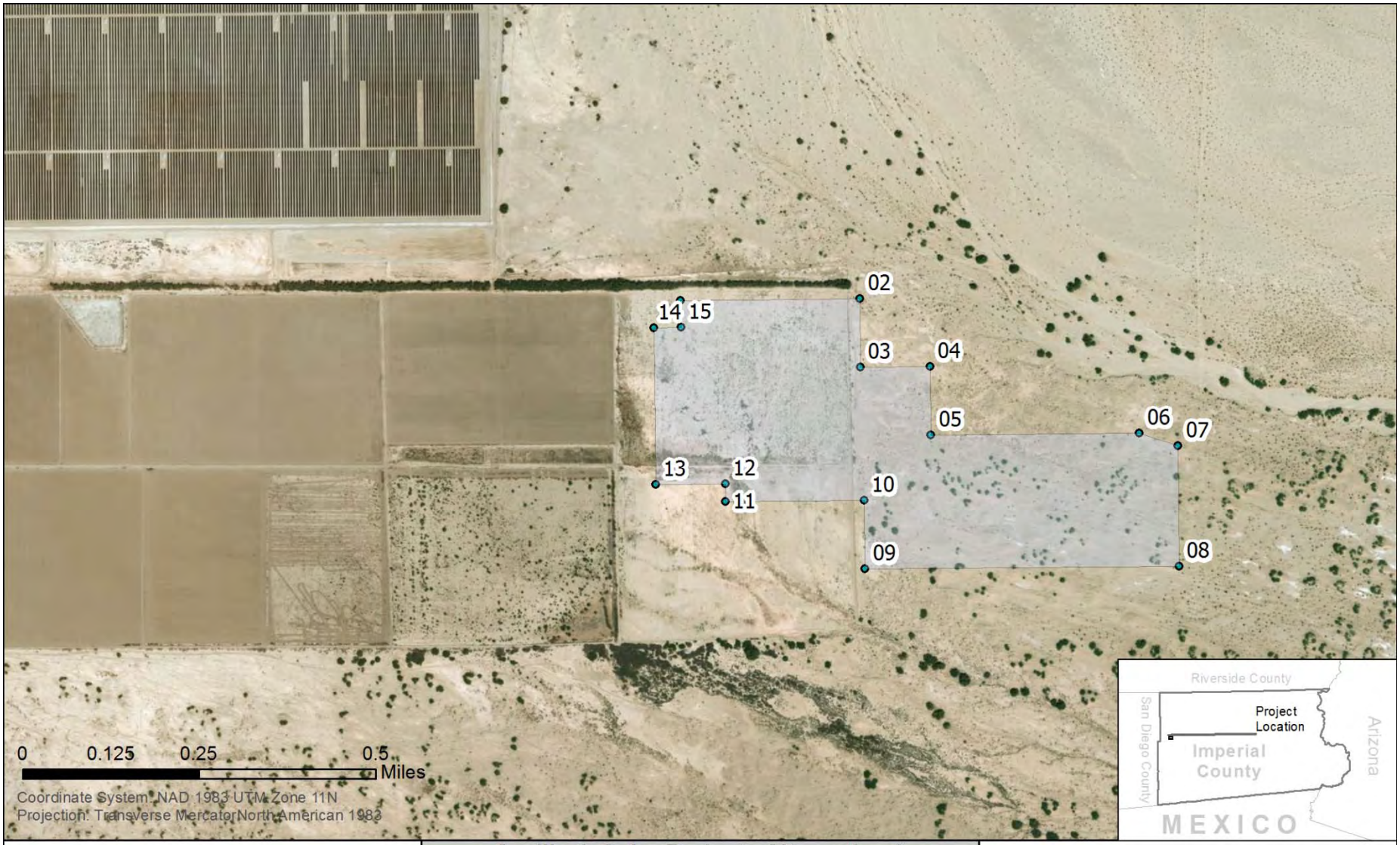


Figure 7: Annual Log-Log Ocular Hazard Plot as a Function of Retinal Irradiance and Subtended Source Angle

