



Dakota Range Wind Project

Shadow Flicker Assessment

Northern States Power Company, a Minnesota corporation,
d/b/a Xcel Energy

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1. Introduction

Dakota Range I, LLC and Dakota Range II, LLC (Dakota Range), a wholly owned, indirect subsidiary of Northern States Power Company – Minnesota doing business as Xcel Energy (Xcel Energy) is proposing to construct the approximately 300-megawatt (MW) wind energy conversion facility to be located in Grant and Codington counties, South Dakota, known as the Dakota Range Wind Energy Project (Project). The Project consists of up to 72 turbines, 11 alternative turbine locations, access roads, underground electrical collection and communication systems, collection substation, meteorological evaluation towers, an operations and maintenance facility, and temporary works spaces for a construction laydown area and a batch plant. The Project will consist of Vestas V120 2.2 MW, V136 3.6 MW and V136 4.2 MW models. Only 72 turbines will be constructed. AECOM conducted the following shadow flicker analysis for the Project to support Dakota Range's application for a Certificate of Site Compatibility to the South Dakota Public Utilities Commission (Commission).

2. Project Components

The Project will consist of up to 72 wind turbines: 64 Vestas V136 4.2 MW, seven Vestas V136 3.6 MW, and one Vestas V120 2.2 MW models (Figure 1). The turbine technology is 3-bladed, upwind, and horizontal-axis. Each Vestas V136 4.2 MW and 3.6 MW model will have an 82-meter (269 feet) hub height and a 136-meter (446 feet) rotor diameter with a swept area of 14,527 m² (3.59 ac). The Vestas V120 2.2 MW model has an 80-meter hub height (262.5 feet), and a 120-meter (394 feet) rotor diameter with a swept area of 11,310 m² (2.79 ac). The Vestas V136 and V120 turbines begin operation in wind speeds of 3.0 meters per second (m/s)12, or 6.7 miles per hour (mph). The coordinates for the 83 (72 proposed and 11 alternate locations) turbines are listed in Table 1.

3. Shadow Flicker Background

Shadow flicker is a temporary condition resulting from the sun casting intermittent shadows from the rotating blades of a wind turbine onto a sensitive receptor such as a building window. The flicker is due to alternating light intensity between the direct beam of sunlight and the shadow from the turbine blades. For shadow flicker to occur, the following criteria must be met:

1. The sun must be shining and unobscured.
2. The wind turbine blades must be between the sun and the shadow receptor. The wind turbine must be facing directly towards (or away from) the sun such that the rotational plane of the blades is perpendicular to the azimuth of incident sun rays (i.e. the sun, turbine and receptor are aligned and the turbine blades are perpendicular to receptor). For this to occur, the wind direction would have to perpetually be parallel to the azimuth of the incident sun rays throughout the day.
3. The line of sight between the turbine and the shadow receptor must be clear. Light impermeable obstacles, such as trees, buildings or other structures, will prevent or reduce shadow flicker from occurring at the receptor. Terrain can also affect the exposure at a receptor.
4. The receptor has to be close enough to the turbine to be in the shadow. The shadow from a turbine extends furthest when the sun is low in the sky (sunrise and sunset) such that receptors to the east or west of a turbine will be exposed more than receptors to the north and south of a turbine.
5. The turbine is operational and not stationary due to a lack of wind or maintenance activities.

The frequency of shadow flicker is dependent on the wind turbine's rotor blade speed and the number of blades on the rotor. Shadow flicker intensity diminishes with greater receptor-to-turbine separation distance. Shadow flicker intensity for receptor-to-turbine distances beyond 2,500 meters (8,202 feet) is very low and generally considered

1 <http://nozebra.ipapercms.dk/Vestas/Communication/Productbrochure/2MWbrochure/2MWProductBrochure/?page=12#>

2 <http://nozebra.ipapercms.dk/Vestas/Communication/Productbrochure/4MWbrochure/4MWProductBrochure/?page=16#>

imperceptible. In general, increasing proximity to turbines may make shadow flicker more noticeable, with the largest number of shadow flicker hours, along with greatest shadow flicker intensity, occurring nearest the wind turbines.

Although shadow flicker does not impact health it can be a nuisance to neighboring properties if not kept to a reasonable number of hours a year (Knopper et al., 2014). There have been public concerns that flickering light from wind turbines could trigger seizures in people with epilepsy, but these concerns are unfounded. The UK Epilepsy Society states that turbine blades would need to rotate at speeds greater than 3 Hertz (flashes per second) to potentially cause seizures in persons with photosensitive epilepsy (Epilepsy Society 2016); however, turbines on commercial wind farms rotate at speeds of 2 Hertz or less. The Project turbine models have a maximum rotational speed of 15.7 revolutions per minute (rpm), which corresponds to a shadow flicker frequency of 0.26 Hertz. Therefore, the Project turbines will result in a flash frequency well below that which would cause photosensitive epileptic seizures.

Shadow flicker impacts are not regulated in applicable state or federal law, and there is no permitting threshold with regard to hours per year of anticipated impacts to a receptor from a wind energy project. However, a widely used industry standard of 30 hours per year has been used for this shadow flicker impact analysis. The Commission has recognized the 30 hour per year standard and historically evaluates shadow flicker impacts pursuant to this standard.

4. Shadow Flicker Analysis

The shadow flicker analysis for the Project was completed using the WindPRO Version 3.4 modelling software. As discussed above, the Project will install up to 72 wind turbines. The 72 proposed locations as well as 11 alternate locations have been assessed in two scenarios:

- Scenario A: 72 wind turbines (proposed locations only)
- Scenario B: 83 wind turbines (proposed and alternate locations)

WindPRO considers the terrain features determined by U.S. Geological Survey (USGS) Digital Elevation Model (DEM) data, receptor, and turbine locations in the modelling analysis. It is generally accepted that shadow flicker from wind turbines does not occur beyond a certain distance from a wind turbine (Department of Energy and Climate Change 2011). The *Update of UK Shadow Flicker Evidence Base* by Parsons Brinckerhoff, on behalf of the Department of Energy and Climate Change, states this distance is equivalent to 10 rotor diameters. However, to be consistent with previous submittals, AECOM used a maximum distance of 1.25 miles (6,600 feet). WindPRO also assumes the sun is shining during all daytime hours and that the turbines are always operating. This method produces a theoretical worst-case astronomical prediction at each receptor. A minimum of one year of onsite hourly meteorological data was used to determine what percentage of the hours had an observed wind speed less than the cut-in speed of the turbines. The meteorological data also shows that up to four percent of the hours when flicker is likely to occur, the wind speed would be less than the cut-in speed of the turbine and the blades would not be rotating. The number of operational hours were divided into sectors for use in WindPRO to determine the reduction factors by wind direction and operational time. **Table 2** summarizes the hours by sector as input to WindPRO.

WindPRO was run in "greenhouse mode" such that the wind turbine blades are always perpendicular to the receptor with a direct line of sight where the window is one meter by one meter and the height above ground to the middle of the window is 1.5 meters to determine the maximum exposure. The amount of bright sunshine can also affect the frequency and duration of exposure to shadow flicker. **Table 3** summarizes the percentage of possible sunshine (classified as zero or few clouds) by month at Huron Regional Airport, Huron, South Dakota based on 19-year climatological data (1965 – 1983) from the National Climatic Data Center (NCDC 2018). Huron is the closest station in the database to the project. These monthly values were input to WindPRO to adjust the number of hours when shadow flicker occurs on a monthly basis.

The analysis is inherently conservative by assuming that the receptors all have a direct in-line view of the incoming shadow flicker sunlight and does not account for trees or other obstructions which may block sunlight. In reality, the windows of many houses will not face the sun directly. Adding to the conservatism, both the primary and alternate turbines (for a total of 83 turbines) are modeled cumulatively for Scenario B, even though Dakota Range Wind will only construct no more than 72 turbines.

A total of 186 receptors were identified within and near the Project that are considered either inhabited or capable of habitation. Determination of habitation for existing structures was limited to public knowledge and roadside surveys in order to reduce disturbances to landowners. For purposes of conservatism in this analysis, all structures that were identified as capable of habitation were considered active residential structures.

5. Shadow Flicker Analysis Results

The shadow flicker analysis accounts for the placement of turbines, receptors, and sun angle such that the time when the turbine is in between the sun and the receptor is included in the total hours per year that shadow flicker could occur. However, this is a conservative analysis that does not account for maintenance time, wind speeds less than three meters per second (m/s) when the turbines will not operate, light permeable obstacles such as trees and other structures, or that the turbine will rarely be directly facing the sun, which will shorten the shadow from the turbine blades. It was assumed that the receptor is always perpendicular (facing) to the turbine and a window measuring one meter by one meter at each receptor is located 1.5 meters high off the ground.

5.1 Scenario A Results

The results of the Scenario A analysis are summarized in **Table 4**, **Table 5**, and **Table 6** and shown on **Figure 2**. The maximum shadow flicker per year at a participating landowner's residence is 22 hours per year. It is based on operational time by sector in **Table 2** and monthly percent possible of sunshine in **Table 3** and estimated hours during which the wind speed would be less than the cut-in speed of 3 m/s or the turbine is down for maintenance. This analysis is conservative as it assumes that there is a window facing the turbine at all times ("greenhouse mode"). Even using this conservative analysis, no receptors were predicted to have shadow flicker values of 30 hours or greater each year.

5.2 Scenario B Results

The results of the Scenario B analysis are summarized in **Table 7**, **Table 8**, and **Table 9** and shown on **Figure 3**. Similar to Scenario A, the maximum shadow flicker per year at a participating landowner's residence is 22 hours per year. It is based on operational time by sector in **Table 2** and monthly percent possible of sunshine in **Table 3** and estimated hours during which the wind speed would be less than the cut-in speed of three m/s or the turbine is down for maintenance. This analysis is conservative as it assumes that there is a window facing the turbine at all times ("greenhouse mode"). Even using this conservative analysis, no receptors were predicted to have shadow flicker values of 30 hours or greater each year.

6. Conclusions

As expected, the analysis predicts that shadow flicker impacts will be greatest at receptors nearer to the wind turbines. The analysis of potential shadow flicker impacts from the Project on nearby receptors shows that shadow flicker impacts within the area of study are expected to be minor and well within acceptable ranges for avoiding nuisance conditions. The predicted shadow flicker impacts are less than the Commission-recognized 30 hours per year industry standard at all receptors.

The analysis was deliberately conservative and actual shadow flicker is expected to occur for less than the modeled durations. The analysis assumes that the receptors all have a direct in-line view of the incoming shadow flicker sunlight and does not account for trees or other obstructions that may block sunlight. In reality, the windows of some houses will not face the sun directly for the key shadow flicker impact times. Adding to the conservatism, both the primary and alternate turbines were modeled cumulatively in Scenario B. Dakota Range Wind will only construct up to 72 turbines, which is fewer wind turbines than were included in the Scenario B modeled results.

7. Literature Cited

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Tables

Table 1. Wind Turbine Locations

Turbine ID	UTM Coordinates		Turbine ID	UTM Coordinates		Turbine ID	UTM Coordinates	
	X	Y		X	Y		X	Y
T-001(1)	649151	5009211	T-029	656948	5008365	T-057	654672	5002981
T-002	649593	5009301	T-030	657593	5008380	T-058	653413	5001019
T-003	650382	5008394	T-031	653251	5007492	T-059	654244	5001104
T-004	651221	5008389	T-032	653912	5007486	T-060	654286	5000211
T-005	651888	5008536	T-033	653972	5007080	T-061	655673	5001011
T-006	652671	5007586	T-034	654113	5006574	T-062	655443	5000400
T-007(1)	650048	5006906	T-035	656181	5007604	T-063	656999	5000470
T-008	650429	5007024	T-036	655319	5006761	T-064	657424	5000476
T-009	650942	5007008	T-037	656220	5006808	T-065	657851	5000546
T-010	651702	5006813	T-038	657250	5006673	T-066	658167	5000252
T-011	652445	5006824	T-039	657671	5006727	T-067(1)	654626	4999457
T-012	652068	5005967	T-040	658032	5006709	T-068	655965	4997937
T-013	652355	5004449	T-041	658728	5007539	T-069	655963	4997416
T-014	652354	5003672	T-042	659200	5006854	T-070(1)	655111	4996175
T-015(1)	652508	5002155	T-043	659531	5006717	T-071	655723	4996172
T-016	654739	5010310	T-044	652980	5005140	T-072	656367	4996074
T-017	655343	5010618	T-045(1)	654125	5005949	A12a	648811	5005306
T-018	655960	5010046	T-046	656234	5006118	A13	649517	5005260
T-019	656354	5010078	T-047	656341	5005779	A14	650399	5005390
T-020	656800	5009939	T-048	656373	5005145	A22	653061	5000625
T-021	657156	5010005	T-049	656929	5005957	A26	655110	4997437
T-022(1)	657545	5010093	T-050	657388	5005960	A3	646727	5008564
T-023	654074	5008760	T-051	657840	5006079	A4	647138	5008617
T-024(2)	654850	5008650	T-052	652960	5004165	A5	647540	5008821
T-025	655210	5009459	T-053	653327	5003802	A6	647957	5008902
T-026	656124	5009415	T-054	654008	5004449	A7	648410	5008903
T-027	656191	5008691	T-055	654041	5003475	A8	649561	5008528
T-028	657114	5009343	T-056	654539	5003479			

(1) V136 3.6 MW Turbines

(2) V120 2.2 MW Turbines

Source: AECOM 2020

Table 2. Hours of Operation by Wind Sector

Sector	Operational Hours
N	556
NNE	556
NE	324
ENE	284
E	272
ESE	414
SE	411
SSE	562
S	777
SSW	629
SW	408
WSW	387
W	518
WNW	803
NW	796
NNW	721
Annual	8418

Source: AECOM 2020

Table 3. Percent of Possible Sunshine

Month	% Possible Sunshine (Huron Regional Airport, Huron, SD)
January	62
February	62
March	62
April	59
May	66
June	69
July	76
August	74
September	69
October	59
November	51
December	51

Source: National Climatic Data Center (2018)

Table 4. Scenario A Statistical Summary of Predicted Shadow Flicker at Receptors

Total Shadow Flicker Time (predicted)	Number of Receptors
Total	186
= 0 Hours	141
> 0 Hours < 10 Hours	32
> 10 Hours < 20 Hours	6
> 20 Hours < 30 Hours	7

Source: AECOM 2020

Table 5. Scenario A Results by Modeled Receptor

Receptor ID	Receptor Coordinates (UTM Zone 14, NAD 83)		Participation Status	County	Predicted Shadow Flicker Hours/Year
	Easting (m)	Northing (m)			
1406	652416	4988919	Non-Participating	Codington	0.0
1412	654042	4988526	Non-Participating	Codington	0.0
1419	654682	4990406	Participating	Codington	0.0
1420	655847	4989588	Participating	Codington	0.0
1425	656835	4990400	Participating	Codington	0.0
1434	657862	4991817	Non-Participating	Codington	0.0
1436	659447	4992233	Non-Participating	Codington	0.0
1437	659433	4992153	Non-Participating	Codington	0.0
1470	653858	4990720	Participating	Codington	0.0
1472	653951	4991544	Participating	Codington	0.0
1476	653550	4991972	Non-Participating	Codington	0.0
1481	652432	4989894	Non-Participating	Codington	0.0
1482	652414	4990051	Participating	Codington	0.0
1489	651609	4990365	Non-Participating	Codington	0.0
1497	650662	4989915	Non-Participating	Codington	0.0
1498	650857	4990054	Non-Participating	Codington	0.0
1503	650658	4990853	Non-Participating	Codington	0.0
1510	650693	4992058	Non-Participating	Codington	0.0
1511	650707	4992321	Participating	Codington	0.0
1520	652311	4992164	Non-Participating	Codington	0.0
1528	653395	4993505	Participating	Codington	0.0
1537	655804	4993536	Non-Participating	Codington	0.0
1540	656798	4994383	Non-Participating	Codington	0.0
1546	657465	4995164	Non-Participating	Codington	0.0
1554	658362	4995128	Non-Participating	Codington	0.0
1555	658579	4995244	Non-Participating	Codington	0.0
1564	656622	4995251	Non-Participating	Codington	0.0
1575	655955	4995240	Non-Participating	Codington	0.0
1584	654917	4995237	Non-Participating	Codington	0.0
1588	653838	4995578	Non-Participating	Codington	0.0
1590	652996	4995886	Non-Participating	Codington	0.0
1591	652437	4996048	Non-Participating	Codington	0.0
1595	650593	4996054	Non-Participating	Codington	0.0

Receptor ID	Receptor Coordinates (UTM Zone 14, NAD 83)		Participation Status	County	Predicted Shadow Flicker Hours/Year
	Easting (m)	Northing (m)			
1596	650496	4995587	Non-Participating	Codington	0.0
1599	650637	4995303	Non-Participating	Codington	0.0
1614	650527	4994742	Non-Participating	Codington	0.0
1618	648862	4994650	Non-Participating	Codington	0.0
1624	648375	4996645	Participating	Codington	0.0
1635	647648	4997080	Non-Participating	Codington	0.0
1639	647523	4997800	Non-Participating	Codington	0.0
1647	649155	4997753	Non-Participating	Codington	0.0
1653	650473	4996848	Participating	Codington	0.0
1659	650596	4997697	Non-Participating	Codington	0.0
1666	647489	4998353	Non-Participating	Codington	0.0
1669	649341	4999050	Participating	Codington	0.0
1675	651994	4999721	Non-Participating	Codington	0.0
1684	653787	4998023	Non-Participating	Codington	0.0
1684a	653823	4998032	Non-Participating	Codington	0.0
1688	653778	4996826	Non-Participating	Codington	2.5
1695	654385	4996688	Non-Participating	Codington	17.4
1697	655254	4997957	Participating	Codington	20.6
1698	655366	4998312	Non-Participating	Codington	17.3
1705	656685	4997836	Non-Participating	Codington	7.4
1710	656977	4997093	Non-Participating	Codington	2.2
1717	656868	4998570	Non-Participating	Codington	4.9
1721	657770	4996904	Non-Participating	Codington	1.1
1722	657793	4996940	Non-Participating	Codington	1.1
1725	656816	4999863	Non-Participating	Codington	0.0
1745	647461	5000525	Non-Participating	Codington	0.0
1746	647456	5000456	Non-Participating	Codington	0.0
1749	648160	5000058	Participating	Codington	0.0
1759	648809	4999992	Non-Participating	Codington	0.0
1762	649064	5001386	Non-Participating	Codington	0.0
1764	663179	5001621	Non-Participating	Codington	0.0
1772	661543	5000761	Non-Participating	Codington	0.0
1782	658372	5001257	Non-Participating	Codington	8.0
1784	655170	5001262	Non-Participating	Codington	27.0
1787	655087	5000952	Participating	Codington	6.6
1791	654852	5000076	Participating	Codington	0.0
1794	653693	5000273	Participating	Codington	20.3
1799	645387	4999932	Non-Participating	Codington	0.0
1805	644357	5002651	Participating	Grant	0.0
1809	647235	5001567	Participating	Grant	0.0
1815	648971	5002809	Non-Participating	Grant	0.0
1821	649665	5003051	Non-Participating	Grant	0.0
1828	650524	5003104	Participating	Grant	0.0
1832	651108	5003102	Participating	Grant	2.2
1837	651910	5003058	Non-Participating	Grant	0.0
1840	650833	5001658	Non-Participating	Grant	0.0
1847	652661	5002766	Participating	Grant	0.0
1849	653531	5002925	Non-Participating	Grant	3.8

