Appendix F

GLARE ANALYSIS

Mantle Rock Solar LLC

Livingston County, Kentucky

COPPERHEAD
ENVIRONMENTAL CONSULTING

Glare Analysis for Proposed Mantle Rock Solar LLC Project, Livingston County, Kentucky

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BACKGROUND

Project Summary

Atlantica contracted Copperhead Environmental Consulting, Inc., (Copperhead) to conduct a glare analysis for the proposed 42-megawatt (MW) Mantle Rock Solar project (Mantle Rock or Project). The Project is located on approximately 537 acres in Livingston County, KY, near the intersection of Carrsville Road (KY 135) and KY 1608. The proposed project site is rural and currently a mix of agricultural fields, pasture, and forested areas.

The Project would generate electricity using solar photovoltaic (PV) panels. It would include a utility interconnection substation, a storage/maintenance container, inverter boxes, transformers, and overhead and underground electrical conveyance lines.

Figure 1. View of land use near Mantle Rock Solar project site.

Solar Glare

The glare analysis was conducted using the latest version of the ForgeSolar GlareGauge solar glare tool, formerly known as the Solar Glare Hazard Analysis (SGHAT), developed by Sandia National Laboratories to analyze potential glare caused by the sun reflecting off solar panels.

Glare is defined as a continuous source of bright light and is a common phenomenon in our everyday lives. The sun and artificial light sources can cause glare directly, such as from a sunset when driving westbound, or indirectly, such as from the sun's reflections from a lake or mirror. Potential concerns associated with glare may include:

- Safety impacts, such as the potential to disorient motorists when driving or pilots when taking off or landing; or
- Annoyance impacts, such as distraction, after-image in the viewer's vision, or temporary avoidance of a view due to the presence of reflected light.

The GlareGauge model results in three possible levels of glare:

1. Green: Low potential for after-image
2. Yellow: Potential for after-image
3. Red: Potential for permanent eye damage

SOLAR GLARE ANALYSIS

Using the GlareGauge software, Copperhead completed an analysis to identify the potential for solar glare to result from the Project. The locations for which potential solar glare from the Project was analyzed include six road segments (all two-way roads) and 13 observation points (OPs) representing specific nearby residences. No public airports are in the vicinity of the Project.

Design Parameters

In deploying the model, we broke up the entire array footprint into six sections to allow for more accurate modeling given the limitations of the GlareGauge tool. The project design parameters for the array provided by Mantle Rock are shown in Table 1. The height above ground for all sections of the array is 15 feet.

Table 1. Mantle Rock Solar LLC Proposed Project Design Parameters.

System Tracking	Backtracking Method	Tracking Axis Orientation	Maximum Tracking Angle	Resting Angle	Ground Coverage Ratio (GPR)	Module Surface Material
Single	Shade-slope	180	60	5	.5	Smooth glass with anti-reflective coating (ARC)

Observation Point and Route Receptor Parameters

The analysis was performed for the observation points at each of the residences adjacent to the proposed solar facility. No commercial properties were found in the area. The elevation at each point was set at 6 feet above the ground to assume typical eye level.

A total of 6 routes near the proposed project site were modeled using an elevation of 5 feet. The view angle along all routes was set at 50 degrees.

Obstruction Parameters

To try to make this analysis as accurate as possible, existing vegetation was modeled as obstructions. Portions of the perimeter of the solar facility are forested, and only forested areas within the security fence line will be altered.

The options for adding and modeling obstructions in the GlareGauge tool are limited. For example, only a single height for each line representing an obstruction can be entered. Because the GlareGauge model does not consider natural obstructions such as vegetation and topography, a top height of 32.8 feet was used for each of the four obstructions representing mature vegetation.

SUMMARY OF RESULTS FOR NEARBY ROADWAY AND OBSERVATION LOCATIONS

Roadway Segments

Any potential solar glare to the vehicles traveling along the nearby roadways is very similar or representative to aircraft along final approach in the FAA standards. Therefore, in lieu of county-specific standards, the standards of acceptable ocular impact as contained in the FAA policy for aircraft on final approach were applied to the vehicles traveling along these sections of roadways. It should be noted that the GlareGauge model does not consider potential obstacles associated with the landscape, such as trees, buildings, or hills, which could block a direct view of the solar panels to the nearby observer locations.

Based on the design and layout of the Project, the GlareGauge modeling showed no green, yellow, or red glare detected at any of the six road segments analyzed using the tool.

Observation Points

Based on the design and layout of the Project and existing vegetation, the GlareGauge model showed that no green, yellow, or red glare would be experienced at any of the 13 observation points. To further reduce the possibility of experiencing glare at any of the observation points, landscape buffers are planned in areas where there is no existing mature vegetation. The preliminary landscape plan is in Appendix C.

AIRPORT SENSITIVE RECEPTORS AND PILOT ANALYSIS

In 2013, the FAA published an Interim Policy for Solar Projects at Airports. This Policy was finalized and went into effect on May 11, 2021 (86 FR 25801). In developing the final rule, the FAA concluded that the glint and glare from solar energy systems to pilots on final approach is similar to glint and glare pilots routinely experience from waterbodies, glass-façade buildings, parking lots, and similar features. The FAA continued to receive reports of glint and glare effects from on-airport solar arrays on air traffic control tower cab (ATCT) personnel and determined that agency policy should focus on the impact of these systems to federally-obligated towered airports, specifically the ATCT cab (14 CFR Part 77).

Although the final rule does not apply to off-airport solar facilities, we searched for airports within the vicinity of the Project and determined there were none proximal that necessitated analysis. Therefore, no ATCT receptors were assessed, and no glare effects were found. The GlareGauge model results summary for aviation is in Appendix B.

CONCLUSIONS

ForgeSolar's GlareGauge tool, which incorporates the SGHAT model, was used to assess 13 observation points (OPs) and six roadway segments to identify the Project's potential to cause glare. The model indicated that no green, yellow, or red glare would be experienced at any of the observation points or roadway segments. No public airports are in the vicinity of the Project, and therefore none were analyzed using the GlareGauge tool.

REFERENCES

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Appendix A

ForgeSolar GlareGauge Model Results

FORGESOLAR GLARE ANALYSIS

Project: **Mantle Rock**

A 65MW site proposed by Enerfin near Mantle Rock, KY. Site will have single axis tracking panels mounted 15 ft off the ground. No FAA observers are near the site. Elevation data provided through Forge Solar via Google Earth. Array polygons are generated from MCPs based on the proposed fence lines.

Site configuration: **C2_Obs_noTrailer_0**

Client: Enerfin

Site description: Config with 2 proposed obstructions

Created 03 Oct, 2023
Updated 03 Oct, 2023
Time-step 1 minute
Timezone offset UTC-6
Minimum sun altitude 0.0 deg
DNI peaks at 1,000.0 W/m^2
Category 10 MW to 100 MW
Site ID 102077.15978

Ocular transmission coefficient 0.5
Pupil diameter 0.002 m
Eye focal length 0.017 m
Sun subtended angle 9.3 mrad
PV analysis methodology V2

Summary of Results No glare predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy	Peak Luminance
	°	°	min	hr	min	hr	kWh	cd/m^2
PV1	SA tracking	SA tracking	0	0.0	0	0.0	-	0
PV2	SA tracking	SA tracking	0	0.0	0	0.0	-	0
PV3	SA tracking	SA tracking	0	0.0	0	0.0	-	0
PV4	SA tracking	SA tracking	0	0.0	0	0.0	-	0
PV5	SA tracking	SA tracking	0	0.0	0	0.0	-	0
PV6	SA tracking	SA tracking	0	0.0	0	0.0	-	0

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
FrankMayRd	0	0.0	0	0.0
KY135	0	0.0	0	0.0
KY1608	0	0.0	0	0.0
PD1	0	0.0	0	0.0
PeckBranchRd	0	0.0	0	0.0
QuatermousRd	0	0.0	0	0.0
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	0	0.0	0	0.0
OP 8	0	0.0	0	0.0
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0

