FORGESOLAR GLARE ANALYSIS

Project: **Casement and Weston**
Site configuration: **Airtraks - Baldonnell Business Park**
Analysis conducted by Luis Dominguez (luis@macroworks.ie) at 12:34 on 28 Sep, 2021.

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
2-mile flight path(s)	PASS	Flight path receptor(s) do not receive yellow glare
ATCT(s)	FAIL	Receptor(s) marked as ATCT receive green and/or yellow glare

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

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

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

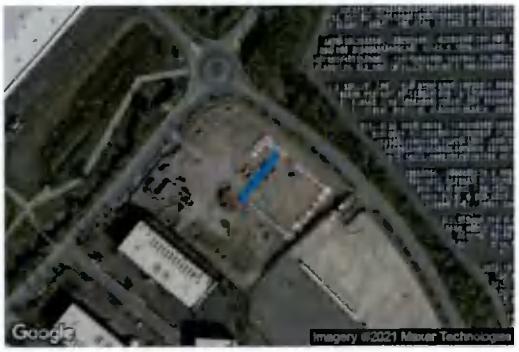
SITE CONFIGURATION

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: 59227.10262

PV Array(s)

Name: Panel Array 1
Axis tracking: Fixed (no rotation)
Tilt: 6.0°
Orientation: 310.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material



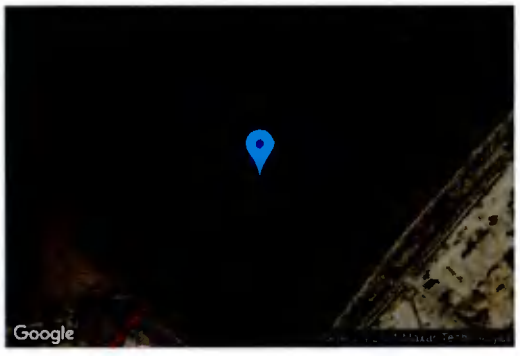
Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.296230	-6.439927	97.10	14.44	111.54
2	53.296219	-6.439904	97.10	14.81	111.91
3	53.295967	-6.440248	97.10	14.81	111.91
4	53.295979	-6.440272	97.10	14.44	111.54
5	53.296230	-6.439927	97.10	14.44	111.54

Name: Panel Array 2
Axis tracking: Fixed (no rotation)
Tilt: 6.0°
Orientation: 130.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
1	53.296201	-6.439868	97.10	14.39	111.49
2	53.296212	-6.439891	97.10	14.76	111.86
3	53.295961	-6.440236	97.10	14.75	111.85
4	53.295949	-6.440212	97.10	14.39	111.49
5	53.296201	-6.439868	97.10	14.39	111.49

Flight Path Receptor(s)

Name: Casement 04 Runway
Description: None
Threshold height: 15 m
Direction: 41.3°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°



Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	53.293830	-6.453465	98.30	15.20	113.50
Two-mile	53.272113	-6.485435	154.40	127.80	282.20

Name: Casement 10 Runway
Description: None
Threshold height: 15 m
Direction: 101.8°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	53.304622	-6.468287	86.30	15.30	101.60
Two-mile	53.310549	-6.515700	73.60	196.60	270.20

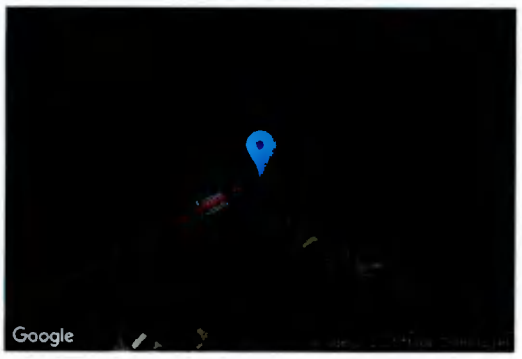
Name: Casement 22 Runway
Description: None
Threshold height: 15 m
Direction: 220.9°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	53.303267	-6.439788	93.40	15.20	108.60
Two-mile	53.325107	-6.408047	62.50	214.80	277.30

Name: Casement 28 Runway
Description: None
Threshold height: 15 m
Direction: 281.8°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