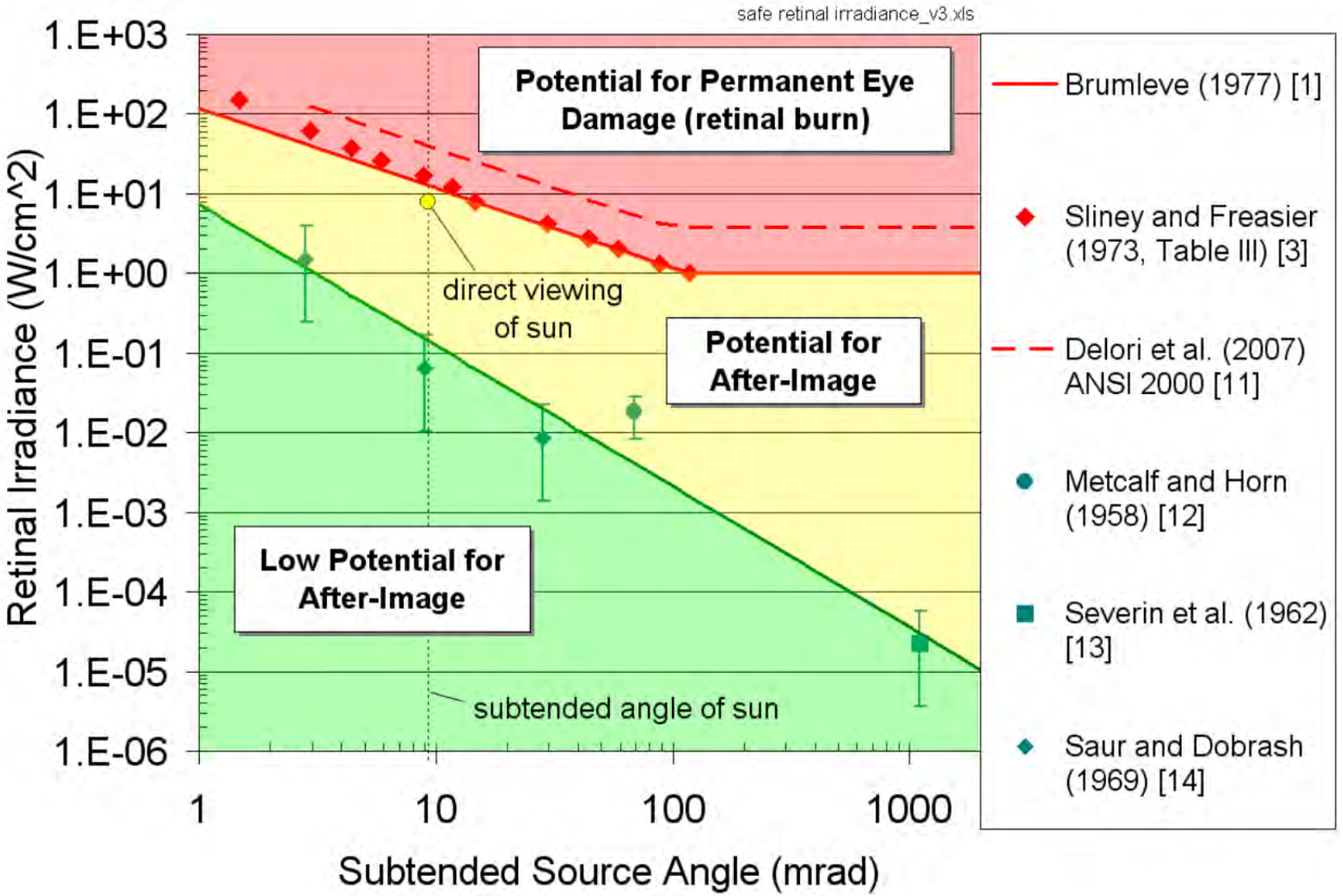


Figure 8: Example Annual Log-Log Ocular Hazard Plot

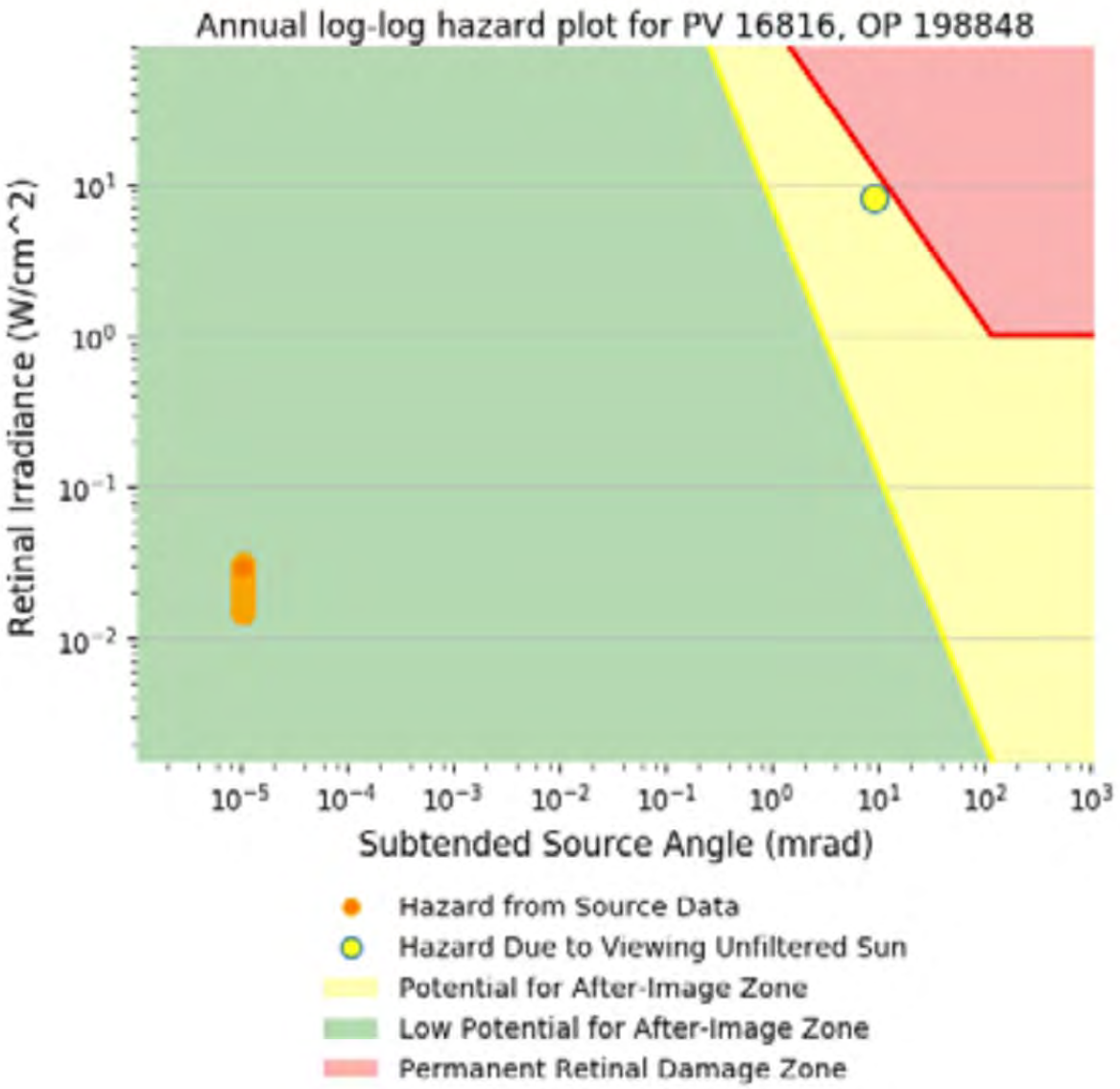


Figure 9: Example Annual Predicted Glare Occurrence Graph

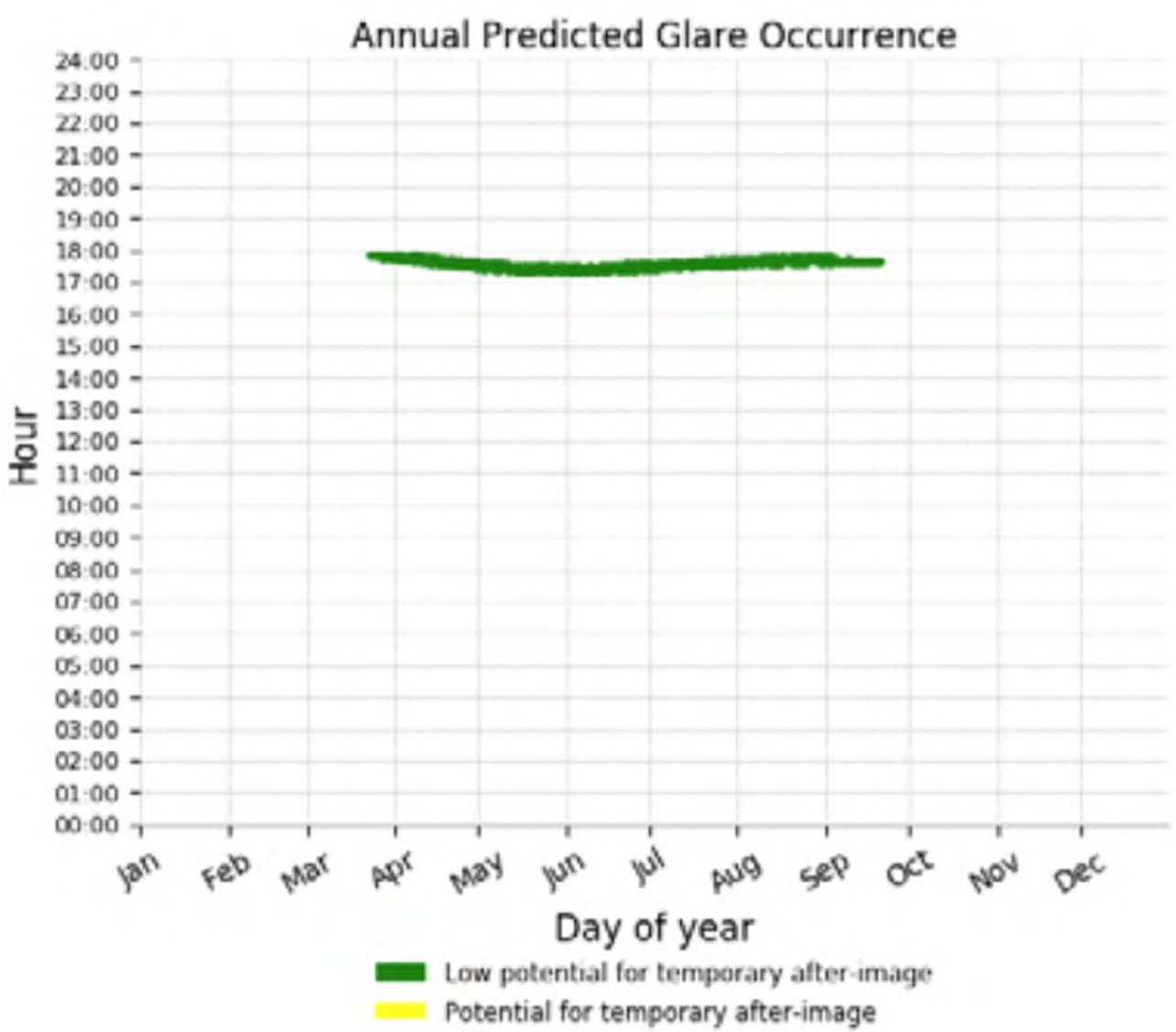


Figure 10: Example Daily Duration of Glare Graph

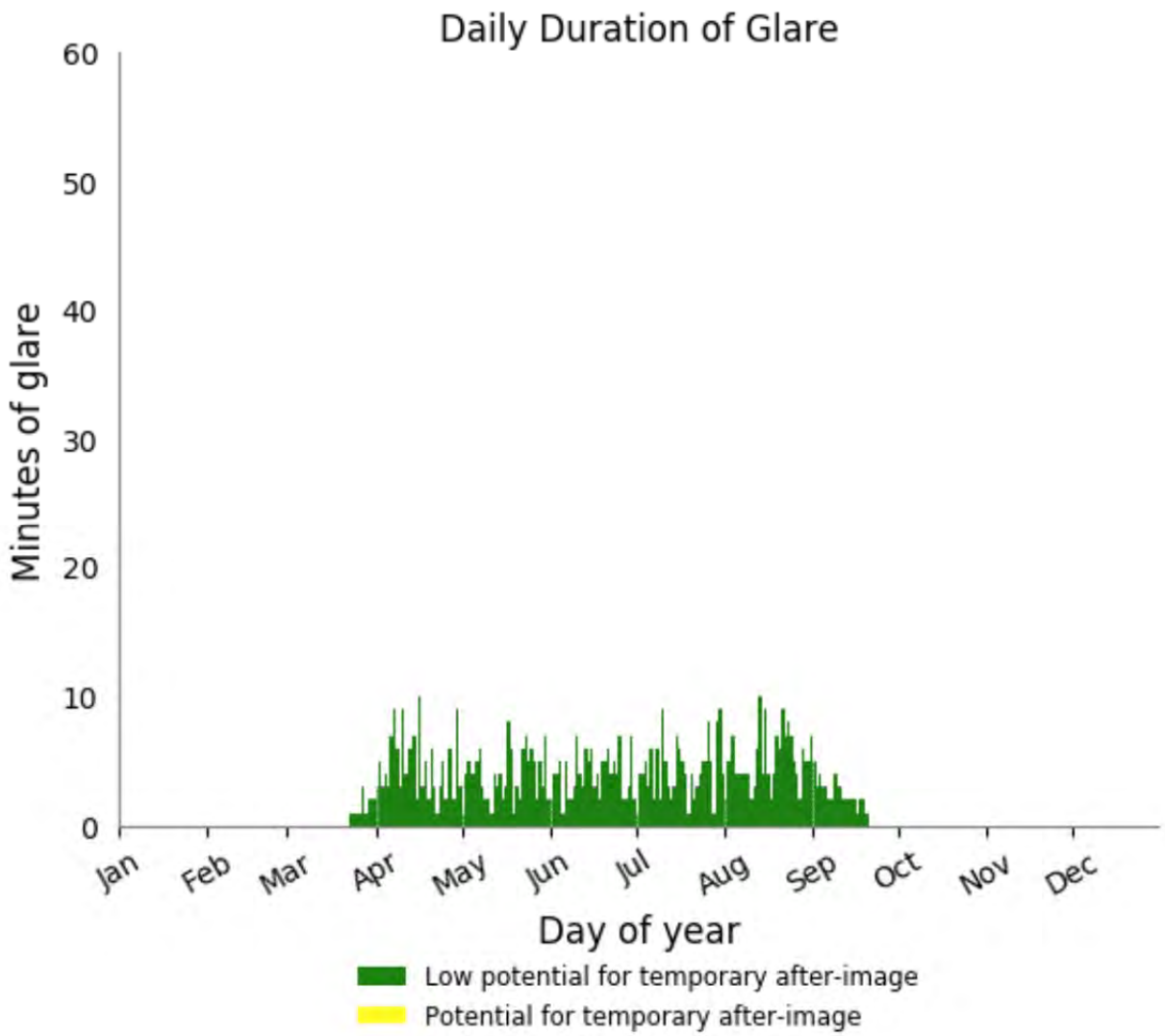
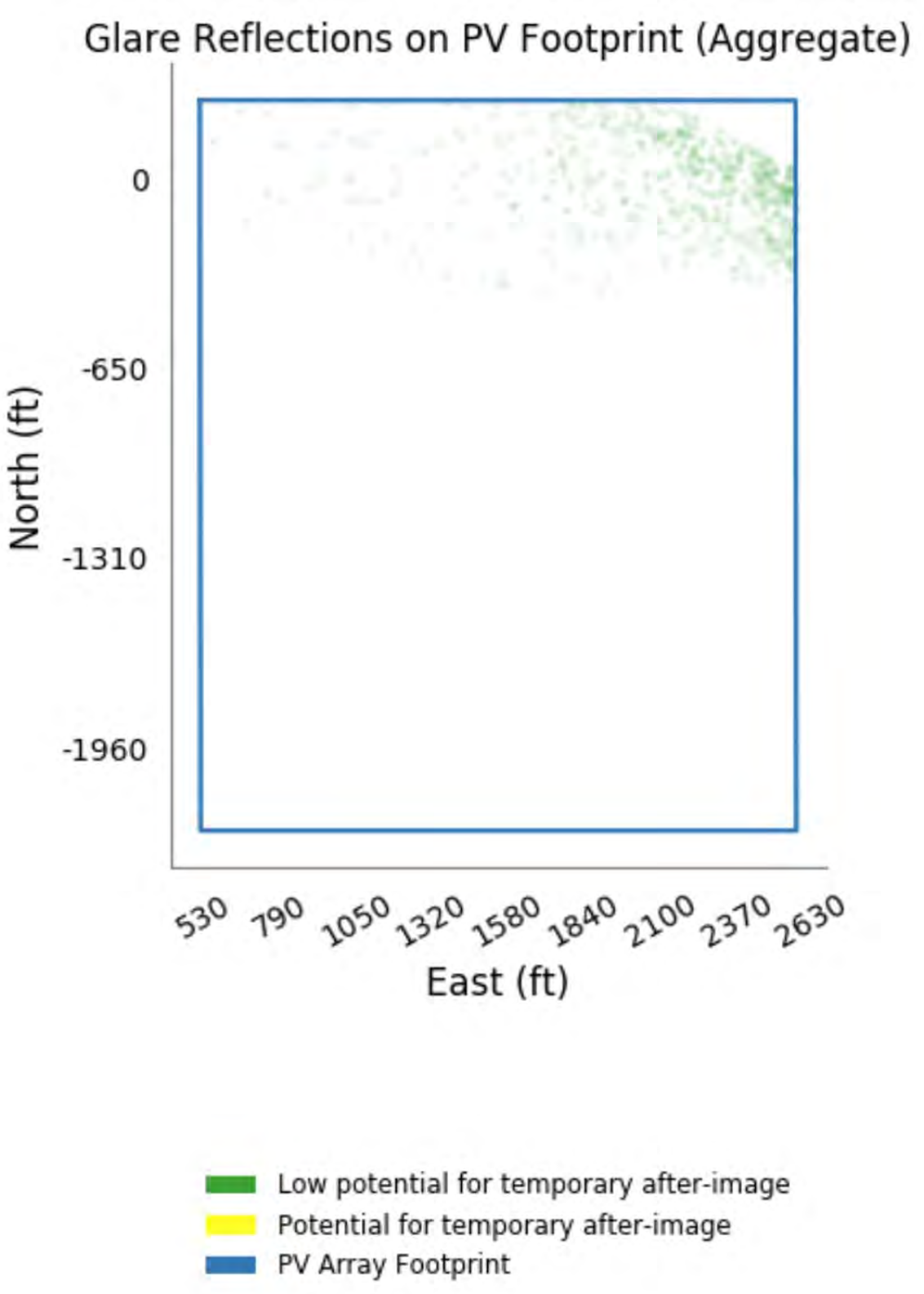


Figure 11: Example Glare Reflections on PV Footprint



APPENDIX A: SGHAT MODELING PARAMETERS AND VALUES

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Site Configuration Parameters

- *Height Units*: (Per Project) – **feet**.
- *Subtended angle of the sun*: = **9.3 mrad** (the average subtended angle of the sun as viewed from earth).
- *Peak & Variable Direct Normal Irradiance (DNI):* = **DNI varies and peaks at 1,000.0 W/m^2** (On a clear sunny day at solar noon, a typical peak DNI is ~1,000 W/m2. "Variable" scales the peak DNI at each time step based on the changing position of the sun.)
- *Ocular transmission coefficient*: = **0.5** (The ocular transmission coefficient accounts for radiation that is absorbed in the eye before reaching the retina. A value of 0.5 is typical.)
- *Pupil diameter*: = **0.002 m** (Typical value for daylight adjusted eyes. The size impacts the amount of light entering the eye and reaching the retina.)
- *Eye focal length*: = **0.017 m** (typical value. Distance between the nodal point (where rays intersect in the eye) and the retina.)
- *Time interval*: = **1 minute** (Time step for the glare analysis which will determine the sun position at each time step throughout the year. "A time step of 1 minute yields excellent resolution.")

PV Array Parameters

- *Axis tracking:* (Per Project) = **"None" for fixed-tilt panels and "single" for single-axis tracking.**
    - *Orientation of array: (fixed-tilt panels)* = **180º** (The orientation of the array in degrees, measured clockwise from true north.)
    - *Tilt of solar panels: (fixed-tilt panels)* = **25º** (tilt (elevation angle) of the modules in degrees, where 0° is facing up and 90° is facing horizontally.)
    - *Tilt of tracking axis: (single-axis tracking)* = **0º** (the elevation angle of the tracking axis in degrees, where 0° is facing up and 90° is facing horizontally. The panels rotate about the tracking axis.)
    - *Orientation of tracking axis: (single-axis tracking)* = **0º** (the orientation of the tracking axis in degrees, measured clockwise from true north. Panels facing south at solar noon would have an orientation of 180°. Panels facing east at solar noon would have an orientation of 90°.)
    - *Offset angle of module: (single-axis tracking)* = **0º** (the vertical offset angle between the tracking axis and the panel.)
    - *Limit the rotation angle: (single-axis tracking) = Maximum tracking angle: (single-axis tracking)* = **+60º to -60º** (the maximum angle the panel will rotate in both the clockwise and counterclockwise directions from the zenith (upward) position.)
- *Module surface material:* = **Smooth Glass with Anti-Reflection Coating** (the type of material comprising the PV modules. The reflectivity of the material choice has been characterized to generate scaled values for each time step.)
- *Correlate slope error to module surface type*. = **checked** (the slope error value was set, based on the selected module surface material.)

    - *Slope error*: - **not checked** (Not used if correlate slope error to module surface type is checked.)
- *Reflectivity varies with incidence angle*: = **checked** (the reflectivity of the modules at each time step is calculated as a function of module surface material and incidence angle between the panel normal and sun position.)
    - *Reflectivity of PV module*: = **not checked** (Not used if reflectivity does not vary with incidence angle.)
- List of the array vertex parameters:
    - *Latitude*: geographic coordinate, in degrees, representing north-south position of the point. 0 at the equator and positive above it.
    - *Longitude*: geographic coordinate, in degrees, representing east-west position of the point. The value must be between -180 and 180, with 0 at the Prime Meridian and negative to the west of it.
    - *Ground Elevation*: the height above sea level of the ground at the position of the point.
    - *Height above ground*: The absolute height of the observation point above the ground elevation.
    - *Total elevation*: the sum of the ground elevation and height above ground.

Flight Path Parameters

- *Direction*: angle, in degrees, from threshold along which to specify observations. 0 is true north, 90 is due east of true north. The direction value may deviate from the specified runway angle.
- *threshold crossing height*: height above ground of aircraft as it crosses threshold point.
- *glide slope*: angle, in degrees, of ascent/descent of aircraft along path. Defaults to 3°.
- *consider pilot visibility from cockpit*: If checked, glare below the "max downward viewing angle" is ignored. Defaults to unchecked.
- *max downward viewing angle*: The angle below the horizon indicating the field of view of the pilot in the cockpit from the flight path observation points. Glare occurring below this field of view is ignored. Only used if "consider pilot visibility from cockpit" is checked. Defaults to 30°.
- *Azimuthal viewing angle*: The horizontal angle clockwise and counter-clockwise from the front of the aircraft parallel with the horizon. Glare occurring past this field of view is ignored. An azimuthal viewing angle of 180° means glare behind the aircraft can be seen (360° field of view). Default value is set to 180°.

