Appendix J

Glare Analysis

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MEMORANDUM

To:	Wild Springs Solar, LLC - c/o Melisa Schmit, Geronimo Energy
From:	Philip DeVita, HMMH
Date:	January 6, 2020
Subject:	Wild Springs Solar, LLC
Reference:	HMMH Job No.309700.018

Introduction

Harris Miller Miller & Hanson Inc. (HMMH) evaluated potential glare at nearby Ellsworth Air Force Base (AFB) sensitive observer locations from the proposed 128 MW Wild Springs Solar, LLC (Wild Springs) solar project in Pennington County, South Dakota. The proposed project would be located on land just south of Route 90 and New Underwood, SD approximately 11.5 miles to the southeast of the AFB. **Figure 1** shows the project location relative to the airport and its runways.

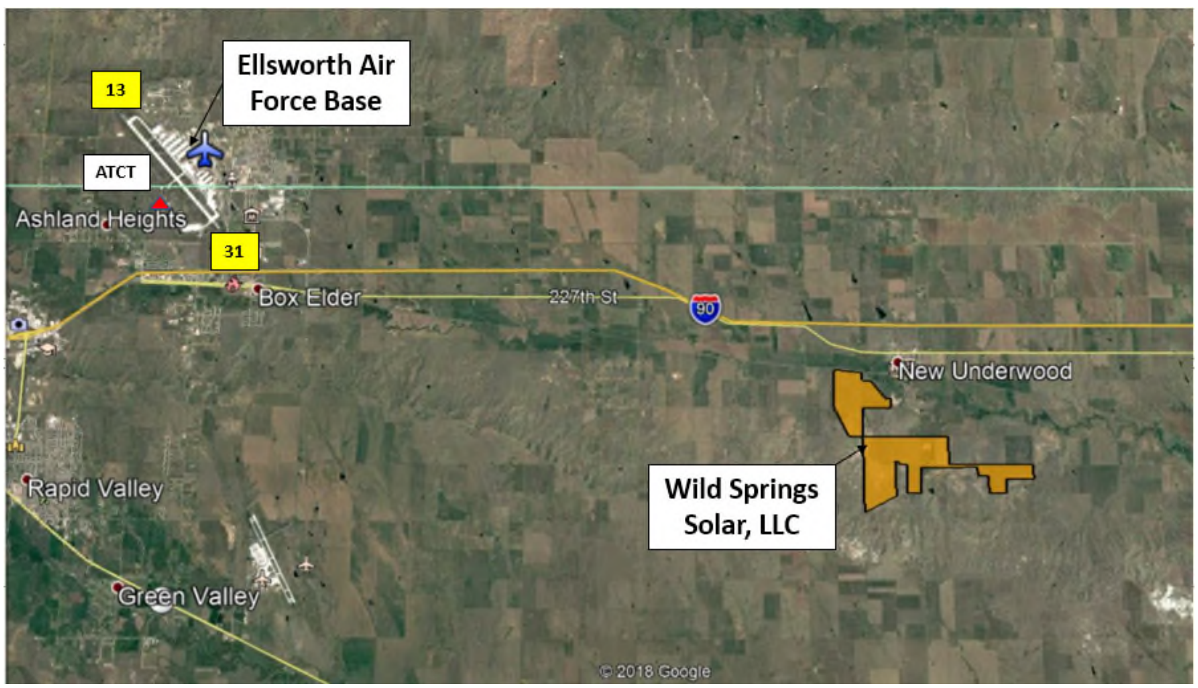


Figure 1. Locus Map of Wild Spring Solar, LLC Solar Project Relative to Ellsworth Air Force Base

HMMH used the latest version of the ForgeSolar GlareGauge solar glare tool, formerly known as the Solar Glare Hazard Analysis Tool (SGHAT) developed by Sandia National Laboratories to analyze potential glare at sensitive airport receptor locations and reviewed the model results relative to the Federal Aviation Administration's (FAA) Interim Policy of Solar Projects at Airports.

In deploying the model, we selected the footprint of the solar project area of the Wild Springs array on the GlareGauge google map interface and input the project design parameter provided by Wild Spring Solar, LLC as shown in **Table 1.**

Table 1. Wild Spring Solar, LLC Proposed Project Design Parameters

Solar System	System	Orientation	Tilt Angle	Panel Height (AGL)
Wild Springs Solar, LLC Array	***Single Axis***	***180°***	***60°[1]***	***20 feet***

1. Denotes maximum tracking angle.

The Project is proposing a 128 MW single axis tracking system with a tracking orientation north to south and a maximum tracking angle of 60°. The project will be located on the ground at a height of up to 20 feet above ground level.

To assess airport sensitive receptors, the FAA requires an evaluation of potential glare for pilots on final approach and at the air traffic control tower (ATCT). For the pilot analysis, we selected the runway threshold and a second point away from the runway to represent the direction of the flight path. The previous version of GlareGauge (e.g. SGHAT) automatically identified the location and height above ground of eight additional observation points (spaced at quarter mile intervals based on a 3 degree glide slope) to determine if the pilot at those locations would be exposed to glare. However, the new version of GlareGauge automatically evaluates glare along the entire distance of the flight path at a 3 degree glide slope out to two miles.

There is an active ATCT at the AFB; therefore, the analysis included evaluating impacts to the ATCT as well as aircraft on final approach to each runway end.

FAA Jurisdiction and Standards for Measuring Ocular Impact

The FAA published an Interim Policy for Solar Projects at Airports on October 23, 2013. The policy clarifies the FAA's jurisdiction in reviewing solar projects and the standards it uses to determine if a project will result in a negative glare impact to airspace safety.

Relative to its jurisdiction, the FAA affirmed that it has jurisdiction to regulate potential glare impacts as part of its responsibilities under Federal Aviation Regulations (FAR) Part 77 to any solar project proposed on the property of a Federally-obligated airport, which includes most airports in the U.S. The FAA also clarified that it does not have jurisdiction to regulate potential glare from projects located on non-airport land. However, as stated in the Policy, "the FAA urges proponents of off-airport solar-installations to voluntarily implement the provisions in this policy." *As the project is not located at a Federally-obligated airport, Wild Springs is not required to conduct a glare analysis for FAA approval.* Similarly, the Department of Defense (DOD) has prepared "Procedures Memo#4: Glint/Glare Issues on or near Department of Defense Aviation Operations"[1] dated June 13, 2014. The memorandum outlines the use of the FAA's interim procedures as discussed in the Federal Register including the use of SGHAT to evaluate acceptable glint and glare impacts at DoD airports. *Furthermore, as noted above, to assess airport sensitive receptors, the FAA requires an evaluation of potential glare for pilots on final approach and at the air traffic control tower (ATCT). Final approach path is defined in the policy as "two (2) miles from fifty (50) feet above the landing threshold using a standard three (3) degree glide path"[2]. The project is located beyond the final approach path of two miles from the AFB, however as discussed above, Wild Springs has sought to voluntarily comply with FAA ocular hazard standards published in the FAA's Interim Policy.*

The Policy also describes the standards for measuring ocular impact:

To obtain FAA approval and 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: (1) no potential for glint or glare in the existing or planned Air Traffic Control Tower cab, and (2) no potential for glare or "low potential for after-image" (shown in green) along the final approach path.

[1] http://www.acq.osd.mil/dodsc/library/Procedures_Memo_4_Glint%20Glare%20Issues%20on%20or%20near%20DoD%20Aviation%20Operations.pdf

[2] https://www.federalregister.gov/documents/2013/10/23/2013-24729/interim-policy-faa-review-of-solar-energy-system-projects-on-federally-obligated-airports

Table 2 presents the airport sensitive receptors that must be evaluated, the potential results presented by the model and whether the result complies with the FAA ocular hazard standard presented in the Policy.