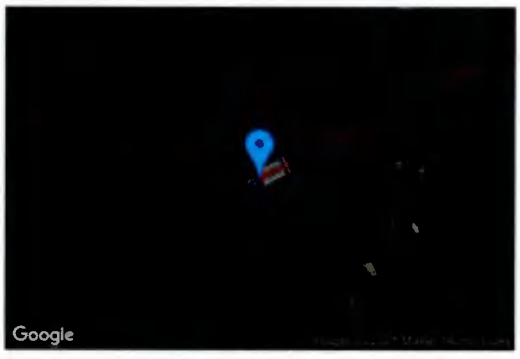
Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	53.301696	-6.445153	96.10	15.20	111.30
Two-mile	53.295759	-6.397747	106.20	173.80	280.00

Name: Weston 07 Runway
Description: None
Threshold height: 15 m
Direction: 63.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°



Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	53.350770	-6.493330	47.50	15.20	62.70
Two-mile	53.337644	-6.536538	56.30	175.10	231.40

Name: Weston 25 Runway
Description: None
Threshold height: 15 m
Direction: 243.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°



Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	53.354037	-6.482623	46.80	15.20	62.00
Two-mile	53.367163	-6.439411	31.60	199.10	230.70

Discrete Observation Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (m)	Height (m)
2-ATCT	2	53.305496	-6.441790	93.50	9.00
3-ATCT	3	53.355640	-6.489488	49.40	15.00

Map image of 2-ATCT

Map image of 3-ATCT

GLARE ANALYSIS RESULTS

Summary of Glare

PV Array Name	Tilt (°)	Orient (°)	"Green" Glare min	"Yellow" Glare min	Energy kWh
Panel Array 1	6.0	310.0	9,189	0	-
Panel Array 2	6.0	130.0	5,704	0	-

Total annual glare received by each receptor

Receptor	Annual Green Glare (min)	Annual Yellow Glare (min)
Casement 04 Runway	5602	0
Casement 10 Runway	1437	0
Casement 22 Runway	0	0
Casement 28 Runway	6511	0
Weston 07 Runway	0	0
Weston 25 Runway	0	0
2-ATCT	0	0
3-ATCT	1343	0

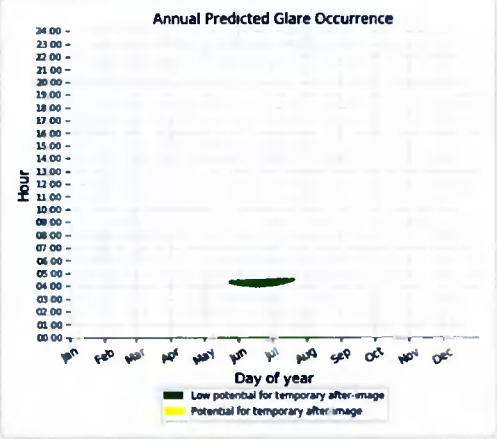
Results for: Panel Array 1

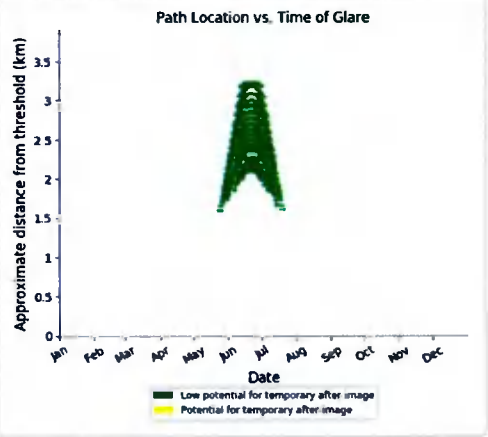
Receptor	Green Glare (min)	Yellow Glare (min)
Casement 04 Runway	4950	0
Casement 10 Runway	1437	0
Casement 22 Runway	0	0
Casement 28 Runway	1459	0
Weston 07 Runway	0	0
Weston 25 Runway	0	0
2-ATCT	0	0
3-ATCT	1343	0