Observation Point Parameters

- *Latitude*: geographic coordinate, in degrees, representing north-south position of the point. 0 at the equator and positive above it.
- *Longitude*: geographic coordinate, in degrees, representing east-west position of the point. The value must be between -180 and 180, with 0 at the Prime Meridian and negative to the west of it.
- *Ground Elevation*: the height above sea level of the ground at the position of the point.

- *Height above ground*: The absolute height of the observation point above the ground elevation.

APPENDIX B: FIXED-FRAME MODELING (BOTTOM) - RESIDENCE AND COMMERCIAL BUILDING KOPS

FORGESOLAR GLARE ANALYSIS

Project: **Seville 4**
Site configuration: **Seville_4_Fixed_3ft_Res_OPs_03**
Analysis conducted by Dwight Carey (dlcarey@emacorp.com) at 22:55 on 30 Jan, 2018.

U.S. FAA 2013 Policy Adherence

The following table summarizes the policy adherence of the glare analysis based on the 2013 U.S. Federal Aviation Administration Interim Policy 78 FR 63276. This policy requires the following criteria be met for solar energy systems on airport property:

- No "yellow" glare (potential for after-image) for any flight path from threshold to 2 miles
- No glare of any kind for Air Traffic Control Tower(s) ("ATCT") at cab height.
- Default analysis and observer characteristics (see list below)

ForgeSolar does not represent or speak officially for the FAA and cannot approve or deny projects. Results are informational only.

COMPONENT	STATUS	DESCRIPTION
Analysis parameters	PASS	Analysis time interval and eye characteristics used are acceptable
Flight path(s)	N/A	No flight paths analyzed
ATCT(s)	N/A	No ATCT receptors designated

Default glare analysis and observer eye characteristics are as follows:

- 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

FAA Policy 78 FR 63276 can be read at https://www.federalregister.gov/d/2013-24729

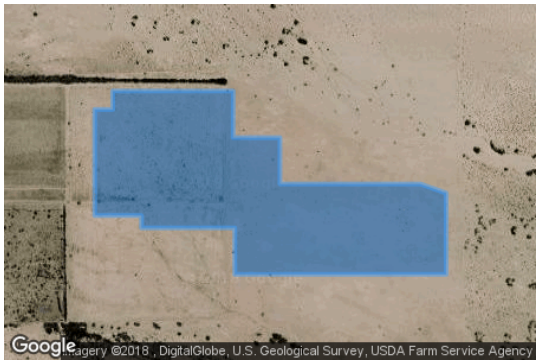
SITE CONFIGURATION

Analysis Parameters

DNI: peaks at 1,000.0 W/m^2
Time interval: 1 min
Ocular transmission coefficient: 0.5
Pupil diameter: 0.002 m
Eye focal length: 0.017 m
Sun subtended angle: 9.3 mrad
Site Config ID: 14583.1632

PV Array(s)

Name: Seville 4 Fixed Array v03
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with 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	33.104452	-115.991016	-46.33	3.00	-43.33
2	33.104452	-115.986640	-46.84	3.00	-43.84
3	33.103042	-115.986644	-48.00	3.00	-45.00
4	33.103043	-115.984942	-48.96	3.00	-45.96
5	33.101638	-115.984941	-42.02	3.00	-39.02
6	33.101638	-115.979849	-46.17	3.00	-43.17
7	33.101362	-115.978914	-49.04	3.00	-46.04
8	33.098899	-115.978913	-60.45	3.00	-57.45
9	33.098900	-115.986583	-55.89	3.00	-52.89
10	33.100306	-115.986582	-54.55	3.00	-51.55
11	33.100306	-115.989970	-54.16	3.00	-51.16
12	33.100680	-115.989971	-54.23	3.00	-51.23
13	33.100681	-115.991667	-50.98	3.00	-47.98
14	33.103895	-115.991669	-46.63	3.00	-43.63
15	33.103896	-115.991011	-48.07	3.00	-45.07

Discrete Observation Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (ft)	Height (ft)
OP 1	1	33.125270	-116.044420	42.30	5.00
OP 2	2	33.123450	-116.040750	30.12	5.00
OP 3	3	33.121760	-116.031770	16.93	5.00
OP 4	4	33.122910	-116.052040	42.20	5.00
OP 5	5	33.112370	-116.041880	10.01	5.00
OP 6	6	33.105510	-116.040630	5.36	5.00
OP 7	7	33.108380	-116.038420	1.74	5.00
OP 8	8	33.084850	-116.104720	64.83	5.00
OP 9	9	33.116980	-115.826883	-187.30	5.00

GLARE ANALYSIS RESULTS

Summary of Glare

PV Array Name	Tilt (°)	Orient (°)	"Green" Glare min	"Yellow" Glare min	Energy kWh
Seville 4 Fixed Array v03	25.0	180.0	24	1	-

Total annual glare received by each receptor

Receptor	Annual Green Glare (min)	Annual Yellow Glare (min)
1	0	0
2	0	0
3	0	0
4	0	0
5	0	0
6	6	1
7	0	0
8	18	0
9	0	0

Results for: Seville 4 Fixed Array v03

OP 1	0	0

Receptor	Green Glare (min)	Yellow Glare (min)
OP 2	0	0
OP 3	0	0
OP 4	0	0
OP 5	0	0
OP 6	6	1
OP 7	0	0
OP 8	18	0
OP 9	0	0

Point Receptor: OP 1

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 2

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 3

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 4

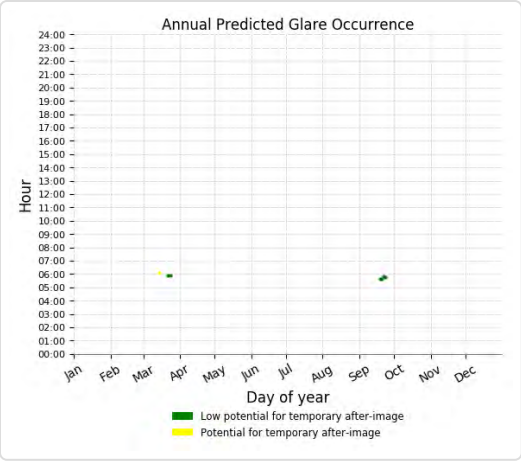
0 minutes of yellow glare
0 minutes of green glare

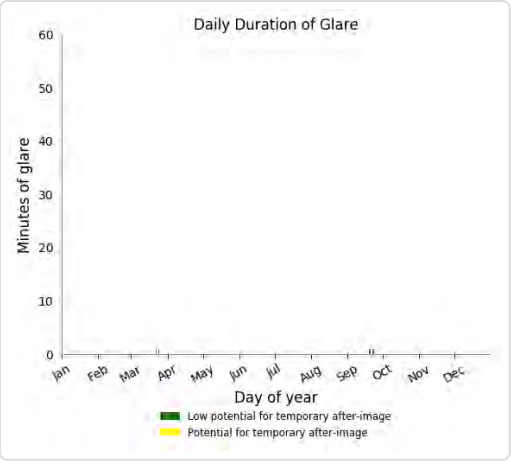
Point Receptor: OP 5

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 6

1 minutes of yellow glare
6 minutes of green glare



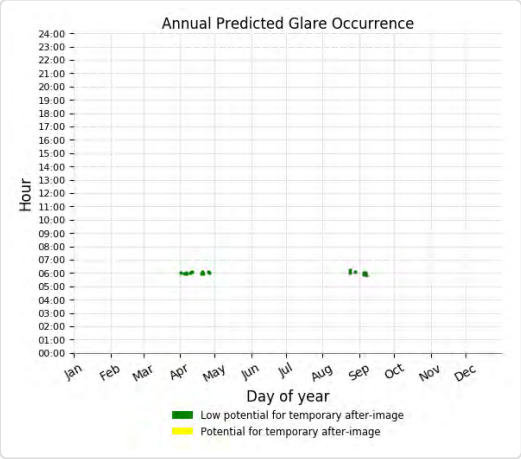


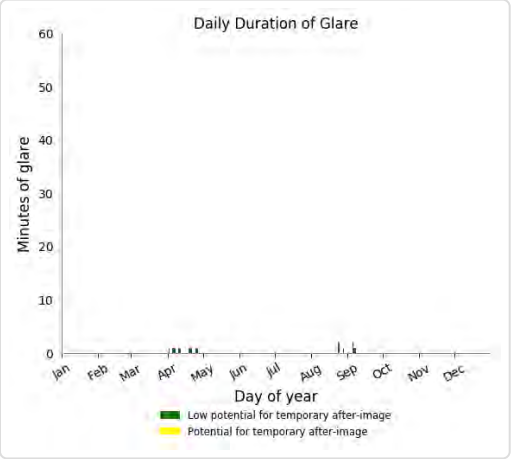
Point Receptor: OP 7

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 8

0 minutes of yellow glare
18 minutes of green glare





Point Receptor: OP 9

0 minutes of yellow glare
0 minutes of green glare

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.
Glare analyses do not account for physical obstructions between reflectors and receptors. This includes buildings, tree cover and geographic obstructions.
The glare hazard determination relies on several approximations including observer eye characteristics, angle of view, and typical blink response time. Actual values may differ.
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.

APPENDIX C: FIXED-FRAME MODELING (BOTTOM) - ROAD AND OWSVRA KOPS

FORGESOLAR GLARE ANALYSIS

Project: **Seville 4**
Site configuration: **Seville_4_Fixed_3ft_Veh_OPs_03**
Analysis conducted by Dwight Carey (dlcarey@emacorp.com) at 23:14 on 30 Jan, 2018.

U.S. FAA 2013 Policy Adherence

The following table summarizes the policy adherence of the glare analysis based on the 2013 U.S. Federal Aviation Administration Interim Policy 78 FR 63276. This policy requires the following criteria be met for solar energy systems on airport property:

- No "yellow" glare (potential for after-image) for any flight path from threshold to 2 miles
- No glare of any kind for Air Traffic Control Tower(s) ("ATCT") at cab height.
- Default analysis and observer characteristics (see list below)

ForgeSolar does not represent or speak officially for the FAA and cannot approve or deny projects. Results are informational only.

COMPONENT	STATUS	DESCRIPTION
Analysis parameters	PASS	Analysis time interval and eye characteristics used are acceptable
Flight path(s)	N/A	No flight paths analyzed
ATCT(s)	N/A	No ATCT receptors designated

Default glare analysis and observer eye characteristics are as follows:

- 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

FAA Policy 78 FR 63276 can be read at https://www.federalregister.gov/d/2013-24729

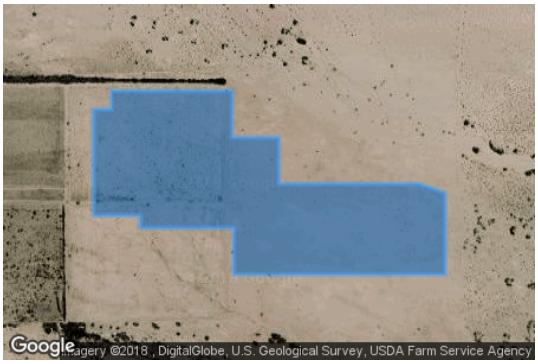
SITE CONFIGURATION

Analysis Parameters

DNI: peaks at 1,000.0 W/m^2
Time interval: 1 min
Ocular transmission coefficient: 0.5
Pupil diameter: 0.002 m
Eye focal length: 0.017 m
Sun subtended angle: 9.3 mrad
Site Config ID: 14586.1632

PV Array(s)

Name: Seville 4 Fixed Array v03
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with 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	33.104452	-115.991016	-46.33	3.00	-43.33
2	33.104452	-115.986640	-46.84	3.00	-43.84
3	33.103042	-115.986644	-48.00	3.00	-45.00
4	33.103043	-115.984942	-48.96	3.00	-45.96
5	33.101638	-115.984941	-42.02	3.00	-39.02
6	33.101638	-115.979849	-46.17	3.00	-43.17
7	33.101362	-115.978914	-49.04	3.00	-46.04
8	33.098899	-115.978913	-60.45	3.00	-57.45
9	33.098900	-115.986583	-55.89	3.00	-52.89
10	33.100306	-115.986582	-54.55	3.00	-51.55
11	33.100306	-115.989970	-54.16	3.00	-51.16
12	33.100680	-115.989971	-54.23	3.00	-51.23
13	33.100681	-115.991667	-50.98	3.00	-47.98
14	33.103895	-115.991669	-46.63	3.00	-43.63
15	33.103896	-115.991011	-48.07	3.00	-45.07

Discrete Observation Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (ft)	Height (ft)
OP 1	1	33.125550	-115.983140	15.59	5.00
OP 2	2	33.125760	-116.003740	-3.04	5.00
OP 3	3	33.125840	-116.024850	16.18	5.00
OP 4	4	33.137910	-116.081620	129.34	5.00
OP 5	5	33.148220	-116.086330	210.35	5.00
OP 6	6	33.148910	-115.934340	127.22	5.00
OP 7	7	33.137630	-116.048990	75.74	5.00
OP 8	8	33.143680	-116.013550	58.12	5.00
OP 9	9	33.145280	-115.972800	46.59	5.00
OP 10	10	33.155050	-115.943440	53.99	5.00

GLARE ANALYSIS RESULTS

Summary of Glare

PV Array Name	Tilt (°)	Orient (°)	"Green" Glare min	"Yellow" Glare min	Energy kWh
Seville 4 Fixed Array v03	25.0	180.0	0	0	-

Total annual glare received by each receptor

Receptor	Annual Green Glare (min)	Annual Yellow Glare (min)
1	0	0
2	0	0
3	0	0
4	0	0
5	0	0
6	0	0
7	0	0
8	0	0
9	0	0
10	0	0

Results for: Seville 4 Fixed Array v03

Receptor	Green Glare (min)	Yellow Glare (min)
OP 1	0	0
OP 2	0	0
OP 3	0	0
OP 4	0	0
OP 5	0	0
OP 6	0	0
OP 7	0	0
OP 8	0	0
OP 9	0	0
OP 10	0	0

Point Receptor: OP 1

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 2

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 3

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 4

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 5

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 6

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 7

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 8

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 9

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 10

0 minutes of yellow glare
0 minutes of green glare

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.
Glare analyses do not account for physical obstructions between reflectors and receptors. This includes buildings, tree cover and geographic obstructions.
The glare hazard determination relies on several approximations including observer eye characteristics, angle of view, and typical blink response time. Actual values may differ.
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.

