

APPENDIX H – Shadow Flicker Analysis



SHADOW FLICKER MODELING REPORT

Dodge County Wind Project Dodge and Steele Counties, Minnesota

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1.0 EXECUTIVE SUMMARY

The Dodge County Wind Project (Project) is a proposed wind power generation facility proposed to consist of 79 wind turbines in Dodge and Steele Counties, Minnesota. The proposed Project is nameplate capacity is 258.92 megawatts (MW) and is being developed by Dodge County Wind, LLC (DCW) an indirect, wholly owned subsidiary of NextEra Energy Resources, LLC, (NEER). DCW has retained Epsilon Associates, Inc. (Epsilon) to conduct a shadow flicker assessment for the proposed wind turbines for this Project. This report presents results of the shadow flicker modeling analysis.

The purpose of this analysis is to predict the annual durations of wind turbine shadow flicker at nearby receptors.

The maximum expected annual duration of shadow flicker at a modeling receptor resulting from the operation of the 79 wind turbines is 59 hours, 42 minutes, which occurs at a participating receptor. The maximum expected duration of annual shadow flicker at a non-participating receptor is 40 hours, 30 minutes. The modeling results are conservative in that modeling receptors were treated as “greenhouses” (i.e. having windows on all sides) and the surrounding area was assumed to be without vegetation or structures (“bare earth”).

2.0 INTRODUCTION

The Project will consist of 79 wind turbines using a combination of two potential General Electric (GE) models including the 2.52 MW, 90-meter hub height wind turbine; and the 3.40 MW wind turbine at either 81-meter or 98-meter hub height. Figure 2-1 shows the locations of the 79 wind turbines with the Project Boundary over aerial imagery.

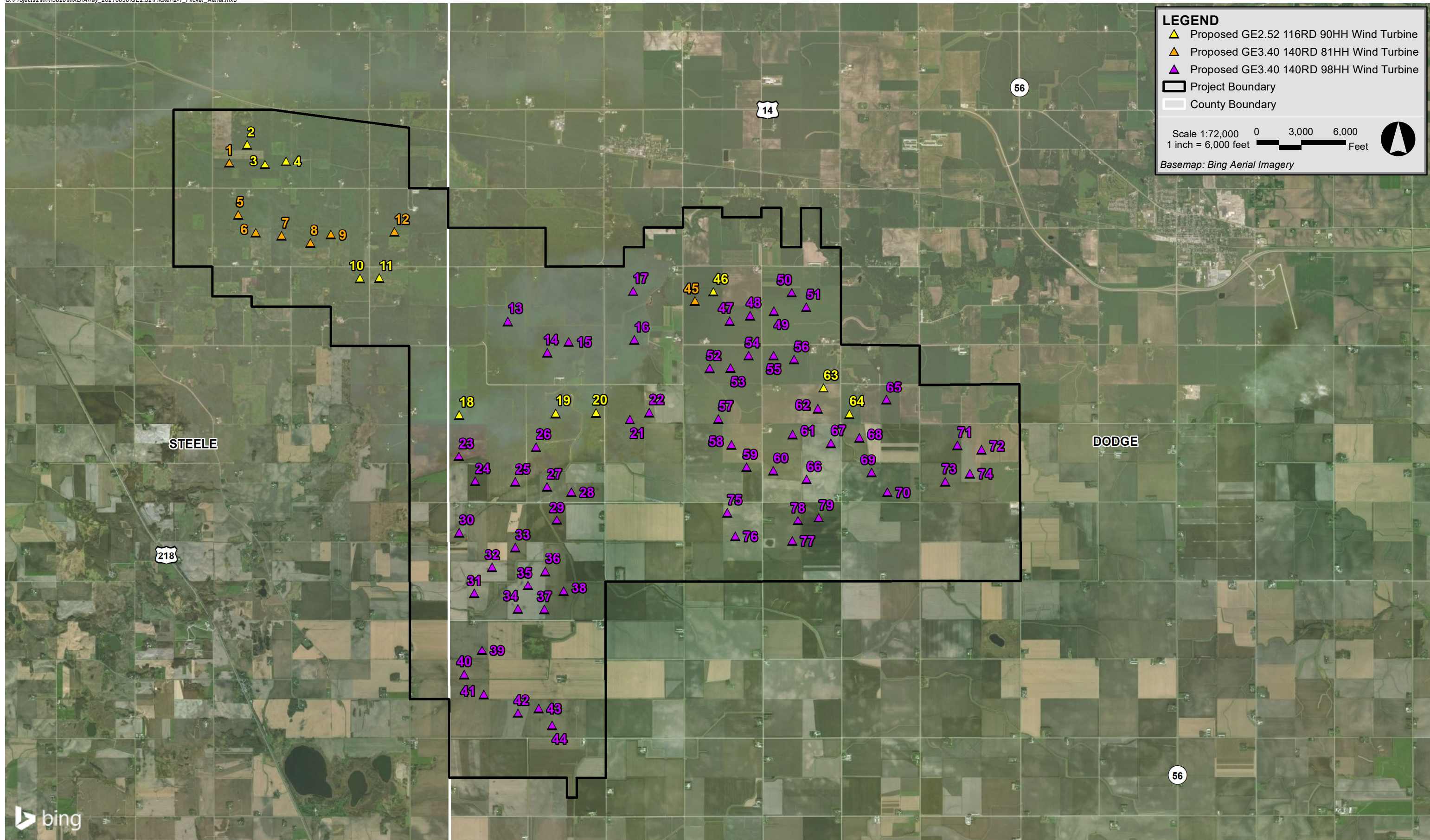
Shadow flicker can be defined as an intermittent change in the intensity of light in a given area resulting from the operation of a wind turbine due to its interaction with the sun. An indoor observer experiences repeated changes in the brightness of the room as shadows cast from the wind turbine blades briefly pass by windows as the blades rotate. In order for this to occur, the wind turbine must be operating, the sun must be shining, and the window must be within the shadow region of the wind turbine, otherwise there is no shadow flicker. A stationary wind turbine only generates a stationary shadow similar to any other structure.

Based on the current design and operation of typical modern wind turbines, shadow flicker is not a cause of epileptic seizures. According to the Epilepsy Foundation, “Generally, flashing lights most likely to trigger seizures are between the frequency of 5 to 30 flashes per second (Hertz).”¹ Based on the data available for the actual or similar wind turbine models proposed for this Project, the maximum rotational speed of 15.7 rpm² corresponds to a shadow flicker frequency of 0.8 Hz. This frequency is well below the frequency identified by the Epilepsy Foundation; therefore, the triggering of epileptic seizures is not a concern with this Project.

This report presents the findings of a shadow flicker modeling study for the Project. The wind turbines were modeled with the WindPRO software package using information provided by DCW. The expected annual duration of shadow flicker was calculated at modeling receptors and shadow flicker isolines for the area surrounding the Project were generated. The results of the modeling are found within this report.

¹ Epilepsy Foundation, <http://www.epilepsy.com/learn/triggers-seizures/photosensitivity-and-seizures>. Accessed in July 2021.

² The maximum rpm of the GE 3.40 wind turbine is not currently available from GE. The maximum rpm of the GE 3.4 wind turbine is expected to be equal to the maximum rotor speed of the GE 3.03-140 wind turbine which according to the Technical Documentation Wind Turbine Generator Systems Sierra Platform - 60 Hz is 12.6 rpm. The maximum rpm of the GE 2.52-116 wind turbine is 15.7 rpm.



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3.0 SHADOW FLICKER MODELING

3.1 Modeling Methodology

Shadow flicker was modeled using a software package, WindPRO version 3.4. WindPRO is a software suite developed by EMD International A/S and is used for assessing potential environmental impacts from wind turbines. Using the Shadow module within WindPRO, worst-case shadow flicker in the area surrounding the wind turbines was calculated based on data inputs including: location of the wind turbines, location of discrete receptor points, wind turbine dimensions, flicker calculation limits, and terrain data. Based on these data, the model was able to incorporate the appropriate sun angle and maximum daily sunlight for this latitude into the calculations. The resulting worst-case calculations assume that the sun is always shining during daylight hours and that the wind turbine is always operating. The WindPRO Shadow module can be further refined by incorporating sunshine probabilities and wind turbine operational estimates by wind direction over the course of a year. The values produced by this further refinement are known as the “expected” shadow flicker. Both worst-case and expected annual shadow flicker durations are presented in this section.

This analysis is for the wind turbine array dated August 6, 2021. The analysis incorporates a Project boundary provided to Epsilon on June 10, 2021. Locations of the turbines are shown in Figure 3-1 and the coordinates are provided in Appendix A. Eleven (11) wind turbines are GE 2.52-116 wind turbines with a 116.5-meter rotor diameter and a hub height of 90 meters. Eight (8) wind turbines are GE 3.40-140 wind turbines with a 140-meter rotor diameter and a hub height of 81 meters. Sixty (60) wind turbines are GE 3.40-140 wind turbines with a 140-meter rotor diameter and a hub height of 98 meters. Each wind turbine has the following characteristics based on the technical data provided by DCW:

		<u>GE 2.52-116</u>	<u>GE 3.40-140</u>
◆ Rated Power	=	2,520 kW	3,400 kW
◆ Hub Height	=	90 meters	81/98 meters
◆ Rotor Diameter	=	116.5 meters	140 meters
◆ Cut-in Wind Speed	=	3 m/s	3 m/s ³
◆ Cut-out Wind Speed	=	32 m/s	26 m/s ⁴
◆ Maximum RPM	=	15.7 rpm	N/A rpm ⁵

³ Identified as “preliminary” by GE.

⁴ Identified as “preliminary” by GE.

⁵ The maximum rpm is not currently available from the manufacturer for this model. The maximum rpm of the GE 3.4 wind turbine is expected to be equal to the maximum rotor speed of the GE 3.03-140 wind turbine which according to the Technical Documentation Wind Turbine Generator Systems Sierra Platform - 60 Hz is 12.6 rpm.

