

SHADOW FLICKER ANALYSIS REPORT

Burke Wind Energy Center Burke County, North Dakota

Prepared for:

Burke Wind, LLC
700 Universe Blvd.
Juno Beach, FL 33408

Prepared by:



Epsilon Associates, Inc.
3 Mill & Main Place, Suite 250
Maynard, MA 01754

November 6, 2018

TABLE OF CONTENTS

1.0	EXECUTIVE SUMMARY	1-1
2.0	INTRODUCTION	2-1
3.0	REGULATIONS	3-1
4.0	SHADOW FLICKER ANALYSIS	4-1
4.1	Modeling Methodology	4-1
4.2	Results	4-6
5.0	EVALUATION	5-1
6.0	CONCLUSIONS	6-1

LIST OF APPENDICES

Appendix A	Burke Wind Energy Center: Wind Turbine Coordinates
Appendix B	Shadow Flicker Modeling Results: Discrete Points

LIST OF FIGURES

Figure 4-1	Shadow Flicker Modeling Locations	4-4
Figure 4-2	Shadow Flicker Modeling Results	4-7

LIST OF TABLES

Table 4-1	Monthly Percent of Possible Sunshine	4-5
Table 4-2	Operational Hours per Wind Direction Sector	4-5

1.0 EXECUTIVE SUMMARY

The Burke Wind Energy Center (the Project) is a proposed wind-powered electric generation facility located in Burke County, North Dakota. The Project is being developed by Burke Wind, LLC (Burke Wind), an indirect, wholly-owned subsidiary of NextEra Energy Resources, LLC (NEER). Epsilon Associates, Inc. (Epsilon) has been retained by Atwell, LLC (Atwell) to conduct a shadow flicker modeling study for this Project. This analysis accounts for changes to the Project site plan as contained in the Project's Amended Application for Certificate of Site Compatibility and is filed to update and replace the prior shadow flicker analysis filed as Docket No. 6 in Case No. PU-18-344.

A shadow flicker analysis was conducted for 81 Burke Wind Energy Center wind turbines, which consists of 76 turbine locations and five (5) alternates. The purpose of this analysis is to predict the expected annual durations of wind turbine shadow flicker at nearby inhabitable residences and community buildings in the project area. Consistent with North Dakota Public Service Commission precedent and industry standard, a design goal of 30 hours per year of expected shadow flicker at inhabited structures and community buildings was established. The duration of shadow flicker was calculated at 68 discrete modeling points, and isolines were generated from a grid encompassing the area surrounding the wind turbines.

The modeling results are conservative in that modeling receptors were treated as "greenhouses" and the surrounding area was assumed to be without vegetation or structures ("bare earth"). The layout results in a maximum expected annual duration of shadow flicker at a modeled receptor of 25 hours, 30 minutes. This receptor is on a non-participating parcel. The maximum expected annual duration of shadow flicker at a modeled receptor on a participating parcel is 22 hours, 11 minutes of shadow flicker. Shadow flicker is modeled to be below 30 hours per year at all receptor locations, and therefore the Project will meet the design goal at all modeling receptors.

2.0 INTRODUCTION

The Project will be located in Burke County, North Dakota and will consist of two models of General Electric (GE) wind turbines. The proposed wind turbines will be a combination of GE 1.7-103 and GE 2.72-116 units. The GE 1.7-103 wind turbines have a hub height of 80 meters (263 feet) and a rotor diameter of 103 meters (338 feet). The GE 2.72-116 wind turbines have a hub height of 90 meters (295 feet) and a rotor diameter of 116 meters (381 feet). The Project will have a total capacity of approximately 200 megawatts.

With respect to wind turbines, 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. While indoors, an 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 The GE 2.72-116² wind turbines for this Project have a maximum rotational speed of 15.7 rpm, which corresponds to a shadow flicker frequency of 0.8 Hertz. The GE 1.7-103³ wind turbines for this Project have a maximum rotational speed of 17.1 rpm, which corresponds to a shadow flicker frequency of 0.9 Hertz. 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 analysis for the Project. The wind turbines were modeled with the WindPRO software package using information provided by Burke Wind. The expected annual duration of shadow flicker was calculated at discrete modeling locations within Burke County and shadow flicker isolines for the area surrounding the Project were generated. The results of this analysis are found within this report.