Component Data

PV Arrays

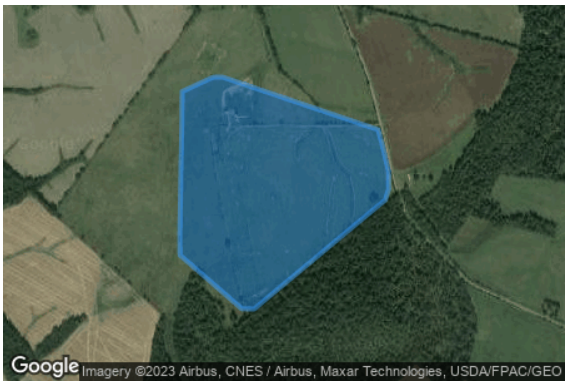
Name: PV1
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 180.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Ground Coverage Ratio: 0.5
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.303533	-88.395070	609.95	15.00	624.95
2	37.303533	-88.395690	602.38	15.00	617.38
3	37.305356	-88.398183	609.87	15.00	624.87
4	37.306221	-88.398180	627.28	15.00	642.28
5	37.306606	-88.397894	627.04	15.00	642.04
6	37.306610	-88.397891	627.04	15.00	642.04
7	37.308011	-88.396616	634.81	15.00	649.81
8	37.308390	-88.396268	630.83	15.00	645.83
9	37.308744	-88.395942	622.09	15.00	637.09
10	37.309492	-88.395234	617.31	15.00	632.31
11	37.309492	-88.394953	615.07	15.00	630.07
12	37.306986	-88.395003	631.84	15.00	646.84

Name: PV2
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 180.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Ground Coverage Ratio: 0.5
Rated power: -
Panel material: Smooth glass with 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	37.318169	-88.396363	558.38	15.00	573.38
2	37.319397	-88.396371	562.71	15.00	577.71
3	37.319784	-88.395279	558.58	15.00	573.58
4	37.319790	-88.394776	563.78	15.00	578.78
5	37.317378	-88.394810	569.73	15.00	584.73
6	37.317382	-88.395314	564.10	15.00	579.10

Name: PV3
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 180.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Ground Coverage Ratio: 0.5
Rated power: -
Panel material: Smooth glass with 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	37.303184	-88.392236	623.08	15.00	638.08
2	37.304641	-88.394353	614.25	15.00	629.25
3	37.305115	-88.394362	616.49	15.00	631.49
4	37.306908	-88.394325	619.82	15.00	634.82
5	37.308173	-88.394292	611.93	15.00	626.93
6	37.309096	-88.394281	608.09	15.00	623.09
7	37.309487	-88.393212	604.98	15.00	619.98
8	37.309490	-88.392897	602.50	15.00	617.50
9	37.308058	-88.387546	622.33	15.00	637.33
10	37.307783	-88.387451	624.99	15.00	639.99
11	37.307507	-88.387363	623.50	15.00	638.50
12	37.306911	-88.387187	625.67	15.00	640.67
13	37.306436	-88.387187	625.62	15.00	640.62
14	37.306150	-88.387300	628.43	15.00	643.43
15	37.303177	-88.391805	628.26	15.00	643.26

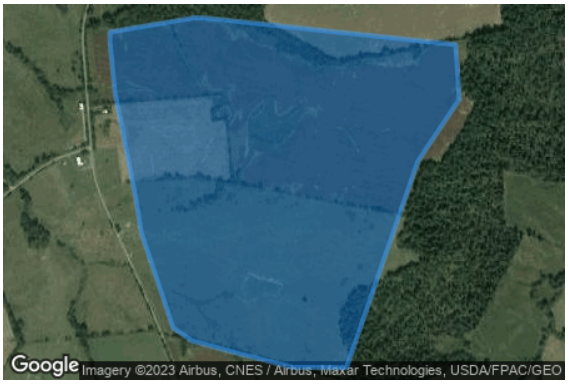
Name: PV4
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 180.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Ground Coverage Ratio: 0.5
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.315987	-88.394139	568.25	15.00	583.25
2	37.320512	-88.394071	571.50	15.00	586.50
3	37.320851	-88.394062	563.85	15.00	578.85
4	37.320858	-88.393158	563.42	15.00	578.42
5	37.320770	-88.392894	568.65	15.00	583.65
6	37.320289	-88.392714	578.53	0.00	578.53
7	37.320289	-88.392714	578.53	0.00	578.53
8	37.320289	-88.392714	578.53	0.00	578.53
9	37.319888	-88.392329	586.54	0.00	586.54
10	37.319888	-88.392329	586.54	0.00	586.54
11	37.319888	-88.392329	586.54	0.00	586.54
12	37.319773	-88.391751	590.64	15.00	605.64
13	37.318362	-88.391623	589.46	15.00	604.46
14	37.318104	-88.391623	584.82	15.00	599.82
15	37.316381	-88.392902	586.41	15.00	601.41
16	37.316096	-88.393175	576.55	15.00	591.55
17	37.315963	-88.393414	576.95	15.00	591.95
18	37.315967	-88.394088	569.03	15.00	584.03

Name: PV5
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 180.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Ground Coverage Ratio: 0.5
Rated power: -
Panel material: Smooth glass with 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	37.308543	-88.389283	601.95	15.00	616.95
2	37.308640	-88.389611	600.99	15.00	615.99
3	37.309540	-88.390640	592.34	15.00	607.34
4	37.309780	-88.390899	592.11	15.00	607.11
5	37.309890	-88.390977	591.85	15.00	606.85
6	37.311176	-88.391478	587.99	15.00	602.99
7	37.311512	-88.391547	589.48	15.00	604.48
8	37.311821	-88.391590	580.45	15.00	595.45
9	37.312234	-88.391590	579.24	15.00	594.24
10	37.314392	-88.391391	581.42	15.00	596.42
11	37.314454	-88.391322	581.63	15.00	596.63
12	37.314454	-88.390622	593.75	15.00	608.75
13	37.311560	-88.389067	602.86	15.00	617.86
14	37.310488	-88.388531	610.64	15.00	625.64
15	37.309780	-88.388194	614.41	15.00	629.41
16	37.309423	-88.388056	619.79	15.00	634.79
17	37.309038	-88.387927	621.15	15.00	636.15
18	37.308495	-88.387927	613.77	15.00	628.77

Name: PV6
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 180.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Ground Coverage Ratio: 0.5
Rated power: -
Panel material: Smooth glass with 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	37.310636	-88.384418	628.06	15.00	643.06
2	37.310987	-88.386170	606.16	15.00	621.16
3	37.311361	-88.387895	605.27	15.00	620.27
4	37.311712	-88.388544	605.80	15.00	620.80
5	37.312520	-88.388880	595.94	15.00	610.94
6	37.313347	-88.389234	590.25	15.00	605.25
7	37.314301	-88.389634	594.05	15.00	609.05
8	37.315312	-88.389842	584.62	15.00	599.62
9	37.318089	-88.390532	588.60	15.00	603.60
10	37.318254	-88.390560	586.71	15.00	601.71
11	37.319472	-88.390711	592.76	15.00	607.76
12	37.319768	-88.390712	588.66	15.00	603.66
13	37.320142	-88.387937	599.13	15.00	614.13
14	37.320164	-88.387827	599.98	15.00	614.98
15	37.320153	-88.387454	603.09	15.00	618.09
16	37.319428	-88.378828	630.46	15.00	645.46
17	37.317935	-88.378704	630.14	15.00	645.14
18	37.316247	-88.380131	634.44	15.00	649.44
19	37.310625	-88.382582	619.07	15.00	634.07

Route Receptors

Name: FrankMayRd
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.323530	-88.363707	539.77	6.00	545.77
2	37.318924	-88.364458	530.30	6.00	536.30
3	37.314744	-88.365157	511.78	6.00	517.78
4	37.314550	-88.365297	511.55	6.00	517.55
5	37.314522	-88.365768	511.97	6.00	517.97
6	37.314744	-88.367863	485.15	6.00	491.15
7	37.314633	-88.368125	481.89	6.00	487.89
8	37.314272	-88.368474	474.33	6.00	480.33
9	37.314126	-88.368651	476.90	6.00	482.90
10	37.313832	-88.368999	484.23	6.00	490.23
11	37.313654	-88.369069	488.27	6.00	494.27
12	37.312374	-88.369313	498.22	6.00	504.22
13	37.308370	-88.370690	494.97	6.00	500.97
14	37.308212	-88.370679	494.00	6.00	500.00
15	37.305211	-88.368897	532.36	6.00	538.36
16	37.303995	-88.368358	526.75	6.00	532.75
17	37.302692	-88.367962	544.28	6.00	550.28
18	37.299489	-88.366796	567.81	6.00	573.81