Table 2. Levels of Glare and Compliance with FAA Policy

Airport Sensitive Receptor	Level of Glare	Color Result	Compliance with FAA Policy
ATCT Cab	No glare	None	Yes
	Low Potential for After-Image	Green	No
	Potential for After-Image	Yellow	No
	Potential for Permanent Eye Damage	Red	No
Aircraft along final approach path	No glare	None	Yes
	Low Potential for After-Image	Green	Yes
	Potential for After-Image	Yellow	No
	Potential for Permanent Eye Damage	Red	No

Any glare recorded on the ATCT is not compliant with FAA policy and will not receive a "no objection" determination from the FAA. Measurement of *low potential for after-image* or "Green" is acceptable for aircraft on final approach but greater levels (indicated in yellow and red) are not allowed.

Summary of Results

HMMH analyzed the potential for the Wild Springs Project site to produce glare on pilots on final approach to the Ellsworth Air Force Base as well as at the ATCT. Based on the design and layout, GlareGauge modeling showed:

- Runway End 13 and 31: No glare detected at any observation points along the flight path; proposed design meets the FAA Standard for aircraft on final approach
- ATCT: no glare detected at the ATCT, proposed design meets the FAA Standard for glare at the ATCT.

Results in Detail

To accurately model the proposed project, HMMH outlined the project array on the model's interactive google map, and the GlareGauge tool analyzed the potential glare impact from the project site. **Figure 2** shows the layout of the project area as input into the model.

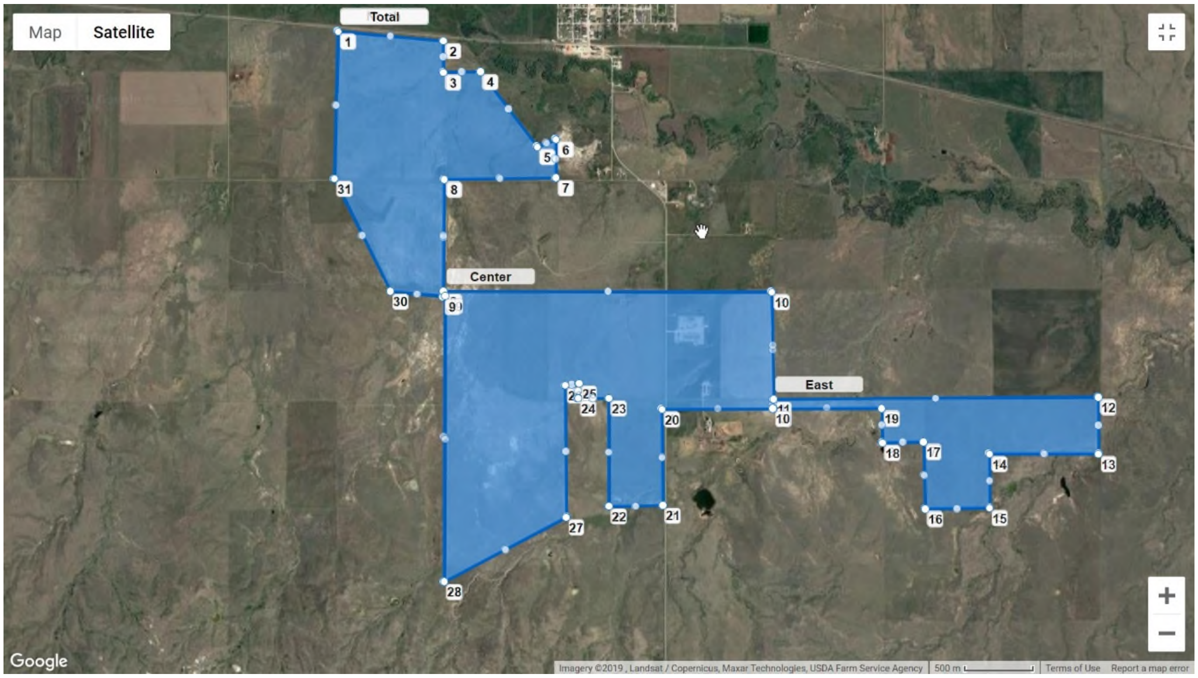


Figure 2. Wild Springs Solar, LLC Array as Input into the GlareGauge Model

We input the specifications of the array including a single axis tracking system with a north-south orientation, maximum tracking angle of 60° and a panel height of 20 feet above ground level. We also assumed a smooth panel surface without any anti-reflective coating to provide maximum flexibility in module selection. Modeling was then undertaken for the applicable sensitive receptors required by FAA: the pilots in aircraft along final descent to each runway end. There is an active ATCT at Ellsworth Air Force Base, and therefore, an analysis of the ATCT was conducted. All of the modeling result output sheets are provided as **Attachment A**.

ATCT

Modeling was conducted for the ATCT location. The ATCT tower was located on the Google Maps aerial tool and input into the model. Based on a review of an online literature search, we were unable to find an official cab tower height at the airport. Therefore, using Google Earth and some common assumptions for guard rail heights, we were able to estimate the ATCT cab height at 65 feet above ground. The ATCT cab height assumptions are provided in **Attachment B**. The GlareGauge results show that no glare was detected at the ATCT location; therefore, the proposed solar project design is consistent with the FAA Standards for ATCT.

Arriving Aircraft

To analyze arriving aircraft, HMMH selected locational information associated with each runway individually and generated associated results to evaluate the potential impacts of the proposed project on that runway. Given that there is one runway and two runway ends at the AFB; modeling was conducted separately for each runway end.

To model a runway approach, we selected a point at the centerline on the runway threshold which is located near the runway end. We then selected a second point away from the runway to represent the orientation of the aircraft descent (or glide) path. The model automatically plots the glide path out two miles from the runway end and evaluates potential for glare along the entire glide path. Given that Ellsworth Air Force Base has two runway ends; the model assessed the potential for glare along each of the two aircraft flight paths landing at the airport. The model automatically plots the location and height above ground of each observation point along the glide path assuming a 3 degree glide slope for the approach. In the model's flight path window, we checked the "consider pilot visibility from cockpit" box and kept the default azimuth-viewing angle of 50° so that the model would not register glare that the pilot would not see from behind the aircraft. We also kept the default downward viewing angle of 30° to eliminate false glare results from below the aircraft. **Figure 3** shows the flight path analyzed by the model for each runway along with ATCT location denoted as the red bubble "1".

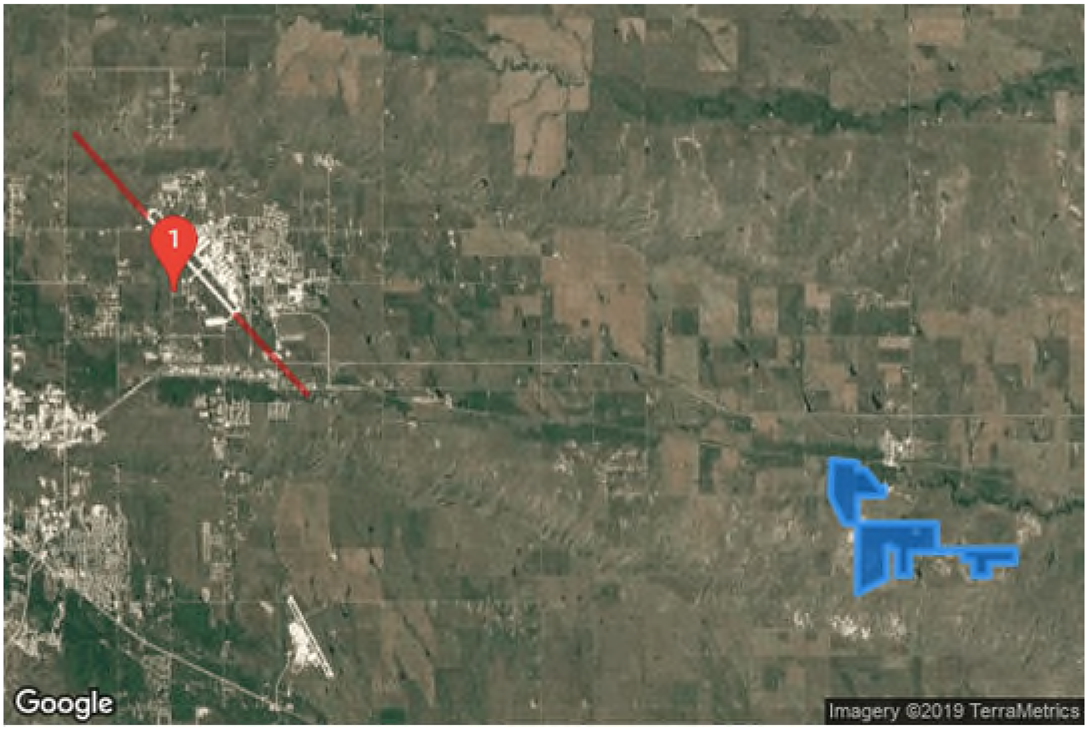


Figure 3. Flight Path Analyzed by GlareGauge

The latest version of the model now shows component results in time for the aircraft along a continuous route. **Table 3** presents the GlareGauge modeling results for each runway in terms of predicted minutes of green, yellow, or red glare.