¹ Epilepsy Foundation, <http://www.epilepsy.com/learn/triggers-seizures/photosensitivity-and-seizures>. Accessed in April 2018.

² General Electric Company, Technical Documentation Wind Turbine Generator Systems 1 & 2 MW Platform, 2017.

³ General Electric Company, Technical Documentation Wind Turbine Generator Systems 1.7-103 – 50 and 60 Hz, 2015.

3.0 REGULATIONS

There are no federal, state, or local shadow flicker limits applicable to this Project. Although there are no shadow flicker regulations with specific limits directly applicable to the Project, this issue has been addressed in other jurisdictions. According to the Danish Wind Industry Association (DWIA), a German court has ruled that 30 hours of actual shadow flicker per year was acceptable at a neighbor's property.⁴ In addition, a 30 hour per year limit has been adopted by multiple jurisdictions in the United States. For example, in Connecticut, Section 16-50j-95, part (c) of the Regulations of Connecticut State Agencies limits the annual duration of shadow flicker to 30 hours at any off-site occupied structure.⁵ In 2015 when Huron County, Michigan revised their wind energy ordinance⁶ they adopted a 30 hours per year limit for shadow flicker. The North Dakota Public Service Commission requires effects from the impact upon light-sensitive land uses to be managed and maintained at an acceptable minimum.⁷ The North Dakota Public Service Commission has recognized the 30 hour per year standard and historically evaluates shadow flicker impacts pursuant to this standard.

Therefore, a design goal for the Project of 30 hours per year at inhabitable structures was established.

⁴ Danish Wind Industry Association, 2003. <http://xn--drmsttre-64ad.dk/wp-content/wind/miller/windpower%20web/en/tour/env/shadow/index.htm> Accessed in July 2017.

⁵ State of Connecticut, 2014. http://www.sots.ct.gov/sots/lib/sots/regulations/recentlyadopted/ecopy_reg_6158.pdf. Accessed in December 2014.

⁶ Huron County Wind Energy Conversion Facility Overlay Zoning Ordinance, Adopted November 10, 2015. <http://www.co.huron.mi.us/documents/ArticleXWindEnergyOverlayZoningOrdinanceNovember2015.pdf> . Accessed in July 2017.

⁷ N.D. Admin. Code § 69-06-08-01(5)(c)(3).

4.0 SHADOW FLICKER ANALYSIS

4.1 Modeling Methodology

Shadow flicker was modeled using a software package, WindPRO version 3.2.117. 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 modeling 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 for this further refinement, also known as the “expected” shadow flicker, are presented in this section.

The proposed wind turbine layout (Layout 181008) for the Project was provided by Burke Wind on October 8, 2018. The 81 total wind turbines (76 primary and five (5) alternates) were input into the model. Locations of the wind turbines are shown in Figure 4-1 and presented in Table A-1 in Appendix A. Seventy-three (73) wind turbines are GE 2.72-116 units, and eight (8) wind turbines are GE 1.7-103 units. The GE 2.72-116 wind turbines have a hub height of 90 meters (295 feet) and a rotor diameter of 116 meters (381 feet). The GE 1.7-103 wind turbines have a hub height of 80 meters (263 feet) and a rotor diameter of 103 meters (338 feet). Each wind turbine has the following characteristics based on the technical data provided by Burke Wind:

		<u>GE 2.72-116</u>	<u>GE 1.7-103</u>
◆ Rated Power	=	2,720 kW	1,700 kW
◆ Hub Height	=	90 meters (295 feet)	80 meters (263 feet)
◆ Rotor Diameter	=	116 meters (381 feet)	103 meters (338 feet)
◆ Cut-in Wind Speed	=	3 m/s (7 mph)	3 m/s (7 mph)
◆ Cut-out Wind Speed ⁸	=	31 m/s (69 mph)	20 m/s (45 mph)
◆ Maximum RPM	=	15.7 rpm	17.1 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

