SHADOW FLICKER ANALYSIS REPORT

Burke Wind Energy Center
Burke County, North Dakota

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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.

A shadow flicker analysis was conducted for 120 Burke Wind Energy Center wind turbines, which consists of 114 turbine locations and six (6) 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 89 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 21 hours, 55 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 300 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 2.72-116[2] 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 1.7-103[3] 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.

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[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 ordinance[6] 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.

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4 Danish Wind Industry Association, 2003. http://xn--drmstrre-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 180820) for the Project was provided by Burke Wind on August 20, 2018. The 120 total wind turbines (114 primary and six (6) 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. One-hundred and eight (108) wind turbines are GE 2.72-116 units, and twelve (12) 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:

		GE 2.72-116	GE 1.7-103
♦ 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 July 18, 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 89 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 89 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.

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[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/aspx/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.

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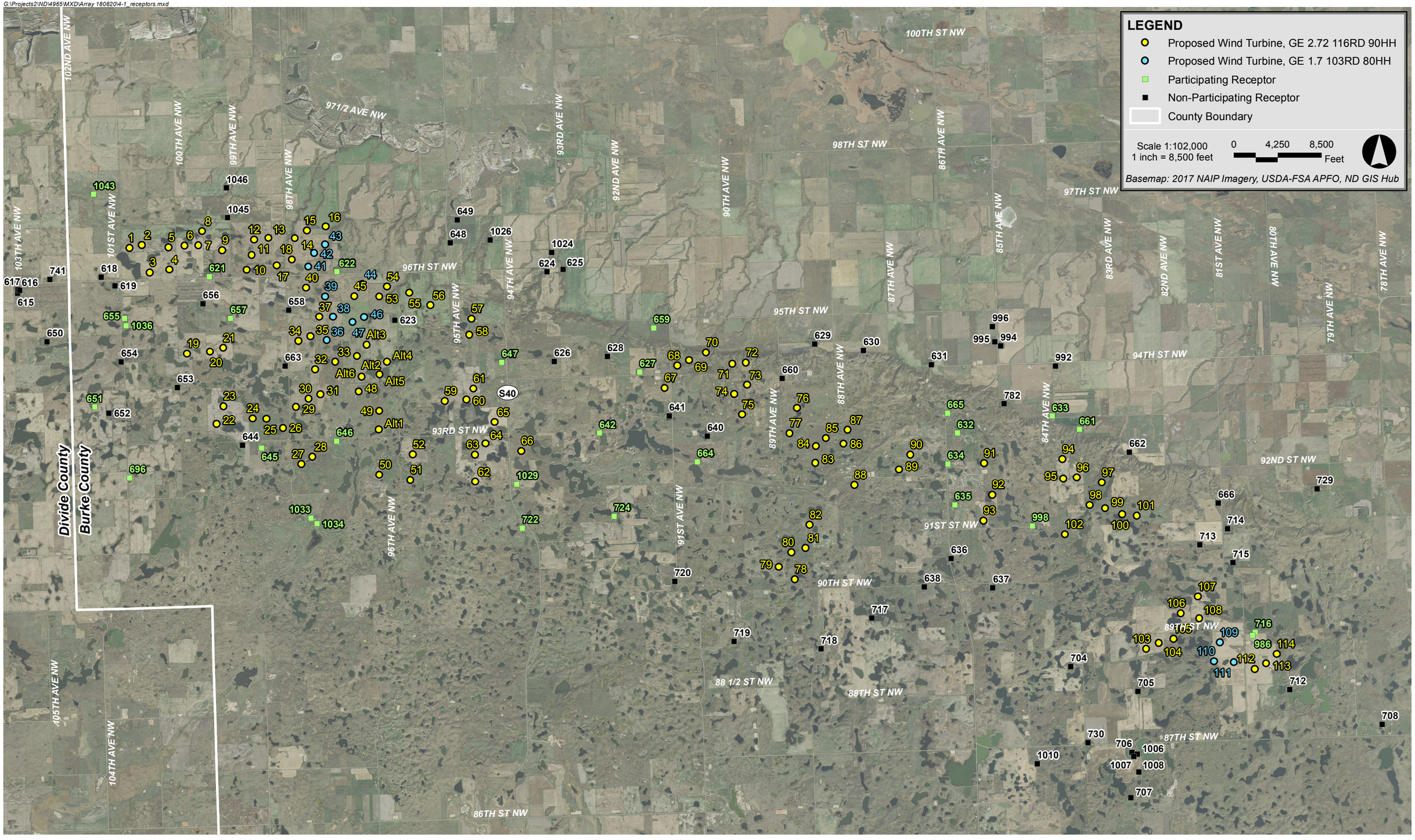