Name: KY135
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.300770	-88.375941	500.72	6.00	506.72
2	37.300989	-88.376417	496.57	6.00	502.57
3	37.303785	-88.384258	519.30	6.00	525.30
4	37.304248	-88.384921	532.01	6.00	538.01
5	37.305446	-88.386345	593.41	6.00	599.41
6	37.305840	-88.386670	614.87	6.00	620.87
7	37.306395	-88.386883	627.10	6.00	633.10
8	37.309659	-88.387943	616.92	6.00	622.92
9	37.312627	-88.389515	591.77	6.00	597.77
10	37.314999	-88.390872	581.55	6.00	587.55
11	37.315723	-88.391229	589.88	6.00	595.88
12	37.319296	-88.391611	597.00	6.00	603.00
13	37.320099	-88.391583	585.79	6.00	591.79
14	37.321032	-88.391198	573.57	6.00	579.57
15	37.324952	-88.388798	595.09	6.00	601.09
16	37.325148	-88.388578	590.95	6.00	596.95

Name: KY1608
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.302361	-88.414186	598.70	6.00	604.70
2	37.302526	-88.413731	591.59	6.00	597.59
3	37.303824	-88.412037	568.41	6.00	574.41
4	37.307029	-88.407842	614.88	6.00	620.88
5	37.310185	-88.402697	594.87	6.00	600.87
6	37.315353	-88.394261	574.23	6.00	580.23
7	37.316036	-88.393109	578.66	6.00	584.66
8	37.316266	-88.392675	587.35	6.00	593.35
9	37.316430	-88.392116	588.25	6.00	594.25
10	37.316594	-88.391476	591.74	6.00	597.74

Name: PD1
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.324439	-88.378093	637.25	6.00	643.25
2	37.324436	-88.378009	636.05	6.00	642.05
3	37.324405	-88.377900	634.30	6.00	640.30
4	37.324260	-88.377750	633.34	6.00	639.34
5	37.324034	-88.377618	631.87	6.00	637.87
6	37.323501	-88.377419	634.25	6.00	640.25
7	37.323275	-88.377277	632.51	6.00	638.51

Name: PeckBranchRd
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.316678	-88.405139	585.43	6.00	591.43
2	37.316648	-88.404927	587.22	6.00	593.22
3	37.316656	-88.404850	587.69	6.00	593.69
4	37.316787	-88.404557	587.71	6.00	593.71
5	37.316880	-88.404347	585.13	6.00	591.13
6	37.317040	-88.404068	580.99	6.00	586.99
7	37.317153	-88.403830	577.15	6.00	583.15
8	37.317322	-88.403492	572.99	6.00	578.99
9	37.317422	-88.403261	569.78	6.00	575.78
10	37.317627	-88.402886	567.41	6.00	573.41
11	37.317994	-88.402158	563.76	6.00	569.76
12	37.318094	-88.402008	563.15	6.00	569.15
13	37.318147	-88.401888	562.44	6.00	568.44
14	37.318295	-88.401573	557.68	6.00	563.68
15	37.318544	-88.401287	541.74	6.00	547.74
16	37.318685	-88.401166	539.26	6.00	545.26
17	37.318790	-88.400930	537.54	6.00	543.54
18	37.318797	-88.400775	533.41	6.00	539.41
19	37.318738	-88.400553	527.35	6.00	533.35
20	37.318851	-88.400041	540.19	6.00	546.19
21	37.319374	-88.398907	557.46	6.00	563.46
22	37.319424	-88.398505	562.18	6.00	568.18
23	37.319342	-88.398148	561.64	6.00	567.64
24	37.318867	-88.397799	557.49	6.00	563.49
25	37.318603	-88.397529	555.56	6.00	561.56
26	37.317613	-88.395972	559.00	6.00	565.00
27	37.317189	-88.395607	566.64	6.00	572.64
28	37.316769	-88.395051	565.54	6.00	571.54
29	37.316072	-88.394893	570.71	6.00	576.71
30	37.315595	-88.394185	570.41	6.00	576.41

Name: QuatermousRd
Path type: Two-way
Observer view angle: 50.0°

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.322304	-88.390292	565.01	6.00	571.01
2	37.322307	-88.390076	566.94	6.00	572.94
3	37.322808	-88.387911	598.22	6.00	604.22
4	37.323781	-88.383769	623.47	6.00	629.47
5	37.323784	-88.383445	620.79	6.00	626.79
6	37.323627	-88.382824	621.21	6.00	627.21
7	37.323302	-88.381505	623.97	6.00	629.97
8	37.323297	-88.381320	624.08	6.00	630.08
9	37.323418	-88.380894	627.27	6.00	633.27
10	37.324271	-88.378432	637.07	6.00	643.07
11	37.324393	-88.378163	638.10	6.00	644.10
12	37.324478	-88.378083	637.18	6.00	643.18
13	37.324626	-88.378073	633.64	6.00	639.64
14	37.324911	-88.378144	629.65	6.00	635.65
15	37.325174	-88.378182	623.63	6.00	629.63
16	37.325450	-88.378202	615.62	6.00	621.62
17	37.325567	-88.378252	612.18	6.00	618.18
18	37.325685	-88.378350	609.95	6.00	615.95

Discrete Observation Point Receptors

Name	ID	Latitude (°)	Longitude (°)	Elevation (ft)	Height (ft)
OP 1	1	37.323154	-88.376902	622.01	6.00
OP 2	2	37.323192	-88.385330	619.63	6.00
OP 3	3	37.321491	-88.390350	574.94	6.00
OP 4	4	37.321196	-88.391495	565.63	6.00
OP 5	5	37.316187	-88.391716	592.81	6.00
OP 6	6	37.311747	-88.399485	594.10	6.00
OP 7	7	37.306780	-88.407406	618.22	6.00
OP 8	8	37.306461	-88.407759	614.24	6.00
OP 9	9	37.306628	-88.408846	617.64	6.00
OP 10	10	37.301234	-88.415117	609.62	6.00
OP 11	11	37.309612	-88.370618	514.22	6.00
OP 12	12	37.311907	-88.370574	519.82	6.00
OP 13	13	37.315689	-88.364617	532.00	6.00

Obstruction Components

Name: Existing Trees 1
Top height: 32.8 ft

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)
1	37.319854	-88.394564	565.70
2	37.319820	-88.396377	550.50
3	37.319316	-88.397418	562.00
4	37.318736	-88.397407	551.90
5	37.316842	-88.394628	562.60

Name: Existing Trees 2
Top height: 32.8 ft

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)
1	37.321173	-88.392391	565.40
2	37.321404	-88.393405	567.60
3	37.321314	-88.394108	560.10
4	37.322026	-88.390659	569.50

Name: Existing Trees 3
Top height: 32.8 ft

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)
1	37.322913	-88.387136	599.30
2	37.322593	-88.384888	611.60

Name: Existing Trees 4
Top height: 32.8 ft

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)
1	37.321284	-88.390192	575.40
2	37.320712	-88.389452	592.40
3	37.320721	-88.383915	610.60
4	37.320601	-88.382768	615.10
5	37.320687	-88.381974	618.50
6	37.321173	-88.381727	621.90

Glare Analysis Results

Summary of Results No glare predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy	Peak Luminance
	°	°	min	hr	min	hr	kWh	cd/m^2
PV1	SA tracking	SA tracking	0	0.0	0	0.0	-	0
PV2	SA tracking	SA tracking	0	0.0	0	0.0	-	0
PV3	SA tracking	SA tracking	0	0.0	0	0.0	-	0
PV4	SA tracking	SA tracking	0	0.0	0	0.0	-	0
PV5	SA tracking	SA tracking	0	0.0	0	0.0	-	0
PV6	SA tracking	SA tracking	0	0.0	0	0.0	-	0

Total glare received by each receptor; may include duplicate times of glare from multiple reflective surfaces.

