
To: Casey Willis, ENGIE

From: Leslie Knapp and Ted Guertin, Tetra Tech, Inc.

Date: July 8, 2019

Subject: Triple Wind Energy Project – Updated Shadow Flicker Analysis Memorandum

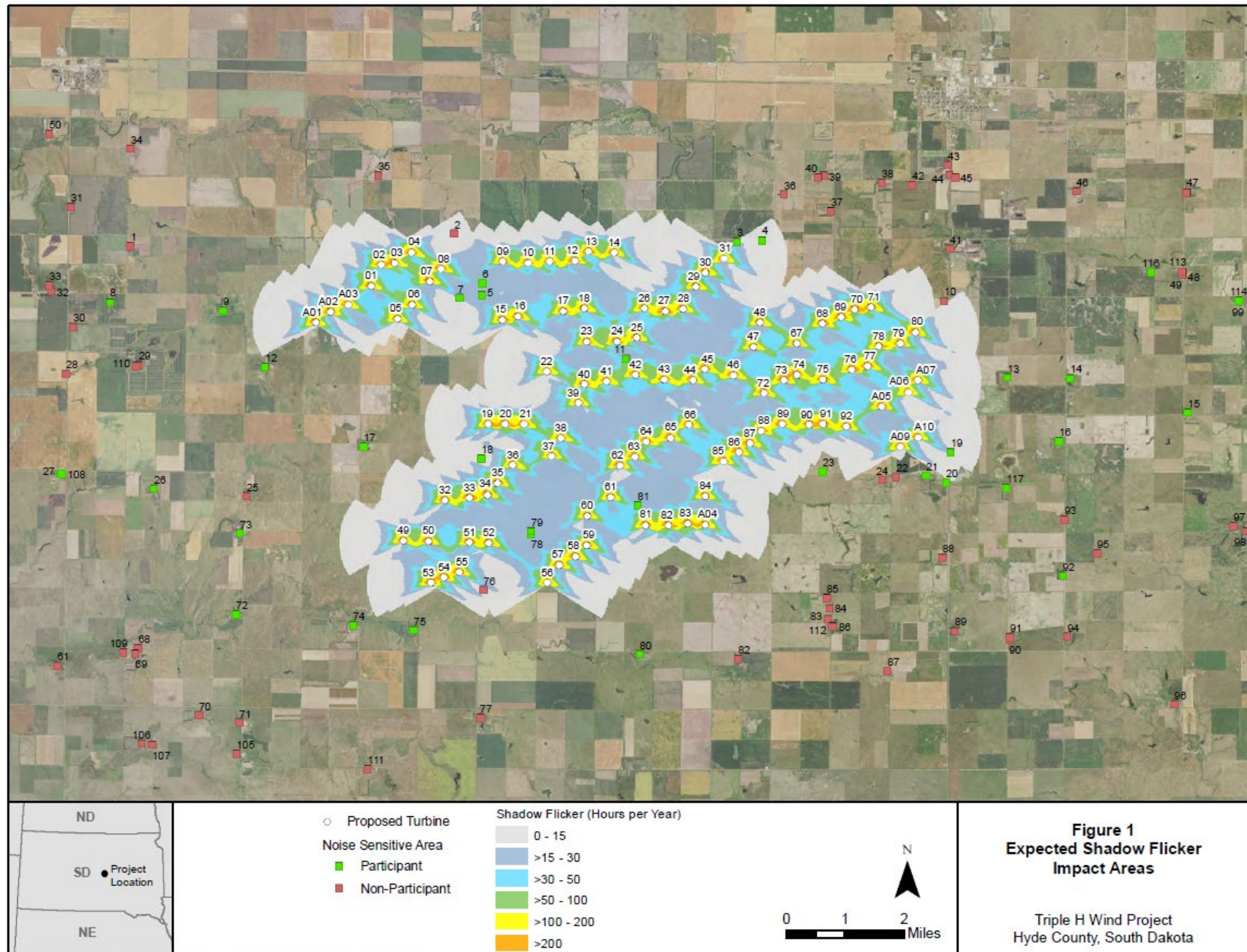
In February 2019 Tetra Tech conducted a shadow flicker impact assessment on behalf of Triple H Wind Project, LLC (Triple H) for the proposed Triple H Wind Energy Project (Project) located in Hyde County, South Dakota. The proposed Project has a maximum nameplate capacity of approximately 250 megawatts (MW). The Project layout includes up to 92 General Electric (GE) 2.72-116 wind turbines, each with 3 blades, a generating capacity of 2.72 MW, a rotor diameter of 116 meters, and a 90-meter-tall hub height.