⁸ Based on a 600-second time interval

facilities, shadow flicker impacts are minimal at and beyond a distance of ten rotor diameters.⁹ 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.¹⁰ 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 assessment to include an impact distance of at least one mile from a wind turbine.¹¹ 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.¹² Conservatively, this analysis includes shadow flicker calculations out to 1.25 miles (2,012 m) from each wind turbine in the model for the existing layout.

A modeling receptor dataset was provided by Burke Wind, which included occupancy status for the receptors in the Project area. Buildings not identified as occupied were excluded from the analysis. A shapefile with parcel participation status dated October 11, 2018 was provided by Burke Wind, which allowed for participation status to be assigned to each modeling receptor. The dataset included receptors at a significant distance from wind turbines (greater than three (3) miles from the wind turbines) and these receptors were excluded from the analysis. After these processing steps, there were 68 receptors in total which were included in the analysis. These receptors were modeled as discrete points and are shown on Figure 4-1. Each modeling point was assumed to have a window facing all directions (“greenhouse” mode) which yields conservative results.

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 68 modeling receptors 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.

⁹ Massachusetts Department of Energy Resources, “Model As-of-Right Zoning Ordinance or Bylaw: Allowing Use of Wind Energy Facilities” 2009.

¹⁰ Parsons Brinckerhoff, “Update of UK Shadow Flicker Evidence Base” Prepared for Department of Energy and Climate Change, 2011.

¹¹ 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 August 2016.

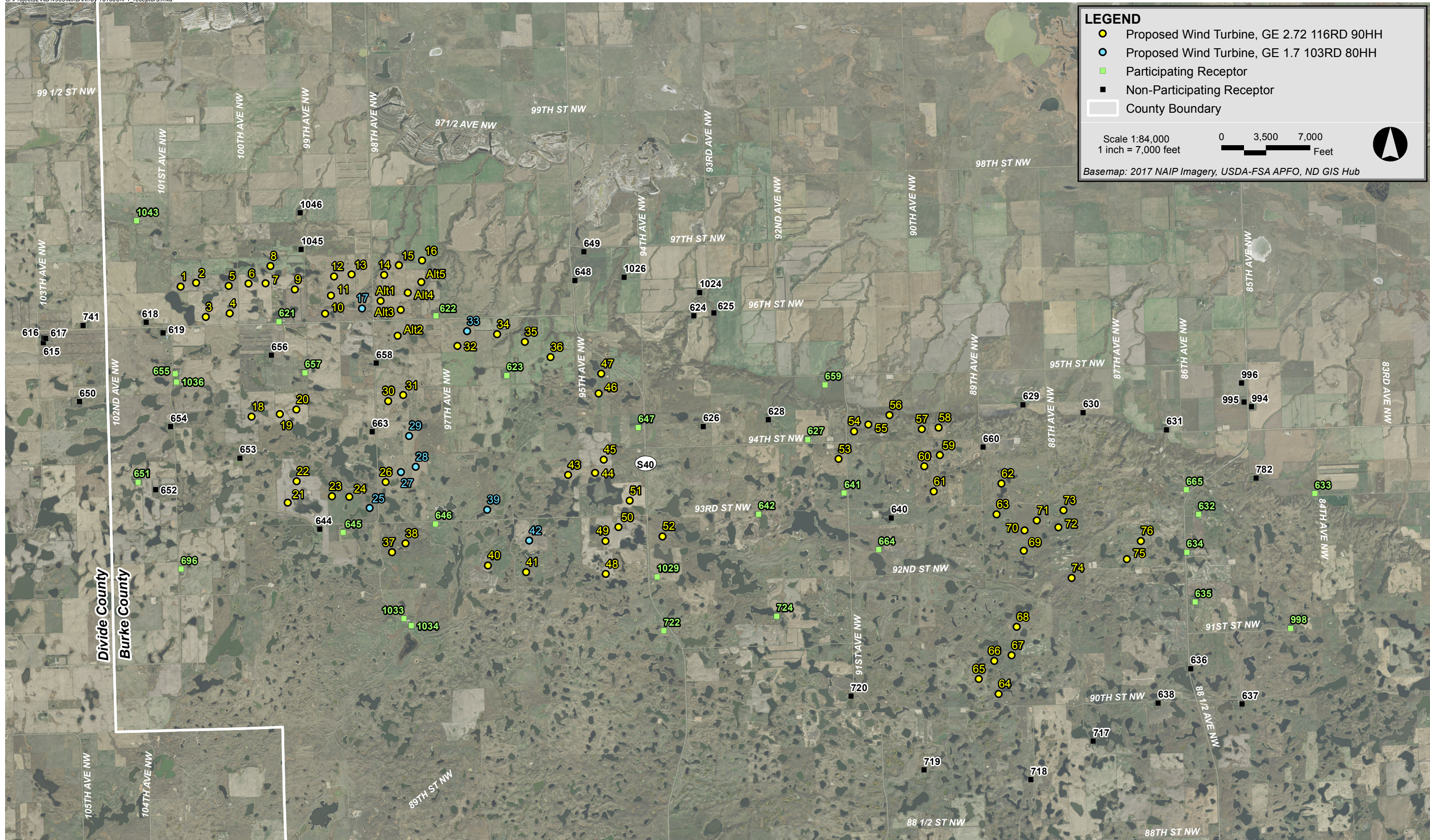
¹² State of Connecticut CSC Wind Regulations (2014), available at <https://www.cga.ct.gov/asp/CGARegulations/CGARegulations.aspx?Yr=2014&Reg=2012-054&Amd=E> Accessed in August 2016.

