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GLINT AND GLARE ASSESSMENT

Proposed Solar PV Energy Development.

Social Housing Bundle 4, Development on Collins Avenue, Whitehall, Dublin 9

Prepared by Macro Works Ltd.

July 2024

TABLE OF CONTENTS

Registered Landscape Architect

macroworks APEM Group

1 INTRODUCTION

1.1.1 This Glint and Glare Assessment was carried out by Macro Works Ltd to determine the potential for solar reflectance effects upon aviation receptors in respect of proposed roof-mounted solar PV installations on the roof of a proposed residential development in located at the former Bring Centre, Collins Avenue, Whitehall, Co. Dublin. The proposed panels will be mounted on the top floor of the proposed development and will remain in a fixed position throughout the day and year (i.e. they will not rotate to track the movement of the sun). Figure 1 and Figure 2 refer. The aviation-based glint and glare assessment will assess the proposed panels at six tilt angles: 0 degrees, 5 degrees, 10 degrees, 15 degrees, 20 degree, and 25 degrees.

Figure 1: Aerial view indicating the approximate location of the proposed PV panels (yellow pin).

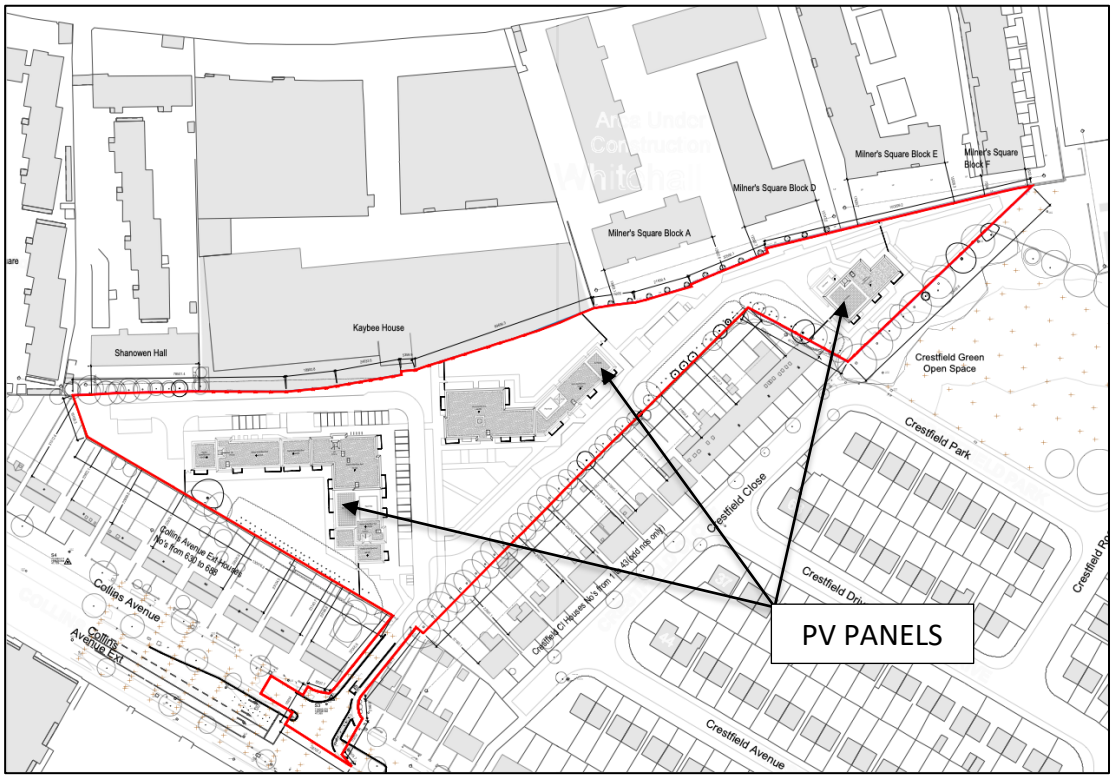


Figure 2: Extract showing the proposed roof layouts with the location of the proposed PV panels.

1.2 Project Description

1.2.1 Development at the site will consist of the following:

- Development at the site will consist of the following:
- The demolition of the existing office building, sheds, warehouses and garages and site clearance works.
- Three apartment blocks comprising a total of 106 residential units and 375.3 sqm of community, arts and cultural space.
- Block A ranges from 3 to 6 storeys and consists of 50 no. residential units (22 no. 1 bed, 20 no. 2 bed and 8 no. 3 bed units) and 272 sqm of community, arts and cultural facilities at ground floor level.
- Block B ranges from 4 to 6 storeys and consists of 38 no. residential units (17 no. 1 bed, 9 no. 2 bed and 12 no. 3 bed units) and 99 sqm of community, arts and cultural facilities at ground floor level.
- Block C ranges from 4 to 5 storeys and consists of 18 no. residential units (10 no. 1 bed and 8 no. 2 bed units).
- 183 no. long-stay and 63 no. short-stay bicycle parking space, 57 no. car parking spaces and 5 no. motorcycle spaces.
- 1,925 sqm of public open space and 3,140 sqm of communal open space.
- One signalised vehicular access is proposed via Collins Avenue and Collins Avenue Extension.
- Provision of pedestrian and cyclist access at northern boundary to allow for future link via Shanowen Business Estate and the Shanowen Hall and Square
- Boundary treatments and planting, public lighting, site drainage works, internal road surfacing and footpath, ESB meter rooms, stores, bin and cycle storage, plant rooms, landscaping; and
- All ancillary site services and development works above and below ground.

1.3 Statement of Authority

1.3.1 Macro Works' relevant experience includes twenty years of analysing the visual effects of a wide range of infrastructural and commercial development types. This experience includes numerous domestic and international wind and solar energy developments.

1.4 Guidance and Best Practice

1.4.1 Guidance has been prepared by the Federal Aviation Authority[1] to address the potential hazards that solar developments may pose to aviation activities, and this has been adopted for use by the Irish Aviation Authority. SGHAT was developed in conjunction with the FAA in harmony with this guidance and is commonly regarded as the accepted industry standard by aviation authorities internationally when considering the glint and glare effects upon aviation related receptors.

1.4.2 By virtue of their efficiency, the intensity of reflected light from modern PV solar panels is deliberately low and currently equates with that of the reflection from still water. Recent studies generally agree, however, that there still exists the potential for hazard or nuisance upon surrounding receptors. Macro Works' glint and glare analysis methods and determination of effects are based on a combination of available studies and established best practice. This methodology has been successfully implemented on numerous previous solar farm projects that met with the approval of both Planning Authorities and An Bord Pleanála.

Federal Aviation Authority

1.4.3 Within the FAA's interim policy, a 'Review of Solar Energy System Projects on Federally Obligated Airports'[2] it states:

> *"To obtain FAA approval to revise an airport layout plan to depict a solar installation and/or a ''no objection'' to a Notice of Proposed Construction Form 7460–1, the airport sponsor will be required to demonstrate that the proposed solar energy system meets the following standards:*
>
> *No potential for glint or glare in the existing or planned Airport Traffic Control Tower (ATCT) cab, and*
>
> *No potential for glare or ''low potential for after-image'' (shown in green in Figure 1 [Figure 3 refers]) along the final approach path for any existing landing threshold or future landing thresholds (including any planned interim phases of the landing thresholds) as shown on the current FAA-approved Airport Layout Plan (ALP). The final approach path is defined as two (2) miles from fifty (50) feet above the landing threshold using a standard three (3) degree glidepath."*

1.4.4 Furthermore, in November 2021 the FAA deprioritised runway approaches as critical aviation receptors, citing the following;

> *"Initially, FAA believed that solar energy systems could introduce a novel glint and glare effect to pilots on final approach. FAA has subsequently concluded that in most cases, the glint and glare from solar energy systems to pilots on final approach is similar to glint and glare pilots routinely experience from water bodies, glass-façade buildings, parking lots, and similar features. However, FAA has continued to receive reports of potential glint and glare from on-airport solar energy systems on personnel working in ATCT cabs. Therefore, FAA has determined the scope of agency policy should be focused on the impact*

[1] Harris, Miller, Miller & Hanson Inc. (November 2010). Technical Guidance for Evaluating Selected Solar Technologies on Airports; 3.1.2 Reflectivity. *Technical Guidance for Evaluating Selected Solar Technologies on Airports*. Available at: https://www.faa.gov/airports/environmental/policy_guidance/media/airport-solar-guide.pdf

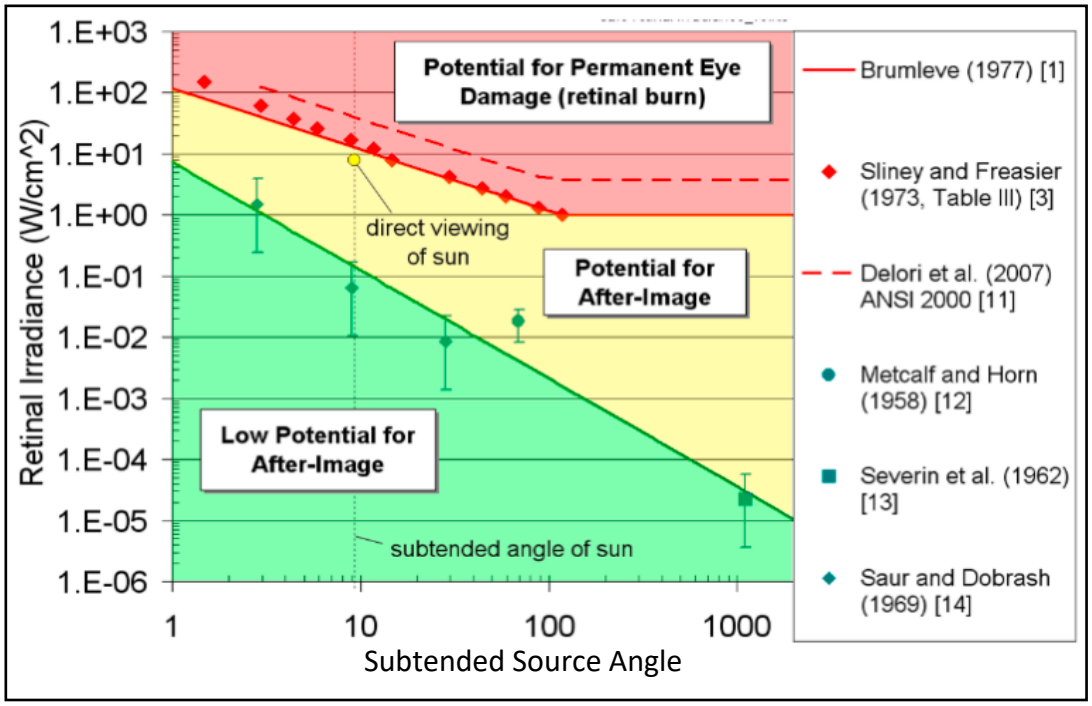
[2] Federal Aviation Administration (FAA). (2013). Department of Transportation - Federal Aviation Administration. *Interim Policy, FAA Review of Solar Energy System Projects on Federally Obligated Airports*. Vol 78 (No 205), 63276-63279.

of on-airport solar energy systems to federally-obligated towered airports, specifically the airport's ATCT" (Federal Aviation Administration 05/11/2021).

1.4.5 In summary, glare at an ATCT is not acceptable and while still relevant glare with a ''low potential for after-image'' is generally acceptable along final approach paths to runways in most instances.

Solar Glare Hazard Analysis Tool

1.4.6 The SGHAT was designed to determine whether a proposed solar energy project would result in the potential for ocular impact as depicted on the Solar Glare Hazard Analysis Plot (Figure 3 refers). SGHAT analyses ocular impact over the entire calendar year in one minute intervals from when the sun rises above the horizon until the sun sets below the horizon. One of the principal outputs from the SGHAT report is a glare plot per receptor that indicates the time of day and days per year that glare has the potential to occur. SGHAT plot classifies the intensity of ocular impact as either Green Glare, Yellow Glare or Red Glare. These colour classifications are equivalent to the FAA's definitions regarding the level of ocular impact e.g. 'Green Glare' in the SGHAT is synonymous to the FAA's *''low potential for after-image','* and so forth. The various correlations are illustrated on the Solar Glare Hazard Analysis Plot.



Solar Glare Ocular Hazard Plot: The potential ocular hazard from solar glare is a function of retinal irradiance and the subtended angle (size/distance) of the glare source. It should be noted that the ratio of spectrally weighted solar illuminance to solar irradiance at the earth's surface yields a conversion factor of ~100 lumens/W. Plot adapted from Ho et al., 2011.

Chart References: Ho, C.K., C.M. Ghanbari, and R.B. Diver, 2011, Methodology to Assess Potential Glint and Glare Hazards from Concentrating Solar Power Plants: Analytical Models and Experimental Validation, J. Solar Energy Engineering, August 2011, Vol. 133, 031021-1 – 031021-9.

Figure 3: Figure 1 from the FAA Interim Policy, FAA Review of Solar Energy System Projects on Federally Obligated Airports

2 METHODOLOGY

2.1.1 The process for dealing with aviation receptors is as follows:

1. The Federal Aviation Administration (FAA) approved Solar Glare Hazard Analysis Tool (SGHAT) is used to determine if any of these aviation receptors has the potential to theoretically experience glint or

glare. This tool also calculates the intensity of such reflectance and whether it is acceptable by FAA standards.

2. SGHAT does not account for terrain screening or screening provided by surface elements such as existing vegetation or buildings, therefore the results of the SGHAT may need to be considered, in conjunction with an assessment of existing intervening screening that may be present, to establish if reflectance can actually be experienced at the receptors.
3. Finally, if necessary, additional assessment is undertaken using Macro Works' bespoke model which would into account any screening provided by any proposed mitigation measures.

2.2 Identification of Relevant Receptors

2.2.1 The Planning and Development (Solar Safeguarding Zone) Regulations 2022 set out 43 Solar Safeguarding Zones (SSZs). A SSZ is an area around an airport, aerodrome or helipad in which there is a potential for glint or glare from solar panels to impact aviation safety.

Runways & Air Traffic Control Towers

2.2.2 This SGHAT analysis was produced to assess the potential for impacts upon aviation receptors, resulting from the proposed solar installation. Dublin Airport is located slightly over 4.5km to the north of the proposed development and comprises 3 active runways. Beaumont helipad is located just over 1.6km east of the site and is represented by 12 observation points.

Figure 4: Aerial view (Google Earth Pro) showing the approximate location of the proposed development (yellow pin) relative to the identified aviation receptors (red and green pins).

3 RESULTS

Runway Approaches – Dublin Airport

The SGHAT Optimisation results are contained in Appendix A and show that five of the six runway approaches analysed had potential for Green Glare to occur, depending on the panel tilt. Each of the panel areas was assessed at orientations of 175°, 180°, 185°, and tilts of 0°,5°, 10°, 15°, 20°, 25°. None of the six runways showed any potential for Yellow Glare as a result of the proposed solar panels. As a result, the 2-mile flight path approaches at Dublin Airport receive a 'pass' status as the flight path receptors do not receive yellow glare.