The shadow flicker assessment was conducted using the WindPro model and according to the methodologies described in the February 2019 shadow flicker assessment report (*Shadow Flicker Impact Analysis for the Triple H Wind Energy Project*). The analysis evaluated 103 potential turbine locations, though the Project would only construct up to 92 turbines. WindPro was used to assess shadow flicker potentially occurring at 117 residences surrounding the Project. The results of the February 2019 assessment indicated that the Project would not result in significant shadow flicker impacts. In July 2019, Tetra Tech received updated wind turbine coordinates and was requested to update the shadow flicker analysis with those coordinates to confirm that shadow flicker would not substantially increase impacts from what was previously determined.

WindPro shadow flicker modeling was completed for the updated turbine layout, which included 101 potential turbine locations. The analysis evaluated all 101 potential turbine locations, though the Project would only construct up to 92 turbines. The results are summarized for the top ten worst case receptors as described in Table 1. Table 1 includes a comparison to the results for the original February 2019 turbine layout. The results show that expected shadow flicker impacts are the same or less than previously reported for the maximum impact receptors and only marginally increased for some other receptors compared to what was previously reported. The maximum predicted shadow flicker impact at any receptor is 24 hours and 57 minutes per year (Receptor 81) for the Project's current turbine layout. This highest predicted shadow flicker impact is approximately 0.6 percent of the potential available daylight hours. Shadow flicker impact hours are less than the Hyde County Zoning Ordinance shadow flicker limit of 30 hours per year at all receptors. Figure 1 shows the 101 potential turbine locations, the 117 receptors (with participation status), and the modeled shadow flicker impact areas. A detailed WindPro shadow flicker analysis summary for each of the modeled receptor locations is provided in Attachment A.

Table 1: WindPro Expected Shadow Flicker Impacts for Receptor

Receptor ID	Expected Shadow Flicker Hours per Year (hh:mm / year)		Participant Status
	Results from July 2019 Analysis	Results from February 2018 Analysis	
81	24:57	24:57	Participant
11	22:22	22:24	Participant
19	18:24	18:24	Participant
7	16:29	21:22	Participant
6	10:27	10:20	Participant
3	9:33	9:34	Participant
78	8:57	8:57	Participant
79	8:28	8:27	Participant
76	7:38	7:39	Non-Participant
5	7:37	11:58	Participant



Attachment A
Detailed Summary of WindPro Shadow Flicker Analysis
Results

Detailed Summary of WindPro Shadow Flicker Analysis Results

Receptor ID	UTM Coordinates		WindPro Expected Shadow Flicker Hours per Year (HH:MM)	
	UTN-E (meters)	UTN-N (meters)	Results from July 2019 Analysis	Results from February 2019 Analysis
1	442,456	4,925,508	0:00	0:00
2	451,309	4,925,851	4:14	4:12
3	459,033	4,925,620	9:33	9:34
4	459,719	4,925,668	2:54	2:53
5	452,062	4,924,182	7:37	11:58
6	452,075	4,924,501	10:27	10:20
7	451,447	4,924,097	16:29	21:22
8	441,895	4,923,973	0:00	0:00
9	444,984	4,923,741	0:00	0:00
10	464,696	4,924,005	0:00	0:00
11	455,990	4,922,426	22:22	22:24
12	446,141	4,922,203	0:00	0:00
13	466,431	4,921,923	0:00	0:00
14	468,148	4,921,891	0:00	0:00
15	471,362	4,920,960	0:00	0:00
16	467,845	4,920,175	0:00	0:00
17	448,828	4,920,034	0:00	0:00
18	452,048	4,919,694	6:01	6:00
19	464,884	4,919,863	18:24	18:24
20	464,748	4,919,035	0:00	0:00
21	464,203	4,919,234	0:00	0:00
22	463,391	4,919,194	0:00	0:00
23	461,381	4,919,347	0:00	0:00
24	463,004	4,919,118	0:00	0:00
25	445,619	4,918,666	0:00	0:00
26	443,100	4,918,874	0:00	0:00
27	440,534	4,919,290	0:00	0:00
28	440,696	4,922,014	0:00	0:00
29	442,687	4,922,261	0:00	0:00
30	440,889	4,923,289	0:00	0:00
31	440,819	4,926,574	0:00	0:00
32	440,290	4,924,271	0:00	0:00
33	440,237	4,924,430	0:00	0:00
34	442,458	4,928,172	0:00	0:00
35	449,221	4,927,448	0:00	0:00
36	460,325	4,926,929	0:00	0:00
37	461,603	4,926,472	0:00	0:00
38	462,994	4,927,231	0:00	0:00
39	461,400	4,927,437	0:00	0:00