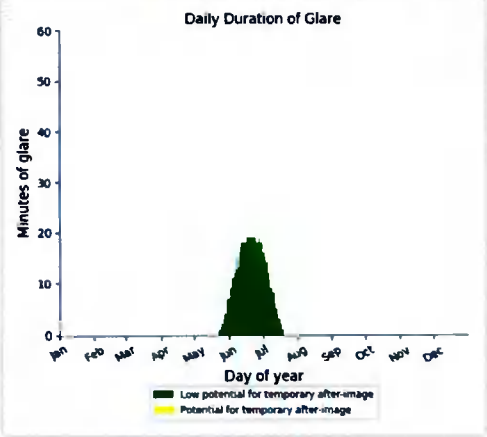
Flight Path: Casement 04 Runway

0 minutes of yellow glare

4950 minutes of green glare



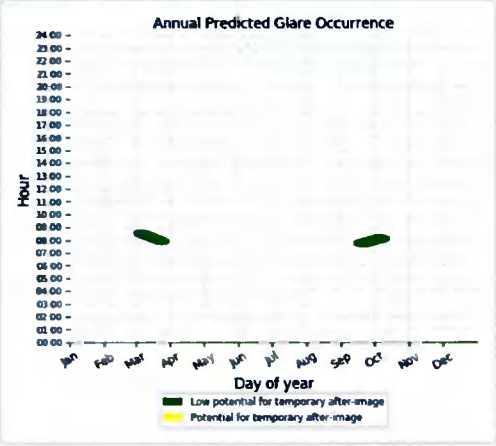


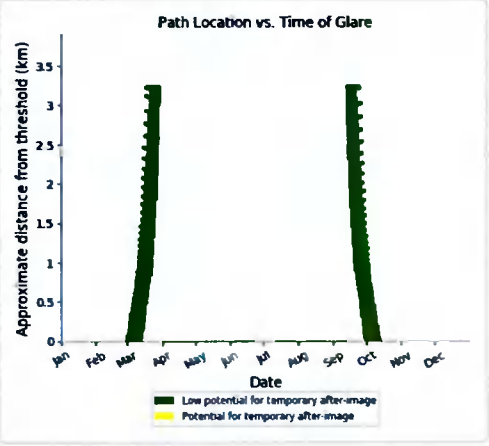


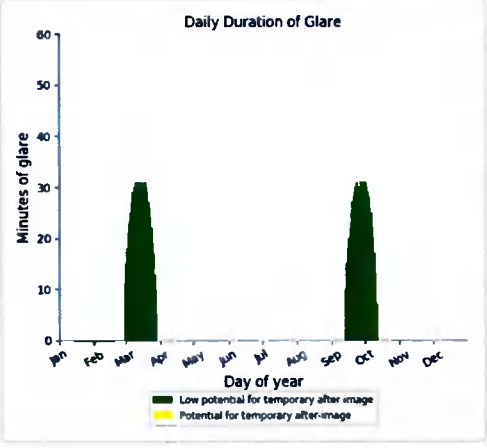
Flight Path: Casement 10 Runway

0 minutes of yellow glare

1437 minutes of green glare







Flight Path: Casement 22 Runway

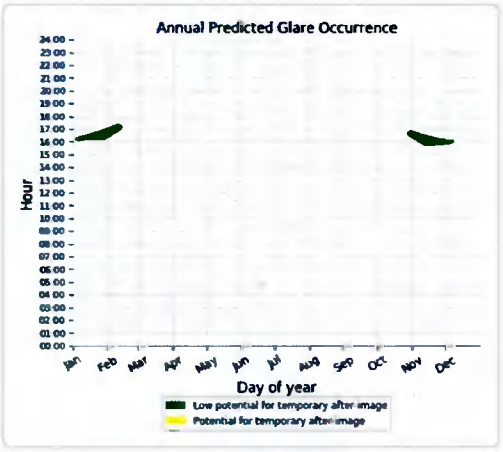
0 minutes of yellow glare

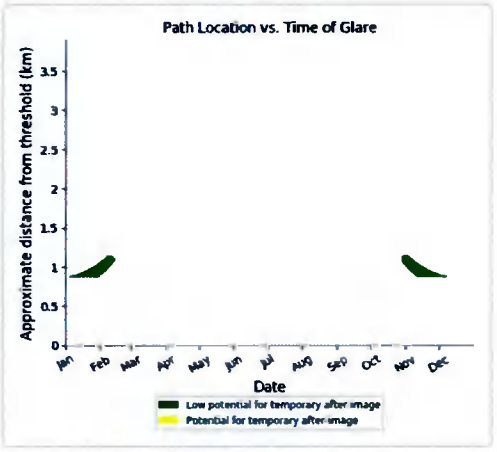
0 minutes of green glare

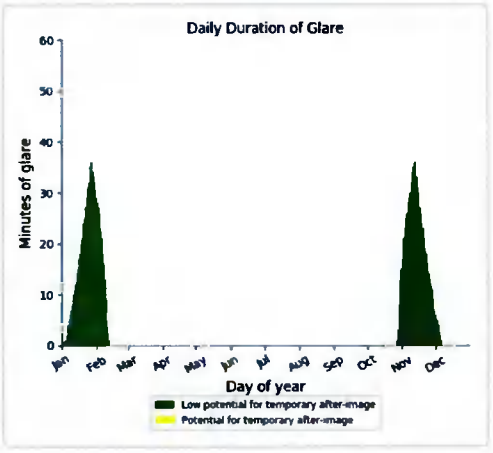
Flight Path: Casement 28 Runway

0 minutes of yellow glare

1459 minutes of green glare







