

**Shadow Flicker Study
Deuel Harvest North
Wind Farm
Deuel County, South Dakota**



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Project No: 193705842
March 20, 2019

**SHADOW FLICKER STUDY
DEUEL HARVEST NORTH WIND FARM
DEUEL COUNTY, SOUTH DAKOTA**

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1.0 Introduction

Deuel Harvest Wind Energy LLC (Deuel Harvest Wind), an affiliate of Invenergy LLC, is considering the development and construction of a wind energy project in eastern South Dakota. The proposed project, known as the Deuel Harvest North Wind Farm (the Project), is located in Deuel County, South Dakota, and will consist of up to 112 wind turbine generators (WTG or turbine), with a nameplate capacity of up to 310.1 megawatts (MW). Deuel Harvest Wind retained Stantec Consulting Services Inc. (Stantec) to conduct an analysis of potential shadow flicker on receptors for the area surrounding 119 potential turbine locations. The estimated shadow flicker within approximately 2,000 meters (1.25 miles) of the potential turbine sites was assessed and is summarized herein. Deuel Harvest Wind proposes to construct wind turbines on 112 of the 119 potential sites included in the analysis; the remaining turbine locations will be considered as alternate sites.

2.0 Shadow Flicker and Regulations

2.1 DESCRIPTION OF SHADOW FLICKER

Shadow flicker is a term used to describe the intermittent change in the intensity of light cast on an area resulting from the rotation of an operating wind turbine's blades. The presence and intensity of shadow flicker are dependent on many factors, including but not limited to the position of the sun in relation to the turbine and receptor, distance of receptor from turbine, physical characteristics of the turbine and blades, time of day, season of year and topography of the Project area. Turbine models with a larger rotor diameter (i.e., longer blades) will cast a longer shadow than turbines with a shorter blade length. A technical description of each turbine type analyzed for the Project is provided in Section 3.1 and Table 3.

Shadow flicker only occurs during the day-time, when skies are not overcast or cloudy. Turbines must be operational, as the flicker effect is caused by rotation of the blades as they intercept the sunlight cast on a receptor. When a turbine is not operating, it may cast a stationary shadow, similar to the shadow cast by other objects such as trees or utility poles.

The amount of shadow flicker received in an area is dependent on the alignment of the rotor blades in relation to the sun and receptor. Maximum shadow flicker is received when both the sun and rotor plane are perpendicular to the receptor. This alignment occurs when the wind is blowing directly from a source turbine towards a receptor. At

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times when the wind is blowing from other directions, the shadow cast on the target receptor is diminished and the shadow flicker effect passes more quickly.

Shadow flicker also diminishes as the distance between the source turbine and receptor increases. It is generally accepted that between a distance of approximately 10 times the rotor diameter and 1,500 meters (4,921 feet), the flicker effect is less pronounced due to dissipation and the relative ratio of the turbine blade to the sun disk area. Shadow flicker becomes nearly imperceptible beyond approximately 1,500 meters (4,921 feet), which is less than the 2,000-meter study distance.

2.2 REGULATIONS WITHIN THE PROJECT AREA

Deuel County's Zoning Ordinance (Ordinance) limits shadow flicker from wind turbines (Section 1215). Shadow flicker at permanent residential dwellings may not exceed 30 hours annually.

This shadow study was conducted to better understand the potential shadow that may be present, due to the normal operation of the proposed Project, and to assess compliance with the shadow requirements of the Ordinance. The model input parameters include the turbines operating under a normal schedule and conditions, and inhabited, permanent residences within approximately 1.25 miles of representative turbine locations.

3.0 Shadow Flicker Analysis

The potential amount of shadow flicker on receptors within the Project area was modeled using WindPRO Software by EMD International, an application that considers the attributes and positions of the wind turbines in relation to receptors within the area. The model also considers the sun position as it passes through each day, 365 days per year.

Deuel Harvest Wind will utilize a combination of up to 101 General Electric (GE) 2.82-127 and 11 GE 2.3-116 for the Project with a total nameplate capacity of 310.1 MW. Deuel Harvest Wind is proposing to construct up to 112 of the 119 sites included in this model; therefore, the overall expected shadow from the final 112-turbine Project will be less than the predicted shadow flicker of 119 turbines summarized in this report. Deuel Harvest Wind will ensure that the Project is designed and operated in compliance with applicable setbacks and limits, as required per the Ordinance and applicable state requirements.

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3.1 SHADOW FLICKER ANALYSIS METHODOLOGY

The potential total time of shadow flicker on each receptor was estimated for the Project area using the Shadow Module of WindPRO Version 3.1 software. WindPRO is an industry-accepted modeling program that calculates the number of hours per year that any given receptor will receive shadow flicker from the source turbines.

The results provided by WindPRO include the expected amount of shadow flicker time on each receptor, given the climatological conditions of the area. The shadow flicker calculation considers the percentage of sunshine based on local regional sunshine statistics; the alignment of the blades in relation to the receptor due to wind direction; and the amount of time that the blades would not be rotating due to wind speeds outside of the turbines operating parameters. The results of the analysis provide the number of annual hours that shadow flicker is expected to occur at the defined receptor.

Climatological information was acquired from the National Climatic Data Center (NCDC) regional meteorological stations. The percentage of sunshine probability was estimated from an analysis of average sunshine statistics for the Huron, South Dakota weather station. Wind data was acquired at on-site meteorological towers. The climatologically based expected hours of sunshine for the Project area are presented in Table 1.

Table 1 Sunshine Probability (sun hours/possible sun hours)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.62	0.62	0.62	0.59	0.66	0.69	0.76	0.74	0.69	0.59	0.51	0.51

The total number of hours that turbines may cause shadow flicker is also dependent on time that the turbine is operational (i.e., blades turning). The total number of hours that turbines are able to cause shadow flicker takes into account non-operational time due to low or high wind speeds. The turbine type that Deuel Wind proposes to use will generally operate when winds at hub-height are between 3 meters per second (m/s) and 20 m/s.