To-date, there are no federal, state, or local regulations regarding the maximum radial distance from a wind turbine to which shadow flicker should be analyzed applicable to this Project. In the United States, shadow flicker is commonly evaluated out to a distance of ten times the rotor diameter. According to the Massachusetts Model Bylaw for wind energy facilities, shadow flicker impacts are minimal at and beyond a distance of ten rotor diameters.⁶ Defining the shadow flicker calculation area has also been addressed in Europe where the ten times rotor diameter approach has been accepted in multiple European countries.⁷ Some jurisdictions conservatively require a larger calculation area. The New Hampshire Site Evaluation Committee through rulemaking docket 2014-04 adopted rules on December 15, 2015 outlining application requirements and criteria for energy facilities, including wind energy facilities. As part of these revised regulations, Site 301.08(a)(2) requires an evaluation distance of at least 1 mile from a wind turbine.⁸ Section 16-50j-94, part (g), of the Regulations of Connecticut State Agencies identifies the components required in a shadow flicker evaluation report which includes the calculation of shadow flicker from each proposed wind turbine to any off-site occupied structure within a 1.25 mile radius.⁹ For this Project, ten times the largest rotor diameter of the proposed wind turbines corresponds to a distance of 0.87 miles (1,400 m). Conservatively, this analysis includes shadow flicker calculations out to 1.25 miles (2,012 m) from each wind turbine in the model for the proposed layout.

A dataset dated September 2, 2021 and containing participation status information for property parcels in the proximity of the Project was provided by DCW. This dataset was utilized to determine participation status for parcels in the vicinity of the Project as shown in Figure 3-1. Color coded shading indicates whether a parcel is participating or non-participating.

A modeling receptor shapefile dataset dated May 5, 2021, was provided by DCW. Epsilon created receptor points of these structures from the centroid of each of these polygons. The resulting 554 receptors were input into the WindPRO model. Each modeling point was assumed to have a window facing all directions (“greenhouse” mode) which yields conservative results. Participation status for each modeling receptor was assigned based on the data presented in Figure 3-1. All modeling receptors are identified in Figure 3-2 and are distinguished as either participating or non-participating. The model was set to limit calculations to 2,012 meters from a wind turbine, the equivalent of 1.25 miles. Consequently, shadow flicker at any of the 554 modeling receptors

⁶ Massachusetts Department of Energy Resources, “Model As-of-Right Zoning Ordinance or Bylaw: Allowing Use of Wind Energy Facilities” 2009.

⁷ Parsons Brinckerhoff, “Update of UK Shadow Flicker Evidence Base” Prepared for Department of Energy and Climate Change, 2011.

⁸ State of New Hampshire Site Evaluation Committee Site 300 Rules (2015), available at http://www.gencourt.state.nh.us/rules/state_agencies/site100-300.html Accessed in June 2020.

⁹ State of Connecticut CSC Wind Regulations (2014), available at https://eregulations.ct.gov/eRegsPortal/Browse/RCSA?id=Title_16Subtitle_16-50jSection_16-50j-94&content=shadow%20flicker/ Accessed in June 2020.

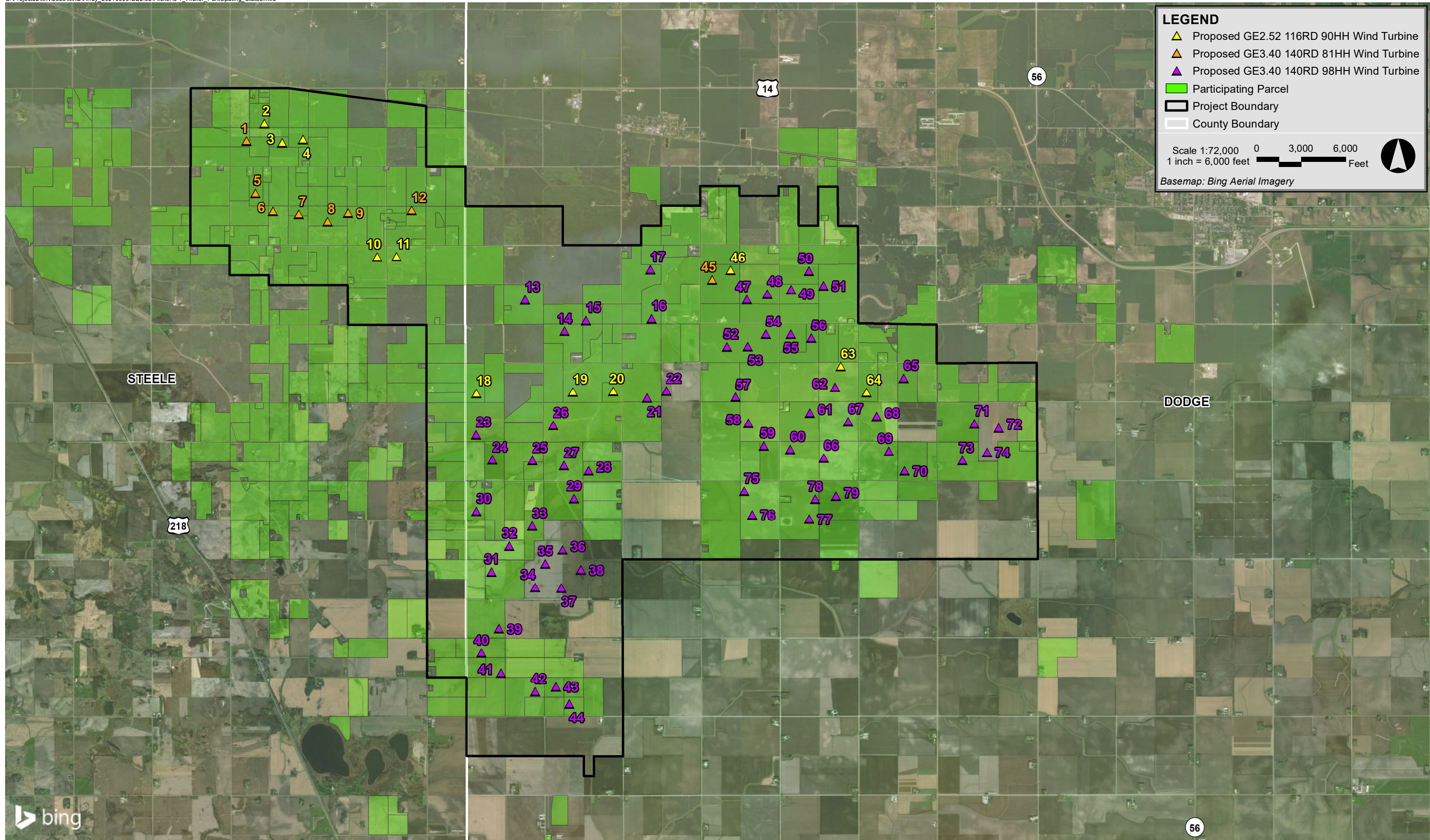
greater than the corresponding limitation distance from a wind turbine was zero. In addition to modeling discrete points, shadow flicker was calculated at grid points in the area surrounding the modeled wind turbines to generate flicker isolines. A 20-meter spacing was used for this grid.

The terrain height contour elevations for the modeling domain were generated from elevation information derived from the National Elevation Dataset (NED) developed by the U.S. Geological Survey. Conservatively, obstacles, i.e. buildings and vegetation, were excluded from the analysis. This is effectively a “bare earth” scenario which is conservative. When accounted for in the shadow flicker calculations, such obstacles may significantly mitigate or eliminate the flicker effect depending on their size, type, and location. In addition, shadow flicker durations were calculated only when the angle of the sun was at least 3° above the horizon.

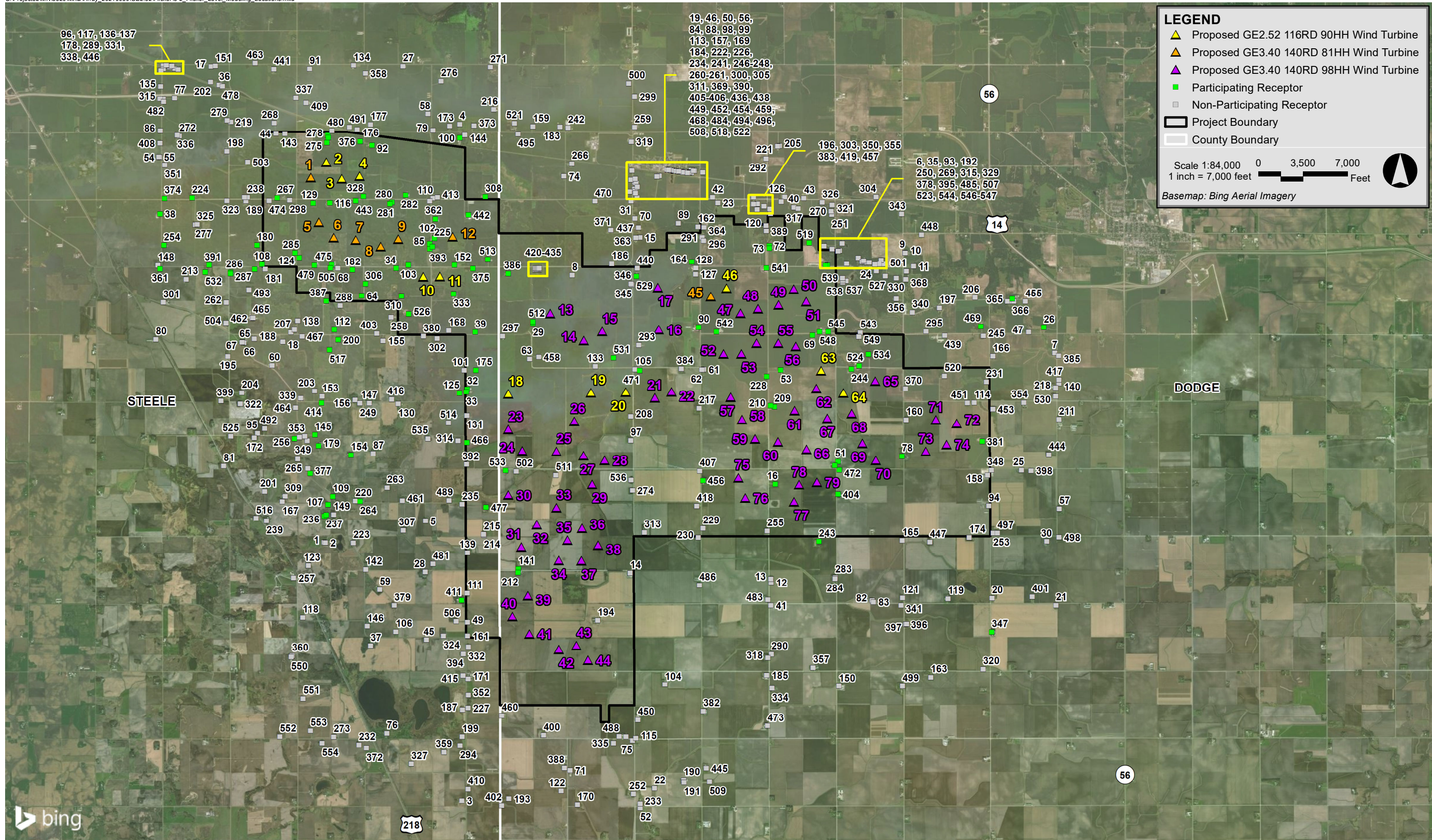
Monthly sunshine probability values were input for each month from January to December. These numbers were obtained from a publicly available historical dataset for Minneapolis-St. Paul, Minnesota from the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI).¹⁰ Table 3-1 shows the percentage of sunshine hours by month used in the shadow flicker modeling. These values are the percentages that the sun is expected to be shining during daylight hours.

