

# FORGESOLAR GLARE ANALYSIS

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Project: **Delta County Airport (ESC)**

Escanaba Glare Assessment

Site configuration: **Delta Aripport Sim\_35 Degree**

Analysis conducted by Brad Norling (Bradley.norling@westwoodps.com) at 22:45 on 14 Nov, 2017.

## 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:

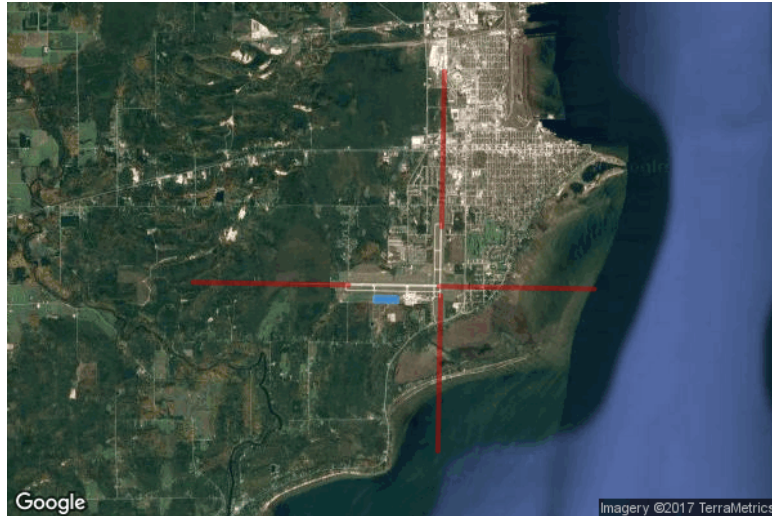
- Analysis time interval: 1 minute
- Ocular transmission coefficient: 0.5
- Pupil diameter: 0.002 meters
- Eye focal length: 0.017 meters
- Sun subtended angle: 9.3 milliradians

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<sup>2</sup>  
 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: 11270.1950



## PV Array(s)

**Name:** 35 Deg PV  
**Axis tracking:** Fixed (no rotation)  
**Tilt:** 35.0°  
**Orientation:** 180.0°  
**Rated power:** 10000.0 kW  
**Panel material:** Smooth glass without AR coating  
**Reflectivity:** Vary with sun  
**Slope error:** 6.55 mrad



Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	45.718564	-87.104151	595.08	6.00	601.08
2	45.718500	-87.098370	596.05	6.00	602.05
3	45.718143	-87.098357	595.92	6.00	601.92
4	45.717747	-87.098346	594.64	6.00	600.64
5	45.717740	-87.104180	597.00	6.00	603.00

## Flight Path Receptor(s)

**Name:** FP 1

**Description:**

**Threshold height:** 50 ft

**Direction:** 271.0°

**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	45.720824	-87.111304	611.44	50.00	661.44
Two-mile	45.721329	-87.152759	681.32	533.58	1214.90

**Name:** FP 2

**Description:**

**Threshold height:** 50 ft

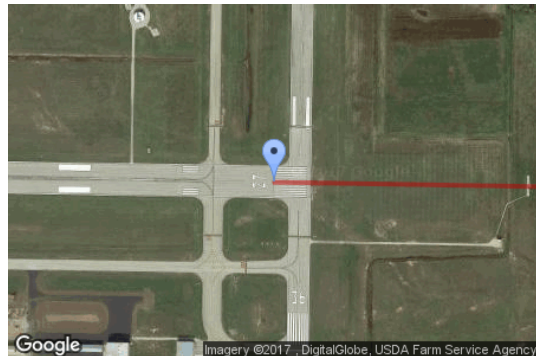
**Direction:** 90.96°

**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	45.720560	-87.087167	595.49	50.00	645.49
Two-mile	45.720076	-87.045711	563.45	635.49	1198.94

**Name:** FP 3

**Description:**

**Threshold height:** 50 ft

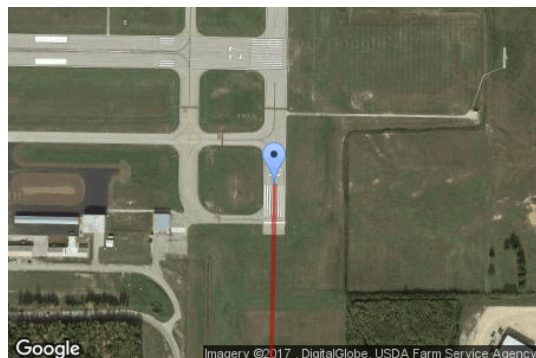
**Direction:** 181.0°

**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	45.718905	-87.086735	595.31	50.00	645.32
Two-mile	45.689997	-87.087458	573.85	624.93	1198.77