The shadow flicker analyses used a 90 percent operational-time, based on available Project-specific wind data, for purposes of calculating the potential expected hours of shadow flicker. The frequency of wind (hours per year) expected in 16 compass directions, at hub height, is provided in Table 2.

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Table 2 Turbine Operational Time per Sector (hours per year)

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
301	197	190	199	234	306	428	510	687	594	428	520	562	750	965	918

The effect of shadow flicker is also dependent on the physical characteristics of the turbine model and the distance between the source turbine and shadow receptor. The analysis was completed assuming 106 - GE 2.82-127 (2.82 MW) and 13 - GE 2.3-116 (2.3 MW) turbines. The maximum Project nameplate generating capacity of the Project is approximately 310.1 MW; therefore, only 112 of the proposed turbines will be constructed.

The proposed GE 2.82-127 turbines have an 88.6-meter (290.7-foot) hub height, with a maximum rotor diameter of 127 meters (416.7 feet). The proposed GE 2.3-116 turbines will have an 80-meter (262.5-foot) hub height and a 116-meter (380.6-foot) rotor diameter. Elevations for turbines and receptors within approximately 2,000 meters (1.25 miles) of potential turbine sites were calculated using the National Elevation Dataset digitally acquired from the U.S. Geological Survey. Turbine tower (hub) height and rotor diameters for the proposed turbines are listed in Table 3.

Table 3 Proposed Turbine Types and Specifications

Turbine Type	Number of Potential Turbine Locations	Tower (Hub) Height (meters/feet)	Rotor Diameter (meters/feet)
GE 2.82-127	106	88.6 (290.7 feet)	127.0 (416.7 feet)
GE 2.3-116	13	80.0 (262.5 feet)	116.0 (380.6 feet)

Deuel Harvest Wind identified receptors within the surrounding area utilizing aerial imagery and on-site inspections. Rural receptors include occupied residences within 1.25 miles of the proposed turbine locations or within the Project area. A total of 233 potential receptors were identified and included in the analysis.

The model utilizes a “greenhouse” approach which defines each receptor as a one-meter glass cube, representing a window able to receive shadow from all directions. Vegetation surrounding receptors will diminish the effect of shadow flicker. A conservative approach assuming that no blocking vegetation is present was used in the analysis.

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Shadow flicker is widely considered imperceptible at a distance greater than 1,500 meters (4,921 feet); however, Stantec conservatively analyzed the impact at all distances when more than 20 percent of the sun would be covered by a turbine blade. Shadow flicker does not occur when the sun-angle is less than three degrees above the horizon, due to atmospheric diffusion.

3.2 SHADOW FLICKER ANALYSIS RESULTS

The amount of shadow flicker on receptors within the Project area was calculated based on the climatological history of wind speed, wind direction and percentage of sunshine for the proposed Project. Figure 1 presents an overview map of the Project area. Figure 2 presents the layout associated with each turbine type, along with the expected shadow flicker hours per year if all turbines were constructed and operational. Results of the analysis indicate that the majority of residences within the area of analysis are expected to receive between 0 and 10 hours of shadow flicker each year. Of the 233 potential receptors analyzed, none are expected to receive more than 30 shadow hours annually. The expected hours of shadow on many receptors will be less than predicted, as not all the potential turbines will be constructed. Table 4 summarizes the predicted shadow flicker expected at receptors within the study area.

Table 4 Shadow Flicker Analysis Results (expected hours per year with all turbines operational)

Annual Shadow Hours	Receptors within Approximately 1.25 Miles of Project Turbines
Less than 10	199
10 – 20	19
20 – 25	9
25 – 30	6
Greater than 30	0

4.0 Conclusion

The analysis of potential shadow flicker from the Deuel Harvest Wind Energy Project on inhabited residences within approximately 2,000 meters (1.25 miles) was assessed using WindPRO's Version 3.1 Shadow Module software.

The majority of residences within and adjacent to the Project are expected to receive less than ten hours of shadow flicker per year. No residential receptors within the Project area are expected to receive more than 30 hours of shadow flicker each year. The Deuel

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County Ordinance requires that residential inhabited buildings receive no more than 30 hours of shadow flicker per year. Deuel Harvest Wind will comply with this ordinance.

The analyses were performed using conservative model inputs and do not include the blocking of shadow flicker due to vegetation or other obstacles. Obstacles such as barns, garages or silos may further reduce the effect of shadow flicker on an individual receptor. The results discussed in this report assume that all potential turbines are operational. However, Deuel Harvest Wind plans to construct only a subset of the potential turbines for the layout analyzed; therefore, expected annual shadow hours will be less than the results of the analyses summarized in this report.