Receptor ID	Receptor Coordinates (UTM Zone 14, NAD 83)		Participation Status	County	Predicted Shadow Flicker Hours/Year
	Easting (m)	Northing (m)			
1850	653518	5002857	Non-Participating	Grant	3.0
1867	661784	5001742	Participating	Grant	0.0
1870	661127	5001722	Participating	Grant	0.0
1874	663970	5002020	Non-Participating	Grant	0.0
1884	664756	5004487	Participating	Grant	0.0
1885	664644	5004251	Non-Participating	Grant	0.0
1888	663576	5004902	Non-Participating	Grant	0.0
1904	658165	5003370	Non-Participating	Grant	0.0
1908	655166	5002087	Non-Participating	Grant	0.0
1914	653600	5003245	Participating	Grant	3.9
1915	653457	5004344	Participating	Grant	26.6
1919	651979	5003440	Participating	Grant	0.0
1928	649364	5003248	Participating	Grant	0.0
1937	648978	5004009	Non-Participating	Grant	0.0
1938	647494	5004033	Non-Participating	Grant	0.0
1947	647511	5006002	Non-Participating	Grant	0.0
1953	648855	5004825	Non-Participating	Grant	0.0
1955	648977	5004832	Non-Participating	Grant	0.0
1957	649090	5004809	Non-Participating	Grant	0.0
1962	649046	5006118	Participating	Grant	0.0
1968	648970	5006430	Non-Participating	Grant	0.0
1970	646969	5006521	Non-Participating	Grant	0.0
1976	647304	5007251	Participating	Grant	0.0
1976a	647274	5007128	Participating	Grant	0.0
1985	648481	5007490	Participating	Grant	1.4
1988	649022	5007624	Non-Participating	Grant	9.2
1991	649187	5007078	Non-Participating	Grant	10.0
1991a	649207	5007154	Non-Participating	Grant	10.7
1991b	649069	5007217	Non-Participating	Grant	7.5
1994	650685	5006150	Non-Participating	Grant	2.2
1995	650838	5006169	Non-Participating	Grant	2.9
2005	650627	5005202	Participating	Grant	0.0
2007	661518	5004784	Participating	Grant	0.0
2008	661243	5005003	Non-Participating	Grant	0.0
2012	661600	5003749	Participating	Grant	0.0
2018	659717	5002264	Non-Participating	Grant	0.0
2020	658319	5004153	Non-Participating	Grant	0.0
2022	650528	4993062	Non-Participating	Codington	0.0
2024	649872	4991904	Participating	Codington	0.0
2025	649922	4991918	Participating	Codington	0.0
2038	646744	4996588	Non-Participating	Codington	0.0
2041	653594	5006202	Non-Participating	Grant	20.5
2066	664806	5006460	Non-Participating	Grant	0.0
2074	663797	5005086	Non-Participating	Grant	0.0
2080	657770	5004970	Non-Participating	Grant	0.0
2085	655202	5004866	Non-Participating	Grant	1.8
2086	653613	5006756	Participating	Grant	23.7
2099	664537	5007281	Non-Participating	Grant	0.0

Receptor ID	Receptor Coordinates (UTM Zone 14, NAD 83)		Participation Status	County	Predicted Shadow Flicker Hours/Year
	Easting (m)	Northing (m)			
2107	664924	5006726	Non-Participating	Grant	0.0
2141	661511	5009230	Non-Participating	Grant	0.0
2149	657735	5008810	Participating	Grant	11.4
2149a	657743	5008855	Participating	Grant	8.3
2153	657619	5009595	Participating	Grant	21.2
2158	655865	5008248	Participating	Grant	0.0
2168	653412	5009060	Participating	Grant	15.3
2182	652821	5009387	Non-Participating	Grant	7.2
2182a	652790	5009416	Non-Participating	Grant	4.5
2193	652045	5009239	Non-Participating	Grant	0.8
2195	650621	5009376	Non-Participating	Grant	6.5
2195a	650638	5009376	Non-Participating	Grant	6.5
2205	650503	5009034	Non-Participating	Grant	9.2
2212	650494	5008777	Non-Participating	Grant	13.1
2214	645841	5008575	Participating	Grant	0.0
2217	645709	5008004	Participating	Grant	0.0
2218	645721	5008021	Participating	Grant	0.0
2219	645631	5008057	Participating	Grant	0.0
2230	644923	5009430	Participating	Grant	0.0
2230a	644923	5009495	Participating	Grant	0.0
2236	646375	5009625	Non-Participating	Grant	0.0
2239	647229	5010860	Non-Participating	Grant	0.0
2240	649025	5010906	Non-Participating	Grant	0.0
2242	648974	5010823	Non-Participating	Grant	0.0
2243	650458	5010136	Non-Participating	Grant	4.0
2251	653709	5011042	Participating	Grant	7.6
2257	655074	5009887	Participating	Grant	4.4
2260	658287	5009765	Non-Participating	Grant	3.1
2270	645592	5011331	Non-Participating	Grant	0.0
2271	646356	5011254	Non-Participating	Grant	0.0
2277	647395	5011472	Non-Participating	Grant	0.0
2279	653707	5011413	Non-Participating	Grant	0.0
2280	653707	5011446	Non-Participating	Grant	0.0
2281	653705	5011489	Non-Participating	Grant	0.0
2287	657521	5013443	Non-Participating	Grant	0.0
2290	657918	5013363	Non-Participating	Grant	0.0
2290a	657897	5013379	Non-Participating	Grant	0.0
2315	649019	4991139	Non-Participating	Codington	0.0
2318	648352	4991903	Participating	Codington	0.0
2339	649064	4992930	Non-Participating	Codington	0.0
2347	649280	4993534	Non-Participating	Codington	0.0
2348	649271	4993557	Non-Participating	Codington	0.0
2353	647627	4993445	Non-Participating	Codington	0.0
2356	647698	4993970	Non-Participating	Codington	0.0
2364	651457	4993587	Non-Participating	Codington	0.0
2368	651076	4993540	Non-Participating	Codington	0.0
2372	658654	4990393	Non-Participating	Codington	0.0
2416	643160	5007930	Non-Participating	Grant	0.0

Receptor ID	Receptor Coordinates (UTM Zone 14, NAD 83)		Participation Status	County	Predicted Shadow Flicker Hours/Year
	Easting (m)	Northing (m)			
2424	643939	5009640	Non-Participating	Grant	0.0
2426	644856	5009638	Non-Participating	Grant	0.0
2449	650900	5006334	Non-Participating	Grant	3.3
2455	651982	5003185	Non-Participating	Grant	0.0
2496	653626	5003190	Participating	Grant	4.8
2500	644112	5010598	Non-Participating	Grant	0.0
2501	645580	5010730	Non-Participating	Grant	0.0
2502	652828	5009872	Non-Participating	Grant	0.0
2503	659098	5009616	Non-Participating	Grant	0.0

Table 6. Scenario A Results by Modeled Receptor (Sorted by Hours/Year)

Receptor ID	Receptor Coordinates (UTM Zone 14, NAD 83)		Participation Status	County	Predicted Shadow Flicker Hours/Year
	Easting (m)	Northing (m)			
1784	655170	5001262	Non-Participating	Codington	27.0
1915	653457	5004344	Participating	Grant	26.6
2086	653613	5006756	Participating	Grant	23.7
2153	657619	5009595	Participating	Grant	21.2
1697	655254	4997957	Participating	Codington	20.6
2041	653594	5006202	Non-Participating	Grant	20.5
1794	653693	5000273	Participating	Codington	20.3
1695	654385	4996688	Non-Participating	Codington	17.4
1698	655366	4998312	Non-Participating	Codington	17.3
2168	653412	5009060	Participating	Grant	15.3
2212	650494	5008777	Non-Participating	Grant	13.1
2149	657735	5008810	Participating	Grant	11.4
1991a	649207	5007154	Non-Participating	Grant	10.7
1991	649187	5007078	Non-Participating	Grant	10.0
1988	649022	5007624	Non-Participating	Grant	9.2
2205	650503	5009034	Non-Participating	Grant	9.2
2149a	657743	5008855	Participating	Grant	8.3
1782	658372	5001257	Non-Participating	Codington	8.0
2251	653709	5011042	Participating	Grant	7.6
1991b	649069	5007217	Non-Participating	Grant	7.5
1705	656685	4997836	Non-Participating	Codington	7.4
2182	652821	5009387	Non-Participating	Grant	7.2
1787	655087	5000952	Participating	Codington	6.6
2195	650621	5009376	Non-Participating	Grant	6.5
2195a	650638	5009376	Non-Participating	Grant	6.5
1717	656868	4998570	Non-Participating	Codington	4.9
2496	653626	5003190	Participating	Grant	4.8
2182a	652790	5009416	Non-Participating	Grant	4.5
2257	655074	5009887	Participating	Grant	4.4
2243	650458	5010136	Non-Participating	Grant	4.0
1914	653600	5003245	Participating	Grant	3.9
1849	653531	5002925	Non-Participating	Grant	3.8

Receptor ID	Receptor Coordinates (UTM Zone 14, NAD 83)		Participation Status	County	Predicted Shadow Flicker Hours/Year
	Easting (m)	Northing (m)			
2449	650900	5006334	Non-Participating	Grant	3.3
2260	658287	5009765	Non-Participating	Grant	3.1
1850	653518	5002857	Non-Participating	Grant	3.0
1995	650838	5006169	Non-Participating	Grant	2.9
1688	653778	4996826	Non-Participating	Codington	2.5
1710	656977	4997093	Non-Participating	Codington	2.2
1832	651108	5003102	Participating	Grant	2.2
1994	650685	5006150	Non-Participating	Grant	2.2
2085	655202	5004866	Non-Participating	Grant	1.8
1985	648481	5007490	Participating	Grant	1.4
1721	657770	4996904	Non-Participating	Codington	1.1
1722	657793	4996940	Non-Participating	Codington	1.1
2193	652045	5009239	Non-Participating	Grant	0.8
1406	652416	4988919	Non-Participating	Codington	0.0
1412	654042	4988526	Non-Participating	Codington	0.0
1419	654682	4990406	Participating	Codington	0.0
1420	655847	4989588	Participating	Codington	0.0
1425	656835	4990400	Participating	Codington	0.0
1434	657862	4991817	Non-Participating	Codington	0.0
1436	659447	4992233	Non-Participating	Codington	0.0
1437	659433	4992153	Non-Participating	Codington	0.0
1470	653858	4990720	Participating	Codington	0.0
1472	653951	4991544	Participating	Codington	0.0
1476	653550	4991972	Non-Participating	Codington	0.0
1481	652432	4989894	Non-Participating	Codington	0.0
1482	652414	4990051	Participating	Codington	0.0
1489	651609	4990365	Non-Participating	Codington	0.0
1497	650662	4989915	Non-Participating	Codington	0.0
1498	650857	4990054	Non-Participating	Codington	0.0
1503	650658	4990853	Non-Participating	Codington	0.0
1510	650693	4992058	Non-Participating	Codington	0.0
1511	650707	4992321	Participating	Codington	0.0
1520	652311	4992164	Non-Participating	Codington	0.0
1528	653395	4993505	Participating	Codington	0.0
1537	655804	4993536	Non-Participating	Codington	0.0
1540	656798	4994383	Non-Participating	Codington	0.0
1546	657465	4995164	Non-Participating	Codington	0.0
1554	658362	4995128	Non-Participating	Codington	0.0
1555	658579	4995244	Non-Participating	Codington	0.0
1564	656622	4995251	Non-Participating	Codington	0.0
1575	655955	4995240	Non-Participating	Codington	0.0
1584	654917	4995237	Non-Participating	Codington	0.0
1588	653838	4995578	Non-Participating	Codington	0.0
1590	652996	4995886	Non-Participating	Codington	0.0
1591	652437	4996048	Non-Participating	Codington	0.0
1595	650593	4996054	Non-Participating	Codington	0.0
1596	650496	4995587	Non-Participating	Codington	0.0
1599	650637	4995303	Non-Participating	Codington	0.0

Receptor ID	Receptor Coordinates (UTM Zone 14, NAD 83)		Participation Status	County	Predicted Shadow Flicker Hours/Year
	Easting (m)	Northing (m)			
1614	650527	4994742	Non-Participating	Codington	0.0
1618	648862	4994650	Non-Participating	Codington	0.0
1624	648375	4996645	Participating	Codington	0.0
1635	647648	4997080	Non-Participating	Codington	0.0
1639	647523	4997800	Non-Participating	Codington	0.0
1647	649155	4997753	Non-Participating	Codington	0.0
1653	650473	4996848	Participating	Codington	0.0
1659	650596	4997697	Non-Participating	Codington	0.0
1666	647489	4998353	Non-Participating	Codington	0.0
1669	649341	4999050	Participating	Codington	0.0
1675	651994	4999721	Non-Participating	Codington	0.0
1684	653787	4998023	Non-Participating	Codington	0.0
1684a	653823	4998032	Non-Participating	Codington	0.0
1725	656816	4999863	Non-Participating	Codington	0.0
1745	647461	5000525	Non-Participating	Codington	0.0
1746	647456	5000456	Non-Participating	Codington	0.0
1749	648160	5000058	Participating	Codington	0.0
1759	648809	4999992	Non-Participating	Codington	0.0
1762	649064	5001386	Non-Participating	Codington	0.0
1764	663179	5001621	Non-Participating	Codington	0.0
1772	661543	5000761	Non-Participating	Codington	0.0
1791	654852	5000076	Participating	Codington	0.0
1799	645387	4999932	Non-Participating	Codington	0.0
1805	644357	5002651	Participating	Grant	0.0
1809	647235	5001567	Participating	Grant	0.0
1815	648971	5002809	Non-Participating	Grant	0.0
1821	649665	5003051	Non-Participating	Grant	0.0
1828	650524	5003104	Participating	Grant	0.0
1837	651910	5003058	Non-Participating	Grant	0.0
1840	650833	5001658	Non-Participating	Grant	0.0
1847	652661	5002766	Participating	Grant	0.0
1867	661784	5001742	Participating	Grant	0.0
1870	661127	5001722	Participating	Grant	0.0
1874	663970	5002020	Non-Participating	Grant	0.0
1884	664756	5004487	Participating	Grant	0.0
1885	664644	5004251	Non-Participating	Grant	0.0
1888	663576	5004902	Non-Participating	Grant	0.0
1904	658165	5003370	Non-Participating	Grant	0.0
1908	655166	5002087	Non-Participating	Grant	0.0
1919	651979	5003440	Participating	Grant	0.0
1928	649364	5003248	Participating	Grant	0.0
1937	648978	5004009	Non-Participating	Grant	0.0
1938	647494	5004033	Non-Participating	Grant	0.0
1947	647511	5006002	Non-Participating	Grant	0.0
1953	648855	5004825	Non-Participating	Grant	0.0
1955	648977	5004832	Non-Participating	Grant	0.0
1957	649090	5004809	Non-Participating	Grant	0.0
1962	649046	5006118	Participating	Grant	0.0

Receptor ID	Receptor Coordinates (UTM Zone 14, NAD 83)		Participation Status	County	Predicted Shadow Flicker Hours/Year
	Easting (m)	Northing (m)			
1968	648970	5006430	Non-Participating	Grant	0.0
1970	646969	5006521	Non-Participating	Grant	0.0
1976	647304	5007251	Participating	Grant	0.0
1976a	647274	5007128	Participating	Grant	0.0
2005	650627	5005202	Participating	Grant	0.0
2007	661518	5004784	Participating	Grant	0.0
2008	661243	5005003	Non-Participating	Grant	0.0
2012	661600	5003749	Participating	Grant	0.0
2018	659717	5002264	Non-Participating	Grant	0.0
2020	658319	5004153	Non-Participating	Grant	0.0
2022	650528	4993062	Non-Participating	Codington	0.0
2024	649872	4991904	Participating	Codington	0.0
2025	649922	4991918	Participating	Codington	0.0
2038	646744	4996588	Non-Participating	Codington	0.0
2066	664806	5006460	Non-Participating	Grant	0.0
2074	663797	5005086	Non-Participating	Grant	0.0
2080	657770	5004970	Non-Participating	Grant	0.0
2099	664537	5007281	Non-Participating	Grant	0.0
2107	664924	5006726	Non-Participating	Grant	0.0
2141	661511	5009230	Non-Participating	Grant	0.0
2158	655865	5008248	Participating	Grant	0.0
2214	645841	5008575	Participating	Grant	0.0
2217	645709	5008004	Participating	Grant	0.0
2218	645721	5008021	Participating	Grant	0.0
2219	645631	5008057	Participating	Grant	0.0
2230	644923	5009430	Participating	Grant	0.0
2230a	644923	5009495	Participating	Grant	0.0
2236	646375	5009625	Non-Participating	Grant	0.0
2239	647229	5010860	Non-Participating	Grant	0.0
2240	649025	5010906	Non-Participating	Grant	0.0
2242	648974	5010823	Non-Participating	Grant	0.0
2270	645592	5011331	Non-Participating	Grant	0.0
2271	646356	5011254	Non-Participating	Grant	0.0
2277	647395	5011472	Non-Participating	Grant	0.0
2279	653707	5011413	Non-Participating	Grant	0.0
2280	653707	5011446	Non-Participating	Grant	0.0
2281	653705	5011489	Non-Participating	Grant	0.0
2287	657521	5013443	Non-Participating	Grant	0.0
2290	657918	5013363	Non-Participating	Grant	0.0
2290a	657897	5013379	Non-Participating	Grant	0.0
2315	649019	4991139	Non-Participating	Codington	0.0
2318	648352	4991903	Participating	Codington	0.0
2339	649064	4992930	Non-Participating	Codington	0.0
2347	649280	4993534	Non-Participating	Codington	0.0
2348	649271	4993557	Non-Participating	Codington	0.0
2353	647627	4993445	Non-Participating	Codington	0.0
2356	647698	4993970	Non-Participating	Codington	0.0
2364	651457	4993587	Non-Participating	Codington	0.0