APPENDIX D: FIXED-FRAME MODELING (BOTTOM) - IID "R" TRANSMISSION LINE ROAD KOPS

FORGESOLAR GLARE ANALYSIS

Project: **Seville 4**
Site configuration: **Seville_4_Fixed_3ft_TLR_OPs_03**
Analysis conducted by Dwight Carey (dlcarey@emacorp.com) at 23:26 on 30 Jan, 2018.

U.S. FAA 2013 Policy Adherence

The following table summarizes the policy adherence of the glare analysis based on the 2013 U.S. Federal Aviation Administration Interim Policy 78 FR 63276. This policy requires the following criteria be met for solar energy systems on airport property:

- No "yellow" glare (potential for after-image) for any flight path from threshold to 2 miles
- No glare of any kind for Air Traffic Control Tower(s) ("ATCT") at cab height.
- Default analysis and observer characteristics (see list below)

ForgeSolar does not represent or speak officially for the FAA and cannot approve or deny projects. Results are informational only.

COMPONENT	STATUS	DESCRIPTION
Analysis parameters	PASS	Analysis time interval and eye characteristics used are acceptable
Flight path(s)	N/A	No flight paths analyzed
ATCT(s)	N/A	No ATCT receptors designated

Default glare analysis and observer eye characteristics are as follows:

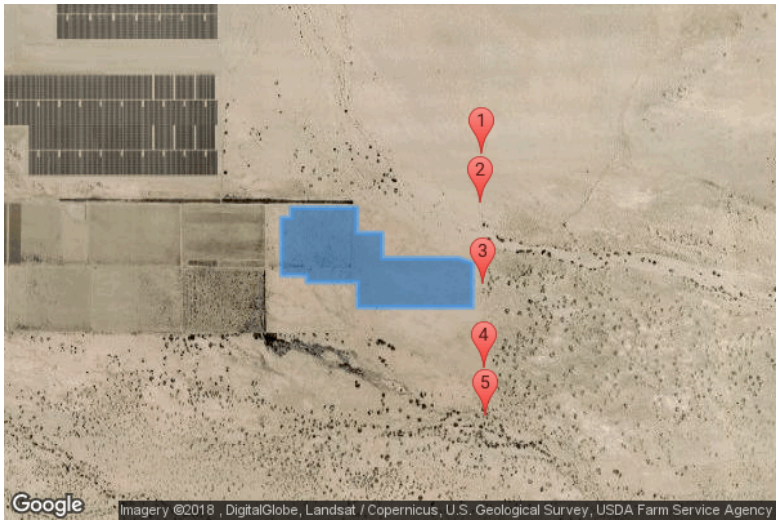
- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

FAA Policy 78 FR 63276 can be read at https://www.federalregister.gov/d/2013-24729

SITE CONFIGURATION

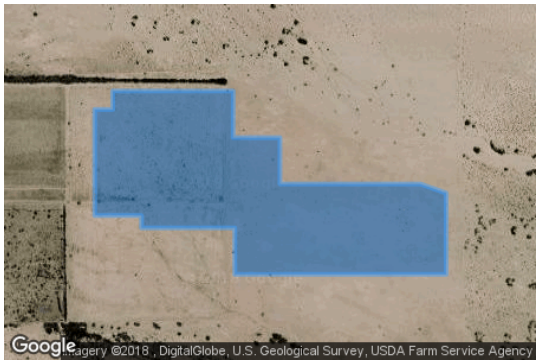
Analysis Parameters

DNI: peaks at 1,000.0 W/m^2
Time interval: 1 min
Ocular transmission coefficient: 0.5
Pupil diameter: 0.002 m
Eye focal length: 0.017 m
Sun subtended angle: 9.3 mrad
Site Config ID: 14589.1632



PV Array(s)

Name: Seville 4 Fixed Array v03
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with 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	33.104452	-115.991016	-46.33	3.00	-43.33
2	33.104452	-115.986640	-46.84	3.00	-43.84
3	33.103042	-115.986644	-48.00	3.00	-45.00
4	33.103043	-115.984942	-48.96	3.00	-45.96
5	33.101638	-115.984941	-42.02	3.00	-39.02
6	33.101638	-115.979849	-46.17	3.00	-43.17
7	33.101362	-115.978914	-49.04	3.00	-46.04
8	33.098899	-115.978913	-60.45	3.00	-57.45
9	33.098900	-115.986583	-55.89	3.00	-52.89
10	33.100306	-115.986582	-54.55	3.00	-51.55
11	33.100306	-115.989970	-54.16	3.00	-51.16
12	33.100680	-115.989971	-54.23	3.00	-51.23
13	33.100681	-115.991667	-50.98	3.00	-47.98
14	33.103895	-115.991669	-46.63	3.00	-43.63
15	33.103896	-115.991011	-48.07	3.00	-45.07

Discrete Observation Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (ft)	Height (ft)
OP 1	1	33.107402	-115.978259	-47.41	5.00
OP 2	2	33.104716	-115.978387	-51.69	5.00
OP 3	3	33.100159	-115.978204	-50.62	5.00
OP 4	4	33.095468	-115.978130	-63.71	5.00
OP 5	5	33.092824	-115.977989	-71.02	5.00

GLARE ANALYSIS RESULTS

Summary of Glare

PV Array Name	Tilt (°)	Orient (°)	"Green" Glare min	"Yellow" Glare min	Energy kWh
Seville 4 Fixed Array v03	25.0	180.0	88	5,648	-

Total annual glare received by each receptor

Receptor	Annual Green Glare (min)	Annual Yellow Glare (min)
1	0	0
2	2	0
3	82	5570
4	4	78
5	0	0

Results for: Seville 4 Fixed Array v03

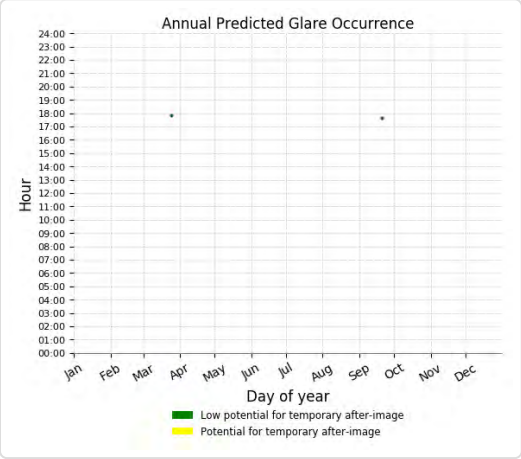
Receptor	Green Glare (min)	Yellow Glare (min)
OP 1	0	0
OP 2	2	0
OP 3	82	5570
OP 4	4	78
OP 5	0	0

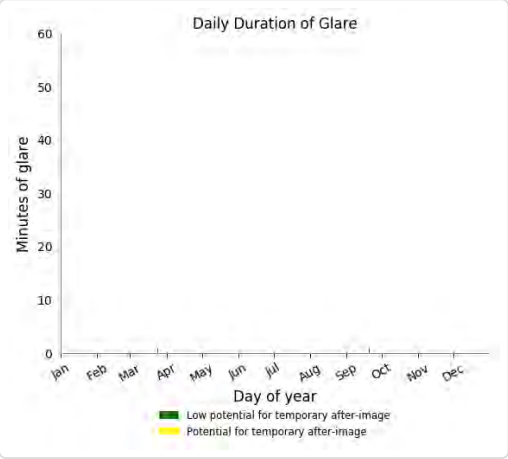
Point Receptor: OP 1

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 2

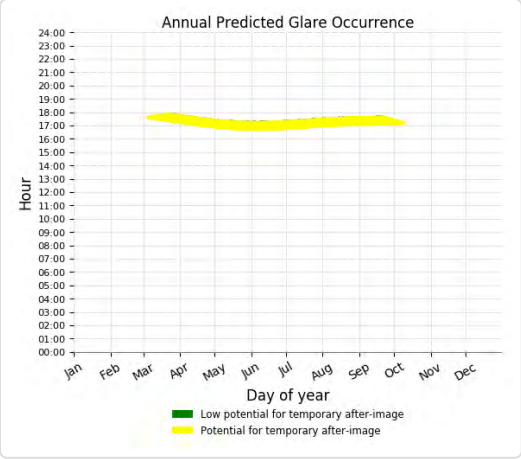
0 minutes of yellow glare
2 minutes of green glare

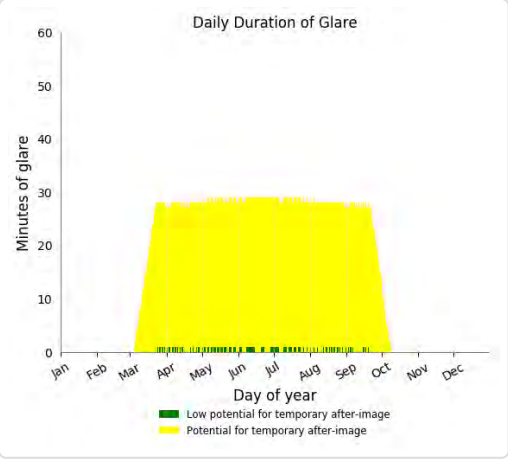




Point Receptor: OP 3

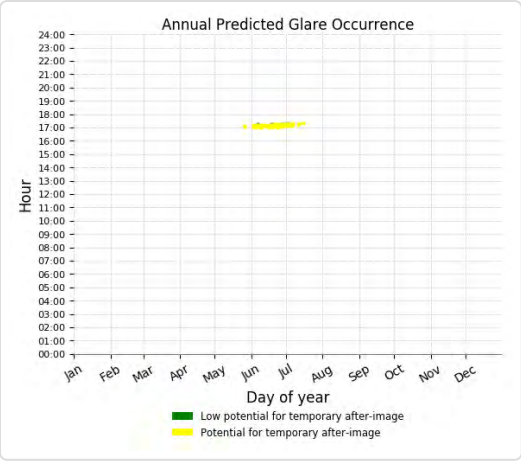
5570 minutes of yellow glare
82 minutes of green glare

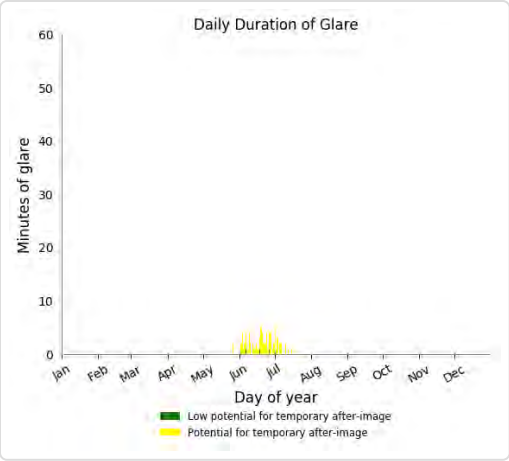




Point Receptor: OP 4

78 minutes of yellow glare
4 minutes of green glare





Point Receptor: OP 5

0 minutes of yellow glare
0 minutes of green glare

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.
Glare analyses do not account for physical obstructions between reflectors and receptors. This includes buildings, tree cover and geographic obstructions.
The glare hazard determination relies on several approximations including observer eye characteristics, angle of view, and typical blink response time. Actual values may differ.
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.

APPENDIX E: FIXED-FRAME MODELING (BOTTOM) - AIRPORT KOPS

FORGESOLAR GLARE ANALYSIS

Project: **Seville 4**
Site configuration: **Seville_4_Fixed_3ft_FLT_FPs_03**
Analysis conducted by Dwight Carey (dlcarey@emacorp.com) at 23:44 on 30 Jan, 2018.

U.S. FAA 2013 Policy Adherence

The following table summarizes the policy adherence of the glare analysis based on the 2013 U.S. Federal Aviation Administration Interim Policy 78 FR 63276. This policy requires the following criteria be met for solar energy systems on airport property:

- No "yellow" glare (potential for after-image) for any flight path from threshold to 2 miles
- No glare of any kind for Air Traffic Control Tower(s) ("ATCT") at cab height.
- Default analysis and observer characteristics (see list below)

ForgeSolar does not represent or speak officially for the FAA and cannot approve or deny projects. Results are informational only.