The number of hours the wind turbines are expected to operate for the 16 cardinal wind directions was input into the model. An hourly dataset for a two year period of wind directions and scaled wind speed was provided by DCW for a height of 98 meters. Epsilon used this data to calculate the typical annual number of operational hours per wind direction sector. These hours per wind direction sector are used by WindPRO to estimate the “wind direction” and “operation time” reduction factors. Based on this dataset, the wind turbines would operate 93% of the year. Table 3-2 shows the distribution of operational hours for the 16 wind directions.

¹⁰ NCEI (formerly NCDC), <http://www1.ncdc.noaa.gov/pub/data/ccd-data/pctpos15.dat>. Accessed in January 2021.



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Table 3-1 Monthly Percent of Possible Sunshine

Month	Possible Sunshine
January	53%
February	59%
March	57%
April	56%
May	62%
June	67%
July	74%
August	69%
September	62%
October	51%
November	37%
December	38%

Table 3-2 Operational Hours per Wind Direction Sector

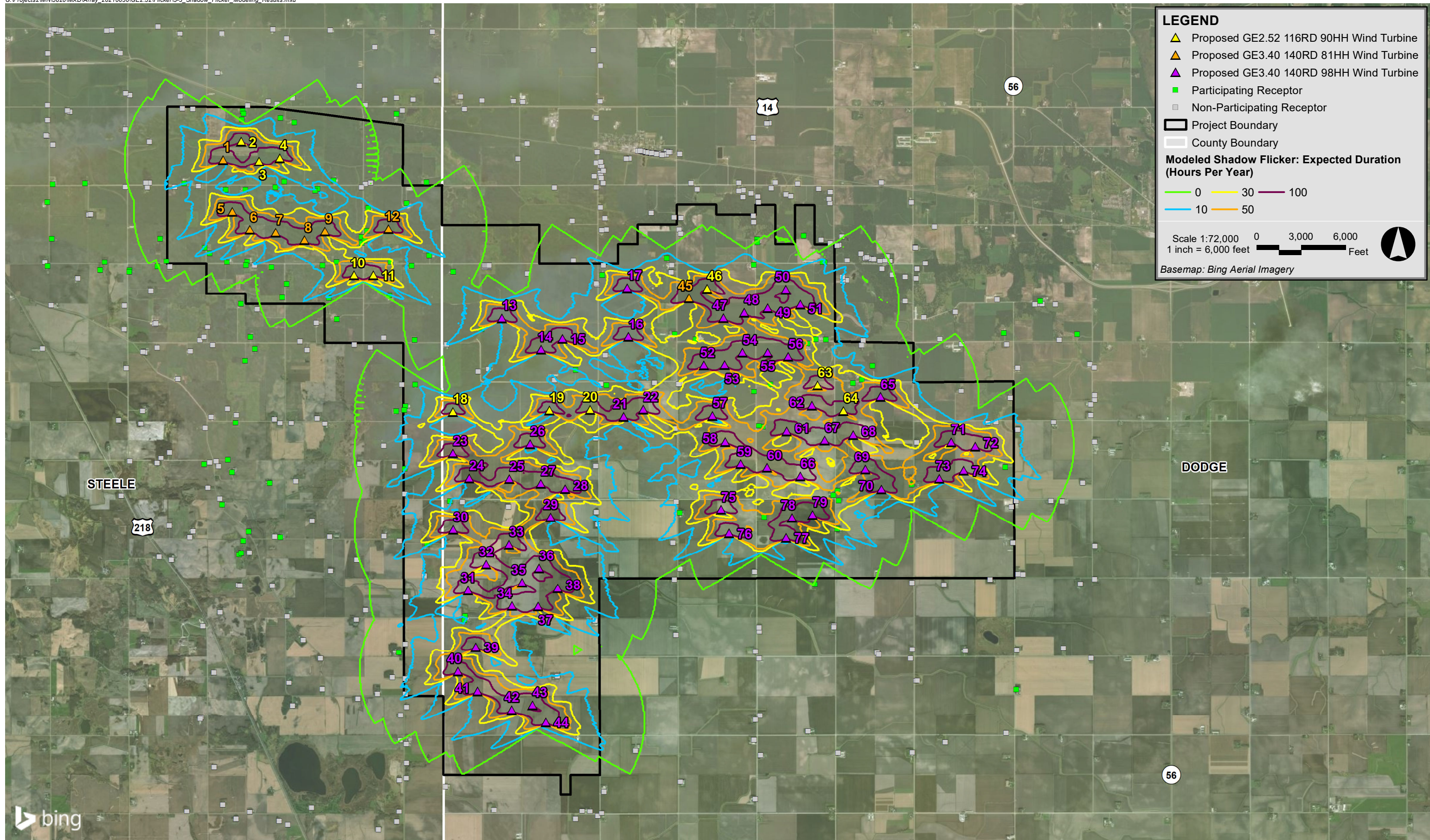
Wind Sector	Operational Hours
N	193
NNE	369
NE	339
ENE	406
E	332
ESE	400
SE	458
SSE	563
S	973
SSW	662
SW	456
WSW	381
W	429
WNW	794
NW	869
NNW	510
Annual	8134

3.2 Results

Following the modeling methodology outlined in Section 3.1, WindPRO was used to calculate shadow flicker at the 554 discrete modeling receptor points and generate shadow flicker isolines based on the grid calculations. Table B-1 in Appendix B presents the modeling results. Both expected and worst-case values are presented.

The predicted expected annual shadow flicker duration ranged from 0 hours, 0 minutes per year to 59 hours, 42 minutes per year for all 554 receptors. The maximum modeled expected annual flicker was at a participating receptor (#16). The maximum modeled expected annual flicker at a non-participating receptor (#217) is 40 hours, 30 minutes. The majority of the receptors (387) were predicted to experience no annual shadow flicker. Ninety-three (93) receptors were predicted to experience some shadow flicker but less than 10 hours per year. The modeling results showed that 52 receptors would be expected to have between 10 hours and 30 hours of shadow flicker per year. Twenty-two (22) receptors are expected to have over 30 hours of flicker per year, three (3) of which are non-participating receptors. Figure 3-3 displays the modeled flicker isolines (expected hours per year) over aerial imagery in relation to modeled wind turbines and modeling receptors.

The modeled worst-case annual shadow flicker duration for all the 554 receptors ranged from 0 hours, 0 minutes per year to 187 hours, 38 minutes per year. The maximum flicker modeled occurs at a participating receptor (#16). The maximum predicted annual flicker at a non-participating receptor (#62) is 129 hours, 17 minutes.



Appendix A

Wind Turbine Coordinates

Table A-1: Wind Turbine Coordinates

Wind Turbine ID	Wind Turbine Type	Hub Height (m)	Coordinates NAD83 UTM Zone 15N (meters)	
			X (Easting)	Y (Northing)
1	GE 3.40-140	81	491833.64	4876550.20
2	GE 2.52-116	90	492201.04	4876919.97
3	GE 2.52-116	90	492569.38	4876518.39
4	GE 2.52-116	90	492996.56	4876584.77
5	GE 3.40-140	81	492019.80	4875481.13
6	GE 3.40-140	81	492378.46	4875113.83
7	GE 3.40-140	81	492907.99	4875054.71
8	GE 3.40-140	81	493499.68	4874900.16
9	GE 3.40-140	81	493919.78	4875078.01
10	GE 2.52-116	90	494517.66	4874174.37
11	GE 2.52-116	90	494914.91	4874179.95
12	GE 3.40-140	81	495224.99	4875131.00
13	GE 3.40-140	98	497555.00	4873299.98
14	GE 3.40-140	98	498362.88	4872653.09
15	GE 3.40-140	98	498801.66	4872874.52
16	GE 3.40-140	98	500151.19	4872915.46
17	GE 3.40-140	98	500128.00	4873915.02
18	GE 2.52-116	90	496551.86	4871371.23
19	GE 2.52-116	90	498533.05	4871403.03
20	GE 2.52-116	90	499365.15	4871415.02
21	GE 3.40-140	98	500057.93	4871278.09
22	GE 3.40-140	98	500455.06	4871419.87
23	GE 3.40-140	98	496549.82	4870523.33
24	GE 3.40-140	98	496884.96	4870009.95
25	GE 3.40-140	98	497707.42	4869998.13
26	GE 3.40-140	98	498132.62	4870716.51
27	GE 3.40-140	98	498355.18	4869896.00
28	GE 3.40-140	98	498856.04	4869788.73
29	GE 3.40-140	98	498557.56	4869211.98
30	GE 3.40-140	98	496554.40	4868952.85
31	GE 3.40-140	98	496863.12	4867708.34
32	GE 3.40-140	98	497232.19	4868242.38
33	GE 3.40-140	98	497702.64	4868650.42
34	GE 3.40-140	98	497760.10	4867390.04
35	GE 3.40-140	98	497969.79	4867869.99
36	GE 3.40-140	98	498320.10	4868159.99
37	GE 3.40-140	98	498299.93	4867380.02
38	GE 3.40-140	98	498699.96	4867749.98
39	GE 3.40-140	98	497020.03	4866539.95
40	GE 3.40-140	98	496654.61	4866044.22
41	GE 3.40-140	98	497058.43	4865628.15
42	GE 3.40-140	98	497758.72	4865252.58
43	GE 3.40-140	98	498185.02	4865349.96