Receptor	Annual Green Glare		Annual Yellow Glare	
	min	hr	min	hr
FrankMayRd	0	0.0	0	0.0
KY135	0	0.0	0	0.0
KY1608	0	0.0	0	0.0
PD1	0	0.0	0	0.0
PeckBranchRd	0	0.0	0	0.0
QuatermousRd	0	0.0	0	0.0
OP 1	0	0.0	0	0.0
OP 2	0	0.0	0	0.0
OP 3	0	0.0	0	0.0
OP 4	0	0.0	0	0.0
OP 5	0	0.0	0	0.0
OP 6	0	0.0	0	0.0
OP 7	0	0.0	0	0.0
OP 8	0	0.0	0	0.0
OP 9	0	0.0	0	0.0
OP 10	0	0.0	0	0.0
OP 11	0	0.0	0	0.0
OP 12	0	0.0	0	0.0
OP 13	0	0.0	0	0.0

PV: PV1 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
FrankMayRd	0	0.0	0	0.0	0
KY135	0	0.0	0	0.0	0
KY1608	0	0.0	0	0.0	0
PD1	0	0.0	0	0.0	0
PeckBranchRd	0	0.0	0	0.0	0
QuatermousRd	0	0.0	0	0.0	0
OP 1	0	0.0	0	0.0	0
OP 2	0	0.0	0	0.0	0
OP 3	0	0.0	0	0.0	0
OP 4	0	0.0	0	0.0	0
OP 5	0	0.0	0	0.0	0
OP 6	0	0.0	0	0.0	0
OP 7	0	0.0	0	0.0	0
OP 8	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 13	0	0.0	0	0.0	0

PV1 and Route: FrankMayRd

No glare found

PV1 and Route: KY135

No glare found

PV1 and Route: KY1608

No glare found

PV1 and Route: PD1

No glare found

PV1 and Route: PeckBranchRd

No glare found

PV1 and Route: QuatermousRd

No glare found

PV1 and OP 1

No glare found

PV1 and OP 2

No glare found

PV1 and OP 3

No glare found

PV1 and OP 4

No glare found

PV1 and OP 5

No glare found

PV1 and OP 6

No glare found

PV1 and OP 7

No glare found

PV1 and OP 8

No glare found

PV1 and OP 9

No glare found

PV1 and OP 10

No glare found

PV1 and OP 11

No glare found

PV1 and OP 12

No glare found

PV1 and OP 13

No glare found

PV: PV2 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
FrankMayRd	0	0.0	0	0.0	0
KY135	0	0.0	0	0.0	0
KY1608	0	0.0	0	0.0	0
PD1	0	0.0	0	0.0	0
PeckBranchRd	0	0.0	0	0.0	0
QuatermousRd	0	0.0	0	0.0	0
OP 1	0	0.0	0	0.0	0
OP 2	0	0.0	0	0.0	0
OP 3	0	0.0	0	0.0	0
OP 4	0	0.0	0	0.0	0
OP 5	0	0.0	0	0.0	0
OP 6	0	0.0	0	0.0	0
OP 7	0	0.0	0	0.0	0
OP 8	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 13	0	0.0	0	0.0	0

PV2 and Route: FrankMayRd

No glare found

PV2 and Route: KY135

No glare found

PV2 and Route: KY1608

No glare found

PV2 and Route: PD1

No glare found

PV2 and Route: PeckBranchRd

No glare found

PV2 and Route: QuatermousRd

No glare found

PV2 and OP 1

No glare found

PV2 and OP 2

No glare found

PV2 and OP 3

No glare found

PV2 and OP 4

No glare found

PV2 and OP 5

No glare found

PV2 and OP 6

No glare found

PV2 and OP 7

No glare found

PV2 and OP 8

No glare found

PV2 and OP 9

No glare found

PV2 and OP 10

No glare found

PV2 and OP 11

No glare found

PV2 and OP 12

No glare found

PV2 and OP 13

No glare found

PV: PV3 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
FrankMayRd	0	0.0	0	0.0	0
KY135	0	0.0	0	0.0	0
KY1608	0	0.0	0	0.0	0
PD1	0	0.0	0	0.0	0
PeckBranchRd	0	0.0	0	0.0	0
QuatermousRd	0	0.0	0	0.0	0
OP 1	0	0.0	0	0.0	0
OP 2	0	0.0	0	0.0	0
OP 3	0	0.0	0	0.0	0
OP 4	0	0.0	0	0.0	0
OP 5	0	0.0	0	0.0	0
OP 6	0	0.0	0	0.0	0
OP 7	0	0.0	0	0.0	0
OP 8	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 13	0	0.0	0	0.0	0

PV3 and Route: FrankMayRd

No glare found

PV3 and Route: KY135

No glare found

PV3 and Route: KY1608

No glare found

PV3 and Route: PD1

No glare found

PV3 and Route: PeckBranchRd

No glare found

PV3 and Route: QuatermousRd

No glare found

PV3 and OP 1

No glare found

PV3 and OP 2

No glare found

PV3 and OP 3

No glare found

PV3 and OP 4

No glare found

PV3 and OP 5

No glare found

PV3 and OP 6

No glare found

PV3 and OP 7

No glare found

PV3 and OP 8

No glare found

PV3 and OP 9

No glare found

PV3 and OP 10

No glare found

PV3 and OP 11

No glare found

PV3 and OP 12

No glare found

PV3 and OP 13

No glare found

PV: PV4 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
FrankMayRd	0	0.0	0	0.0	0
KY135	0	0.0	0	0.0	0
KY1608	0	0.0	0	0.0	0
PD1	0	0.0	0	0.0	0
PeckBranchRd	0	0.0	0	0.0	0
QuatermousRd	0	0.0	0	0.0	0
OP 1	0	0.0	0	0.0	0
OP 2	0	0.0	0	0.0	0
OP 3	0	0.0	0	0.0	0
OP 4	0	0.0	0	0.0	0
OP 5	0	0.0	0	0.0	0
OP 6	0	0.0	0	0.0	0
OP 7	0	0.0	0	0.0	0
OP 8	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 13	0	0.0	0	0.0	0

PV4 and Route: FrankMayRd

No glare found

PV4 and Route: KY135

No glare found

PV4 and Route: KY1608

No glare found

PV4 and Route: PD1

No glare found

PV4 and Route: PeckBranchRd

No glare found

PV4 and Route: QuatermousRd

No glare found

PV4 and OP 1

No glare found

PV4 and OP 2

No glare found

PV4 and OP 3

No glare found

PV4 and OP 4

No glare found

PV4 and OP 5

No glare found

PV4 and OP 6

No glare found

PV4 and OP 7

No glare found

PV4 and OP 8

No glare found

PV4 and OP 9

No glare found

PV4 and OP 10

No glare found

PV4 and OP 11

No glare found

PV4 and OP 12

No glare found

PV4 and OP 13

No glare found

PV: PV5 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
FrankMayRd	0	0.0	0	0.0	0
KY135	0	0.0	0	0.0	0
KY1608	0	0.0	0	0.0	0
PD1	0	0.0	0	0.0	0
PeckBranchRd	0	0.0	0	0.0	0
QuatermousRd	0	0.0	0	0.0	0
OP 1	0	0.0	0	0.0	0
OP 2	0	0.0	0	0.0	0
OP 3	0	0.0	0	0.0	0
OP 4	0	0.0	0	0.0	0
OP 5	0	0.0	0	0.0	0
OP 6	0	0.0	0	0.0	0
OP 7	0	0.0	0	0.0	0
OP 8	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 13	0	0.0	0	0.0	0

PV5 and Route: FrankMayRd

No glare found

PV5 and Route: KY135

No glare found

PV5 and Route: KY1608

No glare found

PV5 and Route: PD1

No glare found

PV5 and Route: PeckBranchRd

No glare found

PV5 and Route: QuatermousRd

No glare found

PV5 and OP 1

No glare found

PV5 and OP 2

No glare found

PV5 and OP 3

No glare found

PV5 and OP 4

No glare found

PV5 and OP 5

No glare found

PV5 and OP 6

No glare found

PV5 and OP 7

No glare found

PV5 and OP 8

No glare found

PV5 and OP 9

No glare found

PV5 and OP 10

No glare found

PV5 and OP 11

No glare found

PV5 and OP 12

No glare found

PV5 and OP 13

No glare found

PV: PV6 no glare found

Receptor results ordered by category of glare

Receptor	Annual Green Glare		Annual Yellow Glare		Peak Luminance
	min	hr	min	hr	cd/m^2
FrankMayRd	0	0.0	0	0.0	0
KY135	0	0.0	0	0.0	0
KY1608	0	0.0	0	0.0	0
PD1	0	0.0	0	0.0	0
PeckBranchRd	0	0.0	0	0.0	0
QuatermousRd	0	0.0	0	0.0	0
OP 1	0	0.0	0	0.0	0
OP 2	0	0.0	0	0.0	0
OP 3	0	0.0	0	0.0	0
OP 4	0	0.0	0	0.0	0
OP 5	0	0.0	0	0.0	0
OP 6	0	0.0	0	0.0	0
OP 7	0	0.0	0	0.0	0
OP 8	0	0.0	0	0.0	0
OP 9	0	0.0	0	0.0	0
OP 10	0	0.0	0	0.0	0
OP 11	0	0.0	0	0.0	0
OP 12	0	0.0	0	0.0	0
OP 13	0	0.0	0	0.0	0