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Figure 1

Project Overview

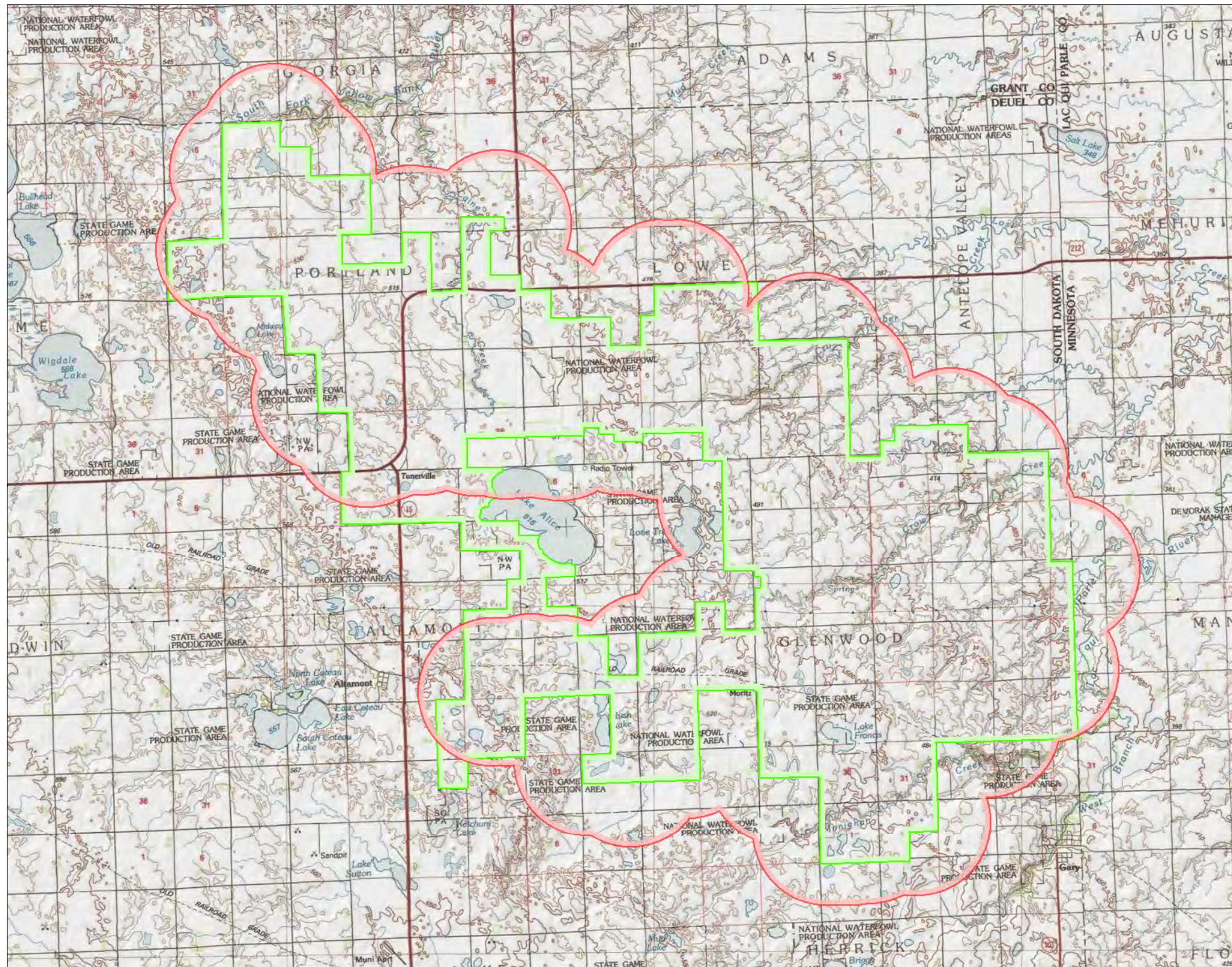
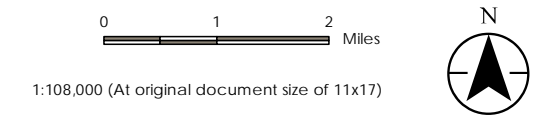


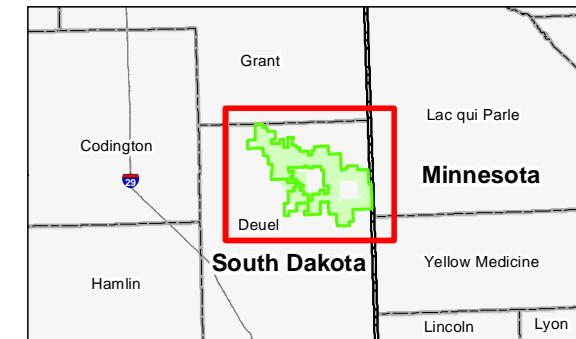
Figure No. 1
 Title **Project Overview**
Deuel Harvest North Wind Farm

Client/Project
 Invenergy, LLC
 Deuel Harvest North Wind Farm Project

Project Location 193705842
 Deuel Co., SD Prepared by JM on 2017-12-20
 Technical Review by JJB on 2017-12-22
 Independent Review by AO on 2017-12-22



- Legend**
- North Project Boundary - Approximate
 - 1.25-Mile Approximate Buffer of Proposed Facilities



- Notes**
1. Coordinate System: NAD 1983 UTM Zone 14N
 2. Data Sources Include: Stantec, Invenergy, NADS
 3. Background: USGS 7.5' Topographic Quadrangles