Receptor ID	Receptor Coordinates (UTM Zone 14, NAD 83)		Participation Status	County	Predicted Shadow Flicker Hours/Year
	Easting (m)	Northing (m)			
2368	651076	4993540	Non-Participating	Codington	0.0
2372	658654	4990393	Non-Participating	Codington	0.0
2416	643160	5007930	Non-Participating	Grant	0.0
2424	643939	5009640	Non-Participating	Grant	0.0
2426	644856	5009638	Non-Participating	Grant	0.0
2455	651982	5003185	Non-Participating	Grant	0.0
2500	644112	5010598	Non-Participating	Grant	0.0
2501	645580	5010730	Non-Participating	Grant	0.0
2502	652828	5009872	Non-Participating	Grant	0.0
2503	659098	5009616	Non-Participating	Grant	0.0

Table 7. Scenario B Results by Modeled Receptor

Receptor ID	Receptor Coordinates (UTM Zone 14, NAD 83)		Participation Status	County	Predicted Shadow Flicker Hours/Year
	Easting (m)	Northing (m)			
1406	652416	4988919	Non-Participating	Codington	0.0
1412	654042	4988526	Non-Participating	Codington	0.0
1419	654682	4990406	Participating	Codington	0.0
1420	655847	4989588	Participating	Codington	0.0
1425	656835	4990400	Participating	Codington	0.0
1434	657862	4991817	Non-Participating	Codington	0.0
1436	659447	4992233	Non-Participating	Codington	0.0
1437	659433	4992153	Non-Participating	Codington	0.0
1470	653858	4990720	Participating	Codington	0.0
1472	653951	4991544	Participating	Codington	0.0
1476	653550	4991972	Non-Participating	Codington	0.0
1481	652432	4989894	Non-Participating	Codington	0.0
1482	652414	4990051	Participating	Codington	0.0
1489	651609	4990365	Non-Participating	Codington	0.0
1497	650662	4989915	Non-Participating	Codington	0.0
1498	650857	4990054	Non-Participating	Codington	0.0
1503	650658	4990853	Non-Participating	Codington	0.0
1510	650693	4992058	Non-Participating	Codington	0.0
1511	650707	4992321	Participating	Codington	0.0
1520	652311	4992164	Non-Participating	Codington	0.0
1528	653395	4993505	Participating	Codington	0.0
1537	655804	4993536	Non-Participating	Codington	0.0
1540	656798	4994383	Non-Participating	Codington	0.0
1546	657465	4995164	Non-Participating	Codington	0.0
1554	658362	4995128	Non-Participating	Codington	0.0
1555	658579	4995244	Non-Participating	Codington	0.0
1564	656622	4995251	Non-Participating	Codington	0.0
1575	655955	4995240	Non-Participating	Codington	0.0
1584	654917	4995237	Non-Participating	Codington	0.0
1588	653838	4995578	Non-Participating	Codington	0.0
1590	652996	4995886	Non-Participating	Codington	0.0

Receptor ID	Receptor Coordinates (UTM Zone 14, NAD 83)		Participation Status	County	Predicted Shadow Flicker Hours/Year
	Easting (m)	Northing (m)			
1591	652437	4996048	Non-Participating	Codington	0.0
1595	650593	4996054	Non-Participating	Codington	0.0
1596	650496	4995587	Non-Participating	Codington	0.0
1599	650637	4995303	Non-Participating	Codington	0.0
1614	650527	4994742	Non-Participating	Codington	0.0
1618	648862	4994650	Non-Participating	Codington	0.0
1624	648375	4996645	Participating	Codington	0.0
1635	647648	4997080	Non-Participating	Codington	0.0
1639	647523	4997800	Non-Participating	Codington	0.0
1647	649155	4997753	Non-Participating	Codington	0.0
1653	650473	4996848	Participating	Codington	0.0
1659	650596	4997697	Non-Participating	Codington	0.0
1666	647489	4998353	Non-Participating	Codington	0.0
1669	649341	4999050	Participating	Codington	0.0
1675	651994	4999721	Non-Participating	Codington	0.0
1684	653787	4998023	Non-Participating	Codington	2.2
1684a	653823	4998032	Non-Participating	Codington	2.3
1688	653778	4996826	Non-Participating	Codington	2.5
1695	654385	4996688	Non-Participating	Codington	17.4
1697	655254	4997957	Participating	Codington	20.6
1698	655366	4998312	Non-Participating	Codington	17.3
1705	656685	4997836	Non-Participating	Codington	8.1
1710	656977	4997093	Non-Participating	Codington	2.2
1717	656868	4998570	Non-Participating	Codington	4.9
1721	657770	4996904	Non-Participating	Codington	1.1
1722	657793	4996940	Non-Participating	Codington	1.1
1725	656816	4999863	Non-Participating	Codington	0.0
1745	647461	5000525	Non-Participating	Codington	0.0
1746	647456	5000456	Non-Participating	Codington	0.0
1749	648160	5000058	Participating	Codington	0.0
1759	648809	4999992	Non-Participating	Codington	0.0
1762	649064	5001386	Non-Participating	Codington	0.0
1764	663179	5001621	Non-Participating	Codington	0.0
1772	661543	5000761	Non-Participating	Codington	0.0
1782	658372	5001257	Non-Participating	Codington	8.0
1784	655170	5001262	Non-Participating	Codington	27.0
1787	655087	5000952	Participating	Codington	6.6
1791	654852	5000076	Participating	Codington	0.0
1794	653693	5000273	Participating	Codington	20.3
1799	645387	4999932	Non-Participating	Codington	0.0
1805	644357	5002651	Participating	Grant	0.0
1809	647235	5001567	Participating	Grant	0.0
1815	648971	5002809	Non-Participating	Grant	0.0
1821	649665	5003051	Non-Participating	Grant	0.0
1828	650524	5003104	Participating	Grant	0.0
1832	651108	5003102	Participating	Grant	2.2
1837	651910	5003058	Non-Participating	Grant	0.0
1840	650833	5001658	Non-Participating	Grant	0.0

Receptor ID	Receptor Coordinates (UTM Zone 14, NAD 83)		Participation Status	County	Predicted Shadow Flicker Hours/Year
	Easting (m)	Northing (m)			
1847	652661	5002766	Participating	Grant	0.0
1849	653531	5002925	Non-Participating	Grant	3.8
1850	653518	5002857	Non-Participating	Grant	3.0
1867	661784	5001742	Participating	Grant	0.0
1870	661127	5001722	Participating	Grant	0.0
1874	663970	5002020	Non-Participating	Grant	0.0
1884	664756	5004487	Participating	Grant	0.0
1885	664644	5004251	Non-Participating	Grant	0.0
1888	663576	5004902	Non-Participating	Grant	0.0
1904	658165	5003370	Non-Participating	Grant	0.0
1908	655166	5002087	Non-Participating	Grant	0.0
1914	653600	5003245	Participating	Grant	3.9
1915	653457	5004344	Participating	Grant	26.6
1919	651979	5003440	Participating	Grant	0.0
1928	649364	5003248	Participating	Grant	0.0
1937	648978	5004009	Non-Participating	Grant	0.0
1938	647494	5004033	Non-Participating	Grant	0.0
1947	647511	5006002	Non-Participating	Grant	2.8
1953	648855	5004825	Non-Participating	Grant	0.0
1955	648977	5004832	Non-Participating	Grant	0.0
1957	649090	5004809	Non-Participating	Grant	0.0
1962	649046	5006118	Participating	Grant	2.1
1968	648970	5006430	Non-Participating	Grant	3.2
1970	646969	5006521	Non-Participating	Grant	0.0
1976	647304	5007251	Participating	Grant	0.0
1976a	647274	5007128	Participating	Grant	0.0
1985	648481	5007490	Participating	Grant	1.4
1988	649022	5007624	Non-Participating	Grant	9.2
1991	649187	5007078	Non-Participating	Grant	10.0
1991a	649207	5007154	Non-Participating	Grant	10.7
1991b	649069	5007217	Non-Participating	Grant	7.5
1994	650685	5006150	Non-Participating	Grant	5.6
1995	650838	5006169	Non-Participating	Grant	4.7
2005	650627	5005202	Participating	Grant	0.2
2007	661518	5004784	Participating	Grant	0.0
2008	661243	5005003	Non-Participating	Grant	0.0
2012	661600	5003749	Participating	Grant	0.0
2018	659717	5002264	Non-Participating	Grant	0.0
2020	658319	5004153	Non-Participating	Grant	0.0
2022	650528	4993062	Non-Participating	Codington	0.0
2024	649872	4991904	Participating	Codington	0.0
2025	649922	4991918	Participating	Codington	0.0
2038	646744	4996588	Non-Participating	Codington	0.0
2041	653594	5006202	Non-Participating	Grant	20.5
2066	664806	5006460	Non-Participating	Grant	0.0
2074	663797	5005086	Non-Participating	Grant	0.0
2080	657770	5004970	Non-Participating	Grant	0.0
2085	655202	5004866	Non-Participating	Grant	1.8

Receptor ID	Receptor Coordinates (UTM Zone 14, NAD 83)		Participation Status	County	Predicted Shadow Flicker Hours/Year
	Easting (m)	Northing (m)			
2086	653613	5006756	Participating	Grant	23.7
2099	664537	5007281	Non-Participating	Grant	0.0
2107	664924	5006726	Non-Participating	Grant	0.0
2141	661511	5009230	Non-Participating	Grant	0.0
2149	657735	5008810	Participating	Grant	11.4
2149a	657743	5008855	Participating	Grant	8.3
2153	657619	5009595	Participating	Grant	21.2
2158	655865	5008248	Participating	Grant	0.0
2168	653412	5009060	Participating	Grant	15.3
2182	652821	5009387	Non-Participating	Grant	7.2
2182a	652790	5009416	Non-Participating	Grant	4.5
2193	652045	5009239	Non-Participating	Grant	0.8
2195	650621	5009376	Non-Participating	Grant	10.0
2195a	650638	5009376	Non-Participating	Grant	9.8
2205	650503	5009034	Non-Participating	Grant	12.8
2212	650494	5008777	Non-Participating	Grant	17.3
2214	645841	5008575	Participating	Grant	4.0
2217	645709	5008004	Participating	Grant	0.0
2218	645721	5008021	Participating	Grant	0.0
2219	645631	5008057	Participating	Grant	0.0
2230	644923	5009430	Participating	Grant	0.0
2230a	644923	5009495	Participating	Grant	0.0
2236	646375	5009625	Non-Participating	Grant	6.2
2239	647229	5010860	Non-Participating	Grant	0.0
2240	649025	5010906	Non-Participating	Grant	0.0
2242	648974	5010823	Non-Participating	Grant	0.0
2243	650458	5010136	Non-Participating	Grant	4.0
2251	653709	5011042	Participating	Grant	7.6
2257	655074	5009887	Participating	Grant	4.4
2260	658287	5009765	Non-Participating	Grant	3.1
2270	645592	5011331	Non-Participating	Grant	0.0
2271	646356	5011254	Non-Participating	Grant	0.0
2277	647395	5011472	Non-Participating	Grant	0.0
2279	653707	5011413	Non-Participating	Grant	0.0
2280	653707	5011446	Non-Participating	Grant	0.0
2281	653705	5011489	Non-Participating	Grant	0.0
2287	657521	5013443	Non-Participating	Grant	0.0
2290	657918	5013363	Non-Participating	Grant	0.0
2290a	657897	5013379	Non-Participating	Grant	0.0
2315	649019	4991139	Non-Participating	Codington	0.0
2318	648352	4991903	Participating	Codington	0.0
2339	649064	4992930	Non-Participating	Codington	0.0
2347	649280	4993534	Non-Participating	Codington	0.0
2348	649271	4993557	Non-Participating	Codington	0.0
2353	647627	4993445	Non-Participating	Codington	0.0
2356	647698	4993970	Non-Participating	Codington	0.0
2364	651457	4993587	Non-Participating	Codington	0.0
2368	651076	4993540	Non-Participating	Codington	0.0

Receptor ID	Receptor Coordinates (UTM Zone 14, NAD 83)		Participation Status	County	Predicted Shadow Flicker Hours/Year
	Easting (m)	Northing (m)			
2372	658654	4990393	Non-Participating	Codington	0.0
2416	643160	5007930	Non-Participating	Grant	0.0
2424	643939	5009640	Non-Participating	Grant	0.0
2426	644856	5009638	Non-Participating	Grant	0.0
2449	650900	5006334	Non-Participating	Grant	5.3
2455	651982	5003185	Non-Participating	Grant	0.0
2496	653626	5003190	Participating	Grant	4.8
2500	644112	5010598	Non-Participating	Grant	0.0
2501	645580	5010730	Non-Participating	Grant	0.0
2502	652828	5009872	Non-Participating	Grant	0.0
2503	659098	5009616	Non-Participating	Grant	0.0

Table 8. Scenario B Results by Modeled Receptor (Sorted by Hours/Year)

Receptor ID	Receptor Coordinates (UTM Zone 14, NAD 83)		Participation Status	County	Predicted Shadow Flicker Hours/Year
	Easting (m)	Northing (m)			
1784	655170	5001262	Non-Participating	Codington	27.0
1915	653457	5004344	Participating	Grant	26.6
2086	653613	5006756	Participating	Grant	23.7
2153	657619	5009595	Participating	Grant	21.2
1697	655254	4997957	Participating	Codington	20.6
2041	653594	5006202	Non-Participating	Grant	20.5
1794	653693	5000273	Participating	Codington	20.3
1695	654385	4996688	Non-Participating	Codington	17.4
2212	650494	5008777	Non-Participating	Grant	17.3
1698	655366	4998312	Non-Participating	Codington	17.3
2168	653412	5009060	Participating	Grant	15.3
2205	650503	5009034	Non-Participating	Grant	12.8
2149	657735	5008810	Participating	Grant	11.4
1991a	649207	5007154	Non-Participating	Grant	10.7
2195	650621	5009376	Non-Participating	Grant	10.0
1991	649187	5007078	Non-Participating	Grant	10.0
2195a	650638	5009376	Non-Participating	Grant	9.8
1988	649022	5007624	Non-Participating	Grant	9.2
2149a	657743	5008855	Participating	Grant	8.3
1705	656685	4997836	Non-Participating	Codington	8.1
1782	658372	5001257	Non-Participating	Codington	8.0
2251	653709	5011042	Participating	Grant	7.6
1991b	649069	5007217	Non-Participating	Grant	7.5
2182	652821	5009387	Non-Participating	Grant	7.2
1787	655087	5000952	Participating	Codington	6.6
2236	646375	5009625	Non-Participating	Grant	6.2
1994	650685	5006150	Non-Participating	Grant	5.6
2449	650900	5006334	Non-Participating	Grant	5.3
1717	656868	4998570	Non-Participating	Codington	4.9
2496	653626	5003190	Participating	Grant	4.8

Receptor ID	Receptor Coordinates (UTM Zone 14, NAD 83)		Participation Status	County	Predicted Shadow Flicker Hours/Year
	Easting (m)	Northing (m)			
1995	650838	5006169	Non-Participating	Grant	4.7
2182a	652790	5009416	Non-Participating	Grant	4.5
2257	655074	5009887	Participating	Grant	4.4
2243	650458	5010136	Non-Participating	Grant	4.0
2214	645841	5008575	Participating	Grant	4.0
1914	653600	5003245	Participating	Grant	3.9
1849	653531	5002925	Non-Participating	Grant	3.8
1968	648970	5006430	Non-Participating	Grant	3.2
2260	658287	5009765	Non-Participating	Grant	3.1
1850	653518	5002857	Non-Participating	Grant	3.0
1947	647511	5006002	Non-Participating	Grant	2.8
1688	653778	4996826	Non-Participating	Codington	2.5
1684a	653823	4998032	Non-Participating	Codington	2.3
1684	653787	4998023	Non-Participating	Codington	2.2
1710	656977	4997093	Non-Participating	Codington	2.2
1832	651108	5003102	Participating	Grant	2.2
1962	649046	5006118	Participating	Grant	2.1
2085	655202	5004866	Non-Participating	Grant	1.8
1985	648481	5007490	Participating	Grant	1.4
1721	657770	4996904	Non-Participating	Codington	1.1
1722	657793	4996940	Non-Participating	Codington	1.1
2193	652045	5009239	Non-Participating	Grant	0.8
2005	650627	5005202	Participating	Grant	0.2
1406	652416	4988919	Non-Participating	Codington	0.0
1412	654042	4988526	Non-Participating	Codington	0.0
1419	654682	4990406	Participating	Codington	0.0
1420	655847	4989588	Participating	Codington	0.0
1425	656835	4990400	Participating	Codington	0.0
1434	657862	4991817	Non-Participating	Codington	0.0
1436	659447	4992233	Non-Participating	Codington	0.0
1437	659433	4992153	Non-Participating	Codington	0.0
1470	653858	4990720	Participating	Codington	0.0
1472	653951	4991544	Participating	Codington	0.0
1476	653550	4991972	Non-Participating	Codington	0.0
1481	652432	4989894	Non-Participating	Codington	0.0
1482	652414	4990051	Participating	Codington	0.0
1489	651609	4990365	Non-Participating	Codington	0.0
1497	650662	4989915	Non-Participating	Codington	0.0
1498	650857	4990054	Non-Participating	Codington	0.0
1503	650658	4990853	Non-Participating	Codington	0.0
1510	650693	4992058	Non-Participating	Codington	0.0
1511	650707	4992321	Participating	Codington	0.0
1520	652311	4992164	Non-Participating	Codington	0.0
1528	653395	4993505	Participating	Codington	0.0
1537	655804	4993536	Non-Participating	Codington	0.0
1540	656798	4994383	Non-Participating	Codington	0.0
1546	657465	4995164	Non-Participating	Codington	0.0
1554	658362	4995128	Non-Participating	Codington	0.0

