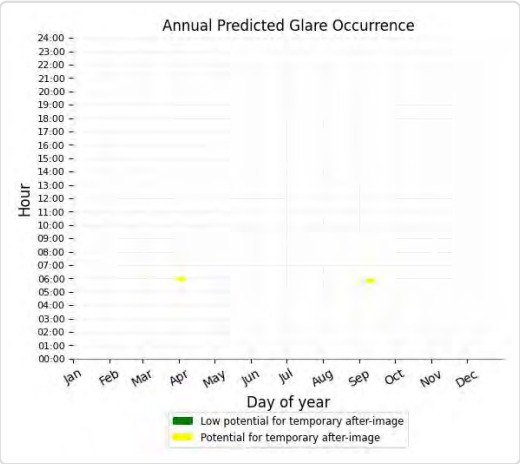
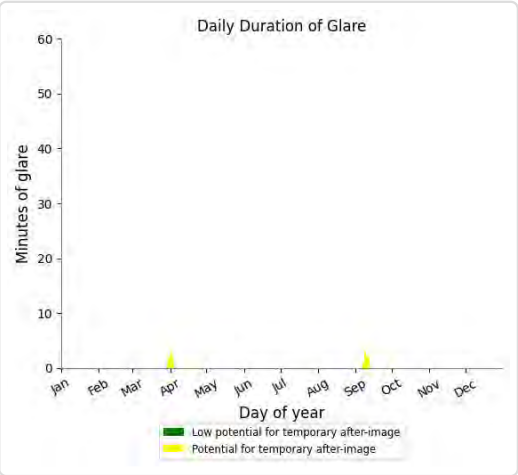
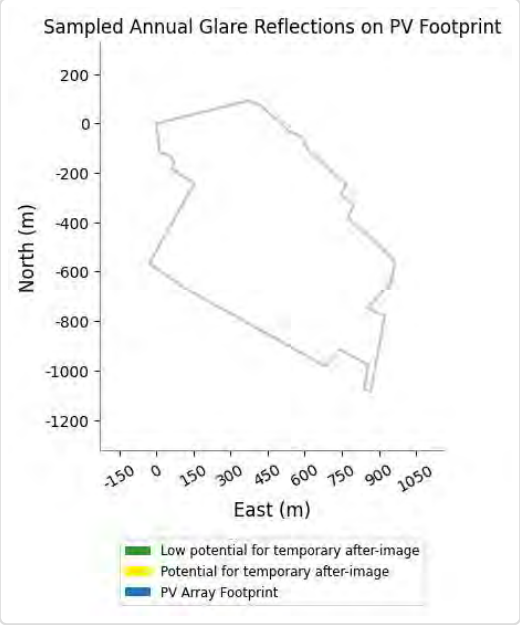
PV array 1 - OP Receptor (OP 11)

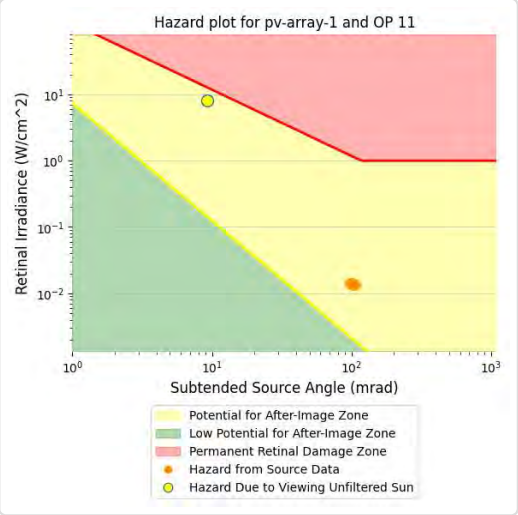
PV array is expected to produce the following glare for receptors at this location:

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









PV array 1 - OP Receptor (OP 12)

No glare found

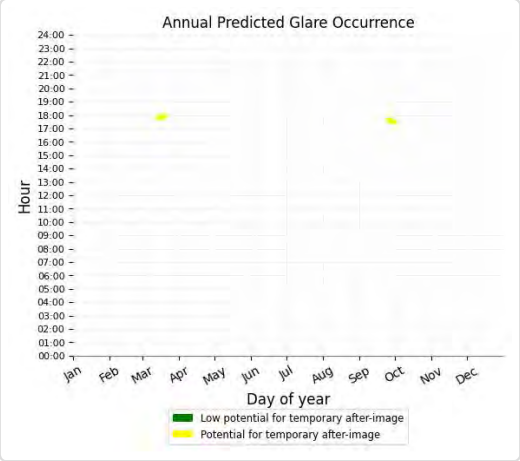
PV array 1 - OP Receptor (OP 13)

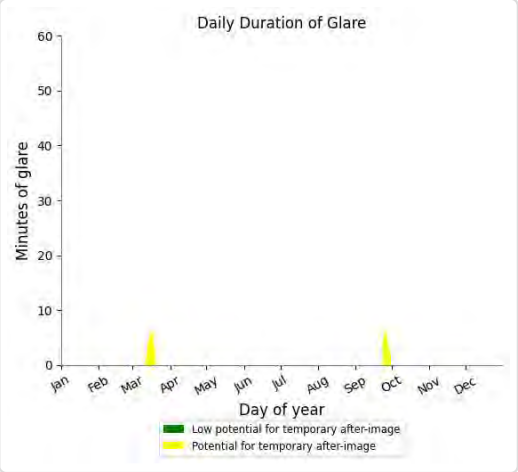
No glare found

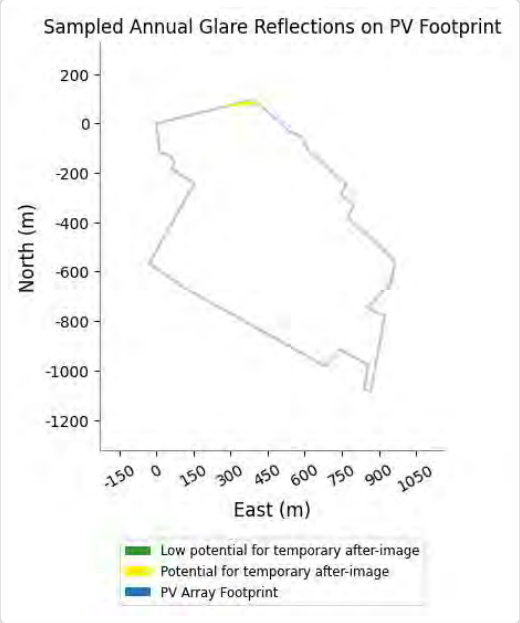
PV array 1 - OP Receptor (OP 14)

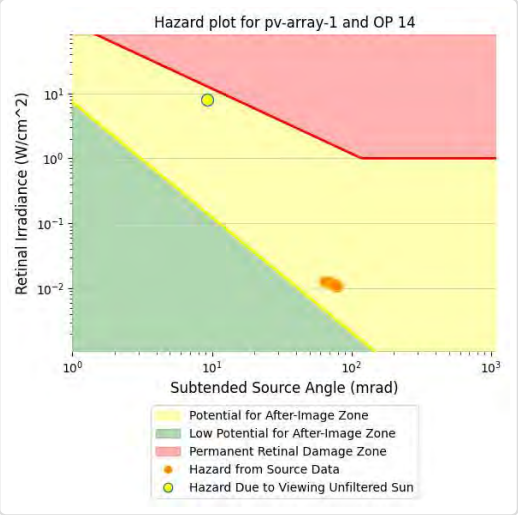
PV array is expected to produce the following glare for receptors at this location:

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





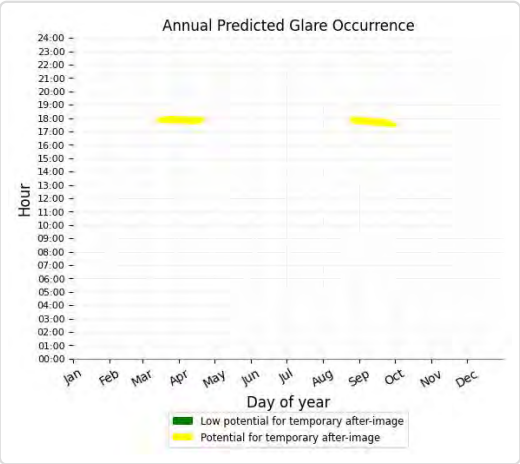


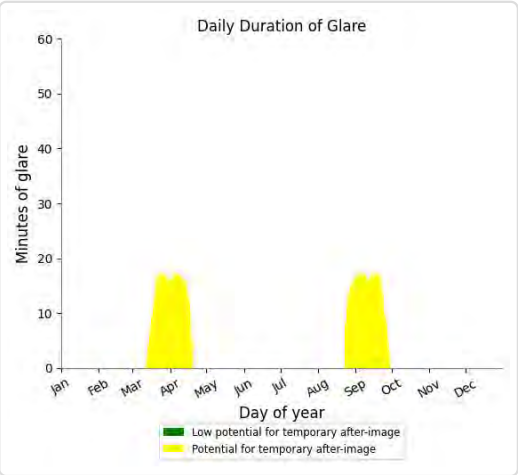


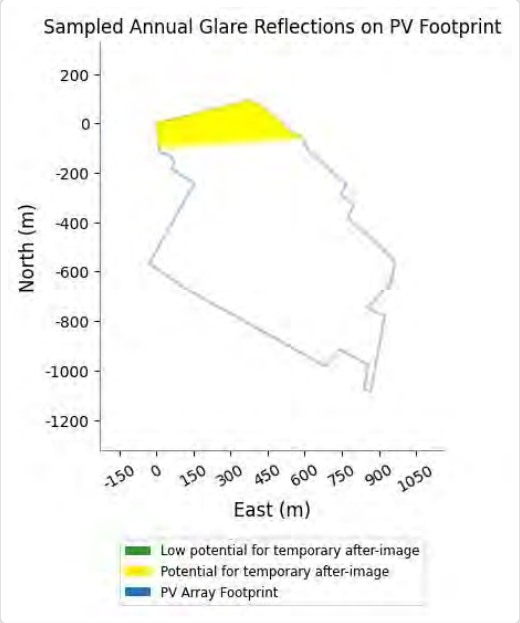
PV array 1 - OP Receptor (OP 15)

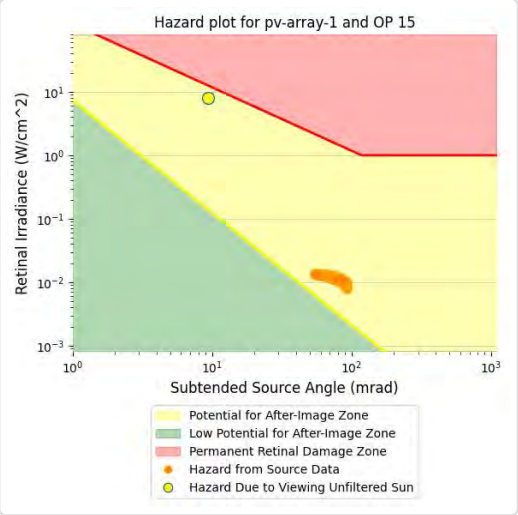
PV array is expected to produce the following glare for receptors at this location:

- 0 minutes of "green" glare with low potential to cause temporary after-image.
- 1,073 minutes of "yellow" glare with potential to cause temporary after-image.





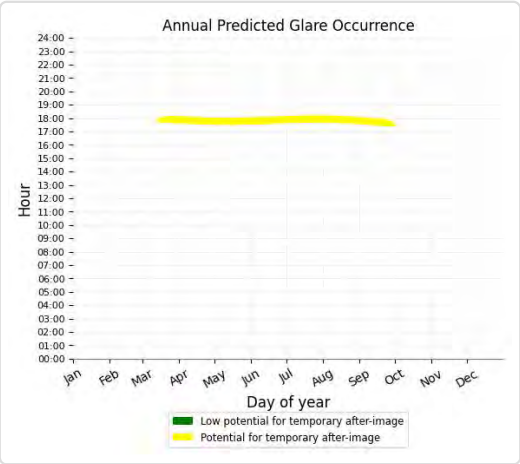


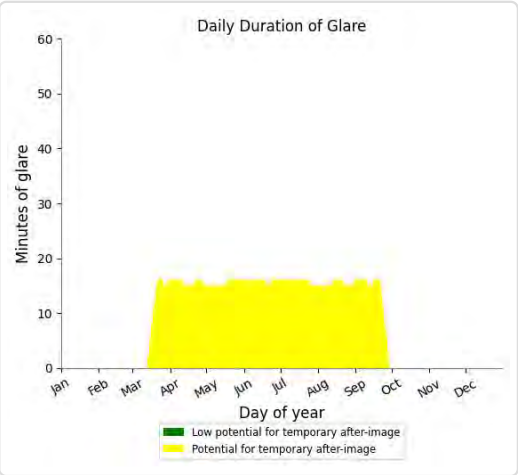


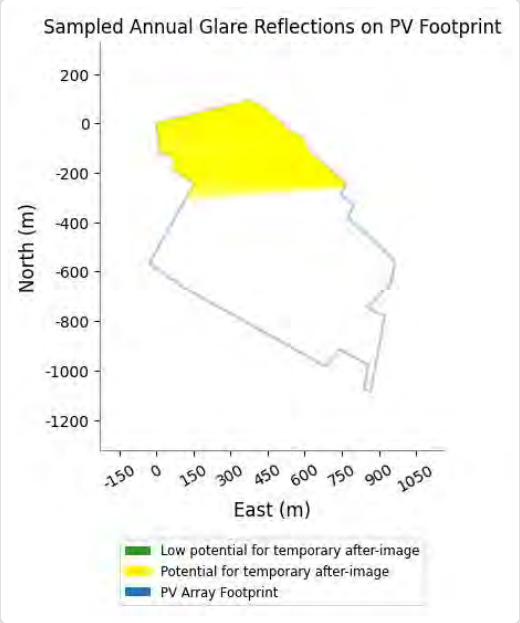
PV array 1 - OP Receptor (OP 16)

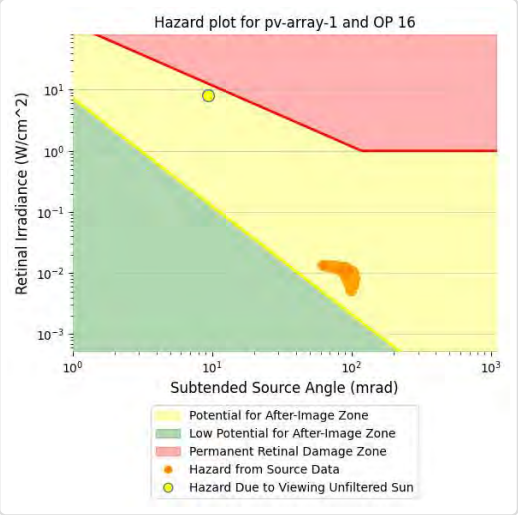
PV array is expected to produce the following glare for receptors at this location:

- 0 minutes of "green" glare with low potential to cause temporary after-image.
- 3,007 minutes of "yellow" glare with potential to cause temporary after-image.





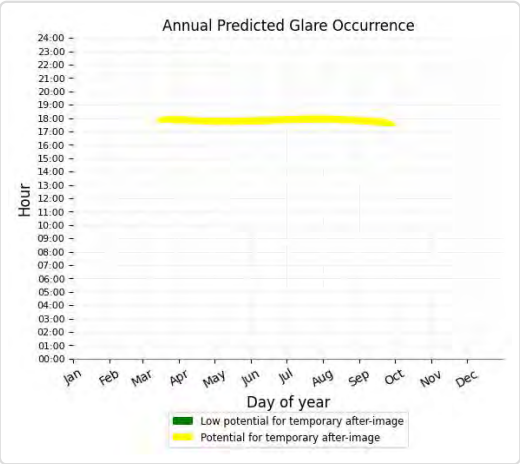


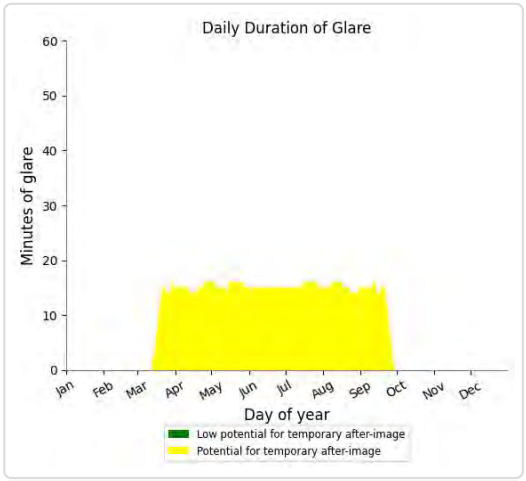


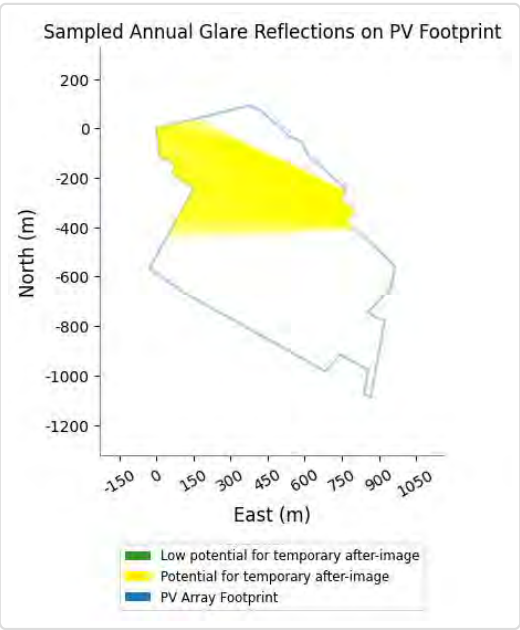
PV array 1 - OP Receptor (OP 17)

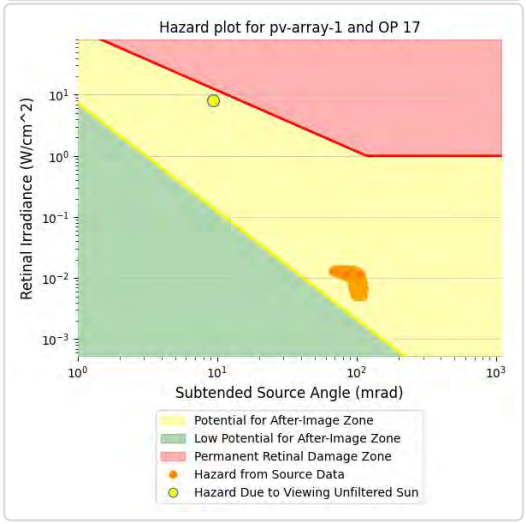
PV array is expected to produce the following glare for receptors at this location:

- 0 minutes of "green" glare with low potential to cause temporary after-image.
- 2,906 minutes of "yellow" glare with potential to cause temporary after-image.





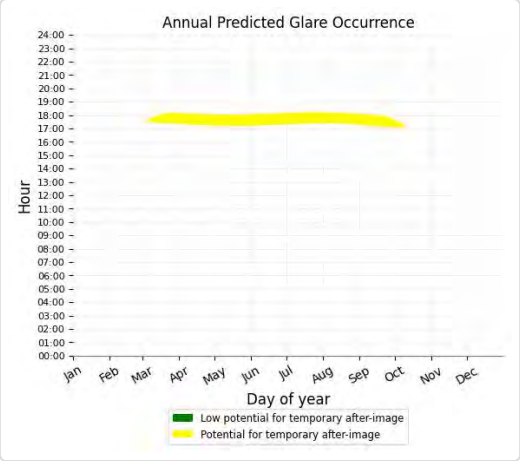


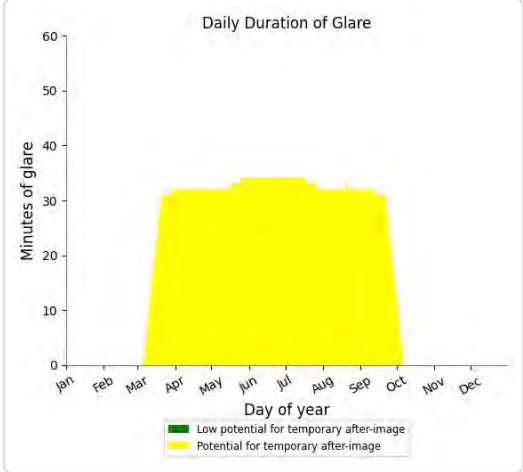


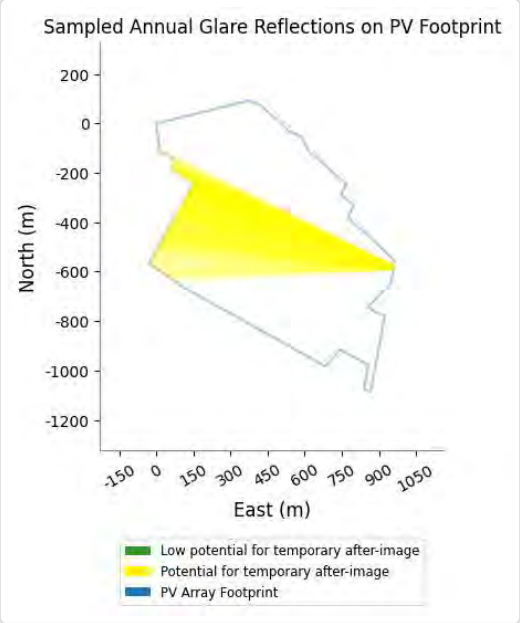
PV array 1 - OP Receptor (OP 18)

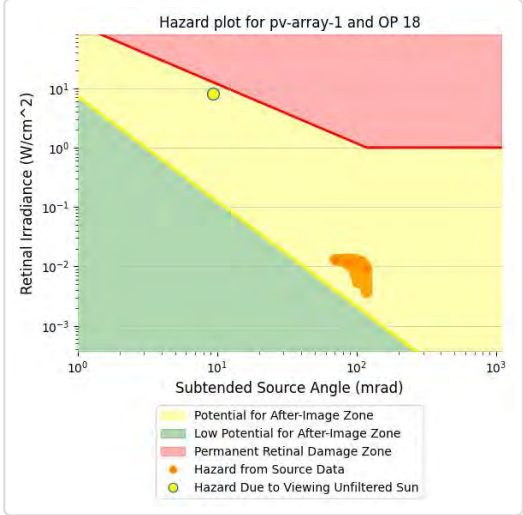
PV array is expected to produce the following glare for receptors at this location:

- 0 minutes of "green" glare with low potential to cause temporary after-image.
- 6,489 minutes of "yellow" glare with potential to cause temporary after-image.





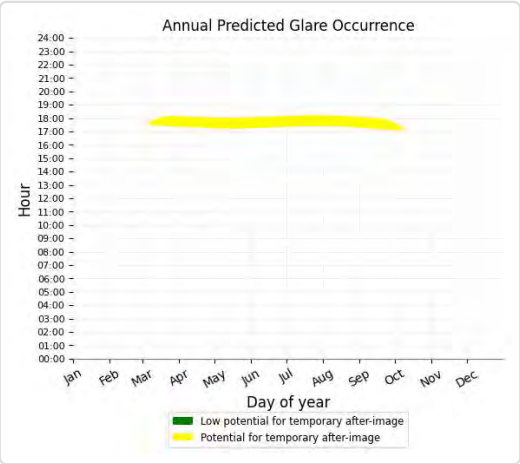


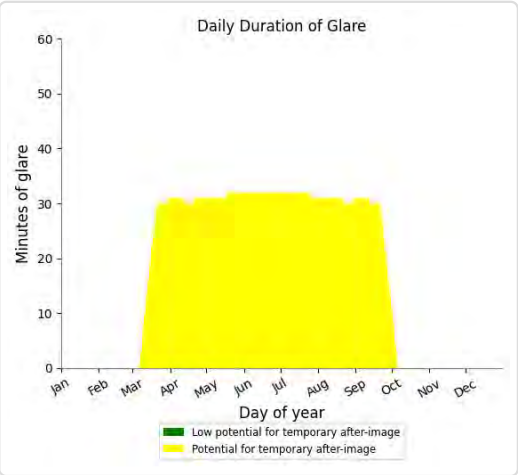


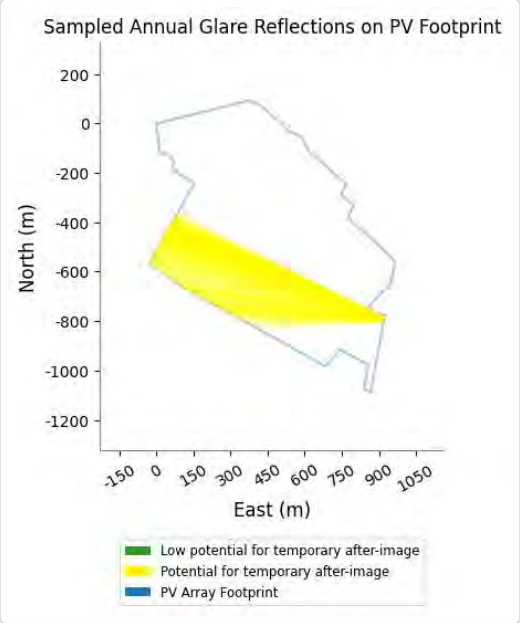
PV array 1 - OP Receptor (OP 19)

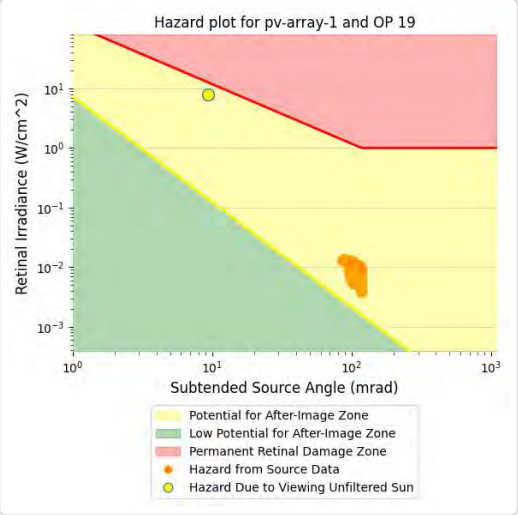
PV array is expected to produce the following glare for receptors at this location:

- 0 minutes of "green" glare with low potential to cause temporary after-image.
- 6,199 minutes of "yellow" glare with potential to cause temporary after-image.





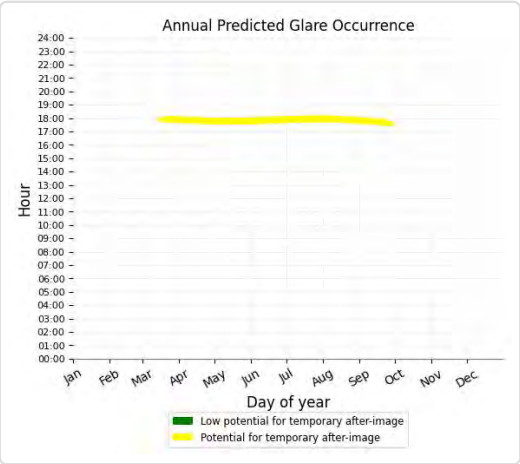


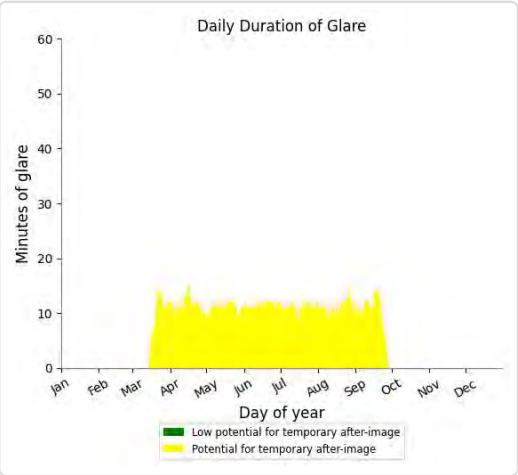


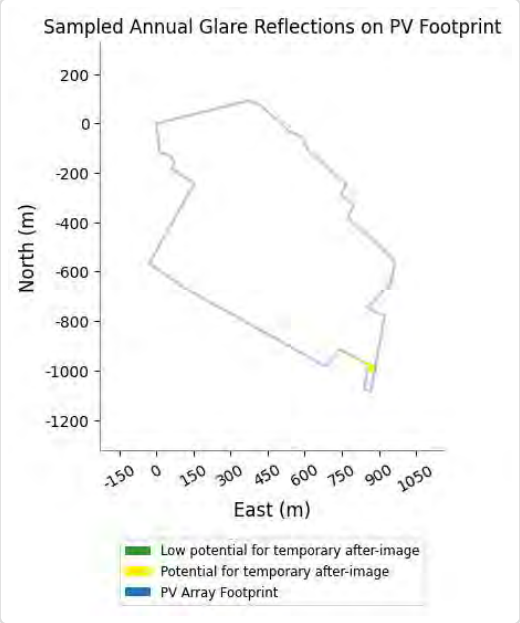
PV array 1 - OP Receptor (OP 20)

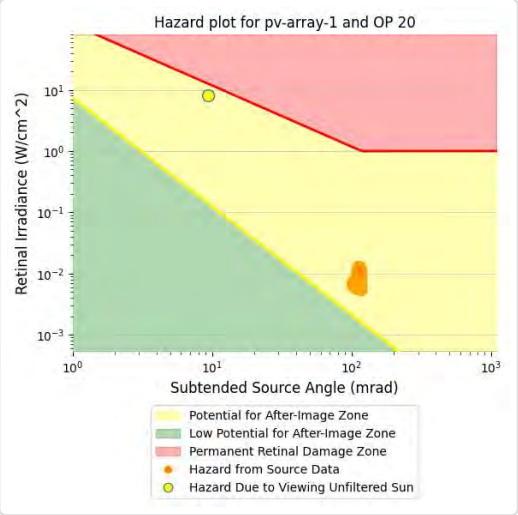
PV array is expected to produce the following glare for receptors at this location:

- 0 minutes of "green" glare with low potential to cause temporary after-image.
- 2,189 minutes of "yellow" glare with potential to cause temporary after-image.









Assumptions

- Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
- Glare analyses do not automatically 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 V1 calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results fc 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.)
- 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.
- Refer to the **Help page** for detailed assumptions and limitations not listed here.