Table A-1: Wind Turbine Coordinates

Wind Turbine ID	Wind Turbine Type	Hub Height (m)	Coordinates NAD83 UTM Zone 15N (meters)	
			X (Easting)	Y (Northing)
44	GE 3.40-140	98	498460.38	4864997.78
45	GE 3.40-140	81	501394.99	4873705.00
46	GE 2.52-116	90	501769.66	4873902.40
47	GE 3.40-140	98	502105.17	4873305.04
48	GE 3.40-140	98	502527.18	4873413.71
49	GE 3.40-140	98	503014.54	4873505.98
50	GE 3.40-140	98	503383.44	4873883.37
51	GE 3.40-140	98	503679.97	4873582.99
52	GE 3.40-140	98	501700.04	4872330.14
53	GE 3.40-140	98	502126.00	4872334.64
54	GE 3.40-140	98	502494.94	4872589.99
55	GE 3.40-140	98	503009.99	4872589.99
56	GE 3.40-140	98	503430.06	4872510.03
57	GE 3.40-140	98	501875.01	4871294.85
58	GE 3.40-140	98	502140.74	4870760.46
59	GE 3.40-140	98	502455.04	4870299.87
60	GE 3.40-140	98	503000.05	4870224.87
61	GE 3.40-140	98	503399.99	4870970.10
62	GE 3.40-140	98	503919.96	4871500.10
63	GE 2.52-116	90	504034.89	4871924.89
64	GE 2.52-116	90	504566.05	4871390.30
65	GE 3.40-140	98	505326.98	4871679.98
66	GE 3.40-140	98	503683.30	4870048.74
67	GE 3.40-140	98	504184.96	4870789.95
68	GE 3.40-140	98	504769.97	4870899.97
69	GE 3.40-140	98	505020.03	4870190.00
70	GE 3.40-140	98	505344.97	4869785.03
71	GE 3.40-140	98	506779.98	4870749.95
72	GE 3.40-140	98	507275.54	4870666.61
73	GE 3.40-140	98	506535.07	4870000.09
74	GE 3.40-140	98	507036.52	4870165.95
75	GE 3.40-140	98	502055.00	4869364.97
76	GE 3.40-140	98	502219.93	4868879.99
77	GE 3.40-140	98	503390.01	4868790.00
78	GE 3.40-140	98	503509.98	4869199.95
79	GE 3.40-140	98	503935.02	4869259.99

Shadow Flicker Modeling Results: Modeling Receptors

Table B-1: Shadow Flicker Modeling Results

Receptor ID	Coordinates NAD83 UTM Zone 15N (meters)		Participation Status	Worst-Case Shadow Flicker - Annual	Worst-Case Shadow Flicker Days - Annual	Worst-Case Shadow Flicker Hours - Daily	Expected Shadow Flicker Hours - Annual
	X (Easting)	Y (Northing)		(HH:MM/year)	(Days/year)	(HH:MM/day)	(HH:MM/year)
1	492148.90	4867812.87	Non-Participating	0:00	0	0:00	0:00
2	492180.08	4867809.47	Non-Participating	0:00	0	0:00	0:00
3	495444.03	4861638.31	Non-Participating	0:00	0	0:00	0:00
4	495390.98	4877824.97	Non-Participating	0:00	0	0:00	0:00
5	494573.56	4868329.31	Non-Participating	0:00	0	0:00	0:00
6	504299.92	4874836.45	Non-Participating	0:00	0	0:00	0:00
7	509624.70	4872351.24	Non-Participating	0:00	0	0:00	0:00
8	498080.72	4874206.33	Non-Participating	0:00	0	0:00	0:00
9	506037.74	4874748.88	Non-Participating	0:00	0	0:00	0:00
10	506050.32	4874743.43	Non-Participating	0:00	0	0:00	0:00
11	506246.45	4874423.48	Non-Participating	0:00	0	0:00	0:00
12	502839.80	4866861.85	Non-Participating	0:00	0	0:00	0:00
13	502835.06	4866942.95	Non-Participating	0:00	0	0:00	0:00
14	499468.85	4867081.29	Non-Participating	26:50	117	0:26	10:49
15	499700.20	4875114.66	Non-Participating	0:00	0	0:00	0:00
16	502937.95	4869210.18	Participating	187:38	233	1:21	59:42
17	489444.63	4879205.60	Non-Participating	0:00	0	0:00	0:00
18	491159.74	4872616.50	Non-Participating	0:00	0	0:00	0:00
19	499576.26	4876273.51	Non-Participating	0:00	0	0:00	0:00
20	508124.36	4866478.11	Non-Participating	0:00	0	0:00	0:00
21	509652.52	4866311.23	Non-Participating	0:00	0	0:00	0:00
22	500054.15	4861931.65	Non-Participating	0:00	0	0:00	0:00
23	501566.55	4875940.76	Non-Participating	0:00	0	0:00	0:00
24	505360.45	4874306.38	Non-Participating	3:31	23	0:14	1:02
25	508830.24	4869546.99	Non-Participating	3:19	26	0:12	1:19
26	509364.26	4872963.09	Participating	0:00	0	0:00	0:00
27	494034.23	4879211.36	Non-Participating	0:00	0	0:00	0:00
28	494568.65	4867108.30	Non-Participating	0:00	0	0:00	0:00
29	497143.55	4873066.70	Participating	56:38	116	0:56	21:04
30	509431.80	4867835.01	Non-Participating	0:00	0	0:00	0:00
31	499492.96	4875983.78	Non-Participating	0:00	0	0:00	0:00
32	495572.93	4871481.19	Participating	10:27	34	0:26	3:38
33	495552.31	4871411.17	Participating	19:17	67	0:26	5:58
34	493871.98	4874370.65	Participating	48:05	128	0:52	16:59
35	504538.01	4874969.76	Non-Participating	0:00	0	0:00	0:00
36	489643.48	4878761.03	Non-Participating	0:00	0	0:00	0:00
37	493257.01	4865337.79	Non-Participating	0:00	0	0:00	0:00
38	488221.75	4875677.22	Participating	0:00	0	0:00	0:00
39	495765.52	4872848.11	Participating	2:38	21	0:11	0:55
40	503390.38	4875834.17	Non-Participating	0:00	0	0:00	0:00
41	502832.53	4866306.09	Non-Participating	0:00	0	0:00	0:00
42	501440.38	4876069.62	Non-Participating	0:00	0	0:00	0:00
43	503625.79	4876054.09	Non-Participating	0:00	0	0:00	0:00
44	490995.28	4877602.23	Non-Participating	8:58	63	0:18	2:35
45	494598.08	4865480.81	Non-Participating	0:00	0	0:00	0:00
46	500508.85	4876698.70	Non-Participating	0:00	0	0:00	0:00
47	508999.23	4872848.82	Non-Participating	0:00	0	0:00	0:00
48	491762.16	4869588.01	Non-Participating	0:00	0	0:00	0:00
49	495577.58	4865899.35	Non-Participating	26:15	109	0:29	9:19
50	499631.54	4876067.43	Non-Participating	0:00	0	0:00	0:00
51	504442.72	4869750.39	Participating	149:48	265	0:51	48:07
52	499711.80	4861462.44	Non-Participating	0:00	0	0:00	0:00
53	503069.05	4871941.72	Participating	89:53	236	0:54	32:35
54	488218.70	4877029.52	Non-Participating	0:00	0	0:00	0:00
55	488197.62	4877040.78	Non-Participating	0:00	0	0:00	0:00
56	500607.23	4876688.71	Non-Participating	0:00	0	0:00	0:00
57	509728.20	4868620.30	Non-Participating	0:00	0	0:00	0:00
58	494631.94	4878067.90	Non-Participating	0:00	0	0:00	0:00
59	493478.04	4866683.95	Non-Participating	0:00	0	0:00	0:00
60	490904.04	4872049.28	Non-Participating	0:00	0	0:00	0:00
61	501225.17	4871956.07	Non-Participating	116:37	216	0:46	36:42
62	501183.46	4871944.67	Non-Participating	129:17	217	0:57	39:38
63	497067.23	4872202.85	Non-Participating	14:08	65	0:23	5:01
64	493047.36	4873719.28	Participating	5:21	38	0:14	1:55
65	490198.35	4872610.03	Non-Participating	0:00	0	0:00	0:00
66	490231.07	4872594.88	Non-Participating	0:00	0	0:00	0:00
67	490185.97	4872604.25	Non-Participating	0:00	0	0:00	0:00
68	492480.63	4874371.00	Non-Participating	22:01	73	0:25	8:24
69	503825.75	4872775.72	Participating	162:46	279	1:09	48:10
70	499581.44	4875569.38	Non-Participating	0:00	0	0:00	0:00
71	498033.70	4862361.30	Non-Participating	0:00	0	0:00	0:00
72	502794.29	4874913.12	Participating	0:00	0	0:00	0:00
73	502796.00	4874854.78	Participating	3:15	21	0:12	0:40