Receptor ID	Receptor Coordinates (UTM Zone 14, NAD 83)		Participation Status	County	Predicted Shadow Flicker Hours/Year
	Easting (m)	Northing (m)			
1555	658579	4995244	Non-Participating	Codington	0.0
1564	656622	4995251	Non-Participating	Codington	0.0
1575	655955	4995240	Non-Participating	Codington	0.0
1584	654917	4995237	Non-Participating	Codington	0.0
1588	653838	4995578	Non-Participating	Codington	0.0
1590	652996	4995886	Non-Participating	Codington	0.0
1591	652437	4996048	Non-Participating	Codington	0.0
1595	650593	4996054	Non-Participating	Codington	0.0
1596	650496	4995587	Non-Participating	Codington	0.0
1599	650637	4995303	Non-Participating	Codington	0.0
1614	650527	4994742	Non-Participating	Codington	0.0
1618	648862	4994650	Non-Participating	Codington	0.0
1624	648375	4996645	Participating	Codington	0.0
1635	647648	4997080	Non-Participating	Codington	0.0
1639	647523	4997800	Non-Participating	Codington	0.0
1647	649155	4997753	Non-Participating	Codington	0.0
1653	650473	4996848	Participating	Codington	0.0
1659	650596	4997697	Non-Participating	Codington	0.0
1666	647489	4998353	Non-Participating	Codington	0.0
1669	649341	4999050	Participating	Codington	0.0
1675	651994	4999721	Non-Participating	Codington	0.0
1725	656816	4999863	Non-Participating	Codington	0.0
1745	647461	5000525	Non-Participating	Codington	0.0
1746	647456	5000456	Non-Participating	Codington	0.0
1749	648160	5000058	Participating	Codington	0.0
1759	648809	4999992	Non-Participating	Codington	0.0
1762	649064	5001386	Non-Participating	Codington	0.0
1764	663179	5001621	Non-Participating	Codington	0.0
1772	661543	5000761	Non-Participating	Codington	0.0
1791	654852	5000076	Participating	Codington	0.0
1799	645387	4999932	Non-Participating	Codington	0.0
1805	644357	5002651	Participating	Grant	0.0
1809	647235	5001567	Participating	Grant	0.0
1815	648971	5002809	Non-Participating	Grant	0.0
1821	649665	5003051	Non-Participating	Grant	0.0
1828	650524	5003104	Participating	Grant	0.0
1837	651910	5003058	Non-Participating	Grant	0.0
1840	650833	5001658	Non-Participating	Grant	0.0
1847	652661	5002766	Participating	Grant	0.0
1867	661784	5001742	Participating	Grant	0.0
1870	661127	5001722	Participating	Grant	0.0
1874	663970	5002020	Non-Participating	Grant	0.0
1884	664756	5004487	Participating	Grant	0.0
1885	664644	5004251	Non-Participating	Grant	0.0
1888	663576	5004902	Non-Participating	Grant	0.0
1904	658165	5003370	Non-Participating	Grant	0.0
1908	655166	5002087	Non-Participating	Grant	0.0
1919	651979	5003440	Participating	Grant	0.0

Receptor ID	Receptor Coordinates (UTM Zone 14, NAD 83)		Participation Status	County	Predicted Shadow Flicker Hours/Year
	Easting (m)	Northing (m)			
1928	649364	5003248	Participating	Grant	0.0
1937	648978	5004009	Non-Participating	Grant	0.0
1938	647494	5004033	Non-Participating	Grant	0.0
1953	648855	5004825	Non-Participating	Grant	0.0
1955	648977	5004832	Non-Participating	Grant	0.0
1957	649090	5004809	Non-Participating	Grant	0.0
1970	646969	5006521	Non-Participating	Grant	0.0
1976	647304	5007251	Participating	Grant	0.0
1976a	647274	5007128	Participating	Grant	0.0
2007	661518	5004784	Participating	Grant	0.0
2008	661243	5005003	Non-Participating	Grant	0.0
2012	661600	5003749	Participating	Grant	0.0
2018	659717	5002264	Non-Participating	Grant	0.0
2020	658319	5004153	Non-Participating	Grant	0.0
2022	650528	4993062	Non-Participating	Codington	0.0
2024	649872	4991904	Participating	Codington	0.0
2025	649922	4991918	Participating	Codington	0.0
2038	646744	4996588	Non-Participating	Codington	0.0
2066	664806	5006460	Non-Participating	Grant	0.0
2074	663797	5005086	Non-Participating	Grant	0.0
2080	657770	5004970	Non-Participating	Grant	0.0
2099	664537	5007281	Non-Participating	Grant	0.0
2107	664924	5006726	Non-Participating	Grant	0.0
2141	661511	5009230	Non-Participating	Grant	0.0
2158	655865	5008248	Participating	Grant	0.0
2217	645709	5008004	Participating	Grant	0.0
2218	645721	5008021	Participating	Grant	0.0
2219	645631	5008057	Participating	Grant	0.0
2230	644923	5009430	Participating	Grant	0.0
2230a	644923	5009495	Participating	Grant	0.0
2239	647229	5010860	Non-Participating	Grant	0.0
2240	649025	5010906	Non-Participating	Grant	0.0
2242	648974	5010823	Non-Participating	Grant	0.0
2270	645592	5011331	Non-Participating	Grant	0.0
2271	646356	5011254	Non-Participating	Grant	0.0
2277	647395	5011472	Non-Participating	Grant	0.0
2279	653707	5011413	Non-Participating	Grant	0.0
2280	653707	5011446	Non-Participating	Grant	0.0
2281	653705	5011489	Non-Participating	Grant	0.0
2287	657521	5013443	Non-Participating	Grant	0.0
2290	657918	5013363	Non-Participating	Grant	0.0
2290a	657897	5013379	Non-Participating	Grant	0.0
2315	649019	4991139	Non-Participating	Codington	0.0
2318	648352	4991903	Participating	Codington	0.0
2339	649064	4992930	Non-Participating	Codington	0.0
2347	649280	4993534	Non-Participating	Codington	0.0
2348	649271	4993557	Non-Participating	Codington	0.0
2353	647627	4993445	Non-Participating	Codington	0.0

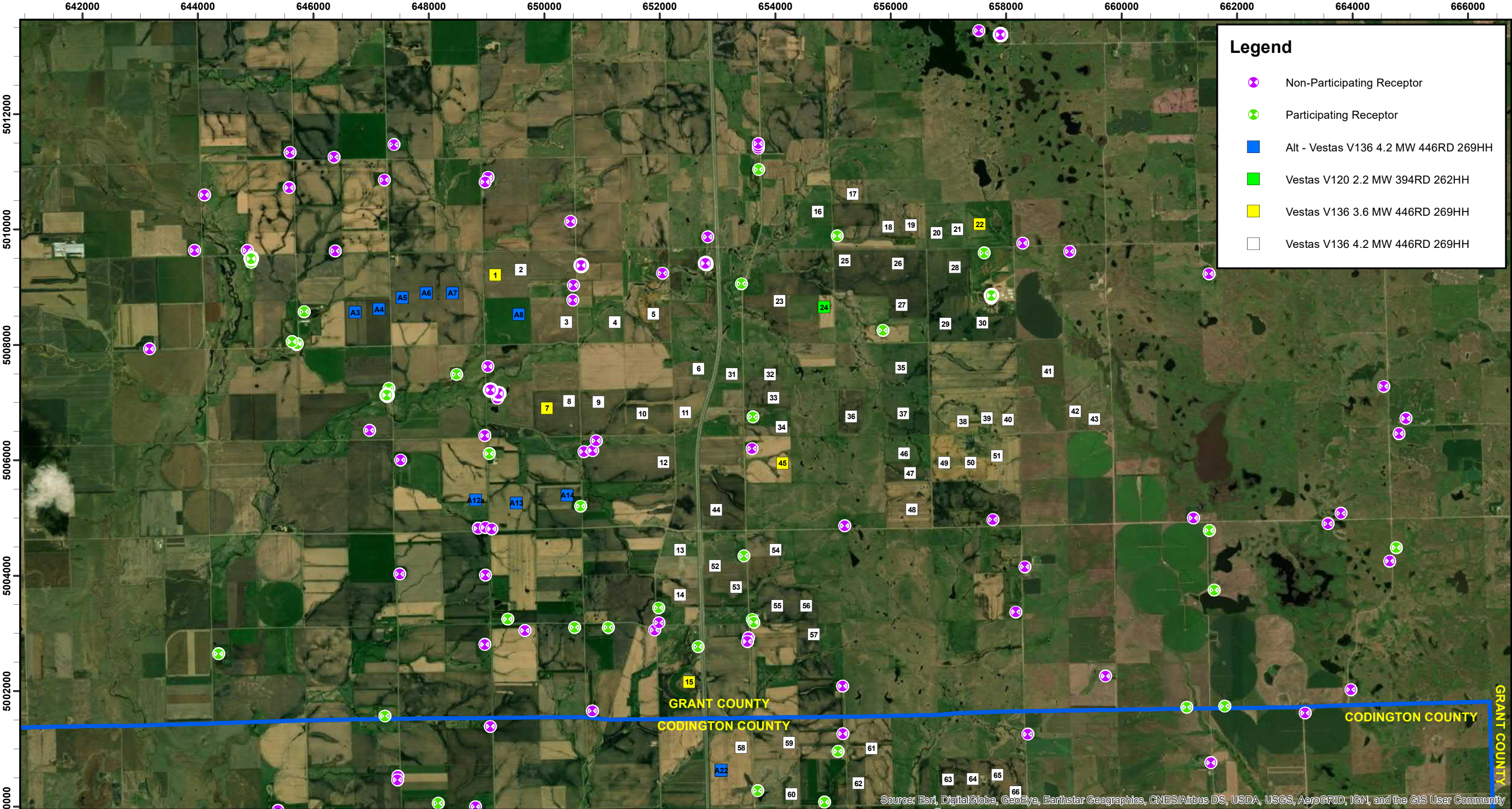
Receptor ID	Receptor Coordinates (UTM Zone 14, NAD 83)		Participation Status	County	Predicted Shadow Flicker Hours/Year
	Easting (m)	Northing (m)			
2356	647698	4993970	Non-Participating	Codington	0.0
2364	651457	4993587	Non-Participating	Codington	0.0
2368	651076	4993540	Non-Participating	Codington	0.0
2372	658654	4990393	Non-Participating	Codington	0.0
2416	643160	5007930	Non-Participating	Grant	0.0
2424	643939	5009640	Non-Participating	Grant	0.0
2426	644856	5009638	Non-Participating	Grant	0.0
2455	651982	5003185	Non-Participating	Grant	0.0
2500	644112	5010598	Non-Participating	Grant	0.0
2501	645580	5010730	Non-Participating	Grant	0.0
2502	652828	5009872	Non-Participating	Grant	0.0
2503	659098	5009616	Non-Participating	Grant	0.0

Table 9. Scenario B Statistical Summary of Predicted Shadow Flicker at Receptors

Total Shadow Flicker Time (predicted)	Number of Receptors
Total	186
= 0 Hours	133
> 0 Hours < 10 Hours	38
> 10 Hours < 20 Hours	8
> 20 Hours < 30 Hours	7