COMPONENT	STATUS	DESCRIPTION
Analysis parameters	PASS	Analysis time interval and eye characteristics used are acceptable
Flight path(s)	PASS	Flight path receptor(s) do not receive yellow glare
ATCT(s)	N/A	No ATCT receptors designated

Default glare analysis and observer eye characteristics are as follows:

- 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

FAA Policy 78 FR 63276 can be read at https://www.federalregister.gov/d/2013-24729

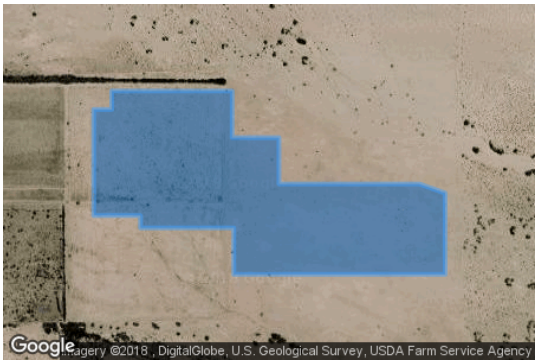
SITE CONFIGURATION

Analysis Parameters

DNI: peaks at 1,000.0 W/m^2
Time interval: 1 min
Ocular transmission coefficient: 0.5
Pupil diameter: 0.002 m
Eye focal length: 0.017 m
Sun subtended angle: 9.3 mrad
Site Config ID: 14591.1632

PV Array(s)

Name: Seville 4 Fixed Array v03
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with 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	33.104452	-115.991016	-46.33	3.00	-43.33
2	33.104452	-115.986640	-46.84	3.00	-43.84
3	33.103042	-115.986644	-48.00	3.00	-45.00
4	33.103043	-115.984942	-48.96	3.00	-45.96
5	33.101638	-115.984941	-42.02	3.00	-39.02
6	33.101638	-115.979849	-46.17	3.00	-43.17
7	33.101362	-115.978914	-49.04	3.00	-46.04
8	33.098899	-115.978913	-60.45	3.00	-57.45
9	33.098900	-115.986583	-55.89	3.00	-52.89
10	33.100306	-115.986582	-54.55	3.00	-51.55
11	33.100306	-115.989970	-54.16	3.00	-51.16
12	33.100680	-115.989971	-54.23	3.00	-51.23
13	33.100681	-115.991667	-50.98	3.00	-47.98
14	33.103895	-115.991669	-46.63	3.00	-43.63
15	33.103896	-115.991011	-48.07	3.00	-45.07

Flight Path Receptor(s)

Name: FP 1 Ocotillo Airport 27
Description:
Threshold height: 50 ft
Direction: °
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 120.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	33.145052	-116.126432	151.66	50.00	201.66
Two-mile	33.137569	-116.093039	105.42	649.70	755.11

Name: FP 2 Ocotillo Airport 9
Description:
Threshold height: 50 ft
Direction: °
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 120.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	33.146833	-116.134321	152.18	50.00	202.18
Two-mile	33.154316	-116.167715	359.89	395.75	755.64

Name: FP 3 Ocotillo Airport 31
Description:
Threshold height: 50 ft
Direction: °
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 120.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	33.144206	-116.128321	149.00	50.00	199.00
Two-mile	33.120237	-116.108989	194.33	558.13	752.46

Name: FP 4 Ocotillo Airport 13
Description:
Threshold height: 50 ft
Direction: °
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 120.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	33.153797	-116.136118	155.20	50.00	205.20
Two-mile	33.177766	-116.155452	198.06	560.60	758.66

Name: FP 5 Salton Sea 7
Description:
Threshold height: 50 ft
Direction: °
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 120.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	33.240555	-115.960732	-81.24	50.00	-31.24
Two-mile	33.238035	-115.995210	-7.78	530.00	522.22

Name: FP 6 Salton Sea 25
Description:
Threshold height: 50 ft
Direction: °
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 120.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	33.241853	-115.944382	-122.14	50.00	-72.13
Two-mile	33.244373	-115.909903	-159.29	640.61	481.32

GLARE ANALYSIS RESULTS

Summary of Glare

PV Array Name	Tilt (°)	Orient (°)	"Green" Glare min	"Yellow" Glare min	Energy kWh
Seville 4 Fixed Array v03	25.0	180.0	0	0	-

Total annual glare received by each receptor

Receptor	Annual Green Glare (min)	Annual Yellow Glare (min)
FP 1 Ocotillo Airport 27	0	0
FP 2 Ocotillo Airport 9	0	0
FP 3 Ocotillo Airport 31	0	0
FP 4 Ocotillo Airport 13	0	0
FP 5 Salton Sea 7	0	0
FP 6 Salton Sea 25	0	0

Results for: Seville 4 Fixed Array v03

Receptor	Green Glare (min)	Yellow Glare (min)
FP 1 Ocotillo Airport 27	0	0

Receptor	Green Glare (min)	Yellow Glare (min)
FP 2 Ocotillo Airport 9	0	0
FP 3 Ocotillo Airport 31	0	0
FP 4 Ocotillo Airport 13	0	0
FP 5 Salton Sea 7	0	0
FP 6 Salton Sea 25	0	0

Flight Path: FP 1 Ocotillo Airport 27

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP 2 Ocotillo Airport 9

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP 3 Ocotillo Airport 31

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP 4 Ocotillo Airport 13

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP 5 Salton Sea 7

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP 6 Salton Sea 25

0 minutes of yellow glare
0 minutes of green glare

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.
Glare analyses do not account for physical obstructions between reflectors and receptors. This includes buildings, tree cover and geographic obstructions.
The glare hazard determination relies on several approximations including observer eye characteristics, angle of view, and typical blink response time. Actual values may differ.
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.

APPENDIX F: FIXED-FRAME MODELING (TOP) - RESIDENCE AND COMMERCIAL BUILDING KOPS

FORGESOLAR GLARE ANALYSIS

Project: **Seville 4**
Site configuration: **Seville_4_Fixed_8_5ft_Res_OPs_03**
Analysis conducted by Dwight Carey (dlcarey@emacorp.com) at 23:06 on 30 Jan, 2018.

U.S. FAA 2013 Policy Adherence

The following table summarizes the policy adherence of the glare analysis based on the 2013 U.S. Federal Aviation Administration Interim Policy 78 FR 63276. This policy requires the following criteria be met for solar energy systems on airport property:

- No "yellow" glare (potential for after-image) for any flight path from threshold to 2 miles
- No glare of any kind for Air Traffic Control Tower(s) ("ATCT") at cab height.
- Default analysis and observer characteristics (see list below)

ForgeSolar does not represent or speak officially for the FAA and cannot approve or deny projects. Results are informational only.

COMPONENT	STATUS	DESCRIPTION
Analysis parameters	PASS	Analysis time interval and eye characteristics used are acceptable
Flight path(s)	N/A	No flight paths analyzed
ATCT(s)	N/A	No ATCT receptors designated

Default glare analysis and observer eye characteristics are as follows:

- 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

FAA Policy 78 FR 63276 can be read at https://www.federalregister.gov/d/2013-24729

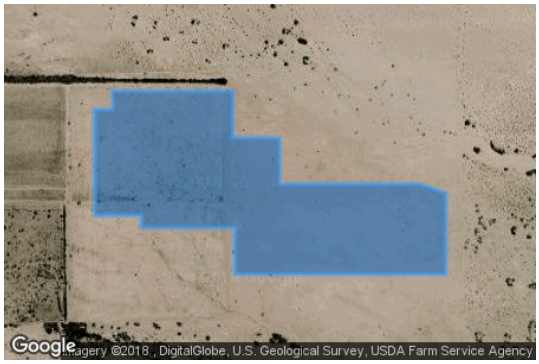
SITE CONFIGURATION

Analysis Parameters

DNI: peaks at 1,000.0 W/m^2
Time interval: 1 min
Ocular transmission coefficient: 0.5
Pupil diameter: 0.002 m
Eye focal length: 0.017 m
Sun subtended angle: 9.3 mrad
Site Config ID: 14585.1632

PV Array(s)

Name: Seville 4 Fixed Array v03
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with 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	33.104452	-115.991016	-46.33	8.50	-37.83
2	33.104452	-115.986640	-46.84	8.50	-38.34
3	33.103042	-115.986644	-48.00	8.50	-39.50
4	33.103043	-115.984942	-48.96	8.50	-40.46
5	33.101638	-115.984941	-42.02	8.50	-33.52
6	33.101638	-115.979849	-46.17	8.50	-37.67
7	33.101362	-115.978914	-49.04	8.50	-40.54
8	33.098899	-115.978913	-60.45	8.50	-51.95
9	33.098900	-115.986583	-55.89	8.50	-47.39
10	33.100306	-115.986582	-54.55	8.50	-46.05
11	33.100306	-115.989970	-54.16	8.50	-45.66
12	33.100680	-115.989971	-54.23	8.50	-45.73
13	33.100681	-115.991667	-50.98	8.50	-42.48
14	33.103895	-115.991669	-46.63	8.50	-38.13
15	33.103896	-115.991011	-48.07	8.50	-39.57

Discrete Observation Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (ft)	Height (ft)
OP 1	1	33.125270	-116.044420	42.30	5.00
OP 2	2	33.123450	-116.040750	30.12	5.00
OP 3	3	33.121760	-116.031770	16.93	5.00
OP 4	4	33.122910	-116.052040	42.20	5.00
OP 5	5	33.112370	-116.041880	10.01	5.00
OP 6	6	33.105510	-116.040630	5.36	5.00
OP 7	7	33.108380	-116.038420	1.74	5.00
OP 8	8	33.084850	-116.104720	64.83	5.00
OP 9	9	33.116980	-115.826883	-187.30	5.00

GLARE ANALYSIS RESULTS

Summary of Glare

PV Array Name	Tilt (°)	Orient (°)	"Green" Glare min	"Yellow" Glare min	Energy kWh
Seville 4 Fixed Array v03	25.0	180.0	21	1	-

Total annual glare received by each receptor

Receptor	Annual Green Glare (min)	Annual Yellow Glare (min)
1	0	0
2	0	0
3	0	0
4	0	0
5	0	0
6	3	1
7	0	0
8	18	0
9	0	0

Results for: Seville 4 Fixed Array v03

OP 1	0	0

Receptor	Green Glare (min)	Yellow Glare (min)
OP 2	0	0
OP 3	0	0
OP 4	0	0
OP 5	0	0
OP 6	3	1
OP 7	0	0
OP 8	18	0
OP 9	0	0

Point Receptor: OP 1

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 2

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 3

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 4

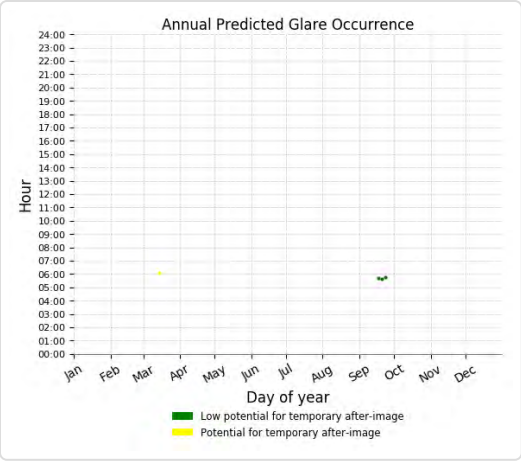
0 minutes of yellow glare
0 minutes of green glare

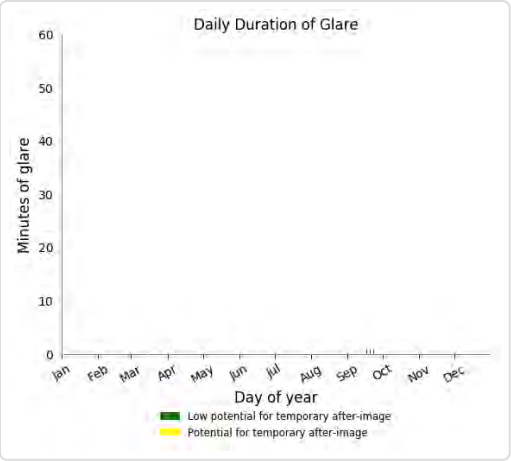
Point Receptor: OP 5

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 6

1 minutes of yellow glare
3 minutes of green glare



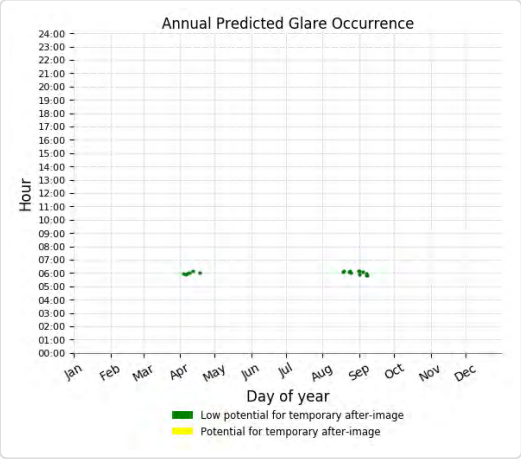


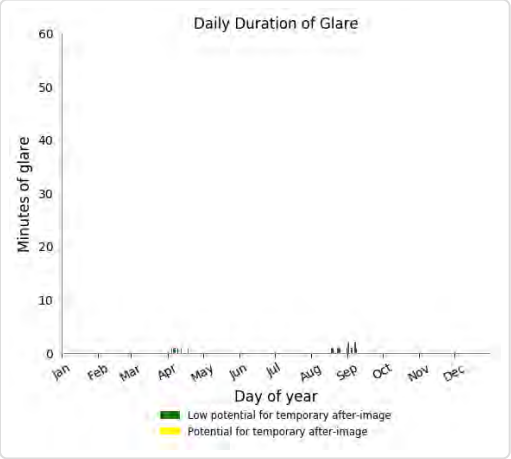
Point Receptor: OP 7

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 8

0 minutes of yellow glare
18 minutes of green glare





Point Receptor: OP 9

0 minutes of yellow glare
0 minutes of green glare

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.
Glare analyses do not account for physical obstructions between reflectors and receptors. This includes buildings, tree cover and geographic obstructions.
The glare hazard determination relies on several approximations including observer eye characteristics, angle of view, and typical blink response time. Actual values may differ.
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.

APPENDIX G: FIXED-FRAME MODELING (TOP) - ROAD AND OWSVRA KOPS

FORGESOLAR GLARE ANALYSIS

Project: **Seville 4**
Site configuration: **Seville_4_Fixed_8_5ft_Veh_OPs_03**
Analysis conducted by Dwight Carey (dlcarey@emacorp.com) at 23:22 on 30 Jan, 2018.

U.S. FAA 2013 Policy Adherence

The following table summarizes the policy adherence of the glare analysis based on the 2013 U.S. Federal Aviation Administration Interim Policy 78 FR 63276. This policy requires the following criteria be met for solar energy systems on airport property:

- No "yellow" glare (potential for after-image) for any flight path from threshold to 2 miles
- No glare of any kind for Air Traffic Control Tower(s) ("ATCT") at cab height.
- Default analysis and observer characteristics (see list below)

ForgeSolar does not represent or speak officially for the FAA and cannot approve or deny projects. Results are informational only.