**Name:** FP 4  
**Description:**  
**Threshold height:** 50 ft  
**Direction:** 1.0°  
**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	45.731613	-87.086445	608.70	50.00	658.70
Two-mile	45.760521	-87.085721	626.64	585.52	1212.16

## GLARE ANALYSIS RESULTS

### Summary of Glare

PV Array Name	Tilt (°)	Orient (°)	"Green" Glare min	"Yellow" Glare min	Energy kWh
35 Deg PV	35.0	180.0	29	0	23,520,000.0

*Total annual glare received by each receptor*

Receptor	Annual Green Glare (min)	Annual Yellow Glare (min)
FP 1	1	0
FP 2	12	0
FP 3	16	0
FP 4	0	0

### Results for: 35 Deg PV

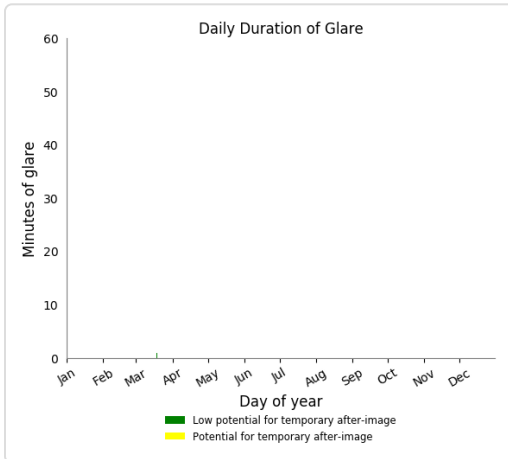
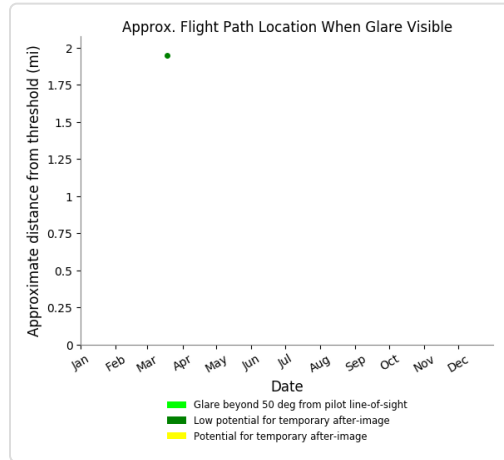
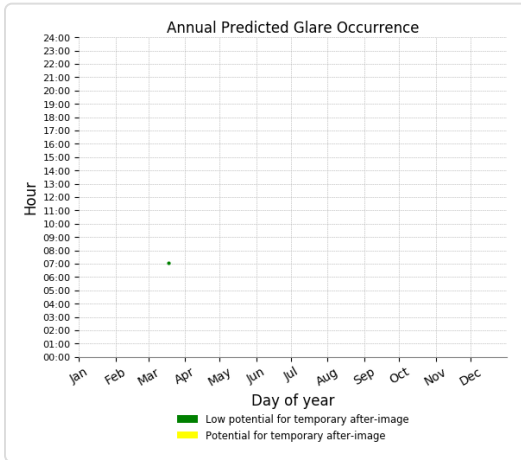
Receptor	Green Glare (min)	Yellow Glare (min)
FP 1	1	0
FP 2	12	0
FP 3	16	0