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Figure 2

Expected Shadow Flicker Analysis Results

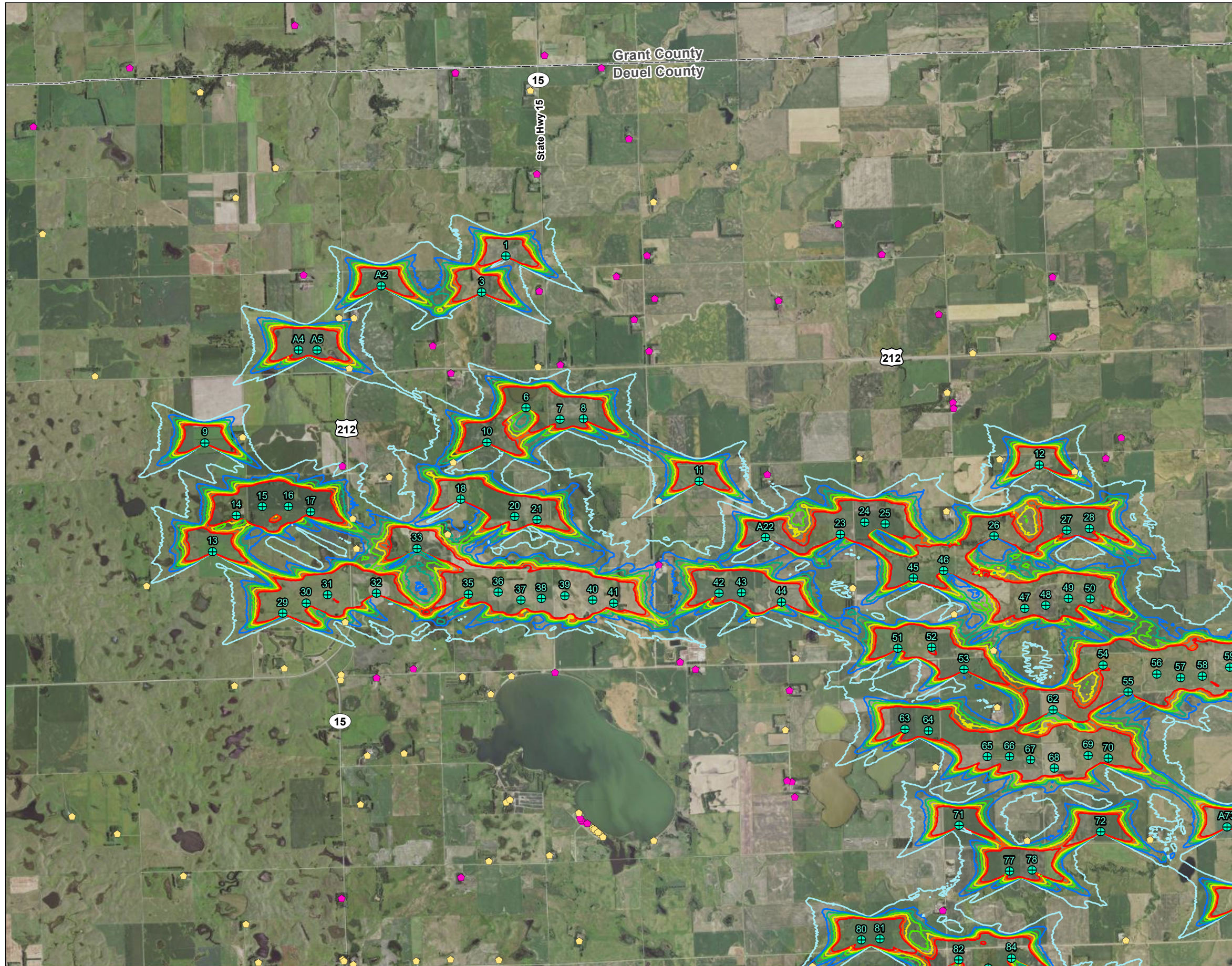
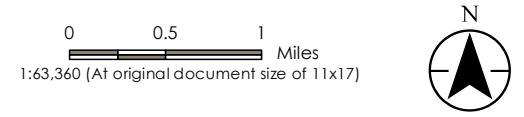
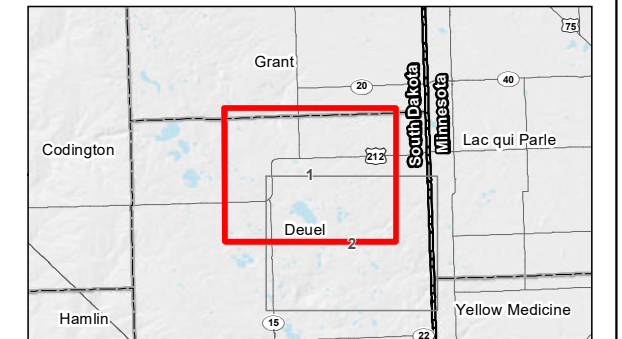


Figure No. **2**
 Title **Shadow Flicker Model Results
 Deuel Harvest North Wind Farm**
 Client/Project
 Invenergy, LLC
 Deuel Harvest North Wind Farm Project
 Project Location 193705842
 Deuel Co., SD Prepared by JM on 2019-03-20
 Technical Review by BT on 2019-03-20
 Independent Review by JB on 2019-03-20



- Legend**
- ⊕ Turbine Location
 - ◆ Receptor - Participant
 - ◆ Receptor - Non-Participant
- Shadow - Expected Annual Hours - North City Permit Hours
- 10
 - 20
 - 25
 - 30
 - 35
 - 40
 - 45



Notes

1. Coordinate System: NAD 1983 UTM Zone 14N
2. Data Sources Include: Stantec, Invenergy, NADS, USGS
3. Orthophotography: 2017 NAIP