COMPONENT	STATUS	DESCRIPTION
Analysis parameters	PASS	Analysis time interval and eye characteristics used are acceptable
Flight path(s)	N/A	No flight paths analyzed
ATCT(s)	N/A	No ATCT receptors designated

Default glare analysis and observer eye characteristics are as follows:

- 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

FAA Policy 78 FR 63276 can be read at https://www.federalregister.gov/d/2013-24729

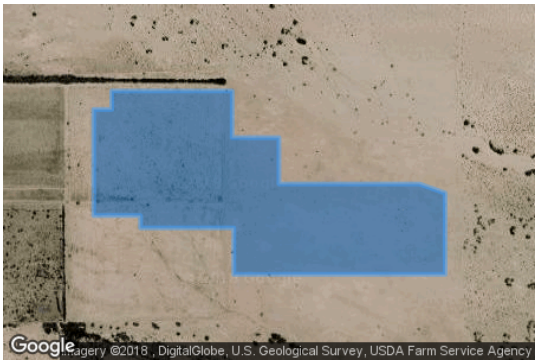
SITE CONFIGURATION

Analysis Parameters

DNI: peaks at 1,000.0 W/m^2
Time interval: 1 min
Ocular transmission coefficient: 0.5
Pupil diameter: 0.002 m
Eye focal length: 0.017 m
Sun subtended angle: 9.3 mrad
Site Config ID: 14588.1632

PV Array(s)

Name: Seville 4 Fixed Array v03
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with 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	33.104452	-115.991016	-46.33	8.50	-37.83
2	33.104452	-115.986640	-46.84	8.50	-38.34
3	33.103042	-115.986644	-48.00	8.50	-39.50
4	33.103043	-115.984942	-48.96	8.50	-40.46
5	33.101638	-115.984941	-42.02	8.50	-33.52
6	33.101638	-115.979849	-46.17	8.50	-37.67
7	33.101362	-115.978914	-49.04	8.50	-40.54
8	33.098899	-115.978913	-60.45	8.50	-51.95
9	33.098900	-115.986583	-55.89	8.50	-47.39
10	33.100306	-115.986582	-54.55	8.50	-46.05
11	33.100306	-115.989970	-54.16	8.50	-45.66
12	33.100680	-115.989971	-54.23	8.50	-45.73
13	33.100681	-115.991667	-50.98	8.50	-42.48
14	33.103895	-115.991669	-46.63	8.50	-38.13
15	33.103896	-115.991011	-48.07	8.50	-39.57

Discrete Observation Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (ft)	Height (ft)
OP 1	1	33.125550	-115.983140	15.59	5.00
OP 2	2	33.125760	-116.003740	-3.04	5.00
OP 3	3	33.125840	-116.024850	16.18	5.00
OP 4	4	33.137910	-116.081620	129.34	5.00
OP 5	5	33.148220	-116.086330	210.35	5.00
OP 6	6	33.148910	-115.934340	127.22	5.00
OP 7	7	33.137630	-116.048990	75.74	5.00
OP 8	8	33.143680	-116.013550	58.12	5.00
OP 9	9	33.145280	-115.972800	46.59	5.00
OP 10	10	33.155050	-115.943440	53.99	5.00

GLARE ANALYSIS RESULTS

Summary of Glare

PV Array Name	Tilt (°)	Orient (°)	"Green" Glare min	"Yellow" Glare min	Energy kWh
Seville 4 Fixed Array v03	25.0	180.0	0	0	-

Total annual glare received by each receptor

Receptor	Annual Green Glare (min)	Annual Yellow Glare (min)
1	0	0
2	0	0
3	0	0
4	0	0
5	0	0
6	0	0
7	0	0
8	0	0
9	0	0
10	0	0

Results for: Seville 4 Fixed Array v03

Receptor	Green Glare (min)	Yellow Glare (min)
OP 1	0	0
OP 2	0	0
OP 3	0	0
OP 4	0	0
OP 5	0	0
OP 6	0	0
OP 7	0	0
OP 8	0	0
OP 9	0	0
OP 10	0	0

Point Receptor: OP 1

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 2

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 3

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 4

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 5

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 6

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 7

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 8

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 9

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 10

0 minutes of yellow glare
0 minutes of green glare

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.
Glare analyses do not account for physical obstructions between reflectors and receptors. This includes buildings, tree cover and geographic obstructions.
The glare hazard determination relies on several approximations including observer eye characteristics, angle of view, and typical blink response time. Actual values may differ.
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.

APPENDIX H: FIXED-FRAME MODELING (TOP) - IID “R” TRANSMISSION LINE ROAD KOPS

FORGESOLAR GLARE ANALYSIS

Project: **Seville 4**
Site configuration: **Seville_4_Fixed_8_5ft_TLR_OPs_03**
Analysis conducted by Dwight Carey (dlcarey@emacorp.com) at 23:32 on 30 Jan, 2018.

U.S. FAA 2013 Policy Adherence

The following table summarizes the policy adherence of the glare analysis based on the 2013 U.S. Federal Aviation Administration Interim Policy 78 FR 63276. This policy requires the following criteria be met for solar energy systems on airport property:

- No "yellow" glare (potential for after-image) for any flight path from threshold to 2 miles
- No glare of any kind for Air Traffic Control Tower(s) ("ATCT") at cab height.
- Default analysis and observer characteristics (see list below)

ForgeSolar does not represent or speak officially for the FAA and cannot approve or deny projects. Results are informational only.

COMPONENT	STATUS	DESCRIPTION
Analysis parameters	PASS	Analysis time interval and eye characteristics used are acceptable
Flight path(s)	N/A	No flight paths analyzed
ATCT(s)	N/A	No ATCT receptors designated

Default glare analysis and observer eye characteristics are as follows:

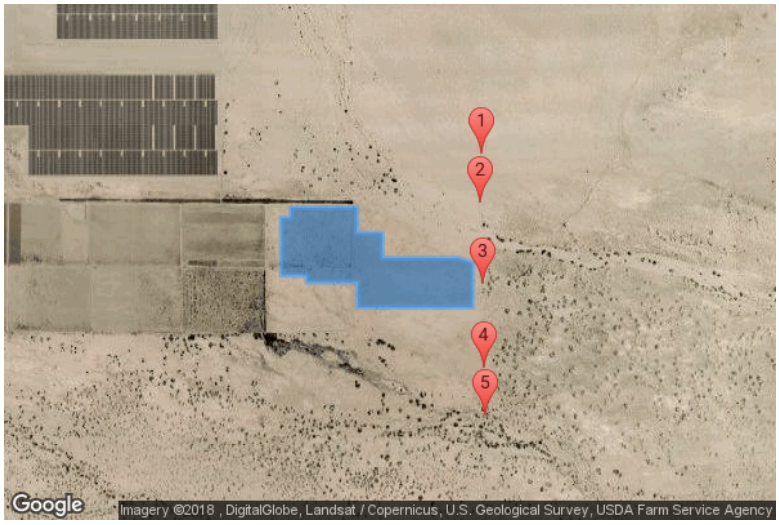
- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

FAA Policy 78 FR 63276 can be read at https://www.federalregister.gov/d/2013-24729

SITE CONFIGURATION

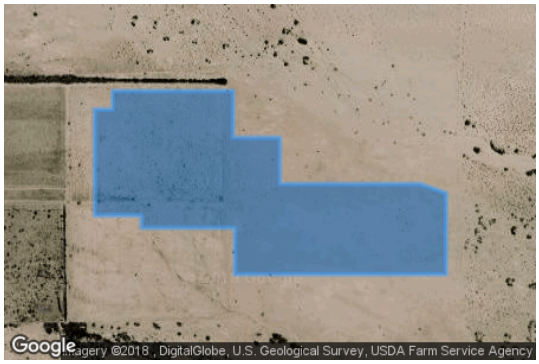
Analysis Parameters

DNI: peaks at 1,000.0 W/m^2
Time interval: 1 min
Ocular transmission coefficient: 0.5
Pupil diameter: 0.002 m
Eye focal length: 0.017 m
Sun subtended angle: 9.3 mrad
Site Config ID: 14590.1632



PV Array(s)

Name: Seville 4 Fixed Array v03
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with 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	33.104452	-115.991016	-46.33	8.50	-37.83
2	33.104452	-115.986640	-46.84	8.50	-38.34
3	33.103042	-115.986644	-48.00	8.50	-39.50
4	33.103043	-115.984942	-48.96	8.50	-40.46
5	33.101638	-115.984941	-42.02	8.50	-33.52
6	33.101638	-115.979849	-46.17	8.50	-37.67
7	33.101362	-115.978914	-49.04	8.50	-40.54
8	33.098899	-115.978913	-60.45	8.50	-51.95
9	33.098900	-115.986583	-55.89	8.50	-47.39
10	33.100306	-115.986582	-54.55	8.50	-46.05
11	33.100306	-115.989970	-54.16	8.50	-45.66
12	33.100680	-115.989971	-54.23	8.50	-45.73
13	33.100681	-115.991667	-50.98	8.50	-42.48
14	33.103895	-115.991669	-46.63	8.50	-38.13
15	33.103896	-115.991011	-48.07	8.50	-39.57

Discrete Observation Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (ft)	Height (ft)
OP 1	1	33.107402	-115.978259	-47.41	5.00
OP 2	2	33.104716	-115.978387	-51.69	5.00
OP 3	3	33.100159	-115.978204	-50.62	5.00
OP 4	4	33.095468	-115.978130	-63.71	5.00
OP 5	5	33.092824	-115.977989	-71.02	5.00

GLARE ANALYSIS RESULTS

Summary of Glare

PV Array Name	Tilt (°)	Orient (°)	"Green" Glare min	"Yellow" Glare min	Energy kWh
Seville 4 Fixed Array v03	25.0	180.0	89	4,311	-

Total annual glare received by each receptor

Receptor	Annual Green Glare (min)	Annual Yellow Glare (min)
1	0	0
2	6	0
3	82	4271
4	1	40
5	0	0

Results for: Seville 4 Fixed Array v03

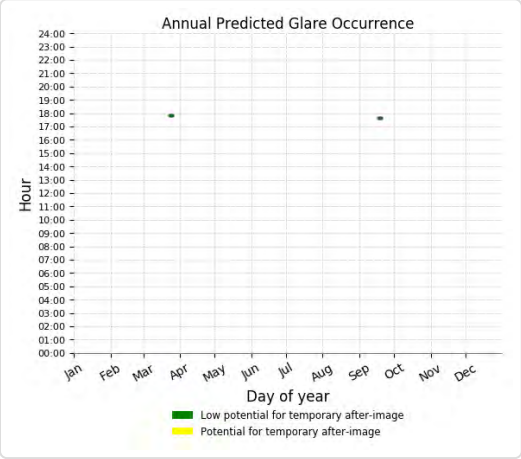
Receptor	Green Glare (min)	Yellow Glare (min)
OP 1	0	0
OP 2	6	0
OP 3	82	4271
OP 4	1	40
OP 5	0	0

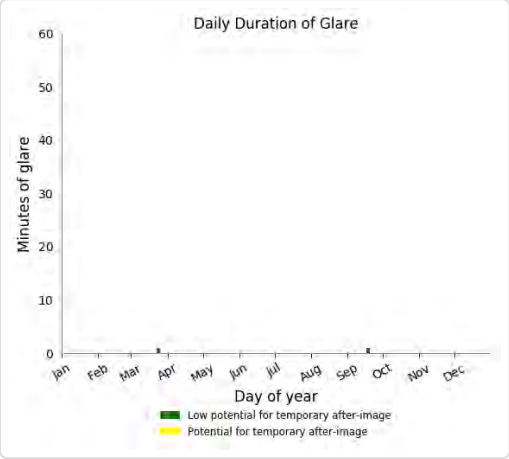
Point Receptor: OP 1

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 2

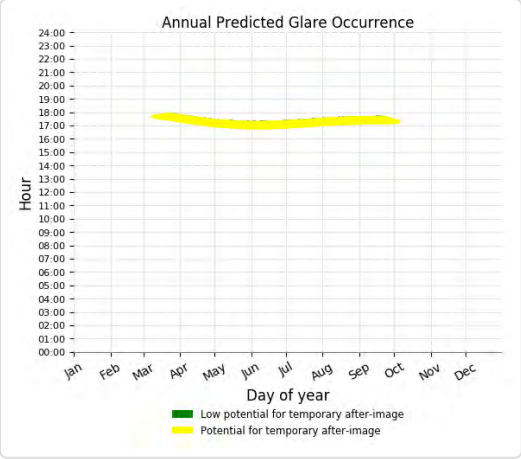
0 minutes of yellow glare
6 minutes of green glare

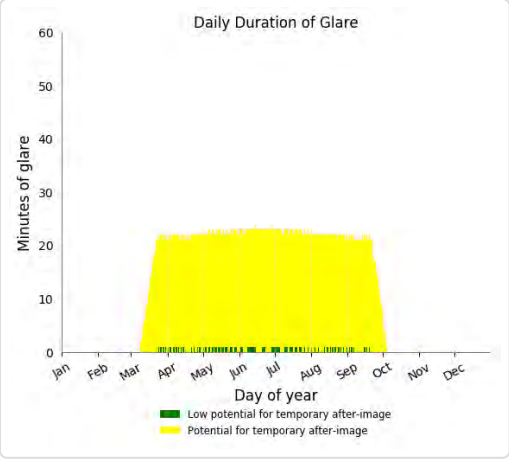




Point Receptor: OP 3

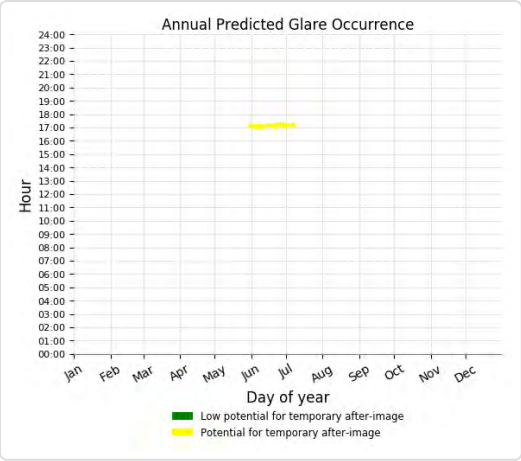
4271 minutes of yellow glare
82 minutes of green glare

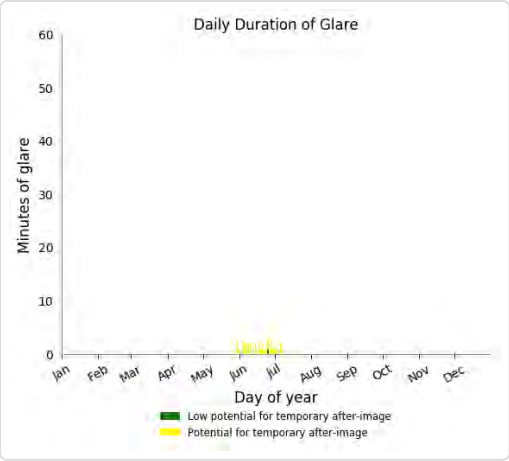




Point Receptor: OP 4

40 minutes of yellow glare
1 minutes of green glare





Point Receptor: OP 5

0 minutes of yellow glare
0 minutes of green glare

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.
Glare analyses do not account for physical obstructions between reflectors and receptors. This includes buildings, tree cover and geographic obstructions.
The glare hazard determination relies on several approximations including observer eye characteristics, angle of view, and typical blink response time. Actual values may differ.
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.