ForgeSolar

Six Oaks Solar Farm

Six Oaks Solar Farm Bridleway Receptors

Created Nov. 4, 2022
Updated Nov. 4, 2022
Time-step 1 minute
Timezone offset UTC0
Site ID 78749.13311

Project type Advanced
Project status: active
Category 10 MW to 100 MW

Misc. Analysis 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: **Off**

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

PV Name	Tilt	Orientation	"Green" Glare	"Yellow" Glare	Energy Produced
	deg	deg	min	min	kWh
PV array 1	25.0	180.0	0	44,243	-

Component Data

PV Array(s)

Total PV footprint area: 660,016 m^2

Name: PV array 1
Footprint area: 660,016 m^2
Axis tracking: Fixed (no rotation)
Tilt: 25.0 deg
Orientation: 180.0 deg

Rated power: -
Panel material: Light textured glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 9.16 mrad

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	52.212724	0.291343	19.50	3.00	22.50
2	52.213552	0.296836	25.15	3.00	28.15
3	52.213368	0.297523	25.82	3.00	28.82
4	52.212934	0.298338	26.67	3.00	29.67
5	52.212777	0.298681	26.73	3.00	29.73
6	52.212474	0.299132	26.48	3.00	29.48
7	52.212224	0.299948	26.95	3.00	29.95
8	52.211672	0.300398	26.24	3.00	29.24
9	52.210541	0.302587	27.79	3.00	30.79
10	52.210121	0.302265	27.20	3.00	30.20
11	52.209753	0.303037	28.40	3.00	31.40
12	52.209305	0.302673	29.16	3.00	32.16
13	52.207728	0.305462	35.68	3.00	38.68
14	52.206939	0.305248	36.22	3.00	39.22
15	52.206044	0.303853	36.17	3.00	39.17
16	52.205847	0.304325	36.92	3.00	39.92
17	52.205755	0.304861	37.84	3.00	40.84
18	52.202941	0.304024	35.08	3.00	38.08
19	52.203072	0.303617	35.46	3.00	38.46
20	52.203927	0.303896	37.48	3.00	40.48
21	52.204506	0.302222	37.05	3.00	40.05
22	52.203888	0.301342	35.28	3.00	38.28
23	52.206807	0.292802	27.78	3.00	30.78
24	52.207228	0.291879	26.13	3.00	29.13
25	52.207636	0.290914	25.52	3.00	28.52
26	52.210528	0.293575	20.00	3.00	23.00
27	52.211067	0.292287	21.00	3.00	24.00
28	52.211343	0.292394	20.72	3.00	23.72
29	52.211567	0.292094	20.39	3.00	23.39
30	52.211672	0.291536	19.83	3.00	22.83

Discrete Observation Receptors

Number	Latitude	Longitude	Ground elevation	Height above ground	Total Elevation
	deg	deg	m	m	m
OP 1	52.215413	0.277185	15.80	2.70	18.50
OP 2	52.213934	0.278612	16.23	2.70	18.93
OP 3	52.212227	0.279191	18.00	2.70	20.70
OP 4	52.210676	0.280050	17.05	2.70	19.75
OP 5	52.209446	0.282678	18.00	2.70	20.70
OP 6	52.208723	0.285554	17.54	2.70	20.24
OP 7	52.208105	0.288322	21.18	2.70	23.88
OP 8	52.207408	0.290907	26.08	2.70	28.78
OP 9	52.206245	0.293793	30.15	2.70	32.85
OP 10	52.205324	0.296347	31.79	2.70	34.49
OP 11	52.204502	0.298847	33.31	2.70	36.01
OP 12	52.203680	0.301175	34.73	2.70	37.43
OP 13	52.202918	0.303707	35.03	2.70	37.73
OP 14	52.202089	0.306464	34.67	2.70	37.37
OP 15	52.201228	0.309211	33.65	2.70	36.35
OP 16	52.200452	0.311753	33.60	2.70	36.30
OP 17	52.199643	0.314328	35.83	2.70	38.53
OP 18	52.198841	0.316968	38.34	2.70	41.04
OP 19	52.203452	0.299063	31.47	2.70	34.17
OP 20	52.202663	0.297025	25.63	2.70	28.33
OP 21	52.201749	0.294825	23.69	2.70	26.39
OP 22	52.200622	0.291880	29.67	2.70	32.37
OP 23	52.200280	0.289251	32.62	2.70	35.32
OP 24	52.199359	0.287009	33.17	2.70	35.87
OP 25	52.215926	0.285142	16.96	2.70	19.66

Summary of PV Glare Analysis

PV configuration and total predicted glare

PV Name	Tilt	Orientation	"Green" Glare	"Yellow" Glare	Energy Produced	Data File
	deg	deg	min	min	kWh	
PV array 1	25.0	180.0	0	44,243	-	-

Distinct glare per month

Excludes overlapping glare from PV array for multiple receptors at matching time(s)

PV	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
pv-array-1 (green)	0	0	0	0	0	0	0	0	0	0	0	0
pv-array-1 (yellow)	0	0	421	1398	2003	2061	2073	1713	812	4	0	0

PV & Receptor Analysis Results

Results for each PV array and receptor

PV array 1 potential temporary after-image

Component	Green glare (min)	Yellow glare (min)
OP: OP 1	0	0
OP: OP 2	0	105
OP: OP 3	0	665
OP: OP 4	0	1013
OP: OP 5	0	0
OP: OP 6	0	2127
OP: OP 7	0	2232
OP: OP 8	0	4997
OP: OP 9	0	6716
OP: OP 10	0	5183
OP: OP 11	0	4665
OP: OP 12	0	2615
OP: OP 13	0	3670
OP: OP 14	0	0
OP: OP 15	0	0
OP: OP 16	0	0
OP: OP 17	0	0
OP: OP 18	0	0
OP: OP 19	0	2274
OP: OP 20	0	2574
OP: OP 21	0	2289
OP: OP 22	0	922
OP: OP 23	0	1146
OP: OP 24	0	1050
OP: OP 25	0	0

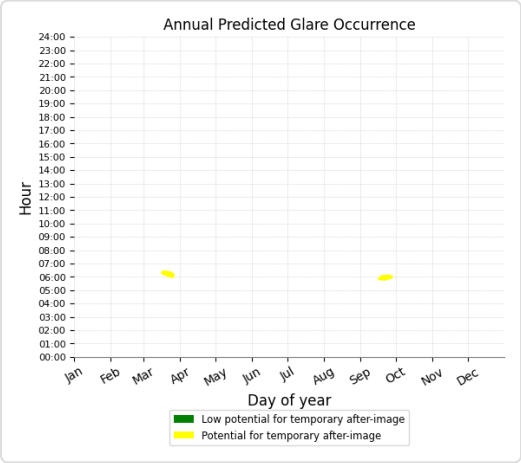
PV array 1 - OP Receptor (OP 1)

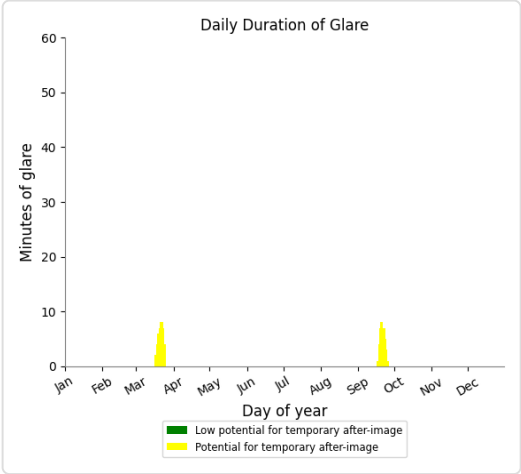
No glare found

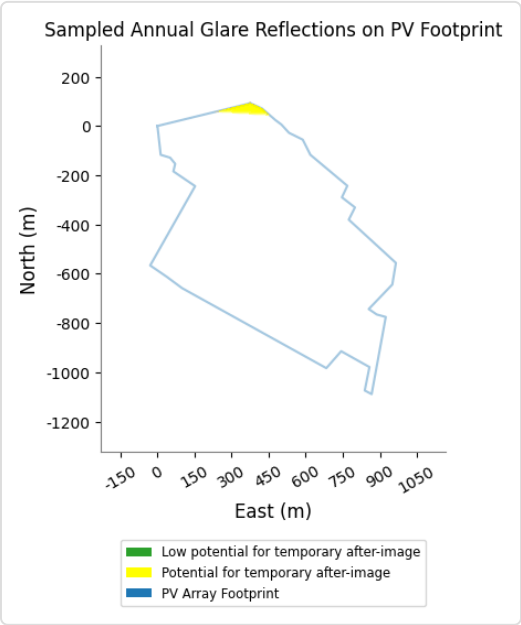
PV array 1 - OP Receptor (OP 2)

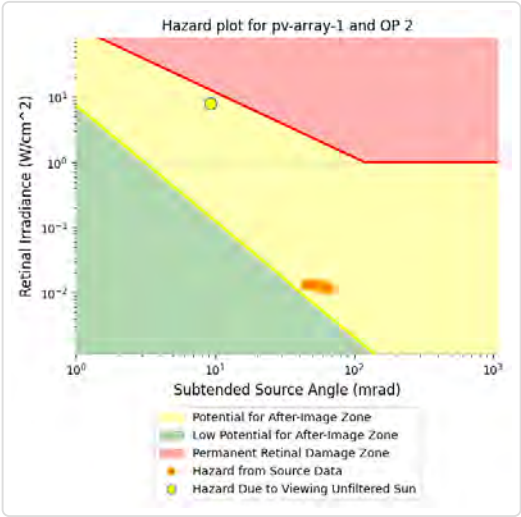
PV array is expected to produce the following glare for receptors at this location:

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





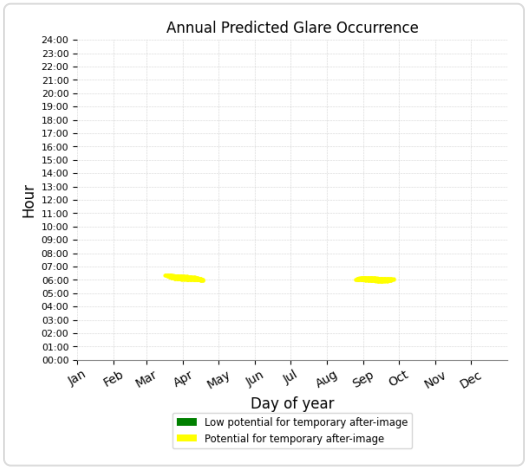


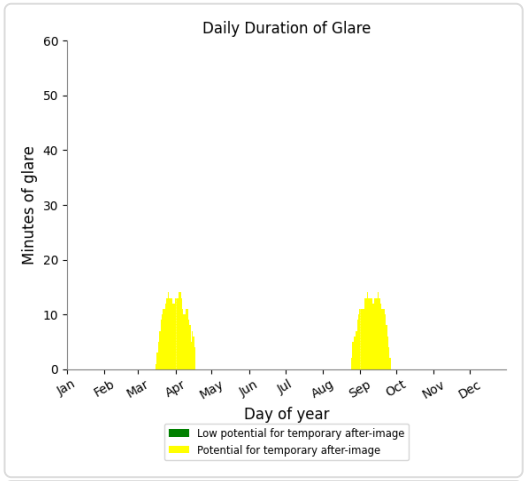


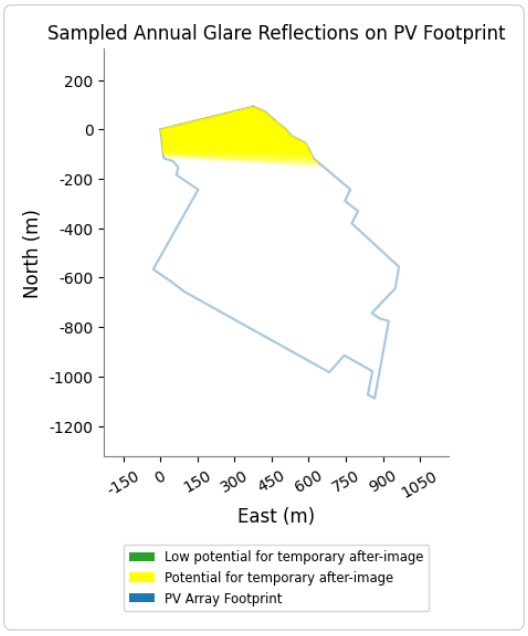
PV array 1 - OP Receptor (OP 3)

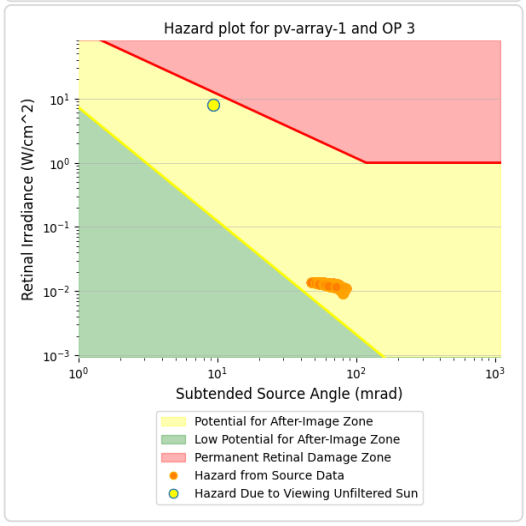
PV array is expected to produce the following glare for receptors at this location:

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





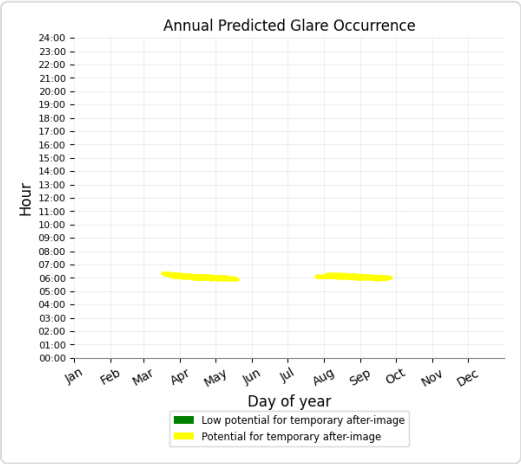


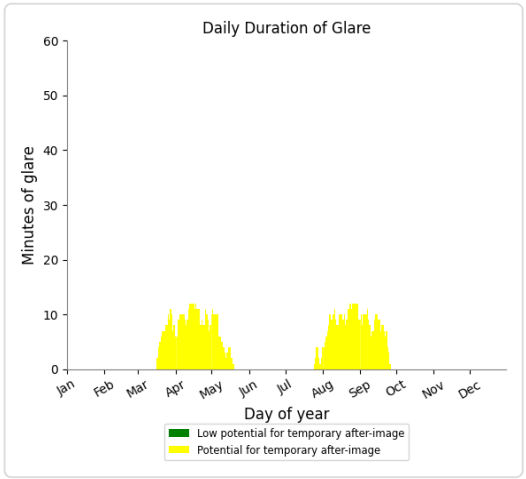


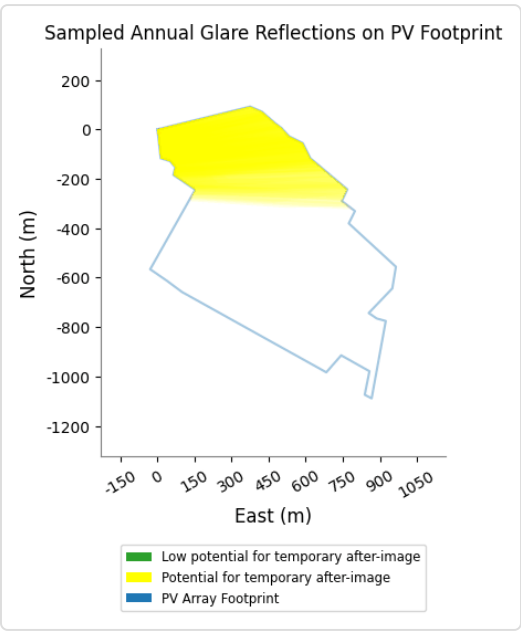
PV array 1 - OP Receptor (OP 4)

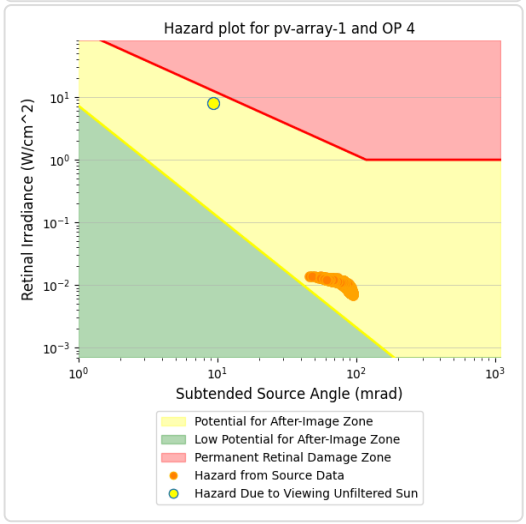
PV array is expected to produce the following glare for receptors at this location:

- 0 minutes of "green" glare with low potential to cause temporary after-image.
- 1,013 minutes of "yellow" glare with potential to cause temporary after-image.









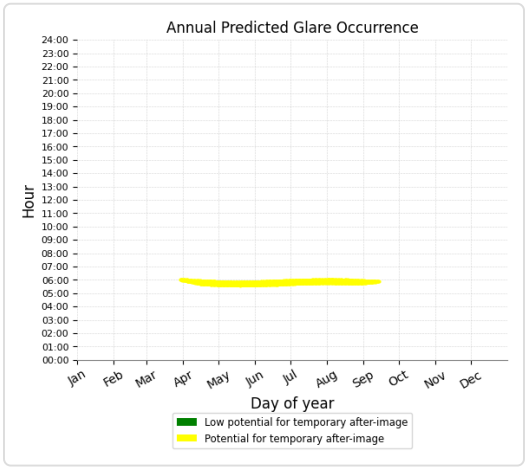
PV array 1 - OP Receptor (OP 5)

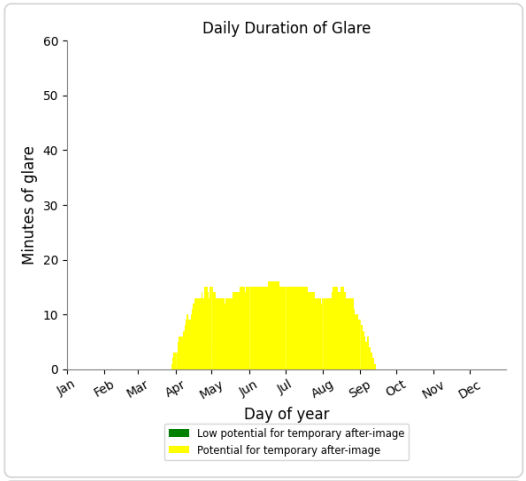
No glare found

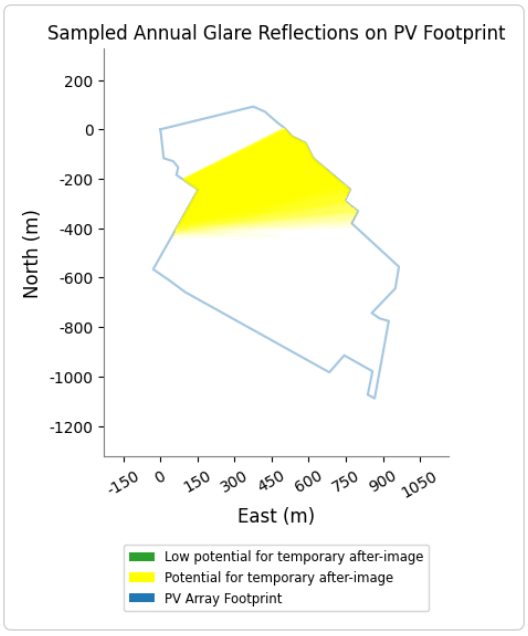
PV array 1 - OP Receptor (OP 6)

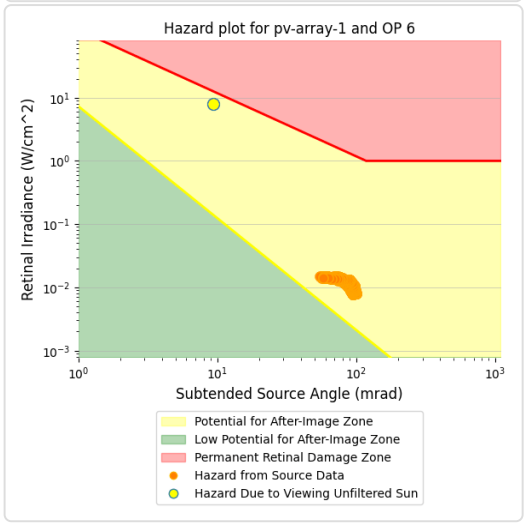
PV array is expected to produce the following glare for receptors at this location:

- 0 minutes of "green" glare with low potential to cause temporary after-image.
- 2,127 minutes of "yellow" glare with potential to cause temporary after-image.





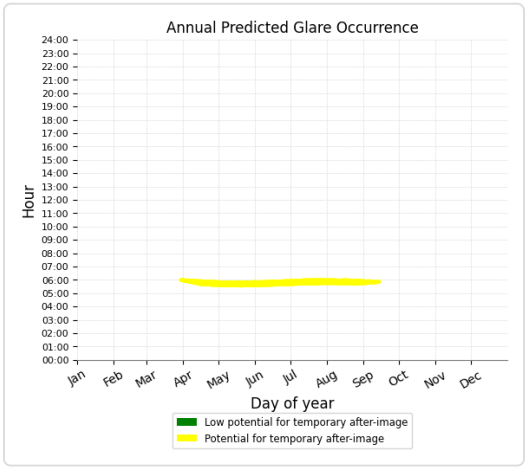


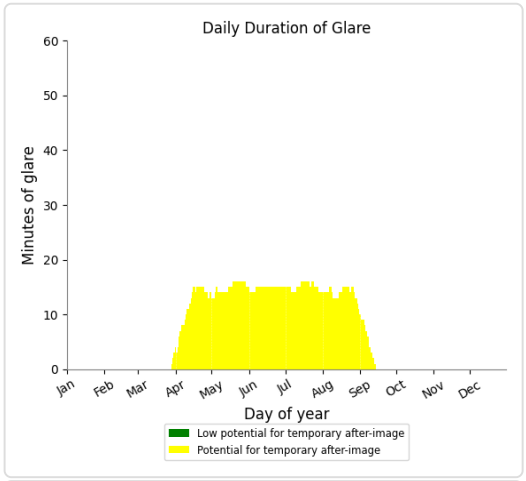


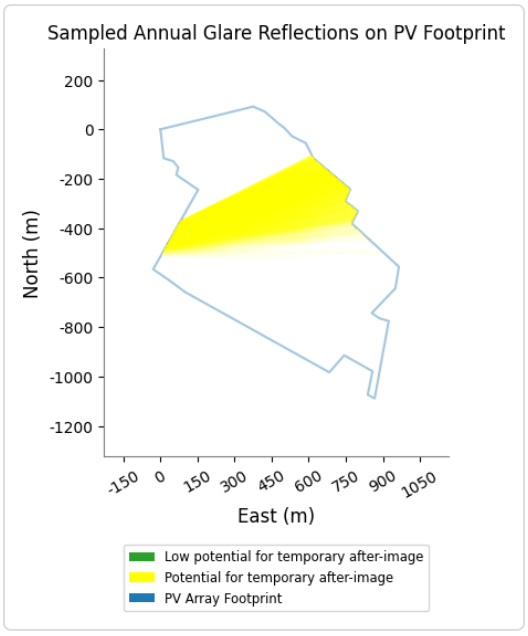
PV array 1 - OP Receptor (OP 7)

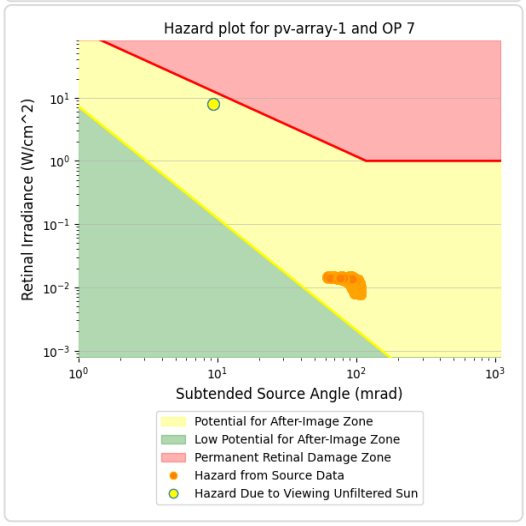
PV array is expected to produce the following glare for receptors at this location:

- 0 minutes of "green" glare with low potential to cause temporary after-image.
- 2,232 minutes of "yellow" glare with potential to cause temporary after-image.





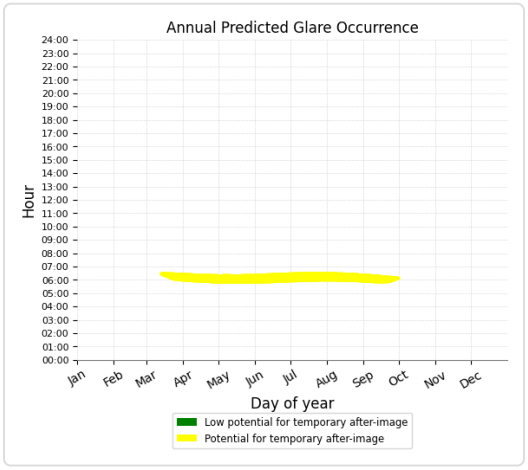


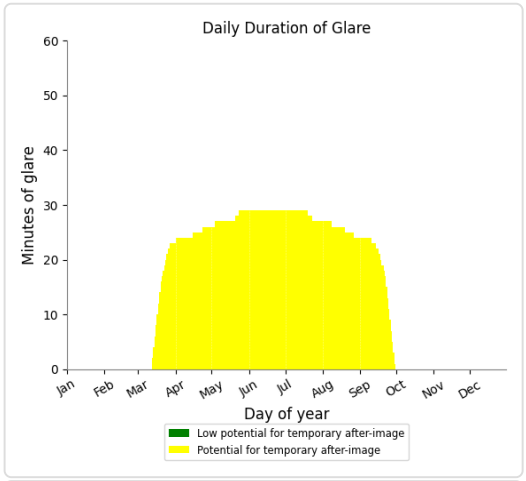


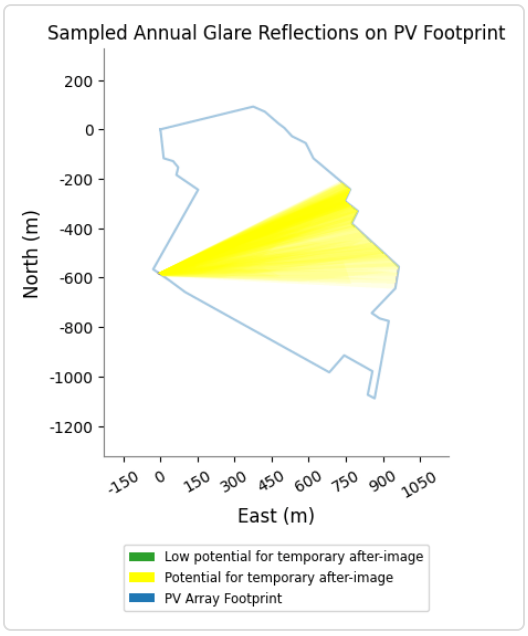
PV array 1 - OP Receptor (OP 8)

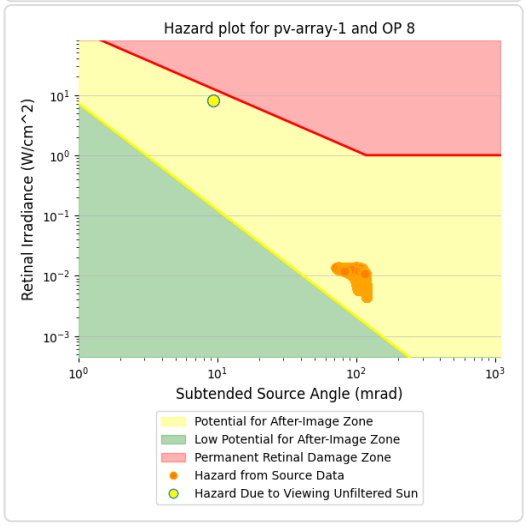
PV array is expected to produce the following glare for receptors at this location:

- 0 minutes of "green" glare with low potential to cause temporary after-image.
- 4,997 minutes of "yellow" glare with potential to cause temporary after-image.





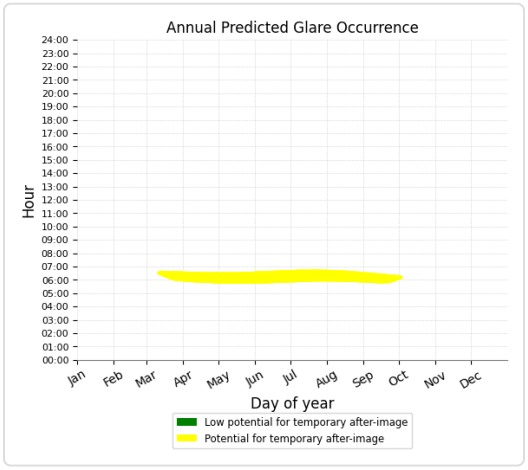


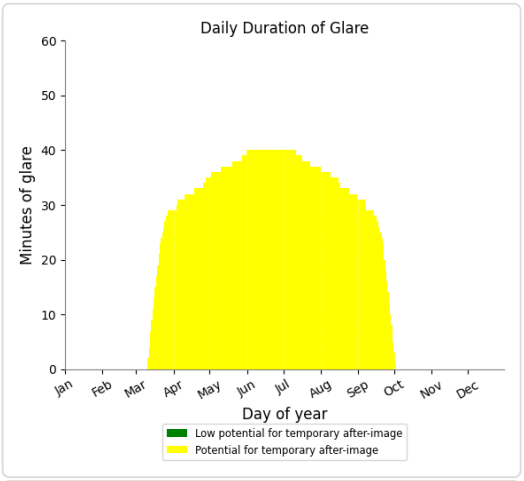


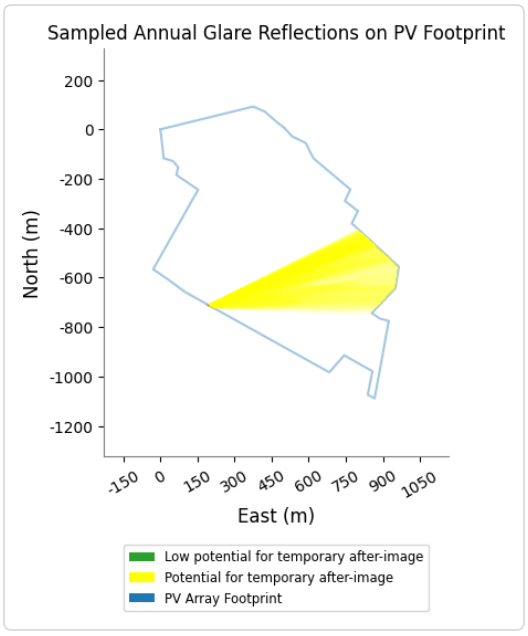
PV array 1 - OP Receptor (OP 9)

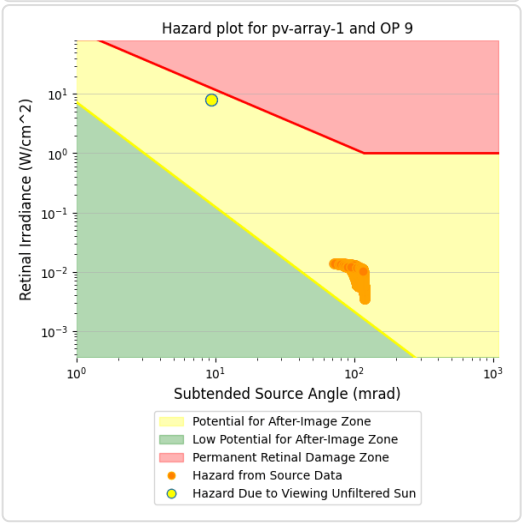
PV array is expected to produce the following glare for receptors at this location:

- 0 minutes of "green" glare with low potential to cause temporary after-image.
- 6,716 minutes of "yellow" glare with potential to cause temporary after-image.





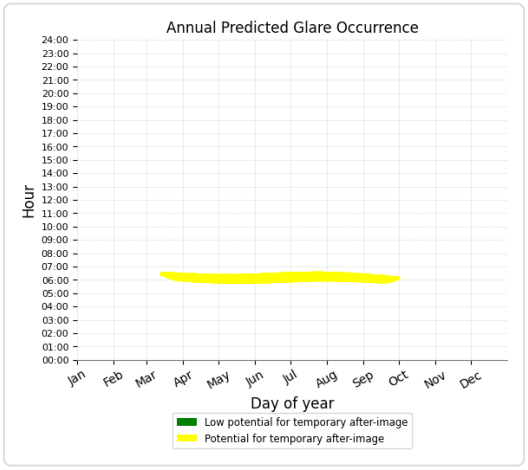


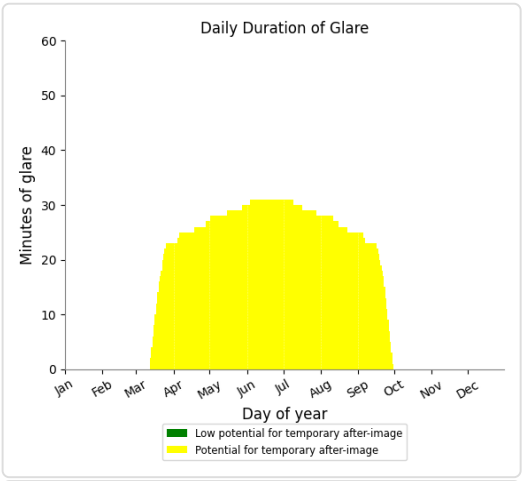


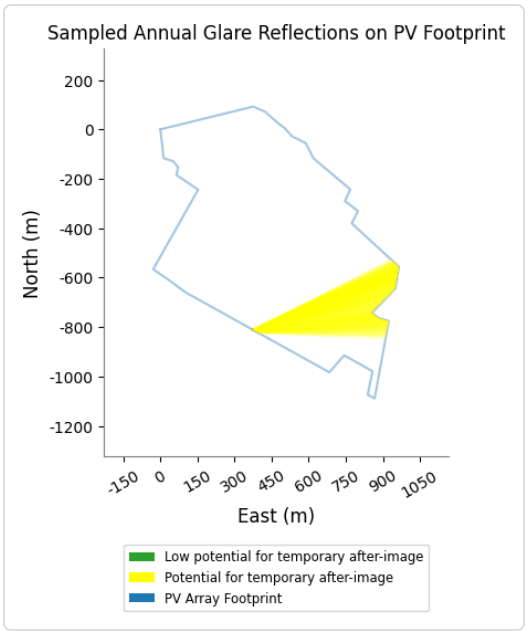
PV array 1 - OP Receptor (OP 10)

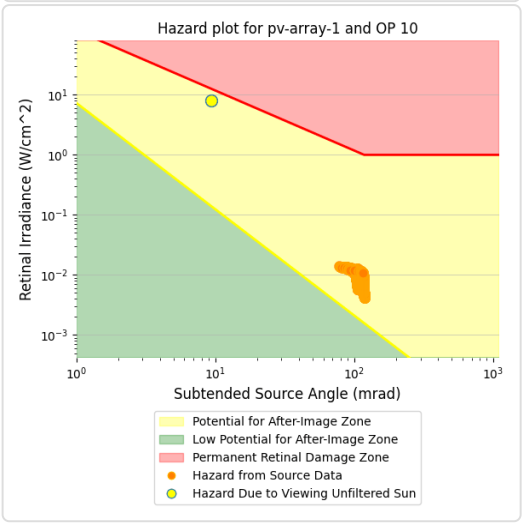
PV array is expected to produce the following glare for receptors at this location:

- 0 minutes of "green" glare with low potential to cause temporary after-image.
- 5,183 minutes of "yellow" glare with potential to cause temporary after-image.





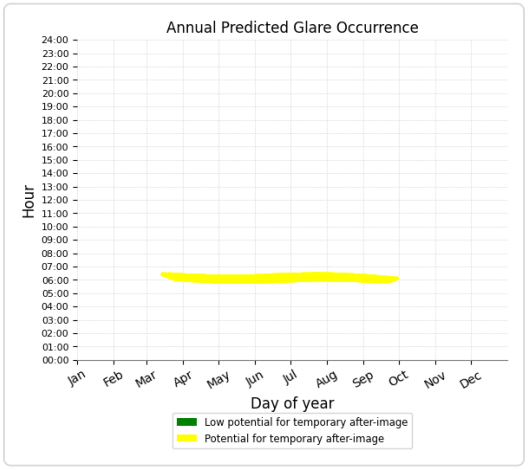


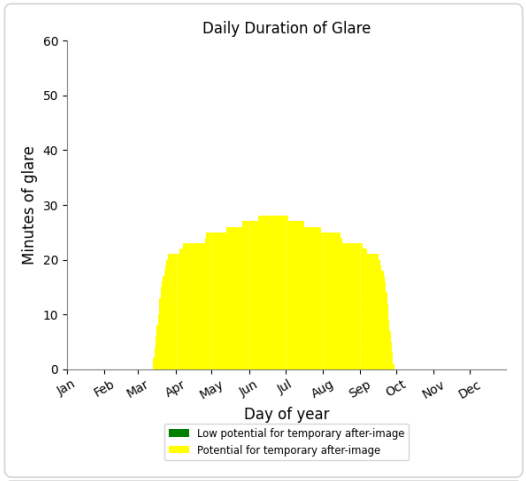


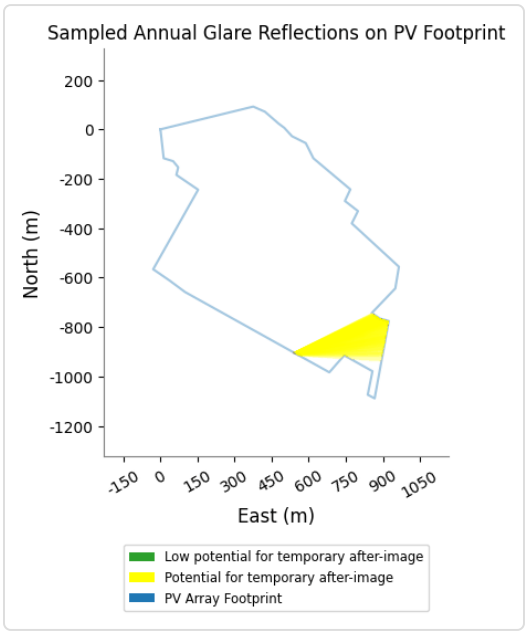
PV array 1 - OP Receptor (OP 11)

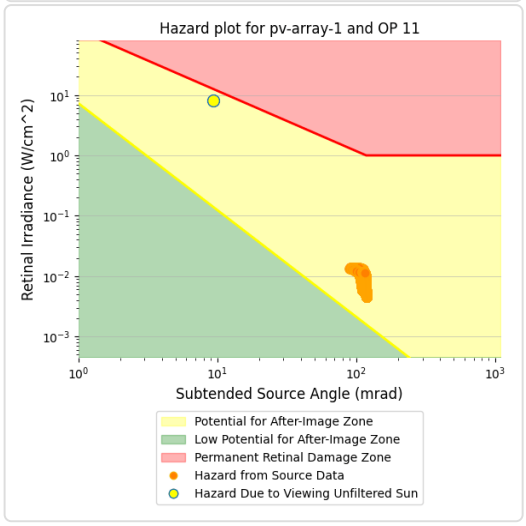
PV array is expected to produce the following glare for receptors at this location:

- 0 minutes of "green" glare with low potential to cause temporary after-image.
- 4,665 minutes of "yellow" glare with potential to cause temporary after-image.