Air Traffic Control Towers – Dublin Airport

3.1.1 The SGHAT Optimisation results contained in Appendix A also assess the potential for reflectance at both of Dublin Airport Air Traffic Control Towers (ATCT) - Figure 5 below refers – with panel tilts of 0°,5°, 10°, 15°, 20°, 25°, and panel orientations of 175°, 180°, 185°. The assessment identifies no potential for reflectance from any of the proposed panel tilt angles at either ATCT at Dublin Airport. Thus, the assessment results in a 'pass' states as the ATCT receptors do not experience glare episodes as a result of the proposed development.

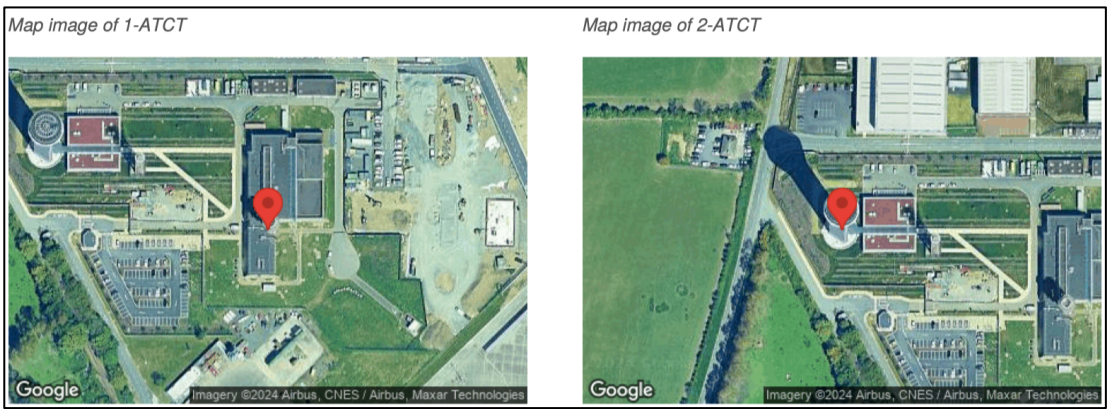


Figure 5: Aerial view (Google Earth Pro) showing the approximate location of the both Air Traffic Control Towers at Dublin Airport.

Observation Points – Beaumont Hospital

3.1.2 The SGHAT results show that each of the Observation Points analysed had potential for Green Glare to occur, depending on tilt and orientation. These are all low levels of glare , with none of the variations predicting as much as 700 minutes of green glare over the course of the year.

None of the Observation Points showed any potential for Yellow Glare as a result of the proposed solar panels. The absence of Yellow Glare is regarded as a pass in this assessment as there would only be low potential for after-image.

4 OVERALL CONCLUSION

4.1.1 From the analysis and discussions contained herein, it is considered that there will not be any significant nuisance effects from glint and glare at the proposed development, as a result of the proposed roof-mounted solar PV panels.

APPENDIX A

SGHAT Results

FORGESOLAR GLARE ANALYSIS

Project: **Dublin North City**
Site configuration: **Social_Housing_Collins_Ave**
Analysis conducted by Luis Dominguez (luis@macroworks.ie) at 09:27 on 18 Jul, 2024.

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)	PASS	Receptor(s) marked as ATCT do not receive 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

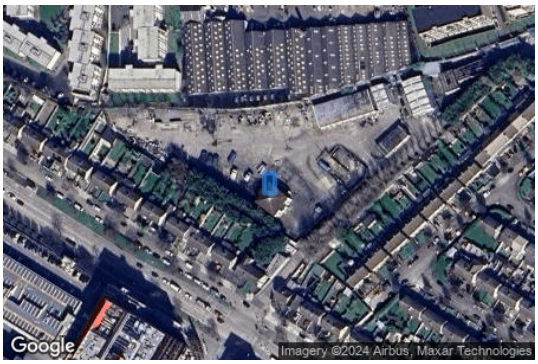
SITE CONFIGURATION

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: 124494.19986
Methodology: V2

PV Array(s)

Name: Block A
Axis tracking: Fixed (no rotation)
Tilt: 10.0°
Orientation: 178.0°
Rated power: -
Panel material: Smooth glass with 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	53.387257	-6.254845	48.00	13.80	61.80
2	53.387258	-6.254748	48.00	13.80	61.80
3	53.387151	-6.254746	48.00	13.80	61.80
4	53.387150	-6.254843	48.00	13.80	61.80
5	53.387257	-6.254845	48.00	13.80	61.80

Name: Block B
Axis tracking: Fixed (no rotation)
Tilt: 10.0°
Orientation: 178.0°
Rated power: -
Panel material: Smooth glass with 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	53.387667	-6.253442	48.00	13.20	61.20
2	53.387624	-6.253372	48.00	13.20	61.20
3	53.387652	-6.253320	48.00	13.20	61.20
4	53.387700	-6.253393	48.00	13.20	61.20
5	53.387670	-6.253446	48.00	13.20	61.20

Name: Block C
Axis tracking: Fixed (no rotation)
Tilt: 10.0°
Orientation: 135.0°
Rated power: -
Panel material: Smooth glass with 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	53.387867	-6.252098	47.50	15.90	63.40
2	53.387902	-6.252037	47.50	15.90	63.40
3	53.387886	-6.252012	47.50	15.90	63.40
4	53.387909	-6.251971	47.50	15.90	63.40
5	53.387858	-6.251890	47.50	15.90	63.40
6	53.387800	-6.251992	47.50	15.90	63.40
7	53.387850	-6.252069	47.50	15.90	63.40

Flight Path Receptor(s)

Name: 10L Runway
Description: None
Threshold height: 15 m
Direction: 95.8°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 120.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	53.436880	-6.280253	71.90	15.20	87.10
Two-mile	53.439822	-6.328592	74.90	180.90	255.80

Name: 10 Runway
Description: None
Threshold height: 15 m
Direction: 95.8°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 120.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	53.422405	-6.289520	74.00	15.30	89.30
Two-mile	53.425327	-6.337846	80.30	177.60	257.90

Name: 16 Runway
Description: None
Threshold height: 15 m
Direction: 156.1°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 120.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	53.436699	-6.261764	66.50	15.20	81.70
Two-mile	53.463138	-6.281428	69.70	180.70	250.40

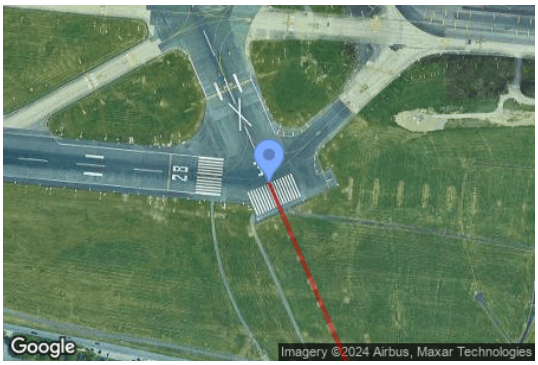
Name: 28R Runway
Description: None
Threshold height: 15 m
Direction: 275.9°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 120.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	53.435084	-6.240975	65.50	15.30	80.80
Two-mile	53.432097	-6.192645	34.00	215.50	249.50

Name: 28 Runway
Description: None
Threshold height: 15 m
Direction: 275.5°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 120.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	53.420299	-6.251111	62.00	15.20	77.20
Two-mile	53.417517	-6.202763	41.90	204.00	245.90

Name: 34 Runway
Description: None
Threshold height: 15 m
Direction: 336.6°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 120.0°

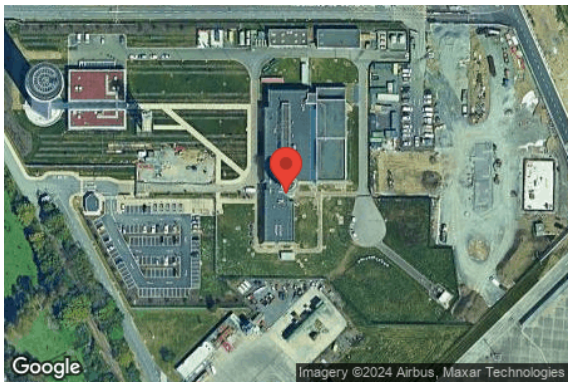


Point	Latitude (°)	Longitude (°)	Ground elevation (m)	Height above ground (m)	Total elevation (m)
Threshold	53.420211	-6.249810	62.20	15.30	77.50
Two-mile	53.393680	-6.230504	49.00	197.10	246.10

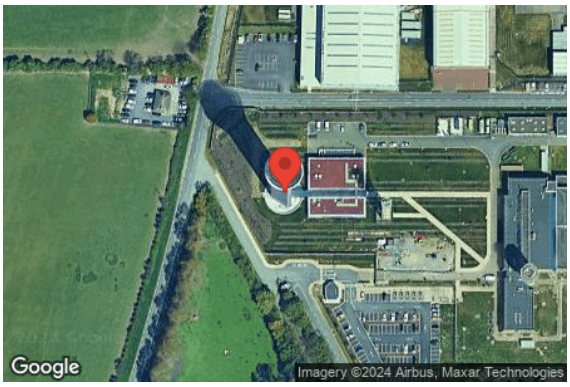
Discrete Observation Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (m)	Height (m)
1-ATCT	1	53.428489	-6.262201	65.90	21.90
2-ATCT	2	53.428937	-6.264259	65.60	75.60
OP 3	3	53.387892	-6.229964	47.40	1.70
OP 4	4	53.387892	-6.229964	47.40	25.00
OP 5	5	53.387892	-6.229964	47.40	50.00
OP 6	6	53.387892	-6.229964	47.40	75.00
OP 7	7	53.387892	-6.229964	47.40	100.00
OP 8	8	53.387892	-6.229964	47.40	125.00
OP 9	9	53.387892	-6.229964	47.40	150.00
OP 10	10	53.387892	-6.229964	47.40	175.00
OP 11	11	53.387892	-6.229964	47.40	200.00
OP 12	12	53.387892	-6.229964	47.40	225.00
OP 13	13	53.387892	-6.229964	47.40	250.00
OP 14	14	53.387892	-6.229964	47.40	275.00
OP 15	15	53.387892	-6.229964	47.40	300.00

Map image of 1-ATCT



Map image of 2-ATCT



GLARE ANALYSIS RESULTS

Summary of Glare

PV Array Name	Tilt (°)	Orient (°)	"Green" Glare min	"Yellow" Glare min	Energy kWh
Block A	10.0	178.0	7,246	0	-
Block B	10.0	178.0	7,451	0	-
Block C	10.0	135.0	17,427	0	-

Total annual glare received by each receptor

Receptor	Annual Green Glare (min)	Annual Yellow Glare (min)
10L Runway	0	0
10 Runway	0	0
16 Runway	0	0
28R Runway	0	0
28 Runway	1578	0
34 Runway	6119	0
1-ATCT	0	0
2-ATCT	0	0
OP 3	395	0
OP 4	711	0
OP 5	1424	0
OP 6	1781	0
OP 7	2063	0
OP 8	2146	0
OP 9	2183	0
OP 10	2205	0
OP 11	2234	0
OP 12	2267	0
OP 13	2299	0
OP 14	2337	0
OP 15	2382	0

Results for: Block A

Receptor	Green Glare (min)	Yellow Glare (min)
10L Runway	0	0
10 Runway	0	0
16 Runway	0	0
28R Runway	0	0
28 Runway	0	0
34 Runway	164	0
1-ATCT	0	0
2-ATCT	0	0
OP 3	0	0
OP 4	109	0
OP 5	405	0
OP 6	521	0
OP 7	613	0
OP 8	671	0
OP 9	679	0
OP 10	677	0
OP 11	679	0
OP 12	683	0
OP 13	681	0
OP 14	681	0
OP 15	683	0

Flight Path: 10L Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: 10 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: 16 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: 28R Runway

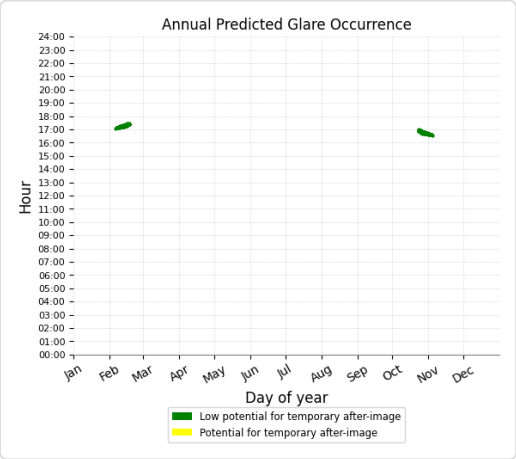
0 minutes of yellow glare
0 minutes of green glare

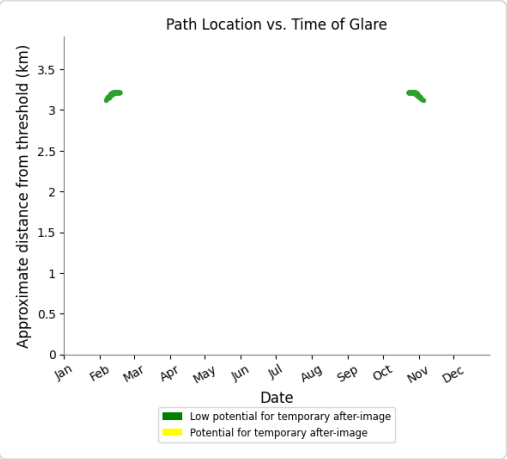
Flight Path: 28 Runway

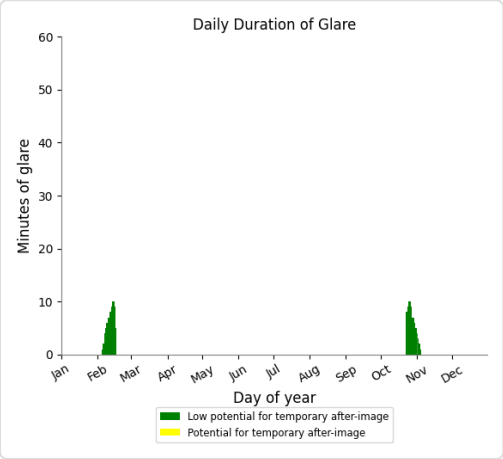
0 minutes of yellow glare
0 minutes of green glare

Flight Path: 34 Runway

0 minutes of yellow glare
164 minutes of green glare







Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 2-ATCT

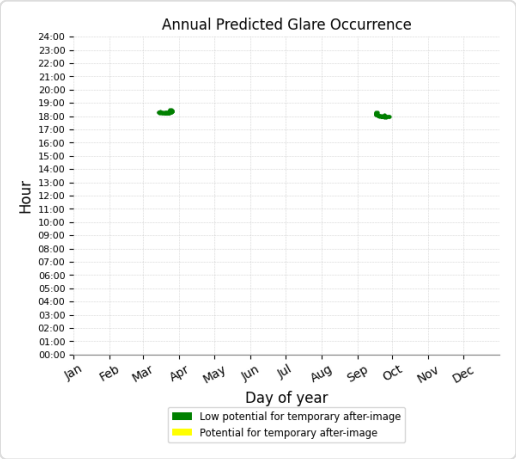
0 minutes of yellow glare
0 minutes of green glare