APPENDIX I: FIXED-FRAME MODELING (TOP) - AIRPORT KOPS

FORGESOLAR GLARE ANALYSIS

Project: **Seville 4**
Site configuration: **Seville_4_Fixed_8_5ft_FLT_FPs_03**
Analysis conducted by Dwight Carey (dlcarey@emacorp.com) at 00:04 on 31 Jan, 2018.

U.S. FAA 2013 Policy Adherence

The following table summarizes the policy adherence of the glare analysis based on the 2013 U.S. Federal Aviation Administration Interim Policy 78 FR 63276. This policy requires the following criteria be met for solar energy systems on airport property:

- No "yellow" glare (potential for after-image) for any flight path from threshold to 2 miles
- No glare of any kind for Air Traffic Control Tower(s) ("ATCT") at cab height.
- Default analysis and observer characteristics (see list below)

ForgeSolar does not represent or speak officially for the FAA and cannot approve or deny projects. Results are informational only.

COMPONENT	STATUS	DESCRIPTION
Analysis parameters	PASS	Analysis time interval and eye characteristics used are acceptable
Flight path(s)	PASS	Flight path receptor(s) do not receive yellow glare
ATCT(s)	N/A	No ATCT receptors designated

Default glare analysis and observer eye characteristics are as follows:

- 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

FAA Policy 78 FR 63276 can be read at https://www.federalregister.gov/d/2013-24729

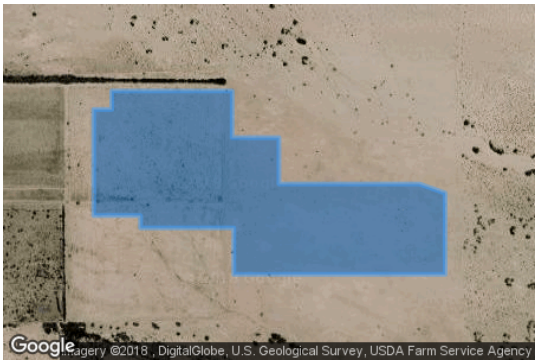
SITE CONFIGURATION

Analysis Parameters

DNI: peaks at 1,000.0 W/m^2
Time interval: 1 min
Ocular transmission coefficient: 0.5
Pupil diameter: 0.002 m
Eye focal length: 0.017 m
Sun subtended angle: 9.3 mrad
Site Config ID: 14592.1632

PV Array(s)

Name: Seville 4 Fixed Array v03
Axis tracking: Fixed (no rotation)
Tilt: 25.0°
Orientation: 180.0°
Rated power: -
Panel material: Smooth glass with 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	33.104452	-115.991016	-46.33	8.50	-37.83
2	33.104452	-115.986640	-46.84	8.50	-38.34
3	33.103042	-115.986644	-48.00	8.50	-39.50
4	33.103043	-115.984942	-48.96	8.50	-40.46
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7	33.101362	-115.978914	-49.04	8.50	-40.54
8	33.098899	-115.978913	-60.45	8.50	-51.95
9	33.098900	-115.986583	-55.89	8.50	-47.39
10	33.100306	-115.986582	-54.55	8.50	-46.05
11	33.100306	-115.989970	-54.16	8.50	-45.66
12	33.100680	-115.989971	-54.23	8.50	-45.73
13	33.100681	-115.991667	-50.98	8.50	-42.48
14	33.103895	-115.991669	-46.63	8.50	-38.13
15	33.103896	-115.991011	-48.07	8.50	-39.57

Flight Path Receptor(s)

Name: FP 1 Ocotillo Airport 27
Description:
Threshold height: 50 ft
Direction: °
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 120.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	33.145052	-116.126432	151.66	50.00	201.66
Two-mile	33.137569	-116.093039	105.42	649.70	755.11

Name: FP 2 Ocotillo Airport 9
Description:
Threshold height: 50 ft
Direction: °
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 120.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	33.146833	-116.134321	152.18	50.00	202.18
Two-mile	33.154316	-116.167715	359.89	395.75	755.64

Name: FP 3 Ocotillo Airport 31
Description:
Threshold height: 50 ft
Direction: °
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 120.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	33.144206	-116.128321	149.00	50.00	199.00
Two-mile	33.120237	-116.108989	194.33	558.13	752.46

Name: FP 4 Ocotillo Airport 13
Description:
Threshold height: 50 ft
Direction: °
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 120.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	33.153797	-116.136118	155.20	50.00	205.20
Two-mile	33.177766	-116.155452	198.06	560.60	758.66

Name: FP 5 Salton Sea 7
Description:
Threshold height: 50 ft
Direction: °
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 120.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	33.240555	-115.960732	-81.24	50.00	-31.24
Two-mile	33.238035	-115.995210	-7.78	530.00	522.22

Name: FP 6 Salton Sea 25
Description:
Threshold height: 50 ft
Direction: °
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 120.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	33.241853	-115.944382	-122.14	50.00	-72.13
Two-mile	33.244373	-115.909903	-159.29	640.61	481.32

GLARE ANALYSIS RESULTS

Summary of Glare

PV Array Name	Tilt (°)	Orient (°)	"Green" Glare min	"Yellow" Glare min	Energy kWh
Seville 4 Fixed Array v03	25.0	180.0	0	0	-

Total annual glare received by each receptor

Receptor	Annual Green Glare (min)	Annual Yellow Glare (min)
FP 1 Ocotillo Airport 27	0	0
FP 2 Ocotillo Airport 9	0	0
FP 3 Ocotillo Airport 31	0	0
FP 4 Ocotillo Airport 13	0	0
FP 5 Salton Sea 7	0	0
FP 6 Salton Sea 25	0	0

Results for: Seville 4 Fixed Array v03

Receptor	Green Glare (min)	Yellow Glare (min)
FP 1 Ocotillo Airport 27	0	0

Receptor	Green Glare (min)	Yellow Glare (min)
FP 2 Ocotillo Airport 9	0	0
FP 3 Ocotillo Airport 31	0	0
FP 4 Ocotillo Airport 13	0	0
FP 5 Salton Sea 7	0	0
FP 6 Salton Sea 25	0	0

Flight Path: FP 1 Ocotillo Airport 27

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP 2 Ocotillo Airport 9

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP 3 Ocotillo Airport 31

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP 4 Ocotillo Airport 13

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP 5 Salton Sea 7

0 minutes of yellow glare
0 minutes of green glare

Flight Path: FP 6 Salton Sea 25

0 minutes of yellow glare
0 minutes of green glare

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.
Glare analyses do not account for physical obstructions between reflectors and receptors. This includes buildings, tree cover and geographic obstructions.
The glare hazard determination relies on several approximations including observer eye characteristics, angle of view, and typical blink response time. Actual values may differ.
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.

PV Array Results

Seville 4 Fixed Array v01

Component	Green glare (min)	Yellow glare (min)	Red glare (min)
OP: 1	0	0	0
OP: 2	0	0	0
OP: 3	0	0	0
OP: 4	0	0	0
OP: 5	0	0	0
OP: 6	0	0	0
OP: 7	0	0	0
OP: 8	0	0	0
OP: 9	0	0	0
OP: 10	0	0	0

Assumptions

- Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
- Glare analyses do not account for physical obstructions between reflectors and receptors. This includes buildings, tree cover and geographi obstructions.
- The glare hazard determination relies on several approximations including observer eye characteristics, angle of view, and typical blink response time. Actual values may differ.
- Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.

APPENDIX L: FIXED-FRAME MODELING (TOP) - IID “R” TRANSMISSION LINE ROAD KOPS

GlareGauge Glare Analysis Results

Site Configuration: Seville_4_Fixed_8-5ft_TLR_OPs_01

Project site configuration details and results.

Created **Aug. 3, 2017 5:39 p.m.**
DNI **varies** and peaks at **1,000.0 W/m^2**
Analyze every **1** minute(s)
0.5 ocular transmission coefficient
0.002 ft pupil diameter
0.017 ft eye focal length
9.3 mrad sun subtended angle
Site Configuration ID: 9619.1632

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

PV name	Tilt	Orientation	"Green" Glare	"Yellow" Glare	Energy Produced
	deg	deg	min	min	kWh
Seville 4 Fixed Array v01	25.0	180.0	58	13,743	-

Component Data

PV Array(s)

Name: Seville 4 Fixed Array v01
Axis tracking: Fixed (no rotation)
Tilt: 25.0 deg
Orientation: 180.0 deg
Rated power: -
Panel material: Smooth glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 8.43 mrad

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	ft	ft	ft
1	33.104020	-115.991000	-46.25	8.50	-37.75
2	33.104570	-115.991000	-45.50	8.50	-37.00
3	33.104570	-115.986710	-46.51	8.50	-38.01
4	33.103190	-115.986710	-45.41	8.50	-36.91
5	33.103180	-115.985030	-46.38	8.50	-37.88
6	33.102830	-115.985020	-50.51	8.50	-42.01
7	33.102830	-115.983360	-49.32	8.50	-40.82
8	33.101820	-115.983360	-53.37	8.50	-44.87
9	33.101820	-115.980050	-51.50	8.50	-43.00
10	33.101270	-115.980040	-50.99	8.50	-42.49
11	33.101270	-115.978460	-50.65	8.50	-42.15
12	33.099110	-115.978450	-49.78	8.50	-41.28
13	33.099110	-115.986650	-45.30	8.50	-36.80
14	33.100480	-115.986660	-53.23	8.50	-44.73
15	33.100490	-115.989980	-50.83	8.50	-42.33
16	33.100840	-115.989980	-49.32	8.50	-40.82
17	33.100840	-115.991640	-45.14	8.50	-36.64
18	33.104030	-115.991630	-47.21	8.50	-38.71

Discrete Observation Receptors

Number	Latitude	Longitude	Ground elevation	Height above ground	Total Elevation
	deg	deg	ft	ft	ft
1	33.107402	-115.978259	-47.41	5.00	-42.41
2	33.104716	-115.978387	-51.69	5.00	-46.69
3	33.100159	-115.978204	-50.62	5.00	-45.62
4	33.095468	-115.978130	-63.71	5.00	-58.71
5	33.092824	-115.977989	-71.02	5.00	-66.02

PV Array Results

Seville 4 Fixed Array v01 potential temporary after-image

Component	Green glare (min)	Yellow glare (min)
OP: 1	0	0
OP: 2	1	20
OP: 3	57	13709
OP: 4	0	14
OP: 5	0	0

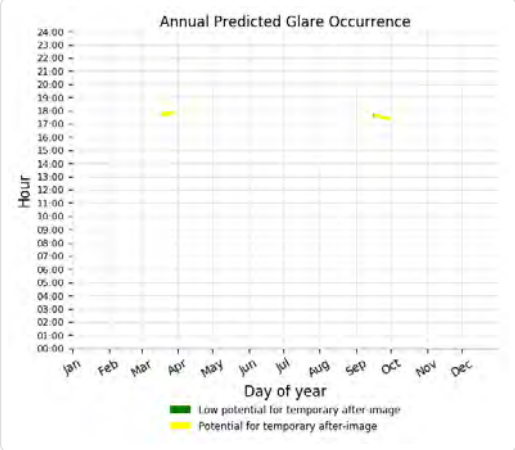
Seville 4 Fixed Array v01 - OP Receptor (1)

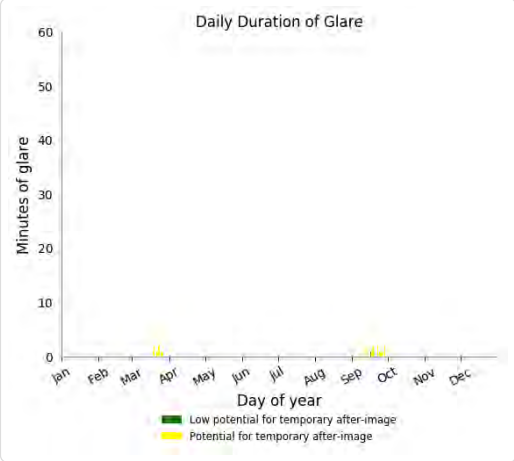
No glare found

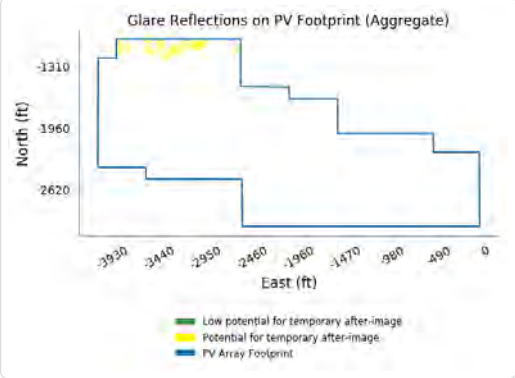
Seville 4 Fixed Array v01 - OP Receptor (2)

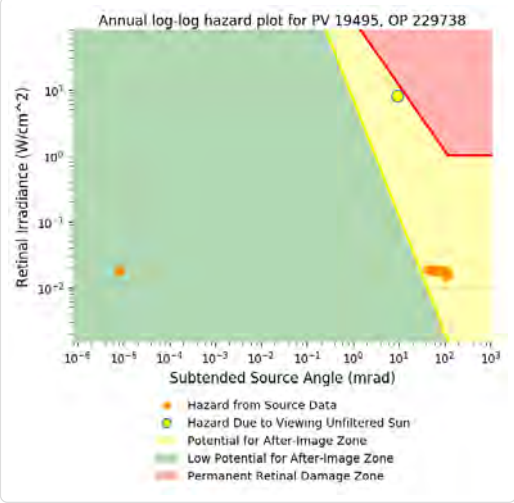
PV array is expected to produce the following glare for receptors at this location:

- 1 minutes of "green" glare with low potential to cause temporary after-image.
- 20 minutes of "yellow" glare with potential to cause temporary after-image.