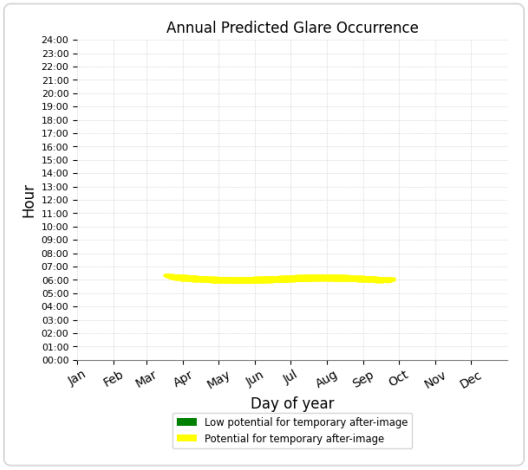


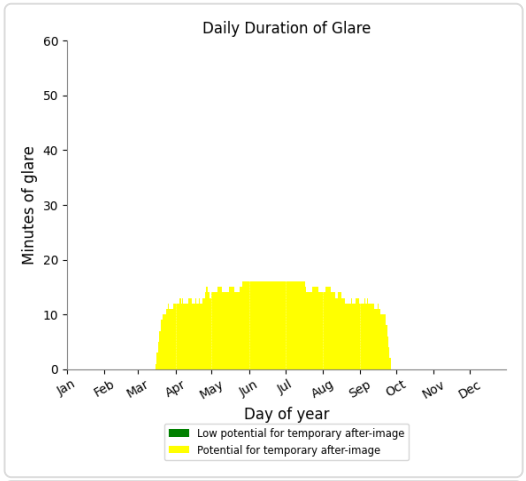


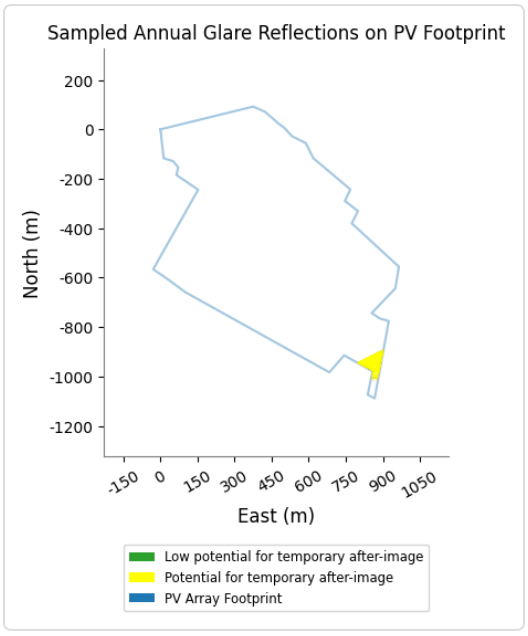
PV array 1 - OP Receptor (OP 12)

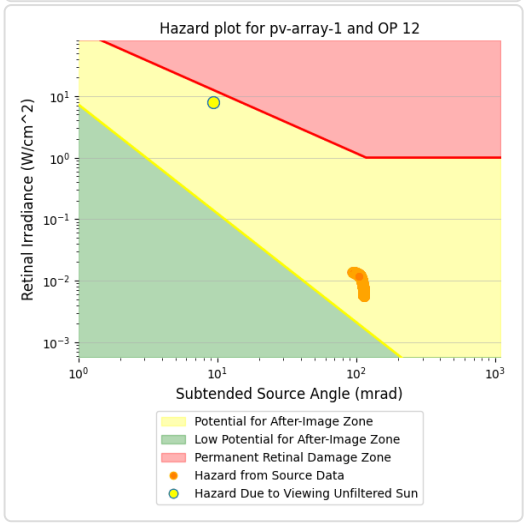
PV array is expected to produce the following glare for receptors at this location:

- 0 minutes of "green" glare with low potential to cause temporary after-image.
- 2,615 minutes of "yellow" glare with potential to cause temporary after-image.





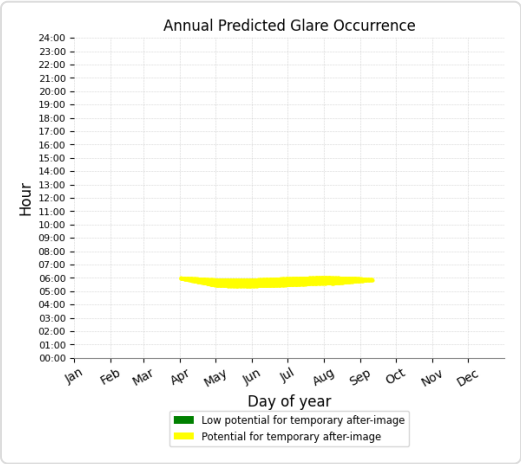


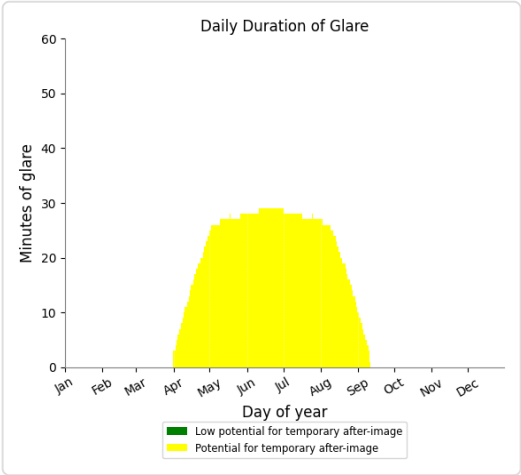


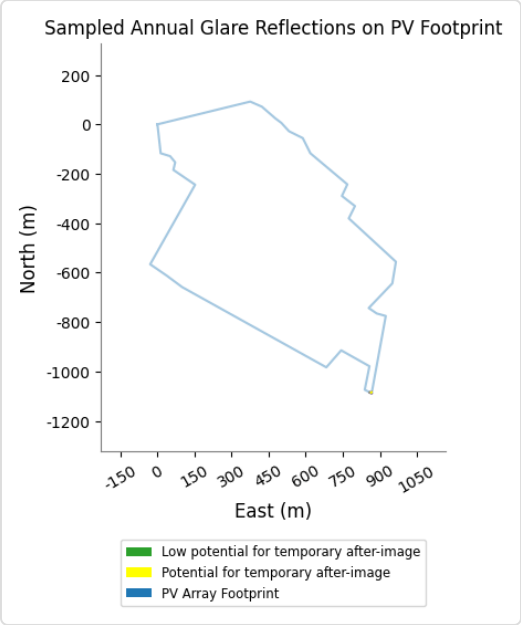
PV array 1 - OP Receptor (OP 13)

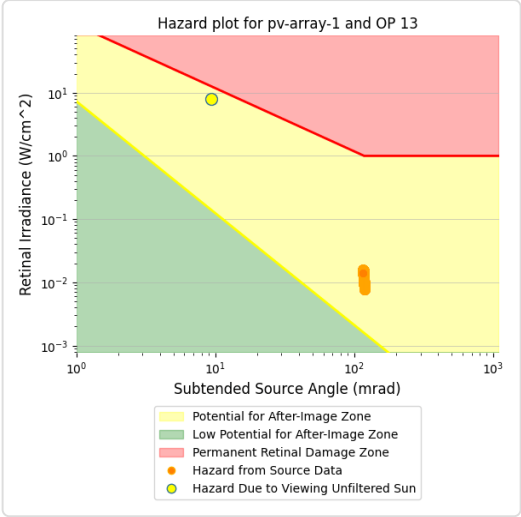
PV array is expected to produce the following glare for receptors at this location:

- 0 minutes of "green" glare with low potential to cause temporary after-image.
- 3,670 minutes of "yellow" glare with potential to cause temporary after-image.









PV array 1 - OP Receptor (OP 14)

No glare found

PV array 1 - OP Receptor (OP 15)

No glare found

PV array 1 - OP Receptor (OP 16)

No glare found

PV array 1 - OP Receptor (OP 17)

No glare found

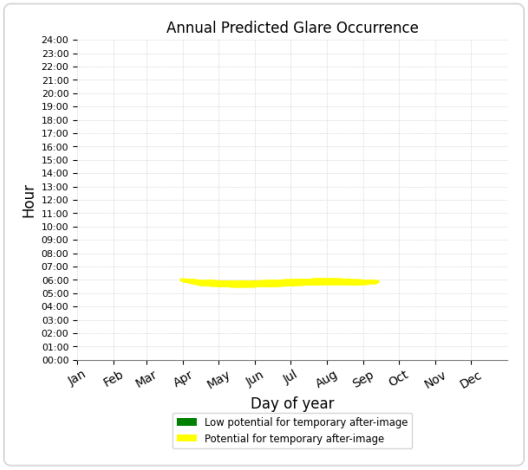
PV array 1 - OP Receptor (OP 18)

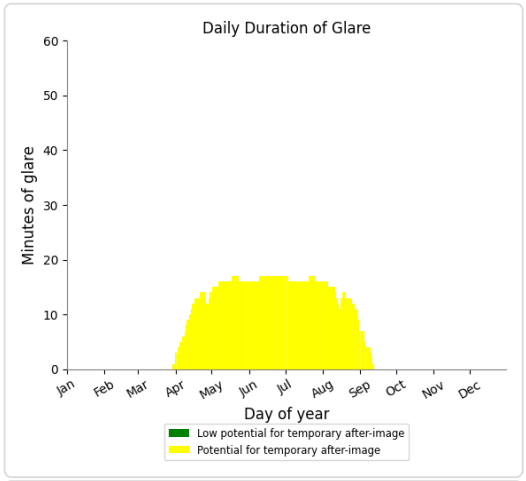
No glare found

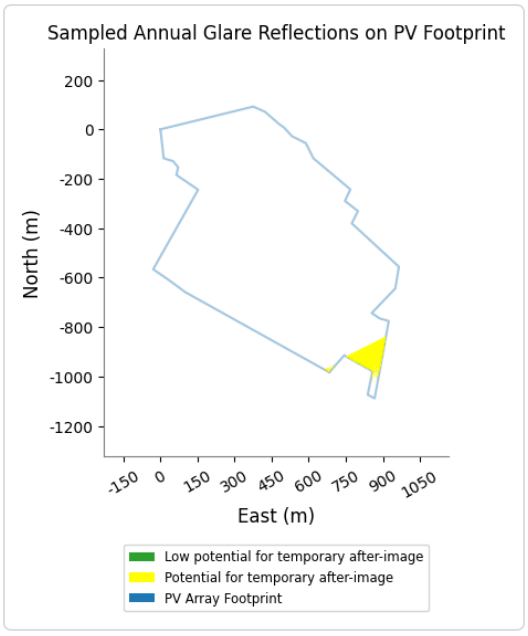
PV array 1 - OP Receptor (OP 19)

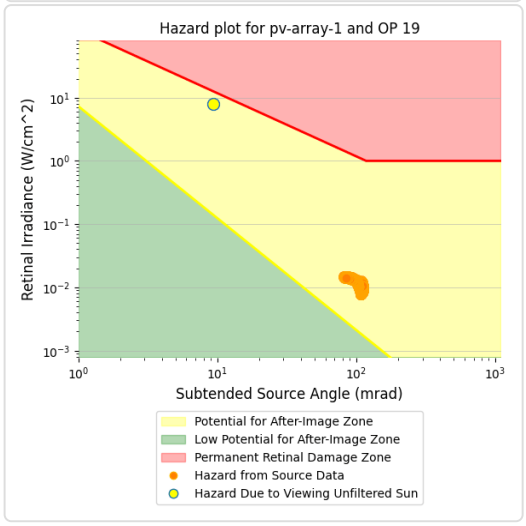
PV array is expected to produce the following glare for receptors at this location:

- 0 minutes of "green" glare with low potential to cause temporary after-image.
- 2,274 minutes of "yellow" glare with potential to cause temporary after-image.





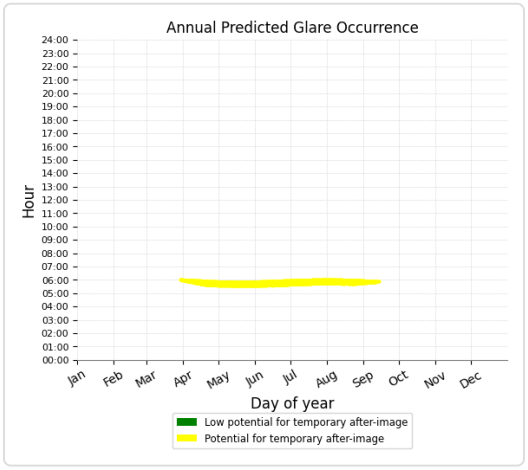


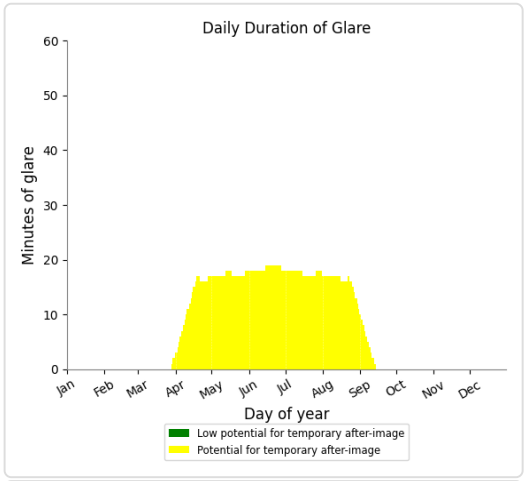


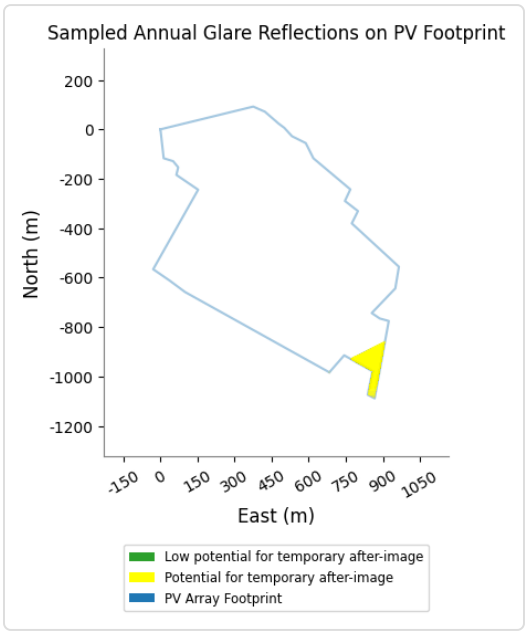
PV array 1 - OP Receptor (OP 20)

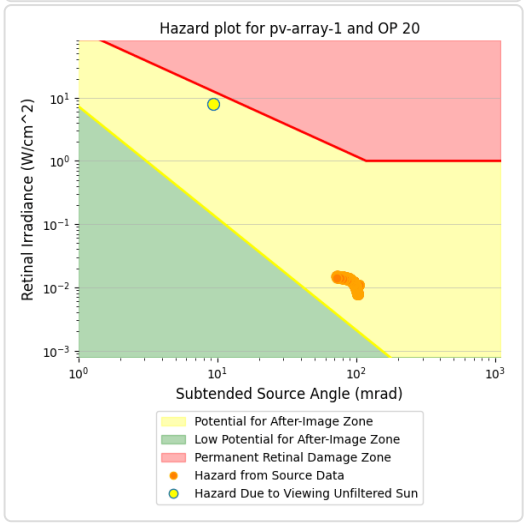
PV array is expected to produce the following glare for receptors at this location:

- 0 minutes of "green" glare with low potential to cause temporary after-image.
- 2,574 minutes of "yellow" glare with potential to cause temporary after-image.





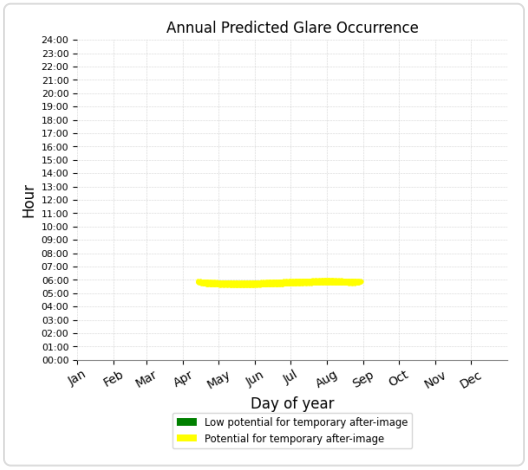


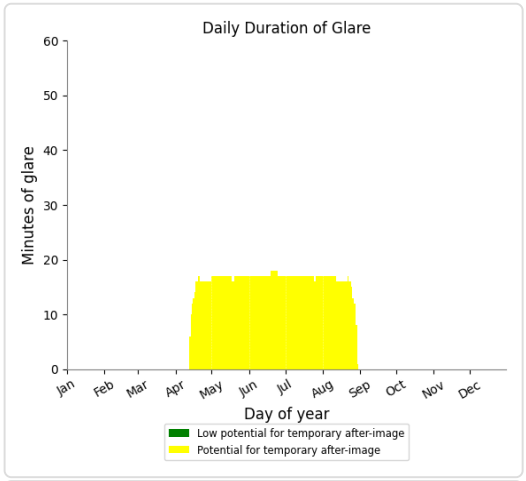


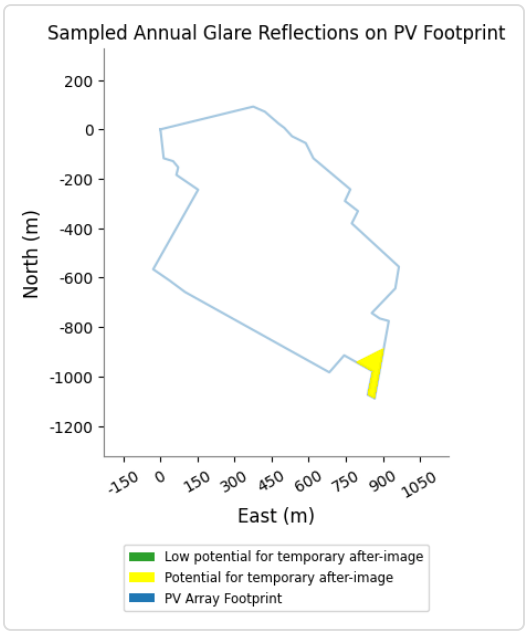
PV array 1 - OP Receptor (OP 21)

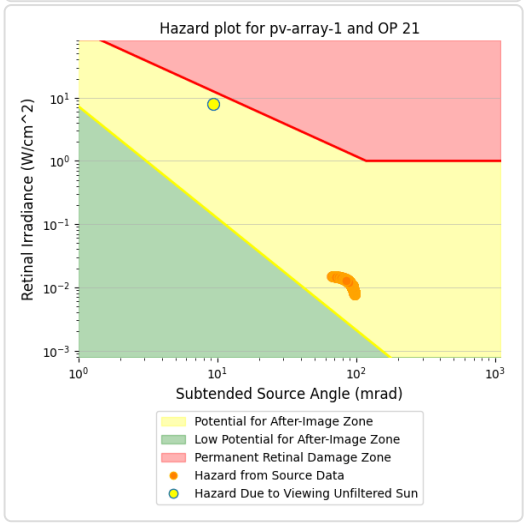
PV array is expected to produce the following glare for receptors at this location:

- 0 minutes of "green" glare with low potential to cause temporary after-image.
- 2,289 minutes of "yellow" glare with potential to cause temporary after-image.





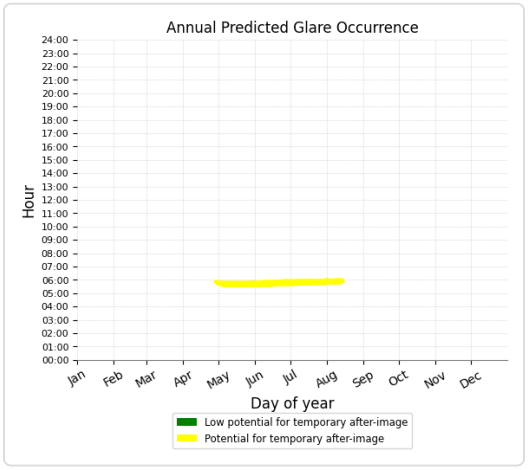


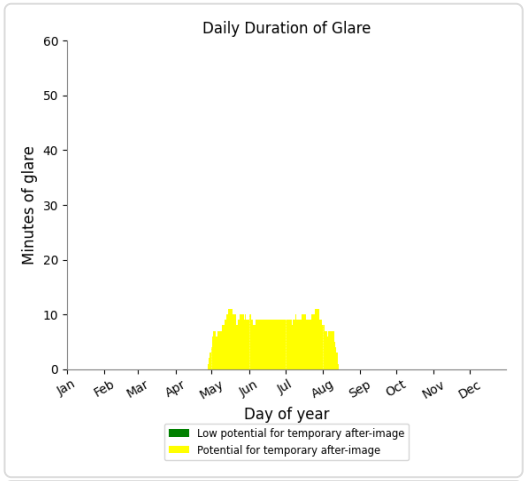


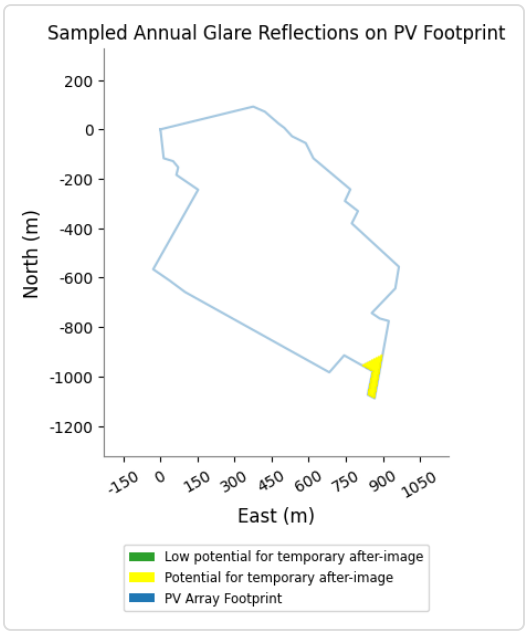
PV array 1 - OP Receptor (OP 22)

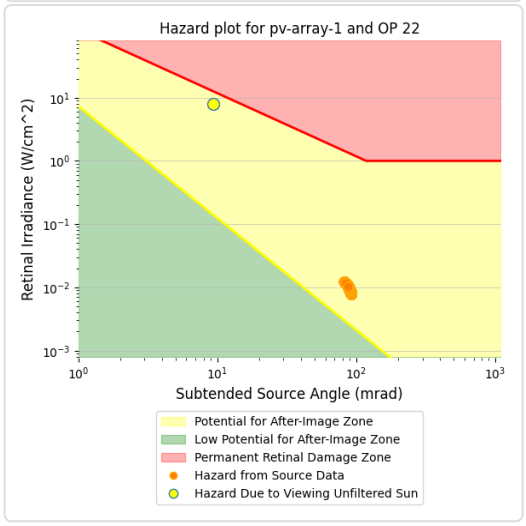
PV array is expected to produce the following glare for receptors at this location:

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





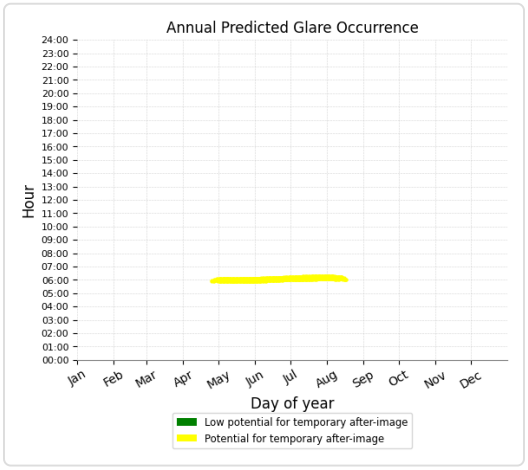


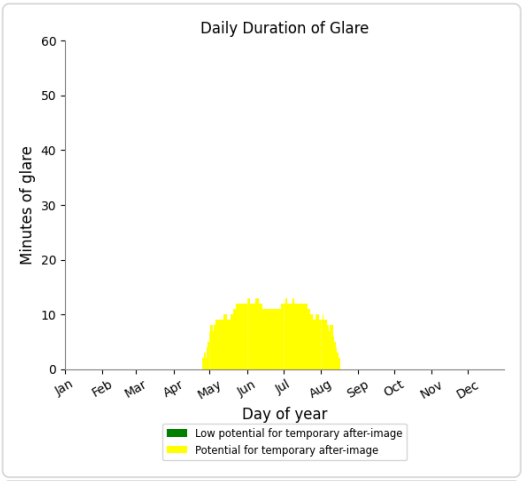


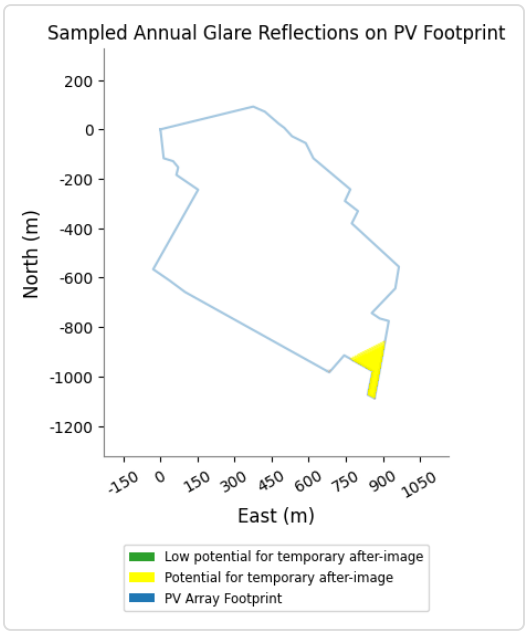
PV array 1 - OP Receptor (OP 23)

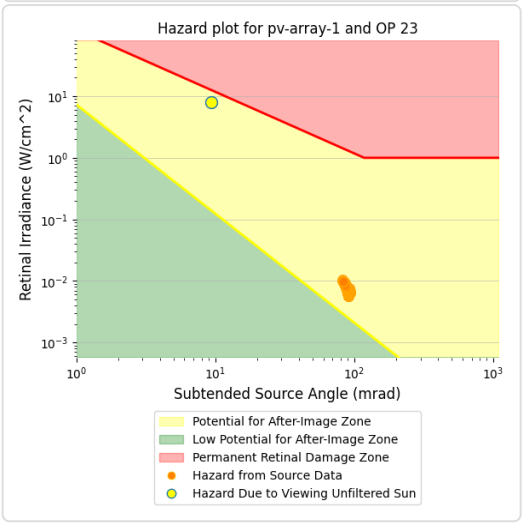
PV array is expected to produce the following glare for receptors at this location:

- 0 minutes of "green" glare with low potential to cause temporary after-image.
- 1,146 minutes of "yellow" glare with potential to cause temporary after-image.





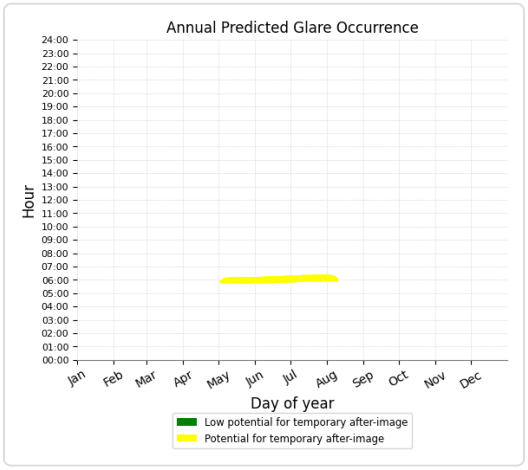


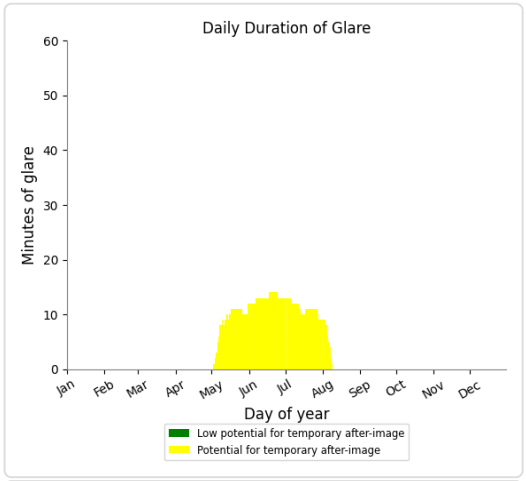


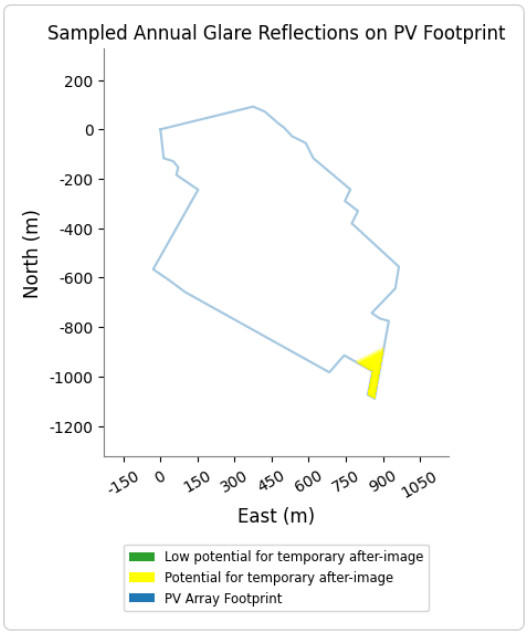
PV array 1 - OP Receptor (OP 24)

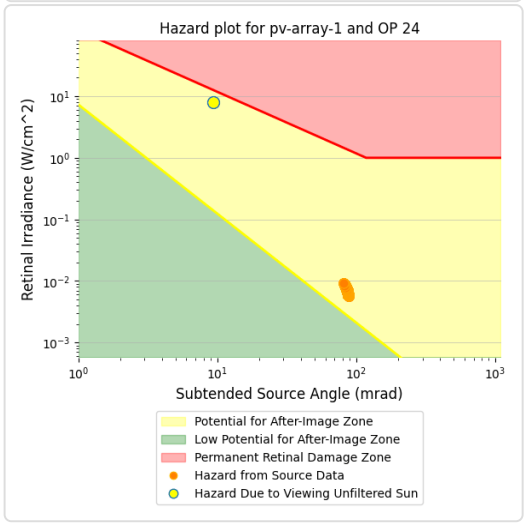
PV array is expected to produce the following glare for receptors at this location:

- 0 minutes of "green" glare with low potential to cause temporary after-image.
- 1,050 minutes of "yellow" glare with potential to cause temporary after-image.









PV array 1 - OP Receptor (OP 25)

No glare found

Assumptions

- Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
- Glare analyses do not automatically 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 V1 calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results fo 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.)
- 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.
- Refer to the **Help page** for detailed assumptions and limitations not listed here.