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Figure 4-1
Wind Turbine and Modeling Receptor Locations

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 89 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 89 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 (56) 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 twelve (12) 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.

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LEGEND

- Proposed Wind Turbine, GE 2.72 116RD 90HH
- Proposed Wind Turbine, GE 1.7 103RD 80HH
- Participating Receptor
- Non-Participating Receptor
- County Boundary

Modeled Shadow Flicker: Expected Values (Hours/Year)

- 0
- 10
- 30
- 50
- 100
- 150

Scale 1:102,000
1 inch = 8,500 feet

0 4,250 8,500 Feet

Basemap: 2017 NAIP Imagery, USDA-FSA APFO, ND GIS Hub

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Figure 4-2
Shadow Flicker Modeling Results

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 21 hours, 55 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. In the absence of a regulatory limit, a design goal of 30 hours per year of expected shadow flicker was established. A total of 114 wind turbines are being proposed for this Project. Shadow flicker resulting from the operation of 120 (114 proposed + six (6) alternates) wind turbines was calculated at 89 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 21 hours, 55 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	657866	5408754
19	654775	5405980
20	655452	5406040
21	655845	5406150
22	655640	5403918
23	655853	5404435
24	656703	5404072
25	657113	5404060
26	657603	5403794
27	658137	5402730
28	658464	5402947
29	657986	5404416
30	658352	5404653
31	658705	5404782
32	658548	5405521
33	659146	5405746
34	658050	5406356
35	658405	5406496
36	658893	5406380
37	658664	5407064
38	659070	5407064
39	658840	5407666
40	658275	5407920
41	658344	5408543
42	658517	5408951
43	658842	5409203
44	659935	5408031
45	659706	5407674
46	659990	5407060
47	659652	5406912
48	659831	5404860
49	660438	5404297
50	660438	5402413

Table A-1: Burke WEC Wind Turbine Coordinates

Wind Turbine ID	Coordinates NAD83 UTM Zone 13N (meters)	
	X (Easting)	Y (Northing)
51	661351	5402258
52	661424	5403015
53	660440	5407659
54	660659	5407956
55	661320	5407771
56	661937	5407408
57	663150	5407010
58	663090	5406539
59	662359	5404584
60	663003	5404633
61	663209	5404952
62	663261	5402212
63	663255	5403003
64	663565	5403335
65	663832	5403968
66	664619	5403113
67	668836	5404970
68	669209	5405630
69	669553	5405789
70	670057	5406015
71	670834	5405685
72	671233	5405717
73	671263	5405061
74	670891	5404793
75	671119	5404187
76	672737	5404380
77	672520	5403639
78	672675	5399335
79	672196	5399698
80	672570	5400128
81	672984	5400261
82	673104	5400943
83	673278	5402768
84	673296	5403254
85	673588	5403493
86	674105	5403330
87	674227	5403738
88	674424	5402115
89	675742	5402569
90	676078	5403003
91	678245	5402753
92	678490	5401825
93	678224	5401066
94	680554	5402877
95	680578	5402298
96	680971	5402330
97	681718	5402184
98	681354	5401521
99	681812	5401425
100	682310	5401257