The terrain height contour elevations for the modeling domain were generated from National Elevation Data, a seamless mosaic of best-available elevation data (ten (10) meters or better) from the U.S. Department of Agriculture, Service Center Agencies. Conservatively, obstacles, *e.g.*, buildings and vegetation, were excluded from the analysis. This is effectively a “bare earth” scenario, which is a conservative assumption. 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 three (3) degrees 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 Williston, North Dakota from the National Oceanic and Atmospheric Administration’s (NOAA) National Centers for Environmental Information (NCEI).¹³ Table 4-1 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. Burke Wind provided Epsilon with an hourly time series for wind speed and wind direction at 90 meters above ground level for the period of 1988 to 2017. Epsilon processed the data into a joint frequency distribution of wind speed and wind direction that allowed for the determination of operational hours per wind direction sector. Operational times were conservatively based upon the cut-in (3 m/s) and cut-out (31 m/s) wind speeds of the GE 2.72-116 turbine. These operating limits were based on the technical data provided by Burke Wind. 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 98% of the year due to cut-in and cut-out specifications of the proposed wind turbines. Table 4-2 shows the distribution of operational hours for the 16 wind directions.

¹³ NCEI (formerly NCDC), <https://www.ncdc.noaa.gov/ghcn/comparative-climatic-data>. Accessed in July 2018.



Burke Wind Energy Center Burke County, North Dakota

Table 4-1 Monthly Percent of Possible Sunshine

Month	Possible Sunshine
January	51%
February	57%
March	61%
April	59%
May	63%
June	68%
July	77%
August	75%
September	67%
October	56%
November	43%
December	47%