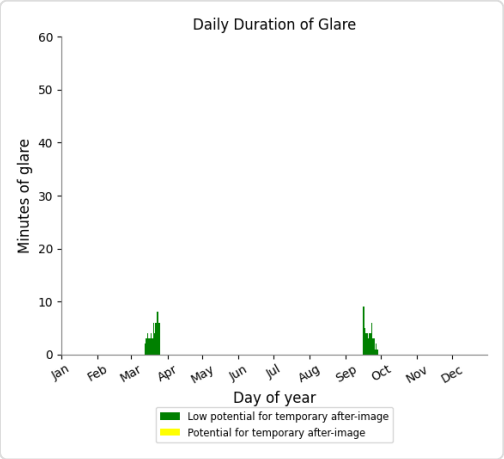
Point Receptor: OP 3

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 4

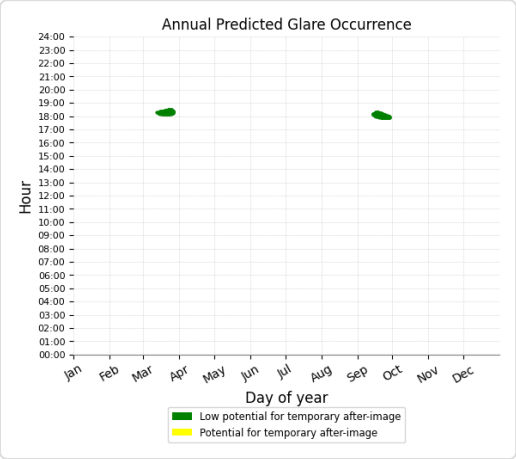
0 minutes of yellow glare
109 minutes of green glare

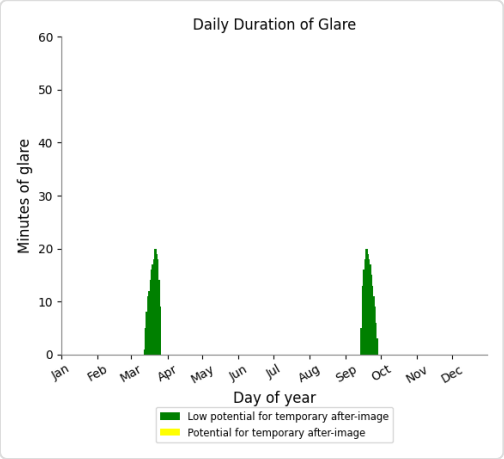




Point Receptor: OP 5

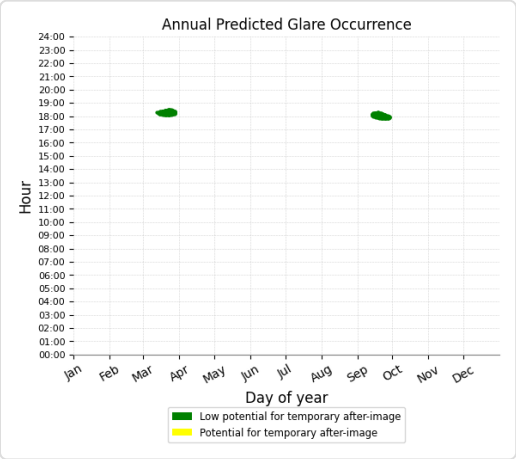
0 minutes of yellow glare
405 minutes of green glare

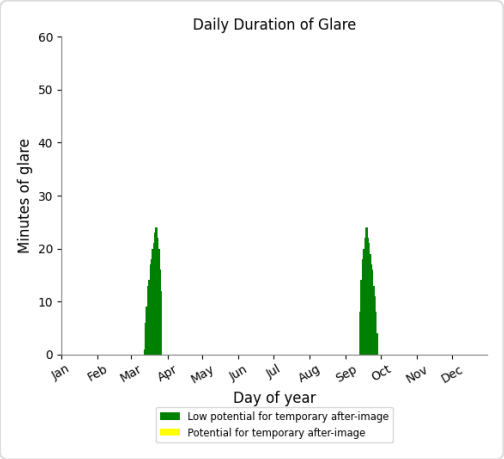




Point Receptor: OP 6

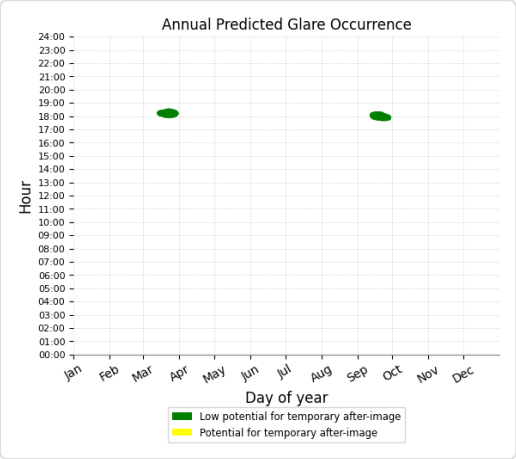
0 minutes of yellow glare
521 minutes of green glare

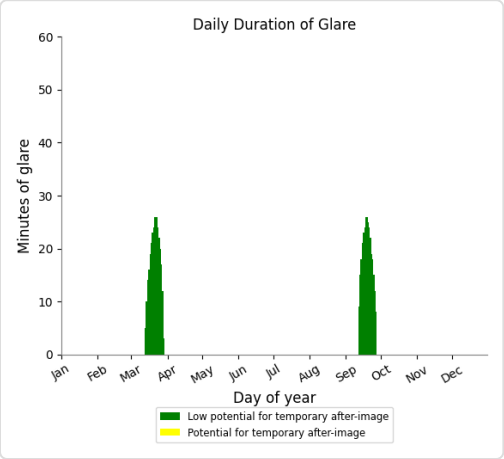




Point Receptor: OP 7

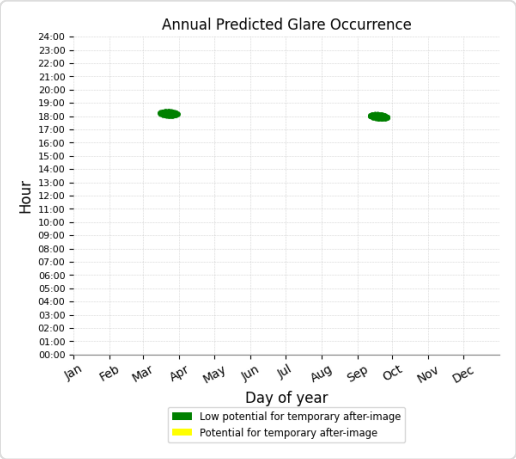
0 minutes of yellow glare
613 minutes of green glare

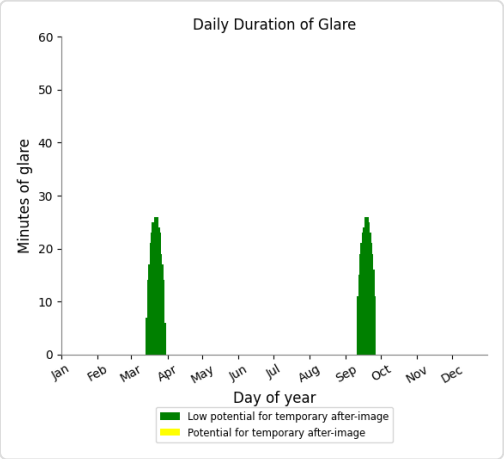




Point Receptor: OP 8

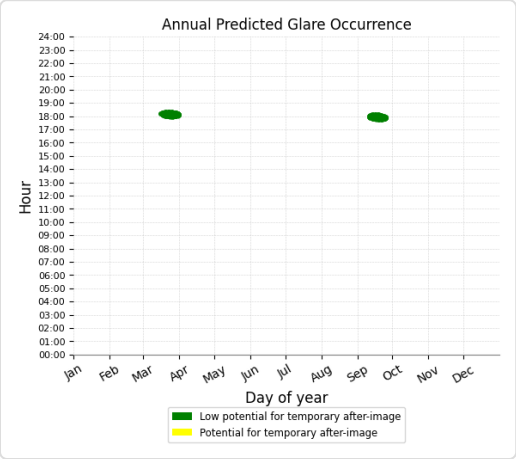
0 minutes of yellow glare
671 minutes of green glare

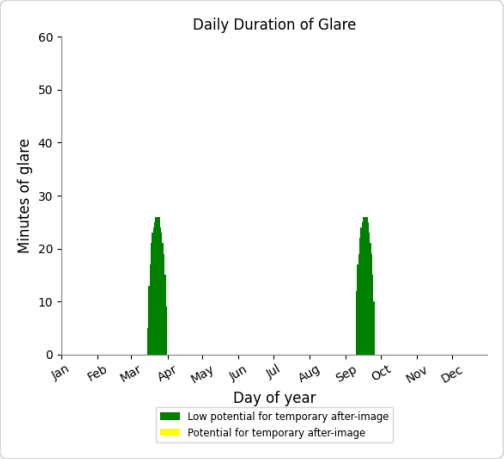




Point Receptor: OP 9

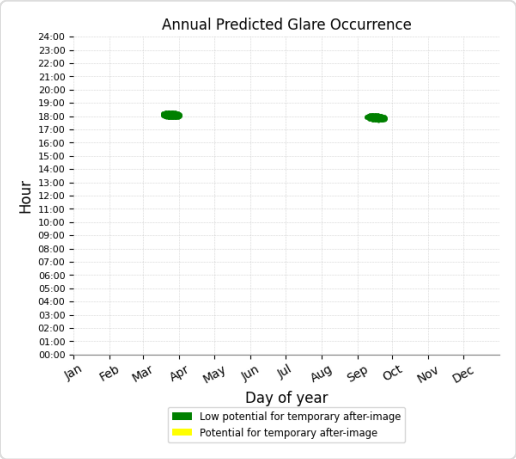
0 minutes of yellow glare
679 minutes of green glare

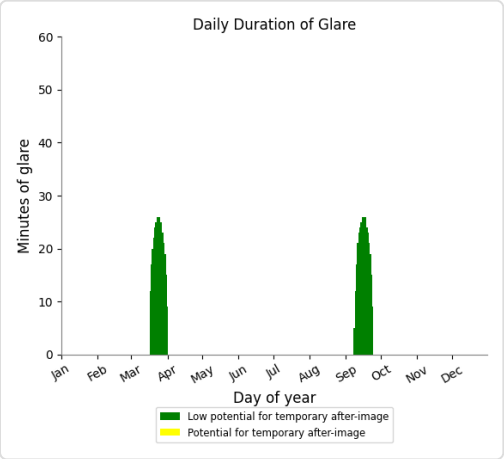




Point Receptor: OP 10

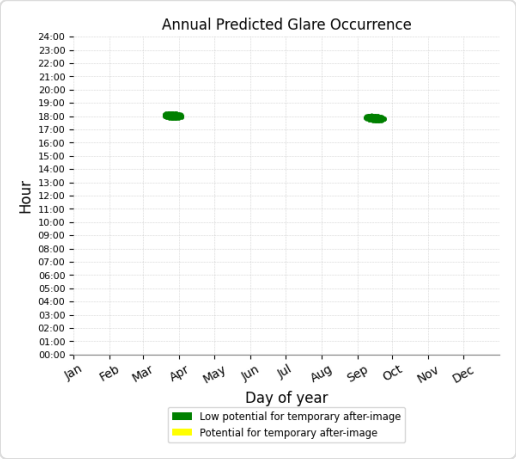
0 minutes of yellow glare
677 minutes of green glare

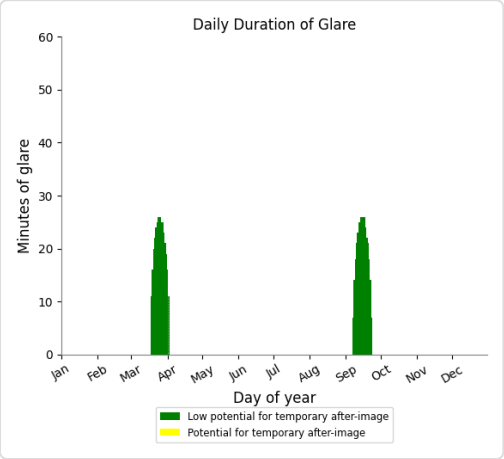




Point Receptor: OP 11

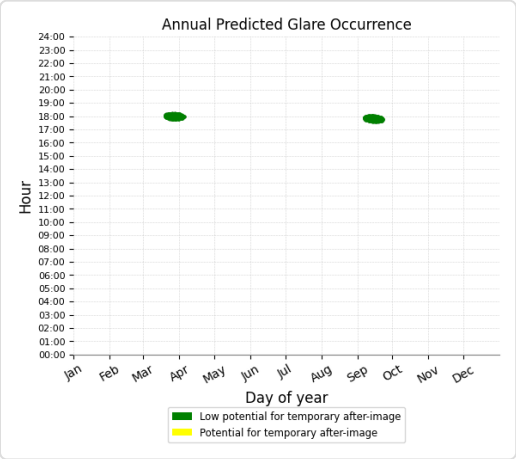
0 minutes of yellow glare
679 minutes of green glare

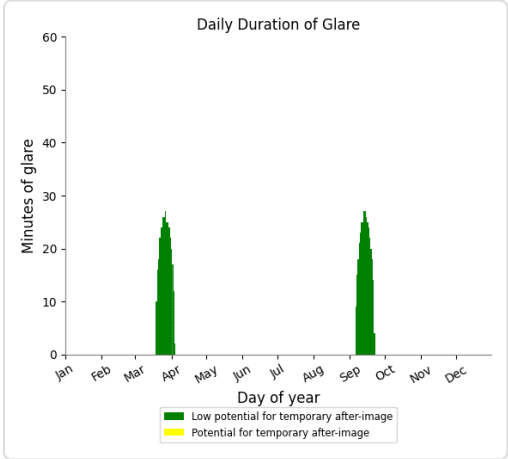




Point Receptor: OP 12

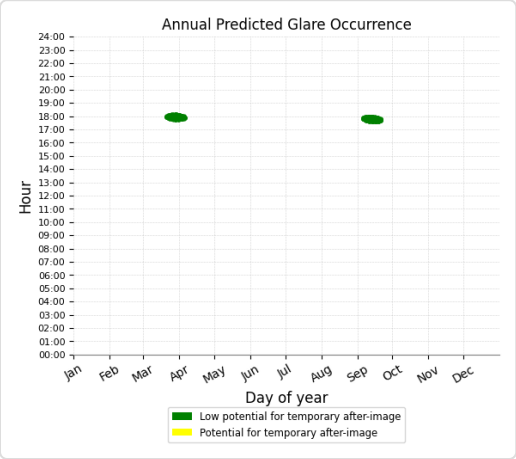
0 minutes of yellow glare
683 minutes of green glare

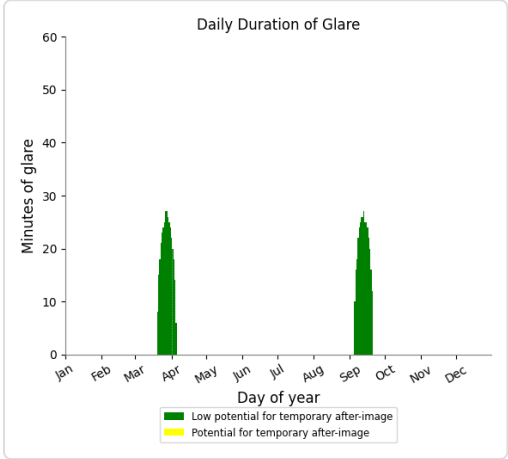




Point Receptor: OP 13

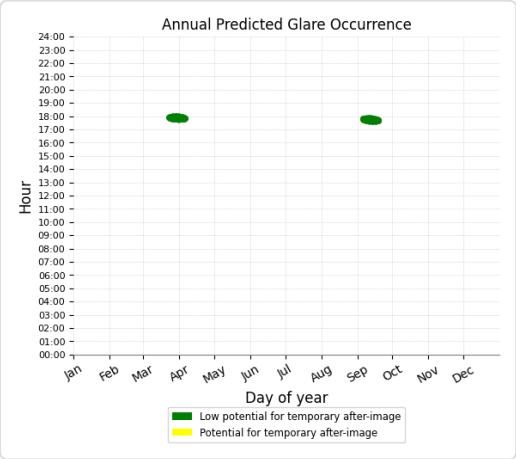
0 minutes of yellow glare
681 minutes of green glare