Table A-1: Burke WEC Wind Turbine Coordinates

Wind Turbine ID	Coordinates NAD83 UTM Zone 13N (meters)	
	X (Easting)	Y (Northing)
101	682740	5401213
102	680625	5400660
103	683021	5397288
104	683389	5397462
105	683826	5397581
106	684041	5398339
107	684539	5398827
108	684580	5398187
109	685192	5397478
110	685016	5396921
111	685602	5396893
112	686216	5396697
113	686553	5396860
114	686860	5397139
Alt1	660419	5403748
Alt2	659785	5405906
Alt3	660062	5406246
Alt4	660665	5405747
Alt5	660443	5405370
Alt6	659917	5405309

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	Nearest Wind Turbine ID	Distance to Nearest Wind Turbine (ft)[1]
			X (m)	Y (m)	(HH:MM/year)		
615	Non-Participating	Occupied	649780.85	5407764.22	0:00	1	11,660
616	Non-Participating	Occupied	649791.01	5407868.94	0:00	1	11,505
617	Non-Participating	Occupied	649837.24	5407854.78	0:00	1	11,379
618	Non-Participating	Occupied	652245.42	5408242.53	1:22	1	3,907
619	Non-Participating	Occupied	652646.18	5407989.44	5:06	3	3,607
621	Participating	Occupied	655426.25	5408259.57	10:22	9	2,821
622	Participating	Occupied	659187.73	5408403.94	21:55	39	2,675
623	Non-Participating	Occupied	660884.27	5406971.54	20:43	53	2,685
624	Non-Participating	Occupied	665365.43	5408398.98	0:00	57	8,577
625	Non-Participating	Occupied	665843.99	5408467.99	0:00	57	10,048
626	Non-Participating	Occupied	665587.06	5405751.51	0:00	65	8,209
627	Participating	Occupied	668093.50	5405440.40	11:02	67	2,885
628	Non-Participating	Occupied	667148.52	5405905.31	0:46	67	6,331
629	Non-Participating	Occupied	673254.17	5406273.56	0:00	76	6,441
630	Non-Participating	Occupied	674690.41	5406084.87	0:00	87	7,848
631	Non-Participating	Occupied	676687.09	5405668.35	0:00	90	8,970
632	Participating	Occupied	677455.70	5403643.77	1:33	91	3,905
633	Participating	Occupied	680245.82	5404143.92	0:00	94	4,277
634	Participating	Occupied	677174.93	5402737.34	12:00	91	3,511
635	Participating	Occupied	677378.00	5401541.41	8:35	93	3,184
636	Non-Participating	Occupied	677267.75	5399947.40	0:00	93	4,828
637	Non-Participating	Occupied	678499.34	5399096.96	0:00	93	6,523
638	Non-Participating	Occupied	676486.21	5399121.19	0:00	93	8,557
640	Non-Participating	Occupied	670095.82	5403560.26	8:10	75	3,937
641	Non-Participating	Occupied	668968.77	5404152.97	0:00	67	2,716
642	Participating	Occupied	666917.33	5403645.19	0:00	67	7,651
644	Non-Participating	Occupied	656402.93	5403286.54	4:53	24	2,759
645	Participating	Occupied	656962.02	5403208.10	9:33	25	2,838
646	Participating	Occupied	659173.59	5403417.13	14:17	28	2,793
647	Participating	Occupied	664035.99	5405726.25	6:37	61	3,717
648	Non-Participating	Occupied	662515.11	5409250.17	0:00	55	6,239
649	Non-Participating	Occupied	662728.64	5409933.36	0:00	55	8,467
650	Non-Participating	Occupied	650646.33	5406344.70	0:00	3	11,963
651	Participating	Occupied	652048.10	5404417.58	0:00	19	10,311
652	Non-Participating	Occupied	652467.71	5404233.35	0:00	19	9,494
653	Non-Participating	Occupied	654489.31	5404994.78	2:07	19	3,365
654	Non-Participating	Occupied	652827.61	5405744.86	0:30	19	6,436
655	Participating	Occupied	652936.65	5407019.68	0:00	3	5,058
656	Non-Participating	Occupied	655241.51	5407453.65	1:47	4	4,630
657	Participating	Occupied	656050.57	5407034.59	1:22	21	2,979
658	Non-Participating	Occupied	657755.93	5407268.31	15:01	40	2,733
659	Participating	Occupied	668510.84	5406750.16	7:13	68	4,330
660	Non-Participating	Occupied	672293.76	5405253.88	17:13	76	3,215
661	Participating	Occupied	681053.16	5403755.15	0:00	94	3,314
662	Non-Participating	Occupied	682516.51	5403083.07	8:23	97	3,946
663	Non-Participating	Occupied	657658.51	5405621.08	15:35	34	2,731
664	Participating	Occupied	669795.86	5402799.28	0:00	75	6,291
665	Participating	Occupied	677165.91	5404232.01	0:16	90	5,385
666	Non-Participating	Occupied	685138.47	5401581.77	0:00	101	7,961
696	Participating	Occupied	653077.60	5402327.99	0:00	22	9,894
704	Non-Participating	Occupied	680793.48	5396773.14	0:00	103	7,501
705	Non-Participating	Occupied	682771.09	5396046.27	0:00	103	4,156
706	Non-Participating	Occupied	682594.75	5394254.02	0:00	103	10,052
707	Non-Participating	Occupied	682564.74	5392909.18	0:00	103	14,444
708	Non-Participating	Occupied	689966.25	5395070.79	0:00	114	12,243
712	Non-Participating	Occupied	687239.87	5396102.41	6:31	113	3,355
713	Non-Participating	Occupied	684595.36	5400358.29	0:00	107	5,027
714	Non-Participating	Occupied	685412.41	5400834.40	0:00	107	7,182
715	Non-Participating	Occupied	685564.97	5399826.29	3:26	107	4,699
716	Participating	Occupied	686223.15	5397780.96	12:50	114	2,967
717	Non-Participating	Occupied	674935.99	5398206.76	0:00	78	8,292
718	Non-Participating	Occupied	673442.47	5397291.89	0:00	78	7,162
719	Non-Participating	Occupied	670879.97	5397517.72	0:00	79	8,355
720	Non-Participating	Occupied	669131.86	5399287.37	0:00	79	10,143
722	Participating	Occupied	664642.14	5400851.93	0:00	62	6,360
724	Participating	Occupied	667348.81	5401202.73	0:00	66	10,931