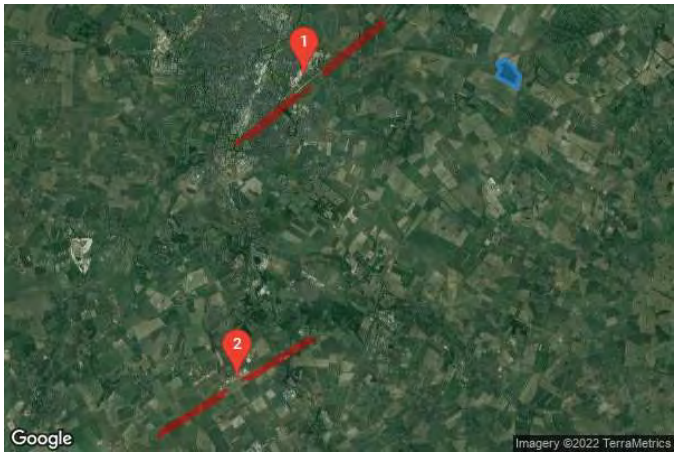
ForgeSolar

Six Oaks Solar Farm

Six Oaks Solar Farm Aviation-temp-0

Created Sept. 22, 2022
Updated Sept. 22, 2022
Time-step 1 minute
Timezone offset UTC0
Site ID 76319.13311

Project type Advanced
Project status: active
Category 10 MW to 100 MW



Misc. Analysis 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: **Off**

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

PV Name	Tilt	Orientation	"Green" Glare	"Yellow" Glare	Energy Produced
	deg	deg	min	min	kWh
PV array 1	25.0	180.0	4,655	0	-

Component Data

PV Array(s)

Total PV footprint area: 660,016 m^2

Name: PV array 1
Footprint area: 660,016 m^2
Axis tracking: Fixed (no rotation)
Tilt: 25.0 deg
Orientation: 180.0 deg

Rated power: -
Panel material: Light textured glass with AR coating
Vary reflectivity with sun position? Yes
Correlate slope error with surface type? Yes
Slope error: 9.16 mrad

Vertex	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
1	52.212724	0.291343	19.50	3.00	22.50
2	52.213552	0.296836	25.15	3.00	28.15
3	52.213368	0.297523	25.82	3.00	28.82
4	52.212934	0.298338	26.67	3.00	29.67
5	52.212777	0.298681	26.73	3.00	29.73
6	52.212474	0.299132	26.48	3.00	29.48
7	52.212224	0.299948	26.95	3.00	29.95
8	52.211672	0.300398	26.24	3.00	29.24
9	52.210541	0.302587	27.79	3.00	30.79
10	52.210121	0.302265	27.20	3.00	30.20
11	52.209753	0.303037	28.40	3.00	31.40
12	52.209305	0.302673	29.16	3.00	32.16
13	52.207728	0.305462	35.68	3.00	38.68
14	52.206939	0.305248	36.22	3.00	39.22
15	52.206044	0.303853	36.17	3.00	39.17
16	52.205847	0.304325	36.92	3.00	39.92
17	52.205755	0.304861	37.84	3.00	40.84
18	52.202941	0.304024	35.08	3.00	38.08
19	52.203072	0.303617	35.46	3.00	38.46
20	52.203927	0.303896	37.48	3.00	40.48
21	52.204506	0.302222	37.05	3.00	40.05
22	52.203888	0.301342	35.28	3.00	38.28
23	52.206807	0.292802	27.78	3.00	30.78
24	52.207228	0.291879	26.13	3.00	29.13
25	52.207636	0.290914	25.52	3.00	28.52
26	52.210528	0.293575	20.00	3.00	23.00
27	52.211067	0.292287	21.00	3.00	24.00
28	52.211343	0.292394	20.72	3.00	23.72
29	52.211567	0.292094	20.39	3.00	23.39
30	52.211672	0.291536	19.83	3.00	22.83

2-Mile Flight Path Receptor(s)

Name: Cambridge RWY 05
Description:
Threshold height : 15 m
Direction: 49.9 deg
Glide slope: 3.0 deg
Pilot view restricted? Yes
Vertical view restriction: 30.0 deg
Azimuthal view restriction: 50.0 deg

Point	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
Threshold	52.200589	0.166444	13.00	15.24	28.24
2-mile point	52.181966	0.130318	15.39	181.53	196.92

Name: Cambridge RWY 05G
Description:
Threshold height : 15 m
Direction: 49.9 deg
Glide slope: 3.0 deg
Pilot view restricted? Yes
Vertical view restriction: 30.0 deg
Azimuthal view restriction: 50.0 deg

Point	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
Threshold	52.203121	0.175596	15.00	15.24	30.24
2-mile point	52.184497	0.139467	19.95	178.97	198.92

Name: Cambridge RWY 23
Description:
Threshold height : 15 m
Direction: 229.9 deg
Glide slope: 3.0 deg
Pilot view restricted? Yes
Vertical view restriction: 30.0 deg
Azimuthal view restriction: 50.0 deg

Point	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
Threshold	52.209891	0.184414	15.96	15.24	31.20
2-mile point	52.228514	0.220548	6.72	193.17	199.88

Name: Cambridge RWY 23G
Description:
Threshold height : 15 m
Direction: 229.9 deg
Glide slope: 3.0 deg
Pilot view restricted? Yes
Vertical view restriction: 30.0 deg
Azimuthal view restriction: 50.0 deg

Point	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
Threshold	52.208319	0.185658	10.46	15.24	25.70
2-mile point	52.226943	0.221791	9.00	185.39	194.39

Name: Duxford RWY 06L
Description:
Threshold height : 15 m
Direction: 58.0 deg
Glide slope: 3.0 deg
Pilot view restricted? Yes
Vertical view restriction: 30.0 deg
Azimuthal view restriction: 50.0 deg

Point	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
Threshold	52.089299	0.124170	38.00	15.24	53.24
2-mile point	52.073978	0.084218	36.93	185.00	221.92

Name: Duxford RWY 06R
Description:
Threshold height : 15 m
Direction: 58.0 deg
Glide slope: 3.0 deg
Pilot view restricted? Yes
Vertical view restriction: 30.0 deg
Azimuthal view restriction: 50.0 deg

Point	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
Threshold	52.087242	0.122958	39.04	15.24	54.28
2-mile point	52.071921	0.083008	37.99	184.98	222.96

Name: Duxford RWY 24L
Description:
Threshold height : 15 m
Direction: 238.0 deg
Glide slope: 3.0 deg
Pilot view restricted? Yes
Vertical view restriction: 30.0 deg
Azimuthal view restriction: 50.0 deg

Point	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
Threshold	52.093456	0.139145	33.62	15.24	48.86
2-mile point	52.108778	0.179101	28.18	189.37	217.54

Name: Duxford RWY 24R
Description:
Threshold height : 15 m
Direction: 238.0 deg
Glide slope: 3.0 deg
Pilot view restricted? Yes
Vertical view restriction: 30.0 deg
Azimuthal view restriction: 50.0 deg

Point	Latitude	Longitude	Ground elevation	Height above ground	Total elevation
	deg	deg	m	m	m
Threshold	52.093476	0.135047	33.43	15.24	48.67
2-mile point	52.108798	0.175003	25.15	192.21	217.35

Discrete Observation Receptors

Number	Latitude	Longitude	Ground elevation	Height above ground	Total Elevation
	deg	deg	m	m	m
1-ATCT	52.208096	0.172751	20.00	26.00	46.00
2-ATCT	52.094076	0.131367	32.00	8.00	40.00

1-ATCT map image

2-ATCT map image

Summary of PV Glare Analysis

PV configuration and total predicted glare

PV Name	Tilt	Orientation	"Green" Glare	"Yellow" Glare	Energy Produced	Data File
	deg	deg	min	min	kWh	
PV array 1	25.0	180.0	4,655	0	-	-

Distinct glare per month

Excludes overlapping glare from PV array for multiple receptors at matching time(s)

PV	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
pv-array-1 (green)	0	0	191	525	386	0	169	570	365	0	0	0
pv-array-1 (yellow)	0	0	0	0	0	0	0	0	0	0	0	0

PV & Receptor Analysis Results

Results for each PV array and receptor

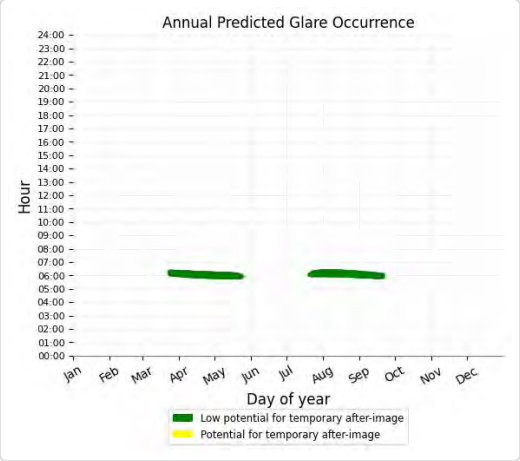
PV array 1 low potential for temporary after-image

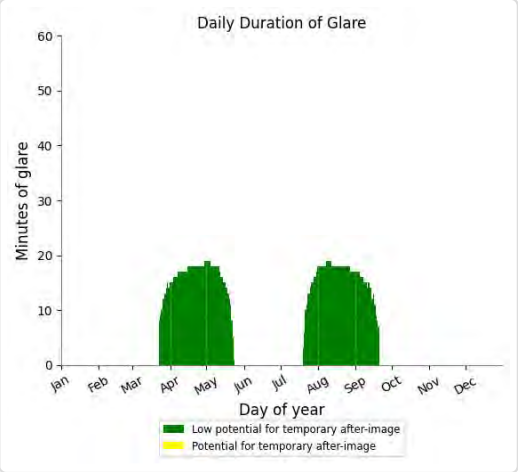
Component	Green glare (min)	Yellow glare (min)
FP: Cambridge RWY 05	1968	0
FP: Cambridge RWY 05G	2065	0
FP: Cambridge RWY 23	0	0
FP: Cambridge RWY 23G	0	0
FP: Duxford RWY 06L	0	0
FP: Duxford RWY 06R	0	0
FP: Duxford RWY 24L	0	0
FP: Duxford RWY 24R	0	0
OP: 1-ATCT	622	0
OP: 2-ATCT	0	0

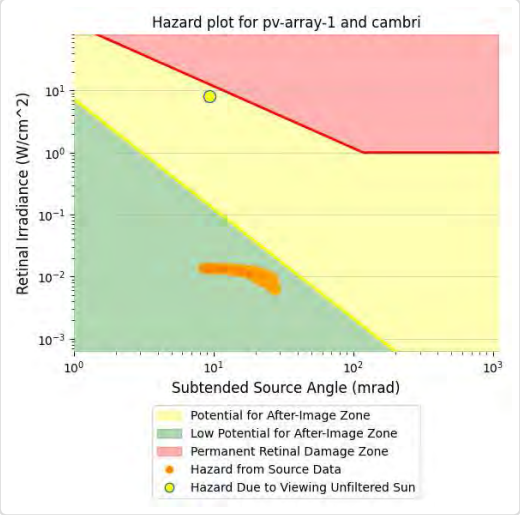
PV array 1 - Receptor (Cambridge RWY 05)

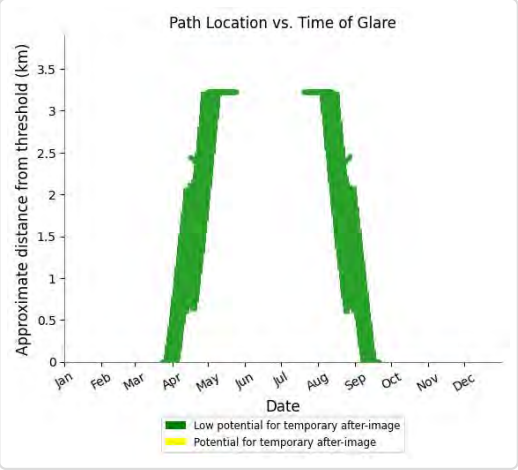
PV array is expected to produce the following glare for observers on this flight path:

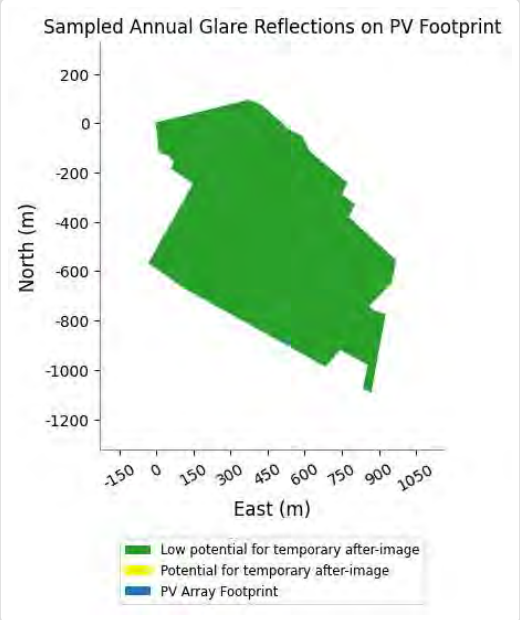
- 1,968 minutes of "green" glare with low potential to cause temporary after-image.
- 0 minutes of "yellow" glare with potential to cause temporary after-image.

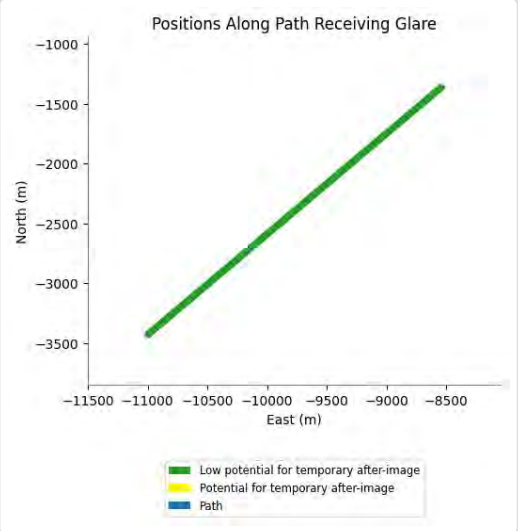








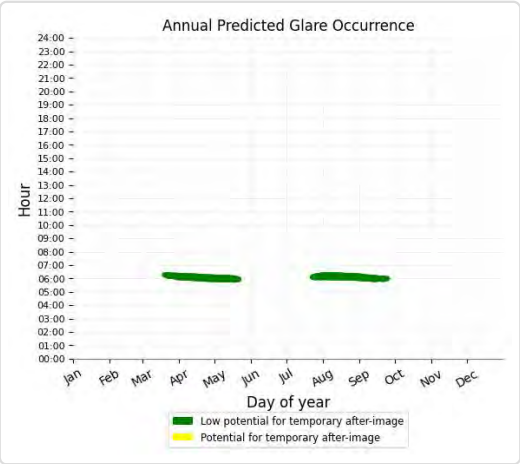


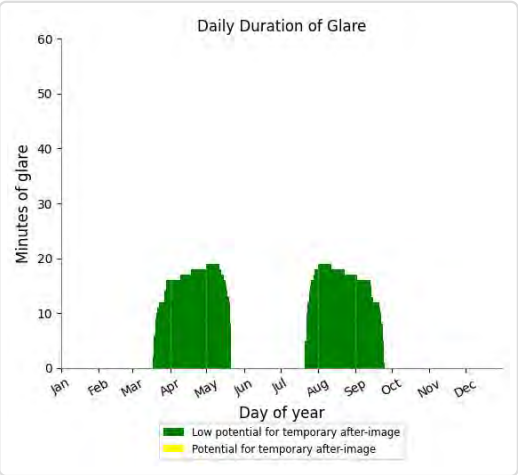


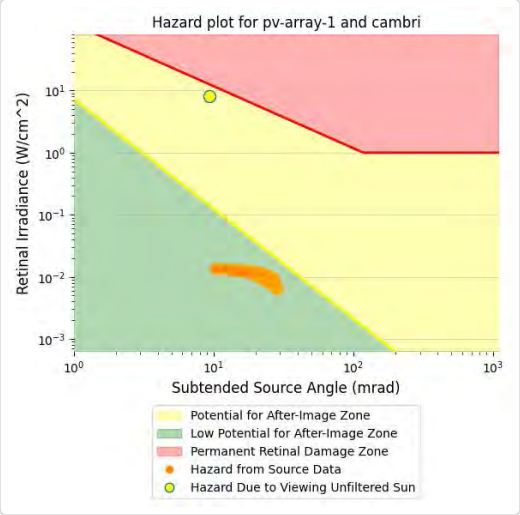
PV array 1 - Receptor (Cambridge RWY 05G)

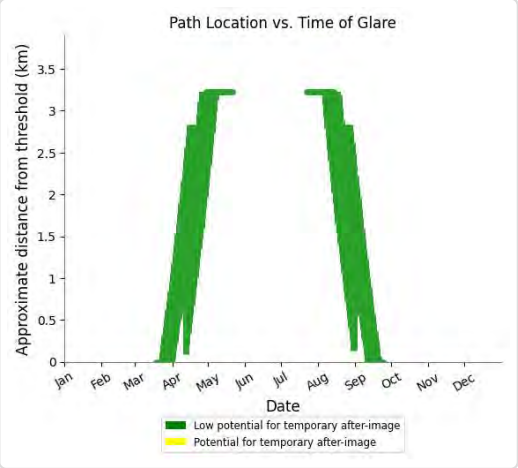
PV array is expected to produce the following glare for observers on this flight path:

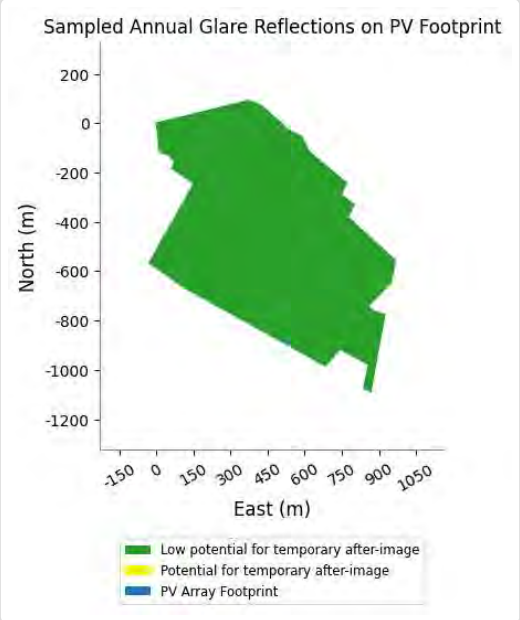
- 2,065 minutes of "green" glare with low potential to cause temporary after-image.
- 0 minutes of "yellow" glare with potential to cause temporary after-image.

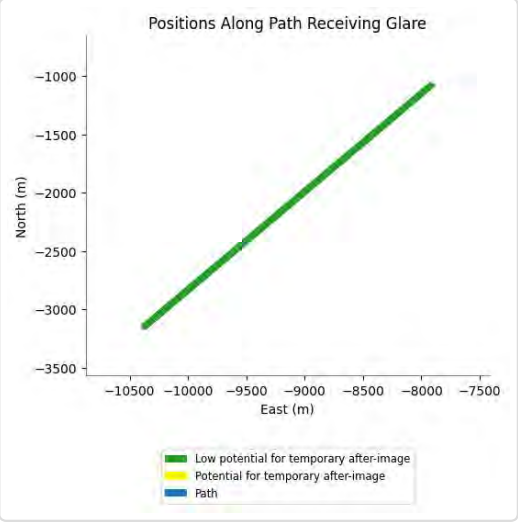












PV array 1 - Receptor (Cambridge RWY 23)

No glare found

PV array 1 - Receptor (Cambridge RWY 23G)

No glare found

PV array 1 - Receptor (Duxford RWY 06L)

No glare found

PV array 1 - Receptor (Duxford RWY 06R)

No glare found

PV array 1 - Receptor (Duxford RWY 24L)

No glare found

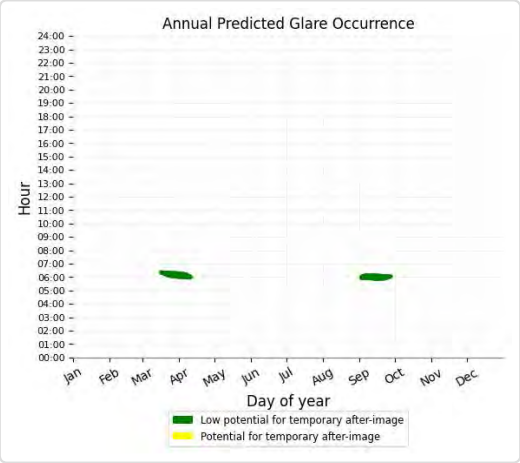
PV array 1 - Receptor (Duxford RWY 24R)

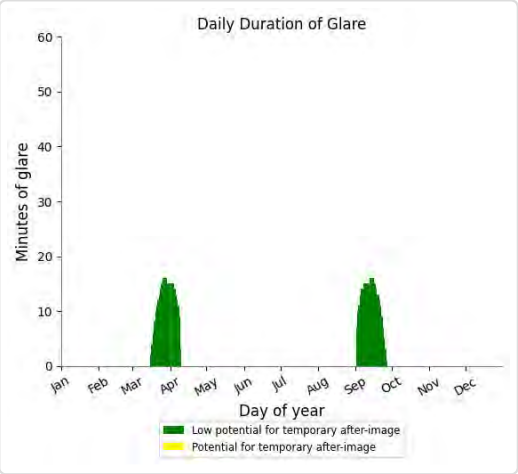
No glare found

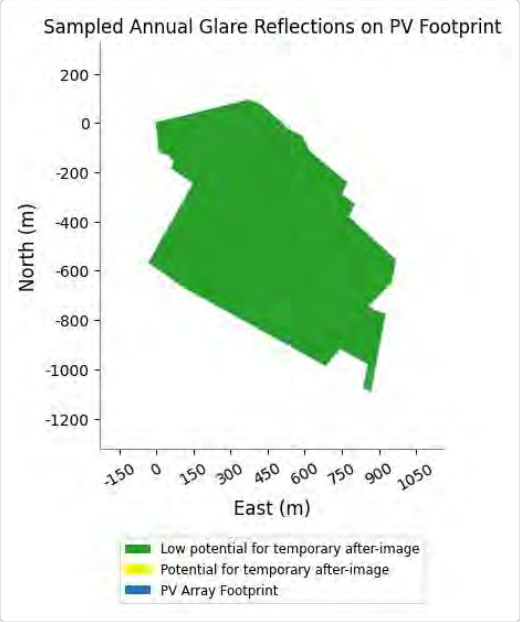
PV array 1 - OP Receptor (1-ATCT)

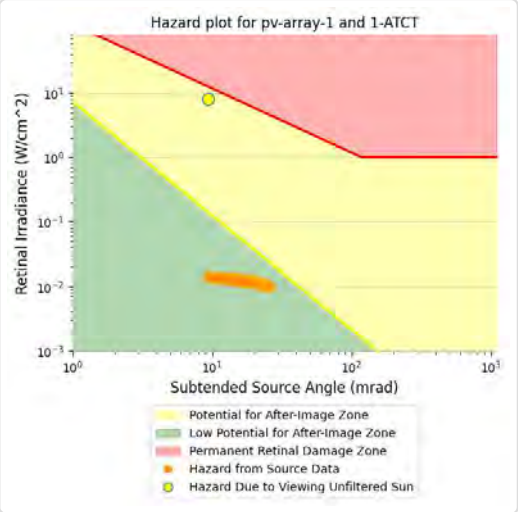
PV array is expected to produce the following glare for receptors at this location:

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









PV array 1 - OP Receptor (2-ATCT)

No glare found

Assumptions

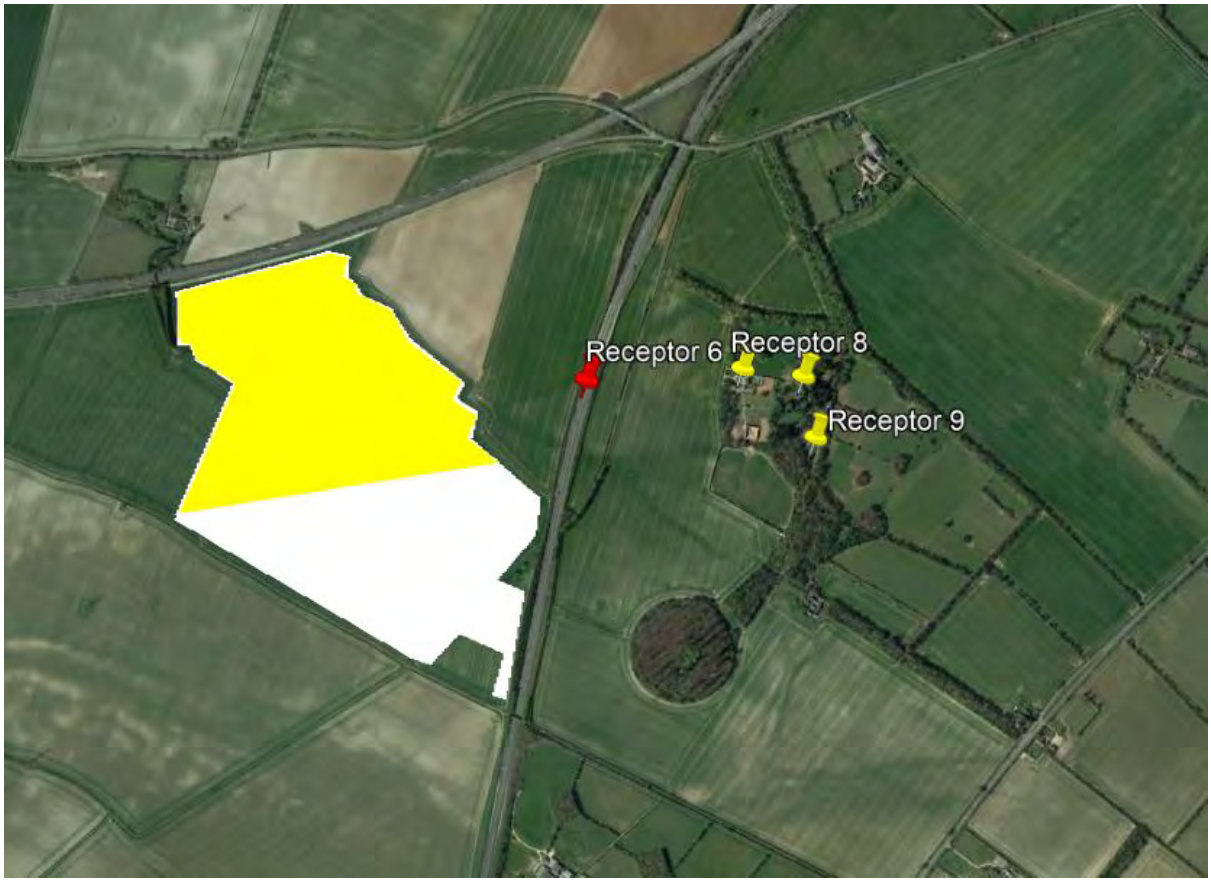
- Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
- Glare analyses do not automatically account for physical obstructions between reflectors and receptors. This includes buildings, tree cover and geographic obstructions.
- Detailed system geometry is not 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 V1 calculations utilize the PV array centroid, rather than the actual glare spot location, due to algorithm limitations. This may affect results fc 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.)
- 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.
- Refer to the **Help page** for detailed assumptions and limitations not listed here.