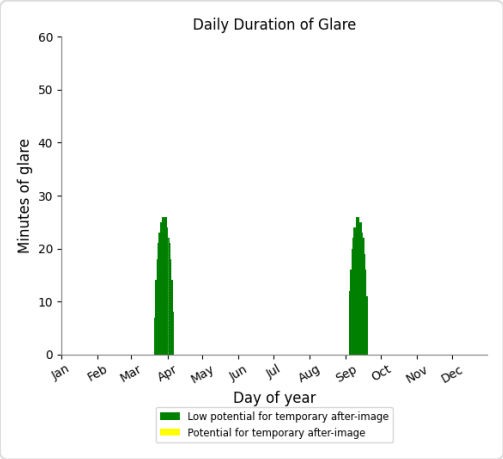




Point Receptor: OP 14

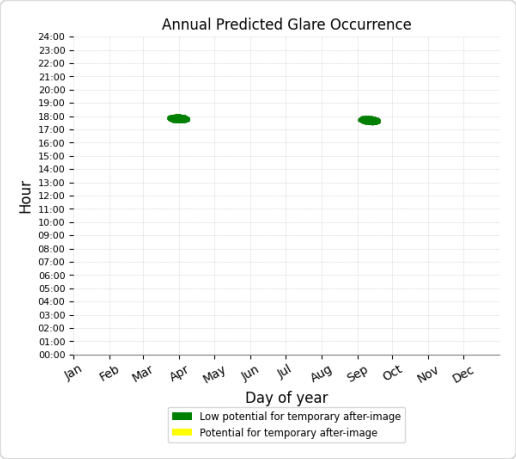
0 minutes of yellow glare
681 minutes of green glare

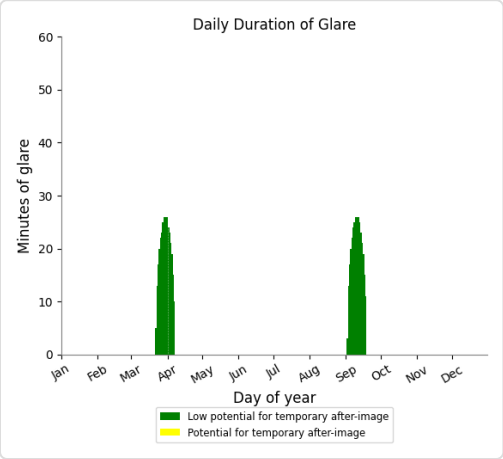




Point Receptor: OP 15

0 minutes of yellow glare
683 minutes of green glare





Results for: Block B

Receptor	Green Glare (min)	Yellow Glare (min)
10L Runway	0	0
10 Runway	0	0
16 Runway	0	0
28R Runway	0	0
28 Runway	0	0
34 Runway	258	0
1-ATCT	0	0
2-ATCT	0	0
OP 3	0	0
OP 4	232	0
OP 5	452	0
OP 6	553	0
OP 7	644	0
OP 8	655	0
OP 9	660	0
OP 10	662	0
OP 11	663	0
OP 12	662	0
OP 13	667	0
OP 14	669	0
OP 15	674	0

Flight Path: 10L Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: 10 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: 16 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: 28R Runway

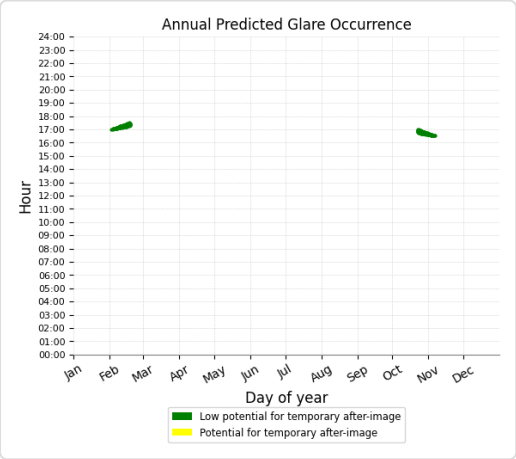
0 minutes of yellow glare
0 minutes of green glare

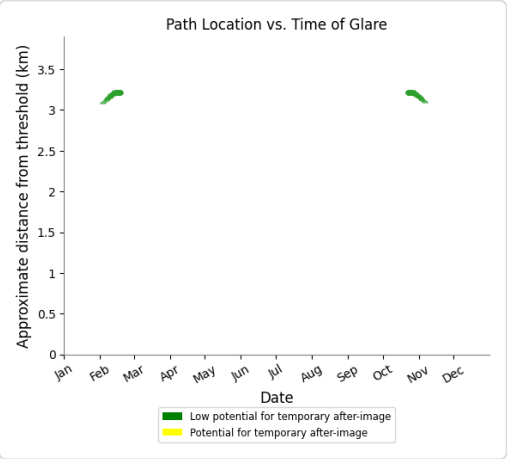
Flight Path: 28 Runway

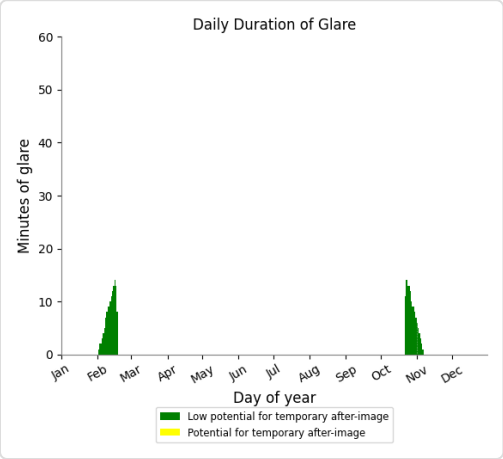
0 minutes of yellow glare
0 minutes of green glare

Flight Path: 34 Runway

0 minutes of yellow glare
258 minutes of green glare







Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 2-ATCT

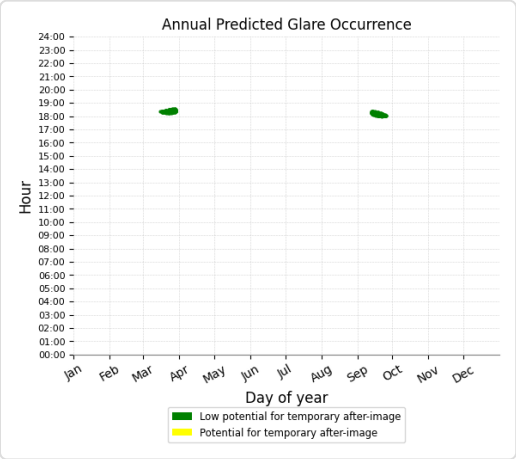
0 minutes of yellow glare
0 minutes of green glare

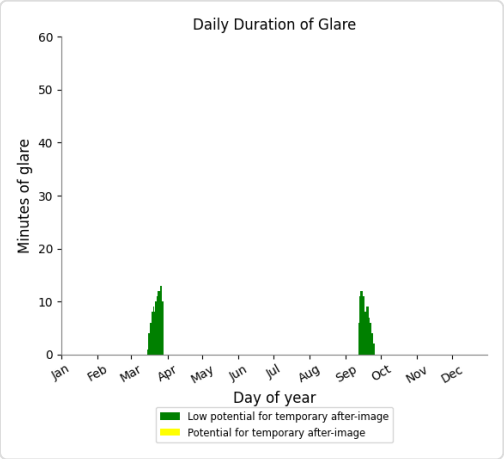
Point Receptor: OP 3

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: OP 4

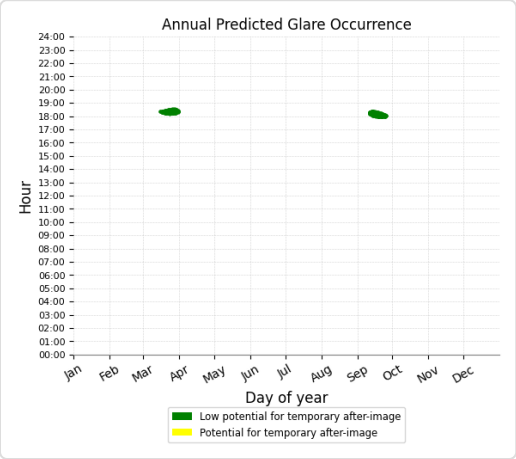
0 minutes of yellow glare
232 minutes of green glare

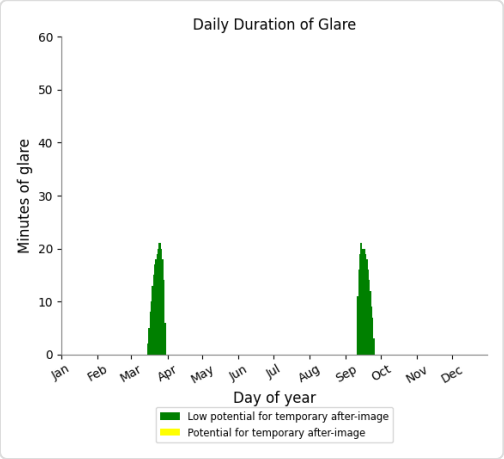




Point Receptor: OP 5

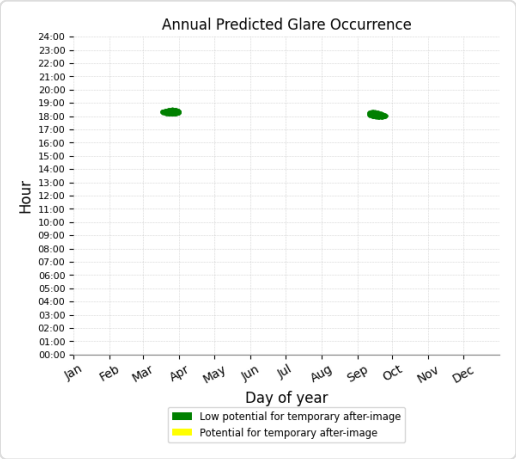
0 minutes of yellow glare
452 minutes of green glare

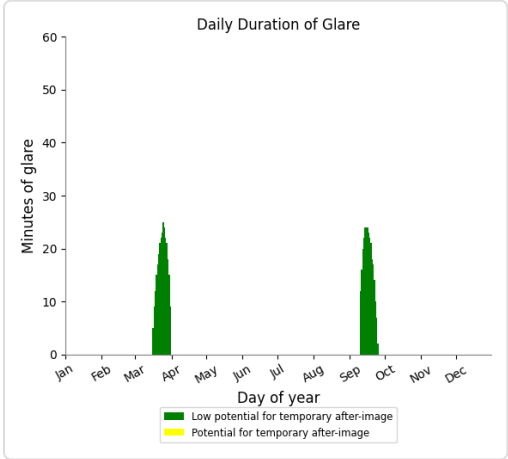




Point Receptor: OP 6

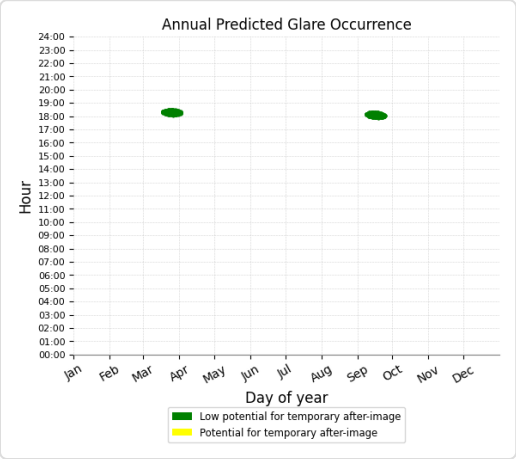
0 minutes of yellow glare
553 minutes of green glare

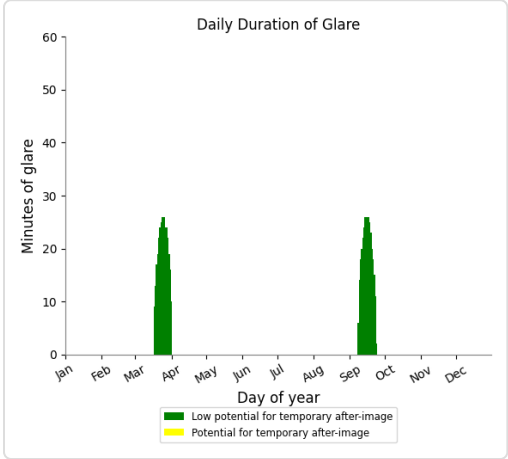




Point Receptor: OP 7

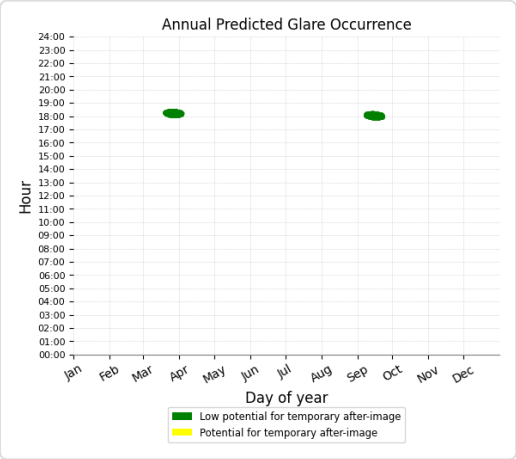
0 minutes of yellow glare
644 minutes of green glare

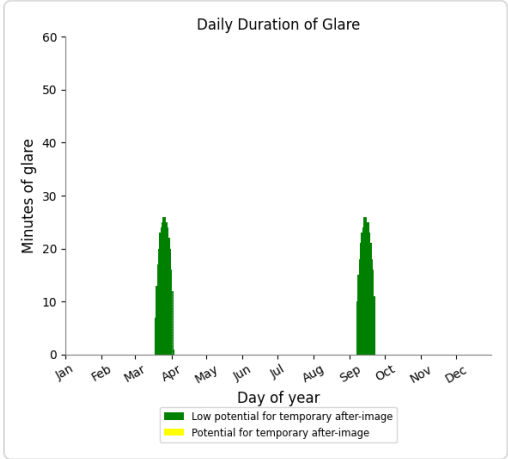




Point Receptor: OP 8

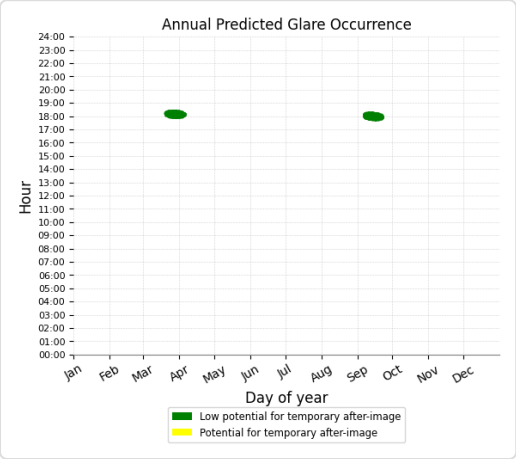
0 minutes of yellow glare
655 minutes of green glare