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)		
729	Non-Participating	Occupied	688050.69	5402004.88	0:00	107	15,538
730	Non-Participating	Occupied	681298.51	5394533.17	0:00	103	10,659
741	Non-Participating	Occupied	650732.26	5408171.48	0:00	1	8,266
782	Non-Participating	Occupied	678832.34	5404513.40	0:00	91	6,089
986	Participating	Occupied	686148.76	5397685.01	15:45	114	2,942
992	Non-Participating	Occupied	680339.86	5405621.24	0:00	94	9,030
994	Non-Participating	Occupied	678728.52	5406216.47	0:00	91	11,473
995	Non-Participating	Occupied	678551.63	5406336.20	0:00	91	11,799
996	Non-Participating	Occupied	678486.54	5406784.24	0:00	91	13,250
998	Participating	Occupied	679663.45	5400914.56	6:28	102	3,263
1006	Non-Participating	Occupied	682754.32	5394189.38	0:00	103	10,204
1007	Non-Participating	Occupied	682647.39	5394121.11	0:00	103	10,462
1008	Non-Participating	Occupied	682800.17	5393659.22	0:00	103	11,927
1010	Non-Participating	Occupied	679805.52	5393905.09	0:00	103	15,313
1024	Non-Participating	Occupied	665502.49	5408964.57	0:00	57	10,033
1026	Non-Participating	Occupied	663691.88	5409327.88	0:00	57	7,809
1029	Participating	Occupied	664482.88	5402146.18	2:38	66	3,203
1033	Participating	Occupied	658419.99	5401142.26	0:00	27	5,291
1034	Participating	Occupied	658597.00	5400979.64	0:00	27	5,938
1036	Participating	Occupied	652972.03	5406813.33	0:31	3	5,613
1043	Participating	Occupied	652014.34	5410678.80	0:00	1	6,253
1045	Non-Participating	Occupied	655959.74	5409989.76	25:30	8	2,743
1046	Non-Participating	Occupied	655929.94	5410862.54	0:00	8	4,770

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