Table B-1: Shadow Flicker Modeling Results

Receptor ID	Coordinates NAD83 UTM Zone 15N (meters)		Participation Status	Worst-Case Shadow Flicker - Annual	Worst-Case Shadow Flicker Days - Annual	Worst-Case Shadow Flicker Hours - Daily	Expected Shadow Flicker Hours - Annual
	X (Easting)	Y (Northing)		(HH:MM/year)	(Days/year)	(HH:MM/day)	(HH:MM/year)
74	497881.90	4876575.38	Non-Participating	0:00	0	0:00	0:00
75	499526.62	4863072.56	Non-Participating	0:00	0	0:00	0:00
76	493648.84	4863245.61	Non-Participating	0:00	0	0:00	0:00
77	488576.77	4878448.64	Non-Participating	0:00	0	0:00	0:00
78	505966.88	4869878.37	Participating	145:06	209	1:29	52:38
79	494750.75	4877672.55	Non-Participating	0:00	0	0:00	0:00
80	488124.42	4872673.44	Non-Participating	0:00	0	0:00	0:00
81	489743.70	4869646.39	Non-Participating	0:00	0	0:00	0:00
82	505258.78	4866422.16	Non-Participating	0:00	0	0:00	0:00
83	505289.10	4866389.62	Non-Participating	0:00	0	0:00	0:00
84	500430.38	4876723.10	Non-Participating	0:00	0	0:00	0:00
85	494674.40	4874964.71	Participating	127:15	199	1:09	47:29
86	488229.97	4877669.00	Non-Participating	0:00	0	0:00	0:00
87	493327.54	4869945.54	Non-Participating	0:00	0	0:00	0:00
88	500474.45	4876712.64	Non-Participating	0:00	0	0:00	0:00
89	500623.45	4875455.65	Non-Participating	0:00	0	0:00	0:00
90	501103.54	4872965.76	Participating	79:58	239	0:33	25:58
91	491805.15	4879143.63	Non-Participating	0:00	0	0:00	0:00
92	493295.90	4877317.09	Participating	10:42	58	0:21	3:08
93	505521.46	4874472.14	Non-Participating	0:00	0	0:00	0:00
94	508048.16	4868687.71	Non-Participating	0:00	0	0:00	0:00
95	490558.27	4870427.40	Non-Participating	0:00	0	0:00	0:00
96	488455.23	4879188.75	Non-Participating	0:00	0	0:00	0:00
97	499482.01	4870257.86	Non-Participating	78:17	190	0:44	21:09
98	499579.78	4876426.53	Non-Participating	0:00	0	0:00	0:00
99	500954.88	4876712.04	Non-Participating	0:00	0	0:00	0:00
100	495393.83	4877492.70	Participating	0:00	0	0:00	0:00
101	495503.67	4871935.80	Non-Participating	8:48	37	0:22	2:36
102	494809.73	4875554.74	Participating	82:42	129	0:59	22:51
103	494160.31	4874449.84	Participating	138:22	248	1:02	43:37
104	500298.35	4864413.90	Non-Participating	2:46	22	0:11	1:05
105	499582.97	4871955.15	Non-Participating	39:57	115	0:50	12:36
106	493864.69	4865674.98	Non-Participating	0:00	0	0:00	0:00
107	492244.31	4868718.62	Participating	0:00	0	0:00	0:00
108	490664.39	4874465.11	Participating	2:50	24	0:10	1:03
109	492356.73	4868911.94	Participating	0:00	0	0:00	0:00
110	494752.02	4876048.27	Non-Participating	1:38	18	0:08	0:38
111	495573.03	4866602.09	Non-Participating	22:21	105	0:26	6:57
112	492395.06	4872907.23	Participating	0:00	0	0:00	0:00
113	500368.53	4876730.47	Non-Participating	0:00	0	0:00	0:00
114	507701.03	4871155.54	Non-Participating	64:22	113	0:51	16:13
115	499602.96	4863130.00	Non-Participating	0:00	0	0:00	0:00
116	492288.94	4875934.54	Participating	7:01	44	0:21	1:49
117	488579.52	4879153.91	Non-Participating	0:00	0	0:00	0:00
118	491639.96	4866018.48	Non-Participating	0:00	0	0:00	0:00
119	507073.63	4866464.97	Non-Participating	0:00	0	0:00	0:00
120	502717.76	4875399.03	Non-Participating	0:00	0	0:00	0:00
121	505982.22	4866488.49	Non-Participating	0:00	0	0:00	0:00
122	497815.41	4861867.43	Non-Participating	0:00	0	0:00	0:00
123	491772.09	4867257.85	Non-Participating	0:00	0	0:00	0:00
124	491554.77	4874628.63	Participating	21:54	103	0:21	8:08
125	495388.32	4871382.70	Participating	22:54	92	0:22	6:50
126	503168.34	4876081.13	Non-Participating	0:00	0	0:00	0:00
127	501030.87	4874233.06	Non-Participating	52:56	122	0:58	16:17
128	501040.98	4874377.91	Non-Participating	42:55	90	0:49	12:13
129	491888.32	4875933.22	Participating	19:59	107	0:22	6:04
130	493922.16	4871131.52	Non-Participating	0:00	0	0:00	0:00
131	495560.88	4870852.56	Non-Participating	42:01	150	0:31	14:42
132	488299.76	4878423.35	Non-Participating	0:00	0	0:00	0:00
133	498636.66	4872028.29	Non-Participating	40:17	152	0:31	11:50
134	492857.85	4879228.58	Non-Participating	0:00	0	0:00	0:00
135	488237.17	4878728.89	Non-Participating	0:00	0	0:00	0:00
136	488407.42	4879222.82	Non-Participating	0:00	0	0:00	0:00
137	488660.48	4879131.37	Non-Participating	0:00	0	0:00	0:00
138	491517.60	4873118.79	Non-Participating	0:00	0	0:00	0:00
139	495581.70	4867569.37	Non-Participating	21:26	123	0:23	7:02
140	509724.36	4871619.32	Non-Participating	0:00	0	0:00	0:00
141	496797.40	4867179.31	Participating	31:16	110	0:37	11:13
142	493147.64	4867171.40	Non-Participating	0:00	0	0:00	0:00
143	491208.49	4877594.08	Non-Participating	18:38	78	0:23	5:07
144	495513.20	4877563.58	Non-Participating	0:00	0	0:00	0:00
145	491932.00	4870388.39	Participating	0:00	0	0:00	0:00
146	493183.89	4865808.35	Non-Participating	0:00	0	0:00	0:00

Table B-1: Shadow Flicker Modeling Results

Receptor ID	Coordinates NAD83 UTM Zone 15N (meters)		Participation Status	Worst-Case Shadow Flicker - Annual	Worst-Case Shadow Flicker Days - Annual	Worst-Case Shadow Flicker Hours - Daily	Expected Shadow Flicker Hours - Annual
	X (Easting)	Y (Northing)		(HH:MM/year)	(Days/year)	(HH:MM/day)	(HH:MM/year)
147	493234.84	4871143.88	Non-Participating	0:00	0	0:00	0:00
148	488176.82	4874444.29	Non-Participating	0:00	0	0:00	0:00
149	492375.72	4868476.15	Non-Participating	0:00	0	0:00	0:00
150	504458.08	4864371.22	Non-Participating	0:00	0	0:00	0:00
151	489544.91	4879213.73	Non-Participating	0:00	0	0:00	0:00
152	495267.53	4874447.81	Participating	134:13	217	1:08	36:42
153	492103.49	4871307.03	Non-Participating	0:00	0	0:00	0:00
154	492791.30	4869909.10	Participating	0:00	0	0:00	0:00
155	493559.19	4872640.63	Non-Participating	0:00	0	0:00	0:00
156	492888.38	4871222.75	Non-Participating	0:00	0	0:00	0:00
157	500491.51	4876706.12	Non-Participating	0:00	0	0:00	0:00
158	508018.56	4869420.73	Non-Participating	6:58	36	0:17	2:53
159	497144.63	4877768.68	Non-Participating	0:00	0	0:00	0:00
160	506068.93	4870747.29	Non-Participating	79:55	167	0:59	26:14
161	495577.32	4865576.05	Non-Participating	27:23	104	0:27	10:20
162	501089.42	4875368.23	Non-Participating	0:00	0	0:00	0:00
163	506656.97	4864586.31	Non-Participating	0:00	0	0:00	0:00
164	500941.84	4874531.82	Participating	60:30	79	1:05	15:31
165	505975.17	4867859.30	Non-Participating	0:00	0	0:00	0:00
166	508144.63	4872272.89	Non-Participating	0:00	0	0:00	0:00
167	491147.12	4868792.53	Non-Participating	0:00	0	0:00	0:00
168	495131.09	4872888.37	Non-Participating	0:00	0	0:00	0:00
169	500930.64	4876656.51	Non-Participating	0:00	0	0:00	0:00
170	498210.22	4861540.63	Non-Participating	0:00	0	0:00	0:00
171	495589.79	4864552.29	Non-Participating	0:00	0	0:00	0:00
172	490476.84	4870316.70	Non-Participating	0:00	0	0:00	0:00
173	495153.79	4877778.54	Non-Participating	0:00	0	0:00	0:00
174	507576.91	4867930.10	Non-Participating	0:00	0	0:00	0:00
175	495774.75	4871932.37	Participating	27:30	81	0:30	7:37
176	492942.35	4877694.92	Non-Participating	0:00	0	0:00	0:00
177	493256.63	4877818.13	Non-Participating	5:59	29	0:16	1:18
178	488305.00	4879226.91	Non-Participating	0:00	0	0:00	0:00
179	492013.05	4870129.41	Participating	0:00	0	0:00	0:00
180	490540.60	4874928.89	Participating	6:48	48	0:14	2:28
181	490740.99	4874350.24	Non-Participating	4:13	34	0:11	1:36
182	492825.92	4874335.43	Participating	1:54	17	0:10	0:40
183	497791.37	4877758.09	Non-Participating	0:00	0	0:00	0:00
184	499586.33	4876218.60	Non-Participating	0:00	0	0:00	0:00
185	502733.21	4864639.89	Non-Participating	0:00	0	0:00	0:00
186	499027.32	4874481.53	Non-Participating	17:55	75	0:26	4:56
187	495454.20	4863810.52	Non-Participating	0:00	0	0:00	0:00
188	490478.72	4872689.88	Non-Participating	0:00	0	0:00	0:00
189	490278.72	4875981.79	Non-Participating	6:43	49	0:14	2:25
190	500749.17	4862127.79	Non-Participating	0:00	0	0:00	0:00
191	500757.86	4862075.69	Non-Participating	0:00	0	0:00	0:00
192	504107.57	4874903.13	Non-Participating	0:00	0	0:00	0:00
193	496567.40	4861683.18	Non-Participating	0:00	0	0:00	0:00
194	498696.73	4865948.08	Non-Participating	47:11	124	0:44	11:54
195	489845.83	4872269.79	Non-Participating	0:00	0	0:00	0:00
196	502511.25	4875918.65	Non-Participating	0:00	0	0:00	0:00
197	506867.25	4873425.96	Non-Participating	0:00	0	0:00	0:00
198	489825.59	4877177.74	Non-Participating	0:00	0	0:00	0:00
199	495448.22	4863162.40	Non-Participating	0:00	0	0:00	0:00
200	492485.87	4872667.38	Participating	0:00	0	0:00	0:00
201	490726.89	4869031.52	Non-Participating	0:00	0	0:00	0:00
202	489435.33	4878830.81	Non-Participating	0:00	0	0:00	0:00
203	491925.48	4871433.16	Non-Participating	0:00	0	0:00	0:00
204	490181.91	4871393.10	Non-Participating	0:00	0	0:00	0:00
205	503040.46	4877305.74	Non-Participating	0:00	0	0:00	0:00
206	507720.87	4873679.54	Non-Participating	0:00	0	0:00	0:00
207	491353.72	4872843.53	Non-Participating	0:00	0	0:00	0:00
208	499483.98	4870832.33	Non-Participating	35:29	132	0:28	11:07
209	502915.25	4871061.73	Participating	148:02	263	1:15	51:49
210	502825.89	4871089.68	Participating	123:12	224	1:04	41:44
211	509723.09	4870758.45	Non-Participating	0:00	0	0:00	0:00
212	496786.19	4867096.04	Participating	25:26	77	0:32	9:15
213	488850.02	4874111.98	Non-Participating	0:00	0	0:00	0:00
214	495966.80	4867986.23	Non-Participating	32:37	124	0:34	11:13
215	495966.13	4868005.71	Non-Participating	32:14	122	0:34	11:07
216	496208.01	4878176.00	Non-Participating	0:00	0	0:00	0:00
217	501117.53	4871025.47	Non-Participating	107:36	210	0:48	40:30
218	509646.97	4871517.51	Non-Participating	0:00	0	0:00	0:00
219	489915.77	4877879.58	Non-Participating	0:00	0	0:00	0:00