As shown in **Table 3**, no glare was detected by the model for any of the runway approaches for the single axis tracking system. The no glare result on aircraft on approach for each alternative to each runway comply with the FAA's ocular impact standard as published in the Federal Register on October 23, 2013 and shown in Table 2.

Table 3 – GlareGauge Results (in minutes per year) for the Wild Springs Solar, LLC Project near Ellsworth Air Force Base

Site	Fixed/Tracker System	(orientation/tilt)	ATCT	RWY 13	RWY 31	Comply with FAA Thresholds
Wild Springs Solar, LLC	Single Axis Tracker	180° (max tracker of 60°)	0	0	0	Yes

Notes:

G (Green) = Low Potential for Temporary After-Image
Y (Yellow) = Potential for Temporary After-Image
R (Red) = Potential for Permanent Eye-Damage

N/A = Not applicable, no analysis conducted.

Conclusions

HMMH utilized the GlareGauge model developed by the Department of Energy's Sandia National Laboratories to evaluate potential glare from a proposed single axis tracking solar PV project to the southeast of the Ellsworth Air Force Base. The analysis focused on potential glare effects on aircraft arriving on final approach to runway ends 13/31 as well as the ATCT.

While the project *is not located on airport property and therefore not subject to FAA jurisdiction under Federal Aviation Regulations Part 77 to protect airspace safety; and the project is located beyond the two mile final approach as defined in the Interim Solar Policy*, the proponents have sought to voluntarily comply with FAA ocular hazard standards published in the FAA's Interim Solar Policy in the Federal Register on of October 23, 2013. Similarly, the DoD has prepared the "Procedures Memo#4: Glint/Glare Issues on or near Department of Defense Aviation Operations" and outlines the use of the FAA's interim procedures as discussed in the Federal Register for using SGHAT to evaluate acceptable glint and glare impacts at DoD airports.

GlareGauge model results were compared to the FAA's ocular hazard standard. The model results provided in **Attachment A** show that for aircraft on final approach to Runway 13 and 31, GlareGauge model results for the project design result in no glare detected along the approach to each runway end or at the ATCT. These results *comply* with the FAA standards described in the Interim Solar Policy.

Attachment A

GlareGauge Modeling Results – Wild Springs Solar Project Design

FORGESOLAR GLARE ANALYSIS

Project: **Wild Spring Solar, LLC**
Near Rapid City, SD

Site configuration: **Wild Springs Solar LLC Ellsworth**
Analysis conducted by Phil DeVita (pdevita@hmmh.com) at 19:23 on 30 Dec, 2019.

U.S. FAA 2013 Policy Adherence

The following table summarizes the policy adherence of the glare analysis based on the 2013 U.S. Federal Aviation Administration Interim Policy 78 FR 63276. This policy requires the following criteria be met for solar energy systems on airport property:

- No "yellow" glare (potential for after-image) for any flight path from threshold to 2 miles
- No glare of any kind for Air Traffic Control Tower(s) ("ATCT") at cab height.
- Default analysis and observer characteristics (see list below)

ForgeSolar does not represent or speak officially for the FAA and cannot approve or deny projects. Results are informational only.

COMPONENT	STATUS	DESCRIPTION
Analysis parameters	PASS	Analysis time interval and eye characteristics used are acceptable
Flight path(s)	PASS	Flight path receptor(s) do not receive yellow glare
ATCT(s)	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

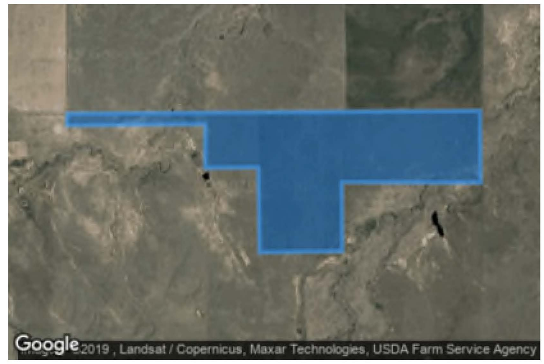
DNI: peaks at 1,000.0 W/m^2
Time interval: 1 min
Ocular transmission coefficient: 0.5
Pupil diameter: 0.002 m
Eye focal length: 0.017 m
Sun subtended angle: 9.3 mrad
Site Config ID: 34609.6355

PV Array(s)

Name: Center
Description: Single Axis Center Portion
Axis tracking: Single-axis rotation
Tracking axis orientation: 180.0°
Tracking axis tilt: 0.0°
Tracking axis panel offset: 0.0°
Max tracking angle: 60.0°
Resting angle: 60.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	44.074460	-102.849613	2894.19	20.00	2914.19
2	44.074429	-102.819486	2853.46	20.00	2873.46
3	44.066690	-102.819229	2868.43	20.00	2888.43
4	44.066659	-102.829614	2904.20	20.00	2924.21
5	44.060245	-102.829528	2917.64	20.00	2937.64
6	44.060214	-102.834549	2932.23	20.00	2952.23
7	44.067368	-102.834507	2938.49	20.00	2958.49
8	44.067337	-102.837382	2905.65	20.00	2925.65
9	44.068355	-102.837253	2904.43	20.00	2924.44
10	44.068232	-102.838541	2908.27	20.00	2928.28
11	44.059505	-102.838369	2948.34	20.00	2968.34
12	44.055218	-102.849742	3025.50	20.00	3045.51

Name: East
Description: Single Axis East Portion
Axis tracking: Single-axis rotation
Tracking axis orientation: 180.0°
Tracking axis tilt: 0.0°
Tracking axis panel offset: 0.0°
Max tracking angle: 60.0°
Resting angle: 60.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

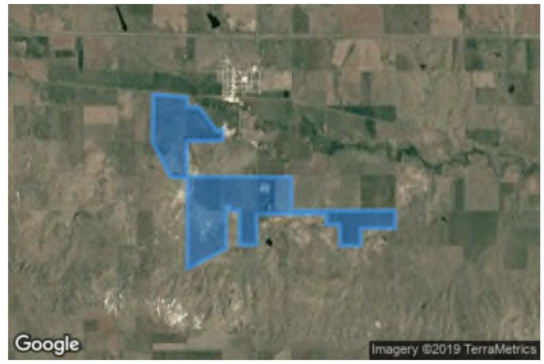


Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	44.067302	-102.819300	2868.89	20.00	2888.89
2	44.067456	-102.789345	2840.34	20.00	2860.34
3	44.063694	-102.789302	2828.67	20.00	2848.67
4	44.063724	-102.799388	2874.75	20.00	2894.76
5	44.060116	-102.799345	2871.20	20.00	2891.20
6	44.060055	-102.805353	2902.47	20.00	2922.47
7	44.064495	-102.805439	2897.21	20.00	2917.21
8	44.064465	-102.809301	2857.51	20.00	2877.51
9	44.066746	-102.809301	2873.71	20.00	2893.71
10	44.066685	-102.819343	2869.61	20.00	2889.61