Appendix F: Visibility Assessment Evidence

Left Blank

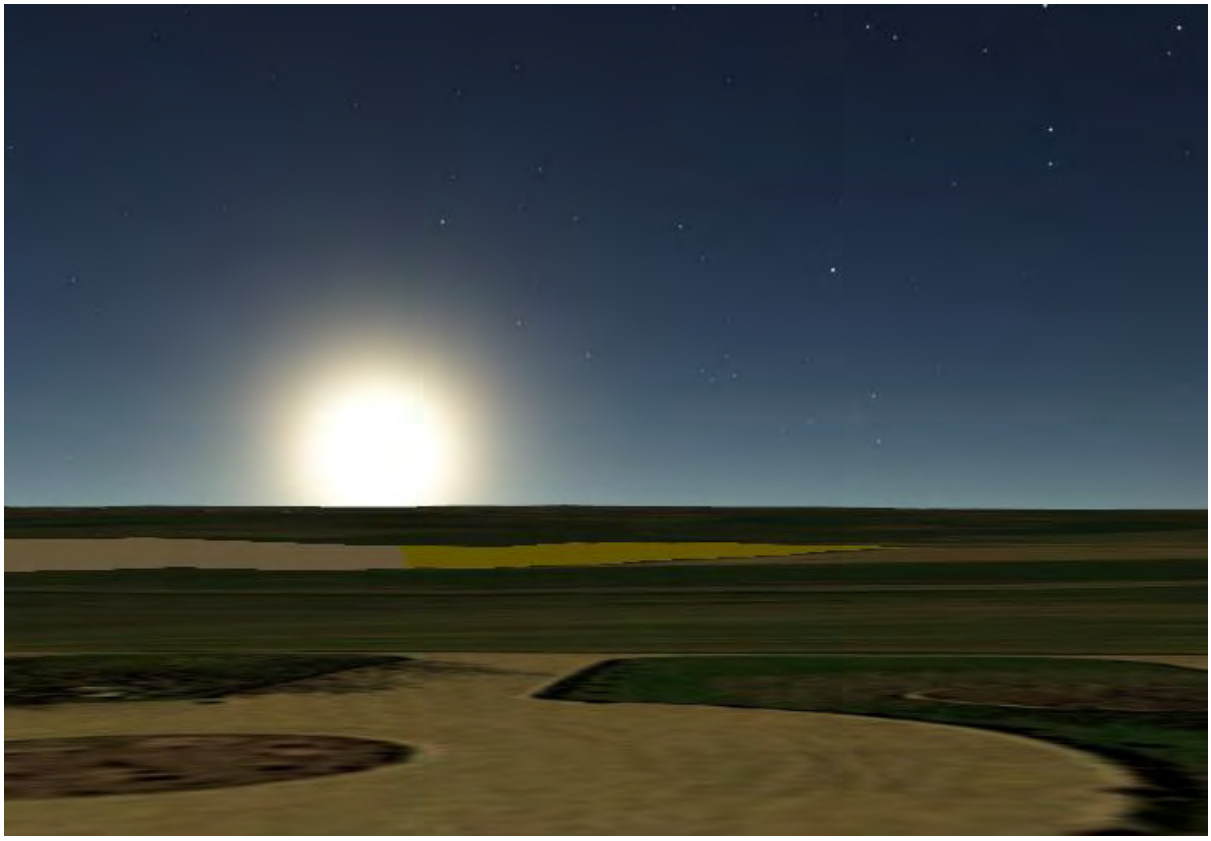
Residential Receptors

Receptors 6, 8 and 9

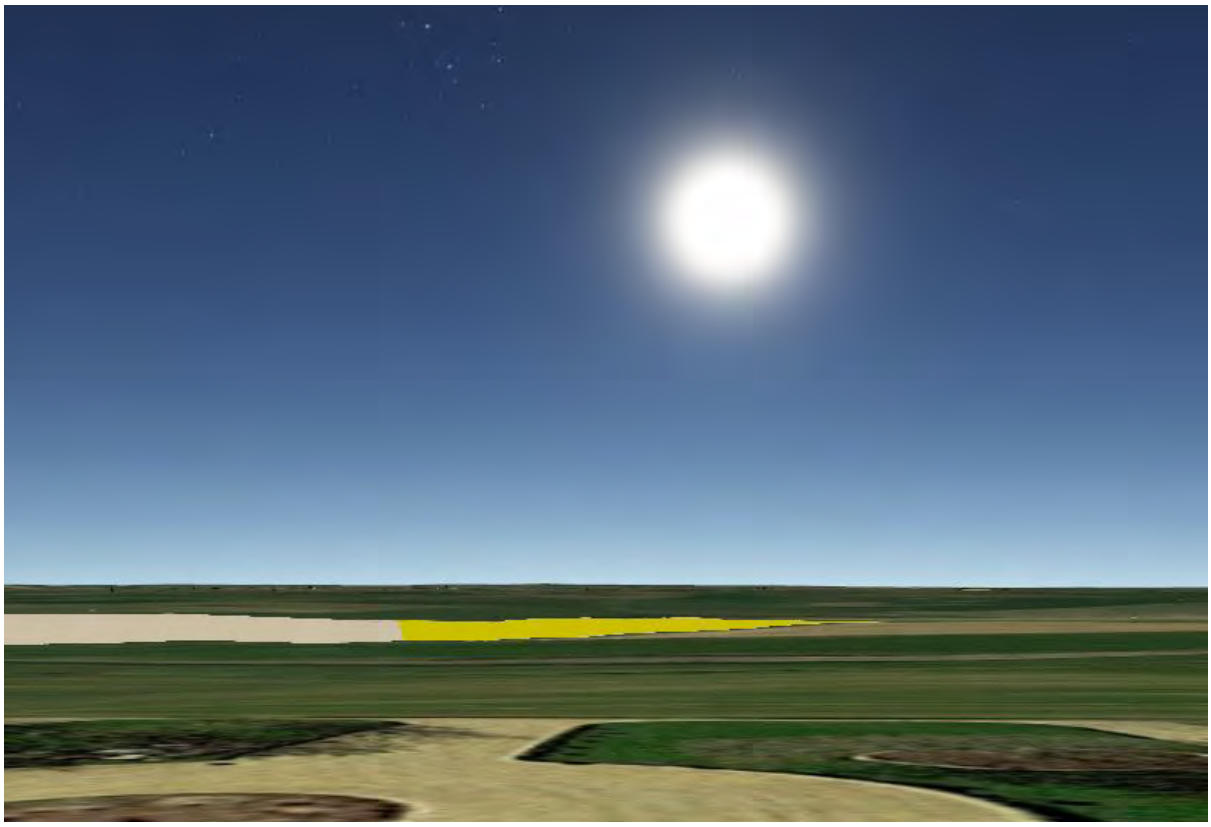


Receptor 7

March 15th 17:45 UTC

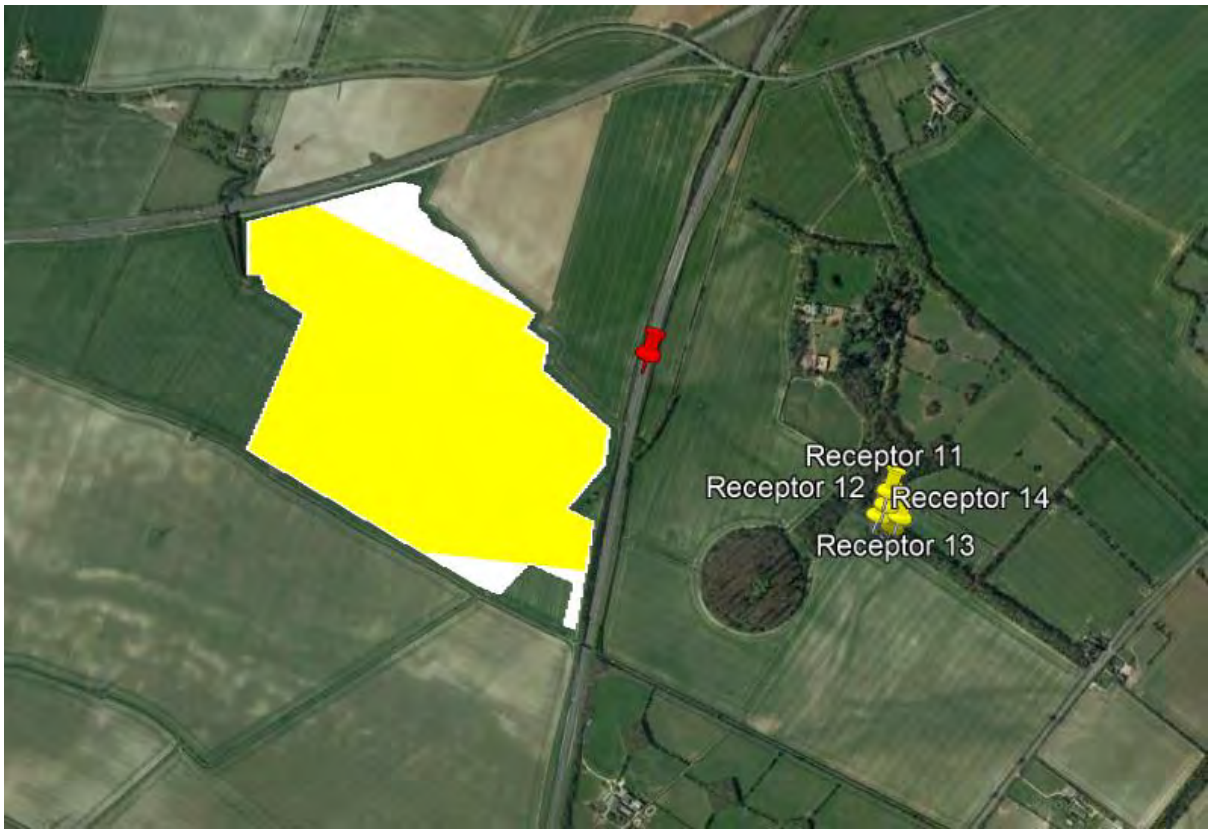


May 15th 17:45 UTC



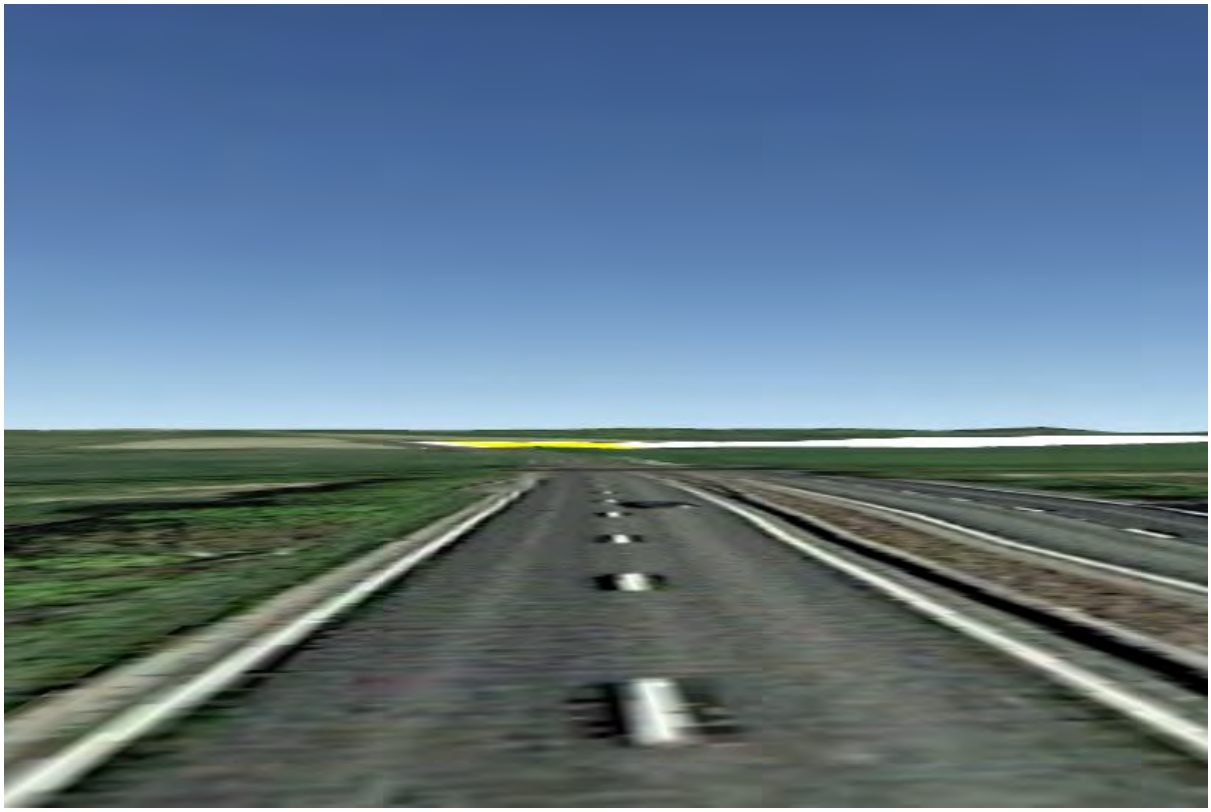
Receptor 10

Receptors 11 – 15

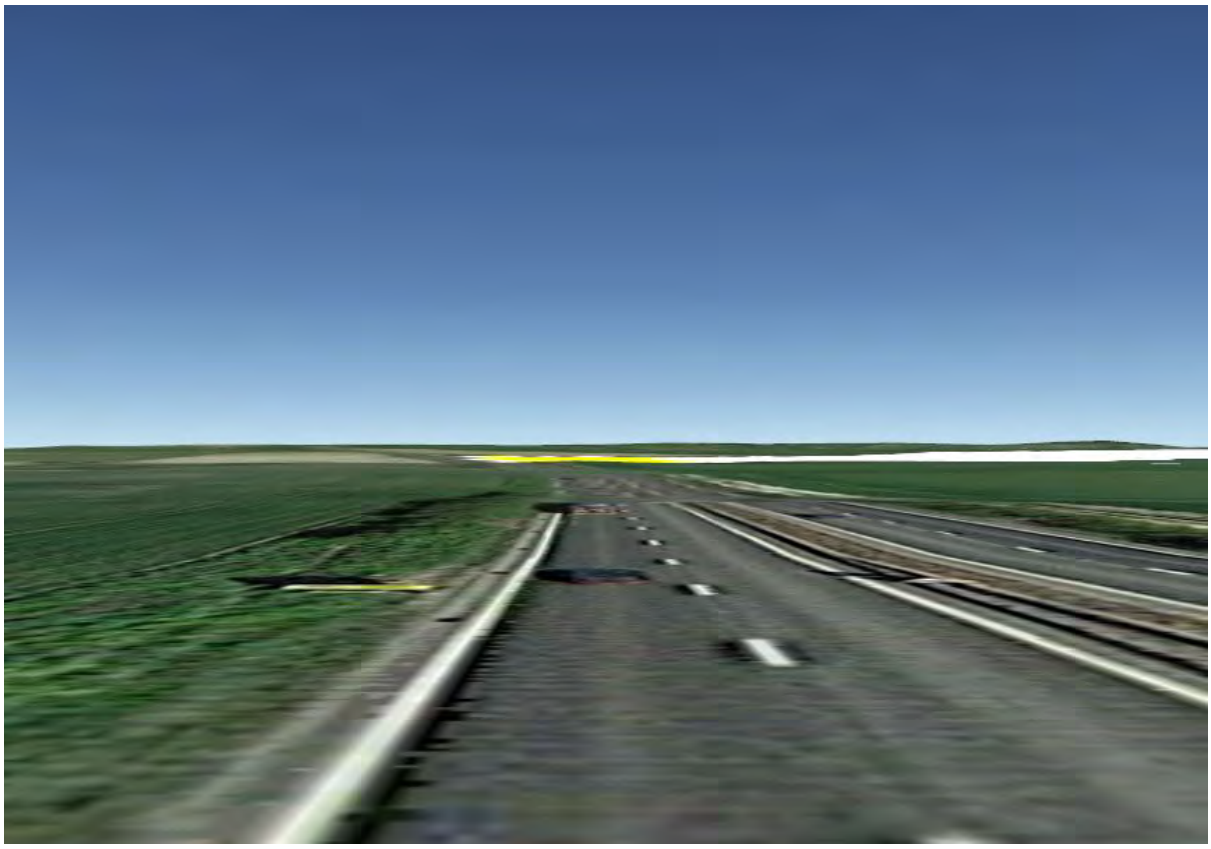


Road Receptors

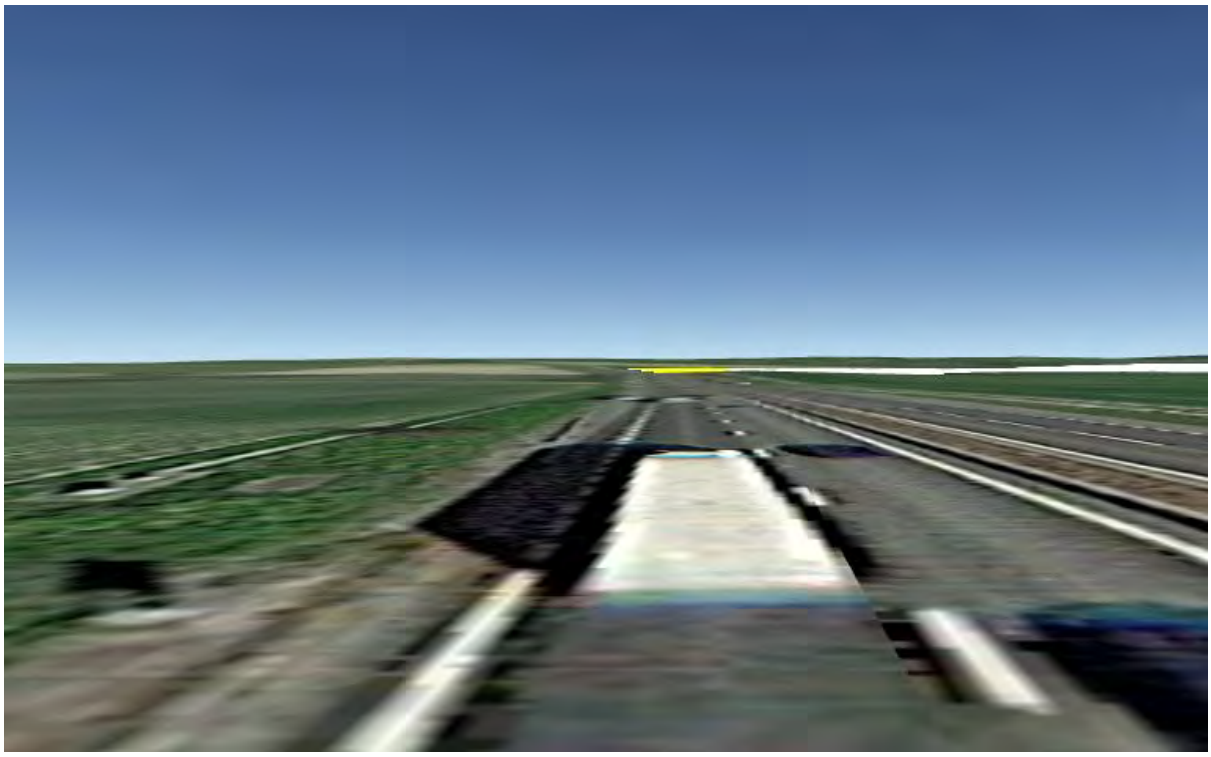
Receptor 5



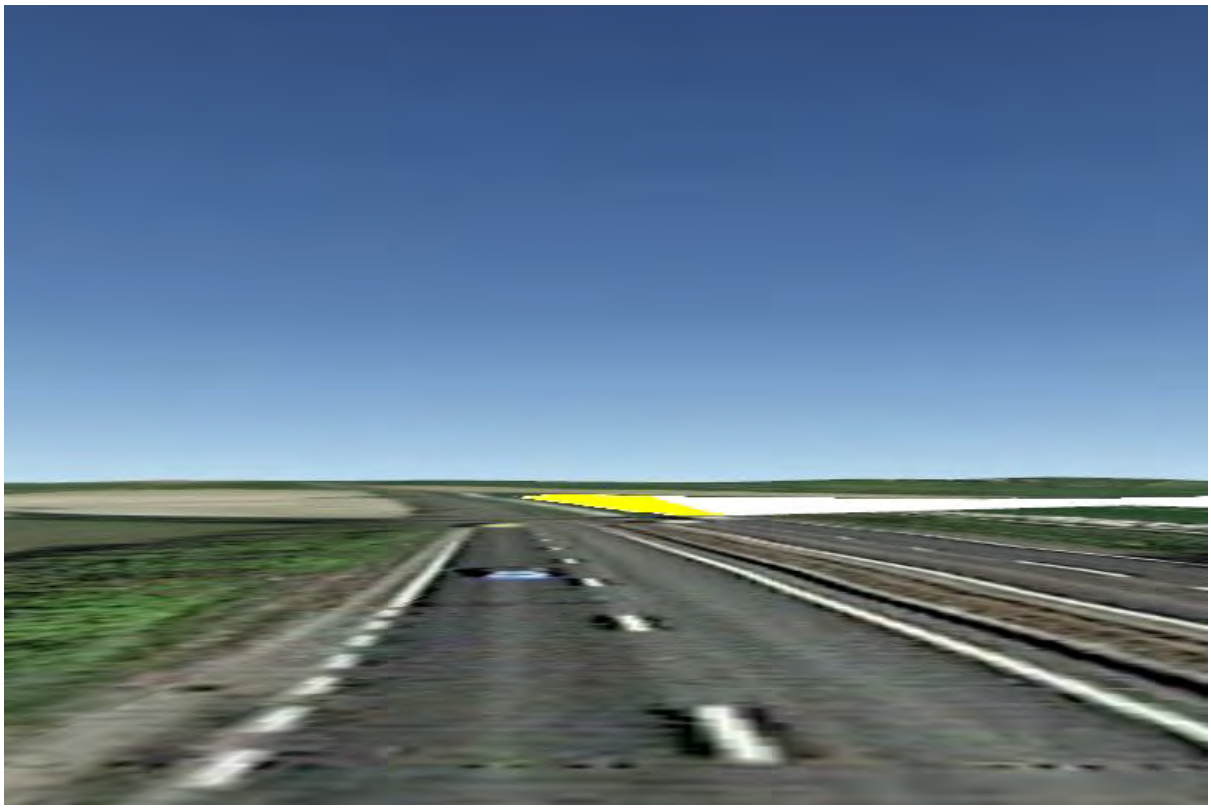
Receptor 6



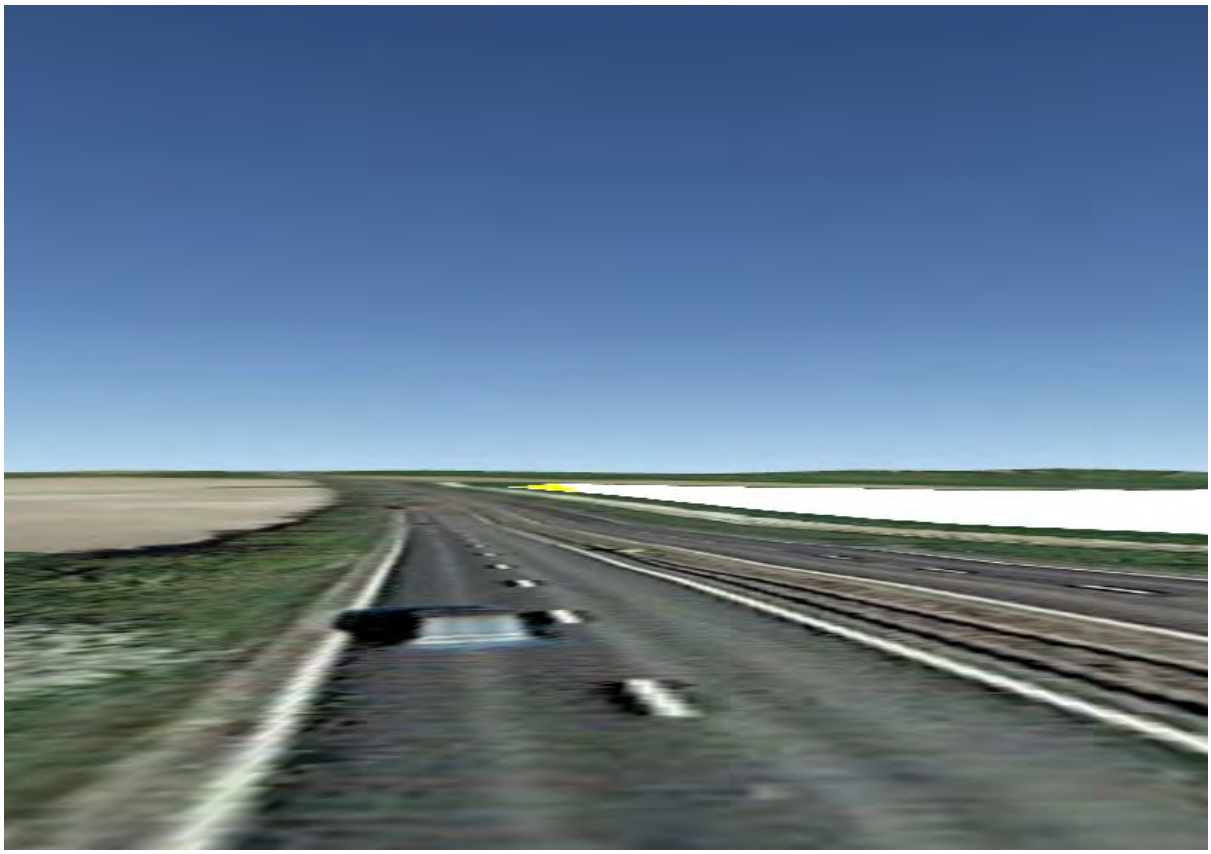
Receptor 8



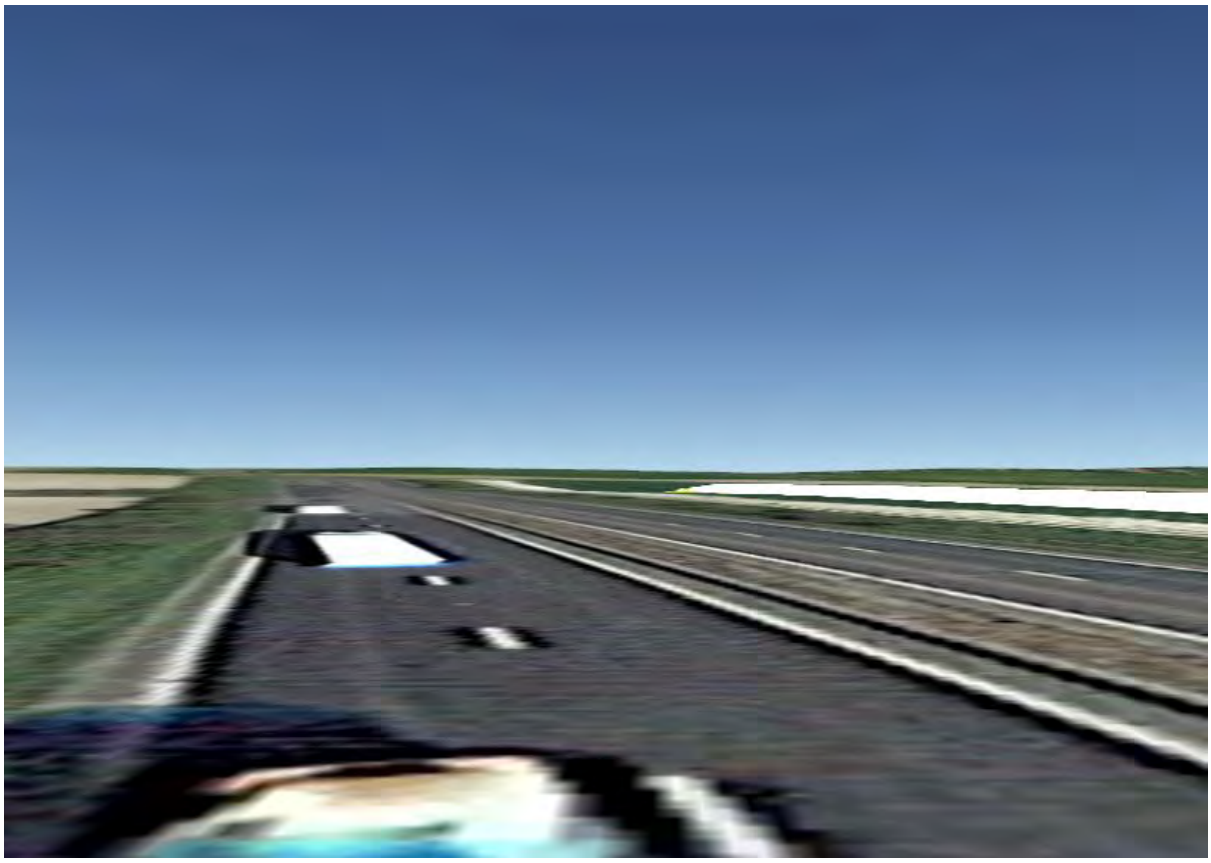
Receptor 9



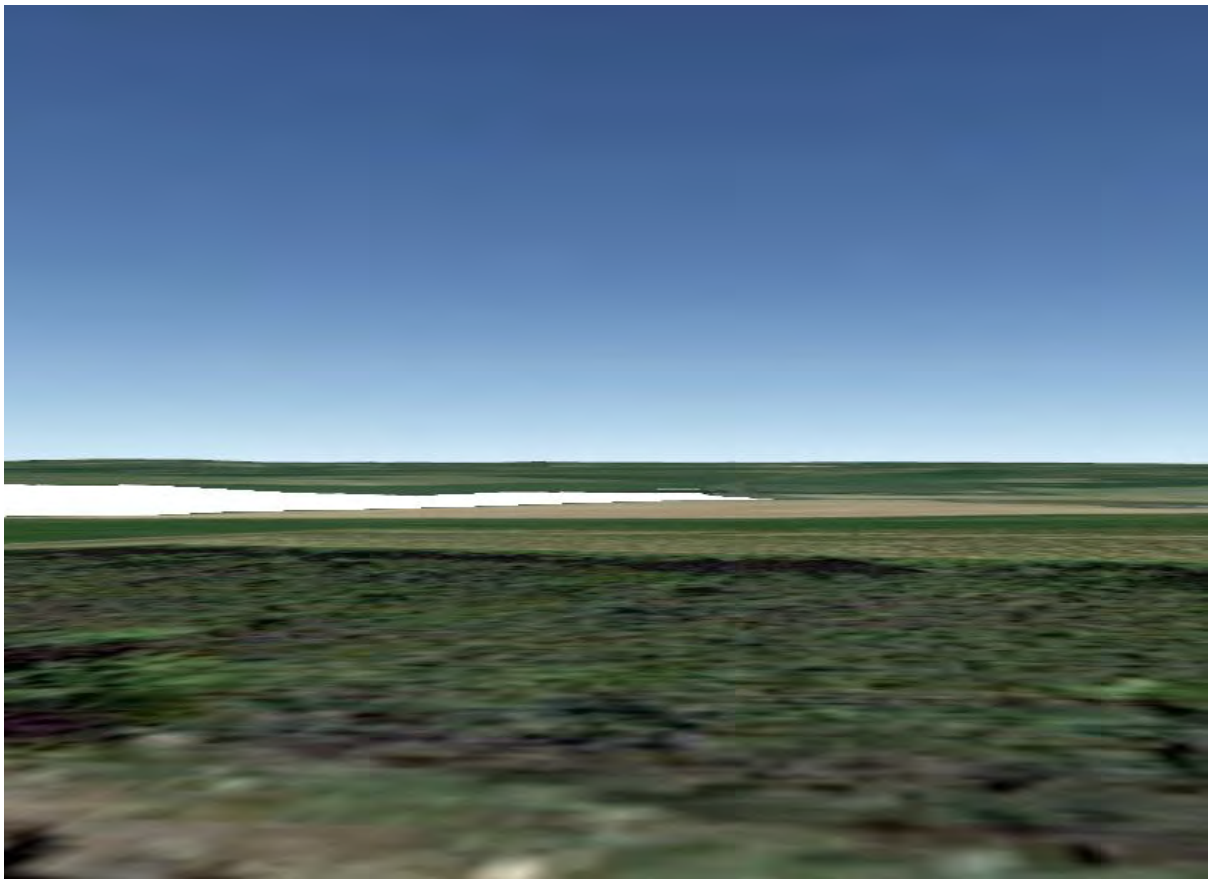
Receptor 10



Receptor 11

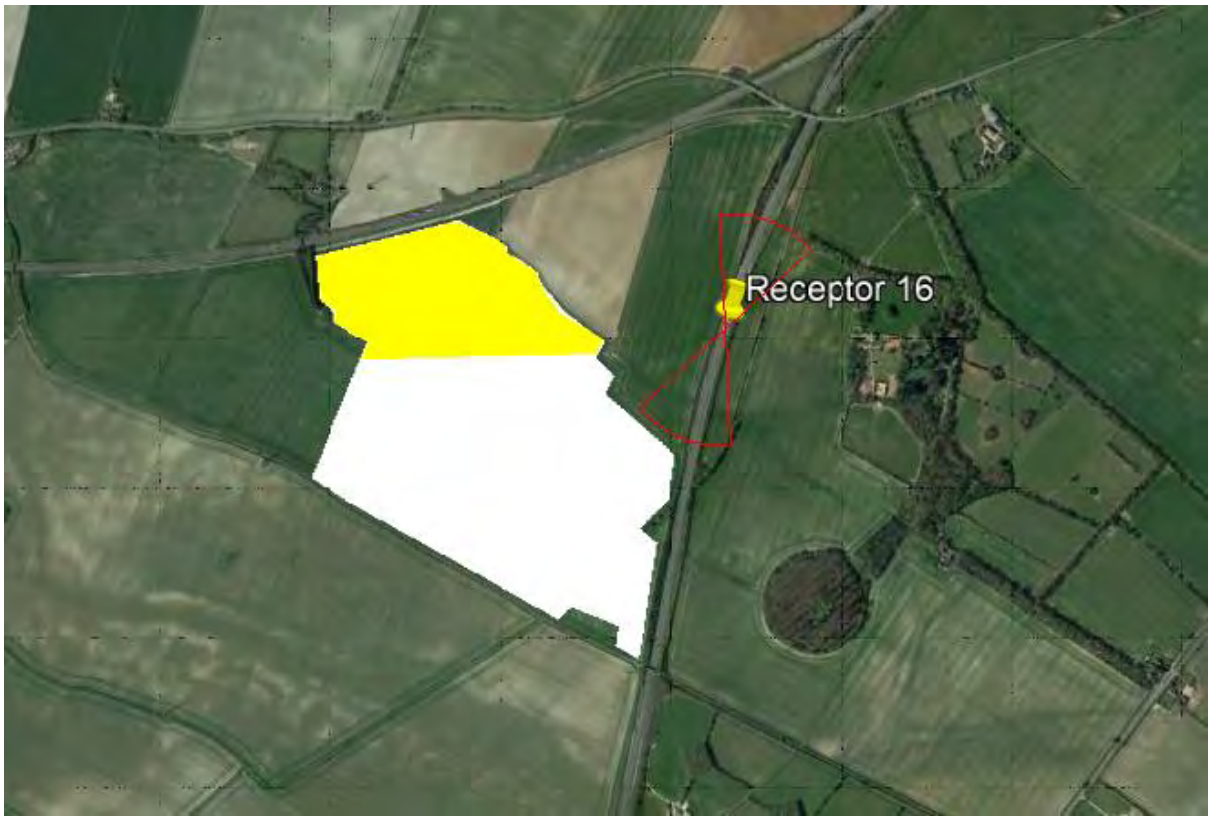


Receptor 14

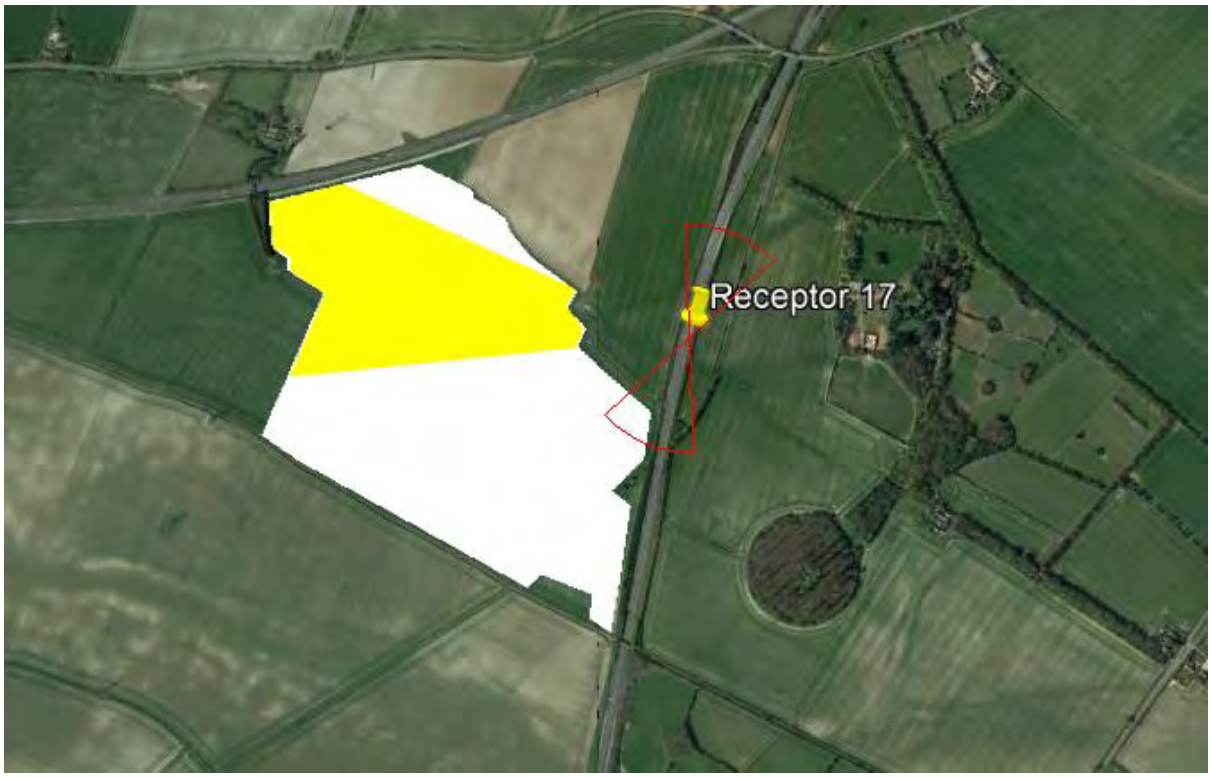


Receptor 15

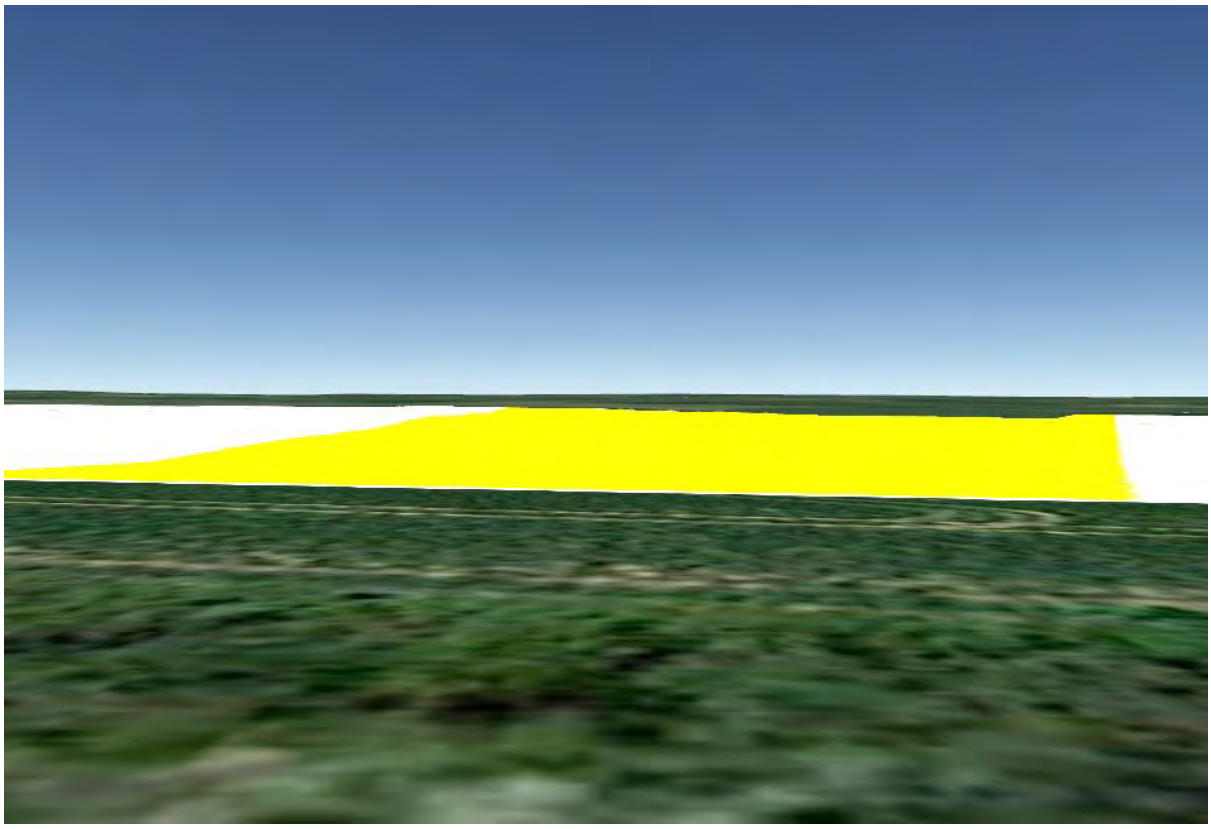
Receptor 16



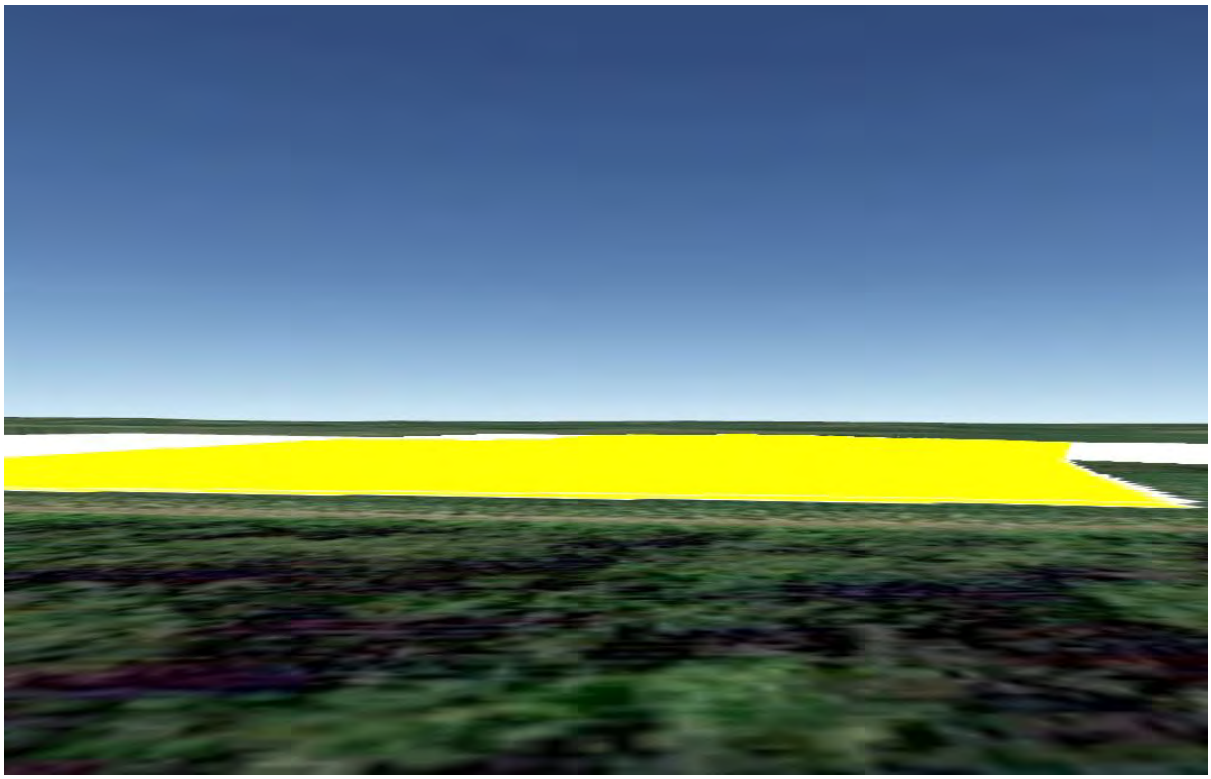
Receptor 17



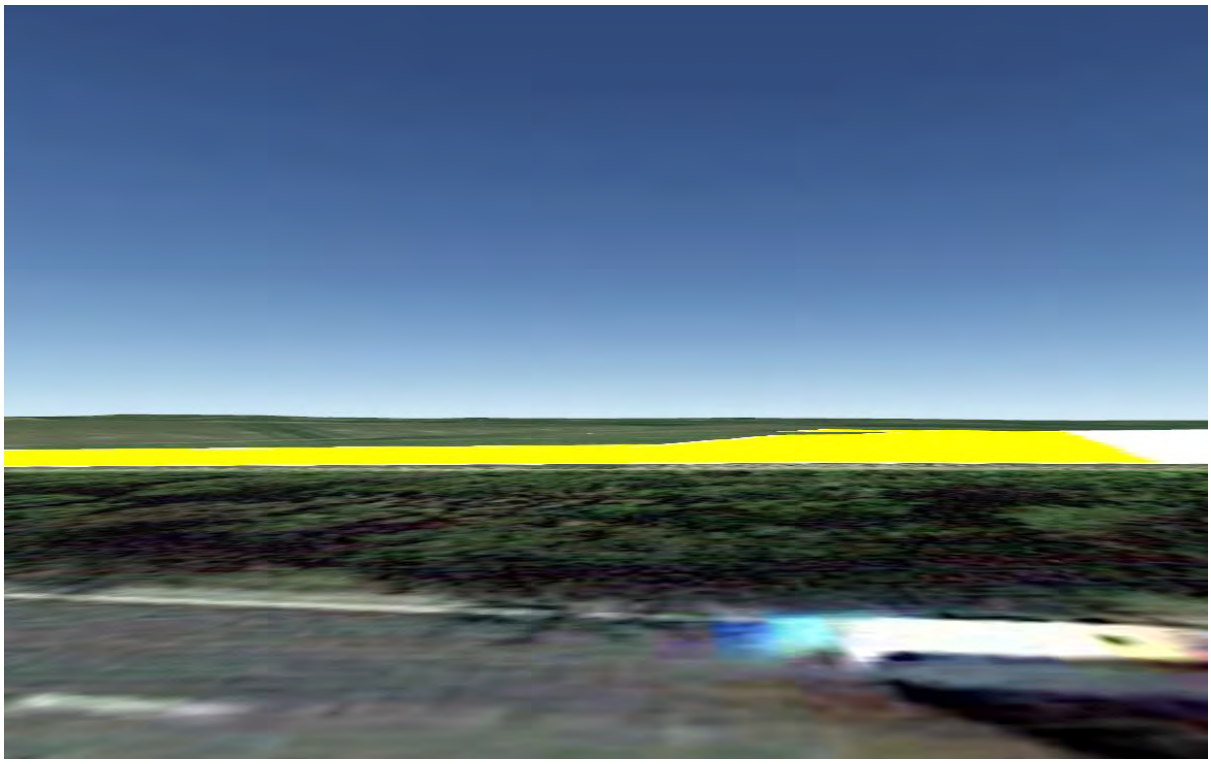
Receptor 18



Receptor 19



Receptor 20



Bridleway Receptors

Receptor 2

View towards the receptor from the position of the red pin

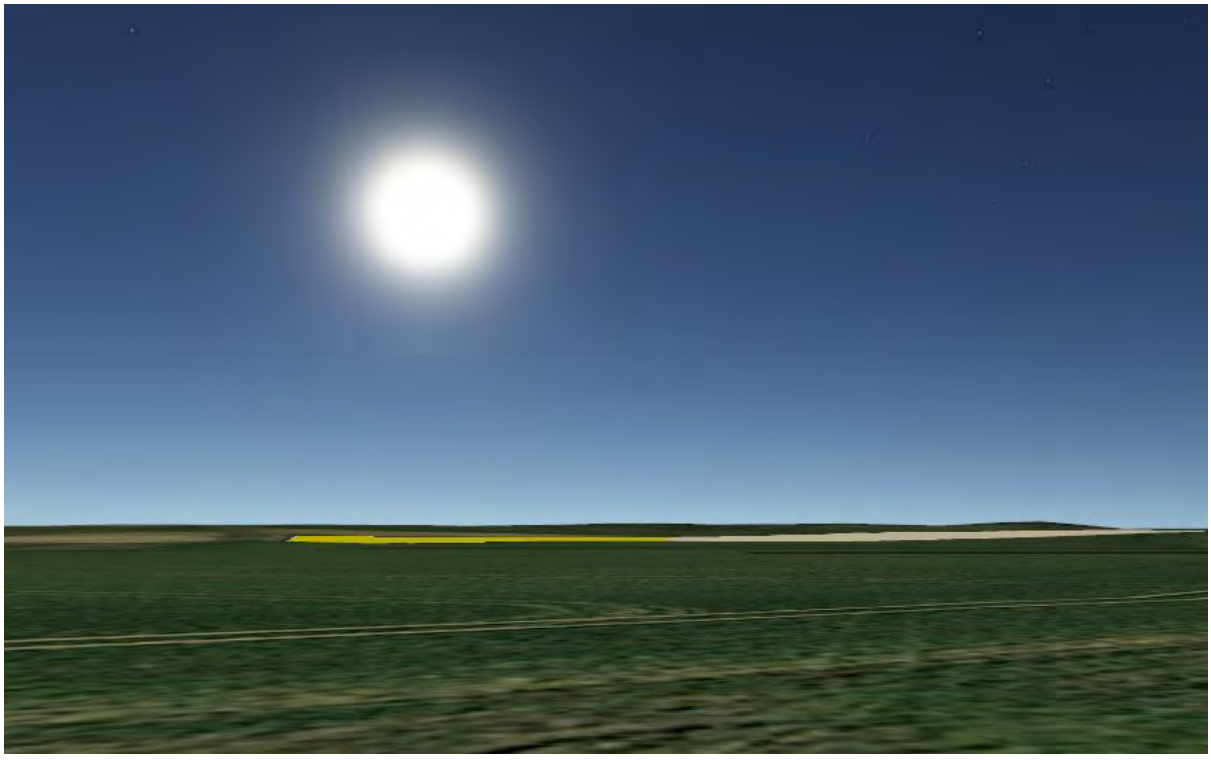
Receptor 3

View towards the Proposed Development from the position of the red pin

Receptor 4

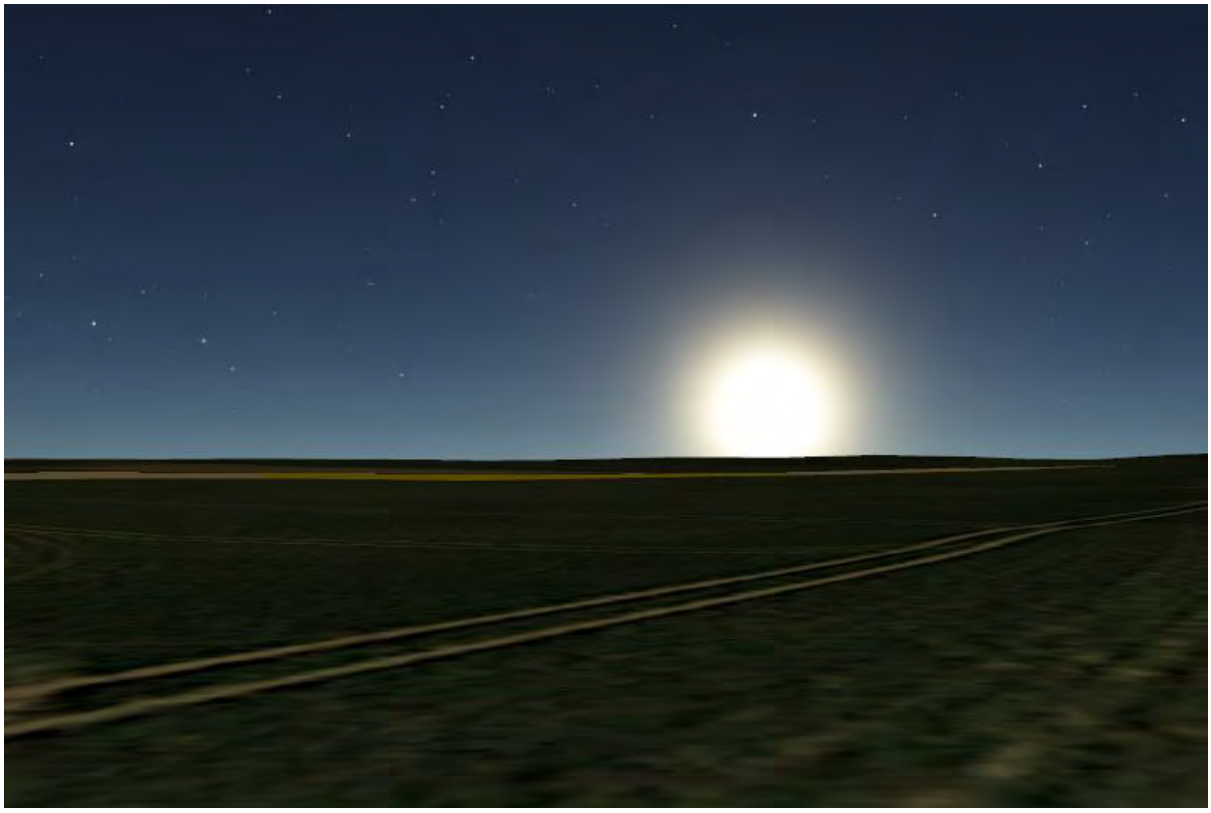
March 15th 06:30 UTC

May 15th 06:00 UTC

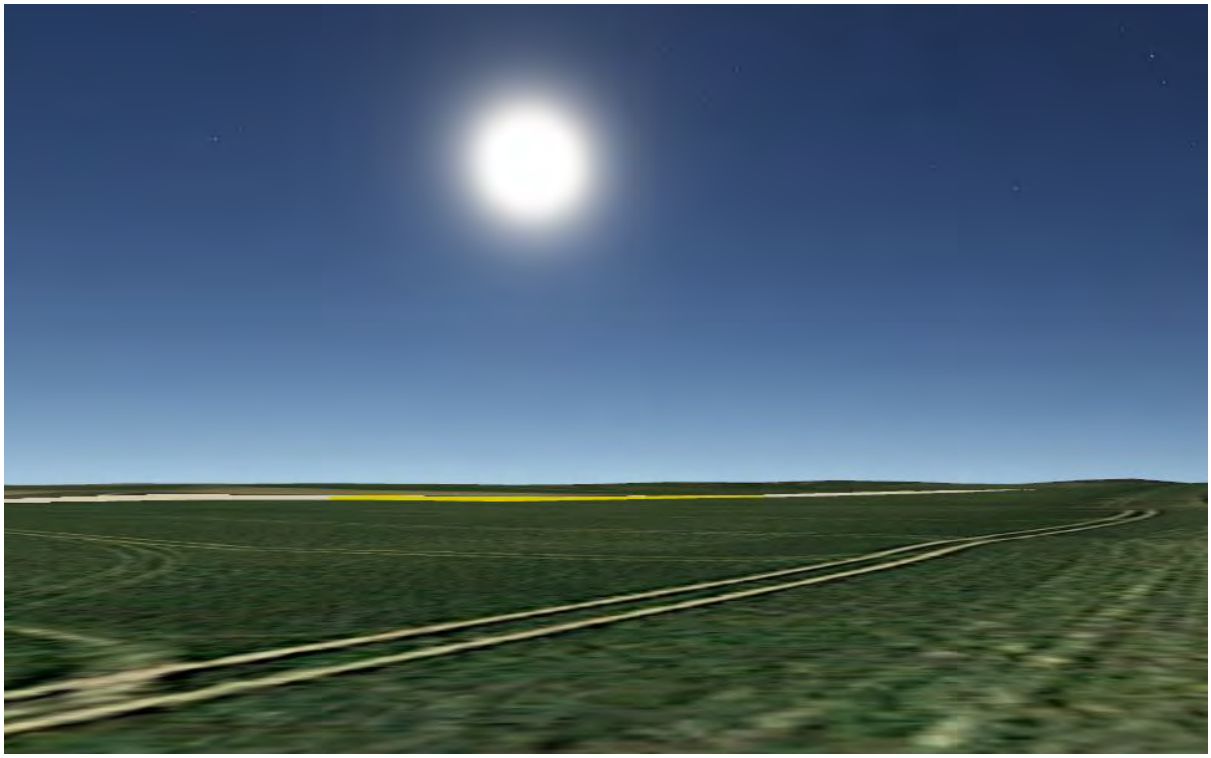


Receptor 6

April 1st 06:00 UTC

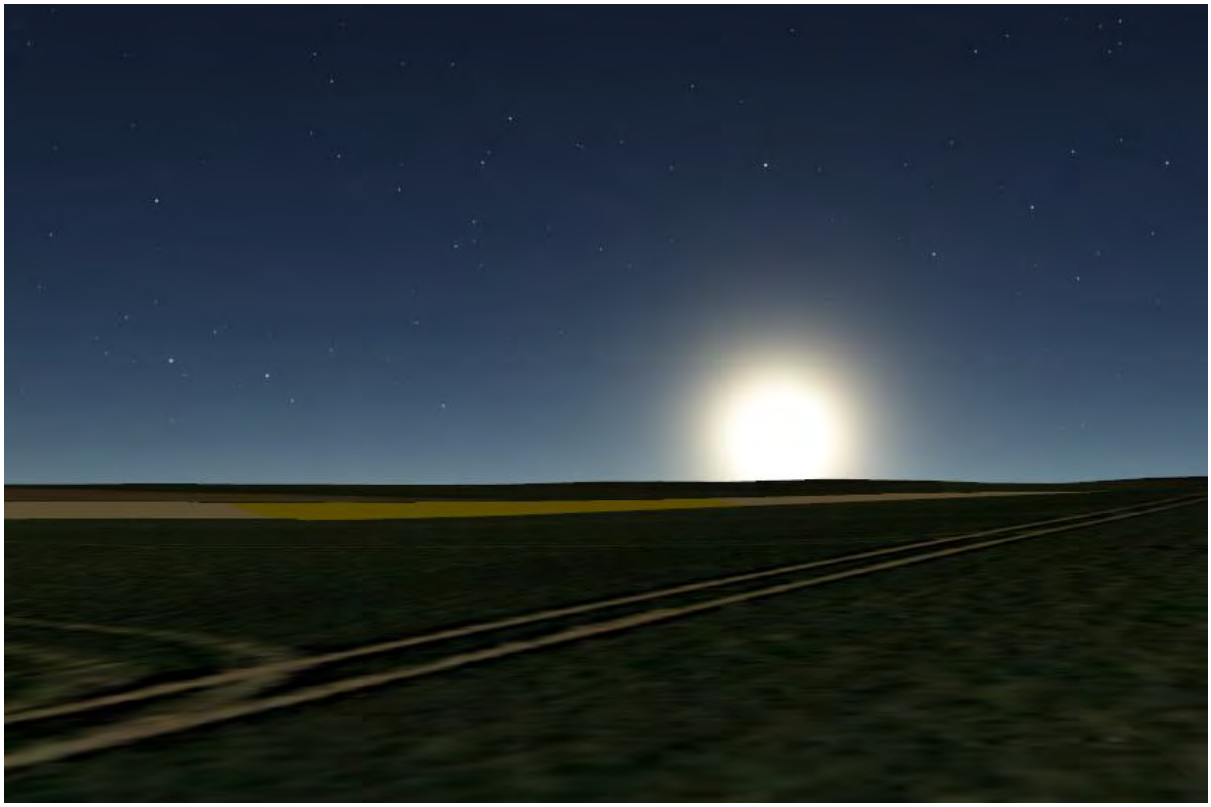


July 1st 06:00 UTC

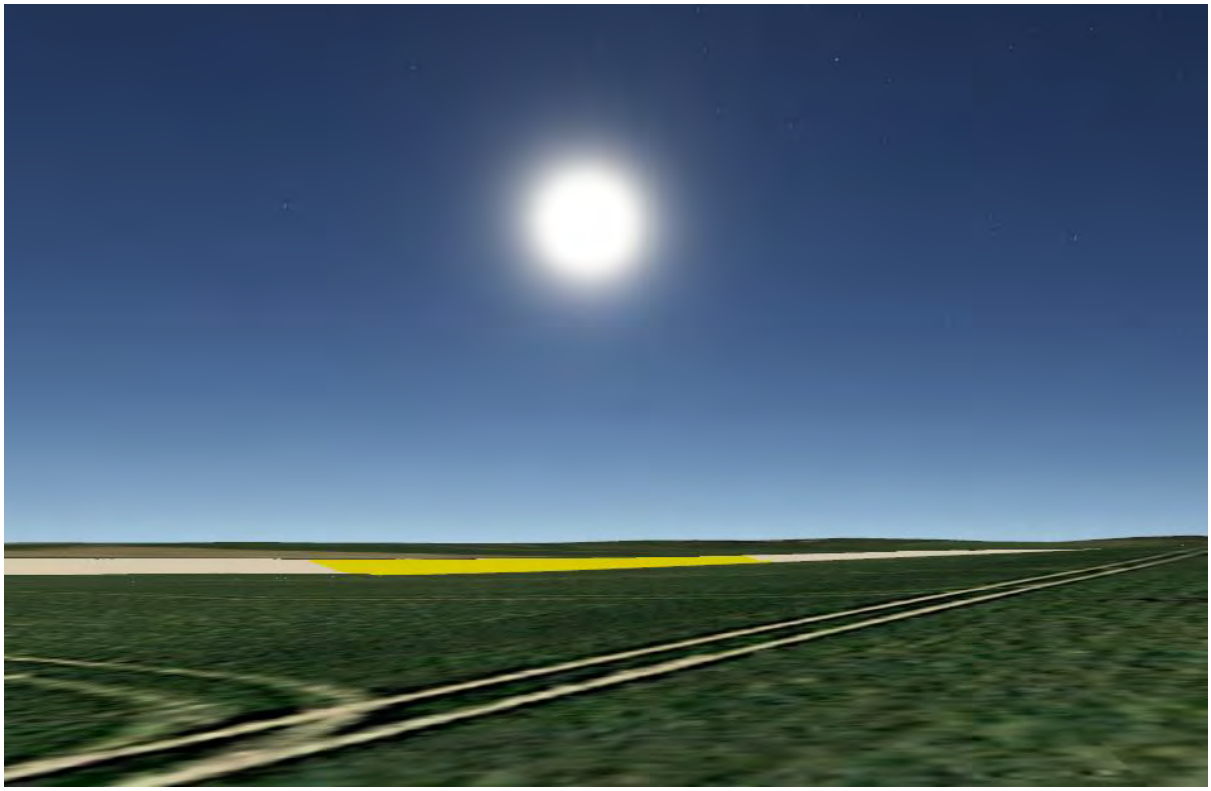


Receptor 7

April 1st 06:00 UTC

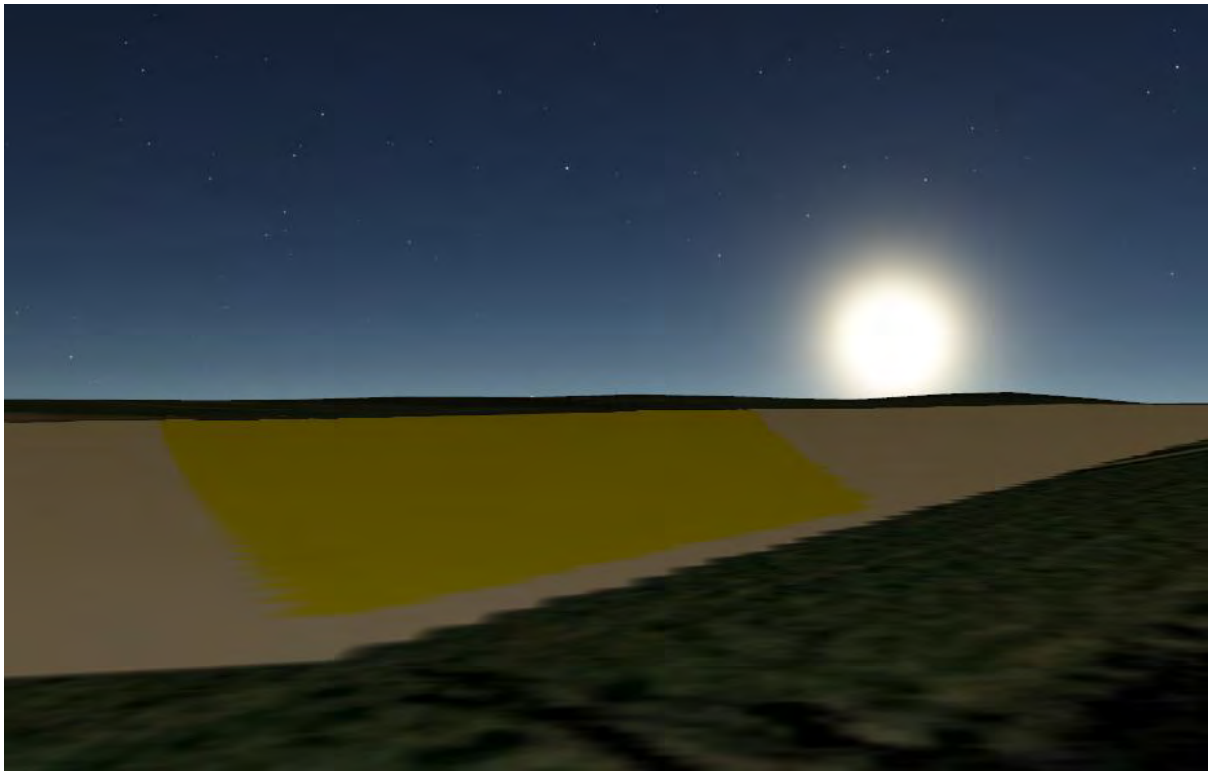


July 1st 06:00 UTC

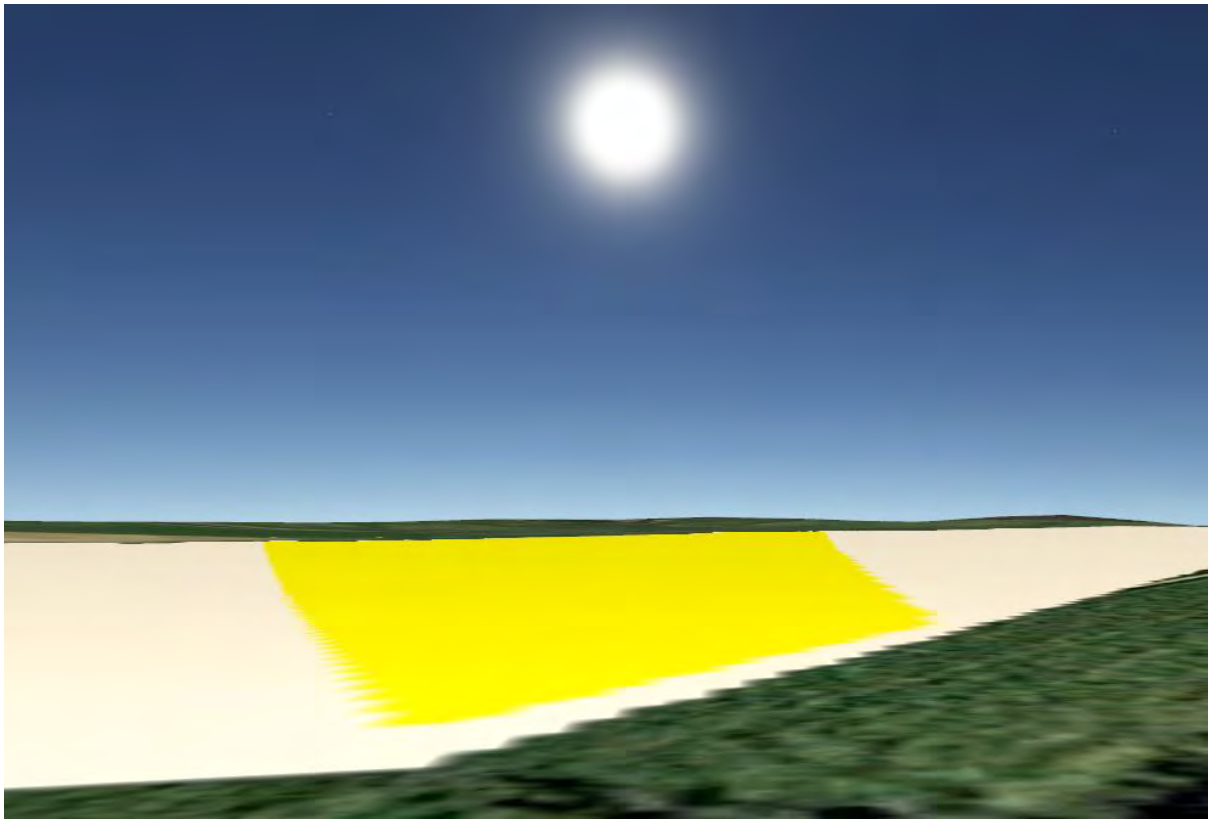


Receptor 8

March 15th 06:45 UTC

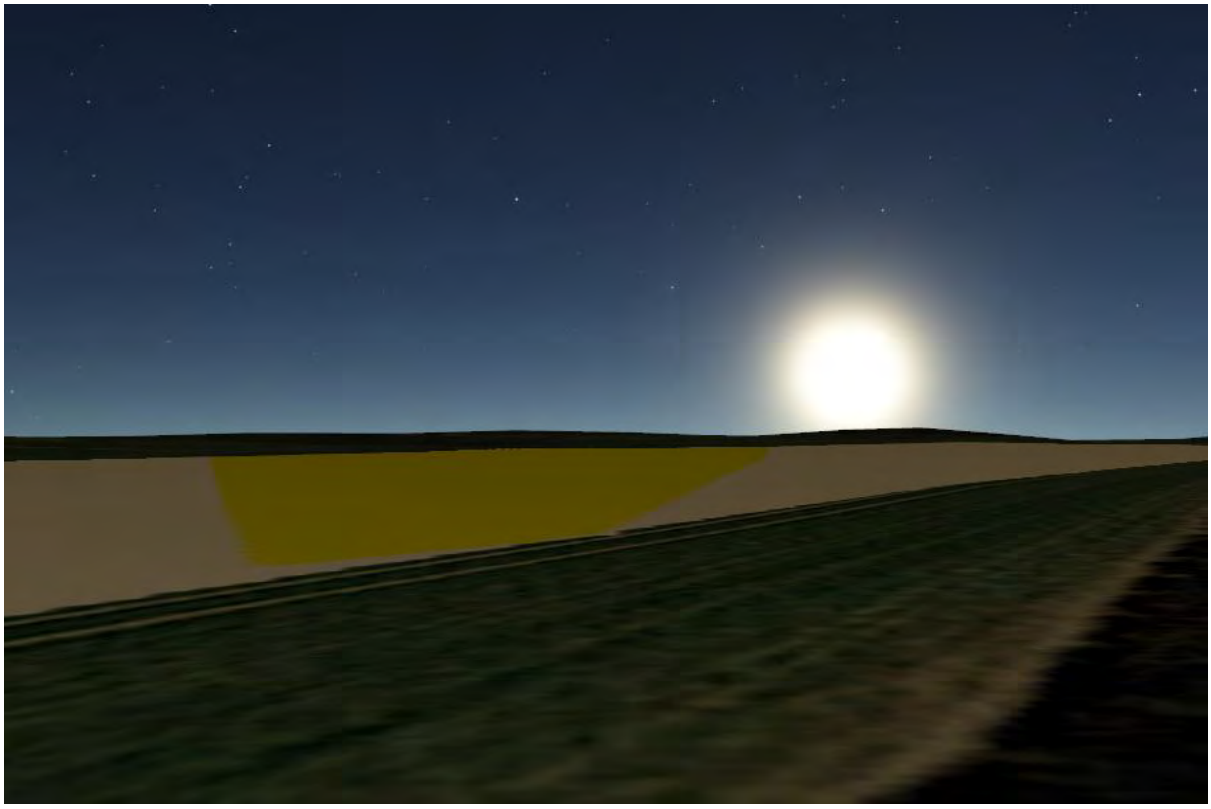


July 1st 06:30 UTC

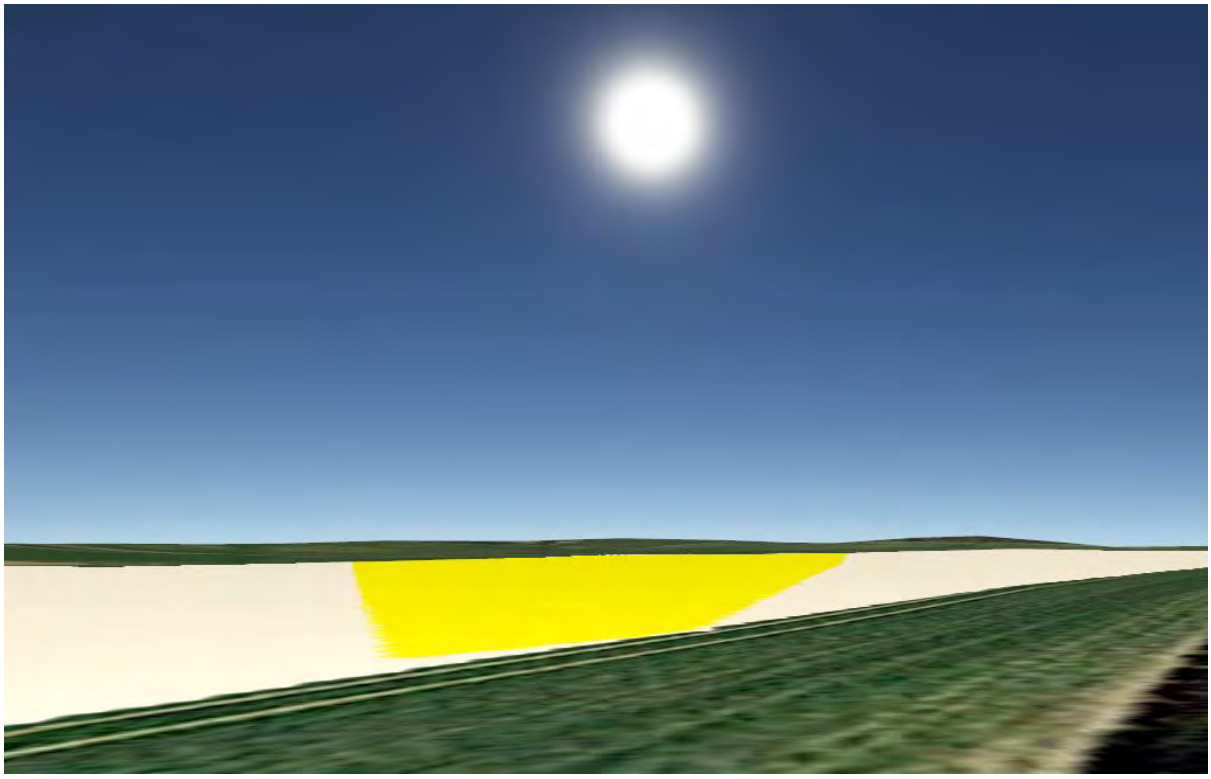


Receptor 9

March 15th 06:45 UTC

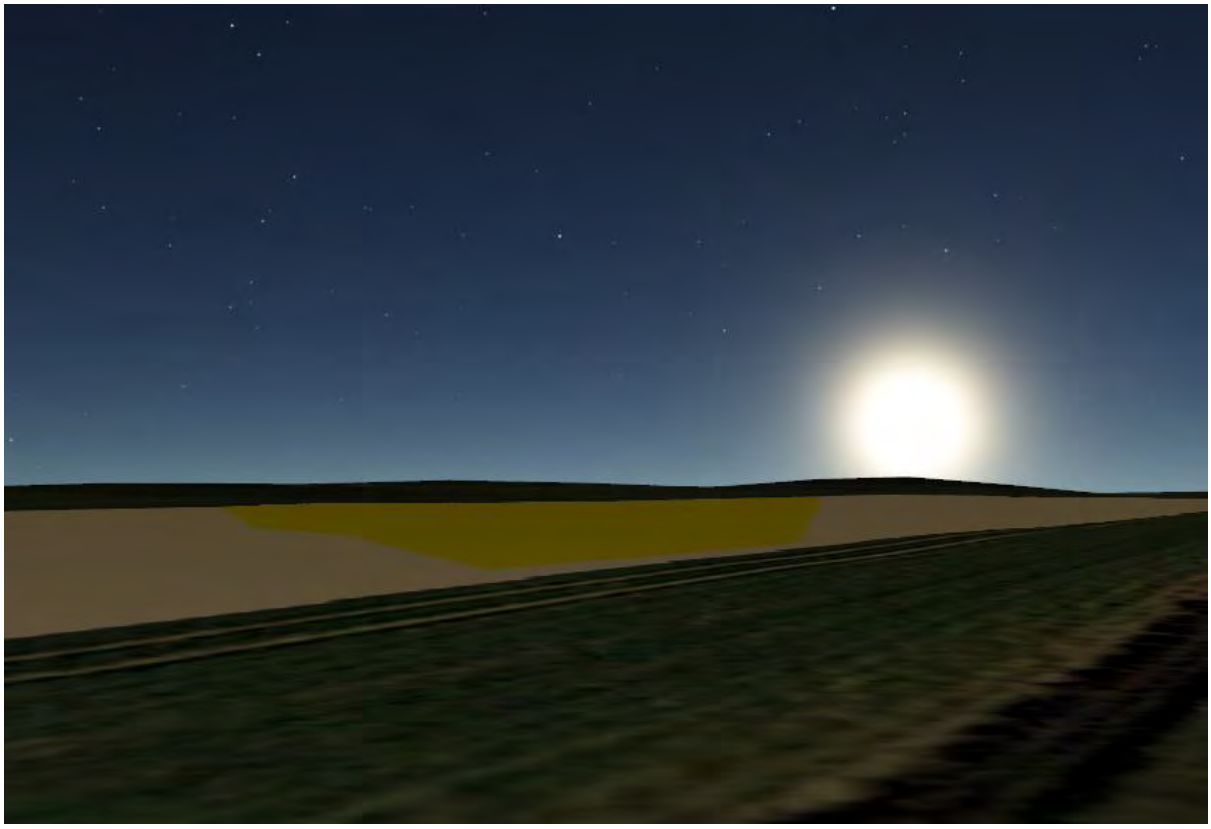


July 1st 06:45 UTC

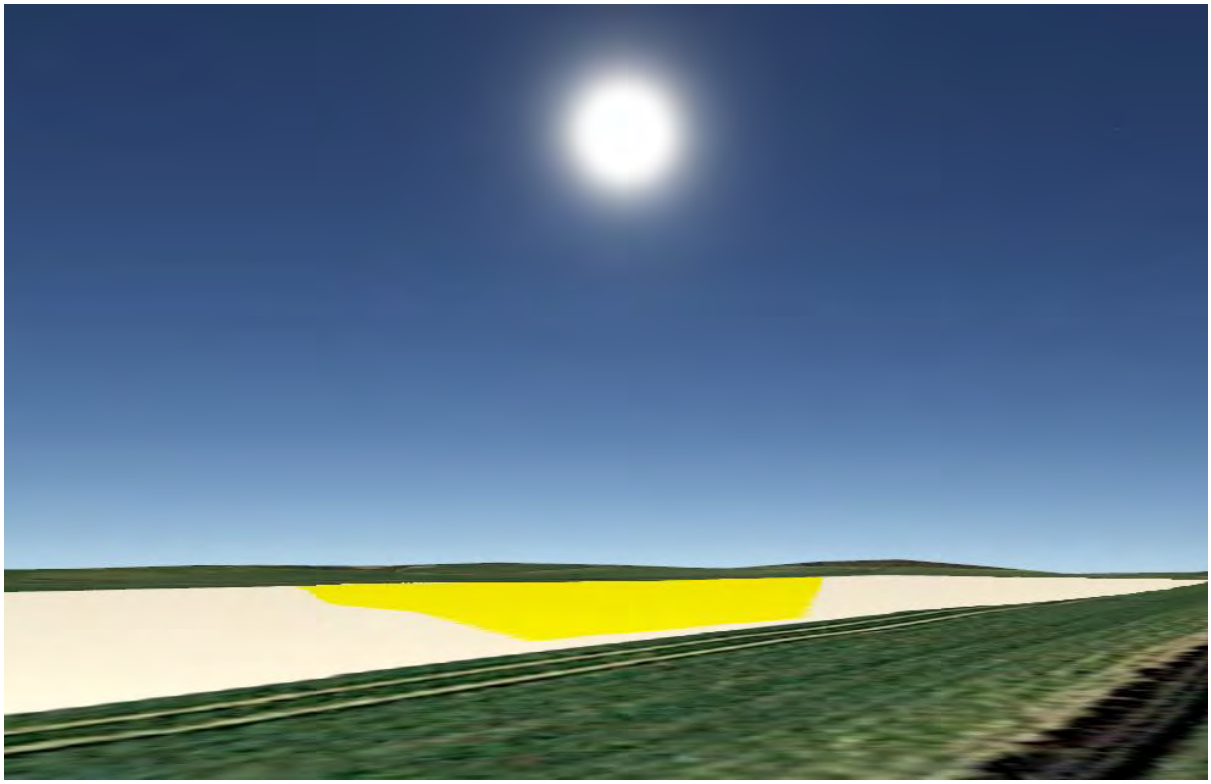


Receptor 10

March 15th 06:45 UTC

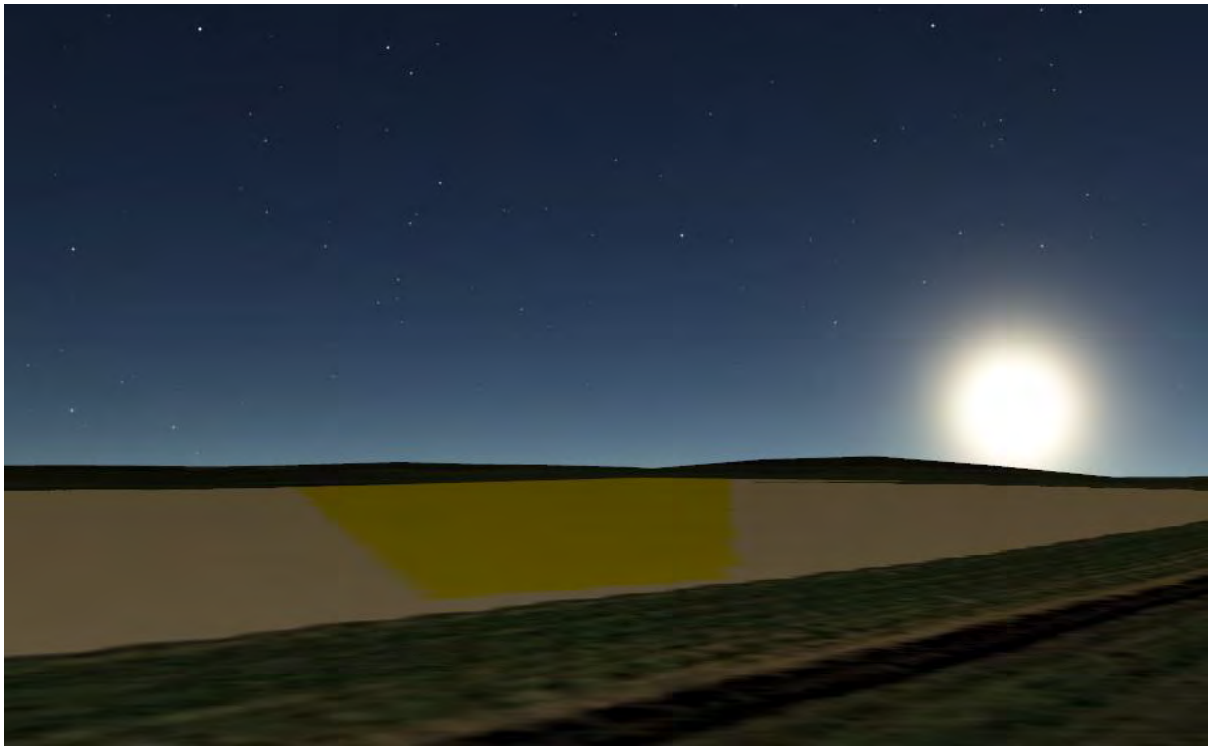


July 1st 16:45 UTC

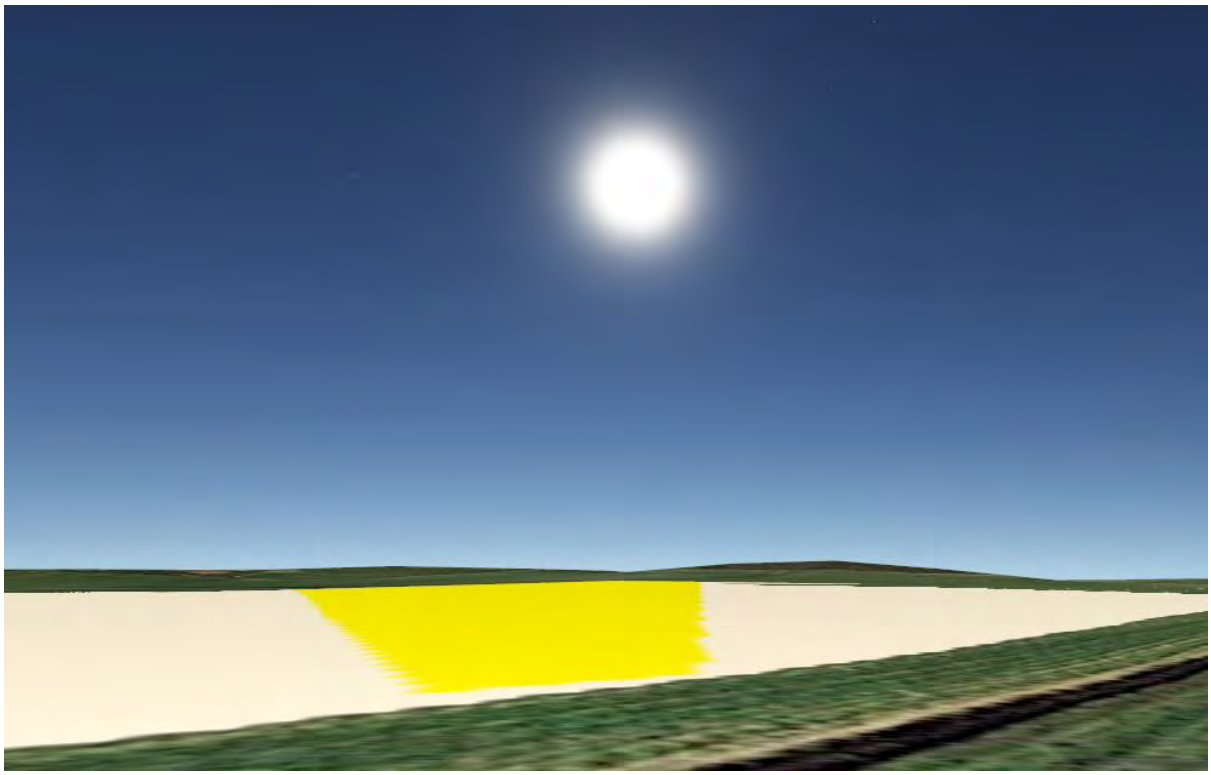


Receptor 11

March 15th 06:45 UTC

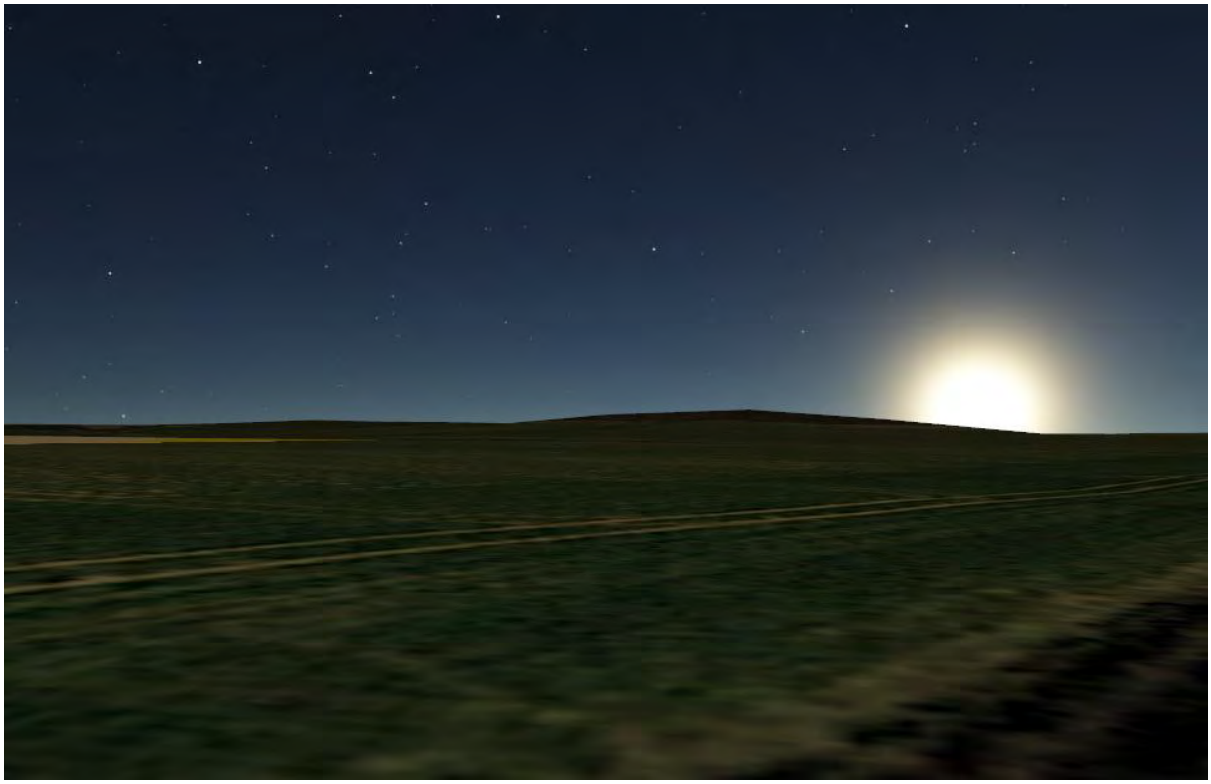


July 1st 06:30 UTC

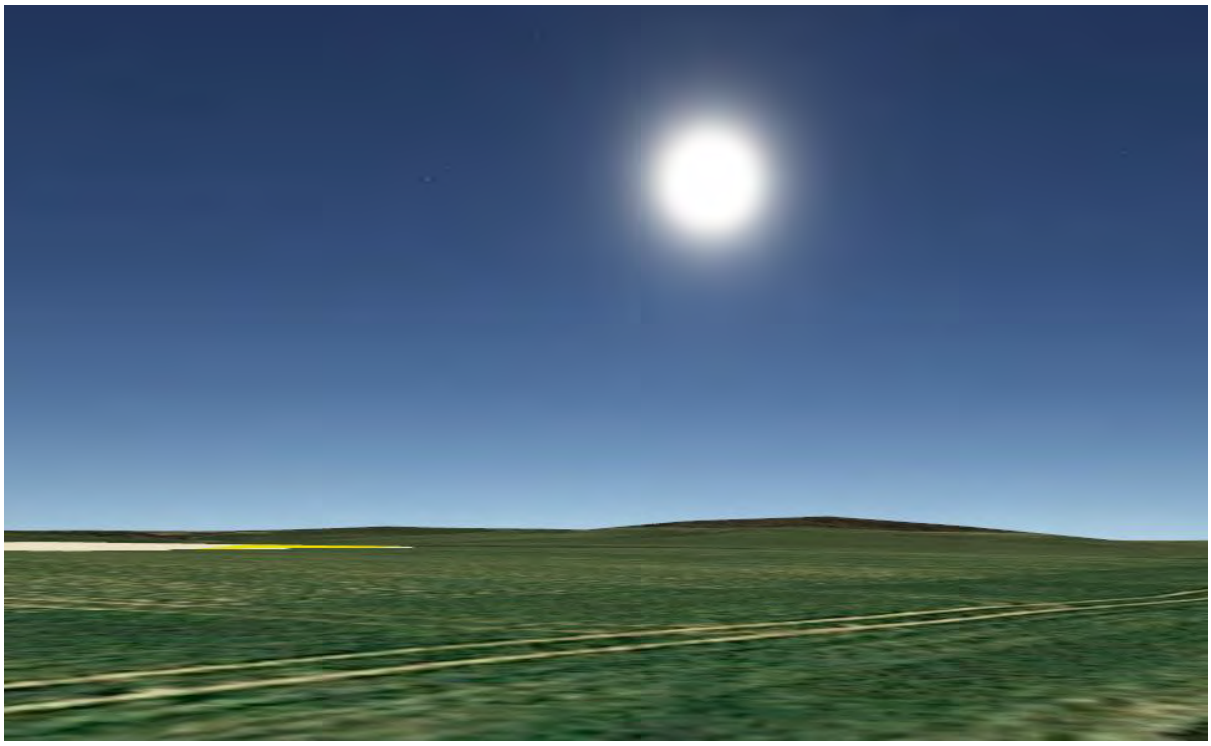


Receptor 12

March 15th 06:30 UTC



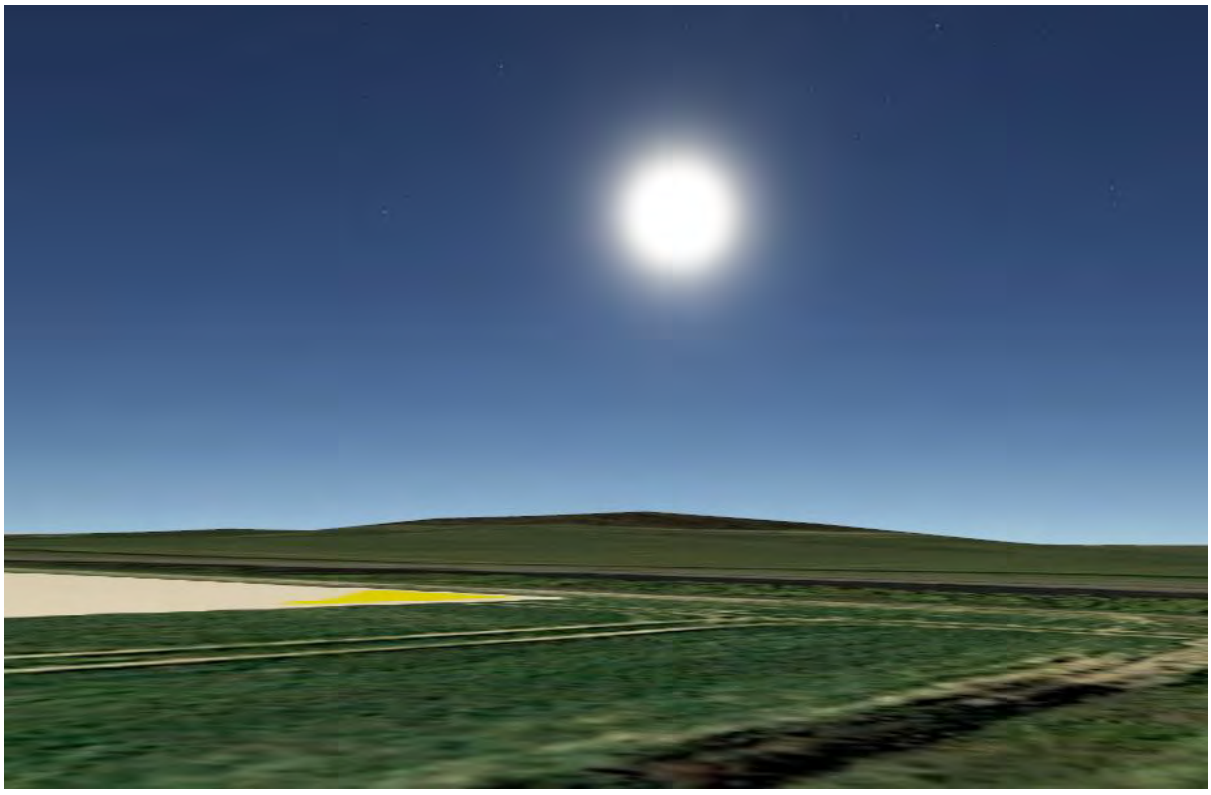
July 1st 06:15 UTC



Receptor 13

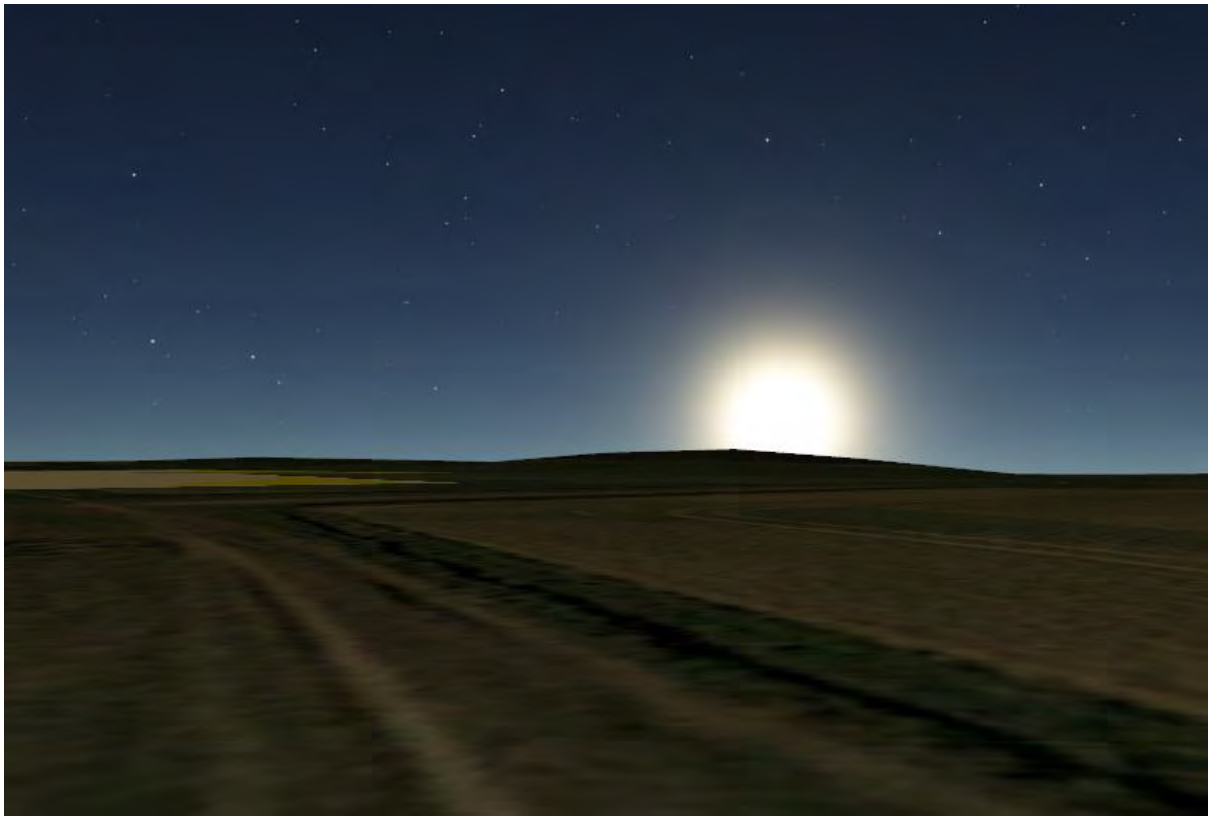
April 1st 06:00 UTC

July 1st 06:00 UTC

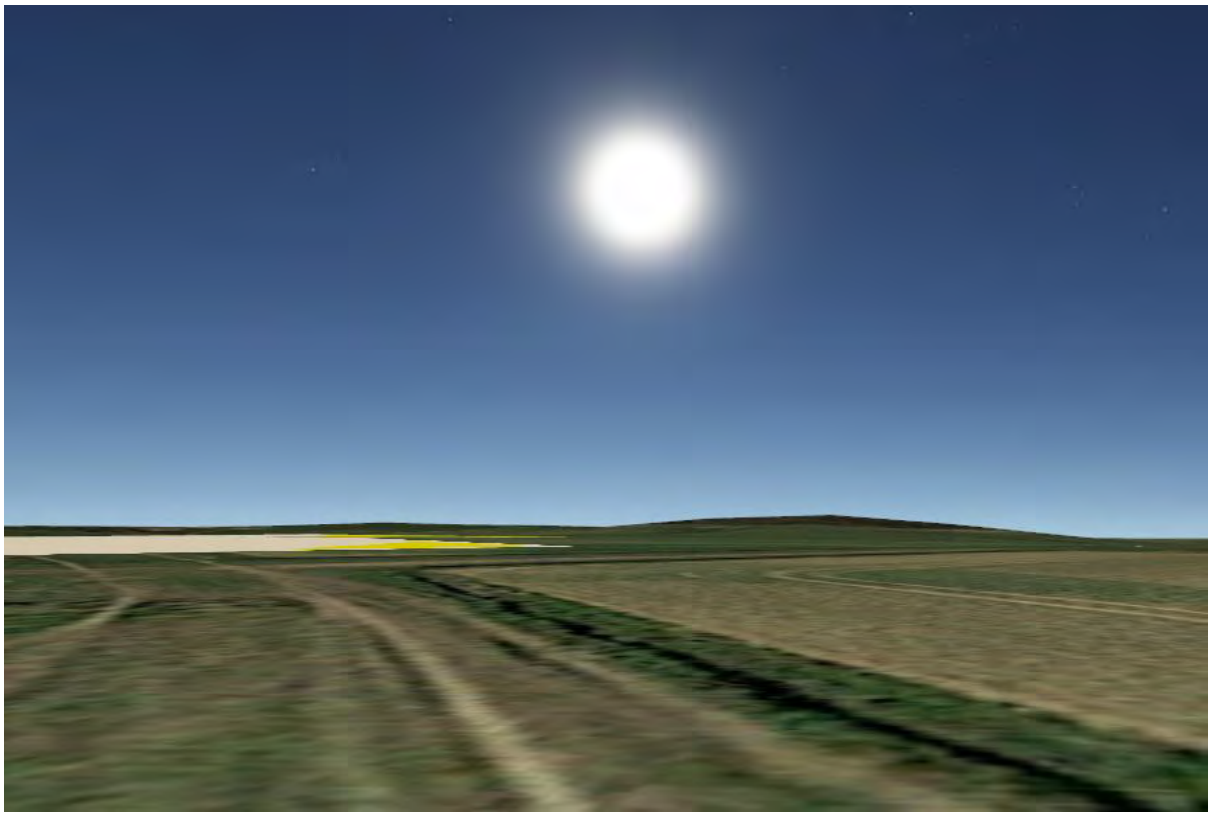


Receptor 19

April 1st 06:00 UTC

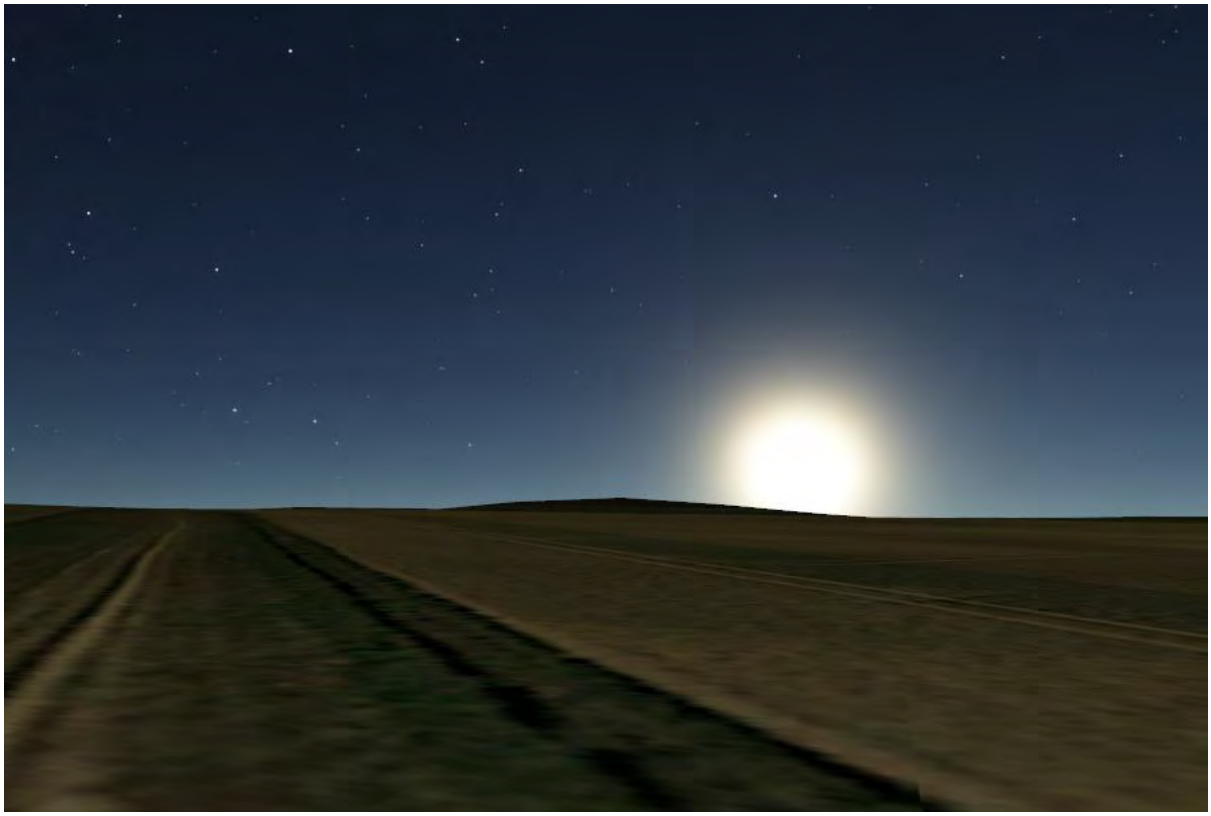


July 1st 06:00 UTC

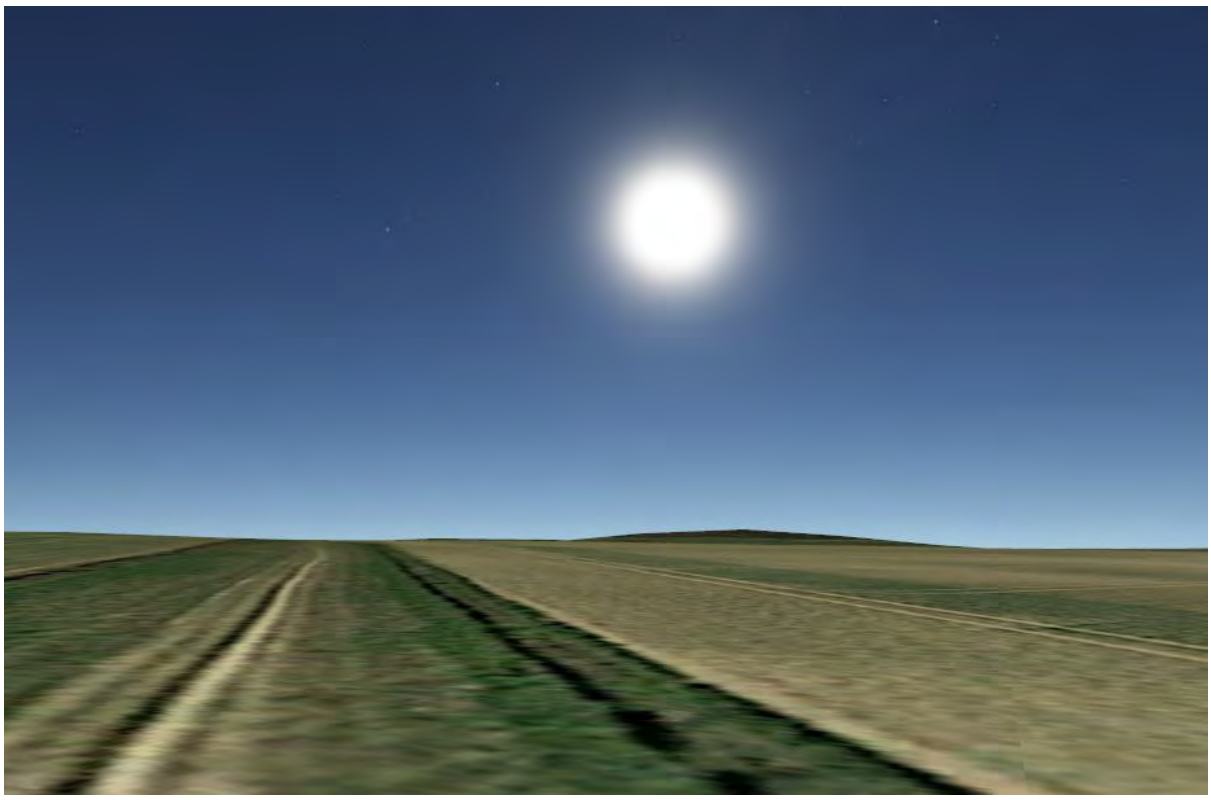