Table B-1: Shadow Flicker Modeling Results

Receptor ID	Coordinates NAD83 UTM Zone 15N (meters)		Participation Status	Worst-Case Shadow Flicker - Annual	Worst-Case Shadow Flicker Days - Annual	Worst-Case Shadow Flicker Hours - Daily	Expected Shadow Flicker Hours - Annual
	X (Easting)	Y (Northing)		(HH:MM/year)	(Days/year)	(HH:MM/day)	(HH:MM/year)
220	492895.31	4868806.16	Non-Participating	0:00	0	0:00	0:00
221	502995.95	4877296.70	Non-Participating	0:00	0	0:00	0:00
222	501003.67	4876706.51	Non-Participating	0:00	0	0:00	0:00
223	492845.37	4867800.41	Non-Participating	0:00	0	0:00	0:00
224	488996.21	4876058.27	Participating	0:00	0	0:00	0:00
225	494785.68	4875094.79	Participating	122:49	151	1:23	43:49
226	500169.04	4876581.94	Non-Participating	0:00	0	0:00	0:00
227	495593.56	4863852.66	Non-Participating	0:00	0	0:00	0:00
228	502731.49	4871786.99	Participating	64:38	218	0:34	21:36
229	501213.17	4868148.37	Non-Participating	0:00	0	0:00	0:00
230	501099.20	4867929.07	Non-Participating	0:00	0	0:00	0:00
231	507989.46	4871655.59	Non-Participating	16:18	63	0:22	3:52
232	492984.78	4862963.95	Non-Participating	0:00	0	0:00	0:00
233	499708.68	4861562.23	Non-Participating	0:00	0	0:00	0:00
234	501207.50	4876670.87	Non-Participating	0:00	0	0:00	0:00
235	495449.98	4868723.71	Non-Participating	24:16	118	0:28	7:51
236	492158.99	4868443.65	Participating	0:00	0	0:00	0:00
237	492202.23	4868471.49	Participating	0:00	0	0:00	0:00
238	490317.49	4876072.38	Non-Participating	7:07	48	0:15	2:32
239	490772.87	4868330.67	Non-Participating	0:00	0	0:00	0:00
240	504474.32	4874800.84	Non-Participating	14:56	45	0:24	3:25
241	499451.86	4876209.11	Non-Participating	0:00	0	0:00	0:00
242	497981.30	4877738.38	Non-Participating	0:00	0	0:00	0:00
243	503983.64	4867834.43	Participating	0:00	0	0:00	0:00
244	504760.55	4871962.27	Participating	121:01	254	1:21	38:51
245	507916.22	4872759.08	Non-Participating	0:00	0	0:00	0:00
246	500109.86	4876571.91	Non-Participating	0:00	0	0:00	0:00
247	499493.32	4876494.63	Non-Participating	0:00	0	0:00	0:00
248	500792.52	4876671.42	Non-Participating	0:00	0	0:00	0:00
249	493001.46	4871141.57	Non-Participating	0:00	0	0:00	0:00
250	505468.21	4874567.16	Non-Participating	0:00	0	0:00	0:00
251	504293.80	4875657.39	Non-Participating	0:00	0	0:00	0:00
252	499548.84	4861796.60	Non-Participating	0:00	0	0:00	0:00
253	508150.60	4868038.13	Non-Participating	0:00	0	0:00	0:00
254	488314.12	4874924.71	Participating	0:00	0	0:00	0:00
255	502745.82	4868089.17	Non-Participating	0:00	0	0:00	0:00
256	491441.79	4870295.15	Participating	0:00	0	0:00	0:00
257	491419.59	4866969.08	Non-Participating	0:00	0	0:00	0:00
258	493748.19	4873206.06	Non-Participating	0:00	0	0:00	0:00
259	499574.91	4877748.37	Non-Participating	0:00	0	0:00	0:00
260	500570.48	4876697.94	Non-Participating	0:00	0	0:00	0:00
261	500682.67	4876686.29	Non-Participating	0:00	0	0:00	0:00
262	489807.34	4873556.75	Non-Participating	0:00	0	0:00	0:00
263	493660.68	4869127.12	Non-Participating	0:00	0	0:00	0:00
264	493008.97	4868796.76	Participating	0:00	0	0:00	0:00
265	491521.01	4869811.96	Non-Participating	0:00	0	0:00	0:00
266	498071.67	4876876.94	Non-Participating	0:00	0	0:00	0:00
267	491030.47	4876061.23	Participating	33:22	166	0:27	10:48
268	490953.76	4877850.89	Non-Participating	9:39	53	0:16	2:38
269	504925.86	4874621.85	Non-Participating	15:08	65	0:20	3:39
270	504273.69	4875741.16	Non-Participating	0:00	0	0:00	0:00
271	496127.52	4879185.09	Non-Participating	0:00	0	0:00	0:00
272	488684.76	4877538.01	Non-Participating	0:00	0	0:00	0:00
273	492380.19	4863158.39	Non-Participating	0:00	0	0:00	0:00
274	499523.83	4869059.24	Non-Participating	35:21	126	0:33	10:49
275	492212.61	4877378.62	Participating	0:00	0	0:00	0:00
276	494947.99	4878856.51	Non-Participating	0:00	0	0:00	0:00
277	489073.80	4875419.12	Non-Participating	0:00	0	0:00	0:00
278	492233.76	4877556.00	Participating	0:00	0	0:00	0:00
279	489833.11	4877912.50	Non-Participating	0:00	0	0:00	0:00
280	493769.89	4875949.78	Participating	21:53	123	0:26	7:42
281	493718.91	4875916.68	Participating	27:59	147	0:21	10:14
282	494098.64	4876122.28	Participating	18:37	107	0:21	6:58
283	504379.21	4866974.98	Non-Participating	0:00	0	0:00	0:00
284	504371.08	4866947.02	Non-Participating	0:00	0	0:00	0:00
285	491453.41	4874743.92	Participating	30:55	102	0:32	11:37
286	489909.66	4874272.91	Participating	0:00	0	0:00	0:00
287	489907.11	4874247.07	Participating	0:00	0	0:00	0:00
288	492532.30	4873484.11	Non-Participating	0:00	0	0:00	0:00
289	488299.49	4879147.02	Non-Participating	0:00	0	0:00	0:00
290	502850.33	4865135.09	Non-Participating	0:00	0	0:00	0:00
291	501192.38	4875114.79	Non-Participating	0:00	0	0:00	0:00
292	502719.54	4876996.39	Non-Participating	0:00	0	0:00	0:00