Name: North
Description: Single Axis North Portion
Axis tracking: Single-axis rotation
Tracking axis orientation: 180.0°
Tracking axis tilt: 0.0°
Tracking axis panel offset: 0.0°
Max tracking angle: 60.0°
Resting angle: 60.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	44.091718	-102.859507	2865.64	20.00	2885.64
2	44.091039	-102.849765	2856.16	20.00	2876.16
3	44.088974	-102.849765	2853.42	20.00	2873.42
4	44.089005	-102.846374	2850.03	20.00	2870.03
5	44.084042	-102.841096	2847.53	20.00	2867.53
6	44.084535	-102.839379	2841.44	20.00	2861.44
7	44.081977	-102.839379	2858.52	20.00	2878.53
8	44.081915	-102.849722	2867.58	20.00	2887.58
9	44.074084	-102.849765	2896.21	20.00	2916.21
10	44.074423	-102.854614	2901.77	20.00	2921.77
11	44.081884	-102.859850	2881.23	20.00	2901.23

Name: Total
Description: Single Axis Tracker
Axis tracking: Single-axis rotation
Tracking axis orientation: 180.0°
Tracking axis tilt: 0.0°
Tracking axis panel offset: 0.0°
Max tracking angle: 60.0°
Resting angle: 60.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material



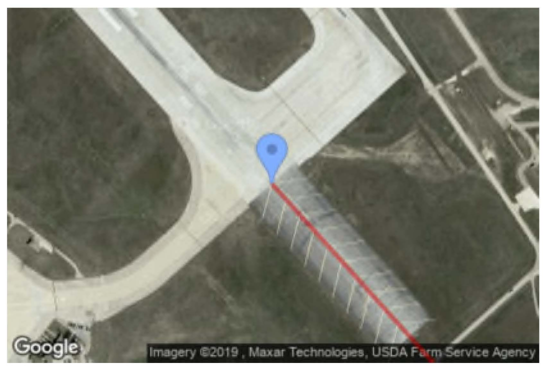
Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	44.091672	-102.859447	2865.85	20.00	2885.85
2	44.091025	-102.849705	2856.05	20.00	2876.05
3	44.088960	-102.849705	2853.02	20.00	2873.02
4	44.089022	-102.846315	2850.03	20.00	2870.03
5	44.084028	-102.841036	2846.09	20.00	2866.09
6	44.084490	-102.839320	2842.24	20.00	2862.24
7	44.081962	-102.839363	2858.90	20.00	2878.90
8	44.081870	-102.849662	2868.27	20.00	2888.27
9	44.074471	-102.849705	2894.25	20.00	2914.25
10	44.074378	-102.819407	2853.30	20.00	2873.30
11	44.067317	-102.819278	2868.77	20.00	2888.77
12	44.067410	-102.789323	2839.45	20.00	2859.45
13	44.063679	-102.789280	2828.84	20.00	2848.84
14	44.063679	-102.799323	2875.91	20.00	2895.91
15	44.060070	-102.799323	2870.92	20.00	2890.93
16	44.060009	-102.805288	2903.06	20.00	2923.06
17	44.064480	-102.805417	2897.36	20.00	2917.36
18	44.064419	-102.809236	2858.86	20.00	2878.86
19	44.066701	-102.809279	2873.92	20.00	2893.92
20	44.066627	-102.829529	2903.76	20.00	2923.76
21	44.060243	-102.829486	2917.62	20.00	2937.62
22	44.060182	-102.834464	2932.16	20.00	2952.16
23	44.067367	-102.834464	2939.74	20.00	2959.74
24	44.067336	-102.837254	2907.04	20.00	2927.04
25	44.068323	-102.837211	2904.56	20.00	2924.56
26	44.068199	-102.838455	2907.31	20.00	2927.31
27	44.059451	-102.838356	2947.34	20.00	2967.35
28	44.055187	-102.849591	3023.23	20.00	3043.23
29	44.074121	-102.849550	2895.32	20.00	2915.32
30	44.074429	-102.854614	2901.75	20.00	2921.75
31	44.081890	-102.859764	2880.50	20.00	2900.50

Flight Path Receptor(s)

Name: RWY 13
Description:
Threshold height: 50 ft
Direction: 138.5°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	44.158871	-103.120769	3275.93	50.00	3325.93
Two-mile	44.180532	-103.147494	3157.38	722.00	3879.39

Name: RWY 31
Description:
Threshold height: 50 ft
Direction: 318.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°



Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	44.131305	-103.086371	3183.44	50.00	3233.44
Two-mile	44.109816	-103.059390	3022.05	764.84	3786.90

Discrete Observation Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (ft)	Height (ft)
1-ATCT	1	44.137273	-103.109630	3214.26	65.00

Map image of 1-ATCT

GLARE ANALYSIS RESULTS

Summary of Glare

PV Array Name	Tilt (°)	Orient (°)	"Green" Glare min	"Yellow" Glare min	Energy kWh
Center	SA tracking	SA tracking	0	0	-
East	SA tracking	SA tracking	0	0	-
North	SA tracking	SA tracking	0	0	-
Total	SA tracking	SA tracking	0	0	-

Total annual glare received by each receptor

Receptor	Annual Green Glare (min)	Annual Yellow Glare (min)
RWY 13	0	0
RWY 31	0	0
1-ATCT	0	0

Results for: Center

Receptor	Green Glare (min)	Yellow Glare (min)
RWY 13	0	0
RWY 31	0	0
1-ATCT	0	0

Flight Path: RWY 13

0 minutes of yellow glare
0 minutes of green glare

Flight Path: RWY 31

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: East

Receptor	Green Glare (min)	Yellow Glare (min)
RWY 13	0	0
RWY 31	0	0
1-ATCT	0	0

Flight Path: RWY 13

0 minutes of yellow glare
0 minutes of green glare

Flight Path: RWY 31

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare

0 minutes of green glare

Results for: North

Receptor	Green Glare (min)	Yellow Glare (min)
RWY 13	0	0
RWY 31	0	0
1-ATCT	0	0

Flight Path: RWY 13

0 minutes of yellow glare
0 minutes of green glare

Flight Path: RWY 31

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: Total

Receptor	Green Glare (min)	Yellow Glare (min)
RWY 13	0	0
RWY 31	0	0
1-ATCT	0	0

Flight Path: RWY 13

0 minutes of yellow glare
0 minutes of green glare

Flight Path: RWY 31

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
Glare analyses do not account for physical obstructions between reflectors and receptors. This includes buildings, tree cover and geographic obstructions.
Several calculations utilize the PV array centroid, rather than the actual glare spot location, due to 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.

Attachment B

Ellsworth AFB Air Traffic Control Tower Cab Height Estimate

HMMH
77 South Bedford Street
Burlington, Massachusetts 01803
781.229.0707
www.hmmh.com

MEMORANDUM

To:	Wild Springs Solar, LLC - c/o Melisa Schmit, Geronimo Energy
From:	Philip DeVita, HMMH
Date:	January 6, 2020
Subject:	Wild Springs Solar, LLC
Reference:	HMMH Job No.309700.018

Introduction

Harris Miller Miller & Hanson Inc. (HMMH) evaluated potential glare at nearby Rapid City Regional Airport sensitive observer locations from the proposed 128 MW Wild Springs Solar, LLC (Wild Springs) solar project in Pennington County, South Dakota. The proposed project would be located on land just south of Route 90 and New Underwood, SD approximately 10.5 miles to the east-northeast of the airport. **Figure 1** shows the project location relative to the airport and its runways.

Figure 1. Locus Map of Wild Spring Solar, LLC Solar Project Relative to Rapid City Regional Airport

HMMH used the latest version of the ForgeSolar GlareGauge solar glare tool, formerly known as the Solar Glare Hazard Analysis Tool (SGHAT) developed by Sandia National Laboratories to analyze potential glare at sensitive airport receptor locations and reviewed the model results relative to the Federal Aviation Administration's (FAA) Interim Policy of Solar Projects at Airports.