Table 4-2 Operational Hours per Wind Direction Sector

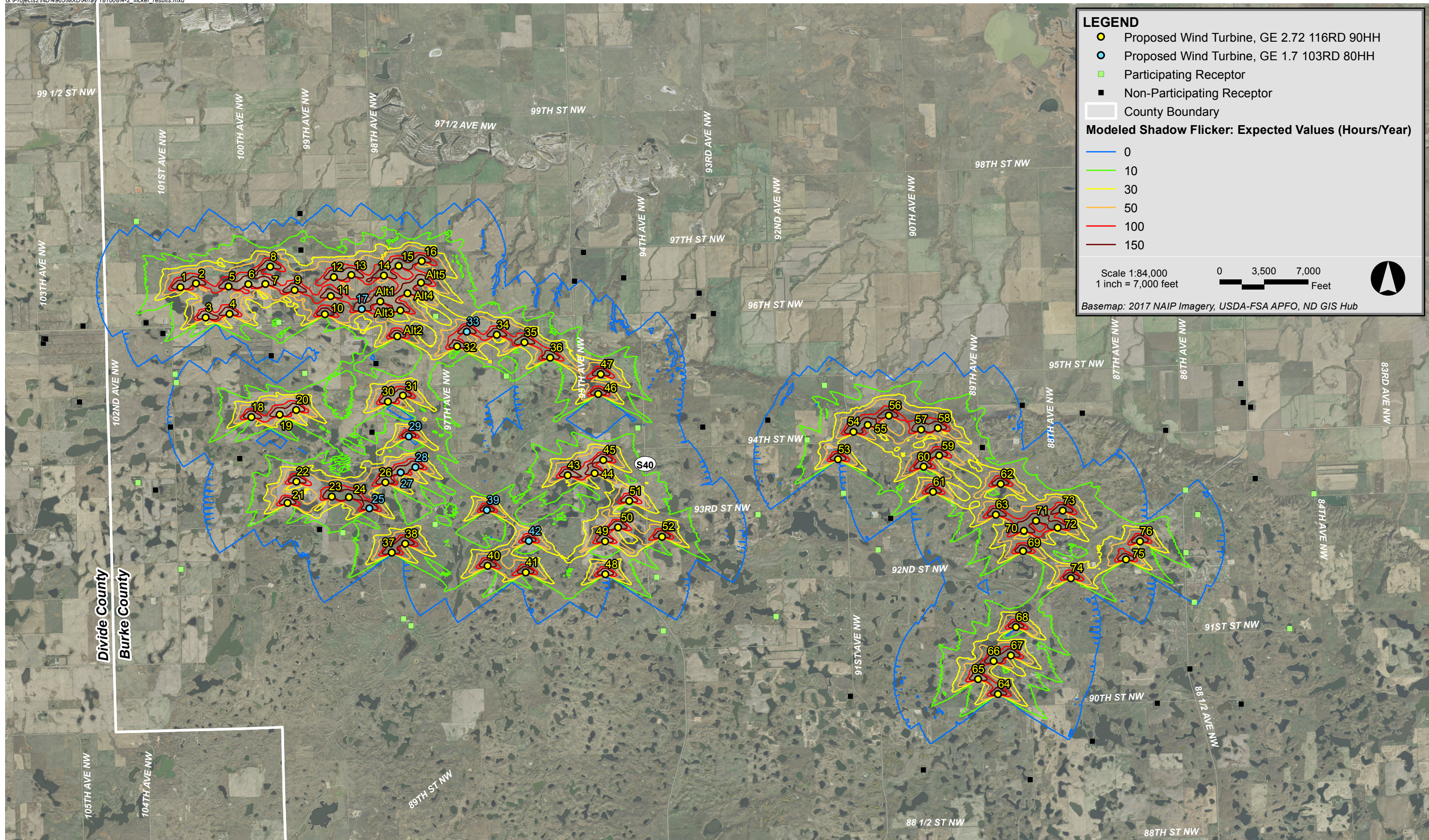
Wind Sector	Operational Hours
N	298
NNE	210
NE	228
ENE	254
E	342
ESE	394
SE	482
SSE	604
S	736
SSW	561
SW	543
WSW	569
W	701
WNW	964
NW	1183
NNW	552
Annual	8,621

4.2 Results

Following the modeling methodology outlined in Section 4.1, WindPRO was used to calculate shadow flicker at the 68 discrete modeling points and to generate shadow flicker isolines based on the grid calculations.