PV6 and Route: FrankMayRd

No glare found

PV6 and Route: KY135

No glare found

PV6 and Route: KY1608

No glare found

PV6 and Route: PD1

No glare found

PV6 and Route: PeckBranchRd

No glare found

PV6 and Route: QuatermousRd

No glare found

PV6 and OP 1

No glare found

PV6 and OP 2

No glare found

PV6 and OP 3

No glare found

PV6 and OP 4

No glare found

PV6 and OP 5

No glare found

PV6 and OP 6

No glare found

PV6 and OP 7

No glare found

PV6 and OP 8

No glare found

PV6 and OP 9

No glare found

PV6 and OP 10

No glare found

PV6 and OP 11

No glare found

PV6 and OP 12

No glare found

PV6 and OP 13

No glare found

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.
The algorithm does not rigorously represent the detailed geometry of a system; detailed features such as gaps between modules, variable height of the PV array, and support structures may impact actual glare results. However, we have validated our models against several systems, including a PV array causing glare to the air-traffic control tower at Manchester-Boston Regional Airport and several sites in Albuquerque, and the tool accurately predicted the occurrence and intensity of glare at different times and days of the year.
Several V1 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. This primarily affects V1 analyses of path receptors.
Random number computations are utilized by various steps of the annual hazard analysis algorithm. Predicted minutes of glare can vary between runs as a result. This limitation primarily affects analyses of Observation Point receptors, including ATCTs. Note that the SGHAT/ ForgeSolar methodology has always relied on an analytical, qualitative approach to accurately determine the overall hazard (i.e. green vs. yellow) of expected glare on an annual basis.
The analysis does not automatically consider obstacles (either man-made or natural) between the observation points and the prescribed solar installation that may obstruct observed glare, such as trees, hills, buildings, etc.
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.)
The variable direct normal irradiance (DNI) feature (if selected) scales the user-prescribed peak DNI using a typical clear-day irradiance profile. This profile has a lower DNI in the mornings and evenings and a maximum at solar noon. The scaling uses a clear-day irradiance profile based on a normalized time relative to sunrise, solar noon, and sunset, which are prescribed by a sun-position algorithm and the latitude and longitude obtained from Google maps. The actual DNI on any given day can be affected by cloud cover, atmospheric attenuation, and other environmental factors.
The ocular hazard predicted by the tool depends on a number of environmental, optical, and human factors, which can be uncertain. We provide input fields and typical ranges of values for these factors so that the user can vary these parameters to see if they have an impact on the results. The speed of SGHAT allows expedited sensitivity and parametric analyses.
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.
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.
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.

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

Appendix B

ForgeSolar GlareGauge Model Results for Aviation

FORGESOLAR GLARE ANALYSIS

Project: **Mantle Rock**

A 65MW site proposed by Enerfin near Mantle Rock, KY. Site will have single axis tracking panels mounted 15 ft off the ground. No FAA observers are near the site. Elevation data provided through Forge Solar via Google Earth. Array polygons are generated from MCPs based on the proposed fence lines.

Site configuration: **C2_Obs_noTrailer_0**

Client: Enerfin

Site description: Config with 2 proposed obstructions

Created 03 Oct, 2023
Updated 03 Oct, 2023
Time-step 1 minute
Timezone offset UTC-6
Minimum sun altitude 0.0 deg
DNI peaks at 1,000.0 W/m^2
Site ID 102077.15978

Ocular transmission coefficient 0.5
Pupil diameter 0.002 m
Eye focal length 0.017 m
Sun subtended angle 9.3 mrad
PV analysis methodology V2

Glare Policy Adherence

The following table estimates the policy adherence of this glare analysis according to the **2021** U.S. Federal Aviation Administration Policy:

Review of Solar Energy System Projects on Federally-Obligated Airports

This policy may require the following criteria be met for solar energy systems on airport property:

- No glare of any kind for Air Traffic Control Tower(s) ("ATCT") at cab height.
- Default analysis and observer characteristics, including 1-minute time step.

ForgeSolar is not affiliated with the U.S. FAA and does not represent or speak officially for the U.S. FAA. ForgeSolar cannot approve or deny projects - results are informational only. Contact the relevant airport and FAA district office for information on policy and requirements.

COMPONENT	STATUS	DESCRIPTION
Analysis parameters	PASS	Analysis time interval and eye characteristics used are acceptable
ATCT(s)	N/A	No ATCT receptors assessed

The referenced policy can be read at https://www.federalregister.gov/d/2021-09862

Component Data

This report includes results for PV arrays and Observation Point ("OP") receptors marked as ATCTs. Components that are not pertinent to the policy, such as routes, flight paths, and vertical surfaces, are excluded.

PV Arrays

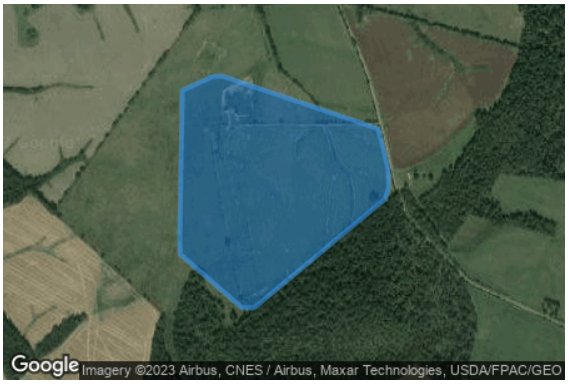
Name: PV1
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 180.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Ground Coverage Ratio: 0.5
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.303533	-88.395070	609.95	15.00	624.95
2	37.303533	-88.395690	602.38	15.00	617.38
3	37.305356	-88.398183	609.87	15.00	624.87
4	37.306221	-88.398180	627.28	15.00	642.28
5	37.306606	-88.397894	627.04	15.00	642.04
6	37.306610	-88.397891	627.04	15.00	642.04
7	37.308011	-88.396616	634.81	15.00	649.81
8	37.308390	-88.396268	630.83	15.00	645.83
9	37.308744	-88.395942	622.09	15.00	637.09
10	37.309492	-88.395234	617.31	15.00	632.31
11	37.309492	-88.394953	615.07	15.00	630.07
12	37.306986	-88.395003	631.84	15.00	646.84

Name: PV2
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 180.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Ground Coverage Ratio: 0.5
Rated power: -
Panel material: Smooth glass with 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	37.318169	-88.396363	558.38	15.00	573.38
2	37.319397	-88.396371	562.71	15.00	577.71
3	37.319784	-88.395279	558.58	15.00	573.58
4	37.319790	-88.394776	563.78	15.00	578.78
5	37.317378	-88.394810	569.73	15.00	584.73
6	37.317382	-88.395314	564.10	15.00	579.10

Name: PV3
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 180.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Ground Coverage Ratio: 0.5
Rated power: -
Panel material: Smooth glass with 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	37.303184	-88.392236	623.08	15.00	638.08
2	37.304641	-88.394353	614.25	15.00	629.25
3	37.305115	-88.394362	616.49	15.00	631.49
4	37.306908	-88.394325	619.82	15.00	634.82
5	37.308173	-88.394292	611.93	15.00	626.93
6	37.309096	-88.394281	608.09	15.00	623.09
7	37.309487	-88.393212	604.98	15.00	619.98
8	37.309490	-88.392897	602.50	15.00	617.50
9	37.308058	-88.387546	622.33	15.00	637.33
10	37.307783	-88.387451	624.99	15.00	639.99
11	37.307507	-88.387363	623.50	15.00	638.50
12	37.306911	-88.387187	625.67	15.00	640.67
13	37.306436	-88.387187	625.62	15.00	640.62
14	37.306150	-88.387300	628.43	15.00	643.43
15	37.303177	-88.391805	628.26	15.00	643.26

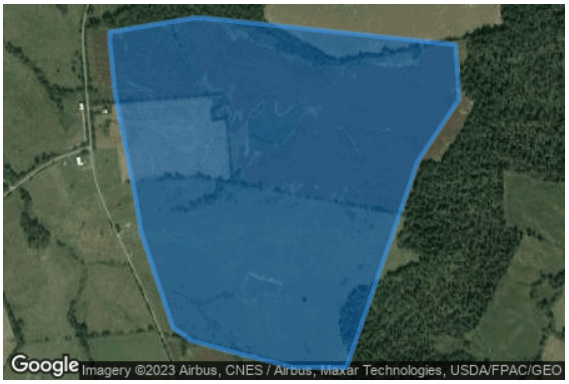
Name: PV4
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 180.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Ground Coverage Ratio: 0.5
Rated power: -
Panel material: Smooth glass with AR coating
Reflectivity: Vary with sun
Slope error: correlate with material