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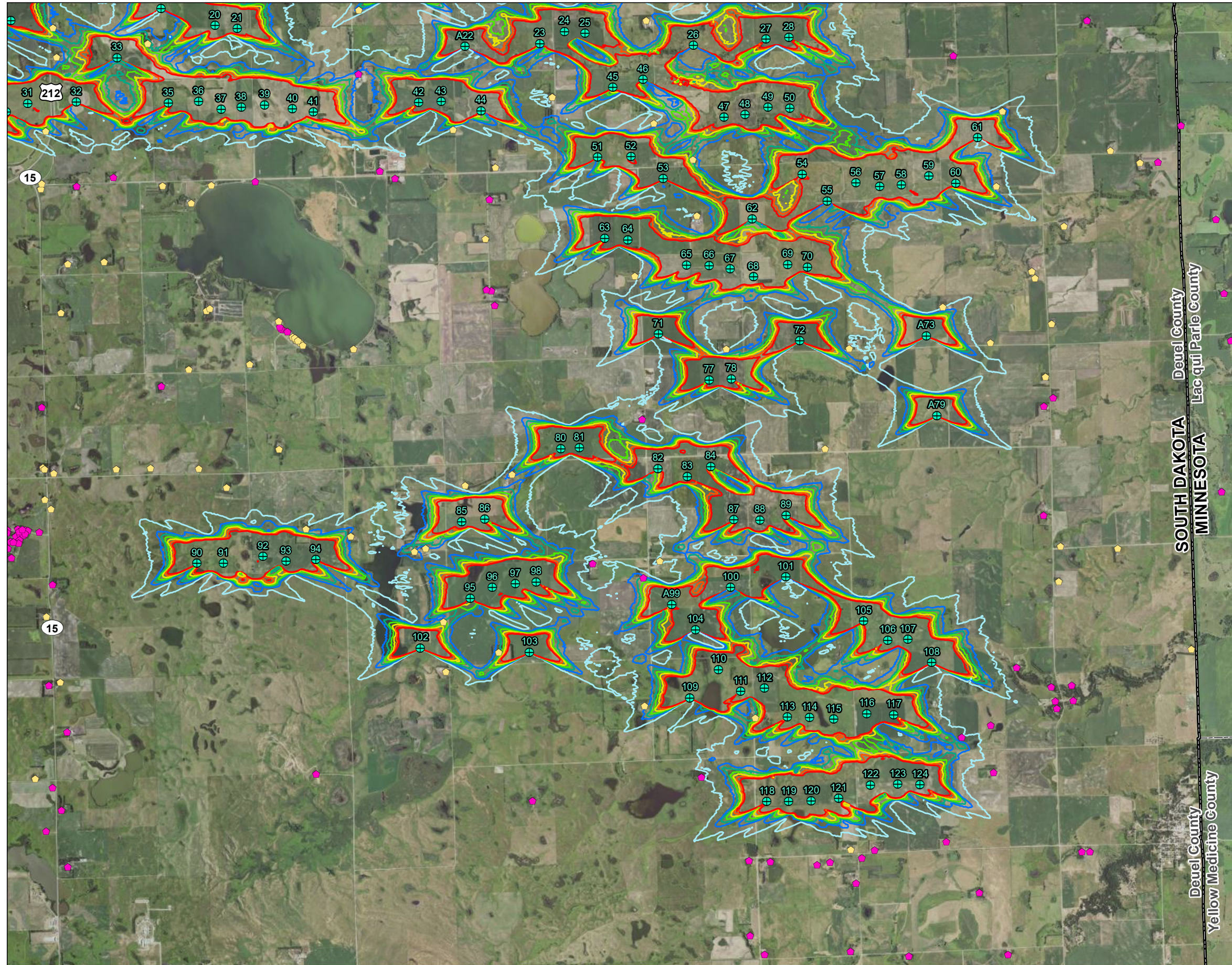
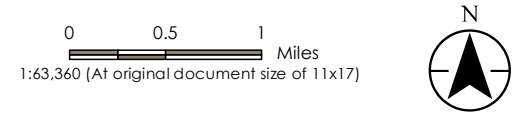
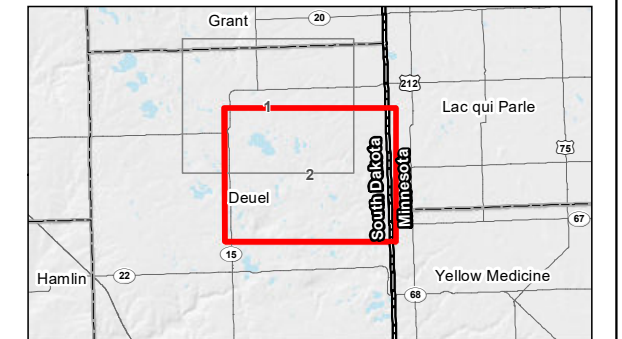


Figure No. **2**
 Title **Shadow Flicker Model Results
 Deuel Harvest North Wind Farm**
 Client/Project
 Invenergy, LLC
 Deuel Harvest North Wind Farm Project
 Project Location 193705842
 Deuel Co., SD Prepared by JM on 2019-03-20
 Technical Review by BT on 2019-03-20
 Independent Review by JB on 2019-03-20



- Legend**
- + Turbine Location
 - * Receptor - Participant
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- Shadow - Expected Annual Hours - North City Permit Hours
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Notes

1. Coordinate System: NAD 1983 UTM Zone 14N
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3. Orthophotography: 2017 NAIP



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Appendix A

Turbine Coordinates

(UTM Zone 14)

Appendix A Deuel Harvest North Wind Energy Project - Turbine Locations

Turbine Identification	X (UTM 14)	Y (UTM 14)
1	685,677	4,980,059
A2	683,683	4,979,587
3	685,286	4,979,482
A4	682,363	4,978,561
A5	682,664	4,978,562
6	685,994	4,977,636
7	686,537	4,977,450
8	686,914	4,977,462
9	680,870	4,977,077
10	685,375	4,977,085
11	688,757	4,976,465
12	694,185	4,976,725
13	680,992	4,975,340
14	681,375	4,975,918
15	681,785	4,976,059
16	682,205	4,976,059
17	682,557	4,975,980
18	684,956	4,976,177
20	685,818	4,975,902
21	686,172	4,975,853
A22	689,815	4,975,566
23	691,010	4,975,615
24	691,401	4,975,810
25	691,728	4,975,779
26	693,463	4,975,588
27	694,624	4,975,683
28	694,987	4,975,714
29	682,114	4,974,359
30	682,487	4,974,521
31	682,826	4,974,655
32	683,605	4,974,680
33	684,257	4,975,390
35	685,075	4,974,663
36	685,555	4,974,691
37	685,914	4,974,567
38	686,240	4,974,595
39	686,614	4,974,636
40	687,056	4,974,568
41	687,392	4,974,523
42	689,074	4,974,673