Table B-1: Shadow Flicker Modeling Results

Receptor ID	Coordinates NAD83 UTM Zone 15N (meters)		Participation Status	Worst-Case Shadow Flicker - Annual	Worst-Case Shadow Flicker Days - Annual	Worst-Case Shadow Flicker Hours - Daily	Expected Shadow Flicker Hours - Annual
	X (Easting)	Y (Northing)		(HH:MM/year)	(Days/year)	(HH:MM/day)	(HH:MM/year)
293	499678.09	4872538.62	Non-Participating	43:35	121	0:36	17:47
294	495398.34	4862952.06	Non-Participating	0:00	0	0:00	0:00
295	506546.78	4872867.33	Non-Participating	0:00	0	0:00	0:00
296	501224.93	4875033.82	Non-Participating	0:00	0	0:00	0:00
297	496419.85	4872754.66	Non-Participating	26:51	96	0:25	10:14
298	491327.24	4876003.33	Non-Participating	55:00	139	0:44	16:25
299	499578.51	4878480.97	Non-Participating	0:00	0	0:00	0:00
300	500931.24	4876716.77	Non-Participating	0:00	0	0:00	0:00
301	488302.80	4873560.59	Non-Participating	0:00	0	0:00	0:00
302	494852.79	4872697.89	Non-Participating	0:00	0	0:00	0:00
303	502421.45	4876071.99	Non-Participating	0:00	0	0:00	0:00
304	505348.39	4876079.30	Non-Participating	0:00	0	0:00	0:00
305	500868.27	4876669.90	Non-Participating	0:00	0	0:00	0:00
306	493138.15	4874000.89	Participating	4:34	28	0:16	1:34
307	494040.64	4868103.53	Non-Participating	0:00	0	0:00	0:00
308	496006.82	4876086.98	Participating	0:00	0	0:00	0:00
309	491215.79	4868919.33	Non-Participating	0:00	0	0:00	0:00
310	494001.93	4873709.24	Participating	24:02	68	0:28	9:10
311	499611.85	4876413.28	Non-Participating	0:00	0	0:00	0:00
312	504182.95	4874445.24	Participating	41:34	94	0:42	10:02
313	499811.09	4868052.86	Non-Participating	22:35	105	0:27	7:08
314	495349.04	4870249.03	Non-Participating	14:29	62	0:24	5:01
315	488228.07	4878434.32	Non-Participating	0:00	0	0:00	0:00
316	491442.10	4872910.02	Non-Participating	0:00	0	0:00	0:00
317	503487.85	4875801.04	Non-Participating	0:00	0	0:00	0:00
318	502760.12	4865050.38	Non-Participating	0:00	0	0:00	0:00
319	499494.76	4877405.80	Non-Participating	0:00	0	0:00	0:00
320	507907.62	4864779.23	Non-Participating	0:00	0	0:00	0:00
321	504300.61	4875884.53	Non-Participating	0:00	0	0:00	0:00
322	490143.16	4871129.16	Non-Participating	0:00	0	0:00	0:00
323	489826.64	4875986.81	Non-Participating	0:00	0	0:00	0:00
324	494999.19	4865577.98	Non-Participating	3:44	25	0:13	1:19
325	489115.47	4875427.87	Non-Participating	0:00	0	0:00	0:00
326	504059.72	4875949.28	Non-Participating	0:00	0	0:00	0:00
327	494233.58	4862515.25	Non-Participating	0:00	0	0:00	0:00
328	493087.73	4876095.24	Participating	18:29	83	0:23	5:55
329	505014.97	4874528.13	Non-Participating	15:41	91	0:19	4:04
330	505833.99	4874138.56	Non-Participating	0:00	0	0:00	0:00
331	488245.43	4879102.59	Non-Participating	0:00	0	0:00	0:00
332	495596.87	4865310.03	Non-Participating	5:26	29	0:17	1:54
333	495246.75	4873763.89	Participating	18:30	54	0:27	7:57
334	502864.73	4864320.41	Non-Participating	0:00	0	0:00	0:00
335	499067.20	4863010.71	Non-Participating	0:00	0	0:00	0:00
336	488635.60	4877560.13	Non-Participating	0:00	0	0:00	0:00
337	491477.34	4878458.84	Non-Participating	0:00	0	0:00	0:00
338	488370.70	4879229.42	Non-Participating	0:00	0	0:00	0:00
339	491586.16	4871267.36	Non-Participating	0:00	0	0:00	0:00
340	506219.35	4873319.67	Non-Participating	0:00	0	0:00	0:00
341	505944.93	4866305.68	Non-Participating	0:00	0	0:00	0:00
342	490485.73	4874353.08	Participating	0:00	0	0:00	0:00
343	505959.74	4875672.79	Non-Participating	0:00	0	0:00	0:00
344	503082.57	4875966.50	Non-Participating	0:00	0	0:00	0:00
345	499507.02	4873983.67	Non-Participating	43:10	68	0:51	15:03
346	499493.07	4874005.43	Non-Participating	40:28	64	0:50	14:01
347	508114.92	4865669.97	Participating	0:00	0	0:00	0:00
348	508112.13	4869543.81	Non-Participating	15:03	75	0:18	6:16
349	491741.81	4870251.28	Non-Participating	0:00	0	0:00	0:00
350	502824.36	4875679.02	Non-Participating	0:00	0	0:00	0:00
351	488336.85	4876851.24	Non-Participating	0:00	0	0:00	0:00
352	495596.99	4864158.82	Non-Participating	0:00	0	0:00	0:00
353	491690.59	4870352.19	Non-Participating	0:00	0	0:00	0:00
354	508881.77	4871158.61	Non-Participating	3:47	22	0:15	1:10
355	502671.38	4875862.64	Non-Participating	0:00	0	0:00	0:00
356	505835.12	4873648.89	Non-Participating	0:00	0	0:00	0:00
357	503841.78	4864815.50	Non-Participating	0:00	0	0:00	0:00
358	493137.26	4879037.00	Non-Participating	0:00	0	0:00	0:00
359	495018.61	4862796.39	Non-Participating	0:00	0	0:00	0:00
360	491382.19	4865101.53	Non-Participating	0:00	0	0:00	0:00
361	488227.26	4874360.15	Participating	0:00	0	0:00	0:00
362	494673.57	4875982.30	Non-Participating	3:45	40	0:09	1:15
363	499603.78	4875103.88	Non-Participating	0:00	0	0:00	0:00
364	501230.12	4875352.04	Non-Participating	0:00	0	0:00	0:00
365	508497.51	4873580.91	Non-Participating	0:00	0	0:00	0:00

Table B-1: Shadow Flicker Modeling Results

Receptor ID	Coordinates NAD83 UTM Zone 15N (meters)		Participation Status	Worst-Case Shadow Flicker - Annual	Worst-Case Shadow Flicker Days - Annual	Worst-Case Shadow Flicker Hours - Daily	Expected Shadow Flicker Hours - Annual
	X (Easting)	Y (Northing)		(HH:MM/year)	(Days/year)	(HH:MM/day)	(HH:MM/year)
366	508610.68	4873584.75	Non-Participating	0:00	0	0:00	0:00
367	508645.50	4873585.73	Non-Participating	0:00	0	0:00	0:00
368	506061.93	4874108.69	Non-Participating	0:00	0	0:00	0:00
369	500547.66	4876700.33	Non-Participating	0:00	0	0:00	0:00
370	506051.62	4871490.73	Non-Participating	72:54	213	0:45	25:17
371	499003.18	4875289.99	Non-Participating	0:00	0	0:00	0:00
372	493163.47	4862892.03	Non-Participating	0:00	0	0:00	0:00
373	495733.86	4877787.86	Non-Participating	0:00	0	0:00	0:00
374	488331.26	4876045.64	Participating	0:00	0	0:00	0:00
375	495703.45	4874365.14	Participating	23:45	66	0:42	7:39
376	493010.79	4877410.17	Participating	28:25	100	0:30	7:00
377	491814.47	4869464.04	Participating	0:00	0	0:00	0:00
378	505131.50	4874516.31	Non-Participating	10:13	61	0:18	2:42
379	493828.30	4866305.38	Non-Participating	0:00	0	0:00	0:00
380	494525.65	4872748.24	Non-Participating	0:00	0	0:00	0:00
381	507887.22	4870232.34	Participating	54:40	148	0:38	20:54
382	501220.91	4863779.36	Non-Participating	0:00	0	0:00	0:00
383	502811.08	4875791.86	Non-Participating	0:00	0	0:00	0:00
384	500691.52	4871972.10	Non-Participating	51:16	167	0:31	16:40
385	509717.05	4872284.24	Non-Participating	0:00	0	0:00	0:00
386	496555.95	4874246.61	Participating	2:28	18	0:12	0:51
387	492199.55	4873593.52	Participating	0:00	0	0:00	0:00
388	497898.95	4862420.50	Non-Participating	0:00	0	0:00	0:00
389	502722.77	4875265.62	Non-Participating	0:00	0	0:00	0:00
390	499511.63	4876710.19	Non-Participating	0:00	0	0:00	0:00
391	489397.15	4874448.48	Participating	0:00	0	0:00	0:00
392	495560.39	4869683.96	Non-Participating	30:55	106	0:27	9:14
393	494677.85	4874842.56	Participating	86:57	163	0:50	33:34
394	495476.72	4865142.67	Non-Participating	4:42	28	0:15	1:42
395	505419.99	4874473.85	Non-Participating	2:52	22	0:12	0:45
396	506061.42	4865852.28	Non-Participating	0:00	0	0:00	0:00
397	506082.39	4865857.89	Non-Participating	0:00	0	0:00	0:00
398	509057.18	4869533.17	Non-Participating	0:00	0	0:00	0:00
399	489683.66	4871204.50	Non-Participating	0:00	0	0:00	0:00
400	497395.94	4863196.86	Non-Participating	0:00	0	0:00	0:00
401	509081.25	4866514.23	Non-Participating	0:00	0	0:00	0:00
402	496393.62	4861524.14	Non-Participating	0:00	0	0:00	0:00
403	493409.85	4872818.20	Non-Participating	0:00	0	0:00	0:00
404	504438.28	4868964.58	Participating	61:06	141	0:40	23:51
405	500749.57	4876674.35	Non-Participating	0:00	0	0:00	0:00
406	499586.30	4876513.64	Non-Participating	0:00	0	0:00	0:00
407	501133.29	4869524.33	Non-Participating	40:32	158	0:35	13:30
408	488226.20	4877367.74	Non-Participating	0:00	0	0:00	0:00
409	491716.82	4878333.38	Non-Participating	0:00	0	0:00	0:00
410	495595.08	4861914.80	Non-Participating	0:00	0	0:00	0:00
411	495437.61	4866427.58	Participating	15:36	80	0:23	5:08
412	491558.71	4870331.03	Non-Participating	0:00	0	0:00	0:00
413	494862.10	4876074.35	Non-Participating	1:08	15	0:07	0:25
414	492089.64	4871150.41	Participating	0:00	0	0:00	0:00
415	495468.48	4864632.88	Non-Participating	0:10	10	0:01	0:03
416	493766.86	4871238.86	Non-Participating	0:00	0	0:00	0:00
417	509722.75	4871708.96	Non-Participating	0:00	0	0:00	0:00
418	501064.43	4868684.20	Non-Participating	11:30	39	0:27	4:01
419	502505.60	4875781.28	Non-Participating	0:00	0	0:00	0:00
420	497293.09	4874334.76	Non-Participating	0:00	0	0:00	0:00
421	497274.63	4874334.92	Non-Participating	0:00	0	0:00	0:00
422	497256.16	4874334.77	Non-Participating	0:00	0	0:00	0:00
423	497237.89	4874334.67	Non-Participating	0:00	0	0:00	0:00
424	497219.31	4874334.59	Non-Participating	0:00	0	0:00	0:00
425	497200.95	4874334.85	Non-Participating	0:00	0	0:00	0:00
426	497278.72	4874353.53	Non-Participating	0:00	0	0:00	0:00
427	497257.81	4874352.60	Non-Participating	0:00	0	0:00	0:00
428	497236.58	4874352.64	Non-Participating	0:00	0	0:00	0:00
429	497221.47	4874352.52	Non-Participating	0:00	0	0:00	0:00
430	497200.99	4874369.50	Non-Participating	0:00	0	0:00	0:00
431	497219.57	4874369.71	Non-Participating	0:00	0	0:00	0:00
432	497237.79	4874369.57	Non-Participating	0:00	0	0:00	0:00
433	497256.20	4874369.63	Non-Participating	0:00	0	0:00	0:00
434	497274.63	4874369.66	Non-Participating	0:00	0	0:00	0:00
435	497293.00	4874369.73	Non-Participating	0:00	0	0:00	0:00
436	500886.20	4876660.66	Non-Participating	0:00	0	0:00	0:00
437	499668.60	4875349.36	Non-Participating	0:00	0	0:00	0:00
438	500770.03	4876675.90	Non-Participating	0:00	0	0:00	0:00