In deploying the model, we selected the footprint of the solar project area of the Wild Springs array on the GlareGauge google map interface and input the project design parameter provided by Wild Spring Solar, LLC as shown in **Table 1.**

Table 1. Wild Spring Solar, LLC Proposed Project Design Parameters

Solar System	System	Orientation	Tilt Angle	Panel Height (AGL)
Wild Springs Solar, LLC Array	***Single Axis***	***180°***	***60°[1]***	***20 feet***

1. Denotes maximum tracking angle.

The Project is proposing a 128 MW single axis tracking system with a tracking orientation north to south and a maximum tracking angle of 60°. The project will be located on the ground at a height of up to 20 feet above ground level.

To assess airport sensitive receptors, the FAA requires an evaluation of potential glare for pilots on final approach and at the air traffic control tower (ATCT). For the pilot analysis, we selected the runway threshold and a second point away from the runway to represent the direction of the flight path. The previous version of GlareGauge (e.g. SGHAT) automatically identified the location and height above ground of eight additional observation points (spaced at quarter mile intervals based on a 3 degree glide slope) to determine if the pilot at those locations would be exposed to glare. However, the new version of GlareGauge automatically evaluates glare along the entire distance of the flight path at a 3 degree glide slope out to two miles.

There is an active ATCT at the airport; therefore, the analysis included evaluating impacts to the ATCT as well as aircraft on final approach to each runway end.

FAA Jurisdiction and Standards for Measuring Ocular Impact

The FAA published an Interim Policy for Solar Projects at Airports on October 23, 2013. The policy clarifies the FAA's jurisdiction in reviewing solar projects and the standards it uses to determine if a project will result in a negative glare impact to airspace safety.

Relative to its jurisdiction, the FAA affirmed that it has jurisdiction to regulate potential glare impacts as part of its responsibilities under Federal Aviation Regulations (FAR) Part 77 to any solar project proposed on the property of a Federally-obligated airport, which includes most airports in the U.S. The FAA also clarified that it does not have jurisdiction to regulate potential glare from projects located on non-airport land. However, as stated in the Policy, "the FAA urges proponents of off-airport solar-installations to voluntarily implement the provisions in this policy." *As the project is not located at a Federally-obligated airport, Wild Springs is not required to conduct a glare analysis for FAA approval. Furthermore, to assess airport sensitive receptors, the FAA requires an evaluation of potential glare for pilots on final approach and at the air traffic control tower (ATCT). Final approach path is defined in the policy as "two (2) miles from fifty (50) feet above the landing threshold using a standard three (3) degree glide path"[1]. The project is located beyond the final approach path of two miles from the airport, however as discussed above, Wild Springs has sought to voluntarily comply with FAA ocular hazard standards published in the FAA's Interim Policy*.

The Policy also describes the standards for measuring ocular impact:

To obtain FAA approval and 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: (1) no potential for glint or glare in the existing or planned Air Traffic Control Tower cab, and (2) no potential for glare or "low potential for after-image" (shown in green) along the final approach path.

Table 2 presents the airport sensitive receptors that must be evaluated, the potential results presented by the model and whether the result complies with the FAA ocular hazard standard presented in the Policy.

[1] https://www.federalregister.gov/documents/2013/10/23/2013-24729/interim-policy-faa-review-of-solar-energy-system-projects-on-federally-obligated-airports

Table 2. Levels of Glare and Compliance with FAA Policy

Airport Sensitive Receptor	Level of Glare	Color Result	Compliance with FAA Policy
ATCT Cab	No glare	None	Yes
	Low Potential for After-Image	Green	No
	Potential for After-Image	Yellow	No
	Potential for Permanent Eye Damage	Red	No
Aircraft along final approach path	No glare	None	Yes
	Low Potential for After-Image	Green	Yes
	Potential for After-Image	Yellow	No
	Potential for Permanent Eye Damage	Red	No

Any glare recorded on the ATCT is not compliant with FAA policy and will not receive a "no objection" determination from the FAA. Measurement of *low potential for after-image* or "Green" is acceptable for aircraft on final approach but greater levels (indicated in yellow and red) are not allowed.

Summary of Results

HMMH analyzed the potential for the Wild Springs Project site to produce glare on pilots on final approach to the Rapid City Regional Airport as well as at the ATCT. Based on the design and layout, GlareGauge modeling showed:

- Runway End 14 and 32: No glare detected at any observation points along the flight path; proposed design meets the FAA Standard for aircraft on final approach
- Runway End 5 and 23: No glare detected at any observation points along the flight path; proposed design meets the FAA Standard for aircraft on final approach
- ATCT: no glare detected at the ATCT, proposed design meets the FAA Standard for glare at the ATCT.

Results in Detail

To accurately model the proposed project, HMMH outlined the project array on the model's interactive google map, and the GlareGauge tool analyzed the potential glare impact from the project site. **Figure 2** shows the layout of the project area as input into the model.

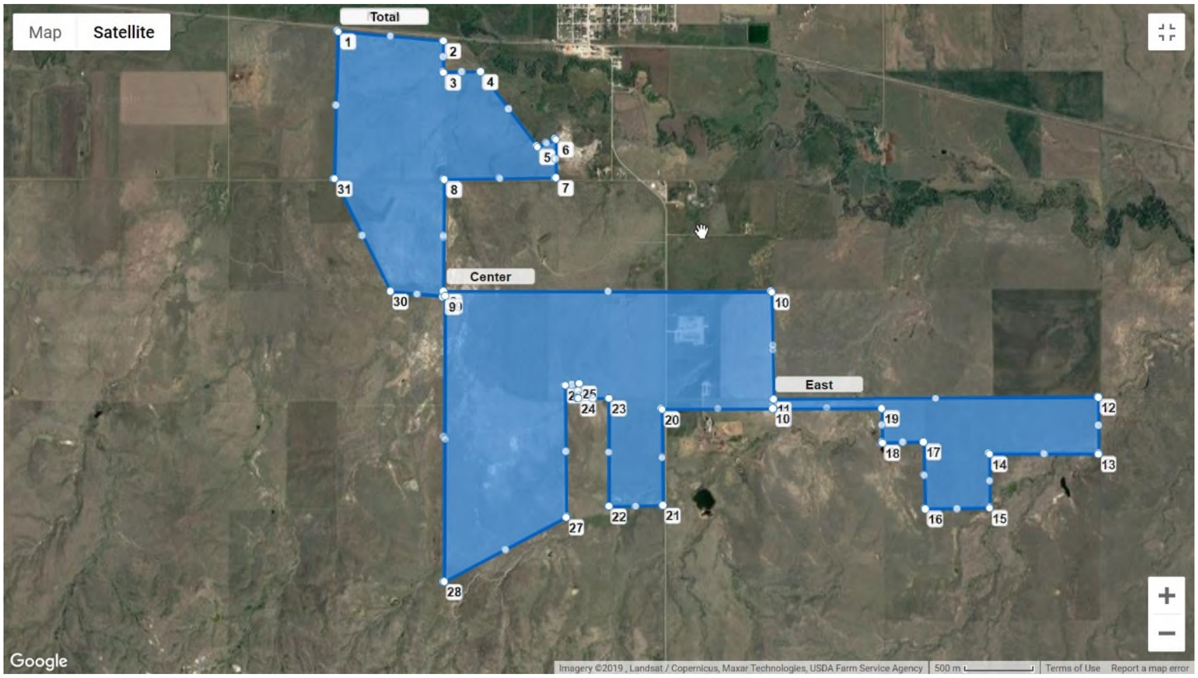


Figure 2. Wild Springs Solar, LLC Array as Input into the GlareGauge Model

We input the specifications of the array including a single axis tracking system with a north-south orientation, maximum tracking angle of 60° and a panel height of 20 feet above ground level. We also assumed a smooth panel surface without any anti-reflective coating to provide maximum flexibility in module selection. Modeling was then undertaken for the applicable sensitive receptors required by FAA: the pilots in aircraft along final descent to each runway end. There is an active ATCT at Rapid City Regional Airport, and therefore, an analysis of the ATCT was conducted. All of the modeling result output sheets are provided as **Attachment A**.