Turbine Identification	X (UTM 14)	Y (UTM 14)
43	689,432	4,974,685
44	690,071	4,974,539
45	692,176	4,974,917
46	692,659	4,975,038
47	693,955	4,974,437
48	694,289	4,974,479
49	694,653	4,974,595
50	695,001	4,974,582
51	691,929	4,973,797
52	692,467	4,973,810
53	692,983	4,973,458
54	695,203	4,973,531
55	695,602	4,973,099
56	696,061	4,973,387
57	696,438	4,973,331
58	696,787	4,973,357
59	697,225	4,973,497
60	697,658	4,973,381
61	698,004	4,974,114
62	694,406	4,972,815
63	692,045	4,972,506
64	692,414	4,972,480
65	693,357	4,972,073
66	693,712	4,972,069
67	694,047	4,972,013
68	694,424	4,971,884
69	694,968	4,972,088
70	695,289	4,972,043
71	692,905	4,970,970
72	695,166	4,970,868
A73	697,184	4,970,947
77	693,713	4,970,238
78	694,069	4,970,257
A79	697,353	4,969,671
80	691,348	4,969,141
81	691,644	4,969,154
82	692,897	4,968,821
83	693,367	4,968,693
84	693,740	4,968,853
85	689,760	4,967,973

Appendix A Deuel Harvest North Wind Energy Project - Turbine Locations

Turbine Identification	X (UTM 14)	Y (UTM 14)
86	690,127	4,968,017
87	694,106	4,968,003
88	694,526	4,967,997
89	694,943	4,968,075
90	685,530	4,967,306
91	685,955	4,967,313
92	686,586	4,967,414
93	686,952	4,967,346
94	687,428	4,967,371
95	689,899	4,966,748
96	690,253	4,966,925
97	690,615	4,966,981
98	690,953	4,967,012
A99	693,117	4,966,653
100	694,057	4,966,925
101	694,940	4,967,091
102	689,097	4,965,955
103	690,842	4,965,887
104	693,494	4,966,245
105	696,180	4,966,384

Turbine Identification	X (UTM 14)	Y (UTM 14)
106	696,565	4,966,080
107	696,888	4,966,090
108	697,272	4,965,722
109	693,406	4,965,158
110	693,865	4,965,610
111	694,217	4,965,262
112	694,599	4,965,309
113	694,962	4,964,854
114	695,316	4,964,845
115	695,707	4,964,814
116	696,232	4,964,906
117	696,662	4,964,888
118	694,632	4,963,500
119	694,986	4,963,502
120	695,341	4,963,514
121	695,785	4,963,550
122	696,293	4,963,768
123	696,729	4,963,777
124	697,081	4,963,770

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Appendix B

Shadow Flicker Results with Receptor Coordinates (UTM Zone 14)

Appendix B Deuel Harvest North Wind Energy Project - Receptor Shadow Flicker Results

Receptor Identification	Easting (UTM 14)	Northing (UTM 14)	Maximum Shadow Days per Year	Expected Shadow Flicker Hours per Year
R-003-NP	683,223	4,963,726	0	0:00
R-004-NP	699,672	4,962,706	0	0:00
R-005-NP	696,155	4,962,600	11	0:04
R-006-NP	695,975	4,961,104	0	0:00
R-191-NP	683,121	4,963,032	0	0:00
R-192-NP	683,367	4,963,367	0	0:00
R-193-NP	683,472	4,962,461	0	0:00
R-194-NP	690,894	4,963,517	0	0:00
R-195-NP	693,658	4,960,634	0	0:00
R-196-NP	694,600	4,961,061	0	0:00
R-197-NP	694,375	4,961,365	0	0:00
R-198-NP	694,692	4,962,542	34	0:25
R-199-NP	698,259	4,963,973	79	3:54
R-200-NP	696,362	4,962,729	67	3:12
R-201-NP	697,509	4,962,861	40	1:36
R-202-NP	695,439	4,962,490	0	0:00
R-203-NP	695,645	4,962,537	0	0:00
R-204-NP	696,067	4,962,192	0	0:00
R-205-NP	698,033	4,962,046	0	0:00
R-207-NP	698,494	4,961,053	0	0:00
R-225-NP	676,853	4,976,229	0	0:00
R-226-NP	678,135	4,982,122	0	0:00
R-227-NP	679,674	4,983,073	0	0:00
R-228-NP	678,464	4,984,192	0	0:00
R-229-NP	682,307	4,983,747	0	0:00
R-231-NP	682,450	4,979,759	27	2:06
R-232-P	683,016	4,979,077	100	14:43
R-233-NP	684,511	4,978,630	68	2:50
R-234-NP	683,614	4,973,334	0	0:00
R-235-NP	683,053	4,969,806	0	0:00
R-236-P	684,245	4,968,817	0	0:00
R-237-P	683,202	4,968,178	7	0:04
R-238-P	683,105	4,968,328	0	0:00
R-239-NP	683,016	4,967,807	0	0:00
R-240-NP	682,674	4,967,857	0	0:00
R-241-NP	682,639	4,967,748	0	0:00
R-242-NP	682,713	4,967,753	0	0:00
R-243-NP	682,794	4,967,839	0	0:00
R-244-NP	682,755	4,967,758	0	0:00
R-245-NP	682,689	4,967,819	0	0:00
R-246-NP	682,831	4,967,838	0	0:00

Appendix B Deuel Harvest North Wind Energy Project - Receptor Shadow Flicker Results