Table B-1: Shadow Flicker Modeling Results

Receptor ID	Coordinates NAD83 UTM Zone 15N (meters)		Participation Status	Worst-Case Shadow Flicker - Annual	Worst-Case Shadow Flicker Days - Annual	Worst-Case Shadow Flicker Hours - Daily	Expected Shadow Flicker Hours - Annual
	X (Easting)	Y (Northing)		(HH:MM/year)	(Days/year)	(HH:MM/day)	(HH:MM/year)
439	506995.22	4872765.17	Non-Participating	3:27	30	0:11	0:50
440	499639.21	4874370.00	Non-Participating	66:36	103	0:52	18:37
441	490945.40	4879140.93	Non-Participating	0:00	0	0:00	0:00
442	495598.94	4875650.06	Participating	2:12	19	0:10	0:40
443	492906.37	4875984.85	Participating	40:30	147	0:30	13:32
444	509479.19	4869914.41	Non-Participating	0:00	0	0:00	0:00
445	501290.11	4862407.81	Non-Participating	0:00	0	0:00	0:00
446	488509.35	4879213.50	Non-Participating	0:00	0	0:00	0:00
447	506635.17	4867819.96	Non-Participating	0:00	0	0:00	0:00
448	506437.32	4875179.84	Non-Participating	0:00	0	0:00	0:00
449	500652.58	4876684.25	Non-Participating	0:00	0	0:00	0:00
450	499654.24	4863571.20	Non-Participating	0:00	0	0:00	0:00
451	507535.22	4871149.63	Non-Participating	34:16	81	0:39	9:09
452	500451.92	4876714.42	Non-Participating	0:00	0	0:00	0:00
453	508143.08	4871003.16	Non-Participating	51:41	149	0:36	14:13
454	500843.70	4876652.47	Non-Participating	0:00	0	0:00	0:00
455	508917.86	4873581.47	Non-Participating	0:00	0	0:00	0:00
456	501209.40	4869298.05	Participating	37:43	95	0:39	13:02
457	502417.67	4875910.23	Non-Participating	0:00	0	0:00	0:00
458	497283.92	4872250.10	Non-Participating	26:05	103	0:30	9:14
459	500981.00	4876708.76	Non-Participating	0:00	0	0:00	0:00
460	496395.27	4863671.46	Non-Participating	0:00	0	0:00	0:00
461	494020.79	4868808.31	Non-Participating	0:00	0	0:00	0:00
462	490427.86	4873183.64	Non-Participating	0:00	0	0:00	0:00
463	490497.29	4879284.50	Non-Participating	0:00	0	0:00	0:00
464	491468.31	4871037.31	Non-Participating	0:00	0	0:00	0:00
465	490452.59	4873194.31	Non-Participating	0:00	0	0:00	0:00
466	495562.49	4870203.57	Participating	26:32	86	0:31	9:38
467	491620.99	4872745.10	Non-Participating	0:00	0	0:00	0:00
468	500723.37	4876670.77	Non-Participating	0:00	0	0:00	0:00
469	507857.09	4872987.73	Participating	0:00	0	0:00	0:00
470	498631.77	4875978.22	Non-Participating	0:00	0	0:00	0:00
471	499698.91	4871923.64	Participating	57:58	176	0:38	17:54
472	504468.79	4869548.16	Participating	124:07	268	1:14	38:39
473	502756.22	4863425.02	Non-Participating	0:00	0	0:00	0:00
474	490837.88	4875989.18	Non-Participating	27:24	137	0:22	9:45
475	492326.49	4874457.09	Participating	10:55	45	0:22	4:06
476	490247.04	4876072.83	Non-Participating	5:52	44	0:13	2:04
477	496021.63	4868651.59	Participating	45:24	114	0:43	16:49
478	489719.66	4878734.68	Non-Participating	0:00	0	0:00	0:00
479	491912.40	4874442.94	Participating	9:08	64	0:13	3:21
480	492335.56	4877666.68	Non-Participating	0:00	0	0:00	0:00
481	494755.62	4867301.87	Non-Participating	0:00	0	0:00	0:00
482	488311.29	4878360.36	Non-Participating	0:00	0	0:00	0:00
483	502759.90	4866445.66	Non-Participating	0:00	0	0:00	0:00
484	500348.72	4876733.11	Non-Participating	0:00	0	0:00	0:00
485	505318.66	4874468.86	Non-Participating	3:34	26	0:13	0:55
486	501125.52	4866792.07	Non-Participating	0:00	0	0:00	0:00
487	508605.03	4873649.14	Participating	0:00	0	0:00	0:00
488	499202.59	4863171.88	Non-Participating	0:00	0	0:00	0:00
489	495135.78	4868817.65	Non-Participating	5:37	27	0:18	1:55
490	494741.77	4874889.79	Participating	94:27	180	0:58	35:48
491	492757.62	4877748.96	Non-Participating	0:00	0	0:00	0:00
492	490731.38	4870543.18	Non-Participating	0:00	0	0:00	0:00
493	490349.33	4873858.84	Non-Participating	0:00	0	0:00	0:00
494	499637.54	4876318.99	Non-Participating	0:00	0	0:00	0:00
495	496785.28	4877588.42	Non-Participating	0:00	0	0:00	0:00
496	500627.99	4876689.66	Non-Participating	0:00	0	0:00	0:00
497	508252.48	4868033.65	Non-Participating	0:00	0	0:00	0:00
498	509725.01	4867937.72	Non-Participating	0:00	0	0:00	0:00
499	505981.82	4864375.37	Non-Participating	0:00	0	0:00	0:00
500	499436.27	4878799.75	Non-Participating	0:00	0	0:00	0:00
501	506077.00	4874303.87	Non-Participating	0:00	0	0:00	0:00
502	496744.15	4869518.04	Non-Participating	47:01	155	0:32	16:42
503	490319.60	4876916.87	Non-Participating	5:27	38	0:15	1:48
504	489803.92	4873069.39	Non-Participating	0:00	0	0:00	0:00
505	492302.79	4874377.83	Participating	12:29	54	0:21	4:45
506	495306.29	4865922.44	Non-Participating	12:45	76	0:20	4:24
507	505185.78	4874513.54	Non-Participating	8:27	54	0:16	2:15
508	499597.88	4876172.38	Non-Participating	0:00	0	0:00	0:00
509	501365.76	4862090.52	Non-Participating	0:00	0	0:00	0:00
510	504360.97	4869658.55	Participating	155:07	271	1:08	45:35
511	497691.90	4869423.21	Non-Participating	43:21	127	0:36	14:32

Table B-1: Shadow Flicker Modeling Results

Receptor ID	Coordinates NAD83 UTM Zone 15N (meters)		Participation Status	Worst-Case Shadow Flicker - Annual	Worst-Case Shadow Flicker Days - Annual	Worst-Case Shadow Flicker Hours - Daily	Expected Shadow Flicker Hours - Annual
	X (Easting)	Y (Northing)		(HH:MM/year)	(Days/year)	(HH:MM/day)	(HH:MM/year)
512	497142.14	4873103.16	Participating	96:05	141	1:13	36:19
513	496060.29	4874587.30	Participating	11:54	63	0:24	3:51
514	495126.58	4870677.51	Non-Participating	14:13	89	0:19	5:10
515	492250.67	4877501.38	Participating	0:00	0	0:00	0:00
516	490521.74	4868389.31	Non-Participating	0:00	0	0:00	0:00
517	492281.45	4872422.94	Participating	0:00	0	0:00	0:00
518	500409.09	4876727.57	Non-Participating	0:00	0	0:00	0:00
519	503747.13	4874987.28	Participating	0:00	0	0:00	0:00
520	506985.27	4871798.35	Non-Participating	3:24	22	0:14	1:10
521	496705.42	4877845.55	Non-Participating	0:00	0	0:00	0:00
522	500389.56	4876729.01	Non-Participating	0:00	0	0:00	0:00
523	505048.39	4874549.97	Non-Participating	14:17	89	0:18	3:42
524	504946.69	4872040.72	Participating	139:23	181	1:18	40:32
525	489918.96	4870356.26	Non-Participating	0:00	0	0:00	0:00
526	494169.21	4873281.87	Participating	0:00	0	0:00	0:00
527	505573.00	4874186.08	Non-Participating	2:04	18	0:11	0:38
528	499366.96	4863166.72	Non-Participating	0:00	0	0:00	0:00
529	499616.32	4874178.09	Participating	62:07	84	0:57	20:15
530	509643.87	4871308.65	Non-Participating	0:00	0	0:00	0:00
531	499067.37	4872230.94	Participating	22:58	81	0:31	8:48
532	489306.45	4874282.73	Participating	0:00	0	0:00	0:00
533	496489.80	4869537.38	Participating	30:00	132	0:24	9:51
534	505164.50	4872318.94	Participating	20:02	99	0:21	5:40
535	494634.19	4870301.00	Non-Participating	2:03	18	0:10	0:41
536	499492.38	4869310.44	Non-Participating	44:13	158	0:34	17:02
537	504630.53	4874072.92	Non-Participating	28:57	95	0:31	8:33
538	504552.69	4874040.29	Non-Participating	35:00	101	0:34	10:23
539	504556.13	4874084.02	Non-Participating	34:44	108	0:33	9:52
540	504547.30	4874140.68	Non-Participating	37:27	126	0:33	10:06
541	502725.31	4874382.87	Participating	61:32	113	0:42	17:09
542	501527.90	4872857.67	Participating	101:24	243	0:44	32:23
543	504972.65	4872837.46	Non-Participating	15:09	83	0:18	5:37
544	504438.06	4874785.50	Non-Participating	14:27	44	0:24	3:18
545	504203.57	4872854.80	Participating	57:35	169	0:39	19:37
546	504139.68	4874436.98	Participating	44:41	91	0:45	10:47
547	504646.40	4874483.32	Non-Participating	20:56	92	0:23	5:18
548	503999.63	4872857.70	Participating	79:40	181	0:50	23:10
549	504935.78	4872740.79	Non-Participating	14:35	67	0:19	3:57
550	491361.28	4865072.21	Non-Participating	0:00	0	0:00	0:00
551	491649.13	4864075.81	Non-Participating	0:00	0	0:00	0:00
552	491087.39	4863167.93	Non-Participating	0:00	0	0:00	0:00
553	491823.21	4863310.08	Non-Participating	0:00	0	0:00	0:00
554	492097.62	4863009.42	Non-Participating	0:00	0	0:00	0:00