Flight Path: Weston 07 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Weston 25 Runway

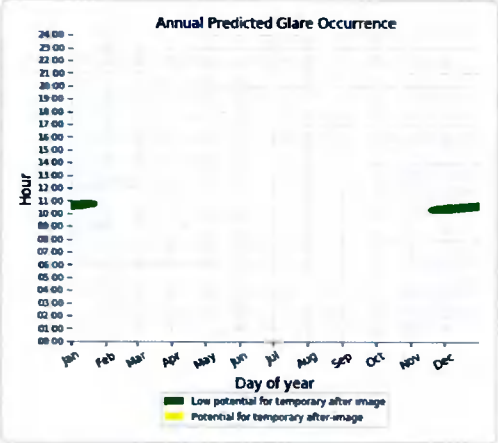
0 minutes of yellow glare
0 minutes of green glare

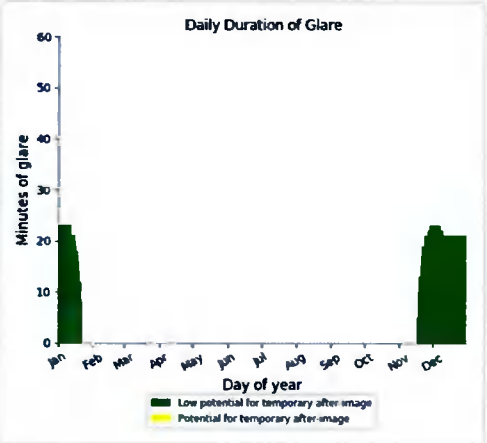
Point Receptor: 2-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 3-ATCT

0 minutes of yellow glare
1343 minutes of green glare





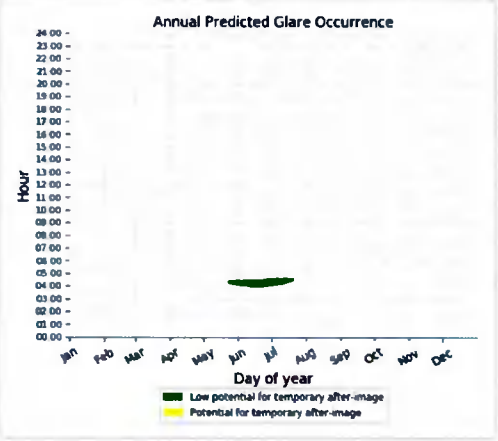
Results for: Panel Array 2

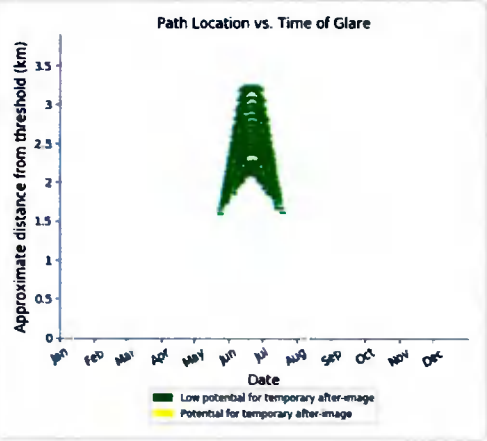
Receptor	Green Glare (min)	Yellow Glare (min)
Casement 04 Runway	652	0
Casement 10 Runway	0	0
Casement 22 Runway	0	0
Casement 28 Runway	5052	0
Weston 07 Runway	0	0
Weston 25 Runway	0	0
2-ATCT	0	0
3-ATCT	0	0