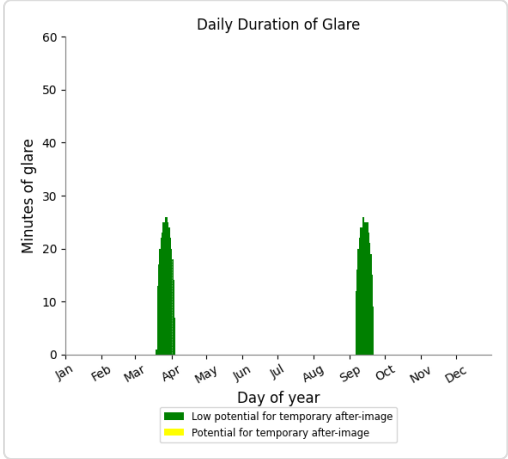




Point Receptor: OP 9

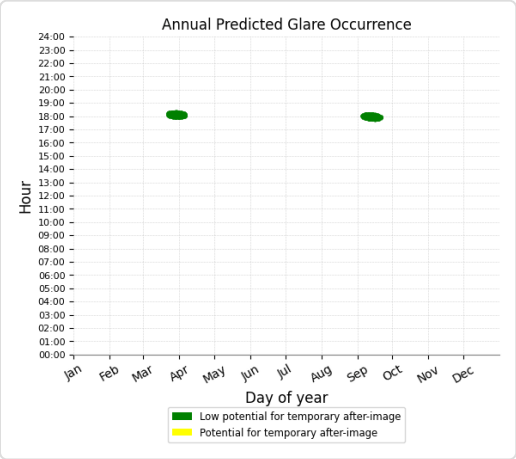
0 minutes of yellow glare
660 minutes of green glare

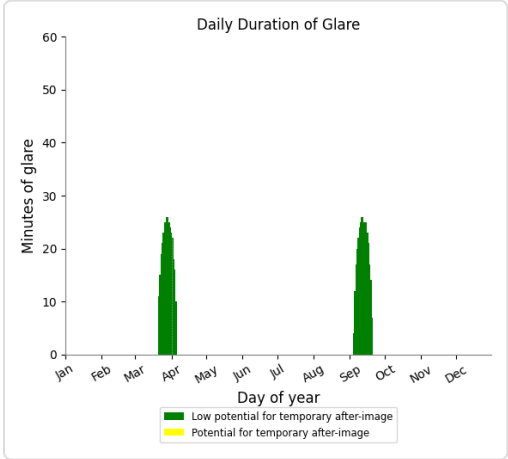




Point Receptor: OP 10

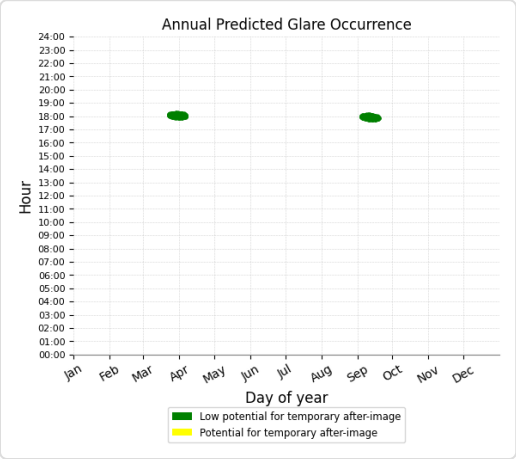
0 minutes of yellow glare
662 minutes of green glare

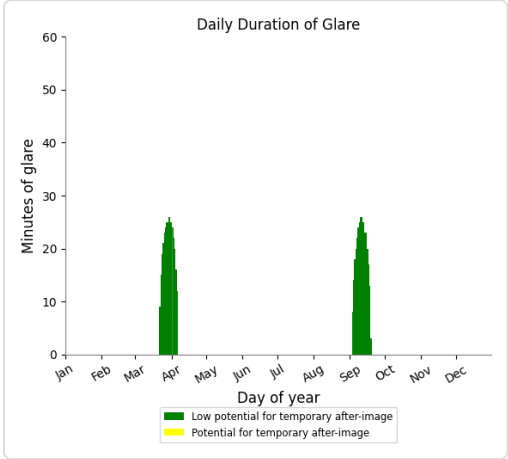




Point Receptor: OP 11

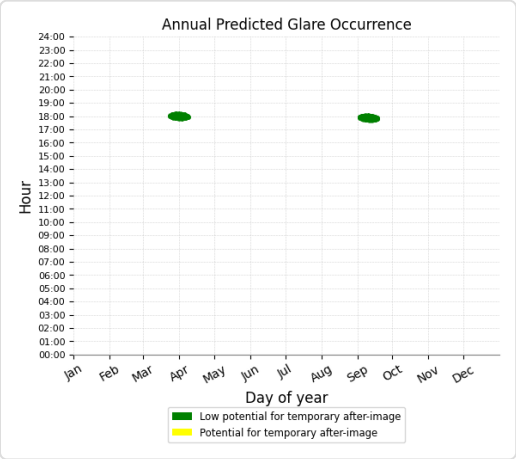
0 minutes of yellow glare
663 minutes of green glare

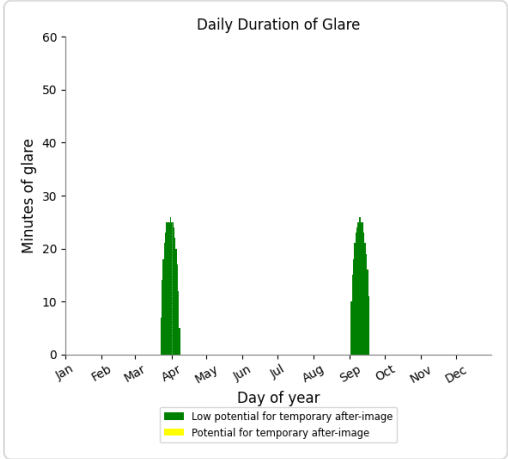




Point Receptor: OP 12

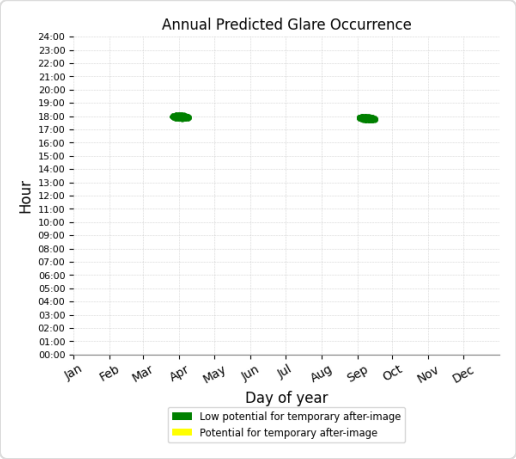
0 minutes of yellow glare
662 minutes of green glare

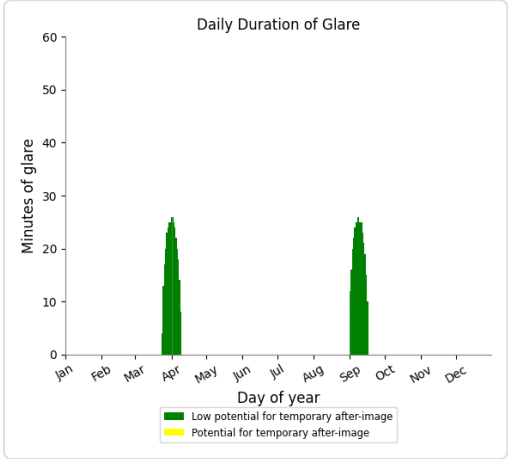




Point Receptor: OP 13

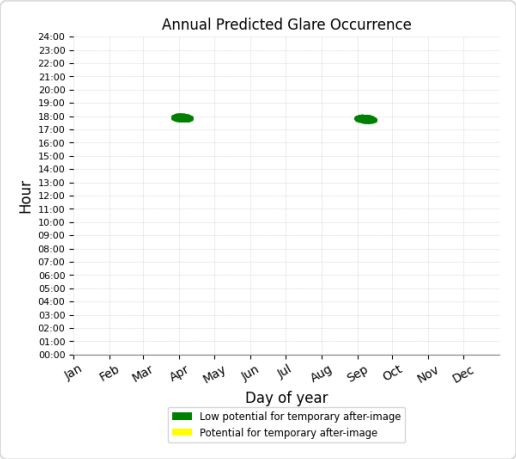
0 minutes of yellow glare
667 minutes of green glare

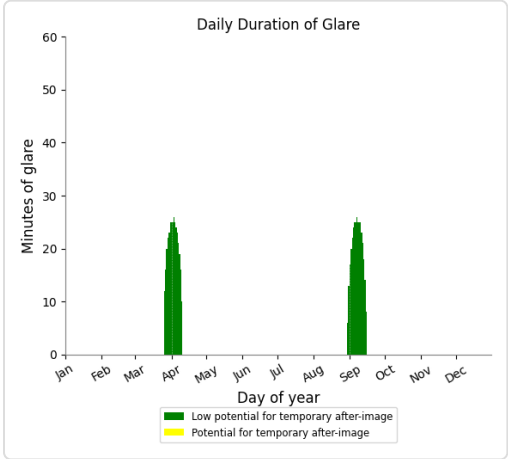




Point Receptor: OP 14

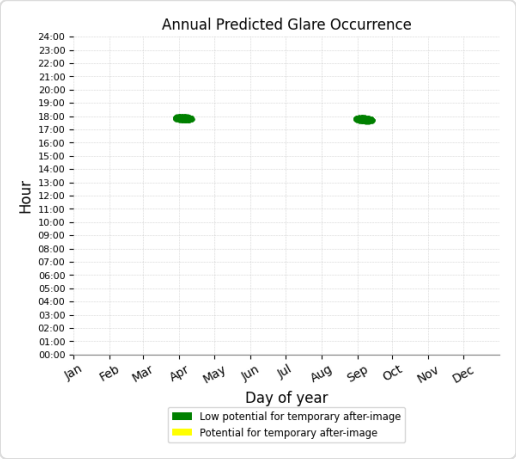
0 minutes of yellow glare
669 minutes of green glare

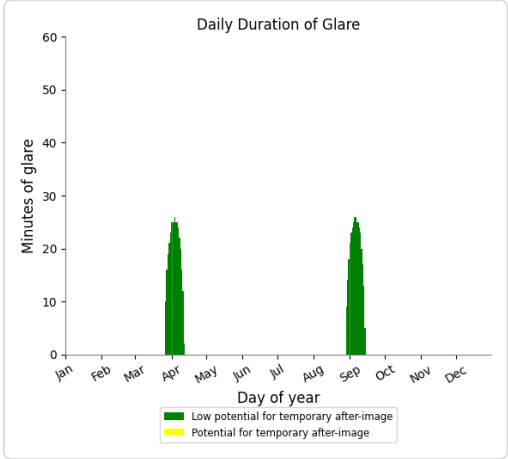




Point Receptor: OP 15

0 minutes of yellow glare
674 minutes of green glare





Results for: Block C

Receptor	Green Glare (min)	Yellow Glare (min)
10L Runway	0	0
10 Runway	0	0
16 Runway	0	0
28R Runway	0	0
28 Runway	1578	0
34 Runway	5697	0
1-ATCT	0	0
2-ATCT	0	0
OP 3	395	0
OP 4	370	0
OP 5	567	0
OP 6	707	0
OP 7	806	0
OP 8	820	0
OP 9	844	0
OP 10	866	0
OP 11	892	0
OP 12	922	0
OP 13	951	0
OP 14	987	0
OP 15	1025	0

Flight Path: 10L Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: 10 Runway

0 minutes of yellow glare
0 minutes of green glare

Flight Path: 16 Runway

0 minutes of yellow glare
0 minutes of green glare

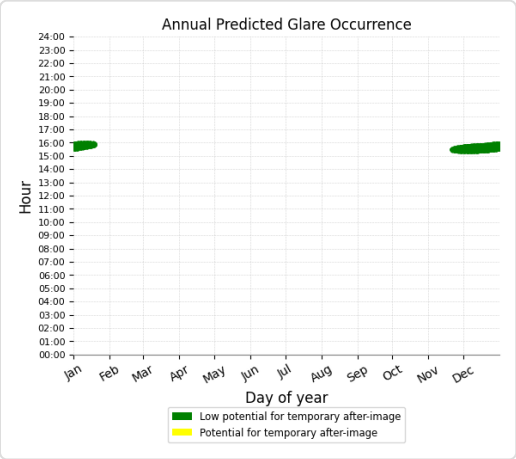
Flight Path: 28R Runway

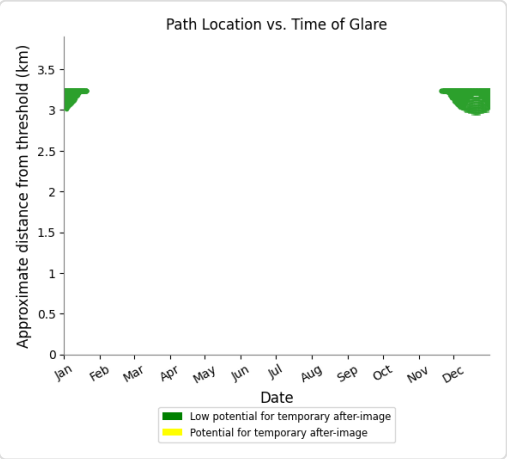
0 minutes of yellow glare
0 minutes of green glare