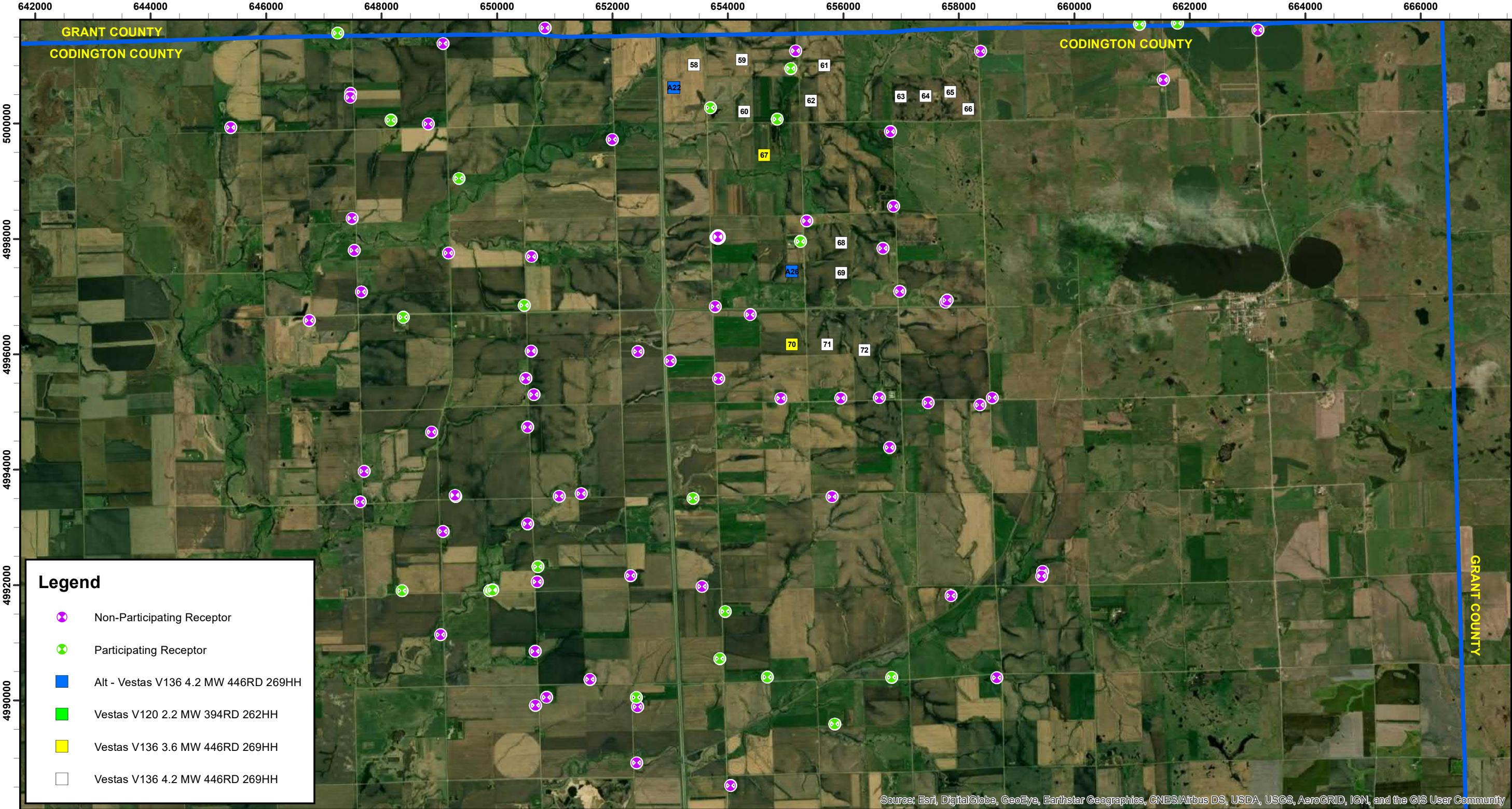
Source: AECOM 2020

Figures

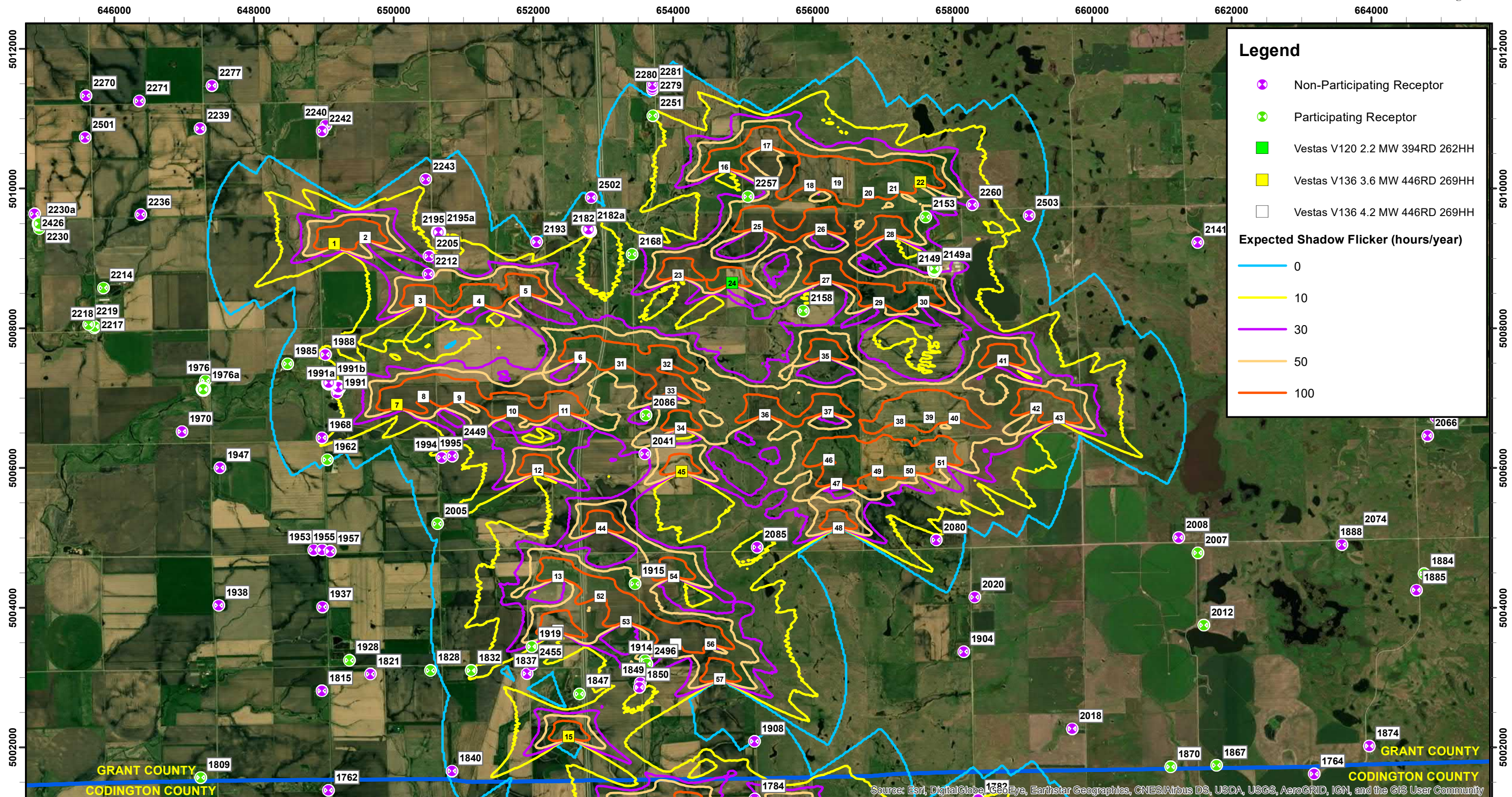


Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

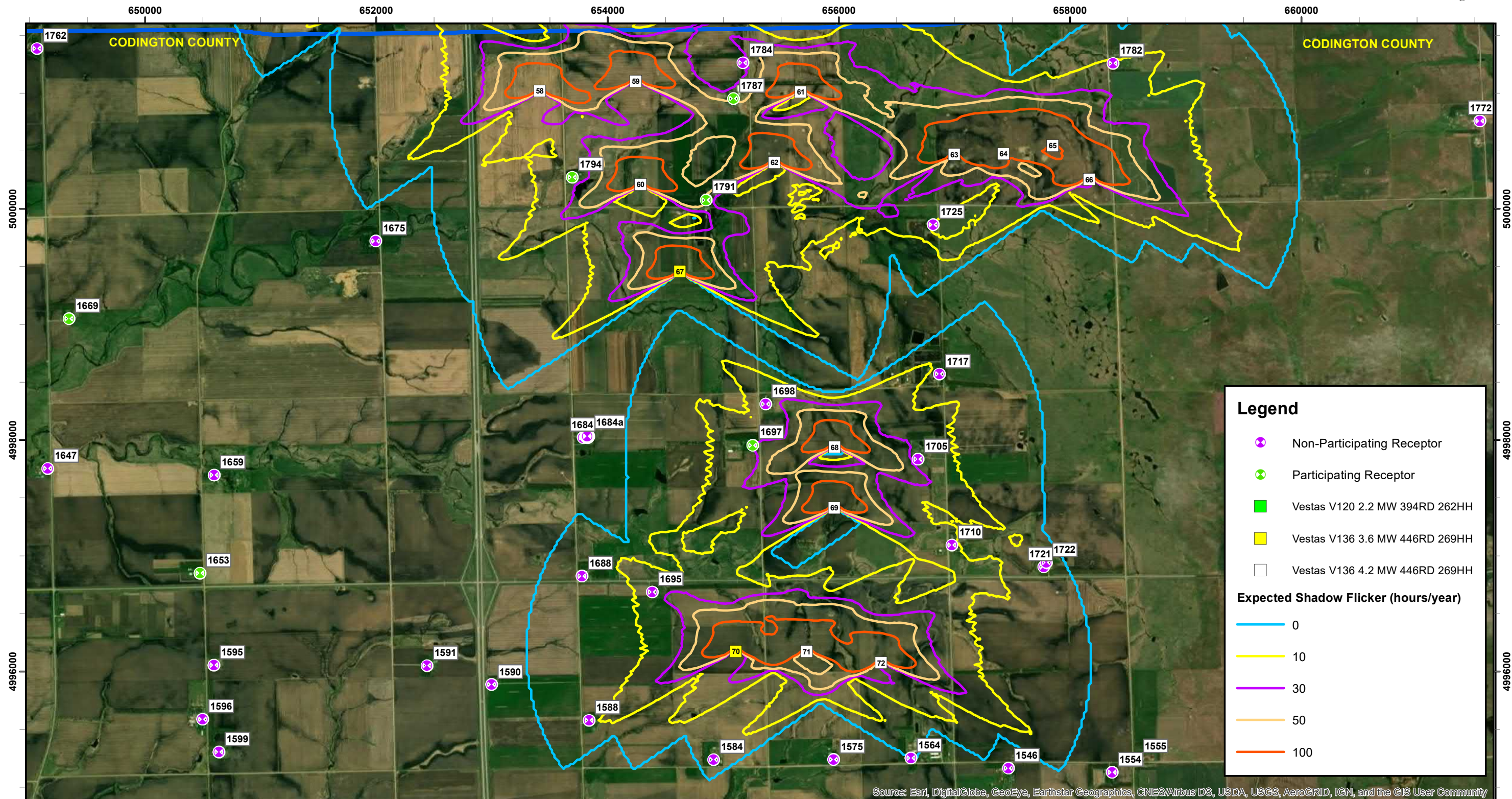
	Date Created: 7/29/2020 Created by: MK	Turbine and Receptor Locations Dakota Range Wind Energy Project Codington and Grant Counties, SD	Figure 1a
			



	Date Created: 7/29/2020	Turbine and Receptor Locations Dakota Range Wind Energy Project Codington and Grant Counties, SD	Figure 1b
	Created by: MK		
			



	Date Created: 7/29/2020	Expected Shadow Flicker (Hours/Year) No Alternates	Figure 2a
	Created by: MK		
	Dakota Range Wind Energy Project Codington and Grant Counties, SD		

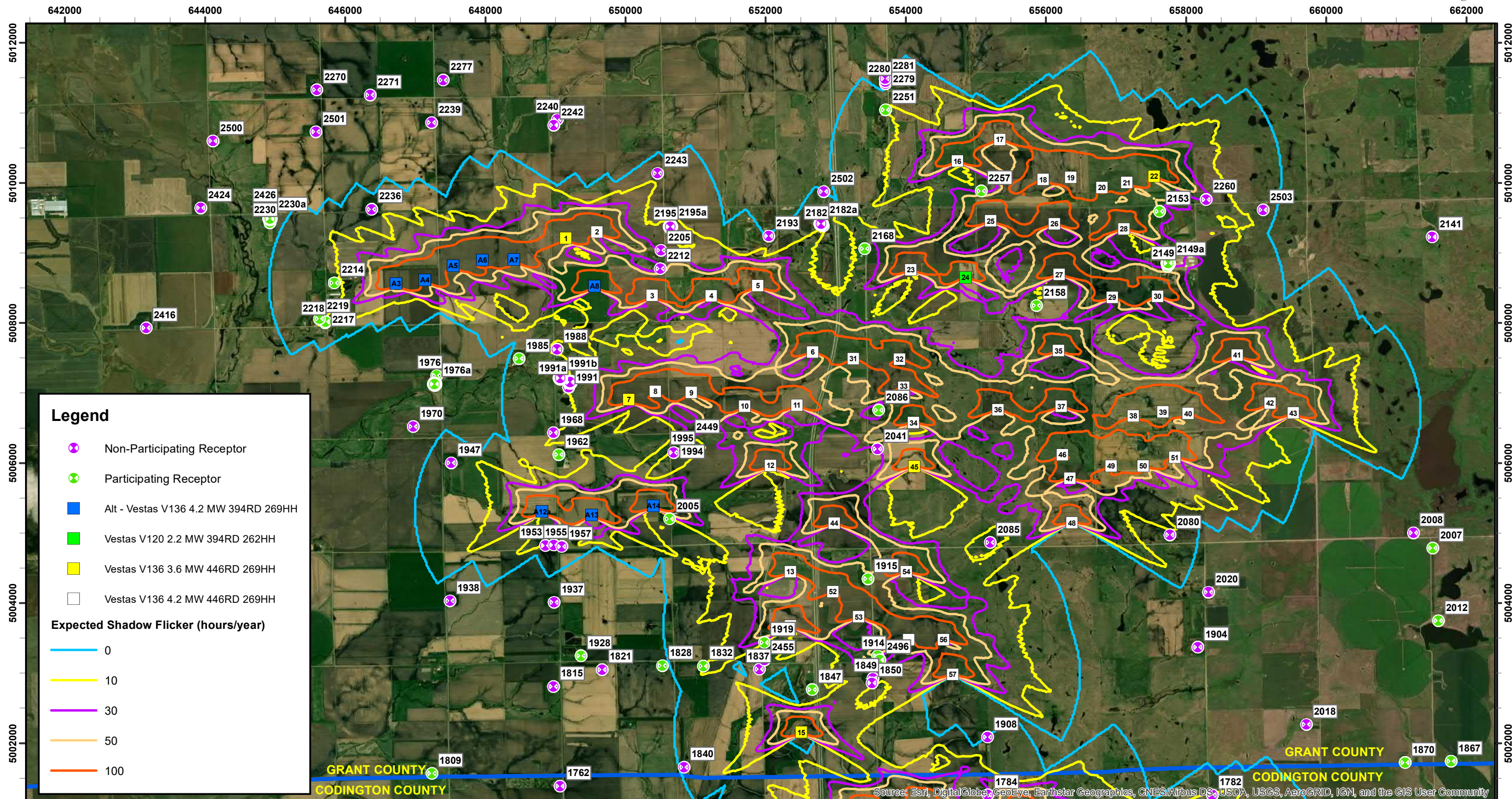


Legend

- Non-Participating Receptor
- Participating Receptor
- Vestas V120 2.2 MW 394RD 262HH
- Vestas V136 3.6 MW 446RD 269HH
- Vestas V136 4.2 MW 446RD 269HH

Expected Shadow Flicker (hours/year)

- 0
- 10
- 30
- 50
- 100



Date Created:
7/29/2020

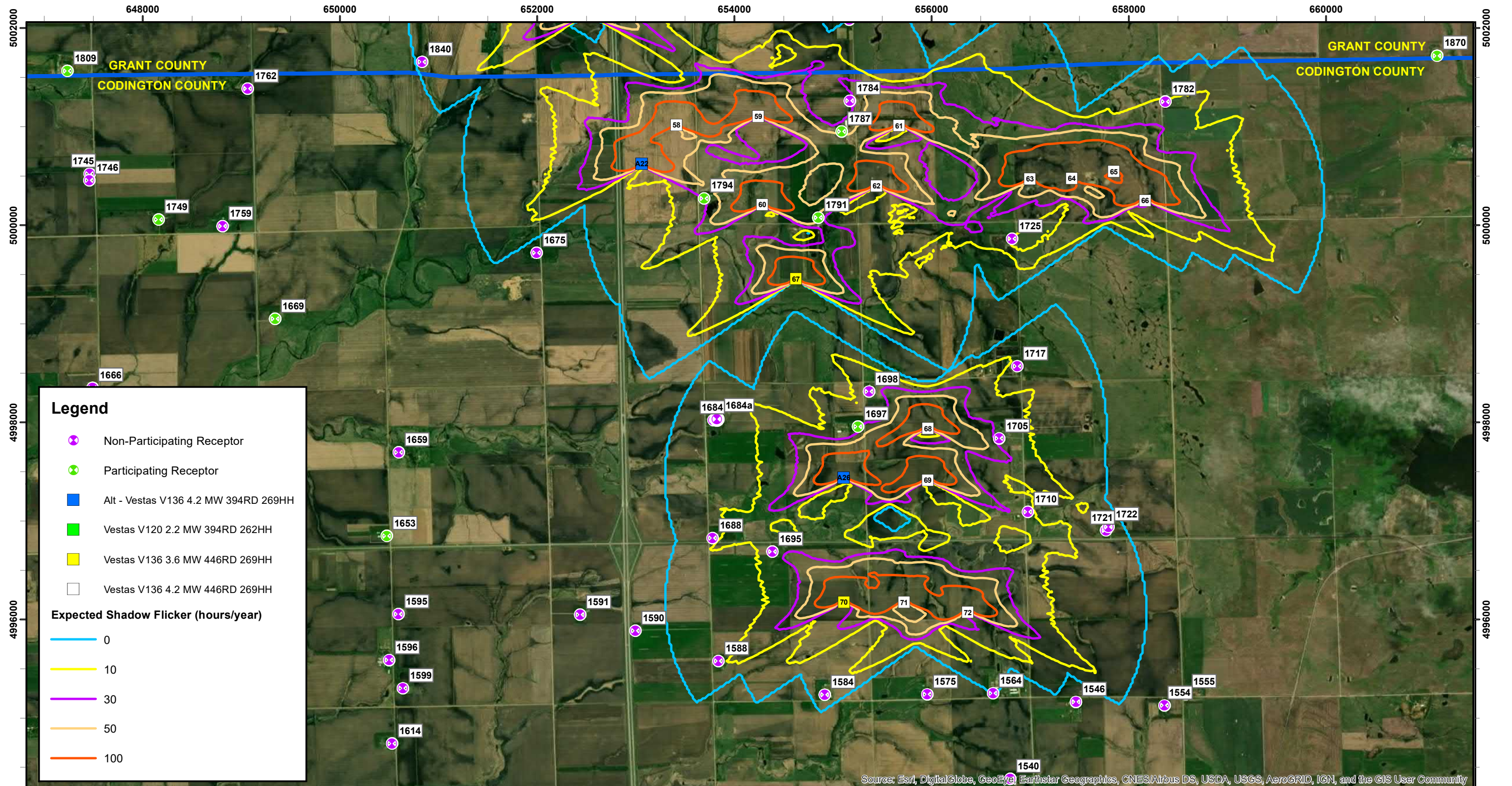
Created by:
MK

AECOM

Expected Shadow Flicker (Hours/Year) | With Alternates

Dakota Range Wind Energy Project
Codington and Grant Counties, SD

**Figure
3a**



	Date Created: 7/29/2020	Expected Shadow Flicker (Hours/Year) With Alternates	Figure 3b
	Created by: MK		
			

Appendix A Detailed Shadow Flicker Results

Project:

DakotaRange52_071020

Licensed user:

AECOM

250 APOLLO DR, AECOM
US-01824-3627 Chelmsford
+1 9789 052 260

Mary Kaplan / mary.kaplan@aecom.com

Calculated:

7/28/2020 5:20 PM/3.4.388

SHADOW - Main Result

Calculation: Dakota Range Shadow Flicker Layout 54 No Alternates 07/28/20

Assumptions for shadow calculations

Maximum distance for influence

Calculate only when more than 20 % of sun is covered by the blade

Please look in WTG table

Minimum sun height over horizon for influence

3 °

Day step for calculation

1 days

Time step for calculation

1 minutes

Sunshine probability S/S0 (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

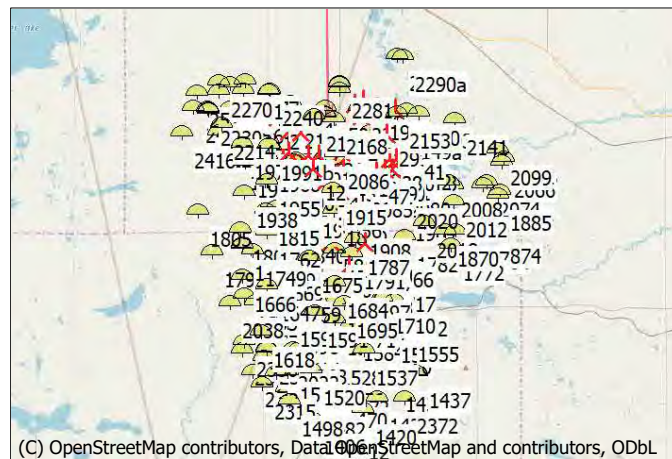
Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW
556	556	324	284	272	414	411	562	777	629	408	387

W	WNW	NW	NNW	Sum
518	803	796	721	8,418

All coordinates are in

UTM (north)-NAD83(NSRS/CSRS) (US+CA), geocentric, GRS80 Zone: 14



WTGs

	Easting	Northing	Z	Row data/Description	WTG type			Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Shadow data	
					Valid	Manufact.	Type-generator				Calculation distance	RPM
			[m]								[m]	[RPM]
1	649,151	5,009,211	578.3	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TOT: ...Yes	Yes	VESTAS	V136-3.6-3,600	3,600	136.0	82.0	1,804	10.4
2	649,593	5,009,301	583.1	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
3	650,382	5,008,394	575.2	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
4	651,221	5,008,389	580.8	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
5	651,888	5,008,536	584.2	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
6	652,671	5,007,586	610.2	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
7	650,048	5,006,906	577.3	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TOT: ...Yes	Yes	VESTAS	V136-3.6-3,600	3,600	136.0	82.0	1,804	10.4
8	650,429	5,007,024	582.3	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
9	650,942	5,007,008	586.5	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
10	651,702	5,006,813	587.1	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
11	652,445	5,006,824	598.2	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
12	652,068	5,005,967	590.8	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
13	652,355	5,004,449	596.4	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
14	652,354	5,003,672	596.5	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
15	652,508	5,002,155	590.9	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TOT: ...Yes	Yes	VESTAS	V136-3.6-3,600	3,600	136.0	82.0	1,804	10.4
16	654,739	5,010,310	598.6	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
17	655,343	5,010,618	609.6	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
18	655,960	5,010,046	616.1	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
19	656,354	5,010,078	619.4	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
20	656,800	5,009,939	619.1	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
21	657,156	5,010,005	604.6	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
22	657,545	5,010,093	597.6	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TOT: ...Yes	Yes	VESTAS	V136-3.6-3,600	3,600	136.0	82.0	1,804	10.4
23	654,074	5,008,760	599.6	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
24	654,850	5,008,650	594.4	VESTAS V120-2.2 2200 120.0 !O! hub: 80.0 m (TOT: ...Yes	Yes	VESTAS	V120-2.2-2,200	2,200	120.0	80.0	1,517	10.4
25	655,210	5,009,459	600.9	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
26	656,124	5,009,415	610.5	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
27	656,191	5,008,691	609.7	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
28	657,114	5,009,343	612.5	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
29	656,948	5,008,365	608.5	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
30	657,593	5,008,380	608.1	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
31	653,251	5,007,492	611.1	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
32	653,912	5,007,486	611.7	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
33	653,972	5,007,080	614.2	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
34	654,113	5,006,575	616.6	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
35	656,181	5,007,604	604.5	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
36	655,319	5,006,761	612.6	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
37	656,220	5,006,808	608.8	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
38	657,250	5,006,673	616.9	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
39	657,671	5,006,727	622.3	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
40	658,032	5,006,709	618.2	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4

To be continued on next page...