ATCT

Modeling was conducted for the ATCT location at the airport. The ATCT tower was located on the Google Maps aerial tool and input into the model. Based on a review of an online literature search, we were unable to find an official cab tower height at the airport. However, using the official airport diagram provided by the FAA, we were able to estimate the tower height of 75 feet above ground level assuming a base elevation of 3,158 feet above sea level (asl) from Google Earth and the top of the tower in the FAA diagram of 3,233 feet asl. The FAA official airport drawing is provided in **Attachment B** which includes the tower height. The GlareGauge results show that no glare was detected at the ATCT location; therefore, the proposed solar project design is consistent with the FAA Standards for ATCT.

Arriving Aircraft

To analyze arriving aircraft, HMMH selected locational information associated with each runway individually and generated associated results to evaluate the potential impacts of the proposed project on that runway. Given that there are two runways and four runway ends at the airport; modeling was conducted separately for each runway end.

To model a runway approach, we selected a point at the centerline on the runway threshold which is located near the runway end. We then selected a second point away from the runway to represent the orientation of the aircraft descent (or glide) path. The model automatically plots the glide path out two miles from the runway end and evaluates potential for glare along the entire glide path. Given that Rapid City Regional Airport has four runway ends; the model assessed the potential for glare along each of the four aircraft flight paths landing at the airport. The model automatically plots the location and height above ground of each observation point along the glide path assuming a 3 degree glide slope for the approach. In the model's flight path window, we checked the “consider pilot visibility from cockpit” box and kept the default azimuth-viewing angle of 50° so that the model would not register glare that the pilot would not see from behind the aircraft. We also kept the default downward viewing angle of 30° to eliminate false glare results from below the aircraft. **Figure 3** shows the flight path analyzed by the model for each runway along with ATCT location denoted as the red bubble “1”.

Figure 3. Flight Path Analyzed by GlareGauge

The latest version of the model now shows component results in time for the aircraft along a continuous route. **Table 3** presents the GlareGauge modeling results for each runway in terms of predicted minutes of green, yellow, or red glare.

As shown in **Table 3**, no glare was detected by the model for any of the runway approaches for the single axis tracking system. The no glare result on aircraft on approach for each alternative to each runway comply with the FAA’s ocular impact standard as published in the Federal Register on October 23, 2013 and shown in Table 2.

Table 3 – GlareGauge Results (in minutes per year) for the Wild Springs Solar, LLC Project near Rapid City Regional Airport

Site	Fixed/Tracker System	(orientation/tilt)	ATCT	RWY 5	RWY 23	RWY 14	RWY 32	Comply with FAA Thresholds
Wild Springs Solar, LLC	Single Axis Tracker	180° (max tracker of 60°)	0	0	0	0	0	Yes

Notes:

G (Green) = Low Potential for Temporary After-Image
Y (Yellow) = Potential for Temporary After-Image
R (Red) = Potential for Permanent Eye-Damage

N/A = Not applicable, no analysis conducted.

Conclusions

HMMH utilized the GlareGauge model developed by the Department of Energy’s Sandia National Laboratories to evaluate potential glare from a proposed single axis tracking solar PV project to the east-northeast of the Rapid City Regional Airport. The analysis focused on potential glare effects on aircraft arriving on final approach to runway ends 5, 23, 14, and 32 as well as the ATCT.

While the project *is not located on airport property and therefore not subject to FAA jurisdiction under Federal Aviation Regulations Part 77 to protect airspace safety; and the project is located beyond the two mile final approach as defined in the Interim Solar Policy*, the proponents have sought to voluntarily comply with FAA ocular hazard standards published in the FAA's Interim Solar Policy in the Federal Register on of October 23, 2013.

GlareGauge model results were compared to the FAA's ocular hazard standard. The model results provided in **Attachment A** show that for aircraft on final approach to Runways 5, 23, 14, and 32, GlareGauge model results for the project design result in no glare detected along the approach to each runway end or at the ATCT. These results *comply* with the FAA standards described in the Interim Solar Policy.

path window, we checked the "consider pilot visibility from cockpit" box and kept the default azimuth-viewing angle of 50° so that the model would not register glare that the pilot would not see from behind the aircraft. We also kept the default downward viewing angle of 30° to eliminate false glare results from below the aircraft. **Figure 3** shows the flight path analyzed by the model for each runway along with ATCT location denoted as the red bubble "1".

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Table 3 – GlareGauge Results (in minutes per year) for the Wild Springs Solar, LLC Project near Rapid City Regional Airport

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Wild Springs Solar, LLC	Single Axis Tracker	180° (max tracker of 60°)	0	0	0	0	0	Yes

Notes:

G (Green) = Low Potential for Temporary After-Image
Y (Yellow) = Potential for Temporary After-Image
R (Red) = Potential for Permanent Eye-Damage

N/A = Not applicable, no analysis conducted.

Conclusions

HMMH utilized the GlareGauge model developed by the Department of Energy's Sandia National Laboratories to evaluate potential glare from a proposed single axis tracking solar PV project to the east-

Attachment A

GlareGauge Modeling Results – Wild Springs Solar Project Design

FORGESOLAR GLARE ANALYSIS

Project: **Wild Spring Solar, LLC**
Near Rapid City, SD

Site configuration: **Wild Spring Solar LLC Rapid City**
Analysis conducted by Phil DeVita (pdevita@hmmh.com) at 15:58 on 26 Dec, 2019.

U.S. FAA 2013 Policy Adherence

The following table summarizes the policy adherence of the glare analysis based on the 2013 U.S. Federal Aviation Administration Interim Policy 78 FR 63276. This policy requires the following criteria be met for solar energy systems on airport property:

- No "yellow" glare (potential for after-image) for any flight path from threshold to 2 miles
- No glare of any kind for Air Traffic Control Tower(s) ("ATCT") at cab height.
- Default analysis and observer characteristics (see list below)

ForgeSolar does not represent or speak officially for the FAA and cannot approve or deny projects. Results are informational only.

COMPONENT	STATUS	DESCRIPTION
Analysis parameters	PASS	Analysis time interval and eye characteristics used are acceptable
Flight path(s)	PASS	Flight path receptor(s) do not receive yellow glare
ATCT(s)	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

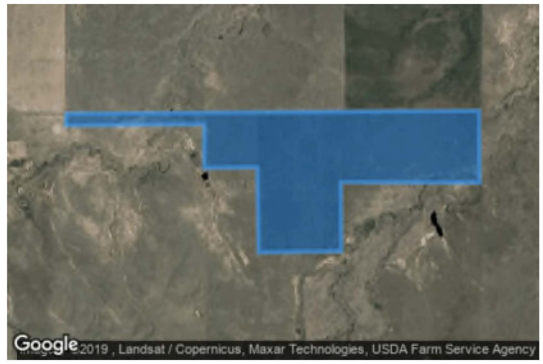
DNI: peaks at 1,000.0 W/m^2
Time interval: 1 min
Ocular transmission coefficient: 0.5
Pupil diameter: 0.002 m
Eye focal length: 0.017 m
Sun subtended angle: 9.3 mrad
Site Config ID: 34606.6355

PV Array(s)

Name: Center
Description: Single Axis Center Portion
Axis tracking: Single-axis rotation
Tracking axis orientation: 180.0°
Tracking axis tilt: 0.0°
Tracking axis panel offset: 0.0°
Max tracking angle: 60.0°
Resting angle: 60.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