Receptor Identification	Easting (UTM 14)	Northing (UTM 14)	Maximum Shadow Days per Year	Expected Shadow Flicker Hours per Year
R-247-P	682,193	4,968,103	0	0:00
R-248-NP	682,502	4,967,842	0	0:00
R-249-NP	682,496	4,967,799	0	0:00
R-250-NP	682,553	4,967,662	0	0:00
R-251-NP	682,698	4,967,682	0	0:00
R-252-NP	682,688	4,967,635	0	0:00
R-253-NP	682,600	4,967,649	0	0:00
R-254-NP	682,510	4,967,549	0	0:00
R-255-NP	682,570	4,967,398	0	0:00
R-256-NP	684,963	4,970,141	0	0:00
R-257-NP	686,461	4,973,411	0	0:00
R-258-NP	688,454	4,973,580	65	2:17
R-259-NP	688,112	4,975,133	188	21:00
R-263-NP	684,868	4,982,990	0	0:00
R-264-NP	686,291	4,983,273	0	0:00
R-265-NP	687,203	4,983,064	0	0:00
R-267-NP	687,636	4,981,940	0	0:00
R-268-NP	687,926	4,980,067	13	0:22
R-269-NP	686,173	4,981,375	0	0:00
R-270-NP	687,441	4,979,742	33	1:22
R-271-NP	688,049	4,979,385	12	0:14
R-272-NP	686,208	4,979,503	42	5:43
R-273-NP	687,721	4,979,046	79	2:07
R-274-NP	687,963	4,978,543	57	1:48
R-275-NP	686,545	4,978,326	12	0:22
R-276-NP	684,797	4,978,196	62	3:47
R-278-NP	690,981	4,980,570	0	0:00
R-279-NP	691,674	4,980,086	0	0:00
R-280-NP	690,024	4,979,348	0	0:00
R-281-NP	692,582	4,979,132	0	0:00
R-282-P	693,123	4,978,509	0	0:00
R-283-NP	694,403	4,978,773	0	0:00
R-284-NP	692,812	4,977,723	46	2:38
R-285-NP	692,820	4,977,636	46	2:07
R-286-P	691,313	4,976,830	38	1:37
R-287-NP	689,844	4,976,580	87	6:05
R-288-P	690,305	4,973,639	56	1:37
R-289-NP	690,203	4,973,129	38	1:02
R-290-P	692,830	4,974,347	109	10:24
R-291-P	693,520	4,972,863	149	12:06
R-292-NP	692,649	4,969,610	204	16:48
R-293-NP	691,851	4,967,303	142	8:42
R-294-NP	692,665	4,967,084	188	22:13

Appendix B Deuel Harvest North Wind Energy Project - Receptor Shadow Flicker Results

Receptor Identification	Easting (UTM 14)	Northing (UTM 14)	Maximum Shadow Days per Year	Expected Shadow Flicker Hours per Year
R-295-NP	697,618	4,975,422	0	0:00
R-297-NP	701,253	4,974,308	0	0:00
R-299-NP	701,813	4,972,806	0	0:00
R-300-NP	701,946	4,971,621	0	0:00
R-301-NP	702,056	4,970,870	0	0:00
R-302-NP	702,305	4,970,792	0	0:00
R-303-NP	701,907	4,968,451	0	0:00
R-304-NP	699,056	4,968,082	0	0:00
R-305-NP	699,214	4,969,952	46	1:50
R-306-NP	699,065	4,969,818	20	1:11
R-312-NP	694,398	4,979,727	0	0:00
R-313-NP	702,340	4,968,613	0	0:00
R-314-NP	699,535	4,965,118	0	0:00
R-315-NP	699,248	4,965,104	20	1:03
R-316-NP	699,274	4,964,989	0	0:00
R-317-NP	699,510	4,965,357	16	0:36
R-318-NP	699,184	4,965,340	0	0:00
R-319-NP	698,631	4,965,644	34	2:06
R-320-P	692,686	4,965,034	122	16:45
R-321-NP	683,225	4,966,963	8	0:03
R-324-NP	700,890	4,973,720	0	0:00
R-325-NP	695,248	4,976,837	62	4:57
R-326-NP	695,494	4,977,161	28	2:05
R-327-NP	699,753	4,975,983	0	0:00
R-331-NP	702,530	4,965,693	0	0:00
R-332-NP	698,214	4,964,717	115	5:59
R-333-P	683,349	4,965,409	0	0:00
R-334-NP	683,171	4,965,365	0	0:00
R-335-NP	683,454	4,964,615	0	0:00
R-340-NP	687,436	4,963,949	0	0:00
R-341-NP	693,591	4,963,893	108	8:02
R-487-NP	696,907	4,961,027	0	0:00
R-491-P	683,039	4,973,297	0	0:00
R-492-NP	702,697	4,971,146	0	0:00
R-494-NP	682,785	4,967,785	0	0:00
R-495-NP	682,366	4,967,893	0	0:00
R-496-NP	682,741	4,967,851	0	0:00
R-498-P	682,947	4,963,870	0	0:00
R-499-NP	694,354	4,962,560	24	0:08
R-596-NP	684,870	4,982,990	0	0:00
R-598-NP	699,800	4,962,703	0	0:00
R-681-P	678,753	4,971,111	0	0:00
R-682-P	679,475	4,970,841	0	0:00

Appendix B Deuel Harvest North Wind Energy Project - Receptor Shadow Flicker Results