Receptor	Green Glare (min)	Yellow Glare (min)
FP 4	0	0

### Flight Path: FP 1

0 minutes of yellow glare

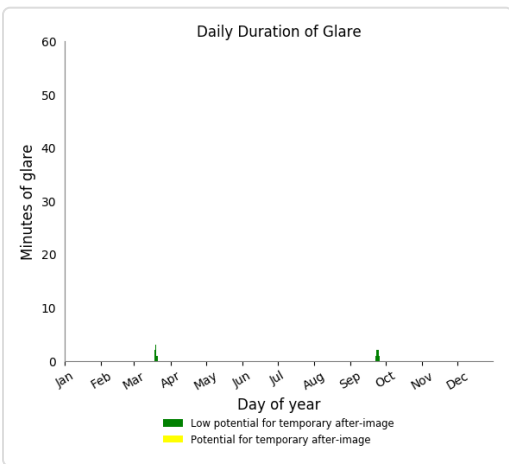
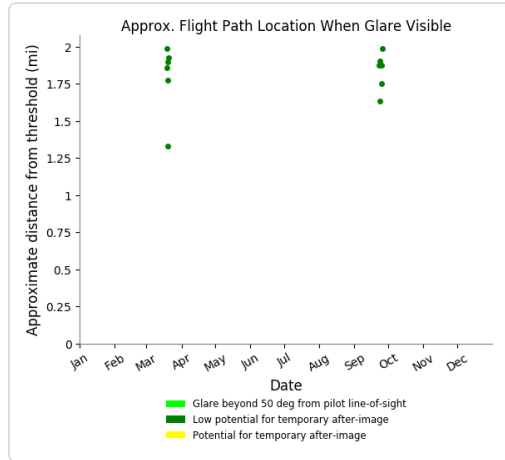
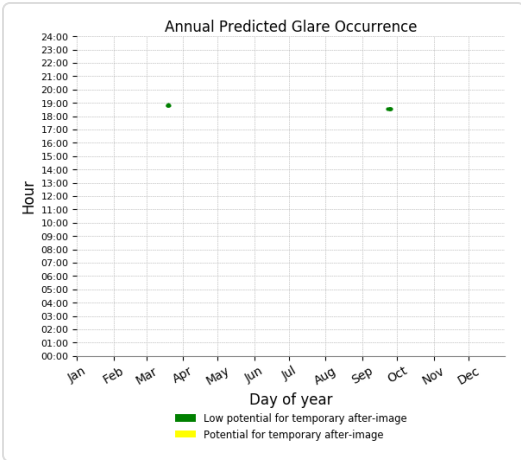
1 minutes of green glare



### Flight Path: FP 2

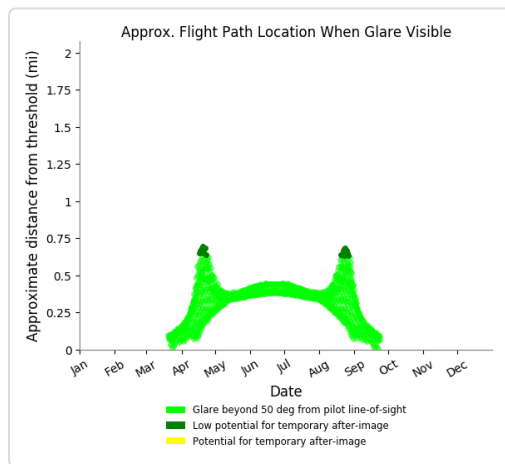
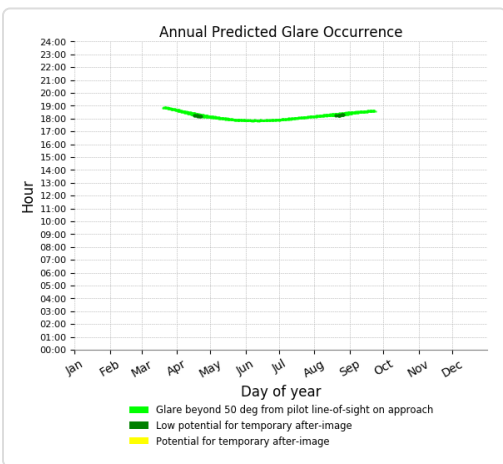
0 minutes of yellow glare

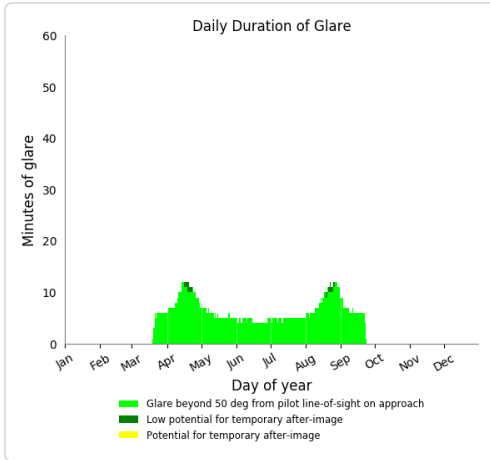
12 minutes of green glare



### Flight Path: FP 3

0 minutes of yellow glare  
 16 minutes of green glare





## Flight Path: FP 4

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.