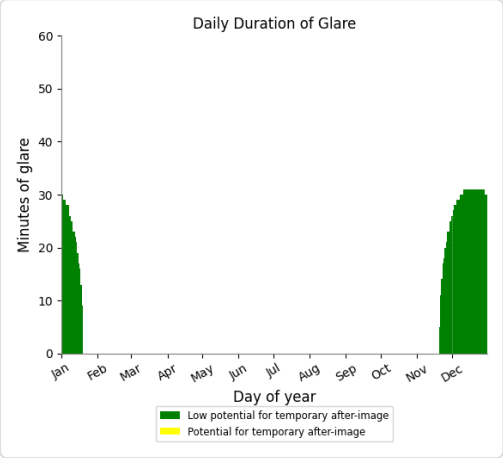
Flight Path: 28 Runway

0 minutes of yellow glare

1578 minutes of green glare



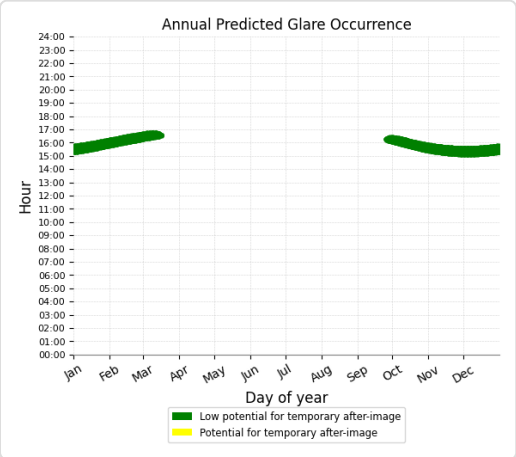


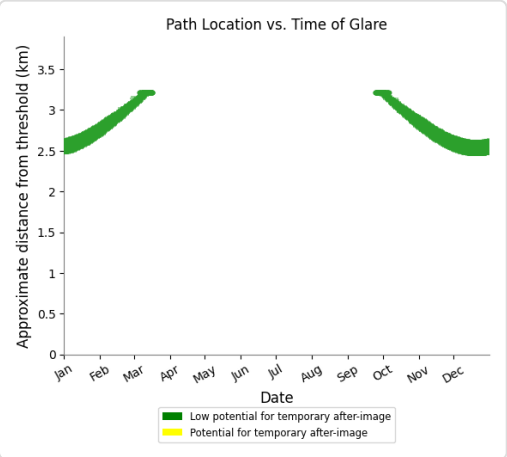


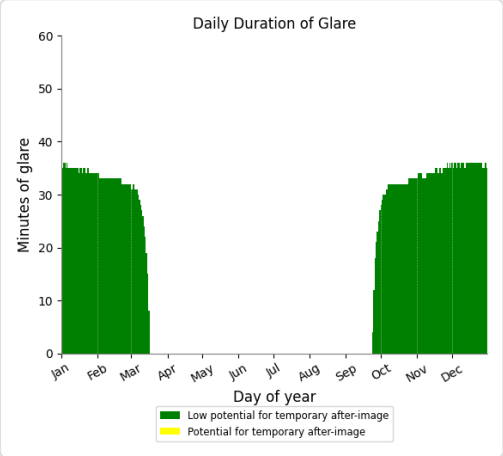
Flight Path: 34 Runway

0 minutes of yellow glare

5697 minutes of green glare







Point Receptor: 1-ATCT

0 minutes of yellow glare

0 minutes of green glare

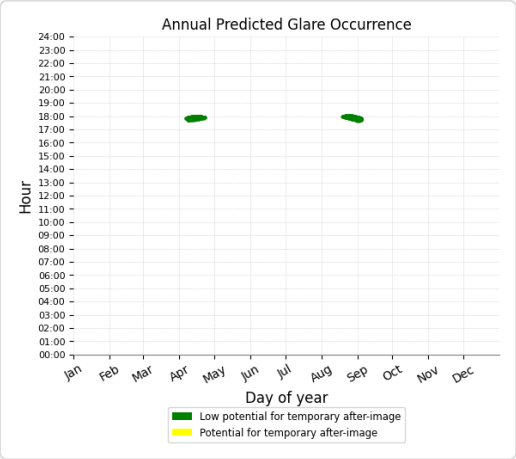
Point Receptor: 2-ATCT

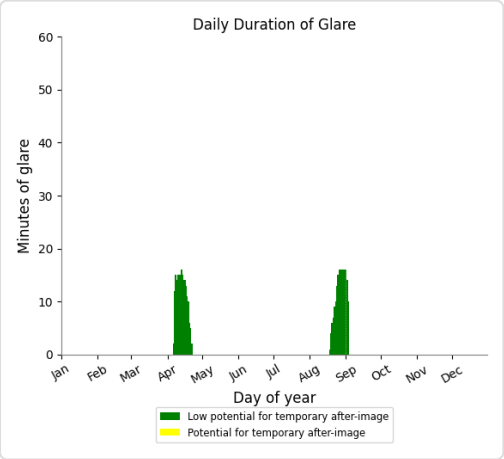
0 minutes of yellow glare

0 minutes of green glare

Point Receptor: OP 3

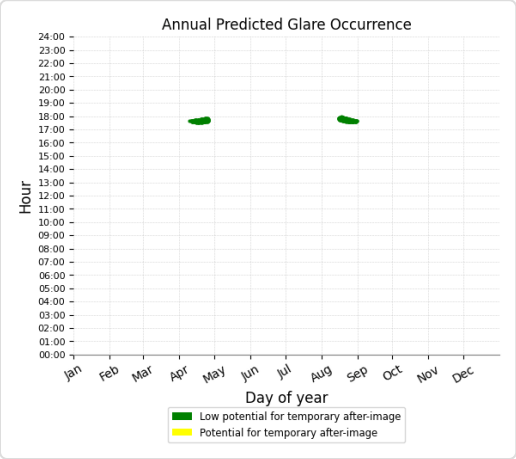
0 minutes of yellow glare
395 minutes of green glare

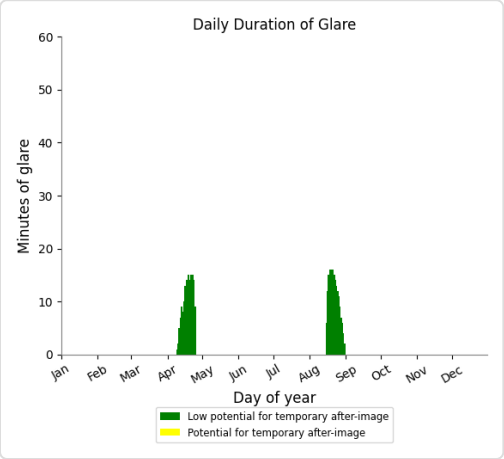




Point Receptor: OP 4

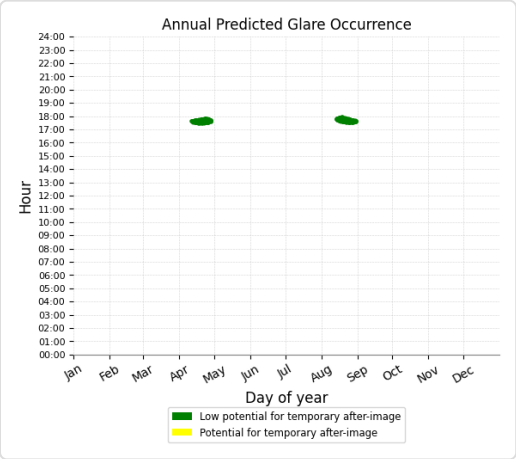
0 minutes of yellow glare
370 minutes of green glare

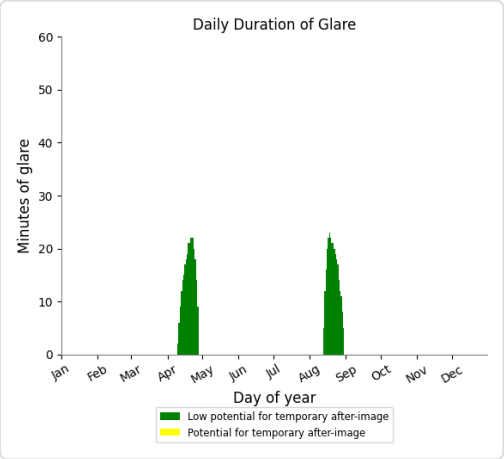




Point Receptor: OP 5

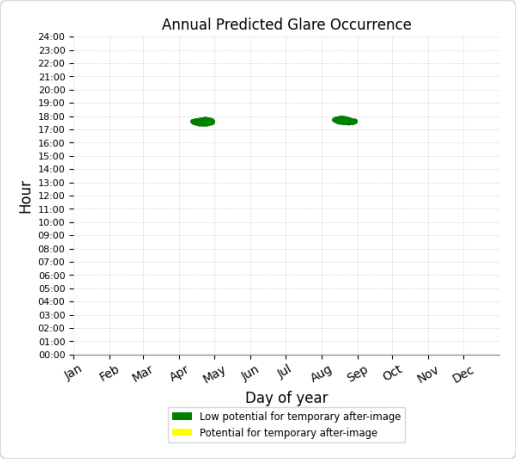
0 minutes of yellow glare
567 minutes of green glare

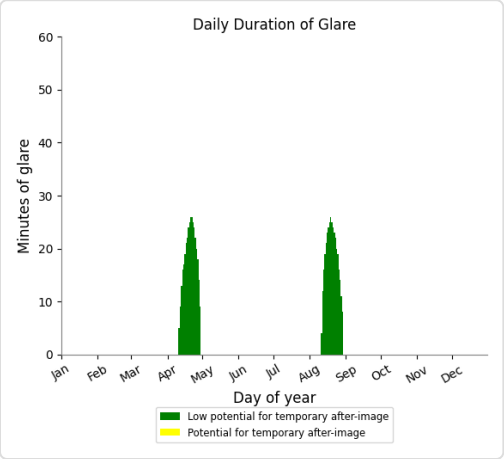




Point Receptor: OP 6

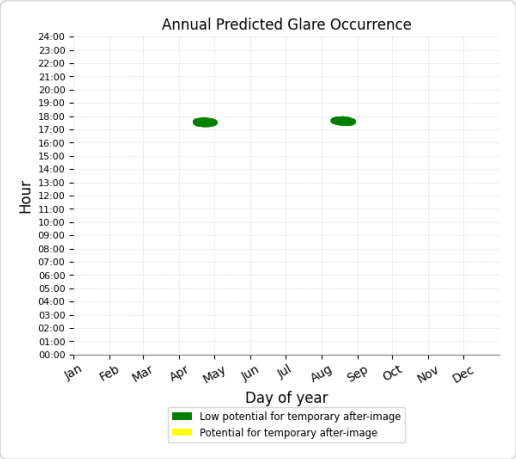
0 minutes of yellow glare
707 minutes of green glare

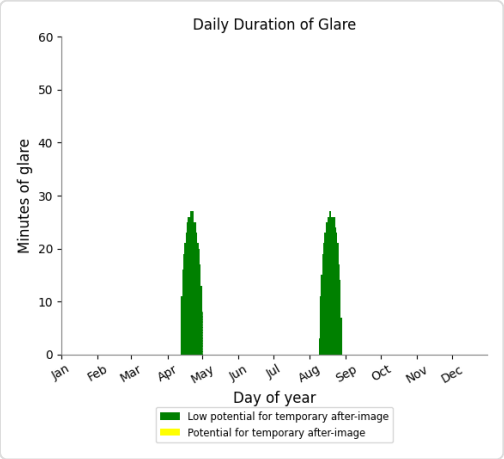




Point Receptor: OP 7

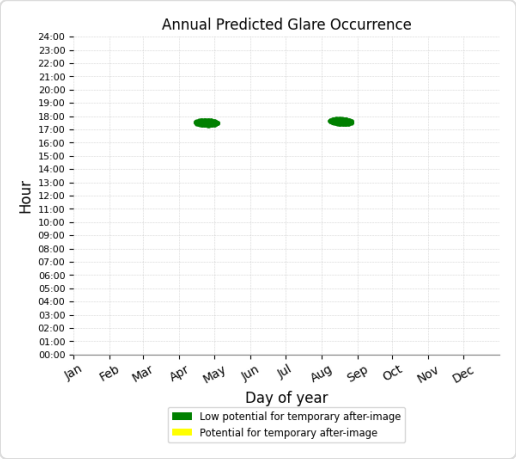
0 minutes of yellow glare
806 minutes of green glare

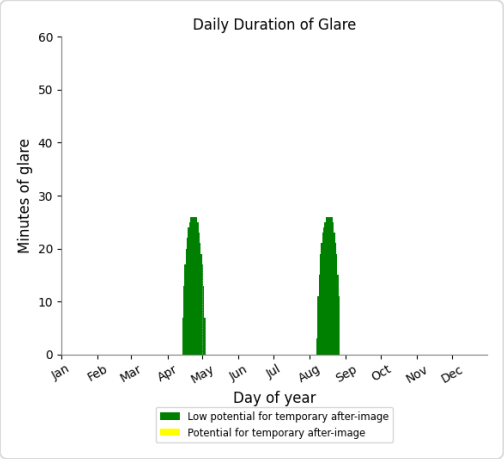




Point Receptor: OP 8

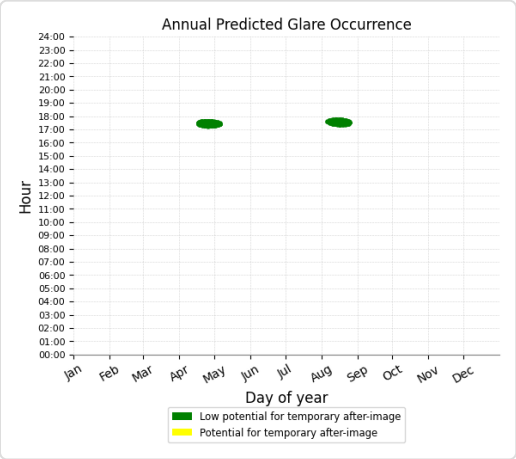
0 minutes of yellow glare
820 minutes of green glare

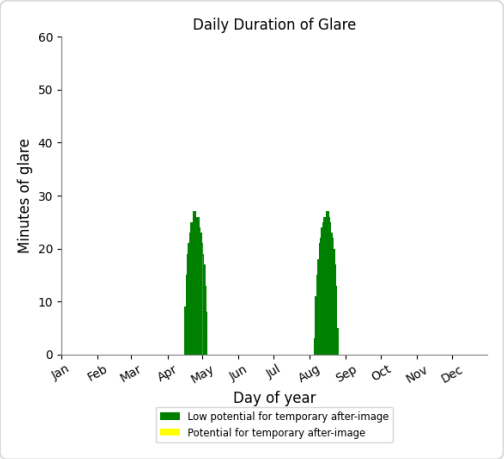




Point Receptor: OP 9

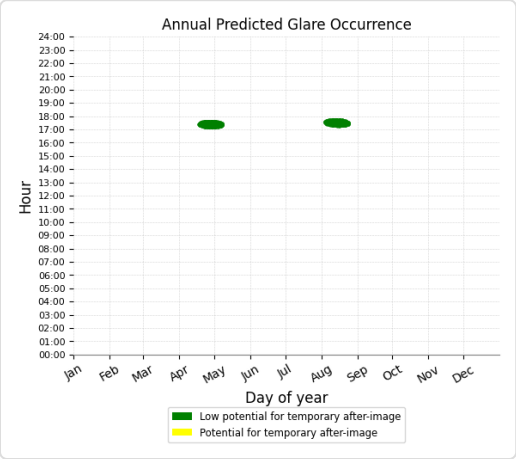
0 minutes of yellow glare
844 minutes of green glare

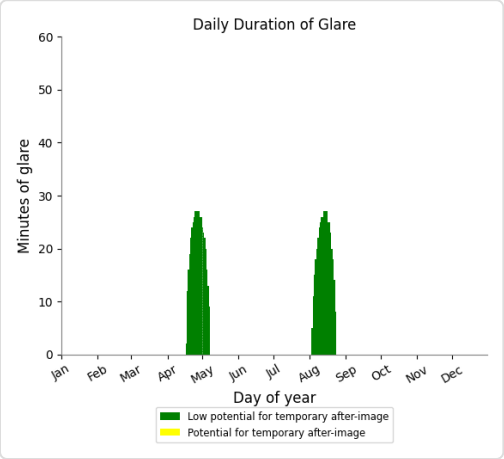




Point Receptor: OP 10

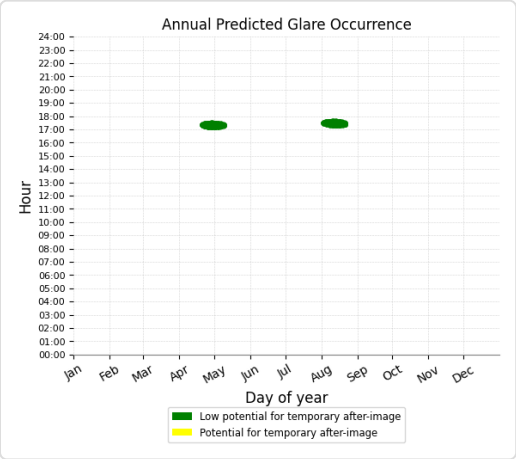
0 minutes of yellow glare
866 minutes of green glare