Receptor 20

April 1st 06:00 UTC

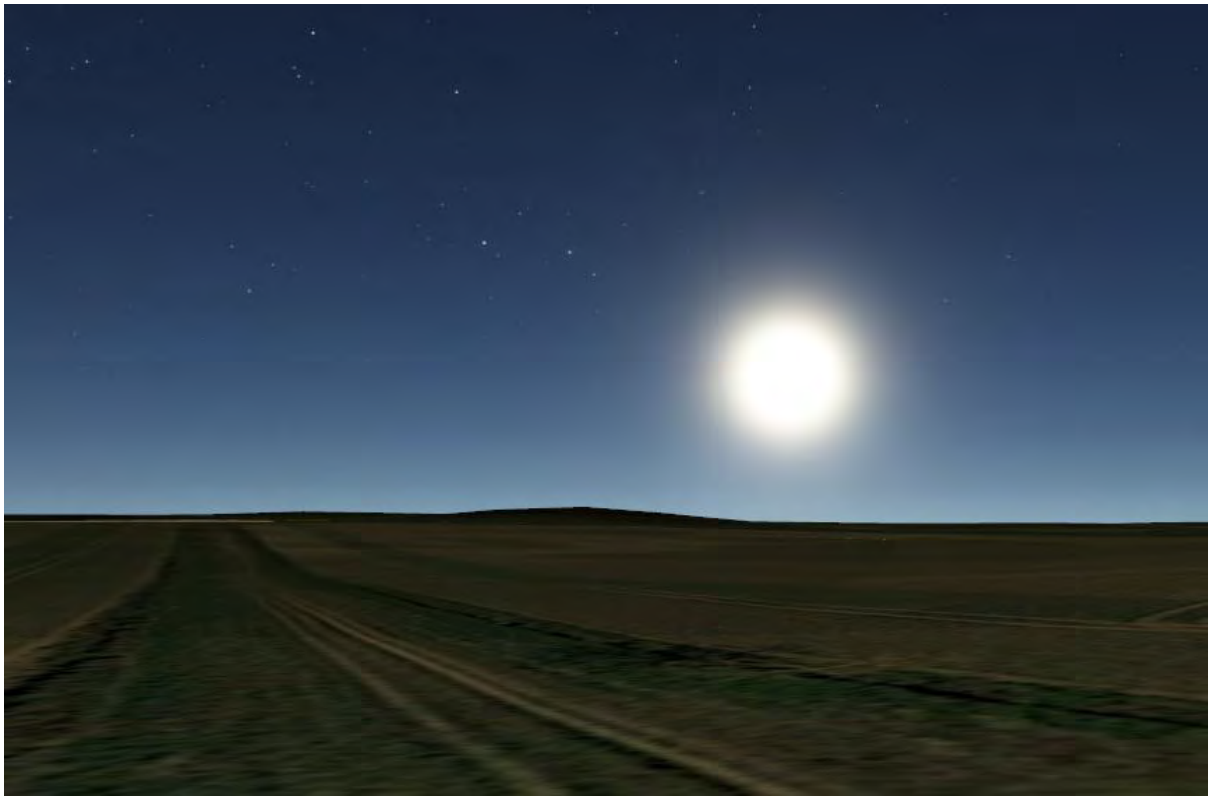


July 1st 06:00 UTC

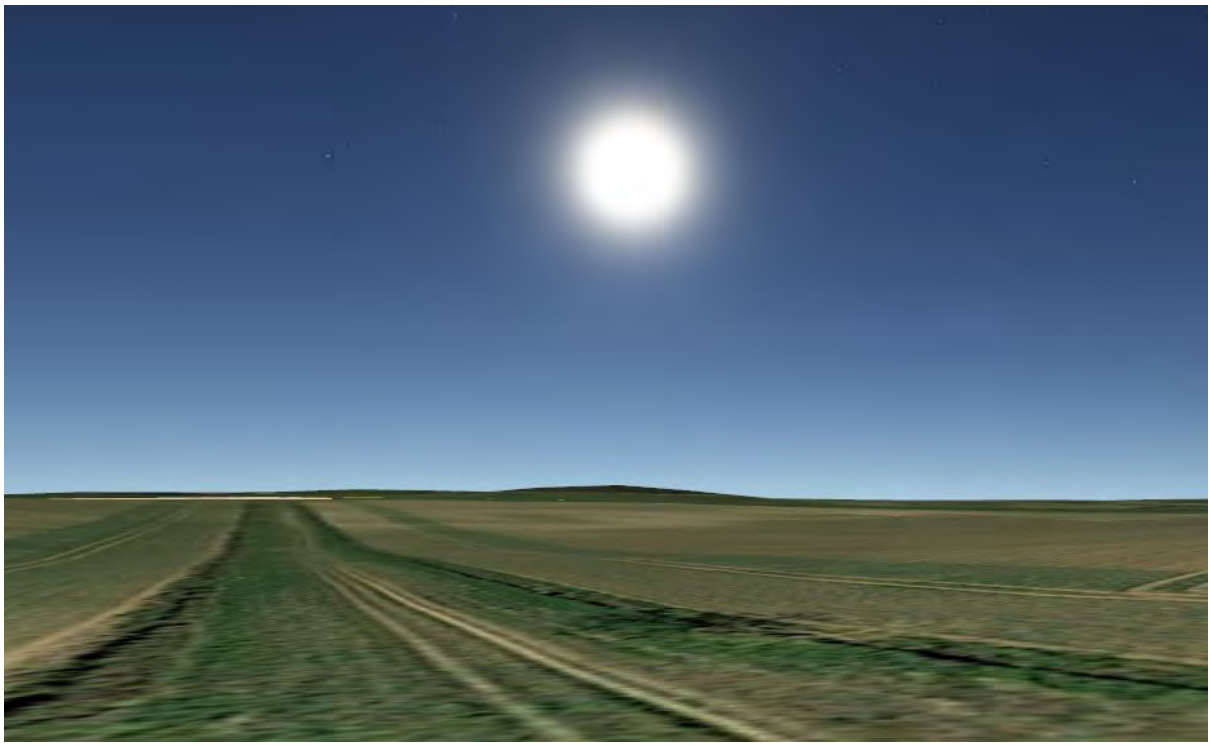


Receptor 21

April 15th 06:00 UTC

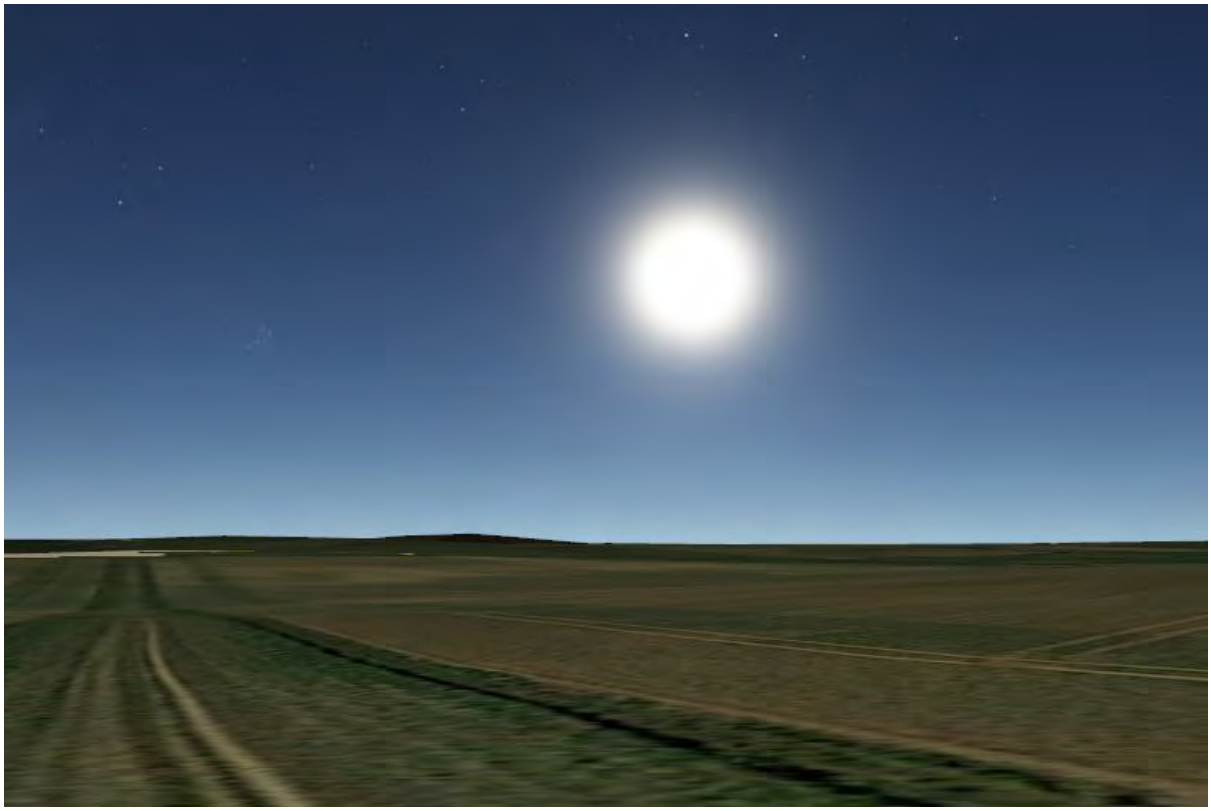


July 1st 06:00 UTC

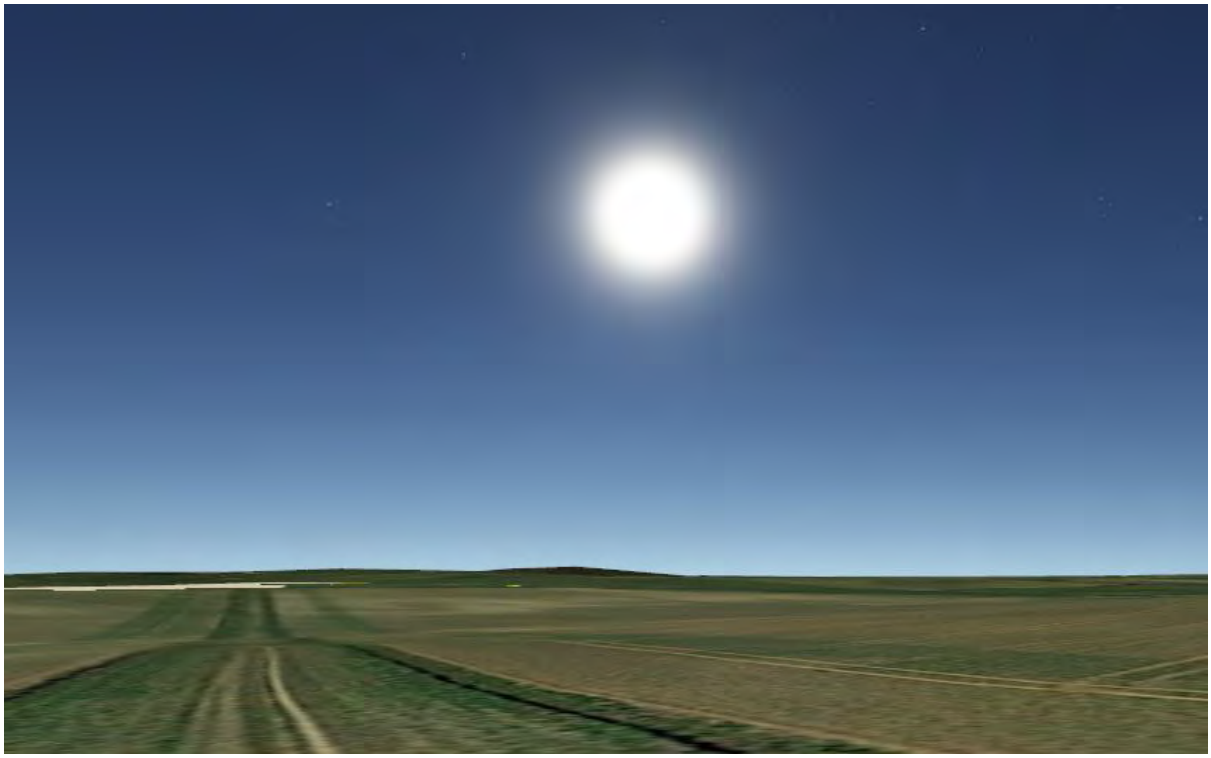


Receptor 22

May 1st 06:00 UTC

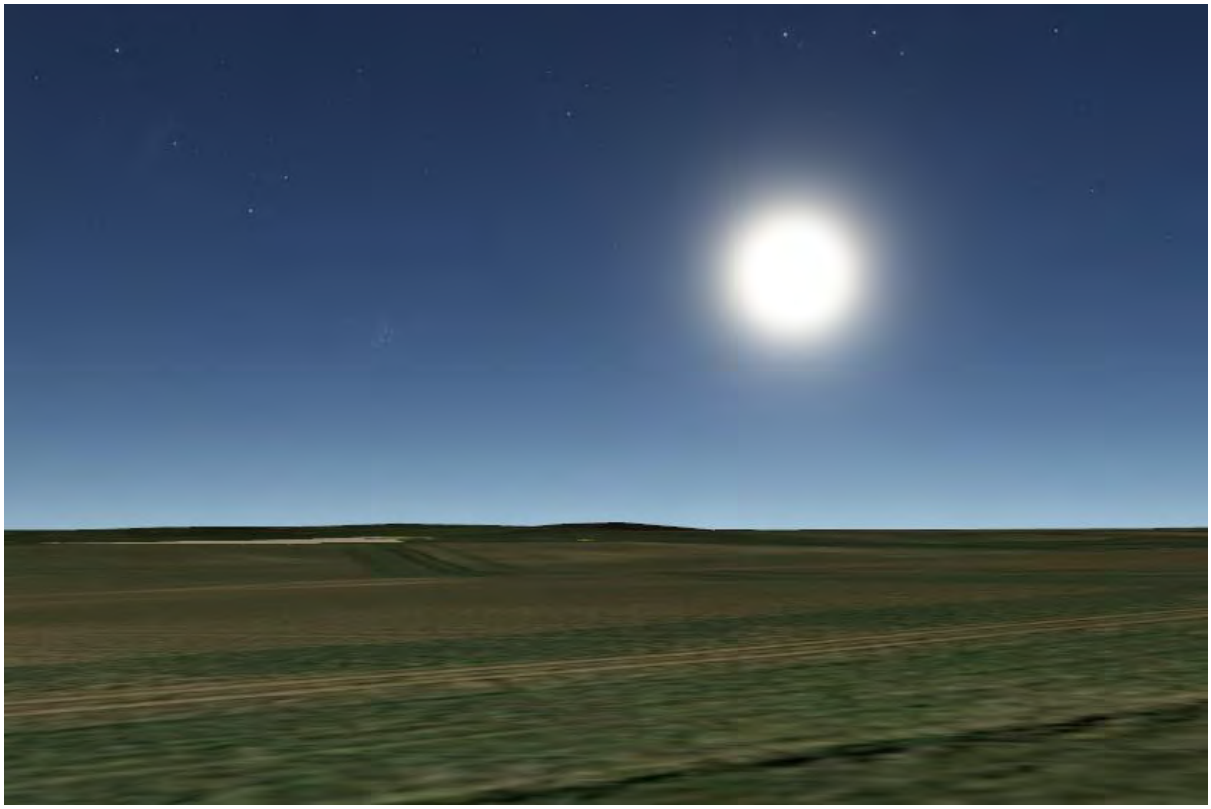


July 1st 06:00 UTC

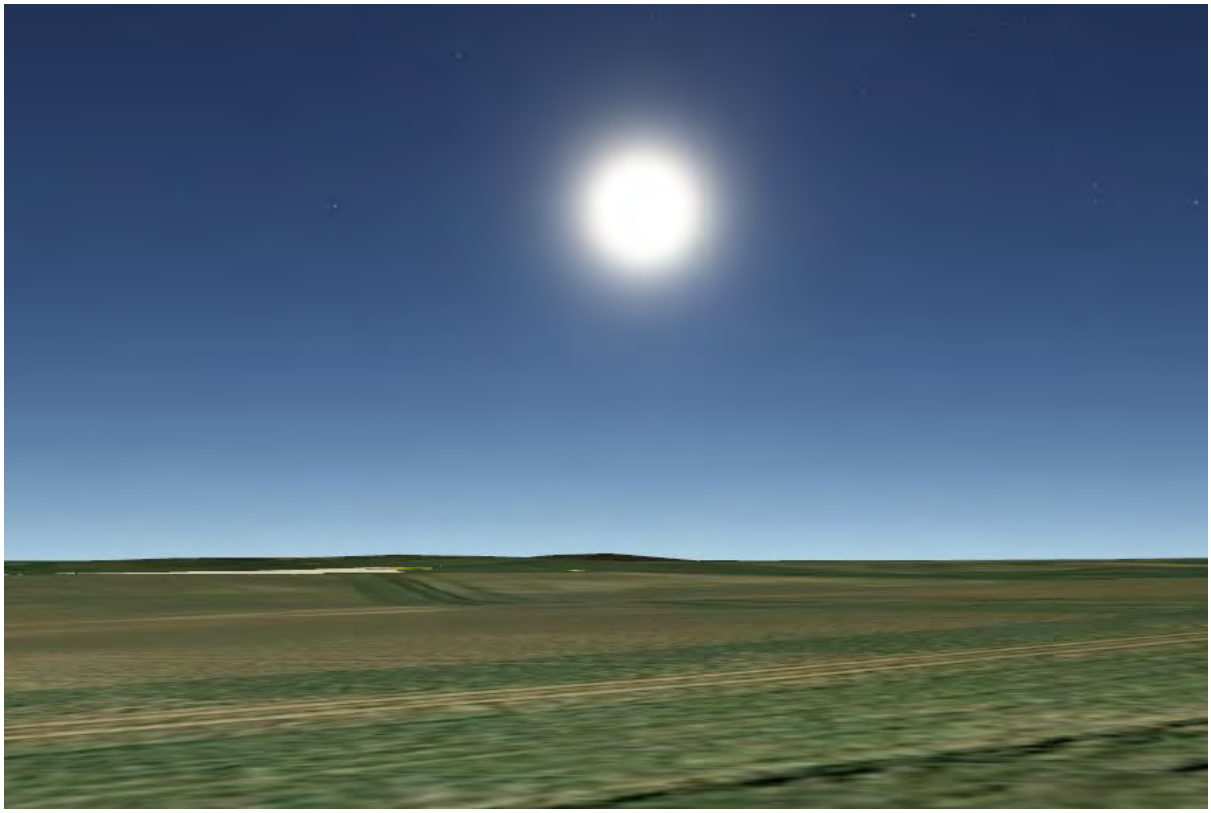


Receptor 23

May 1st 06:00 UTC

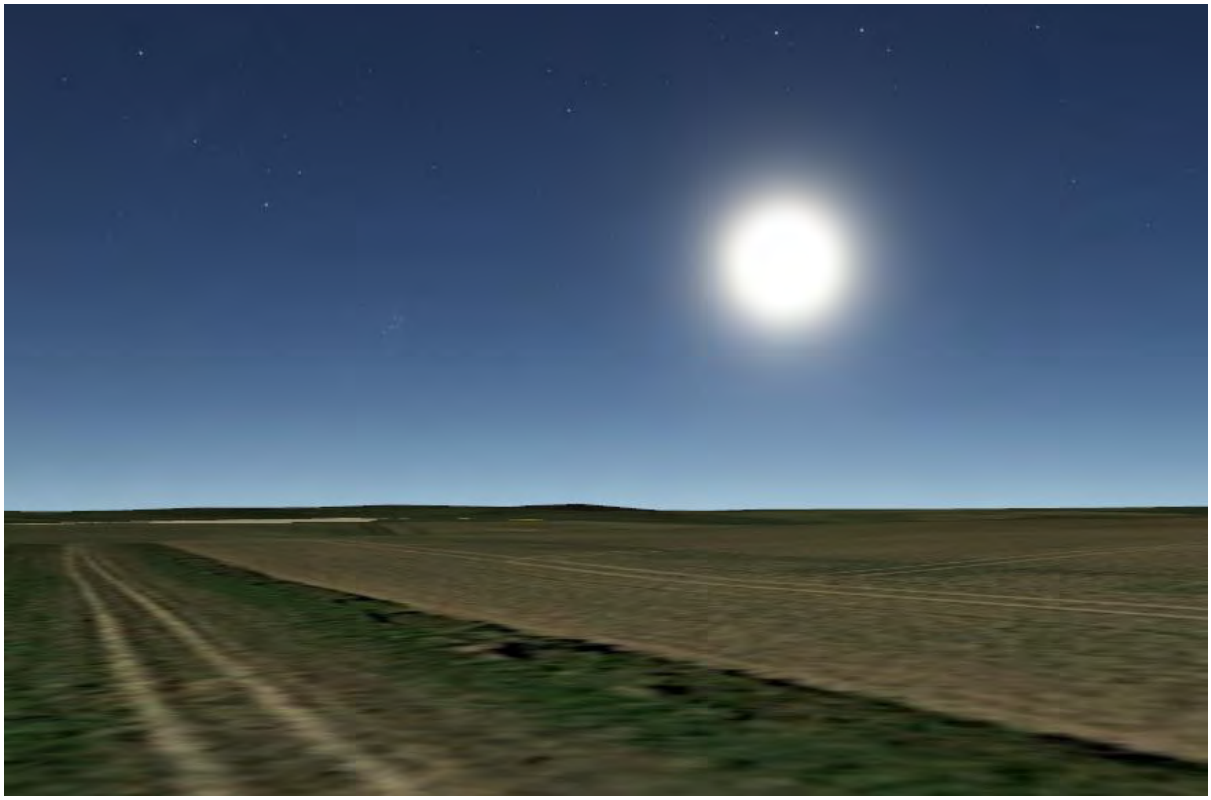


July 1st 06:00 UTC

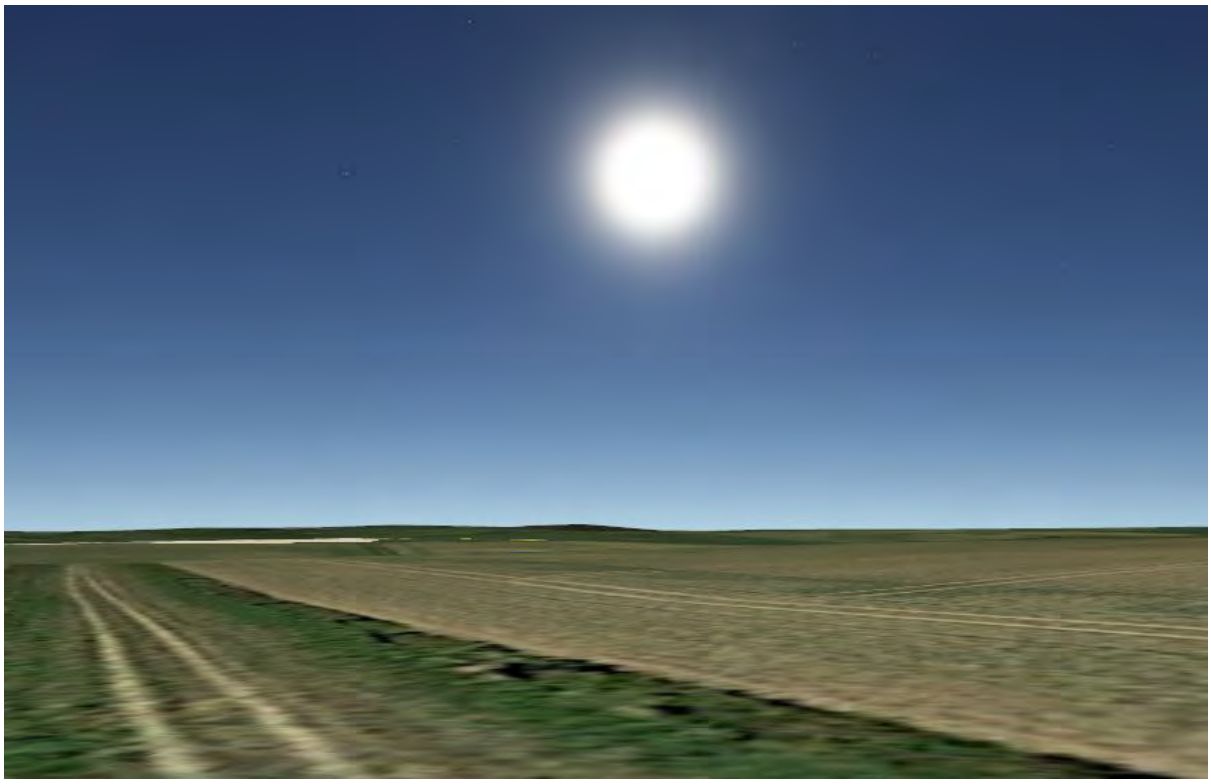


Receptor 24

May 1st 06:00 UTC

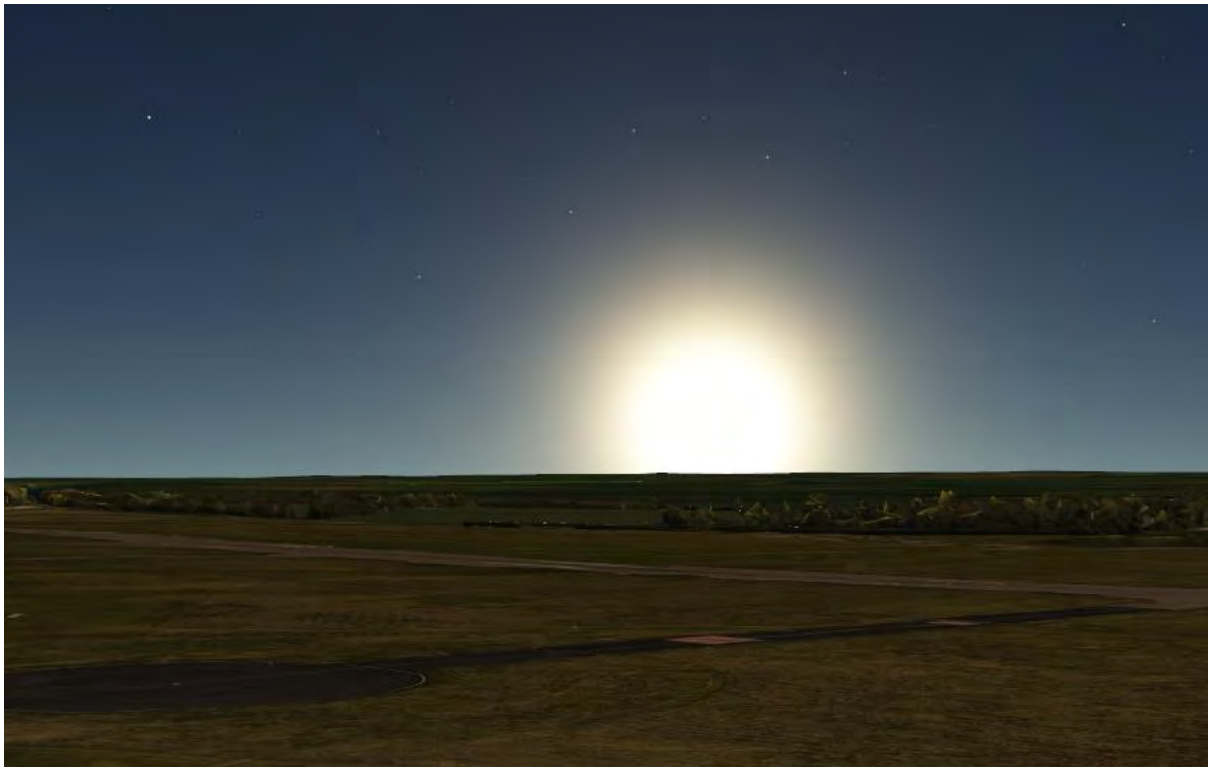


July 1st 06:00 UTC

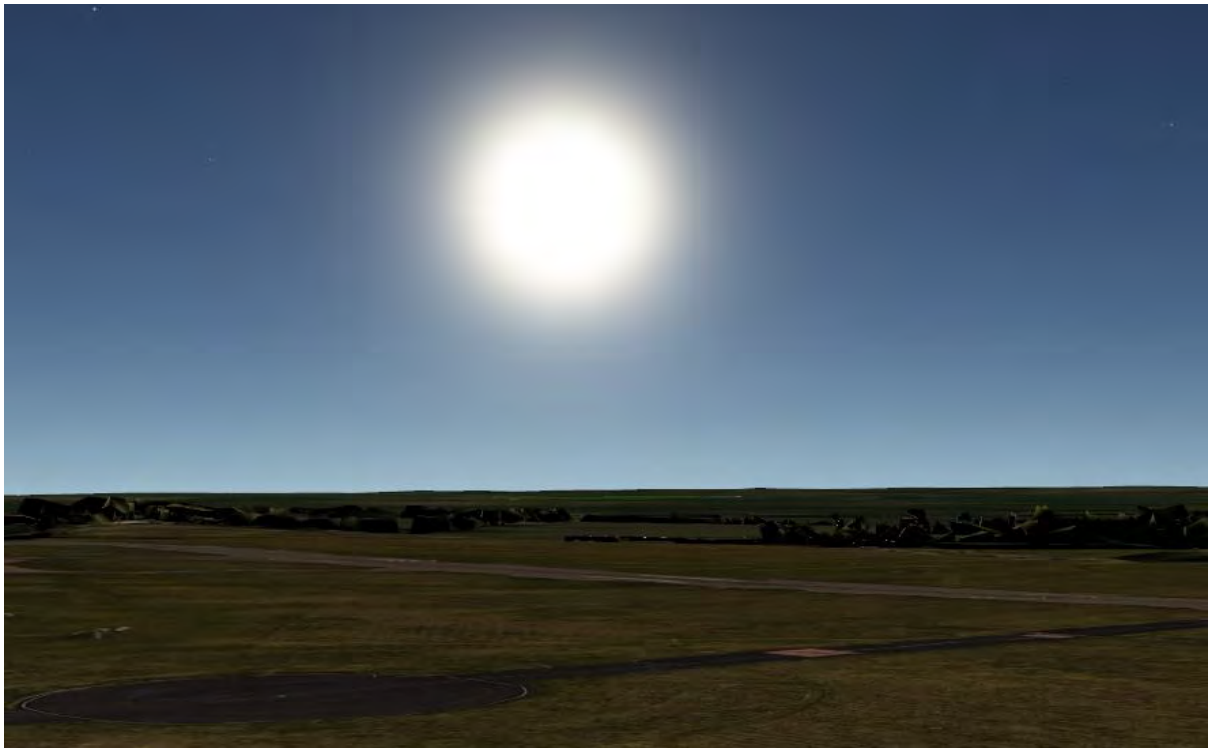


Aviation

March 15th 06:30 UTC



September 1st 06:15 UTC



Appendix G

Solar Module Glare and Reflectance Technical Memo

SUNPOWER

Technical Notification

TITLE: SunPower Solar Module Glare and Reflectance
AUTHORS: Technical Support
APPLICATION: Residential/ Commercial
SCOPE: SunPower Modules

SUMMARY:

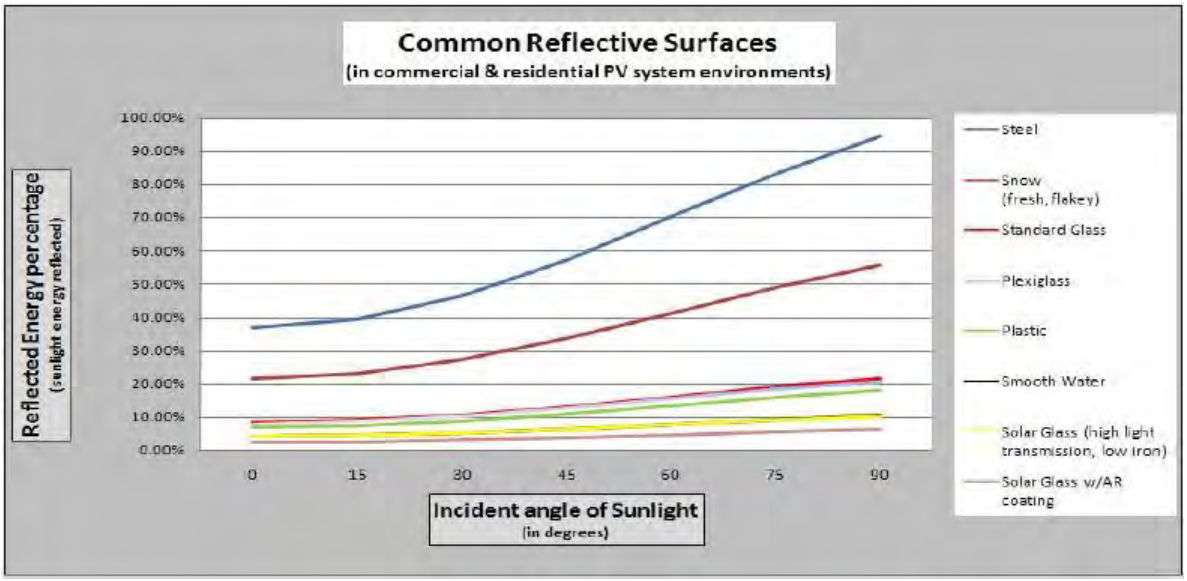
The objective of this document is to increase awareness concerning the possible glare and reflectance impact of PV Systems on their surrounding environment.

The glare and reflectance levels from a given PV system are decisively lower than the glare andreflectance generated by the standard glass and other common reflective surfaces in the environments surrounding the given PV system. Concerning random glare and reflectance observed from the air: SunPower has several large projects installed near airports or on air force bases. Each of these large projects has passed FAA or Air Force standards and all projects have been determined as "No Hazard toAir Navigation". Although the possible glare and reflectance from PV systems are at safe levels and are usually decisively lower than other standard residential and commercial reflective surfaces, SunPower suggests that customers and installers discuss any possible concerns with the neighbors/cohabitants near the planned PV system installation.

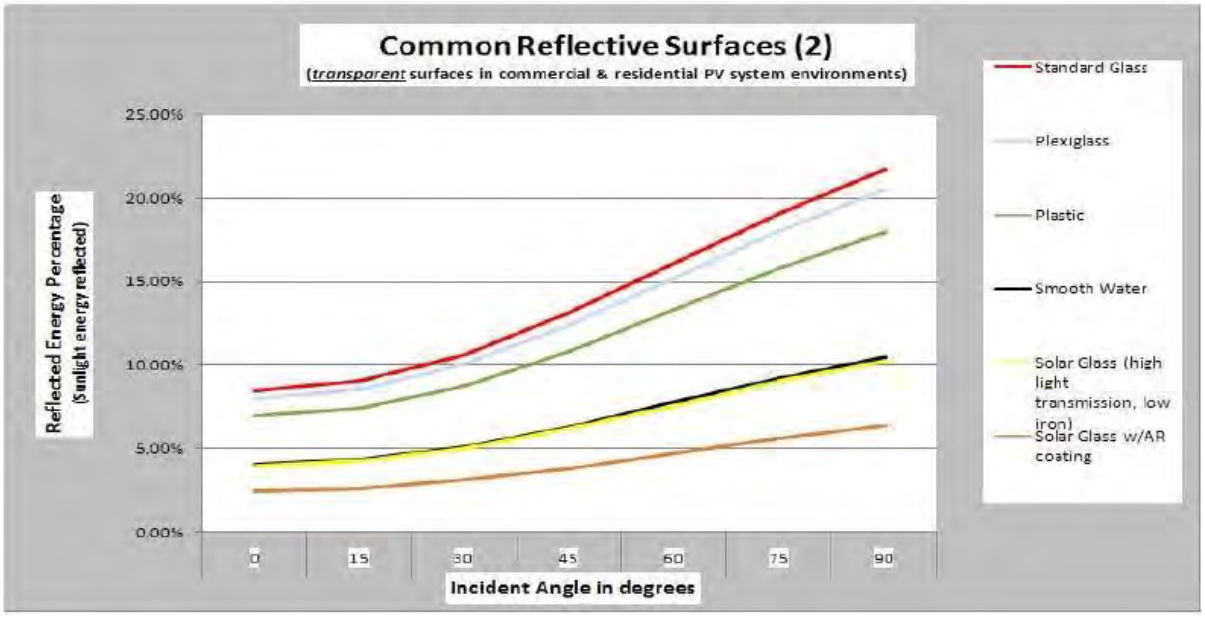
DETAILED EXPLANATION:

In general, since the whole concept of efficient solar power is to absorb as much light as possible while reflecting as little light as possible, standard solar module produces less glare and reflectance than standard window glass. This is pointed out very well in US Patent #6359212 which explains the differences in the refraction and reflection of solar module glass versus standard window glass. Solar modules use "high-transmission, low iron glass" which absorbs more light, producing small amounts of glare and reflectance than normal glass.