Project:

DakotaRange52_071020

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Calculated:

7/28/2020 5:20 PM/3.4.388

SHADOW - Main Result

Calculation: Dakota Range Shadow Flicker Layout 54 No Alternates 07/28/20

...continued from previous page

	Easting	Northing	Z	Row data/Description	WTG type		Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Shadow data	
					Valid	Manufact.					Calculation distance [m]	RPM
			[m]									[RPM]
41	658,728	5,007,539	594.5	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes		VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
42	659,200	5,006,854	591.1	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes		VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
43	659,531	5,006,717	590.0	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes		VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
44	652,980	5,005,140	606.0	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes		VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
45	654,125	5,005,949	617.6	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TOT: ...Yes		VESTAS	V136-3.6-3,600	3,600	136.0	82.0	1,804	10.4
46	656,234	5,006,118	616.8	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes		VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
47	656,341	5,005,779	622.6	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes		VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
48	656,373	5,005,145	625.5	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes		VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
49	656,929	5,005,957	621.3	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes		VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
50	657,388	5,005,960	622.3	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes		VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
51	657,840	5,006,079	625.1	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes		VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
52	652,960	5,004,165	606.9	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes		VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
53	653,327	5,003,802	605.7	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes		VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
54	654,008	5,004,449	612.2	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes		VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
55	654,041	5,003,475	608.0	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TOT: ...Yes		VESTAS	V136-3.6-3,600	3,600	136.0	82.0	1,804	10.4
56	654,539	5,003,479	612.6	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes		VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
57	654,672	5,002,981	607.1	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes		VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
58	653,413	5,001,019	598.4	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes		VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
59	654,244	5,001,104	607.3	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes		VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
60	654,286	5,000,211	596.4	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes		VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
61	655,673	5,001,011	608.5	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes		VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
62	655,443	5,000,400	603.5	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes		VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
63	656,999	5,000,470	600.8	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes		VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
64	657,424	5,000,476	613.8	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes		VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
65	657,851	5,000,546	611.6	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes		VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
66	658,167	5,000,252	613.5	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes		VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
67	654,626	4,999,457	589.7	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TOT: ...Yes		VESTAS	V136-3.6-3,600	3,600	136.0	82.0	1,804	10.4
68	655,965	4,997,937	611.1	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes		VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
69	655,963	4,997,416	603.6	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes		VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
70	655,111	4,996,175	608.0	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TOT: ...Yes		VESTAS	V136-3.6-3,600	3,600	136.0	82.0	1,804	10.4
71	655,723	4,996,172	611.8	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes		VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
72	656,367	4,996,074	613.0	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: ...Yes		VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4

Shadow receptor-Input

No.	Easting	Northing	Z	Width	Height	Elevation a.g.l.	Degrees from south cw	Slope of window	Direction mode	Eye height (ZVI) a.g.l.
			[m]	[m]	[m]	[m]	[°]	[°]		[m]
1406	652,416	4,988,919	554.3	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1412	654,042	4,988,526	567.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1419	654,682	4,990,406	572.3	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1420	655,847	4,989,588	570.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1425	656,835	4,990,400	571.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1434	657,862	4,991,817	584.9	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1436	659,447	4,992,233	581.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1437	659,433	4,992,153	583.2	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1470	653,858	4,990,720	581.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1472	653,951	4,991,544	581.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1476	653,550	4,991,972	576.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1481	652,432	4,989,894	559.1	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1482	652,414	4,990,051	561.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1489	651,609	4,990,365	562.3	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1497	650,662	4,989,915	555.6	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1498	650,857	4,990,054	556.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1503	650,658	4,990,853	554.9	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1510	650,693	4,992,058	556.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1511	650,707	4,992,321	556.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1520	652,311	4,992,164	573.6	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1528	653,395	4,993,505	575.2	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1537	655,804	4,993,536	611.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1540	656,798	4,994,383	621.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1546	657,465	4,995,164	621.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1554	658,362	4,995,128	615.9	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1555	658,579	4,995,244	613.9	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0

To be continued on next page...

Project:

DakotaRange52_071020

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Calculated:

7/28/2020 5:20 PM/3.4.388

SHADOW - Main Result

Calculation: Dakota Range Shadow Flicker Layout 54 No Alternates 07/28/20

...continued from previous page

No.	Easting	Northing	Z	Width	Height	Elevation	Degrees from	Slope of	Direction mode	Eye height
			[m]	[m]	[m]	a.g.l.	south cw	window		(ZVI) a.g.l.
						[m]	[°]	[°]		[m]
1564	656,622	4,995,251	616.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1575	655,955	4,995,240	607.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1584	654,917	4,995,237	606.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1588	653,838	4,995,578	591.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1590	652,996	4,995,886	581.3	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1591	652,437	4,996,048	576.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1595	650,593	4,996,054	576.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1596	650,496	4,995,587	572.4	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1599	650,637	4,995,303	571.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1614	650,527	4,994,742	569.1	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1618	648,862	4,994,650	556.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1624	648,375	4,996,645	557.4	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1635	647,648	4,997,080	555.1	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1639	647,523	4,997,800	551.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1647	649,155	4,997,753	559.1	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1653	650,473	4,996,848	575.6	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1659	650,596	4,997,697	562.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1666	647,489	4,998,353	551.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1669	649,341	4,999,050	562.0	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1675	651,994	4,999,721	571.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1684	653,787	4,998,023	594.3	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1684a	653,823	4,998,032	595.8	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1688	653,778	4,996,826	589.1	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1695	654,385	4,996,688	595.1	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1697	655,254	4,997,957	611.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1698	655,366	4,998,312	606.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1705	656,685	4,997,836	611.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1710	656,977	4,997,093	611.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1717	656,868	4,998,570	615.1	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1721	657,770	4,996,904	616.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1722	657,793	4,996,940	616.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1725	656,816	4,999,863	600.3	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1745	647,461	5,000,525	566.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1746	647,456	5,000,456	566.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1749	648,160	5,000,058	566.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1759	648,809	4,999,992	566.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1762	649,064	5,001,386	574.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1764	663,179	5,001,621	586.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1772	661,543	5,000,761	586.3	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1782	658,372	5,001,257	602.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1784	655,170	5,001,262	607.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1787	655,087	5,000,952	601.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1791	654,852	5,000,076	593.0	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1794	653,693	5,000,273	586.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1799	645,387	4,999,932	548.2	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1805	644,357	5,002,651	554.6	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1809	647,235	5,001,567	561.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1815	648,971	5,002,809	581.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1821	649,665	5,003,051	591.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1828	650,524	5,003,104	591.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1832	651,108	5,003,102	591.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1837	651,910	5,003,058	586.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1840	650,833	5,001,658	576.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1847	652,661	5,002,766	591.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1849	653,531	5,002,925	606.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1850	653,518	5,002,857	606.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1867	661,784	5,001,742	585.0	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1870	661,127	5,001,722	586.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1874	663,970	5,002,020	586.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1884	664,756	5,004,487	568.2	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1885	664,644	5,004,251	576.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1888	663,576	5,004,902	581.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1904	658,165	5,003,370	615.8	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1908	655,166	5,002,087	621.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1914	653,600	5,003,245	599.8	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1915	653,457	5,004,344	607.1	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0

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Project:

DakotaRange52_071020

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Calculated:

7/28/2020 5:20 PM/3.4.388

SHADOW - Main Result

Calculation: Dakota Range Shadow Flicker Layout 54 No Alternates 07/28/20

...continued from previous page

No.	Easting	Northing	Z	Width	Height	Elevation	Degrees from	Slope of	Direction mode	Eye height
			[m]	[m]	[m]	a.g.l.	south cw	window		(ZVI) a.g.l.
						[m]	[°]	[°]		[m]
1919	651,979	5,003,440	591.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1928	649,364	5,003,248	588.2	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1937	648,978	5,004,009	586.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1938	647,494	5,004,033	572.8	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1947	647,511	5,006,002	563.7	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1953	648,855	5,004,825	581.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1955	648,977	5,004,832	583.6	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1957	649,090	5,004,809	586.1	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1962	649,046	5,006,118	576.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1968	648,970	5,006,430	571.0	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1970	646,969	5,006,521	560.3	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1976	647,304	5,007,251	566.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1976a	647,274	5,007,128	564.7	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1985	648,481	5,007,490	565.3	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1988	649,022	5,007,624	566.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1991	649,187	5,007,078	566.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1991a	649,207	5,007,154	566.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1991b	649,069	5,007,217	566.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1994	650,685	5,006,150	576.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1995	650,838	5,006,169	578.3	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2005	650,627	5,005,202	586.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2007	661,518	5,004,784	591.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2008	661,243	5,005,003	591.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2012	661,600	5,003,749	586.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2018	659,717	5,002,264	611.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2020	658,319	5,004,153	621.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2022	650,528	4,993,062	556.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2024	649,872	4,991,904	551.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2025	649,922	4,991,918	551.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2038	646,744	4,996,588	550.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2041	653,594	5,006,202	611.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2066	664,806	5,006,460	547.7	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2074	663,797	5,005,086	581.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2080	657,770	5,004,970	619.6	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2085	655,202	5,004,866	626.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2086	653,613	5,006,756	605.2	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2099	664,537	5,007,281	551.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2107	664,924	5,006,726	546.7	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2141	661,511	5,009,230	581.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2149	657,735	5,008,810	599.8	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2149a	657,743	5,008,855	599.3	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2153	657,619	5,009,595	598.4	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2158	655,865	5,008,248	599.6	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2168	653,412	5,009,060	586.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2182	652,821	5,009,387	586.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2182a	652,790	5,009,416	586.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2193	652,045	5,009,239	581.6	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2195	650,621	5,009,376	591.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2195a	650,638	5,009,376	591.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2205	650,503	5,009,034	586.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2212	650,494	5,008,777	583.9	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2214	645,841	5,008,575	566.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2217	645,709	5,008,004	560.8	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2218	645,721	5,008,021	561.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2219	645,631	5,008,057	561.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2230	644,923	5,009,430	571.3	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2230a	644,923	5,009,495	571.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2236	646,375	5,009,625	571.8	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2239	647,229	5,010,860	582.8	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2240	649,025	5,010,906	581.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2242	648,974	5,010,823	581.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2243	650,458	5,010,136	589.6	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2251	653,709	5,011,042	599.0	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2257	655,074	5,009,887	602.9	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2260	658,287	5,009,765	590.0	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2270	645,592	5,011,331	576.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0

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Project:

DakotaRange52_071020

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Calculated:

7/28/2020 5:20 PM/3.4.388

SHADOW - Main Result

Calculation: Dakota Range Shadow Flicker Layout 54 No Alternates 07/28/20

...continued from previous page

No.	Easting	Northing	Z	Width	Height	Elevation	Degrees from	Slope of	Direction mode	Eye height
			[m]	[m]	[m]	a.g.l.	south cw	window		(ZVI) a.g.l.
						[m]	[°]	[°]		[m]
2271	646,356	5,011,254	582.8	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2277	647,395	5,011,472	583.2	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2279	653,707	5,011,413	603.0	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2280	653,707	5,011,446	603.8	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2281	653,705	5,011,489	605.0	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2287	657,521	5,013,443	610.0	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2290	657,918	5,013,363	602.9	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2290a	657,897	5,013,379	604.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2315	649,019	4,991,139	546.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2318	648,352	4,991,903	547.6	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2339	649,064	4,992,930	552.6	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2347	649,280	4,993,534	556.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2348	649,271	4,993,557	556.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2353	647,627	4,993,445	546.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2356	647,698	4,993,970	548.8	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2364	651,457	4,993,587	561.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2368	651,076	4,993,540	556.8	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2372	658,654	4,990,393	590.2	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2416	643,160	5,007,930	560.9	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2424	643,939	5,009,640	558.1	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2426	644,856	5,009,638	571.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2449	650,900	5,006,334	579.7	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2455	651,982	5,003,185	589.0	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2496	653,626	5,003,190	601.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2500	644,112	5,010,598	556.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2501	645,580	5,010,730	576.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2502	652,828	5,009,872	587.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2503	659,098	5,009,616	599.1	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0

Calculation Results

Shadow receptor

No.	Shadow, worst case			Shadow, expected values	
	Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow hours per year [h/year]	
1406	0:00	0	0:00	0:00	
1412	0:00	0	0:00	0:00	
1419	0:00	0	0:00	0:00	
1420	0:00	0	0:00	0:00	
1425	0:00	0	0:00	0:00	
1434	0:00	0	0:00	0:00	
1436	0:00	0	0:00	0:00	
1437	0:00	0	0:00	0:00	
1470	0:00	0	0:00	0:00	
1472	0:00	0	0:00	0:00	
1476	0:00	0	0:00	0:00	
1481	0:00	0	0:00	0:00	
1482	0:00	0	0:00	0:00	
1489	0:00	0	0:00	0:00	
1497	0:00	0	0:00	0:00	
1498	0:00	0	0:00	0:00	
1503	0:00	0	0:00	0:00	
1510	0:00	0	0:00	0:00	
1511	0:00	0	0:00	0:00	
1520	0:00	0	0:00	0:00	
1528	0:00	0	0:00	0:00	
1537	0:00	0	0:00	0:00	
1540	0:00	0	0:00	0:00	
1546	0:00	0	0:00	0:00	
1554	0:00	0	0:00	0:00	
1555	0:00	0	0:00	0:00	
1564	0:00	0	0:00	0:00	
1575	0:00	0	0:00	0:00	
1584	0:00	0	0:00	0:00	

To be continued on next page...

Project:

DakotaRange52_071020

Licensed user:

AECOM

250 APOLLO DR, AECOM

US-01824-3627 Chelmsford

+1 9789 052 260

Mary Kaplan / mary.kaplan@aecom.com

Calculated:

7/28/2020 5:20 PM/3.4.388

SHADOW - Main Result

Calculation: Dakota Range Shadow Flicker Layout 54 No Alternates 07/28/20

...continued from previous page

No.	Shadow, worst case		Shadow, expected values	
	Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow hours per year [h/year]
1588	0:00	0	0:00	0:00
1590	0:00	0	0:00	0:00
1591	0:00	0	0:00	0:00
1595	0:00	0	0:00	0:00
1596	0:00	0	0:00	0:00
1599	0:00	0	0:00	0:00
1614	0:00	0	0:00	0:00
1618	0:00	0	0:00	0:00
1624	0:00	0	0:00	0:00
1635	0:00	0	0:00	0:00
1639	0:00	0	0:00	0:00
1647	0:00	0	0:00	0:00
1653	0:00	0	0:00	0:00
1659	0:00	0	0:00	0:00
1666	0:00	0	0:00	0:00
1669	0:00	0	0:00	0:00
1675	0:00	0	0:00	0:00
1684	0:00	0	0:00	0:00
1684a	0:00	0	0:00	0:00
1688	6:50	32	0:20	2:30
1695	47:07	122	0:38	17:23
1697	54:53	128	0:37	20:33
1698	46:26	94	0:46	17:16
1705	23:24	60	0:37	7:25
1710	7:00	45	0:16	2:10
1717	15:59	60	0:27	4:55
1721	3:37	26	0:13	1:07
1722	3:27	26	0:12	1:03
1725	0:00	0	0:00	0:00
1745	0:00	0	0:00	0:00
1746	0:00	0	0:00	0:00
1749	0:00	0	0:00	0:00
1759	0:00	0	0:00	0:00
1762	0:00	0	0:00	0:00
1764	0:00	0	0:00	0:00
1772	0:00	0	0:00	0:00
1782	26:13	96	0:26	8:02
1784	71:35	127	0:57	27:00
1787	21:38	72	0:29	6:37
1791	0:00	0	0:00	0:00
1794	53:30	103	0:52	20:20
1799	0:00	0	0:00	0:00
1805	0:00	0	0:00	0:00
1809	0:00	0	0:00	0:00
1815	0:00	0	0:00	0:00
1821	0:00	0	0:00	0:00
1828	0:00	0	0:00	0:00
1832	5:53	44	0:14	2:10
1837	0:00	0	0:00	0:00
1840	0:00	0	0:00	0:00
1847	0:00	0	0:00	0:00
1849	12:07	82	0:19	3:45
1850	9:49	50	0:21	3:01
1867	0:00	0	0:00	0:00
1870	0:00	0	0:00	0:00
1874	0:00	0	0:00	0:00
1884	0:00	0	0:00	0:00
1885	0:00	0	0:00	0:00
1888	0:00	0	0:00	0:00
1904	0:00	0	0:00	0:00
1908	0:00	0	0:00	0:00
1914	10:41	36	0:27	3:56
1915	77:10	163	0:59	26:36
1919	0:00	0	0:00	0:00
1928	0:00	0	0:00	0:00

To be continued on next page...

Project:

DakotaRange52_071020

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Calculated:

7/28/2020 5:20 PM/3.4.388

SHADOW - Main Result

Calculation: Dakota Range Shadow Flicker Layout 54 No Alternates 07/28/20

...continued from previous page

No.	Shadow, worst case		Shadow, expected values	
	Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow hours per year [h/year]
1937	0:00	0	0:00	0:00
1938	0:00	0	0:00	0:00
1947	0:00	0	0:00	0:00
1953	0:00	0	0:00	0:00
1955	0:00	0	0:00	0:00
1957	0:00	0	0:00	0:00
1962	0:00	0	0:00	0:00
1968	0:00	0	0:00	0:00
1970	0:00	0	0:00	0:00
1976	0:00	0	0:00	0:00
1976a	0:00	0	0:00	0:00
1985	3:42	24	0:15	1:24
1988	24:48	103	0:26	9:09
1991	26:32	65	0:36	9:57
1991a	28:23	73	0:36	10:43
1991b	20:01	66	0:30	7:31
1994	5:51	27	0:20	2:12
1995	7:55	31	0:24	2:55
2005	0:00	0	0:00	0:00
2007	0:00	0	0:00	0:00
2008	0:00	0	0:00	0:00
2012	0:00	0	0:00	0:00
2018	0:00	0	0:00	0:00
2020	0:00	0	0:00	0:00
2022	0:00	0	0:00	0:00
2024	0:00	0	0:00	0:00
2025	0:00	0	0:00	0:00
2038	0:00	0	0:00	0:00
2041	53:55	97	0:54	20:32
2066	0:00	0	0:00	0:00
2074	0:00	0	0:00	0:00
2080	0:00	0	0:00	0:00
2085	5:16	28	0:18	1:46
2086	61:56	107	0:59	23:41
2099	0:00	0	0:00	0:00
2107	0:00	0	0:00	0:00
2141	0:00	0	0:00	0:00
2149	35:15	102	0:36	11:23
2149a	25:44	81	0:35	8:15
2153	63:42	127	0:56	21:13
2158	0:00	0	0:00	0:00
2168	40:25	63	1:00	15:16
2182	22:16	78	0:24	7:10
2182a	13:43	62	0:20	4:31
2193	2:53	18	0:12	0:49
2195	17:18	86	0:26	6:29
2195a	17:24	89	0:25	6:32
2205	25:03	74	0:32	9:09
2212	36:25	107	0:39	13:08
2214	0:00	0	0:00	0:00
2217	0:00	0	0:00	0:00
2218	0:00	0	0:00	0:00
2219	0:00	0	0:00	0:00
2230	0:00	0	0:00	0:00
2230a	0:00	0	0:00	0:00
2236	0:00	0	0:00	0:00
2239	0:00	0	0:00	0:00
2240	0:00	0	0:00	0:00
2242	0:00	0	0:00	0:00
2243	13:30	66	0:21	4:02
2251	20:39	89	0:24	7:34
2257	11:38	47	0:27	4:23
2260	9:10	32	0:25	3:06
2270	0:00	0	0:00	0:00
2271	0:00	0	0:00	0:00

To be continued on next page...