Table B-1 in Appendix B presents the modeling results for the 68 modeling receptor locations. The predicted expected annual shadow flicker duration ranged from 0 hours, 0 minutes per year to 25 hours, 30 minutes per year. The majority of the discrete modeling receptors (41) were predicted to experience no annual shadow flicker. Twenty-one (21) locations were predicted to experience some shadow flicker, but less than ten (10) hours per year. The modeling results showed that six (6) locations would be expected to have ten (10) or more hours of shadow flicker per year. The maximum expected annual duration of shadow flicker at a modeling receptor is 25 hours, 30 minutes (Receptor #1045). This occurs at a non-participating parcel.

Figure 4-2 displays the modeled flicker isolines over aerial imagery in relation to modeled wind turbines and modeled receptors.



Burke Wind Energy Center Burke County, North Dakota

5.0 EVALUATION

The design goal for this Project with respect to shadow flicker is a duration limit of 30 hours per year. The modeling predicts that some homes in Burke County will experience shadow flicker during the year. This analysis is conservative in that modeling locations were treated as “greenhouses”, and obstacles such as barns and vegetation were not included.

The modeled layout results in a maximum expected annual duration of shadow flicker at a modeled receptor of 25 hours, 30 minutes (Receptor #1045). This receptor is on a non-participating parcel.

The maximum expected annual duration of shadow flicker modeled at a participating residence is 22 hours, 11 minutes (Receptor #622). Therefore, shadow flicker at all modeled receptors is expected to meet the design goal for this Project of 30 hours per year.

6.0 CONCLUSIONS

A shadow flicker analysis was conducted to determine the location of shadow flicker and evaluate the duration of shadow flicker in the vicinity of the proposed Burke Wind Energy Center within Burke County, North Dakota. Consistent with regulatory precedent and industry standard, a design goal of 30 hours per year of expected shadow flicker was established. A total of 81 wind turbines are being proposed for this Project. Shadow flicker resulting from the operation of 81 (76 proposed + five (5) alternates) wind turbines was calculated at 68 discrete modeling points, and isolines were generated from a grid encompassing the area surrounding the wind turbines using the existing layout.

The maximum expected annual duration of shadow flicker at a modeling receptor is 25 hours, 30 minutes. This receptor is on a non-participating parcel. The maximum expected annual duration of shadow flicker at a modeling receptor on a participating parcel is 22 hours, 11 minutes. This analysis is conservative in that modeling locations were treated as “greenhouses” and obstacles such as structures and vegetation were not included. All of the participating and non-participating modeling receptors are predicted to be below 30 hours per year of shadow flicker, meeting the shadow flicker design goal.

Appendix A

Burke Wind Energy Center: Wind Turbine Coordinates

Table A-1: Burke WEC Wind Turbine Coordinates

Wind Turbine ID	Coordinates NAD83 UTM Zone 13N (meters)	
	X (Easting)	Y (Northing)
1	653076	5409096
2	653445	5409186
3	653677	5408372
4	654250	5408458
5	654229	5409112
6	654702	5409168
7	655111	5409174
8	655225	5409591
9	655808	5409030
10	656535	5408449
11	656677	5408886
12	656750	5409339
13	657169	5409388
14	657950	5409377
15	658302	5409607
16	658857	5409723
17	657418	5408575
18	654775	5405980
19	655452	5406040
20	655845	5406150
21	655640	5403918
22	655853	5404435
23	656703	5404072
24	657113	5404060
25	657603	5403794
26	657986	5404416
27	658352	5404653
28	658705	5404782
29	658548	5405521
30	658050	5406356
31	658405	5406496
32	659706	5407674
33	659935	5408031
34	660659	5407956
35	661320	5407771
36	661937	5407408
37	658137	5402730
38	658464	5402947
39	660419	5403748
40	660438	5402413
41	661351	5402258
42	661424	5403015
43	662359	5404584
44	663003	5404633
45	663209	5404952
46	663090	5406539
47	663150	5407010
48	663261	5402212
49	663255	5403003
50	663565	5403335