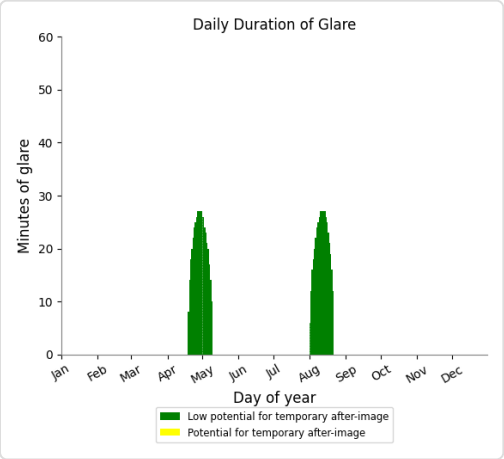




Point Receptor: OP 11

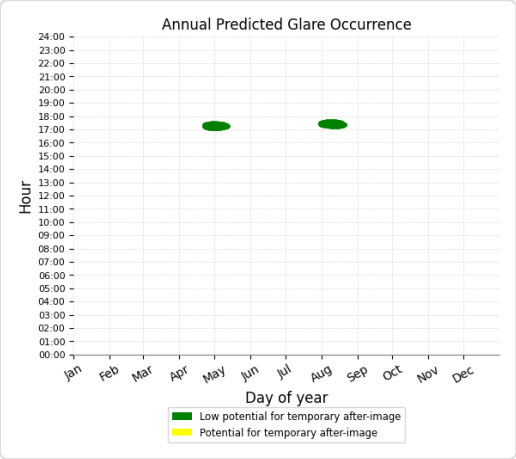
0 minutes of yellow glare
892 minutes of green glare

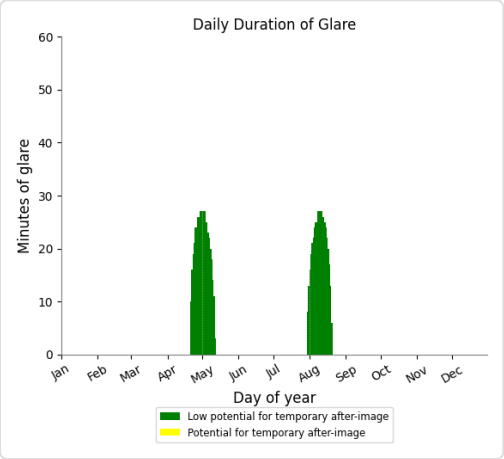




Point Receptor: OP 12

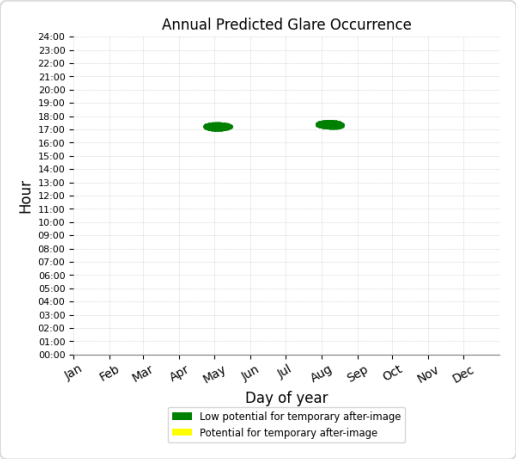
0 minutes of yellow glare
922 minutes of green glare

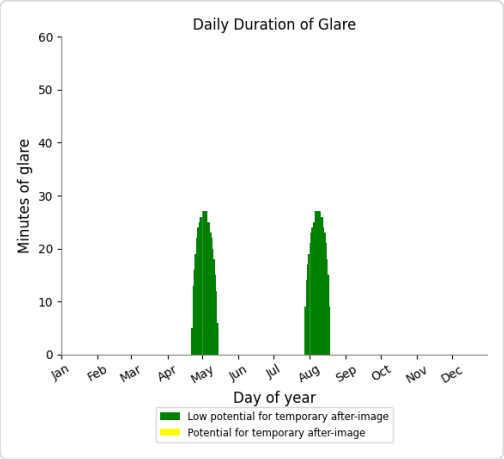




Point Receptor: OP 13

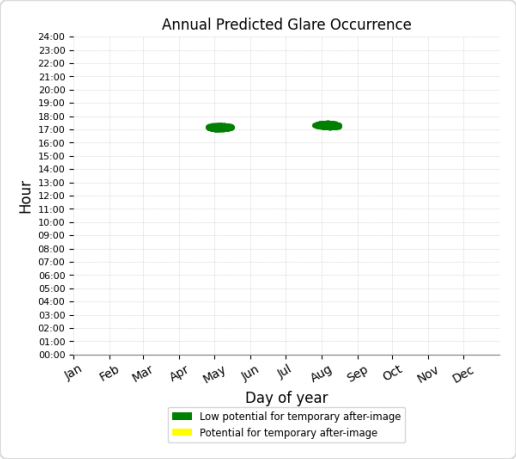
0 minutes of yellow glare
951 minutes of green glare

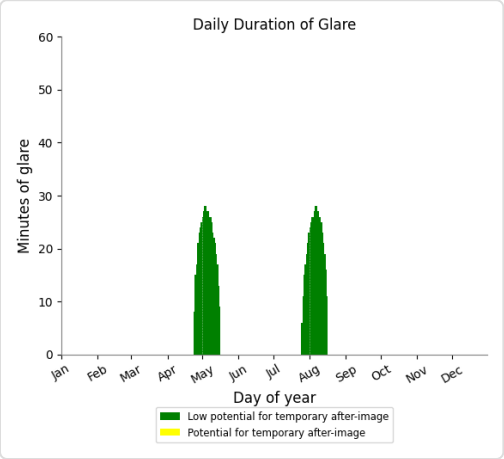




Point Receptor: OP 14

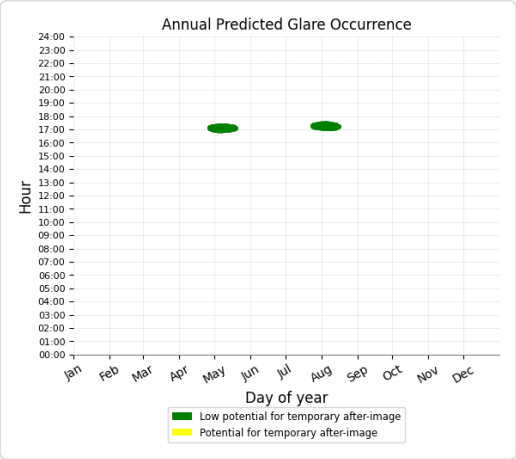
0 minutes of yellow glare
987 minutes of green glare

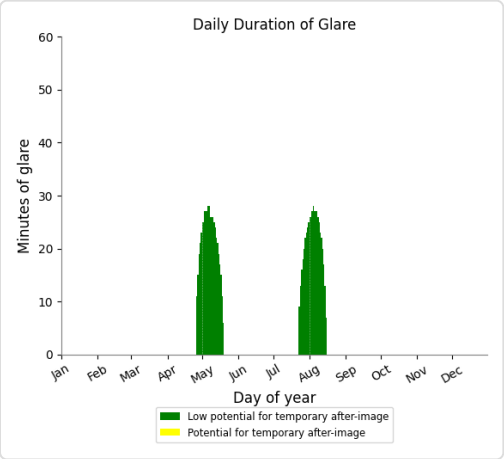




Point Receptor: OP 15

0 minutes of yellow glare
1025 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.

ForgeSolar

Optimization Results

Block A

PV configurations in optimization: 18
Orientation (deg) range: 175 to 185 in intervals of 5
Tilt angle (deg) range: 0 to 25 in intervals of 5
Created: July 18, 2024 5:49 a.m.
Completed: July 18, 2024 5:50 a.m.

Flight path receptors: 6
Route receptors: 0
Observation point receptors: 15
ATCT-specific OP receptors: 2

Note: OPs must be marked as "ATCT" to be included in FAA summary

FAA 2013 Policy Summary Table

Pass/fail results of each optimization case pertaining to FAA policy. Percentages denote system output relative to theoretical max.
Blue: adheres to FAA policy (no glare for ATCT, only green for flight paths).
Red: Fails FAA policy

Tilt → Orient ↓	0°	5°	10°	15°	20°	25°
175°	-	-	-	-	-	-
180°	-	-	-	-	-	-
185°	-	-	-	-	-	-

Color-Coded Hazard Summary Table

Results of each optimization case colored by maximum hazard. Percentages denote system output relative to theoretical max.
Yellow: glare with potential for after-image found.
Green: glare with low potential for after-image.
Blue: no glare found.

Tilt → Orient ↓	0°	5°	10°	15°	20°	25°
175°	-	-	-	-	-	-
180°	-	-	-	-	-	-
185°	-	-	-	-	-	-

2-Mile Flight Path Glare

Case results summary for FP receptors only.

Tilt → Orient ↓	0°	5°	10°	15°	20°	25°
175°	-	-	-	-	-	-
180°	-	-	-	-	-	-
185°	-	-	-	-	-	-

Observation Point Glare

Case results summary for OP receptors, including ATCTs.

Tilt → Orient ↓	0°	5°	10°	15°	20°	25°
175°	-	-	-	-	-	-
180°	-	-	-	-	-	-
185°	-	-	-	-	-	-

ATCT Glare

Case results summary for ATCT receptor(s) only.

Tilt → Orient ↓	0°	5°	10°	15°	20°	25°
175°	-	-	-	-	-	-
180°	-	-	-	-	-	-
185°	-	-	-	-	-	-

Glare & Energy Summary

Compilation of results for each PV configuration. Hazard, minutes of glare and energy produced.

Panel Orientation	Panel Tilt	"Green" Glare	"Yellow" Glare	"Red" Glare	Energy Produced	% Max Energy
deg	deg	min	min	min	kWh	% of max
175.0	5.0	10,459	0	0	-	-
175.0	15.0	7,378	0	0	-	-
175.0	20.0	7,358	0	0	-	-
175.0	0.0	20,817	0	0	-	-
180.0	0.0	20,817	0	0	-	-
175.0	25.0	7,353	0	0	-	-

175.0	10.0	7,797	0	0	-	-
180.0	5.0	9,414	0	0	-	-
180.0	10.0	6,798	0	0	-	-
180.0	15.0	6,404	0	0	-	-
180.0	20.0	5,924	0	0	-	-
180.0	25.0	5,219	0	0	-	-
185.0	0.0	20,817	0	0	-	-
185.0	5.0	8,449	0	0	-	-
185.0	10.0	5,663	0	0	-	-
185.0	15.0	4,483	0	0	-	-
185.0	20.0	3,060	0	0	-	-
185.0	25.0	1,418	0	0	-	-

Results Per Component

Predicted minutes of worst glare per receptor.

PV Orientation	Tilt	% Max Energy	10l-ru	10-run	16-run	28r-ru	28-run	34-run	1-ATCT	2-ATCT	OP 3	OP 4	OP 5	OP 6	OP 7	OP 8	OP 9	OP 10	OP 11	OP 12	OP 13	OP 14	OP 15
175.0	5.0	-	-	-	-	-	-	3,018 green	-	-	-	303 green	455 green	560 green	648 green	671 green	680 green	676 green	681 green	683 green	691 green	693 green	700 green
175.0	15.0	-	-	-	-	-	-	-	-	-	-	286 green	456 green	566 green	653 green	674 green	678 green	679 green	680 green	673 green	677 green	677 green	679 green
175.0	20.0	-	-	-	-	-	-	-	-	-	-	274 green	461 green	567 green	656 green	672 green	672 green	678 green	677 green	673 green	680 green	676 green	672 green
175.0	0.0	-	457 green	2,953 green	-	429 green	2,516 green	7,087 green	-	-	-	270 green	427 green	541 green	628 green	673 green	678 green	680 green	683 green	693 green	695 green	701 green	706 green
180.0	0.0	-	457 green	2,953 green	-	429 green	2,516 green	7,087 green	-	-	-	270 green	427 green	541 green	628 green	673 green	678 green	680 green	683 green	693 green	695 green	701 green	706 green
175.0	25.0	-	-	-	-	-	-	-	-	-	38 green	257 green	459 green	570 green	649 green	669 green	673 green	676 green	673 green	674 green	672 green	673 green	670 green
175.0	10.0	-	-	-	-	-	-	373 green	-	-	-	298 green	457 green	571 green	651 green	675 green	675 green	675 green	679 green	680 green	687 green	686 green	690 green
180.0	5.0	-	-	-	-	-	-	2,400 green	-	-	-	54 green	390 green	515 green	609 green	667 green	674 green	673 green	680 green	684 green	685 green	691 green	692 green
180.0	10.0	-	-	-	-	-	-	63 green	-	-	-	-	323 green	463 green	563 green	646 green	673 green	672 green	673 green	679 green	678 green	682 green	683 green
180.0	15.0	-	-	-	-	-	-	-	-	-	-	-	237 green	392 green	494 green	585 green	652 green	674 green	678 green	671 green	673 green	672 green	676 green
180.0	20.0	-	-	-	-	-	-	-	-	-	-	-	108 green	323 green	408 green	495 green	578 green	632 green	674 green	679 green	675 green	676 green	676 green
180.0	25.0	-	-	-	-	-	-	-	-	-	-	-	-	242 green	324 green	394 green	465 green	530 green	589 green	641 green	674 green	683 green	677 green
185.0	0.0	-	457 green	2,953 green	-	429 green	2,516 green	7,087 green	-	-	-	270 green	427 green	541 green	628 green	673 green	678 green	680 green	683 green	693 green	695 green	701 green	706 green
185.0	5.0	-	-	-	-	-	-	1,809 green	-	-	-	-	277 green	432 green	540 green	631 green	673 green	678 green	676 green	685 green	678 green	688 green	682 green
185.0	10.0	-	-	-	-	-	-	-	-	-	-	-	-	251 green	358 green	464 green	564 green	643 green	672 green	678 green	678 green	676 green	679 green
185.0	15.0	-	-	-	-	-	-	-	-	-	-	-	-	-	175 green	267 green	373 green	467 green	561 green	630 green	673 green	672 green	665 green
185.0	20.0	-	-	-	-	-	-	-	-	-	-	-	-	-	32 green	93 green	174 green	254 green	341 green	429 green	513 green	581 green	643 green
185.0	25.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25 green	68 green	130 green	193 green	262 green	335 green	405 green

Other Settings

DNI: **varies (1,000.0 W/m^2 peak)**
Ocular transmission coefficient: **0.5**
Pupil diameter: **0.002 m**
Eye focal length: **0.017 m**
Sun subtended angle: **9.3 mrad**

Analysis Methodology: **Version 2**
Enhanced subtended angle calculation: **On**

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 geographic obstructions.
- Detailed system geometry is not rigorously simulated.
- The glare hazard determination relies on several approximations including observer eye characteristics, angle of view, and typical blink response time. Actual values and results may vary.
- The system output calculation is a DNI-based approximation that assumes clear, sunny skies year-round. It should not be used in place of more rigorous modeling methods.
- Several calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expect 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 tha 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.)
- 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.
- 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.
- Refer to the **Help page** for assumptions and limitations not listed here.