In the graph below, we show the reflected energy percentages of sunlight, of some common residential and commercial surfaces. The legend and the graph lists the items from top to bottom in order of the highest percentage of reflected energy.



It should be noted that the reflected energy percentage of Solar Glass is far below that of a standard glass and more on the level of smooth water. Also, below are the ratios of the common reflective surfaces:



Light beam physics resolves that the least amount of light is reflected when the beam is the normal, in other words, least light energy is reflected when the beam is at 0 degrees to the normal. The chart below is a result of light beam physics calculations:

Common Reflective Surfaces (in surrounding environments for PV systems)		Incident angle in degrees						
		0	15	30	45	60	75	90
Material Reflectivity (percent of incident light reflected)	Steel	36.78%	39.22%	46.34%	57.11%	70.02%	83.15%	94.40%
	Snow (fresh, flakey)	21.63%	23.09%	27.29%	33.63%	41.23%	48.96%	55.59%
	Standard Glass	8.44%	9.01%	10.65%	13.12%	16.09%	19.10%	21.69%
	Plexiglass	8.00%	8.54%	10.09%	12.44%	15.25%	18.11%	20.56%
	Plastic	6.99%	7.46%	8.82%	10.87%	13.33%	15.83%	17.97%
	Smooth Water	4.07%	4.35%	5.14%	6.33%	7.76%	9.22%	10.47%
	Solar Glass (high light transmission, low iron)	3.99%	4.26%	5.03%	6.20%	7.61%	9.03%	10.26%
	Solar Glass w/AR coating	2.47%	2.64%	3.12%	3.84%	4.71%	5.59%	6.35%

(Note: Index of refraction values may vary slightly depending on suppliers and reference documentation. The values for the above calculations are averages or single values obtained from the list of references for this document).

Important reference – "Stipples glass": In addition to the superior refractive/reflective properties of solar glass versus standard glass, SunPower uses stippled solar glass for our modules. Stippled glass is used with high powered telescopes and powerful beacons and lights. The basic concept behind stippling is for the surfaces of the glass to be textured with small types of indentations. As a result, stippling allows more light energy to be channeled/ transmitted through the glass while diffusing the reflected lightenergy. This concept is why the reflection of off a SunPower solar module will look hazy and less-defined than the reflection from standard glass, this occurs because the stippled SunPower glass is transmitting a larger percentage of light to the solar cell while breaking up the intensity of the reflected light energy.