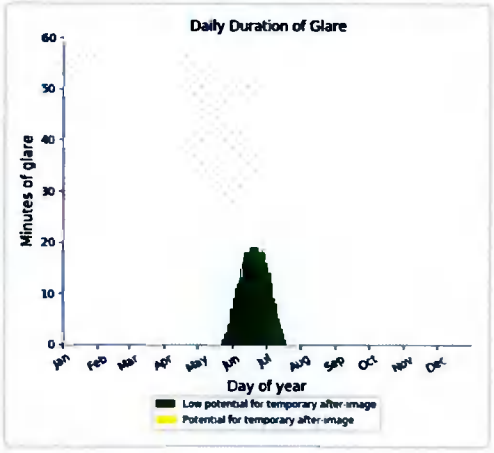
Flight Path: Casement 04 Runway

0 minutes of yellow glare

652 minutes of green glare







Flight Path: Casement 10 Runway

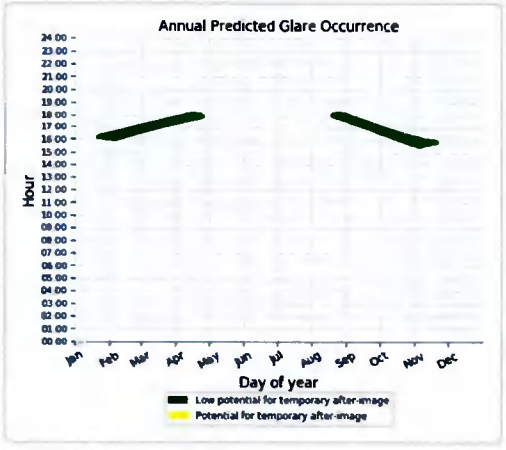
0 minutes of yellow glare
0 minutes of green glare

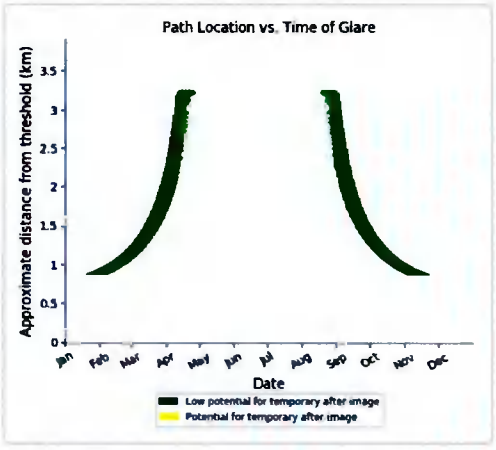
Flight Path: Casement 22 Runway

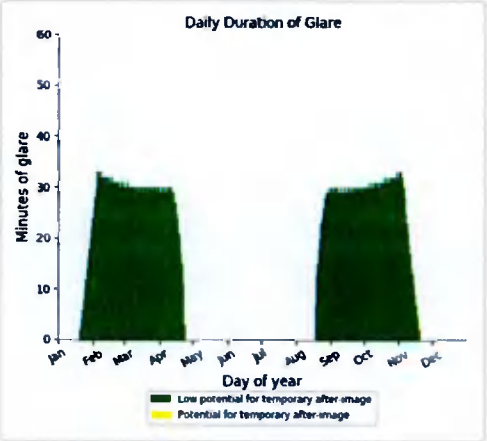
0 minutes of yellow glare
0 minutes of green glare

Flight Path: Casement 28 Runway

0 minutes of yellow glare
5052 minutes of green glare







Flight Path: Weston 07 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: Weston 25 Runway

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 2-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 3-ATCT

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.
Several calculations utilize the PV array centroid, rather than the actual glare spot location, due to V1 algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expected glare.
The subtended source angle (glare spot size) is constrained by the PV array footprint size. Partitioning large arrays into smaller sections will reduce the maximum potential subtended angle, potentially impacting results if actual glare spots are larger than the sub-array size. Additional analyses of the combined area of adjacent sub-arrays can provide more information on potential glare hazards. (See previous point on related limitations.)
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Glare vector plots are simplified representations of analysis data. Actual glare emanations and results may differ.
The glare hazard determination relies on several approximations including observer eye characteristics, angle of view, and typical blink response time. Actual results and glare occurrence 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.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.