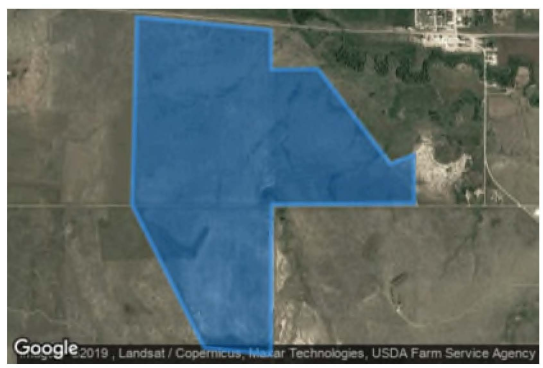
Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	44.074460	-102.849613	2894.19	20.00	2914.19
2	44.074429	-102.819486	2853.46	20.00	2873.46
3	44.066690	-102.819229	2868.43	20.00	2888.43
4	44.066659	-102.829614	2904.20	20.00	2924.21
5	44.060245	-102.829528	2917.64	20.00	2937.64
6	44.060214	-102.834549	2932.23	20.00	2952.23
7	44.067368	-102.834507	2938.49	20.00	2958.49
8	44.067337	-102.837382	2905.65	20.00	2925.65
9	44.068355	-102.837253	2904.43	20.00	2924.44
10	44.068232	-102.838541	2908.27	20.00	2928.28
11	44.059505	-102.838369	2948.34	20.00	2968.34
12	44.055218	-102.849742	3025.50	20.00	3045.51

Name: East
Description: Single Axis East Portion
Axis tracking: Single-axis rotation
Tracking axis orientation: 180.0°
Tracking axis tilt: 0.0°
Tracking axis panel offset: 0.0°
Max tracking angle: 60.0°
Resting angle: 60.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material



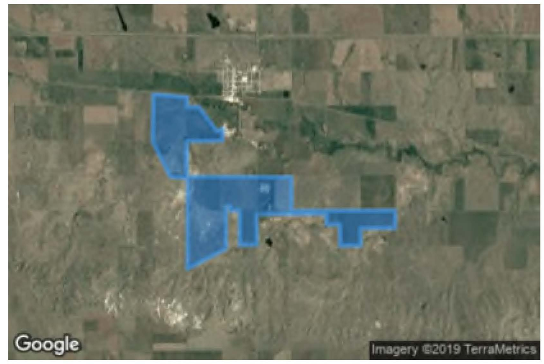
Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	44.067302	-102.819300	2868.89	20.00	2888.89
2	44.067456	-102.789345	2840.34	20.00	2860.34
3	44.063694	-102.789302	2828.67	20.00	2848.67
4	44.063724	-102.799388	2874.75	20.00	2894.76
5	44.060116	-102.799345	2871.20	20.00	2891.20
6	44.060055	-102.805353	2902.47	20.00	2922.47
7	44.064495	-102.805439	2897.21	20.00	2917.21
8	44.064465	-102.809301	2857.51	20.00	2877.51
9	44.066746	-102.809301	2873.71	20.00	2893.71
10	44.066685	-102.819343	2869.61	20.00	2889.61

Name: North
Description: Single Axis North Portion
Axis tracking: Single-axis rotation
Tracking axis orientation: 180.0°
Tracking axis tilt: 0.0°
Tracking axis panel offset: 0.0°
Max tracking angle: 60.0°
Resting angle: 60.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material



Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	44.091718	-102.859507	2865.64	20.00	2885.64
2	44.091039	-102.849765	2856.16	20.00	2876.16
3	44.088974	-102.849765	2853.42	20.00	2873.42
4	44.089005	-102.846374	2850.03	20.00	2870.03
5	44.084042	-102.841096	2847.53	20.00	2867.53
6	44.084535	-102.839379	2841.44	20.00	2861.44
7	44.081977	-102.839379	2858.52	20.00	2878.53
8	44.081915	-102.849722	2867.58	20.00	2887.58
9	44.074084	-102.849765	2896.21	20.00	2916.21
10	44.074423	-102.854614	2901.77	20.00	2921.77
11	44.081884	-102.859850	2881.23	20.00	2901.23

Name: Total
Description: Single Axis Tracker
Axis tracking: Single-axis rotation
Tracking axis orientation: 180.0°
Tracking axis tilt: 0.0°
Tracking axis panel offset: 0.0°
Max tracking angle: 60.0°
Resting angle: 60.0°
Rated power: -
Panel material: Smooth glass without AR coating
Reflectivity: Vary with sun
Slope error: correlate with material



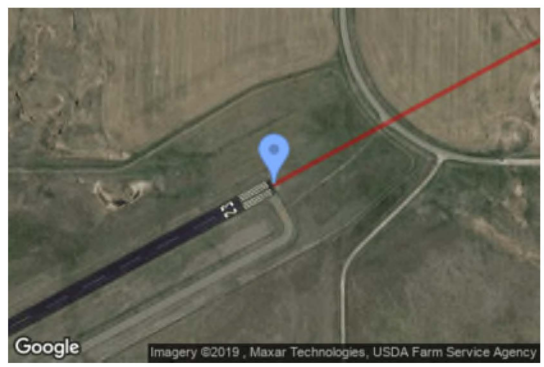
Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	44.091672	-102.859447	2865.85	20.00	2885.85
2	44.091025	-102.849705	2856.05	20.00	2876.05
3	44.088960	-102.849705	2853.02	20.00	2873.02
4	44.089022	-102.846315	2850.03	20.00	2870.03
5	44.084028	-102.841036	2846.09	20.00	2866.09
6	44.084490	-102.839320	2842.24	20.00	2862.24
7	44.081962	-102.839363	2858.90	20.00	2878.90
8	44.081870	-102.849662	2868.27	20.00	2888.27
9	44.074471	-102.849705	2894.25	20.00	2914.25
10	44.074378	-102.819407	2853.30	20.00	2873.30
11	44.067317	-102.819278	2868.77	20.00	2888.77
12	44.067410	-102.789323	2839.45	20.00	2859.45
13	44.063679	-102.789280	2828.84	20.00	2848.84
14	44.063679	-102.799323	2875.91	20.00	2895.91
15	44.060070	-102.799323	2870.92	20.00	2890.93
16	44.060009	-102.805288	2903.06	20.00	2923.06
17	44.064480	-102.805417	2897.36	20.00	2917.36
18	44.064419	-102.809236	2858.86	20.00	2878.86
19	44.066701	-102.809279	2873.92	20.00	2893.92
20	44.066627	-102.829529	2903.76	20.00	2923.76
21	44.060243	-102.829486	2917.62	20.00	2937.62
22	44.060182	-102.834464	2932.16	20.00	2952.16
23	44.067367	-102.834464	2939.74	20.00	2959.74
24	44.067336	-102.837254	2907.04	20.00	2927.04
25	44.068323	-102.837211	2904.56	20.00	2924.56
26	44.068199	-102.838455	2907.31	20.00	2927.31
27	44.059451	-102.838356	2947.34	20.00	2967.35
28	44.055187	-102.849591	3023.23	20.00	3043.23
29	44.074121	-102.849550	2895.32	20.00	2915.32
30	44.074429	-102.854614	2901.75	20.00	2921.75
31	44.081890	-102.859764	2880.50	20.00	2900.50

Flight Path Receptor(s)

Name: RWY 14
Description:
Threshold height: 50 ft
Direction: 153.0°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

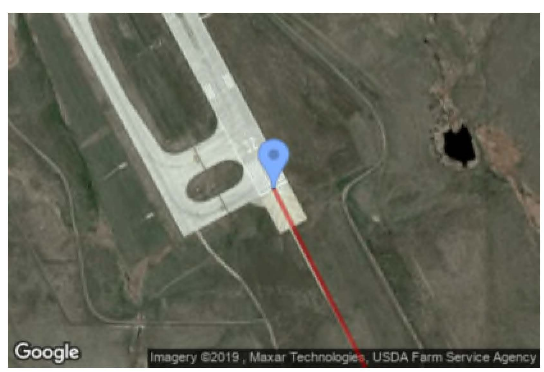
Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	44.053830	-103.065013	3189.99	50.00	3240.00
Two-mile	44.079603	-103.083267	3321.62	471.84	3793.45

Name: RWY 23
Description:
Threshold height: 50 ft
Direction: 241.4°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°



Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	44.052562	-103.051748	3200.50	50.00	3250.50
Two-mile	44.066380	-103.016370	3234.27	569.68	3803.96

Name: RWY 32
Description:
Threshold height: 50 ft
Direction: 332.9°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°



Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	44.032802	-103.049414	3140.49	50.00	3190.49
Two-mile	44.007064	-103.031072	2957.55	786.40	3743.95