Table A-1: Burke WEC Wind Turbine Coordinates

Wind Turbine ID	Coordinates NAD83 UTM Zone 13N (meters)	
	X (Easting)	Y (Northing)
51	663832	5403968
52	664619	5403113
53	668836	5404970
54	669209	5405630
55	669553	5405789
56	670057	5406015
57	670834	5405685
58	671233	5405717
59	671263	5405061
60	670891	5404793
61	671119	5404187
62	672737	5404380
63	672625	5403642
64	672675	5399335
65	672196	5399698
66	672570	5400128
67	672984	5400261
68	673104	5400943
69	673278	5402768
70	673296	5403254
71	673588	5403493
72	674105	5403330
73	674227	5403738
74	674424	5402115
75	675742	5402569
76	676078	5403003
Alt1	657866	5408754
Alt2	658275	5407920
Alt3	658344	5408543
Alt4	658517	5408951
Alt5	658842	5409203

Appendix B

Shadow Flicker Modeling Results: Discrete Points

Table B-1: Shadow Flicker Modeling Results at Discrete Points - Sorted by Modeling ID

Modeling Receptor ID	Participation Status	Occupancy Status	Coordinates UTM NAD83 Zone 13N (meters)		Expected Annual Shadow Flicker (HH:MM/year)	Nearest Wind Turbine ID	Distance to Nearest Wind Turbine (ft) ¹
			X (m)	Y (m)			
615	Non-Participating	Occupied	649780.85	5407764.22	0:00	1	11,662
616	Non-Participating	Occupied	649791.01	5407868.94	0:00	1	11,506
617	Non-Participating	Occupied	649837.24	5407854.78	0:00	1	11,381
618	Non-Participating	Occupied	652245.42	5408242.53	1:22	1	3,908
619	Non-Participating	Occupied	652646.18	5407989.44	5:06	3	3,608
621	Participating	Occupied	655426.25	5408259.57	10:22	9	2,821
622	Participating	Occupied	659187.73	5408403.94	22:11	33	2,740
623	Participating	Occupied	660884.27	5406971.54	8:01	35	2,987
624	Non-Participating	Occupied	665365.43	5408398.98	0:00	47	8,578
625	Non-Participating	Occupied	665843.99	5408467.99	0:00	47	10,049
626	Non-Participating	Occupied	665587.06	5405751.51	0:00	51	8,210
627	Participating	Occupied	668093.50	5405440.40	11:02	53	2,885
628	Non-Participating	Occupied	667148.52	5405905.31	0:46	53	6,331
629	Non-Participating	Occupied	673254.17	5406273.56	0:00	62	6,441
630	Non-Participating	Occupied	674690.41	5406084.87	0:00	73	7,849
631	Non-Participating	Occupied	676687.09	5405668.35	0:00	76	8,970
632	Participating	Occupied	677455.70	5403643.77	1:33	76	4,985
633	Participating	Occupied	680245.82	5404143.92	0:00	76	14,178
634	Participating	Occupied	677174.93	5402737.34	6:36	76	3,703
635	Participating	Occupied	677378.00	5401541.41	0:19	75	6,339
636	Non-Participating	Occupied	677267.75	5399947.40	0:00	75	9,952
637	Non-Participating	Occupied	678499.34	5399096.96	0:00	75	14,547
638	Non-Participating	Occupied	676486.21	5399121.19	0:00	75	11,573
640	Non-Participating	Occupied	670095.82	5403560.26	8:10	61	3,937
641	Participating	Occupied	668968.77	5404152.97	0:00	53	2,716
642	Participating	Occupied	666917.33	5403645.19	0:00	53	7,652
644	Non-Participating	Occupied	656402.93	5403286.54	3:44	23	2,759
645	Participating	Occupied	656962.02	5403208.10	9:33	24	2,839
646	Participating	Occupied	659173.59	5403417.13	11:14	38	2,793
647	Participating	Occupied	664035.99	5405726.25	6:37	45	3,717