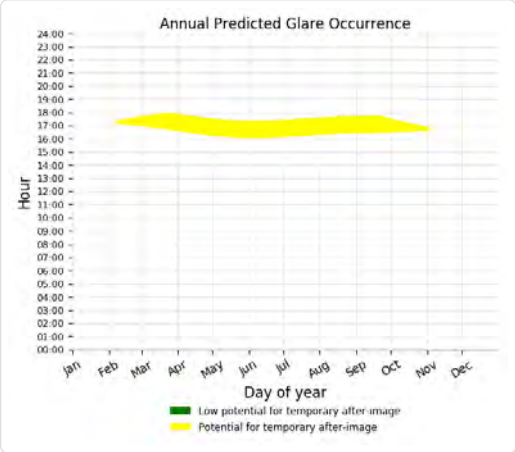


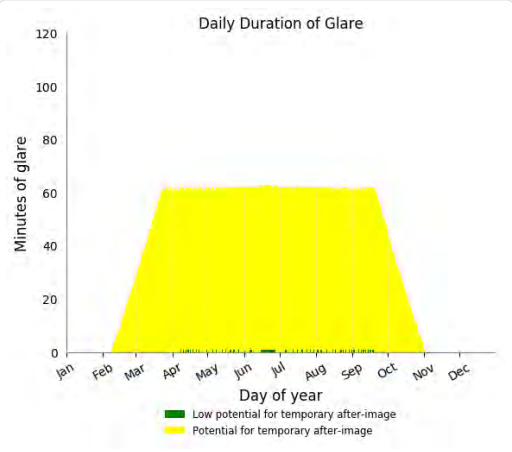


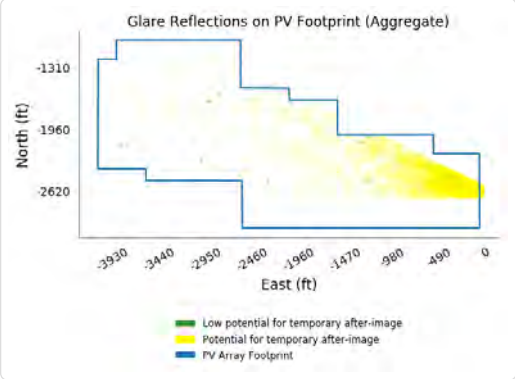
Seville 4 Fixed Array v01 - OP Receptor (3)

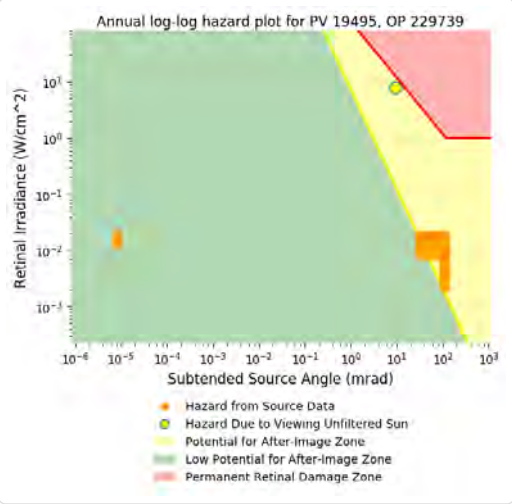
PV array is expected to produce the following glare for receptors at this location:

- 57 minutes of "green" glare with low potential to cause temporary after-image.
- 13,709 minutes of "yellow" glare with potential to cause temporary after-image.





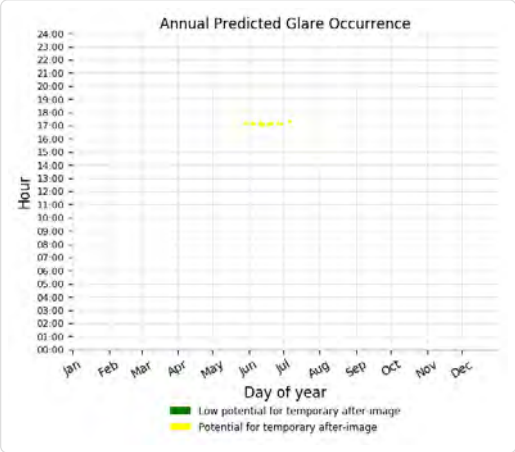


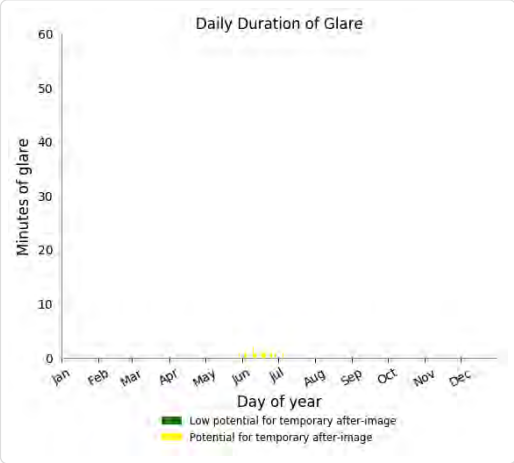


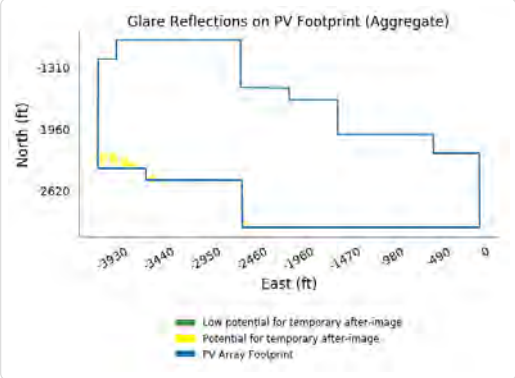
Seville 4 Fixed Array v01 - OP Receptor (4)

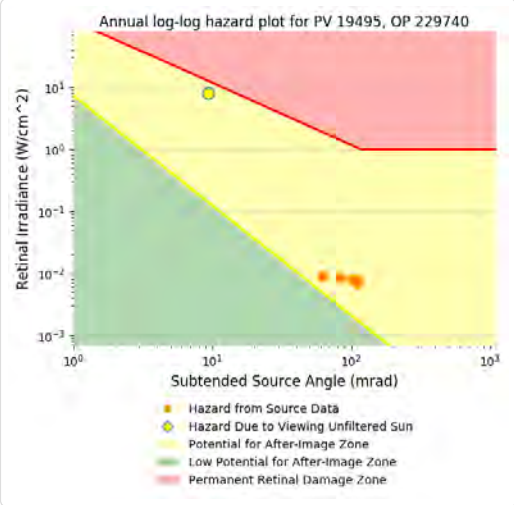
PV array is expected to produce the following glare for receptors at this location:

- 0 minutes of "green" glare with low potential to cause temporary after-image.
- 14 minutes of "yellow" glare with potential to cause temporary after-image.









Seville 4 Fixed Array v01 - OP Receptor (5)

No glare found

Assumptions

- Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
- Glare analyses do not account for physical obstructions between reflectors and receptors. This includes buildings, tree cover and geographi obstructions.
- The glare hazard determination relies on several approximations including observer eye characteristics, angle of view, and typical blink response time. Actual values may differ.
- Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.

APPENDIX M: FIXED-FRAME MODELING (TOP) - AIRPORT KOPS

ForgeSolar

GlareGauge Glare Analysis Results

Site Configuration: Seville_4_Fixed_8-5ft_FLT_FPs_01

Project site configuration details and results.

Created **Aug. 3, 2017 5:45 p.m.**
DNI **varies** and peaks at **1,000.0 W/m^2**
Analyze every **1** minute(s)
0.5 ocular transmission coefficient
0.002 ft pupil diameter
0.017 ft eye focal length
9.3 mrad sun subtended angle
Site Configuration ID: 9620.1632

Summary of Results No glare predicted!

PV name	Tilt	Orientation	"Green" Glare	"Yellow" Glare	Energy Produced
	deg	deg	min	min	kWh
Seville 4 Fixed Array v01	25.0	180.0	0	0	-

Component Data

PV Array(s)

Name: Seville 4 Fixed Array v01
Axis tracking: Fixed (no rotation)
Tilt: 25.0 deg
Orientation: 180.0 deg
Rated power: -
Panel material: Smooth glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 8.43 mrad

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	ft	ft	ft
1	33.104020	-115.991000	-46.25	8.50	-37.75
2	33.104570	-115.991000	-45.50	8.50	-37.00
3	33.104570	-115.986710	-46.51	8.50	-38.01
4	33.103190	-115.986710	-45.41	8.50	-36.91
5	33.103180	-115.985030	-46.38	8.50	-37.88
6	33.102830	-115.985020	-50.51	8.50	-42.01
7	33.102830	-115.983360	-49.32	8.50	-40.82
8	33.101820	-115.983360	-53.37	8.50	-44.87
9	33.101820	-115.980050	-51.50	8.50	-43.00
10	33.101270	-115.980040	-50.99	8.50	-42.49
11	33.101270	-115.978460	-50.65	8.50	-42.15
12	33.099110	-115.978450	-49.78	8.50	-41.28
13	33.099110	-115.986650	-45.30	8.50	-36.80
14	33.100480	-115.986660	-53.23	8.50	-44.73
15	33.100490	-115.989980	-50.83	8.50	-42.33
16	33.100840	-115.989980	-49.32	8.50	-40.82
17	33.100840	-115.991640	-45.14	8.50	-36.64
18	33.104030	-115.991630	-47.21	8.50	-38.71

Flight Path Receptor(s)

Name: FP 1 Ocotillo Airport 27
Description:
Threshold height: 50 ft
Direction: 105.0 deg
Glide slope: 3.0 deg
Pilot view restricted? Yes
Vertical view restriction: 30.0 deg
Azimuthal view restriction: 120.0 deg

Point	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	ft	ft	ft
Threshold	33.145052	-116.126432	151.66	50.00	201.66
2-mile point	33.137569	-116.093039	105.42	649.70	755.11

Name: FP 2 Ocotillo Airport 9
Description:
Threshold height: 50 ft
Direction: 285.0 deg
Glide slope: 3.0 deg
Pilot view restricted? Yes
Vertical view restriction: 30.0 deg
Azimuthal view restriction: 120.0 deg

Point	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	ft	ft	ft
Threshold	33.146833	-116.134321	152.18	50.00	202.18
2-mile point	33.154316	-116.167715	359.89	395.75	755.64

Name: FP 3 Ocotillo Airport 31
Description:
Threshold height: 50 ft
Direction: 146.0 deg
Glide slope: 3.0 deg
Pilot view restricted? Yes
Vertical view restriction: 30.0 deg
Azimuthal view restriction: 120.0 deg

Point	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	ft	ft	ft
Threshold	33.144206	-116.128321	149.00	50.00	199.00
2-mile point	33.120237	-116.108989	194.33	558.13	752.46

Name: FP 4 Ocotillo Airport 13
Description:
Threshold height: 50 ft
Direction: 326.0 deg
Glide slope: 3.0 deg
Pilot view restricted? Yes
Vertical view restriction: 30.0 deg
Azimuthal view restriction: 120.0 deg

Point	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	ft	ft	ft
Threshold	33.153797	-116.136118	155.20	50.00	205.20
2-mile point	33.177766	-116.155452	198.06	560.60	758.66

Name: FP 5 Salton Sea 7
Description:
Threshold height: 50 ft
Direction: 265.0 deg
Glide slope: 3.0 deg
Pilot view restricted? Yes
Vertical view restriction: 30.0 deg
Azimuthal view restriction: 120.0 deg

Point	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	ft	ft	ft
Threshold	33.240555	-115.960732	-81.24	50.00	-31.24
2-mile point	33.238035	-115.995210	-7.78	530.00	522.22

Name: FP 6 Salton Sea 25
Description:
Threshold height: 50 ft
Direction: 85.0 deg
Glide slope: 3.0 deg
Pilot view restricted? Yes
Vertical view restriction: 30.0 deg
Azimuthal view restriction: 120.0 deg

Point	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	ft	ft	ft
Threshold	33.241853	-115.944382	-122.14	50.00	-72.13
2-mile point	33.244373	-115.909903	-159.29	640.61	481.32

PV Array Results

Seville 4 Fixed Array v01

Component	Green glare (min)	Yellow glare (min)	Red glare (min)
FP: FP 1 Ocotillo Airport 27	0	0	0
FP: FP 2 Ocotillo Airport 9	0	0	0
FP: FP 3 Ocotillo Airport 31	0	0	0
FP: FP 4 Ocotillo Airport 13	0	0	0
FP: FP 5 Salton Sea 7	0	0	0
FP: FP 6 Salton Sea 25	0	0	0

Assumptions

- Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
- Glare analyses do not account for physical obstructions between reflectors and receptors. This includes buildings, tree cover and geographi obstructions.
- The glare hazard determination relies on several approximations including observer eye characteristics, angle of view, and typical blink response time. Actual values may differ.
- Hazard zone boundaries shown in the Glare Hazard plot are an approximation and visual aid. Actual ocular impact outcomes encompass a continuous, not discrete, spectrum.