



FORGESOLAR GLARE ANALYSIS

Project: **Connexus**

Site configuration: **Anoka**

Analysis conducted by Michael Werner (mwerner@socoreenergy.com) at 19:41 on 15 Mar, 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

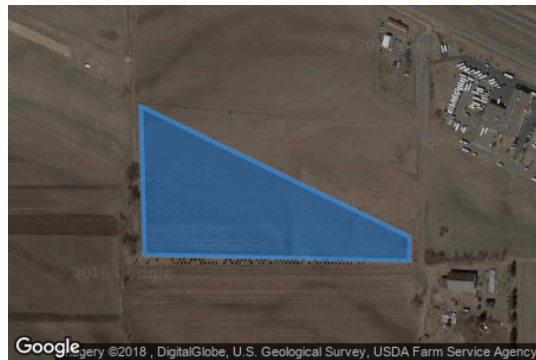
Analysis Parameters

DNI: peaks at 1,000.0 W/m²
 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: 16577.1692



PV Array(s)

Name: PV array 1
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	45.234163	-93.480778	885.40	0.00	885.40
2	45.235825	-93.485649	875.23	0.00	875.23
3	45.233936	-93.485584	868.51	0.00	868.51
4	45.233860	-93.480778	884.62	0.00	884.62

Discrete Observation Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (ft)	Height (ft)
OP 1	1	45.239919	-93.488910	883.91	0.00
OP 2	2	45.238680	-93.485155	881.20	0.00
OP 3	3	45.237698	-93.482108	874.43	0.00
OP 4	4	45.236733	-93.478841	877.88	0.00
OP 5	5	45.235493	-93.474807	882.20	0.00
OP 6	6	45.233701	-93.491379	898.00	0.00
OP 7	7	45.234411	-93.492055	902.13	0.00
OP 8	8	45.238182	-93.492283	882.02	0.00
OP 9	9	45.233304	-93.479286	881.96	0.00
OP 10	10	45.229907	-93.486267	881.81	0.00
OP 11	11	45.229756	-93.480739	860.25	0.00

GLARE ANALYSIS RESULTS

Summary of Glare

PV Array Name	Tilt (°)	Orient (°)	"Green" Glare min	"Yellow" Glare min	Energy kWh
PV array 1	25.0	180.0	73	5,347	-

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	1	0
6	33	2553
7	39	1327
8	0	0
9	0	1467
10	0	0
11	0	0

Results for: PV array 1

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	1	0
OP 6	33	2553
OP 7	39	1327
OP 8	0	0
OP 9	0	1467
OP 10	0	0
OP 11	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

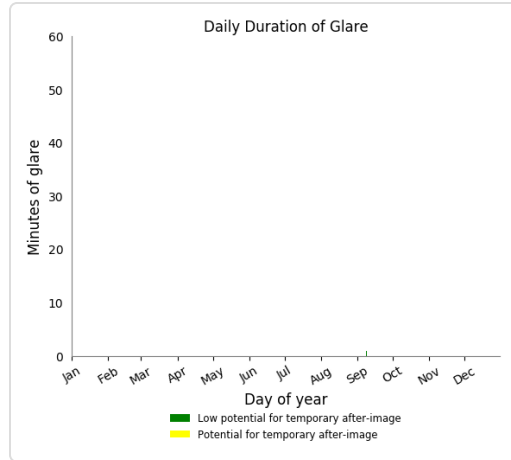
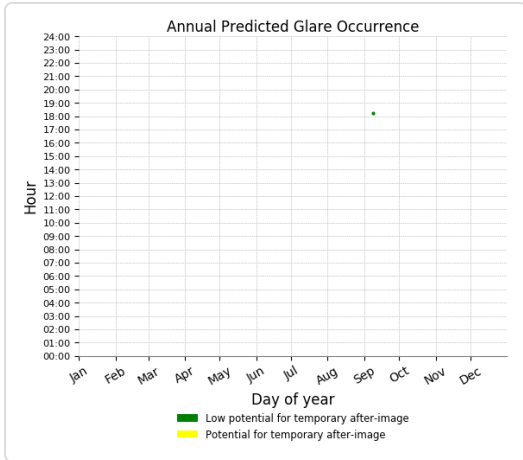
0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 4