648	Non-Participating	Occupied	662515.11	5409250.17	0:00	35	6,240
649	Non-Participating	Occupied	662728.64	5409933.36	0:00	35	8,468
650	Non-Participating	Occupied	650646.33	5406344.70	0:00	3	11,964
651	Participating	Occupied	652048.10	5404417.58	0:00	18	10,312
652	Non-Participating	Occupied	652467.71	5404233.35	0:00	18	9,495
653	Non-Participating	Occupied	654489.31	5404994.78	2:07	18	3,366
654	Non-Participating	Occupied	652827.61	5405744.86	0:30	18	6,436
655	Participating	Occupied	652936.65	5407019.68	0:00	3	5,059
656	Non-Participating	Occupied	655241.51	5407453.65	1:47	4	4,631
657	Participating	Occupied	656050.57	5407034.59	1:22	20	2,980
658	Non-Participating	Occupied	657755.93	5407268.31	3:02	Alt2	2,734
659	Participating	Occupied	668510.84	5406750.16	7:13	54	4,331
660	Non-Participating	Occupied	672293.76	5405253.88	17:13	62	3,215
663	Non-Participating	Occupied	657658.51	5405621.08	8:12	30	2,731
664	Participating	Occupied	669795.86	5402799.28	0:00	61	6,291
665	Participating	Occupied	677165.91	5404232.01	0:16	76	5,385
696	Participating	Occupied	653077.60	5402327.99	0:00	21	9,895
717	Non-Participating	Occupied	674935.99	5398206.76	0:00	64	8,292
718	Non-Participating	Occupied	673442.47	5397291.89	0:00	64	7,162
719	Non-Participating	Occupied	670879.97	5397517.72	0:00	65	8,356
720	Non-Participating	Occupied	669131.86	5399287.37	0:00	65	10,143
722	Participating	Occupied	664642.14	5400851.93	0:00	48	6,360
724	Participating	Occupied	667348.81	5401202.73	0:00	52	10,932
741	Non-Participating	Occupied	650732.26	5408171.48	0:00	1	8,267
782	Non-Participating	Occupied	678832.34	5404513.40	0:00	76	10,306
994	Non-Participating	Occupied	678728.52	5406216.47	0:00	76	13,667
995	Non-Participating	Occupied	678551.63	5406336.20	0:00	76	13,619
996	Non-Participating	Occupied	678486.54	5406784.24	0:00	76	14,709
998	Participating	Occupied	679663.45	5400914.56	0:00	76	13,614
1024	Non-Participating	Occupied	665502.49	5408964.57	0:00	47	10,034
1026	Non-Participating	Occupied	663691.88	5409327.88	0:00	47	7,810
1029	Participating	Occupied	664482.88	5402146.18	2:38	52	3,204
1033	Participating	Occupied	658419.99	5401142.26	0:00	37	5,292
1034	Participating	Occupied	658597.00	5400979.64	0:00	37	5,938
1036	Participating	Occupied	652972.03	5406813.33	0:31	3	5,613
1043	Participating	Occupied	652014.34	5410678.80	0:00	1	6,254
1045	Non-Participating	Occupied	655959.74	5409989.76	25:30	8	2,743

Table B-1: Shadow Flicker Modeling Results at Discrete Points - Sorted by Modeling ID

Modeling Receptor ID	Participation Status	Occupancy Status	Coordinates UTM NAD83 Zone 13N (meters)		Expected Annual Shadow Flicker	Nearest Wind Turbine ID	Distance to Nearest Wind Turbine (ft) ¹
			X (m)	Y (m)	(HH:MM/year)		
1046	Non-Participating	Occupied	655929.94	5410862.54	0:00	8	4,771

1) The distances presented are calculated from the receptor (assumed building center point) to the closest wind turbine and are not intended for the evaluation of setback requirements