SUMMARY/ACTION REQUIRED:

The studies, data and light beam physics behind the charts and graphs prove beyond a reasonable doubt that solar glass has less glare and reflectance than standard glass. The figures also make it clear that the difference is very decisive between solar glass and other common residential/commercial glasses. In addition, not to be lost in the standard light/glass equations and calculations, the SunPower solar glass is stippled and has a very photon-absorbent solar cell attached to the back side, contributing two additional factors which results in even less light energy being reflected.

REGIONAL CONTACTS:

****

EU Toll Free number: SunPower Technical Support, **00800–SUNPOWER (00800–78676937)**

- **For inquiries by e-mail, please use**:
  - Spain: SunPower – Soporte Técnico España: soportetecnico@sunpowercorp.com
  - Germany: SunPower – Technischer Support: technischersupport@sunpowercorp.com
  - Italy: SunPower – Servizio Tecnico Italia: serviziotecnico@sunpowercorp.com
  - France: SunPower – Support Technique France: supporttechnique@sunpowercorp.com

USA Toll Free number: SunPower Technical Support, **1-800–SUNPOWER (786-76937)**

- **For inquiries by e-mail, please use:** Technicalsupport@Sunpowercorp.com

Australia (Sunpower Corporation Australia PTY LTD) contact number: +**61-8-9477-5888**.

Korea – SPK (SunPower Korea) contact number: (02) 3453-0941

REFERENCES:

- Center for Sustainable Building Research. College of Dean – University of Minnesota. All rights Reserved. JDP activity by the University of Minnesota and Lawrence Berkeley National Laboratory
- H.K Pulker, Coatings on Glass, (1999), 2ed, Elsevier, Amsterdam
- C.G Granqvist, Materials Science for Solar Energy Conversion Systems, (1991), Pergamon, G.B
- D. Chen, anti-reflection (AR) coatings made by sol-gel processes: A review, Solar energy Materials and Solar Cells, 68, (2000), 313-336
- P. Nostell, A. Roos, B. Karlsson, Antireflection of glazings for solar energy applications, Solar Energy Materials and Solar Cells, 54, (1998), 23-233
- M. Fukawa, T. Ikeda, T. Yonedaans K. Sato, Antireflective coatings y single layer with refractive index of 1.3, Proceedings of the 3rd International Conference on Coatings on Glass (ICGG), (2000), 257-264
- J. Karlsson and A. Roos, Modeling the angular behavior of the solar energy transmittance of windows, Solar Energy, 69, 4, (2000)
- J. Karlsson, B. Karlsson and A. Roos, A Simple model for assessing the energy efficiency of windows, In Press, Energy and Buildings