Detailed Summary of WindPro Shadow Flicker Analysis Results

Receptor ID	UTM Coordinates		WindPro Expected Shadow Flicker Hours per Year (HH:MM)	
	UTN-E (meters)	UTN-N (meters)	Results from July 2019 Analysis	Results from February 2019 Analysis
40	461,242	4,927,391	0:00	0:00
41	464,857	4,925,441	0:00	0:00
42	463,829	4,927,184	0:00	0:00
43	464,803	4,927,722	0:00	0:00
44	464,851	4,927,459	0:00	0:00
45	465,002	4,927,396	0:00	0:00
46	468,316	4,927,007	0:00	0:00
47	471,332	4,926,983	0:00	0:00
48	471,209	4,924,768	0:00	0:00
49	471,206	4,924,735	0:00	0:00
50	440,238	4,928,577	0:00	0:00
51	438,694	4,928,202	0:00	0:00
52	435,698	4,928,234	0:00	0:00
53	438,710	4,926,367	0:00	0:00
54	437,503	4,925,640	0:00	0:00
55	438,592	4,919,467	0:00	0:00
56	437,526	4,918,519	0:00	0:00
57	437,554	4,918,480	0:00	0:00
58	435,779	4,916,792	0:00	0:00
59	436,640	4,914,868	0:00	0:00
60	435,784	4,915,280	0:00	0:00
61	440,462	4,914,035	0:00	0:00
62	435,967	4,912,462	0:00	0:00
63	435,919	4,912,203	0:00	0:00
64	435,242	4,912,250	0:00	0:00
65	435,423	4,912,001	0:00	0:00
66	435,331	4,912,501	0:00	0:00
67	434,868	4,912,262	0:00	0:00
68	442,662	4,914,507	0:00	0:00
69	442,582	4,914,367	0:00	0:00
70	444,337	4,912,679	0:00	0:00
71	445,435	4,912,474	0:00	0:00
72	445,330	4,915,443	0:00	0:00
73	445,448	4,917,655	0:00	0:00
74	448,546	4,915,132	0:00	0:00
75	450,196	4,915,008	0:00	0:00
76	452,106	4,916,110	7:38	7:39
77	452,006	4,912,597	0:00	0:00
78	453,410	4,917,626	8:57	8:57

Detailed Summary of WindPro Shadow Flicker Analysis Results

Receptor ID	UTM Coordinates		WindPro Expected Shadow Flicker Hours per Year (HH:MM)	
	UTN-E (meters)	UTN-N (meters)	Results from July 2019 Analysis	Results from February 2019 Analysis
79	453,397	4,917,705	8:28	8:27
80	456,381	4,914,352	0:00	0:00
81	456,315	4,918,412	24:57	24:57
82	459,068	4,914,217	0:00	0:00
83	461,526	4,915,309	0:00	0:00
84	461,567	4,915,598	0:00	0:00
85	461,490	4,915,880	0:00	0:00
86	461,668	4,915,110	0:00	0:00
87	463,152	4,913,889	0:00	0:00
88	464,660	4,916,997	0:00	0:00
89	464,996	4,914,979	0:00	0:00
90	466,480	4,914,752	0:00	0:00
91	466,495	4,914,819	0:00	0:00
92	467,931	4,916,490	0:00	0:00
93	467,980	4,918,031	0:00	0:00
94	468,070	4,914,826	0:00	0:00
95	468,886	4,917,101	0:00	0:00
96	470,985	4,912,972	0:00	0:00
97	472,613	4,917,854	0:00	0:00
98	472,969	4,917,714	0:00	0:00
99	472,739	4,924,006	0:00	0:00
100	473,852	4,920,692	0:00	0:00
101	473,795	4,925,678	0:00	0:00
102	475,241	4,920,717	0:00	0:00
103	474,504	4,919,960	0:00	0:00
104	477,592	4,926,817	0:00	0:00
105	445,356	4,911,624	0:00	0:00
106	442,769	4,911,898	0:00	0:00
107	443,050	4,911,873	0:00	0:00
108	440,574	4,919,273	0:00	0:00
109	442,257	4,914,401	0:00	0:00
110	442,602	4,922,219	0:00	0:00
111	448,944	4,911,212	0:00	0:00
112	461,642	4,915,097	0:00	0:00
113	471,201	4,924,811	0:00	0:00
114	472,755	4,924,016	0:00	0:00
115	473,177	4,921,096	0:00	0:00
116	470,358	4,924,798	0:00	0:00
117	466,407	4,918,894	0:00	0:00