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 5

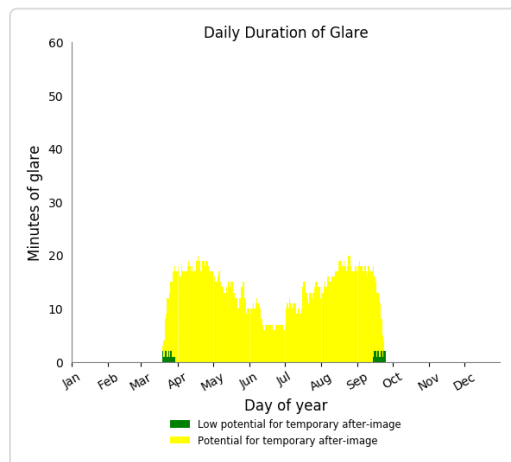
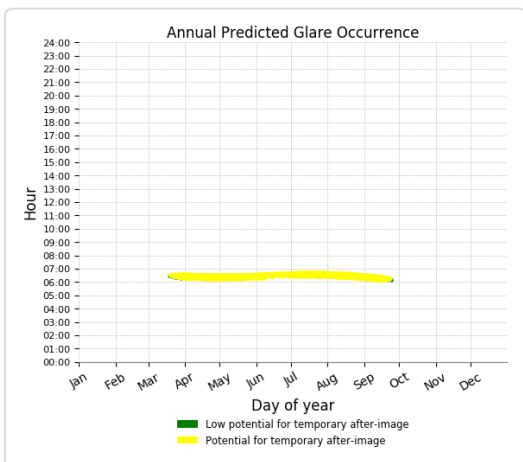
0 minutes of yellow glare
1 minutes of green glare



Point Receptor: OP 6

2553 minutes of yellow glare

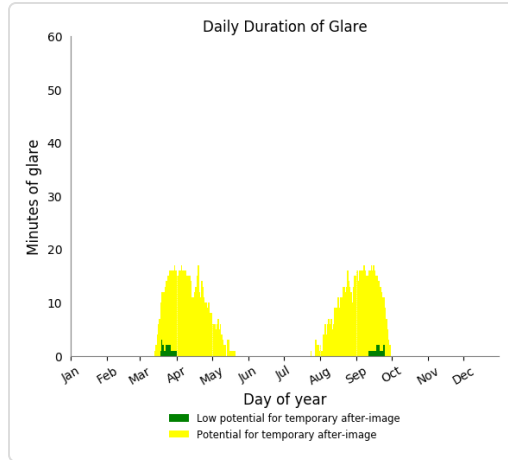
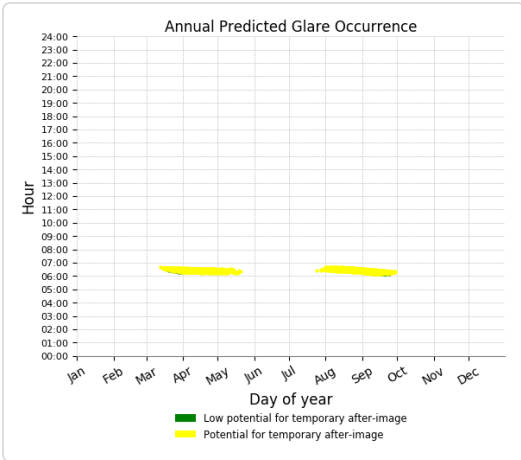
33 minutes of green glare



Point Receptor: OP 7

1327 minutes of yellow glare

39 minutes of green glare

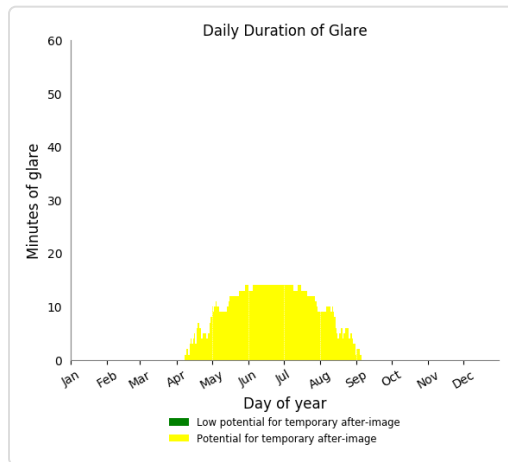
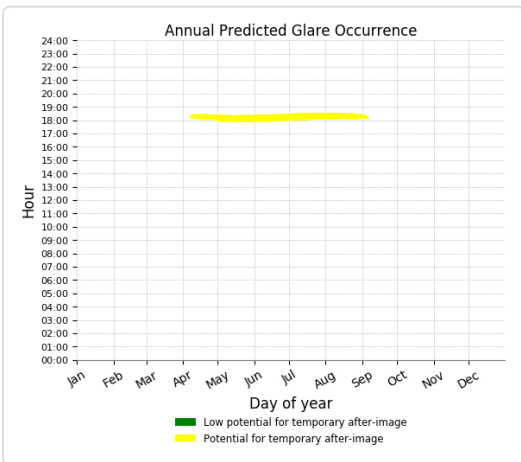


Point Receptor: OP 8

0 minutes of yellow glare
 0 minutes of green glare

Point Receptor: OP 9

1467 minutes of yellow glare
 0 minutes of green glare



Point Receptor: OP 10

0 minutes of yellow glare
 0 minutes of green glare

Point Receptor: OP 11

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.

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