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)	Height above ground (ft)	Total elevation (ft)
1	37.315987	-88.394139	568.25	15.00	583.25
2	37.320512	-88.394071	571.50	15.00	586.50
3	37.320851	-88.394062	563.85	15.00	578.85
4	37.320858	-88.393158	563.42	15.00	578.42
5	37.320770	-88.392894	568.65	15.00	583.65
6	37.320289	-88.392714	578.53	0.00	578.53
7	37.320289	-88.392714	578.53	0.00	578.53
8	37.320289	-88.392714	578.53	0.00	578.53
9	37.319888	-88.392329	586.54	0.00	586.54
10	37.319888	-88.392329	586.54	0.00	586.54
11	37.319888	-88.392329	586.54	0.00	586.54
12	37.319773	-88.391751	590.64	15.00	605.64
13	37.318362	-88.391623	589.46	15.00	604.46
14	37.318104	-88.391623	584.82	15.00	599.82
15	37.316381	-88.392902	586.41	15.00	601.41
16	37.316096	-88.393175	576.55	15.00	591.55
17	37.315963	-88.393414	576.95	15.00	591.95
18	37.315967	-88.394088	569.03	15.00	584.03

Name: PV5
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 180.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Ground Coverage Ratio: 0.5
Rated power: -
Panel material: Smooth glass with 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	37.308543	-88.389283	601.95	15.00	616.95
2	37.308640	-88.389611	600.99	15.00	615.99
3	37.309540	-88.390640	592.34	15.00	607.34
4	37.309780	-88.390899	592.11	15.00	607.11
5	37.309890	-88.390977	591.85	15.00	606.85
6	37.311176	-88.391478	587.99	15.00	602.99
7	37.311512	-88.391547	589.48	15.00	604.48
8	37.311821	-88.391590	580.45	15.00	595.45
9	37.312234	-88.391590	579.24	15.00	594.24
10	37.314392	-88.391391	581.42	15.00	596.42
11	37.314454	-88.391322	581.63	15.00	596.63
12	37.314454	-88.390622	593.75	15.00	608.75
13	37.311560	-88.389067	602.86	15.00	617.86
14	37.310488	-88.388531	610.64	15.00	625.64
15	37.309780	-88.388194	614.41	15.00	629.41
16	37.309423	-88.388056	619.79	15.00	634.79
17	37.309038	-88.387927	621.15	15.00	636.15
18	37.308495	-88.387927	613.77	15.00	628.77

Name: PV6
Axis tracking: Single-axis rotation
Backtracking: Shade-slope
Tracking axis orientation: 180.0°
Max tracking angle: 60.0°
Resting angle: 5.0°
Ground Coverage Ratio: 0.5
Rated power: -
Panel material: Smooth glass with 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	37.310636	-88.384418	628.06	15.00	643.06
2	37.310987	-88.386170	606.16	15.00	621.16
3	37.311361	-88.387895	605.27	15.00	620.27
4	37.311712	-88.388544	605.80	15.00	620.80
5	37.312520	-88.388880	595.94	15.00	610.94
6	37.313347	-88.389234	590.25	15.00	605.25
7	37.314301	-88.389634	594.05	15.00	609.05
8	37.315312	-88.389842	584.62	15.00	599.62
9	37.318089	-88.390532	588.60	15.00	603.60
10	37.318254	-88.390560	586.71	15.00	601.71
11	37.319472	-88.390711	592.76	15.00	607.76
12	37.319768	-88.390712	588.66	15.00	603.66
13	37.320142	-88.387937	599.13	15.00	614.13
14	37.320164	-88.387827	599.98	15.00	614.98
15	37.320153	-88.387454	603.09	15.00	618.09
16	37.319428	-88.378828	630.46	15.00	645.46
17	37.317935	-88.378704	630.14	15.00	645.14
18	37.316247	-88.380131	634.44	15.00	649.44
19	37.310625	-88.382582	619.07	15.00	634.07

Observation Point ATCT Receptors

No ATCT receptors were included in the analysis.

Obstruction Components

Name: Existing Trees 1
Top height: 32.8 ft

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)
1	37.319854	-88.394564	565.70
2	37.319820	-88.396377	550.50
3	37.319316	-88.397418	562.00
4	37.318736	-88.397407	551.90
5	37.316842	-88.394628	562.60

Name: Existing Trees 2
Top height: 32.8 ft

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)
1	37.321173	-88.392391	565.40
2	37.321404	-88.393405	567.60
3	37.321314	-88.394108	560.10
4	37.322026	-88.390659	569.50

Name: Existing Trees 3
Top height: 32.8 ft

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)
1	37.322913	-88.387136	599.30
2	37.322593	-88.384888	611.60

Name: Existing Trees 4
Top height: 32.8 ft

Vertex	Latitude (°)	Longitude (°)	Ground elevation (ft)
1	37.321284	-88.390192	575.40
2	37.320712	-88.389452	592.40
3	37.320721	-88.383915	610.60
4	37.320601	-88.382768	615.10
5	37.320687	-88.381974	618.50
6	37.321173	-88.381727	621.90

Glare Analysis Results

Summary of Results No glare predicted

PV Array	Tilt	Orient	Annual Green Glare		Annual Yellow Glare		Energy
	°	°	min	hr	min	hr	kWh
PV1	SA tracking	SA tracking	0	0.0	0	0.0	-
PV2	SA tracking	SA tracking	0	0.0	0	0.0	-
PV3	SA tracking	SA tracking	0	0.0	0	0.0	-
PV4	SA tracking	SA tracking	0	0.0	0	0.0	-
PV5	SA tracking	SA tracking	0	0.0	0	0.0	-
PV6	SA tracking	SA tracking	0	0.0	0	0.0	-

No ATCT receptors were included in the analysis.

PV: PV1

No ATCT receptors assessed.

PV: PV2

No ATCT receptors assessed.

PV: PV3

No ATCT receptors assessed.

PV: PV4

No ATCT receptors assessed.

PV: PV5

No ATCT receptors assessed.

PV: PV6

No ATCT receptors assessed.