Project:

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Calculated:

7/28/2020 5:20 PM/3.4.388

SHADOW - Main Result

Calculation: Dakota Range Shadow Flicker Layout 54 No Alternates 07/28/20

...continued from previous page

No.	Shadow, worst case			Shadow, expected values	
	Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow hours per year [h/year]	
2277	0:00	0	0:00	0:00	
2279	0:00	0	0:00	0:00	
2280	0:00	0	0:00	0:00	
2281	0:00	0	0:00	0:00	
2287	0:00	0	0:00	0:00	
2290	0:00	0	0:00	0:00	
2290a	0:00	0	0:00	0:00	
2315	0:00	0	0:00	0:00	
2318	0:00	0	0:00	0:00	
2339	0:00	0	0:00	0:00	
2347	0:00	0	0:00	0:00	
2348	0:00	0	0:00	0:00	
2353	0:00	0	0:00	0:00	
2356	0:00	0	0:00	0:00	
2364	0:00	0	0:00	0:00	
2368	0:00	0	0:00	0:00	
2372	0:00	0	0:00	0:00	
2416	0:00	0	0:00	0:00	
2424	0:00	0	0:00	0:00	
2426	0:00	0	0:00	0:00	
2449	8:47	34	0:24	3:18	
2455	0:00	0	0:00	0:00	
2496	13:52	55	0:28	4:50	
2500	0:00	0	0:00	0:00	
2501	0:00	0	0:00	0:00	
2502	0:00	0	0:00	0:00	
2503	0:00	0	0:00	0:00	

Total amount of flickering on the shadow receptors caused by each WTG

No.	Name	Worst case [h/year]	Expected [h/year]
1	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (1)	7:14	2:25
2	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (2)	19:05	6:26
3	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (3)	5:46	1:45
4	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (4)	49:35	18:01
5	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (5)	35:30	11:56
6	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (6)	0:00	0:00
7	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (7)	53:26	19:52
8	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (8)	20:37	7:51
9	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (9)	5:09	1:59
10	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (10)	0:00	0:00
11	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (11)	0:00	0:00
12	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (12)	22:02	8:07
13	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (69)	0:00	0:00
14	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (70)	7:23	2:16
15	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (13)	24:12	7:44
16	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (14)	17:26	6:22
17	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (15)	3:13	1:11
18	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (16)	0:00	0:00
19	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (17)	0:00	0:00
20	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (18)	0:14	0:05
21	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (19)	0:00	0:00
22	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (20)	0:00	0:00
23	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (22)	35:14	13:26
24	VESTAS V120-2.2 2200 120.0 !O! hub: 80.0 m (TOT: 140.0 m) (23)	3:34	1:19
25	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (25)	0:00	0:00
26	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (26)	15:49	5:56
27	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (27)	9:48	3:22
28	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (68)	62:06	20:41
29	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (28)	28:30	9:01
30	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (29)	9:34	2:56
31	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (43)	0:00	0:00
32	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (44)	0:00	0:00
33	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (45)	0:00	0:00

To be continued on next page...

Project:

DakotaRange52_071020

Licensed user:

AECOM

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Mary Kaplan / mary.kaplan@aecom.com

Calculated:

7/28/2020 5:20 PM/3.4.388

SHADOW - Main Result

Calculation: Dakota Range Shadow Flicker Layout 54 No Alternates 07/28/20

...continued from previous page

No.	Name	Worst case [h/year]	Expected [h/year]
34	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (46)	58:51	22:38
35	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (30)	0:00	0:00
36	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (24)	1:17	0:29
37	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (31)	0:00	0:00
38	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (71)	0:00	0:00
39	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (38)	0:00	0:00
40	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (39)	0:00	0:00
41	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (40)	0:00	0:00
42	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (41)	0:00	0:00
43	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (42)	0:00	0:00
44	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (48)	0:00	0:00
45	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (47)	51:57	19:49
46	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (32)	0:00	0:00
47	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (33)	0:00	0:00
48	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (34)	0:00	0:00
49	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (35)	0:00	0:00
50	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (36)	0:00	0:00
51	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (37)	0:00	0:00
52	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (50)	55:11	18:58
53	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (51)	0:00	0:00
54	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (49)	5:16	1:46
55	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (77)	0:00	0:00
56	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (52)	14:36	5:15
57	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (53)	15:58	5:51
58	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (54)	1:29	0:32
59	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (55)	14:04	5:02
60	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (56)	63:18	22:40
61	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (59)	58:53	22:24
62	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (58)	0:00	0:00
63	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (60)	4:05	1:16
64	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (61)	22:08	6:46
65	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (72)	0:00	0:00
66	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (62)	0:00	0:00
67	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (57)	10:27	3:42
68	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (63)	81:15	29:26
69	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (64)	59:27	20:37
70	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (65)	47:29	17:26
71	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (66)	13:28	4:38
72	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (67)	4:10	1:17

Total times in Receptor wise and WTG wise tables can differ, as a WTG can lead to flicker at 2 or more receptors simultaneously and/or receptors may receive flicker from 2 or more WTGs simultaneously.

Project:

DakotaRange52_071020

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AECOM

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+1 9789 052 260

Mary Kaplan / mary.kaplan@aecom.com

Calculated:

7/28/2020 4:05 PM/3.4.388

SHADOW - Main Result

Calculation: Dakota Range Shadow Flicker Layout 54 07/28/20

Assumptions for shadow calculations

Maximum distance for influence

Calculate only when more than 20 % of sun is covered by the blade

Please look in WTG table

Minimum sun height over horizon for influence

3 °

Day step for calculation

1 days

Time step for calculation

1 minutes

Sunshine probability S/S0 (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

Operational time

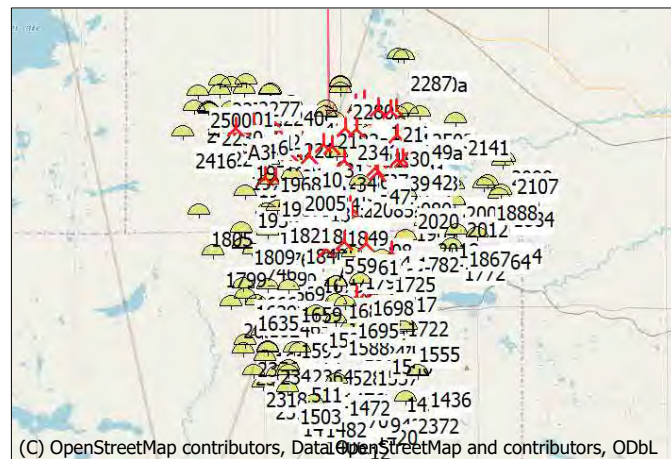
N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW
556	556	324	284	272	414	411	562	777	629	408	387

W WNW NW NNW Sum

518	803	796	721	8,418
-----	-----	-----	-----	-------

All coordinates are in

UTM (north)-NAD83(NSRS/CSRS) (US+CA), geocentric, GRS80 Zone: 14



WTGs

	Easting	Northing	Z	Row data/Description	WTG type			Shadow data				
					Valid	Manufact.	Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Calculation distance [m]	RPM
			[m]									
1	649,151	5,009,211	578.3	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-3.6-3,600	3,600	136.0	82.0	1,804	10.4
10	651,702	5,006,813	587.1	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
11	652,445	5,006,824	598.2	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
12	652,068	5,005,967	590.8	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
13	652,355	5,004,449	596.4	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
14	652,354	5,003,672	596.5	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
15	652,508	5,002,155	590.9	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-3.6-3,600	3,600	136.0	82.0	1,804	10.4
16	654,739	5,010,310	598.6	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
17	655,343	5,010,618	609.6	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
18	655,960	5,010,046	616.1	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
19	656,354	5,010,078	619.4	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
2	649,593	5,009,301	583.1	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
20	656,800	5,009,939	619.1	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
21	657,156	5,010,005	604.6	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
22	657,545	5,010,093	597.6	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-3.6-3,600	3,600	136.0	82.0	1,804	10.4
23	654,074	5,008,760	599.6	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
24	654,850	5,008,650	594.4	VESTAS V120-2.2 2200 120.0 !O! hub: 80.0 m (TO...	Yes	VESTAS	V120-2.2-2,200	2,200	120.0	80.0	1,517	10.4
25	655,210	5,009,459	600.9	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
26	656,124	5,009,415	610.5	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
27	656,191	5,008,691	609.7	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
28	657,114	5,009,343	612.5	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
29	656,948	5,008,365	608.5	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
3	650,382	5,008,394	575.2	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
30	657,593	5,008,380	608.1	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
31	653,251	5,007,492	611.1	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
32	653,912	5,007,486	611.7	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
33	653,972	5,007,080	614.2	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
34	654,113	5,006,575	616.6	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
35	656,181	5,007,604	604.5	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
36	655,319	5,006,761	612.6	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
37	656,220	5,006,808	608.8	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
38	657,250	5,006,673	616.9	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
39	657,671	5,006,727	622.3	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
4	651,221	5,008,389	580.8	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
40	658,032	5,006,709	618.2	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
41	658,728	5,007,539	594.5	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
42	659,200	5,006,854	591.1	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
43	659,531	5,006,717	590.0	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
44	652,980	5,005,140	606.0	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
45	654,125	5,005,949	617.6	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-3.6-3,600	3,600	136.0	82.0	1,804	10.4
46	656,234	5,006,118	616.8	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4

To be continued on next page...

Project:

DakotaRange52_071020

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Calculated:

7/28/2020 4:05 PM/3.4.388

SHADOW - Main Result

Calculation: Dakota Range Shadow Flicker Layout 54 07/28/20

...continued from previous page

	Easting	Northing	Z	Row data/Description	WTG type		Type-generator	Power, rated [kW]	Rotor diameter [m]	Hub height [m]	Shadow data	
					Valid	Manufact.					Calculation distance [m]	RPM [RPM]
			[m]									
47	656,341	5,005,779	622.6	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
48	656,373	5,005,145	625.5	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
49	656,929	5,005,957	621.3	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
5	651,888	5,008,536	584.2	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
50	657,388	5,005,960	622.3	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
51	657,840	5,006,079	625.1	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
52	652,960	5,004,165	606.9	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
53	653,327	5,003,802	605.7	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
54	654,008	5,004,449	612.2	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
55	654,041	5,003,475	608.0	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-3.6-3,600	3,600	136.0	82.0	1,804	10.4
56	654,539	5,003,479	612.6	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
57	654,672	5,002,981	607.1	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
58	653,413	5,001,019	598.4	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
59	654,244	5,001,104	607.3	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
6	652,671	5,007,586	610.2	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
60	654,286	5,000,211	596.4	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
61	655,673	5,001,011	608.5	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
62	655,443	5,000,400	603.5	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
63	656,999	5,000,470	600.8	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
64	657,424	5,000,476	613.8	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
65	657,851	5,000,546	611.6	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
66	658,167	5,000,252	613.5	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
67	654,626	4,999,457	589.7	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-3.6-3,600	3,600	136.0	82.0	1,804	10.4
68	655,965	4,997,937	611.1	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
69	655,963	4,997,416	603.6	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
7	650,048	5,006,906	577.3	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-3.6-3,600	3,600	136.0	82.0	1,804	10.4
70	655,111	4,996,175	608.0	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-3.6-3,600	3,600	136.0	82.0	1,804	10.4
71	655,723	4,996,172	611.8	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
72	656,367	4,996,074	613.0	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
8	650,429	5,007,024	582.3	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
9	650,942	5,007,008	586.5	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-4.2-4,200	4,200	136.0	82.0	1,804	10.4
A12a	648,811	5,005,306	582.9	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-3.6-3,600	3,600	136.0	82.0	1,804	10.4
A13	649,517	5,005,260	582.0	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-3.6-3,600	3,600	136.0	82.0	1,804	10.4
A14	650,399	5,005,390	582.9	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-3.6-3,600	3,600	136.0	82.0	1,804	10.4
A22	653,061	5,000,624	584.6	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-3.6-3,600	3,600	136.0	82.0	1,804	10.4
A26	655,110	4,997,437	600.5	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-3.6-3,600	3,600	136.0	82.0	1,804	10.4
A3	646,727	5,008,564	571.3	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-3.6-3,600	3,600	136.0	82.0	1,804	10.4
A4	647,138	5,008,617	577.2	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-3.6-3,600	3,600	136.0	82.0	1,804	10.4
A5	647,540	5,008,821	581.4	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-3.6-3,600	3,600	136.0	82.0	1,804	10.4
A6	647,957	5,008,902	583.9	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-3.6-3,600	3,600	136.0	82.0	1,804	10.4
A7	648,410	5,008,903	578.7	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-3.6-3,600	3,600	136.0	82.0	1,804	10.4
A8	649,561	5,008,528	575.5	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TO...	Yes	VESTAS	V136-3.6-3,600	3,600	136.0	82.0	1,804	10.4

Shadow receptor-Input

No.	Easting	Northing	Z	Width	Height	Elevation	Degrees from	Slope of	Direction mode	Eye height
			[m]	[m]	[m]	a.g.l.	south cw	window		(ZVI) a.g.l.
						[m]	[°]	[°]		[m]
1406	652,416	4,988,919	554.3	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1412	654,042	4,988,526	567.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1419	654,682	4,990,406	572.3	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1420	655,847	4,989,588	570.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1425	656,835	4,990,400	571.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1434	657,862	4,991,817	584.9	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1436	659,447	4,992,233	581.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1437	659,433	4,992,153	583.2	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1470	653,858	4,990,720	581.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1472	653,951	4,991,544	581.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1476	653,550	4,991,972	576.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1481	652,432	4,989,894	559.1	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1482	652,414	4,990,051	561.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1489	651,609	4,990,365	562.3	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1497	650,662	4,989,915	555.6	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1498	650,857	4,990,054	556.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1503	650,658	4,990,853	554.9	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0

To be continued on next page...

Project:

DakotaRange52_071020

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Calculated:

7/28/2020 4:05 PM/3.4.388

SHADOW - Main Result

Calculation: Dakota Range Shadow Flicker Layout 54 07/28/20

...continued from previous page

No.	Easting	Northing	Z	Width	Height	Elevation	Degrees from	Slope of	Direction mode	Eye height
			[m]	[m]	[m]	a.g.l.	south cw	window		(ZVI) a.g.l.
			[m]			[m]	[°]	[°]		[m]
1510	650,693	4,992,058	556.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1511	650,707	4,992,321	556.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1520	652,311	4,992,164	573.6	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1528	653,395	4,993,505	575.2	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1537	655,804	4,993,536	611.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1540	656,798	4,994,383	621.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1546	657,465	4,995,164	621.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1554	658,362	4,995,128	615.9	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1555	658,579	4,995,244	613.9	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1564	656,622	4,995,251	616.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1575	655,955	4,995,240	607.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1584	654,917	4,995,237	606.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1588	653,838	4,995,578	591.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1590	652,996	4,995,886	581.3	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1591	652,437	4,996,048	576.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1595	650,593	4,996,054	576.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1596	650,496	4,995,587	572.4	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1599	650,637	4,995,303	571.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1614	650,527	4,994,742	569.1	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1618	648,862	4,994,650	556.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1624	648,375	4,996,645	557.4	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1635	647,648	4,997,080	555.1	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1639	647,523	4,997,800	551.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1647	649,155	4,997,753	559.1	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1653	650,473	4,996,848	575.6	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1659	650,596	4,997,697	562.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1666	647,489	4,998,353	551.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1669	649,341	4,999,050	562.0	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1675	651,994	4,999,721	571.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1684	653,787	4,998,023	594.3	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1684a	653,823	4,998,032	595.8	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1688	653,778	4,996,826	589.1	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1695	654,385	4,996,688	595.1	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1697	655,254	4,997,957	611.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1698	655,366	4,998,312	606.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1705	656,685	4,997,836	611.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1710	656,977	4,997,093	611.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1717	656,868	4,998,570	615.1	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1721	657,770	4,996,904	616.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1722	657,793	4,996,940	616.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1725	656,816	4,999,863	600.3	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1745	647,461	5,000,525	566.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1746	647,456	5,000,456	566.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1749	648,160	5,000,058	566.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1759	648,809	4,999,992	566.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1762	649,064	5,001,386	574.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1764	663,179	5,001,621	586.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1772	661,543	5,000,761	586.3	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1782	658,372	5,001,257	602.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1784	655,170	5,001,262	607.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1787	655,087	5,000,952	601.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1791	654,852	5,000,076	593.0	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1794	653,693	5,000,273	586.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1799	645,387	4,999,932	548.2	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1805	644,357	5,002,651	554.6	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1809	647,235	5,001,567	561.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1815	648,971	5,002,809	581.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1821	649,665	5,003,051	591.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1828	650,524	5,003,104	591.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1832	651,108	5,003,102	591.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1837	651,910	5,003,058	586.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1840	650,833	5,001,658	576.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1847	652,661	5,002,766	591.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1849	653,531	5,002,925	606.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1850	653,518	5,002,857	606.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1867	661,784	5,001,742	585.0	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0

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Project:

DakotaRange52_071020

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Calculated:

7/28/2020 4:05 PM/3.4.388

SHADOW - Main Result

Calculation: Dakota Range Shadow Flicker Layout 54 07/28/20

...continued from previous page

No.	Easting	Northing	Z	Width	Height	Elevation	Degrees from	Slope of	Direction mode	Eye height
			[m]	[m]	[m]	a.g.l.	south cw	window		(ZVI) a.g.l.
						[m]	[°]	[°]		[m]
1870	661,127	5,001,722	586.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1874	663,970	5,002,020	586.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1884	664,756	5,004,487	568.2	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1885	664,644	5,004,251	576.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1888	663,576	5,004,902	581.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1904	658,165	5,003,370	615.8	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1908	655,166	5,002,087	621.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1914	653,600	5,003,245	599.8	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1915	653,457	5,004,344	607.1	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1919	651,979	5,003,440	591.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1928	649,364	5,003,248	588.2	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1937	648,978	5,004,009	586.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1938	647,494	5,004,033	572.8	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1947	647,511	5,006,002	563.7	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1953	648,855	5,004,825	581.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1955	648,977	5,004,832	583.6	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1957	649,090	5,004,809	586.1	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1962	649,046	5,006,118	576.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1968	648,970	5,006,430	571.0	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1970	646,969	5,006,521	560.3	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1976	647,304	5,007,251	566.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1976a	647,274	5,007,128	564.7	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1985	648,481	5,007,490	565.3	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1988	649,022	5,007,624	566.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1991	649,187	5,007,078	566.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1991a	649,207	5,007,154	566.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1991b	649,069	5,007,217	566.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1994	650,685	5,006,150	576.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
1995	650,838	5,006,169	578.3	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2005	650,627	5,005,202	586.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2007	661,518	5,004,784	591.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2008	661,243	5,005,003	591.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2012	661,600	5,003,749	586.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2018	659,717	5,002,264	611.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2020	658,319	5,004,153	621.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2022	650,528	4,993,062	556.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2024	649,872	4,991,904	551.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2025	649,922	4,991,918	551.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2038	646,744	4,996,588	550.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2041	653,594	5,006,202	611.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2066	664,806	5,006,460	547.7	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2074	663,797	5,005,086	581.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2080	657,770	5,004,970	619.6	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2085	655,202	5,004,866	626.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2086	653,613	5,006,756	605.2	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2099	664,537	5,007,281	551.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2107	664,924	5,006,726	546.7	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2141	661,511	5,009,230	581.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2149	657,735	5,008,810	599.8	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2149a	657,743	5,008,855	599.3	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2153	657,619	5,009,595	598.4	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2158	655,865	5,008,248	599.6	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2168	653,412	5,009,060	586.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2182	652,821	5,009,387	586.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2182a	652,790	5,009,416	586.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2193	652,045	5,009,239	581.6	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2195	650,621	5,009,376	591.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2195a	650,638	5,009,376	591.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2205	650,503	5,009,034	586.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2212	650,494	5,008,777	583.9	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2214	645,841	5,008,575	566.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2217	645,709	5,008,004	560.8	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2218	645,721	5,008,021	561.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2219	645,631	5,008,057	561.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2230	644,923	5,009,430	571.3	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2230a	644,923	5,009,495	571.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0

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Project:

DakotaRange52_071020

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Calculated:

7/28/2020 4:05 PM/3.4.388

SHADOW - Main Result

Calculation: Dakota Range Shadow Flicker Layout 54 07/28/20

...continued from previous page

No.	Easting	Northing	Z	Width	Height	Elevation	Degrees from	Slope of	Direction mode	Eye height
			[m]	[m]	[m]	a.g.l.	south cw	window		(ZVI) a.g.l.
						[m]	[°]	[°]		[m]
2236	646,375	5,009,625	571.8	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2239	647,229	5,010,860	582.8	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2240	649,025	5,010,906	581.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2242	648,974	5,010,823	581.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2243	650,458	5,010,136	589.6	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2251	653,709	5,011,042	599.0	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2257	655,074	5,009,887	602.9	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2260	658,287	5,009,765	590.0	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2270	645,592	5,011,331	576.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2271	646,356	5,011,254	582.8	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2277	647,395	5,011,472	583.2	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2279	653,707	5,011,413	603.0	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2280	653,707	5,011,446	603.8	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2281	653,705	5,011,489	605.0	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2287	657,521	5,013,443	610.0	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2290	657,918	5,013,363	602.9	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2290a	657,897	5,013,379	604.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2315	649,019	4,991,139	546.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2318	648,352	4,991,903	547.6	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2339	649,064	4,992,930	552.6	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2347	649,280	4,993,534	556.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2348	649,271	4,993,557	556.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2353	647,627	4,993,445	546.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2356	647,698	4,993,970	548.8	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2364	651,457	4,993,587	561.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2368	651,076	4,993,540	556.8	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2372	658,654	4,990,393	590.2	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2416	643,160	5,007,930	560.9	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2424	643,939	5,009,640	558.1	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2426	644,856	5,009,638	571.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2449	650,900	5,006,334	579.7	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2455	651,982	5,003,185	589.0	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2496	653,626	5,003,190	601.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2500	644,112	5,010,598	556.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2501	645,580	5,010,730	576.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2502	652,828	5,009,872	587.5	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0
2503	659,098	5,009,616	599.1	1.0	1.0	1.0	0.0	90.0	Fixed direction	2.0

Calculation Results

Shadow receptor

No.	Shadow, worst case			Shadow, expected values	
	Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow hours per year [h/year]	
1406	0:00	0	0:00	0:00	
1412	0:00	0	0:00	0:00	
1419	0:00	0	0:00	0:00	
1420	0:00	0	0:00	0:00	
1425	0:00	0	0:00	0:00	
1434	0:00	0	0:00	0:00	
1436	0:00	0	0:00	0:00	
1437	0:00	0	0:00	0:00	
1470	0:00	0	0:00	0:00	
1472	0:00	0	0:00	0:00	
1476	0:00	0	0:00	0:00	
1481	0:00	0	0:00	0:00	
1482	0:00	0	0:00	0:00	
1489	0:00	0	0:00	0:00	
1497	0:00	0	0:00	0:00	
1498	0:00	0	0:00	0:00	
1503	0:00	0	0:00	0:00	
1510	0:00	0	0:00	0:00	
1511	0:00	0	0:00	0:00	
1520	0:00	0	0:00	0:00	

To be continued on next page...

Project:

DakotaRange52_071020

Licensed user:

AECOM

250 APOLLO DR, AECOM

US-01824-3627 Chelmsford

+1 9789 052 260

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Calculated:

7/28/2020 4:05 PM/3.4.388

SHADOW - Main Result

Calculation: Dakota Range Shadow Flicker Layout 54 07/28/20

...continued from previous page

No.	Shadow, worst case		Shadow, expected values	
	Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow hours per year [h/year]
1528	0:00	0	0:00	0:00
1537	0:00	0	0:00	0:00
1540	0:00	0	0:00	0:00
1546	0:00	0	0:00	0:00
1554	0:00	0	0:00	0:00
1555	0:00	0	0:00	0:00
1564	0:00	0	0:00	0:00
1575	0:00	0	0:00	0:00
1584	0:00	0	0:00	0:00
1588	0:00	0	0:00	0:00
1590	0:00	0	0:00	0:00
1591	0:00	0	0:00	0:00
1595	0:00	0	0:00	0:00
1596	0:00	0	0:00	0:00
1599	0:00	0	0:00	0:00
1614	0:00	0	0:00	0:00
1618	0:00	0	0:00	0:00
1624	0:00	0	0:00	0:00
1635	0:00	0	0:00	0:00
1639	0:00	0	0:00	0:00
1647	0:00	0	0:00	0:00
1653	0:00	0	0:00	0:00
1659	0:00	0	0:00	0:00
1666	0:00	0	0:00	0:00
1669	0:00	0	0:00	0:00
1675	0:00	0	0:00	0:00
1684	5:52	30	0:18	2:12
1684a	6:18	30	0:19	2:20
1688	6:50	32	0:20	2:30
1695	47:07	122	0:38	17:23
1697	54:53	128	0:37	20:33
1698	46:26	94	0:46	17:16
1705	25:33	78	0:37	8:08
1710	7:00	45	0:16	2:10
1717	15:59	60	0:27	4:55
1721	3:37	26	0:13	1:07
1722	3:27	26	0:12	1:03
1725	0:00	0	0:00	0:00
1745	0:00	0	0:00	0:00
1746	0:00	0	0:00	0:00
1749	0:00	0	0:00	0:00
1759	0:00	0	0:00	0:00
1762	0:00	0	0:00	0:00
1764	0:00	0	0:00	0:00
1772	0:00	0	0:00	0:00
1782	26:13	96	0:26	8:02
1784	71:35	127	0:57	27:00
1787	21:38	72	0:29	6:37
1791	0:00	0	0:00	0:00
1794	53:30	103	0:52	20:20
1799	0:00	0	0:00	0:00
1805	0:00	0	0:00	0:00
1809	0:00	0	0:00	0:00
1815	0:00	0	0:00	0:00
1821	0:00	0	0:00	0:00
1828	0:00	0	0:00	0:00
1832	5:53	44	0:14	2:10
1837	0:00	0	0:00	0:00
1840	0:00	0	0:00	0:00
1847	0:00	0	0:00	0:00
1849	12:07	82	0:19	3:45
1850	9:49	50	0:21	3:01
1867	0:00	0	0:00	0:00
1870	0:00	0	0:00	0:00
1874	0:00	0	0:00	0:00

To be continued on next page...

Project:

DakotaRange52_071020

Licensed user:

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7/28/2020 4:05 PM/3.4.388

SHADOW - Main Result

Calculation: Dakota Range Shadow Flicker Layout 54 07/28/20

...continued from previous page

No.	Shadow, worst case			Shadow, expected values	
	Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow hours per year [h/year]	
1884	0:00	0	0:00	0:00	
1885	0:00	0	0:00	0:00	
1888	0:00	0	0:00	0:00	
1904	0:00	0	0:00	0:00	
1908	0:00	0	0:00	0:00	
1914	10:41	36	0:27	3:56	
1915	77:10	163	0:59	26:36	
1919	0:00	0	0:00	0:00	
1928	0:00	0	0:00	0:00	
1937	0:00	0	0:00	0:00	
1938	0:00	0	0:00	0:00	
1947	7:32	35	0:20	2:45	
1953	0:00	0	0:00	0:00	
1955	0:00	0	0:00	0:00	
1957	0:00	0	0:00	0:00	
1962	5:42	32	0:17	2:05	
1968	8:57	52	0:15	3:14	
1970	0:00	0	0:00	0:00	
1976	0:00	0	0:00	0:00	
1976a	0:00	0	0:00	0:00	
1985	3:42	24	0:15	1:24	
1988	24:48	103	0:26	9:09	
1991	26:32	65	0:36	9:57	
1991a	28:23	73	0:36	10:43	
1991b	20:01	66	0:30	7:31	
1994	16:52	95	0:20	5:35	
1995	13:38	69	0:24	4:40	
2005	0:24	11	0:03	0:09	
2007	0:00	0	0:00	0:00	
2008	0:00	0	0:00	0:00	
2012	0:00	0	0:00	0:00	
2018	0:00	0	0:00	0:00	
2020	0:00	0	0:00	0:00	
2022	0:00	0	0:00	0:00	
2024	0:00	0	0:00	0:00	
2025	0:00	0	0:00	0:00	
2038	0:00	0	0:00	0:00	
2041	53:55	97	0:54	20:32	
2066	0:00	0	0:00	0:00	
2074	0:00	0	0:00	0:00	
2080	0:00	0	0:00	0:00	
2085	5:16	28	0:18	1:46	
2086	61:56	107	0:59	23:41	
2099	0:00	0	0:00	0:00	
2107	0:00	0	0:00	0:00	
2141	0:00	0	0:00	0:00	
2149	35:15	102	0:36	11:23	
2149a	25:44	81	0:35	8:15	
2153	63:42	127	0:56	21:13	
2158	0:00	0	0:00	0:00	
2168	40:25	63	1:00	15:16	
2182	22:16	78	0:24	7:10	
2182a	13:43	62	0:20	4:31	
2193	2:53	18	0:12	0:49	
2195	29:01	108	0:30	10:02	
2195a	28:18	105	0:31	9:50	
2205	36:14	104	0:32	12:46	
2212	48:38	121	0:44	17:18	
2214	10:23	40	0:25	3:59	
2217	0:00	0	0:00	0:00	
2218	0:00	0	0:00	0:00	
2219	0:00	0	0:00	0:00	
2230	0:00	0	0:00	0:00	
2230a	0:00	0	0:00	0:00	
2236	16:49	93	0:22	6:11	

To be continued on next page...

Project:

DakotaRange52_071020

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Calculated:

7/28/2020 4:05 PM/3.4.388

SHADOW - Main Result

Calculation: Dakota Range Shadow Flicker Layout 54 07/28/20

...continued from previous page

No.	Shadow, worst case			Shadow, expected values	
	Shadow hours per year [h/year]	Shadow days per year [days/year]	Max shadow hours per day [h/day]	Shadow hours per year [h/year]	
2239	0:00	0	0:00	0:00	
2240	0:00	0	0:00	0:00	
2242	0:00	0	0:00	0:00	
2243	13:30	66	0:21	4:02	
2251	20:39	89	0:24	7:34	
2257	11:38	47	0:27	4:23	
2260	9:10	32	0:25	3:06	
2270	0:00	0	0:00	0:00	
2271	0:00	0	0:00	0:00	
2277	0:00	0	0:00	0:00	
2279	0:00	0	0:00	0:00	
2280	0:00	0	0:00	0:00	
2281	0:00	0	0:00	0:00	
2287	0:00	0	0:00	0:00	
2290	0:00	0	0:00	0:00	
2290a	0:00	0	0:00	0:00	
2315	0:00	0	0:00	0:00	
2318	0:00	0	0:00	0:00	
2339	0:00	0	0:00	0:00	
2347	0:00	0	0:00	0:00	
2348	0:00	0	0:00	0:00	
2353	0:00	0	0:00	0:00	
2356	0:00	0	0:00	0:00	
2364	0:00	0	0:00	0:00	
2368	0:00	0	0:00	0:00	
2372	0:00	0	0:00	0:00	
2416	0:00	0	0:00	0:00	
2424	0:00	0	0:00	0:00	
2426	0:00	0	0:00	0:00	
2449	15:12	90	0:24	5:16	
2455	0:00	0	0:00	0:00	
2496	13:52	55	0:28	4:50	
2500	0:00	0	0:00	0:00	
2501	0:00	0	0:00	0:00	
2502	0:00	0	0:00	0:00	
2503	0:00	0	0:00	0:00	

Total amount of flickering on the shadow receptors caused by each WTG

No.	Name	Worst case [h/year]	Expected [h/year]
1	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (1)	7:14	2:25
10	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (10)	0:00	0:00
11	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (11)	0:00	0:00
12	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (12)	22:02	8:07
13	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (69)	0:00	0:00
14	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (70)	7:23	2:16
15	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (13)	24:12	7:44
16	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (14)	17:26	6:22
17	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (15)	3:13	1:11
18	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (16)	0:00	0:00
19	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (17)	0:00	0:00
2	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (2)	19:05	6:26
20	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (18)	0:14	0:05
21	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (19)	0:00	0:00
22	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (20)	0:00	0:00
23	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (22)	35:14	13:26
24	VESTAS V120-2.2 2200 120.0 !O! hub: 80.0 m (TOT: 140.0 m) (23)	3:34	1:19
25	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (25)	0:00	0:00
26	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (26)	15:49	5:56
27	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (27)	9:48	3:22
28	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (68)	62:06	20:41
29	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (28)	28:30	9:01
3	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (3)	5:46	1:45
30	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (29)	9:34	2:56

To be continued on next page...

Project:

DakotaRange52_071020

Licensed user:

AECOM

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Mary Kaplan / mary.kaplan@aecom.com

Calculated:

7/28/2020 4:05 PM/3.4.388

SHADOW - Main Result

Calculation: Dakota Range Shadow Flicker Layout 54 07/28/20

...continued from previous page

No.	Name	Worst case [h/year]	Expected [h/year]
31	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (43)	0:00	0:00
32	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (44)	0:00	0:00
33	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (45)	0:00	0:00
34	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (46)	58:51	22:38
35	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (30)	0:00	0:00
36	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (24)	1:17	0:29
37	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (31)	0:00	0:00
38	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (71)	0:00	0:00
39	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (38)	0:00	0:00
4	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (4)	49:35	18:01
40	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (39)	0:00	0:00
41	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (40)	0:00	0:00
42	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (41)	0:00	0:00
43	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (42)	0:00	0:00
44	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (48)	0:00	0:00
45	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (47)	51:57	19:49
46	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (32)	0:00	0:00
47	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (33)	0:00	0:00
48	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (34)	0:00	0:00
49	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (35)	0:00	0:00
5	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (5)	35:30	11:56
50	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (36)	0:00	0:00
51	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (37)	0:00	0:00
52	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (50)	55:11	18:58
53	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (51)	0:00	0:00
54	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (49)	5:16	1:46
55	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (77)	0:00	0:00
56	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (52)	14:36	5:15
57	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (53)	15:58	5:51
58	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (54)	1:29	0:32
59	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (55)	14:04	5:02
6	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (6)	0:00	0:00
60	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (56)	63:18	22:40
61	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (59)	58:53	22:24
62	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (58)	0:00	0:00
63	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (60)	4:05	1:16
64	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (61)	22:08	6:46
65	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (72)	0:00	0:00
66	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (62)	0:00	0:00
67	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (57)	10:27	3:42
68	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (63)	81:15	29:26
69	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (64)	59:27	20:37
7	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (7)	53:26	19:52
70	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (65)	47:29	17:26
71	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (66)	13:28	4:38
72	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (67)	4:10	1:17
8	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (8)	20:37	7:51
9	VESTAS V136-4.2 4200 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (9)	5:09	1:59
A12a	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (74)	7:32	2:45
A13	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (75)	14:32	4:30
A14	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (76)	14:39	5:20
A22	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (78)	0:00	0:00
A26	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (79)	9:32	3:28
A3	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (80)	10:23	3:59
A4	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (81)	1:02	0:23
A5	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (82)	13:19	4:53
A6	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (83)	3:30	1:17
A7	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (84)	0:00	0:00
A8	VESTAS V136-3.6 3600 136.0 !O! hub: 82.0 m (TOT: 150.0 m) (85)	35:47	11:29

Total times in Receptor wise and WTG wise tables can differ, as a WTG can lead to flicker at 2 or more receptors simultaneously and/or receptors may receive flicker from 2 or more WTGs simultaneously.

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