ForgeSolar

Optimization Results

Block B

PV configurations in optimization: 18
Orientation (deg) range: 175 to 185 in intervals of 5
Tilt angle (deg) range: 0 to 25 in intervals of 5
Created: July 18, 2024 5:49 a.m.
Completed: July 18, 2024 5:51 a.m.

Flight path receptors: 6
Route receptors: 0
Observation point receptors: 15
ATCT-specific OP receptors: 2

Note: OPs must be marked as "ATCT" to be included in FAA summary

FAA 2013 Policy Summary Table

Pass/fail results of each optimization case pertaining to FAA policy. Percentages denote system output relative to theoretical max.
Blue: adheres to FAA policy (no glare for ATCT, only green for flight paths).
Red: Fails FAA policy

Tilt → Orient ↓	0°	5°	10°	15°	20°	25°
175°	-	-	-	-	-	-
180°	-	-	-	-	-	-
185°	-	-	-	-	-	-

Color-Coded Hazard Summary Table

Results of each optimization case colored by maximum hazard. Percentages denote system output relative to theoretical max.
Yellow: glare with potential for after-image found.
Green: glare with low potential for after-image.
Blue: no glare found.

Tilt → Orient ↓	0°	5°	10°	15°	20°	25°
175°	-	-	-	-	-	-
180°	-	-	-	-	-	-
185°	-	-	-	-	-	-

2-Mile Flight Path Glare

Case results summary for FP receptors only.

Tilt → Orient ↓	0°	5°	10°	15°	20°	25°
175°	-	-	-	-	-	-
180°	-	-	-	-	-	-
185°	-	-	-	-	-	-

Observation Point Glare

Case results summary for OP receptors, including ATCTs.

Tilt → Orient ↓	0°	5°	10°	15°	20°	25°
175°	-	-	-	-	-	-
180°	-	-	-	-	-	-
185°	-	-	-	-	-	-

ATCT Glare

Case results summary for ATCT receptor(s) only.

Tilt → Orient ↓	0°	5°	10°	15°	20°	25°
175°	-	-	-	-	-	-
180°	-	-	-	-	-	-
185°	-	-	-	-	-	-

Glare & Energy Summary

Compilation of results for each PV configuration. Hazard, minutes of glare and energy produced.

Panel Orientation	Panel Tilt	"Green" Glare	"Yellow" Glare	"Red" Glare	Energy Produced	% Max Energy
deg	deg	min	min	min	kWh	% of max
175.0	0.0	20,993	0	0	-	-
175.0	5.0	10,759	0	0	-	-
175.0	10.0	7,857	0	0	-	-
175.0	20.0	7,332	0	0	-	-
175.0	15.0	7,351	0	0	-	-
180.0	0.0	20,993	0	0	-	-

175.0	25.0	7,333	0	0	-	-
180.0	5.0	9,905	0	0	-	-
180.0	15.0	6,720	0	0	-	-
180.0	10.0	7,070	0	0	-	-
180.0	20.0	6,477	0	0	-	-
185.0	0.0	20,993	0	0	-	-
180.0	25.0	6,191	0	0	-	-
185.0	5.0	8,853	0	0	-	-
185.0	10.0	6,051	0	0	-	-
185.0	15.0	5,238	0	0	-	-
185.0	20.0	4,195	0	0	-	-
185.0	25.0	2,806	0	0	-	-

Results Per Component

Predicted minutes of worst glare per receptor.

PV Orientation	Tilt	% Max Energy	10l-ru	10-run	16-run	28r-ru	28-run	34-run	1-ATCT	2-ATCT	OP 3	OP 4	OP 5	OP 6	OP 7	OP 8	OP 9	OP 10	OP 11	OP 12	OP 13	OP 14	OP 15
175.0	0.0	-	653 green	3,012 green	-	356 green	2,473 green	7,202 green	-	-	-	284 green	425 green	548 green	633 green	655 green	662 green	666 green	674 green	680 green	684 green	688 green	698 green
175.0	5.0	-	-	-	-	-	-	3,362 green	-	-	-	324 green	462 green	577 green	651 green	658 green	664 green	661 green	669 green	678 green	678 green	685 green	690 green
175.0	10.0	-	-	-	-	-	-	493 green	-	-	-	327 green	467 green	579 green	655 green	656 green	665 green	661 green	667 green	669 green	670 green	674 green	674 green
175.0	20.0	-	-	-	-	-	-	-	-	-	55 green	321 green	469 green	578 green	646 green	650 green	657 green	657 green	658 green	662 green	658 green	663 green	658 green
175.0	15.0	-	-	-	-	-	-	-	-	-	19 green	319 green	470 green	580 green	654 green	659 green	657 green	659 green	665 green	661 green	671 green	671 green	666 green
180.0	0.0	-	653 green	3,012 green	-	356 green	2,473 green	7,202 green	-	-	-	284 green	425 green	548 green	633 green	655 green	662 green	666 green	674 green	680 green	684 green	688 green	698 green
175.0	25.0	-	-	-	-	-	-	-	-	-	84 green	316 green	463 green	576 green	651 green	653 green	657 green	657 green	653 green	655 green	664 green	654 green	650 green
180.0	5.0	-	-	-	-	-	-	2,750 green	-	-	-	223 green	412 green	535 green	625 green	656 green	662 green	665 green	667 green	672 green	673 green	682 green	683 green
180.0	15.0	-	-	-	-	-	-	-	-	-	-	39 green	352 green	490 green	586 green	653 green	653 green	651 green	658 green	657 green	661 green	662 green	658 green
180.0	10.0	-	-	-	-	-	-	131 green	-	-	-	120 green	389 green	521 green	617 green	654 green	660 green	659 green	662 green	660 green	667 green	664 green	666 green
180.0	20.0	-	-	-	-	-	-	-	-	-	-	-	292 green	452 green	541 green	614 green	656 green	654 green	653 green	653 green	653 green	655 green	654 green
185.0	0.0	-	653 green	3,012 green	-	356 green	2,473 green	7,202 green	-	-	-	284 green	425 green	548 green	633 green	655 green	662 green	666 green	674 green	680 green	684 green	688 green	698 green
180.0	25.0	-	-	-	-	-	-	-	-	-	-	-	225 green	397 green	486 green	551 green	612 green	649 green	652 green	654 green	658 green	652 green	655 green
185.0	5.0	-	-	-	-	-	-	2,152 green	-	-	-	-	322 green	477 green	582 green	649 green	656 green	661 green	664 green	668 green	669 green	674 green	679 green
185.0	10.0	-	-	-	-	-	-	-	-	-	-	-	123 green	341 green	451 green	547 green	632 green	656 green	658 green	659 green	660 green	661 green	663 green
185.0	15.0	-	-	-	-	-	-	-	-	-	-	-	-	188 green	297 green	400 green	492 green	581 green	648 green	662 green	651 green	659 green	660 green
185.0	20.0	-	-	-	-	-	-	-	-	-	-	-	-	20 green	156 green	239 green	329 green	421 green	503 green	585 green	636 green	654 green	652 green
185.0	25.0	-	-	-	-	-	-	-	-	-	-	-	-	-	42 green	94 green	165 green	234 green	310 green	383 green	465 green	526 green	587 green

Other Settings

DNI: **varies (1,000.0 W/m^2 peak)**
Ocular transmission coefficient: **0.5**
Pupil diameter: **0.002 m**
Eye focal length: **0.017 m**
Sun subtended angle: **9.3 mrad**

Analysis Methodology: **Version 2**
Enhanced subtended angle calculation: **On**

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 geographic obstructions.
- Detailed system geometry is not rigorously simulated.
- The glare hazard determination relies on several approximations including observer eye characteristics, angle of view, and typical blink response time. Actual values and results may vary.
- The system output calculation is a DNI-based approximation that assumes clear, sunny skies year-round. It should not be used in place of more rigorous modeling methods.
- Several calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results for large PV footprints. Additional analyses of array sub-sections can provide additional information on expect 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 tha 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.)
- 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.
- 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.
- Refer to the **Help page** for assumptions and limitations not listed here.

ForgeSolar

Optimization Results

Block C

PV configurations in optimization: 18
Orientation (deg) range: 175 to 185 in intervals of 5
Tilt angle (deg) range: 0 to 25 in intervals of 5
Created: July 18, 2024 5:50 a.m.
Completed: July 18, 2024 5:52 a.m.

Flight path receptors: 6
Route receptors: 0
Observation point receptors: 15
ATCT-specific OP receptors: 2

Note: OPs must be marked as "ATCT" to be included in FAA summary

FAA 2013 Policy Summary Table

Pass/fail results of each optimization case pertaining to FAA policy. Percentages denote system output relative to theoretical max.
Blue: adheres to FAA policy (no glare for ATCT, only green for flight paths).
Red: Fails FAA policy

Tilt → Orient ↓	0°	5°	10°	15°	20°	25°
175°	-	-	-	-	-	-
180°	-	-	-	-	-	-
185°	-	-	-	-	-	-

Color-Coded Hazard Summary Table

Results of each optimization case colored by maximum hazard. Percentages denote system output relative to theoretical max.
Yellow: glare with potential for after-image found.
Green: glare with low potential for after-image.
Blue: no glare found.

Tilt → Orient ↓	0°	5°	10°	15°	20°	25°
175°	-	-	-	-	-	-
180°	-	-	-	-	-	-
185°	-	-	-	-	-	-

2-Mile Flight Path Glare

Case results summary for FP receptors only.

Tilt → Orient ↓	0°	5°	10°	15°	20°	25°
175°	-	-	-	-	-	-
180°	-	-	-	-	-	-
185°	-	-	-	-	-	-

Observation Point Glare

Case results summary for OP receptors, including ATCTs.

Tilt → Orient ↓	0°	5°	10°	15°	20°	25°
175°	-	-	-	-	-	-
180°	-	-	-	-	-	-
185°	-	-	-	-	-	-

ATCT Glare

Case results summary for ATCT receptor(s) only.

Tilt → Orient ↓	0°	5°	10°	15°	20°	25°
175°	-	-	-	-	-	-
180°	-	-	-	-	-	-
185°	-	-	-	-	-	-

Glare & Energy Summary

Compilation of results for each PV configuration. Hazard, minutes of glare and energy produced.

Panel Orientation	Panel Tilt	"Green" Glare	"Yellow" Glare	"Red" Glare	Energy Produced	% Max Energy
deg	deg	min	min	min	kWh	% of max
175.0	0.0	21,215	0	0	-	-
175.0	5.0	11,240	0	0	-	-
175.0	10.0	8,183	0	0	-	-
175.0	15.0	7,638	0	0	-	-
175.0	20.0	7,633	0	0	-	-
175.0	25.0	7,625	0	0	-	-

180.0	0.0	21,215	0	0	-	-
180.0	15.0	7,140	0	0	-	-
180.0	10.0	7,456	0	0	-	-
180.0	20.0	6,976	0	0	-	-
180.0	5.0	10,419	0	0	-	-
185.0	0.0	21,215	0	0	-	-
185.0	5.0	9,364	0	0	-	-
185.0	10.0	6,473	0	0	-	-
185.0	15.0	5,742	0	0	-	-
180.0	25.0	6,772	0	0	-	-
185.0	20.0	4,934	0	0	-	-
185.0	25.0	3,698	0	0	-	-

Results Per Component

Predicted minutes of worst glare per receptor.

PV Orientation	Tilt	% Max Energy	10l-ru	10-run	16-run	28r-ru	28-run	34-run	1-ATCT	2-ATCT	OP 3	OP 4	OP 5	OP 6	OP 7	OP 8	OP 9	OP 10	OP 11	OP 12	OP 13	OP 14	OP 15
175.0	0.0	-	818 green	3,024 green	-	240 green	2,342 green	7,214 green	-	-	-	266 green	435 green	574 green	660 green	678 green	690 green	692 green	699 green	713 green	716 green	721 green	733 green
175.0	5.0	-	-	-	-	-	-	3,555 green	-	-	-	309 green	474 green	602 green	678 green	683 green	687 green	690 green	698 green	704 green	711 green	721 green	728 green
175.0	10.0	-	-	-	-	-	-	536 green	-	-	-	317 green	477 green	603 green	681 green	680 green	685 green	691 green	694 green	701 green	704 green	704 green	710 green
175.0	15.0	-	-	-	-	-	-	-	-	-	47 green	316 green	480 green	601 green	679 green	670 green	680 green	686 green	692 green	693 green	694 green	698 green	702 green
175.0	20.0	-	-	-	-	-	-	-	-	-	95 green	309 green	478 green	606 green	682 green	676 green	677 green	684 green	681 green	685 green	684 green	690 green	686 green
175.0	25.0	-	-	-	-	-	-	-	-	-	138 green	312 green	475 green	600 green	678 green	675 green	677 green	675 green	685 green	682 green	678 green	676 green	674 green
180.0	0.0	-	818 green	3,024 green	-	240 green	2,342 green	7,214 green	-	-	-	266 green	435 green	574 green	660 green	678 green	690 green	692 green	699 green	713 green	716 green	721 green	733 green
180.0	15.0	-	-	-	-	-	-	-	-	-	-	101 green	399 green	544 green	641 green	674 green	680 green	672 green	684 green	684 green	686 green	689 green	686 green
180.0	10.0	-	-	-	-	-	-	153 green	-	-	-	161 green	420 green	562 green	656 green	673 green	679 green	686 green	684 green	692 green	697 green	695 green	698 green
180.0	20.0	-	-	-	-	-	-	-	-	-	-	76 green	366 green	511 green	613 green	670 green	678 green	675 green	673 green	682 green	680 green	675 green	677 green
180.0	5.0	-	-	-	-	-	-	2,967 green	-	-	-	228 green	431 green	565 green	661 green	678 green	684 green	685 green	691 green	701 green	704 green	708 green	716 green
185.0	0.0	-	818 green	3,024 green	-	240 green	2,342 green	7,214 green	-	-	-	266 green	435 green	574 green	660 green	678 green	690 green	692 green	699 green	713 green	716 green	721 green	733 green
185.0	5.0	-	-	-	-	-	-	2,379 green	-	-	-	-	343 green	507 green	614 green	670 green	679 green	684 green	687 green	693 green	696 green	703 green	709 green
185.0	10.0	-	-	-	-	-	-	-	-	-	-	-	176 green	396 green	511 green	607 green	677 green	678 green	680 green	682 green	687 green	686 green	693 green
185.0	15.0	-	-	-	-	-	-	-	-	-	-	-	-	261 green	373 green	483 green	581 green	656 green	679 green	674 green	679 green	673 green	683 green
180.0	25.0	-	-	-	-	-	-	-	-	-	-	51 green	318 green	471 green	572 green	636 green	668 green	670 green	678 green	684 green	677 green	675 green	672 green
185.0	20.0	-	-	-	-	-	-	-	-	-	-	-	-	130 green	238 green	330 green	425 green	516 green	601 green	665 green	674 green	680 green	675 green
185.0	25.0	-	-	-	-	-	-	-	-	-	-	-	-	-	111 green	181 green	260 green	341 green	425 green	507 green	575 green	628 green	670 green

Other Settings

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