Assumptions

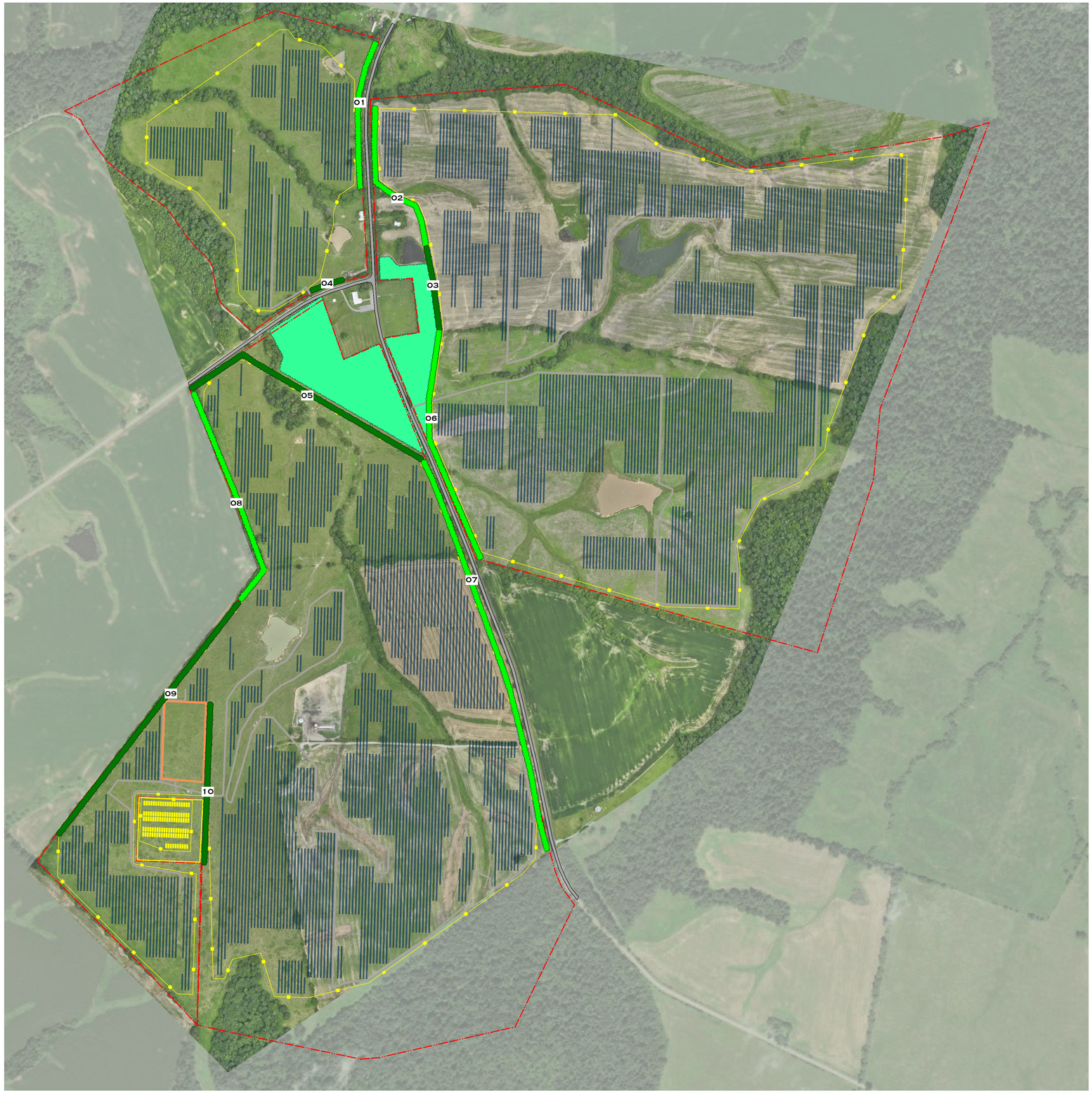
"Green" glare is glare with low potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
"Yellow" glare is glare with potential to cause an after-image (flash blindness) when observed prior to a typical blink response time.
Times associated with glare are denoted in Standard time. For Daylight Savings, add one hour.
The algorithm does not rigorously represent the detailed geometry of a system; detailed features such as gaps between modules, variable height of the PV array, and support structures may impact actual glare results. However, we have validated our models against several systems, including a PV array causing glare to the air-traffic control tower at Manchester-Boston Regional Airport and several sites in Albuquerque, and the tool accurately predicted the occurrence and intensity of glare at different times and days of the year.
Several V1 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. This primarily affects V1 analyses of path receptors.
Random number computations are utilized by various steps of the annual hazard analysis algorithm. Predicted minutes of glare can vary between runs as a result. This limitation primarily affects analyses of Observation Point receptors, including ATCTs. Note that the SGHAT/ ForgeSolar methodology has always relied on an analytical, qualitative approach to accurately determine the overall hazard (i.e. green vs. yellow) of expected glare on an annual basis.
The analysis does not automatically consider obstacles (either man-made or natural) between the observation points and the prescribed solar installation that may obstruct observed glare, such as trees, hills, buildings, etc.
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.)
The variable direct normal irradiance (DNI) feature (if selected) scales the user-prescribed peak DNI using a typical clear-day irradiance profile. This profile has a lower DNI in the mornings and evenings and a maximum at solar noon. The scaling uses a clear-day irradiance profile based on a normalized time relative to sunrise, solar noon, and sunset, which are prescribed by a sun-position algorithm and the latitude and longitude obtained from Google maps. The actual DNI on any given day can be affected by cloud cover, atmospheric attenuation, and other environmental factors.
The ocular hazard predicted by the tool depends on a number of environmental, optical, and human factors, which can be uncertain. We provide input fields and typical ranges of values for these factors so that the user can vary these parameters to see if they have an impact on the results. The speed of SGHAT allows expedited sensitivity and parametric analyses.
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.
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.
Glare locations displayed on receptor plots are approximate. Actual glare-spot locations may differ.
Refer to the Help page at **www.forgesolar.com/help/** for assumptions and limitations not listed here.

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

Appendix C

Mantle Rock Solar Project Landscape Plans



Legend - Landscape Plan

- Standard Screening
- Heavy Screening
- Pollinator Meadow
- Security Fence
- Project Boundary
- Substation/Switchyard area
- Battery Storage Area
- Solar panels

0 500 1000 ft

1 **Site Overview**
Scale: 1:4000

N

DEARBORN & ASSOCIATES

Project Area: **MANTLE ROCK LANDSCAPE**

Client Name and Address: **ATLANTICA**
Livingston County Kentucky

Date: 8/22/25

Scale: 1:4000

PLANT LEGEND

JV
Juniperus virginiana
Eastern Red Cedar

PS
Pinus strobus
Eastern White Pine

PV
Pinus virginiana
Virginia Pine

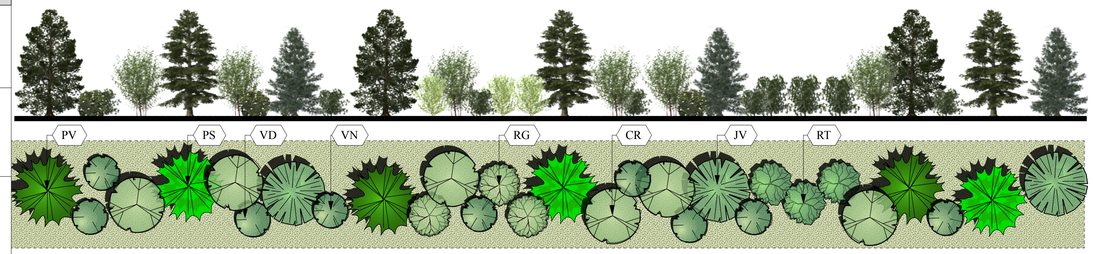
CR
Cornus racemosa
Gray Dogwood

RG
Rhus glabra
Smooth Sumac

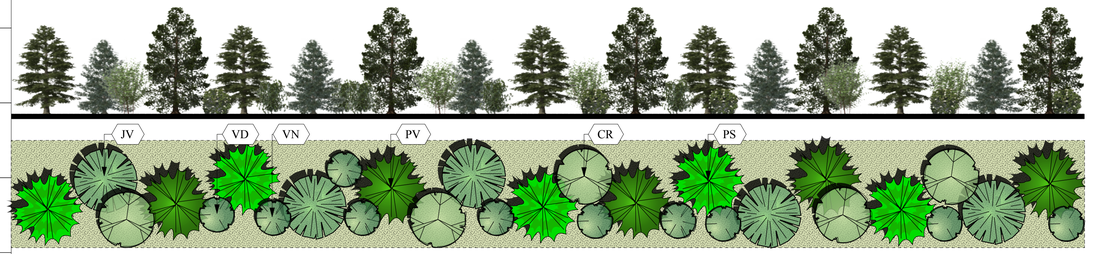
RT
Rhus typhina
Staghorn Sumac

VD
Viburnum dentatum
Arrowwood Viburnum

VN
Viburnum nudum
Witherod Viburnum



2 **Standard Screening**
Scale: 1" = 20'-0"



3 **Dense Screening**
Scale: 1" = 20'-0"

0 50 100 ft

Quantities by Segment

Total Qty	Symbol	SEGMENT: 1	2	3	4	5	6	7	8	9	10
SF		29771	32764	16936	6873	54069	47842	81647	45919	58709	32297
Acres		0.68	0.75	0.39	0.16	1.24	1.10	1.87	1.05	1.35	0.74
Linear Feet		992	1092	565	229	1802	1595	2722	1531	1957	1077
Conifers											
161	JV	9	10	9	4	28	15	25	14	30	17
161	PS	9	10	9	4	28	15	25	14	30	17
161	PV	9	10	9	4	28	15	25	14	30	17
483		**27**	**30**	**27**	**12**	**84**	**45**	**75**	**42**	**90**	**51**
Shrubs											
228	CR	18	20	9	4	28	30	50	28	30	11
73	RG	9	10	0	0	0	15	25	14	0	0
73	RT	9	10	0	0	0	15	25	14	0	0
161	VD	9	10	9	4	28	15	25	14	30	17
234	VN	18	20	9	4	28	30	50	28	30	17
769		**63**	**70**	**27**	**12**	**84**	**105**	**175**	**98**	**90**	**45**
1252	**TTL**	**90**	**100**	**54**	**24**	**168**	**150**	**250**	**140**	**180**	**96**