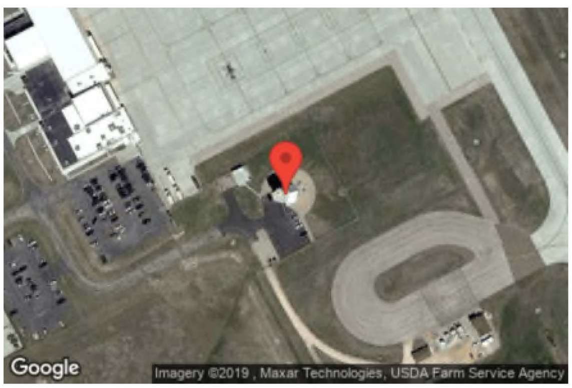
Name: RWY 5
Description:
Threshold height: 50 ft
Direction: 61.2°
Glide slope: 3.0°
Pilot view restricted? Yes
Vertical view: 30.0°
Azimuthal view: 50.0°

Point	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
Threshold	44.047876	-103.063876	3169.29	50.00	3219.29
Two-mile	44.033938	-103.099160	3030.17	742.57	3772.75

Discrete Observation Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (ft)	Height (ft)
1-ATCT	1	44.036439	-103.056484	3156.96	75.00

Map image of 1-ATCT



GLARE ANALYSIS RESULTS

Summary of Glare

PV Array Name	Tilt (°)	Orient (°)	"Green" Glare min	"Yellow" Glare min	Energy kWh
Center	SA tracking	SA tracking	0	0	-
East	SA tracking	SA tracking	0	0	-
North	SA tracking	SA tracking	0	0	-
Total	SA tracking	SA tracking	0	0	-

Total annual glare received by each receptor

Receptor	Annual Green Glare (min)	Annual Yellow Glare (min)
RWY 14	0	0
RWY 23	0	0
RWY 32	0	0
RWY 5	0	0
1-ATCT	0	0

Results for: Center

Receptor	Green Glare (min)	Yellow Glare (min)
RWY 14	0	0
RWY 23	0	0
RWY 32	0	0
RWY 5	0	0
1-ATCT	0	0

Flight Path: RWY 14

0 minutes of yellow glare
0 minutes of green glare

Flight Path: RWY 23

0 minutes of yellow glare
0 minutes of green glare

Flight Path: RWY 32

0 minutes of yellow glare
0 minutes of green glare

Flight Path: RWY 5

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: East

Receptor	Green Glare (min)	Yellow Glare (min)
RWY 14	0	0
RWY 23	0	0
RWY 32	0	0
RWY 5	0	0
1-ATCT	0	0

Flight Path: RWY 14

0 minutes of yellow glare
0 minutes of green glare

Flight Path: RWY 23

0 minutes of yellow glare
0 minutes of green glare

Flight Path: RWY 32

0 minutes of yellow glare
0 minutes of green glare

Flight Path: RWY 5

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: North

Receptor	Green Glare (min)	Yellow Glare (min)
RWY 14	0	0
RWY 23	0	0
RWY 32	0	0
RWY 5	0	0
1-ATCT	0	0

Flight Path: RWY 14

0 minutes of yellow glare
0 minutes of green glare

Flight Path: RWY 23

0 minutes of yellow glare
0 minutes of green glare

Flight Path: RWY 32

0 minutes of yellow glare
0 minutes of green glare

Flight Path: RWY 5

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Results for: Total

Receptor	Green Glare (min)	Yellow Glare (min)
RWY 14	0	0
RWY 23	0	0
RWY 32	0	0
RWY 5	0	0
1-ATCT	0	0

Flight Path: RWY 14

0 minutes of yellow glare
0 minutes of green glare

Flight Path: RWY 23

0 minutes of yellow glare
0 minutes of green glare

Flight Path: RWY 32

0 minutes of yellow glare
0 minutes of green glare

Flight Path: RWY 5

0 minutes of yellow glare
0 minutes of green glare

Point Receptor: 1-ATCT

0 minutes of yellow glare
0 minutes of green glare

Assumptions

"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
Glare analyses do not account for physical obstructions between reflectors and receptors. This includes buildings, tree cover and geographic obstructions.
Several calculations utilize the PV array centroid, rather than the actual glare spot location, due to 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.

Attachment B

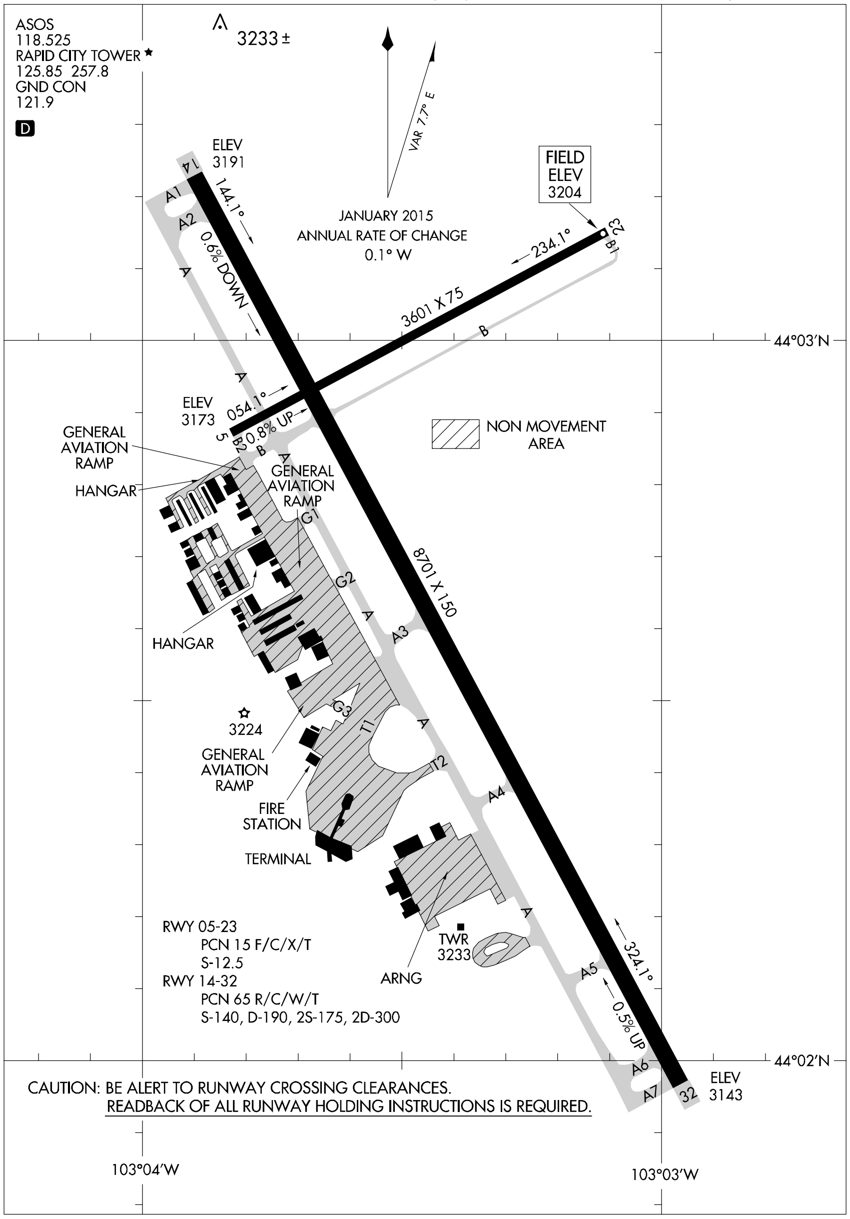
FAA Official Airport Diagram of Rapid City Regional Airport showing ATCT Tower Height in Feet Above Mean Sea Level

AIRPORT DIAGRAM

AL-877 (FAA)

RAPID CITY RGNL (RAP)
RAPID CITY, SOUTH DAKOTA

NC-1, 05 DEC 2019 to 02 JAN 2020



NC-1, 05 DEC 2019 to 02 JAN 2020