Receptor Identification	Easting (UTM 14)	Northing (UTM 14)	Maximum Shadow Days per Year	Expected Shadow Flicker Hours per Year
R-683-P	677,625	4,978,124	0	0:00
R-684-P	679,116	4,978,144	24	0:42
R-685-P	678,281	4,980,416	0	0:00
R-686-P	680,799	4,982,675	0	0:00
R-687-P	682,005	4,981,475	0	0:00
R-688-P	681,368	4,980,996	0	0:00
R-690-P	683,254	4,979,073	127	17:46
R-691-P	681,474	4,977,172	62	13:11
R-692-P	683,177	4,978,266	110	25:57
R-693-P	683,042	4,977,308	75	2:08
R-694-NP	683,066	4,976,707	140	8:27
R-695-P	683,811	4,976,537	93	6:47
R-696-P	683,233	4,975,874	175	20:58
R-697-P	683,292	4,975,394	179	14:09
R-698-P	683,113	4,974,215	112	23:40
R-699-P	683,050	4,973,378	25	0:14
R-700-NP	684,197	4,973,476	69	1:39
R-701-P	682,141	4,973,482	0	0:00
R-702-P	681,350	4,973,209	0	0:00
R-703-P	683,469	4,972,089	0	0:00
R-704-P	684,053	4,972,124	0	0:00
R-705-P	683,358	4,971,312	0	0:00
R-706-P	680,530	4,970,175	0	0:00
R-707-P	681,527	4,969,395	0	0:00
R-708-P	681,438	4,968,478	0	0:00
R-709-P	681,727	4,968,780	0	0:00
R-710-P	683,242	4,968,751	0	0:00
R-711-P	683,072	4,968,840	0	0:00
R-712-P	686,006	4,968,526	8	0:10
R-713-P	687,277	4,967,856	131	14:13
R-715-P	687,994	4,967,739	131	18:09
R-716-P	689,009	4,967,501	223	22:15
R-717-P	689,189	4,967,555	189	19:25
R-718-P	686,844	4,969,130	0	0:00
R-719-P	685,405	4,970,407	0	0:00
R-720-P	686,371	4,970,494	0	0:00
R-721-P	688,036	4,970,732	0	0:00
R-722-P	687,188	4,970,836	0	0:00
R-723-P	687,113	4,970,889	0	0:00
R-724-NP	686,903	4,971,039	0	0:00
R-725-NP	686,879	4,971,059	0	0:00
R-726-NP	686,858	4,971,086	0	0:00
R-727-P	686,840	4,971,175	0	0:00

Appendix B Deuel Harvest North Wind Energy Project - Receptor Shadow Flicker Results

Receptor Identification	Easting (UTM 14)	Northing (UTM 14)	Maximum Shadow Days per Year	Expected Shadow Flicker Hours per Year
R-728-P	685,684	4,971,347	0	0:00
R-729-P	685,738	4,971,385	0	0:00
R-730-P	685,438	4,973,071	0	0:00
R-731-P	684,986	4,973,346	23	0:20
R-732-NP	688,701	4,973,465	21	0:14
R-734-P	688,118	4,976,155	157	21:42
R-735-P	686,067	4,982,710	0	0:00
R-736-P	688,032	4,980,926	0	0:00
R-737-P	689,311	4,981,492	0	0:00
R-738-P	686,192	4,978,291	0	0:00
R-739-P	692,721	4,977,888	15	0:28
R-740-P	693,555	4,976,821	124	15:10
R-741-P	693,459	4,973,767	197	24:05
R-742-P	692,709	4,975,986	124	14:11
R-743-P	691,212	4,974,762	155	11:46
R-744-P	689,627	4,974,245	64	7:07
R-745-P	692,529	4,971,903	87	7:41
R-746-P	690,138	4,972,500	13	0:26
R-747-NP	690,288	4,971,428	54	1:17
R-748-NP	690,240	4,971,667	30	0:45
R-749-NP	690,160	4,971,684	26	0:34
R-750-P	693,991	4,970,730	88	8:13
R-751-P	689,816	4,968,557	31	1:10
R-752-P	690,566	4,968,730	169	22:28
R-753-P	692,928	4,967,345	153	12:10
R-754-P	698,403	4,974,533	90	23:38
R-755-P	700,129	4,973,909	14	0:33
R-756-P	700,246	4,967,543	0	0:00
R-757-P	699,333	4,967,582	0	0:00
R-758-P	700,599	4,973,713	0	0:00
R-759-P	699,387	4,972,695	33	1:52
R-760-P	698,926	4,971,866	20	0:47
R-761-P	698,874	4,971,975	24	1:01
R-762-P	699,187	4,971,136	64	1:48
R-763-P	699,090	4,970,287	40	1:52
R-764-P	697,449	4,971,401	80	9:06
R-765-P	695,958	4,970,746	118	14:33
R-766-P	695,570	4,969,140	89	2:54
R-767-P	684,839	4,976,774	167	18:52
R-768-P	679,946	4,974,799	89	8:15
R-769-P	695,981	4,962,736	35	1:28
R-770-P	694,456	4,964,843	138	27:00
R-771-P	689,468	4,966,375	199	26:52

Appendix B Deuel Harvest North Wind Energy Project - Receptor Shadow Flicker Results

Receptor Identification	Easting (UTM 14)	Northing (UTM 14)	Maximum Shadow Days per Year	Expected Shadow Flicker Hours per Year
R-772-P	690,353	4,965,883	81	25:49
R-773-P	683,128	4,966,458	0	0:00
R-775-P	682,308	4,965,389	0	0:00
R-778-P	684,792	4,968,834	0	0:00
R-779-NP	686,978	4,971,008	0	0:00
R-780-P	687,065	4,970,935	0	0:00
R-781-P	685,764	4,973,353	0	0:00
R-782-P	694,756	4,976,632	146	25:37
R-783-P	701,420	4,965,944	0	0:00
R-786-P	687,093	4,970,914	0	0:00
R-787-P	687,148	4,970,867	0	0:00
R-788-P	687,225	4,970,791	0	0:00
R-790-P	699,305	4,967,020	18	0:30
R-791-P	689,508	4,965,573	30	2:18
R-797-P	683,096	4,968,817	0	0:00
R-798-P	685,562	4,968,828	0	0:00
R-802-P	698,306	4,973,333	77	17:06
R-803-NP	697,749	4,964,533	161	12:57
R-804-P	684,748	4,975,618	204	26:54
R-805-P	698,210	4,970,836	40	5:08