Plant Schedule

	ID	Qty	Common Name	Botanical Name	Plant Zones	Mature Height	Mature Width	Growth Habit	Scheduled Size
Conifers									
	JV	161	Eastern Red Cedar	*Juniperus virginiana*	3| 4| 5| 6| 7| 8| 9	35 - 50 ft	12 - 20 ft	Pyramidal	4-5' B&B / Container
	PS	161	Eastern White Pine	*Pinus strobus*	3| 4| 5| 6| 7| 8| 9	50 - 80 ft	12 - 20 ft	Pyramidal	5-6' B&B / Container
	PV	161	Virginia Pine	*Pinus virginiana*	4| 5| 6| 7| 8	15 - 35 ft	12 - 20 ft	Irregular	4-5' B&B / Container
Shrubs									
	CR	234	Gray Dogwood	*Cornus racemosa*	3| 4| 5| 6| 7| 8	7 - 12 ft	7 - 12 ft	Rounded	3' B&B / Container
	RG	73	Smooth Sumac	*Rhus glabra*	2| 3| 4| 5| 6| 7| 8| 9	7 - 12 ft	7 - 12 ft	Rounded	3' B&B / Container
	RT	73	Staghorn Sumac	*Rhus typhina*	4| 5| 6| 7| 8	12 - 20 ft	12 - 20 ft	Spreading	3' B&B / Container
	VD	161	Arrowwood Viburnum	*Viburnum dentatum*	2| 3| 4| 5| 6| 7| 8	4 - 7 ft	4 - 7 ft	Upright	3' B&B / Container
	VN	234	Witherod Viburnum	*Viburnum nudum*	5| 6| 7| 8| 9	7 - 12 ft	7 - 12 ft	Oval	3' B&B / Container

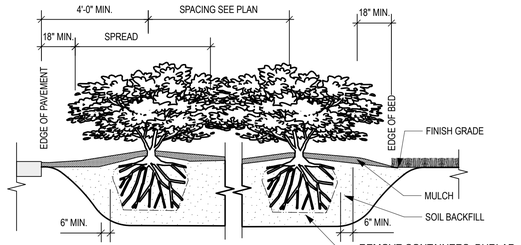
Vegetative Screening Notes:

Shrub and Tree Installation

1. The contractor is responsible for the accurate layout of all work as outlined in these plans.
2. All plant materials, unless specified otherwise, should have uniform branching and a strong, healthy root system. They must be free of defects, diseases, insect infestations, decay, pest eggs, or any signs of infestation. The plants should be in good health, show no transplant shock or visible wilting, and be fresh. Any plants that appear unhealthy will be rejected.
3. All plant materials must meet the minimum requirements and standards outlined in the latest edition of "The American Standard for Nursery Stock" published by the American Association of Nurserymen, 1250 I Street, N.W., Suite 500, Washington, D.C. 20005.
4. All container-grown stock must have been propagated in a container long enough for the root system to be sufficiently developed, allowing it to retain its soil. Any container stock with underdeveloped roots will be rejected.
5. Plants must be prepared for shipment in a manner that ensures no damage to the bark, buds, branches, stems, or overall form of the stock. Container-grown plants should be transported in the containers they were grown in.
6. If plants are not installed on the same day they arrive at the site, the contractor must store and protect them. Storage areas should be shaded and shielded from wind and sun. While on-site, plants should be kept moist by covering the balls or roots with wet burlap, moist sawdust, wood chips, shredded bark, peat moss, or other approved materials to prevent drying out.
7. Plant substitutions may be made if necessary, based on availability, but must match the size and landscape (screening) value of the original plants. All substitutions must be approved by the owner or the owner's representative.
8. The contractor is responsible for verifying all dimensions on-site.
9. Planting shall not take place when the soil is frozen.

Planting Procedure:

- Dig the planting hole at least twice the width of the rootball for the first 12 inches of depth. Below 12 inches, widen the hole enough to allow for adjustment, but do not exceed the rootball's depth measured from base of root flare to bottom of ball.
- Holes for individual plantings should have vertical sides and a flat bottom. Ensure the sides and bottom of the planting hole are roughened or scarified.
- Lift and position the tree by the rootball only—do not lift by the trunk or use the trunk as leverage.
- Remove all foreign or non biodegradable material from root ball including top 1/3 of wire basket.
- Ensure burlap and twine is pulled away from trunk and any excess burlap removed.
- Backfill with soil that has been well-tilled or broken up to ensure proper settling.
- Pruning should be limited to the removal of dead, diseased, or broken limbs and must follow ANSI A300 specifications.
- Remove any remaining trunk wrap at planting and avoid placing any wraps around the trunk.
- The contractor is responsible for restoring areas disturbed during the installation of shrubs and trees.



NOTES
1. PROVIDE MULCHED CIRCULAR SAUCER FOR INDIVIDUAL PLANTS.
2. ROOT FLARE SHOULD BE VISIBLE AT BASE.

Project Acceptance, Maintenance, and Warranty:

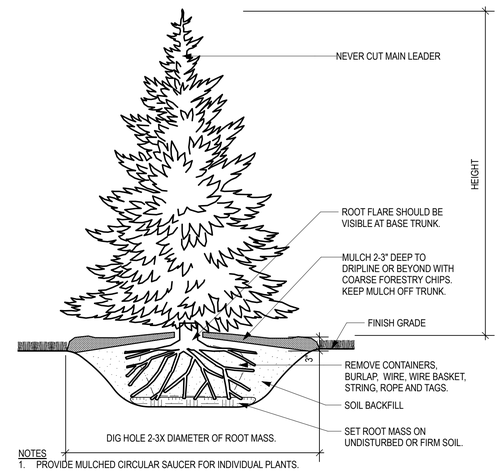
1. Plant areas will be inspected upon completion of installation and will receive initial acceptance if they meet the specified materials and installation requirements. Once the complete installation of all plant material is initially accepted, the warranty period will commence.
2. The contractor is responsible for maintaining the installed shrubs and trees within the project limits until final acceptance of the project by the engineer, which occurs at the end of the warranty period. Maintenance responsibilities include pruning, cultivating, weeding, watering, and ensuring plants remain free from insect infestations, diseases, and other damage from herbivores until final acceptance. The maintenance period will continue throughout the warranty period.
3. The contractor warrants that plant material will remain alive and in healthy, vigorous condition for one (1) year following the initial acceptance. If planting occurs over multiple planting windows, the warranty will apply to all plant material based on the warranty period of the most recently installed plants.
4. All plants deemed unsatisfactory by the owner's representative during the initial planting installation must be removed and immediately replaced.
5. Any plants that are dead or severely unhealthy, as determined by the owner's representative, within the warranty period must be replaced immediately, following the drawings and specifications. These replacements are at the contractor's expense and should be installed during the next suitable planting season.
6. Tree staking should be removed after one full growing season. If staking is necessary for replaced warranty plants, these stakes must be removed after one full growing season following their installation.
7. The contractor is responsible for providing herbivory protection throughout the maintenance and warranty period. Any plants replaced due to herbivory damage will be at the contractor's expense.
8. Upon final acceptance, plant maintenance responsibilities will be transferred to the owner.

PROJECT MEASUREMENT AND PAYMENT:

1. Payment for planting will be based on the actual number of individual plants that are installed and maintained.
2. All work under this item will be compensated at the contract unit price per plant. This price constitutes partial payment (90%) for all associated work, including materials, labor, warranty, and any other incidental items up to initial acceptance. The remaining 10% will be paid upon final acceptance, following the completion of the warranty period.

NOTES:

1. Mature height, spread, and average annual growth are approximate. Actual size and growth rates may vary.
2. Project is located in USDA planting zone 7a (Livingston County, Kentucky)
3. Plant species shown reflect the design intent. Substitutions may be made based on the availability of local nursery stock. The contractor may propose alternative species, subject to approval by the landscape architect.



NOTES
1. PROVIDE MULCHED CIRCULAR SAUCER FOR INDIVIDUAL PLANTS.
2. GUYING AND STAKING TO BE DETERMINED IN THE FIELD BY THE LANDSCAPE ARCHITECT. LOCAL FIELD CONDITIONS AS WELL AS PLANT CHARACTERISTICS WILL DETERMINE THE NECESSITY OF GUYING AND STAKING.
3. TYPICALLY ONLY TREES WITH A 3" OR GREATER CALIPER NEED TO BE STAKED. TREES WITH LESS THAN A 3" CALIPER NEED TO BE STAKED ONLY AS A REQUIRED BY LANDSCAPE ARCHITECT.

DEARBORN & ASSOCIATES
LANDSCAPE ARCHITECTURE | PROJECT MANAGEMENT | CONSTRUCTION

PROJECT AREA:
MANTLE ROCK LANDSCAPE

CLIENT NAME AND ADDRESS:
ATLANTICA
LIVINGSTON COUNTY KENTUCKY

DATE:
8/22/25

SCALE:
AS NOTED

Visual Buffer Rendering

Current View

After Panels Installed

Conceptual Visual Buffers