Appendix M. ReGenerate 2023 Visual Impact and Shadow Flicker Assessments

ReGenerate
Renewable Energy Consulting

Visual Impact Assessment

PROJECT: SILVER QUEEN (IA)

DATE: JANUARY 11, 2024

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Contents

1. Executive Summary 3
2. Introduction 4
3. Background 4
4. Project Details 5
5. Project Regulations 5
6. Modeling Procedures 6
7. Modeling Results 7
8. Conclusions 8
9. References 8

Appendix I – Maps 9

Appendix II – Photomontage Rendering 11

Appendix III – Project Turbine Coordinates (UTM WGS84 Zone 15) 18

Revision History

Issue	Date	Revision Purpose
1	19-Dec-23	Original
2	11-Jan-24	Update ZVI Maps

1. Executive Summary

The Silver Queen Project in western Iowa has been studied for visual impact on the surrounding area. Modeling and topographic reviews were completed to determine impact on in and around the project area and photo rendering of the proposed turbines at specific locations.

The Project consists of 93 GE 3.4-140 LNTE turbines at 98 m hub-height provided by Scout Clean Energy.

ReGenerate used Openwind to model the zone of visual impact and windPRO to complete the rendering of proposed turbines in existing landscape.

Appendix I shows the spatial mapping for zone of visual impact. Appendix II shows the before and after photos of the turbine rendered photomontage. Appendix III shows turbine coordinates provided for the Silver Queen Project.

2. Introduction

The Silver Queen Wind Farm (Project) is being developed by Scout Clean Energy (Scout) in western Iowa. Western EcoSystems Technology, Inc. (WEST) (on behalf of Scout) retained ReGenerate Consulting (ReGenerate) to carry out an independent analysis of the potential visual impact caused by the proposed Project.

The objective of this assessment is to demonstrate the effect that these turbines will have on the surrounding viewshed when compared to the existing landscape. This report describes the Project site, modeling methodology and results of the analysis.

ReGenerate Consulting is an independent engineering consulting agency. The principal investigator for this report, Chris Nuckols, has 20 years of engineering and management experience and 15 years of wind and solar resource assessment experience for clients including renewable energy developers, owners, and OEMs. He has provided engineering support for more than 100 renewable energy projects -- large and small -- on five continents.

3. Background

Visual impact describes the appearance of changes in the landscape which may be caused by the proposed Project. The study addresses the potential viewers who may be impacted, demonstrating if they would be affected and to what extent if so. Viewers may include local residents or commuters who see the wind farm from a road. Additionally, this assesses how the Project blends into the overall landscape.

Based on the Sinclair-Thomas Matrix, under optimal viewing conditions such as flat ground, clear skies and no impact of vegetation, turbines have a dominant impact for up to approximately 4.0 miles and negligible impact beyond 11.9 miles. [1]

Distance Range (mi)	Impact
0 – 4.0	Dominant impact on the landscape due to large scale, movement, and proximity
4.0 - 7.4	Major impact due to the proximity; capable of dominating the landscape
7.4 - 11.9	Clearly visible with moderate visual impact; potentially intrusive
11.9 - 16.8	Clearly visible with moderate visual impact; becoming less distinct
16.8 - 21.8	Less distinct; size is reduced, movement is still discernable
21.8 - 26.7	Low impact, movement noticeable in good light
26.7 - 34.6	Becoming indistinct with negligible impact on the wider landscape

Table 1: Typical Visual Impact of 500-Foot Turbine Under Optimal Conditions

These impacts can serve as a general guideline but are largely subjective in nature, more qualitative modeling for this project, most notably incorporating the exact turbine configuration and terrain elevation, is outlined in the Modeling Results section.

Because the Project area already has a significant number of operational turbines the zone of visual impact (ZVI) analysis considers the current impact and additional area impacted by the Project.

Photo locations for turbine rendering were selected such that they are considered representative of the Project area, this includes the following:

- Provide clear, unobstructed view of the Project;
- Illustrate Project visibility from sensitive locations within the study area;
- Provide impact for either the most significant number of people or residents that are most significantly impacted;
- Illustrate typical views of the surrounding landscape; and
- Provide a variety of viewer distances, orientations and elevations.

4. Project Details

The Project is located near Westside, Iowa in agricultural land consisting primarily of rolling hills. There are scattered dwellings, farm buildings and trees throughout the project area.

Scout provided ReGenerate with the coordinates of proposed turbines and receptors for the Project. The layout features 93 GE 3.4-140 LNTE turbines at 98 m hub-height, including both primary and alternate locations.

Turbine coordinates provided for the Project are shown in Appendix II.

Information on operational neighboring projects was reviewed as part of this analysis based upon the U.S. Wind Turbine Database by USGS. [2] Three nearby projects were found, including:

- Carroll: 100x GE 1.6-91 h80 COD 2008
- Carroll Area: 9x SWT 2.3-108 h80 COD 2015
- Victory: 66x GE 1.5-87 h80 COD 2017

5. Project Regulations

There are no known applicable state or local regulations establishing a restriction on visual impact.

6. Modeling Procedures

ReGenerate used the Openwind software [3] to model the ZVI for this project. Modeling assumptions for the zone of ZVI include:

- Neighboring projects were included in modeling;
- Default observer eye level is 4 m; and
- No obstacles were considered.

ReGenerate used the windPRO software [4] to complete photomontage rendering for this project. Modeling assumptions for the photomontage analysis include:

- Neighboring projects are already included in site photos; and
- Default observer eye level is 1.4 m.

Photo locations for the photomontage rendering are shown in the table and figure below.

Location ID	Description	UTM WGS84 z15		Elevation (m)	Distance to Nearest Turbine (km)	Direction of View	Date Taken	Time Taken
		Easting	Northing					
1	Great Western Park Campground	657849	3729240	420	6.5	N	13-Dec-23	13:58
2	Sauk Rail Trail	657853	3730565	381	6.1	SW	13-Dec-23	9:44
3	Vail Cemetery	654636	3728849	413	6.0	SE	13-Dec-23	11:44
4	Yellow Smoke Campground	656436	3730573	387	12.0	E	13-Dec-23	12:33
5a	Hayes Township Cemetery	656436	3730573	442	1.6	NW	13-Dec-23	10:35
5b					1.9	SE	13-Dec-23	11:01
6	Swan Lake State Park Campground	656507	3724441	391	10.5	W	13-Dec-23	14:49

Table 1: Viewpoints Selected for Photomontage Rendering

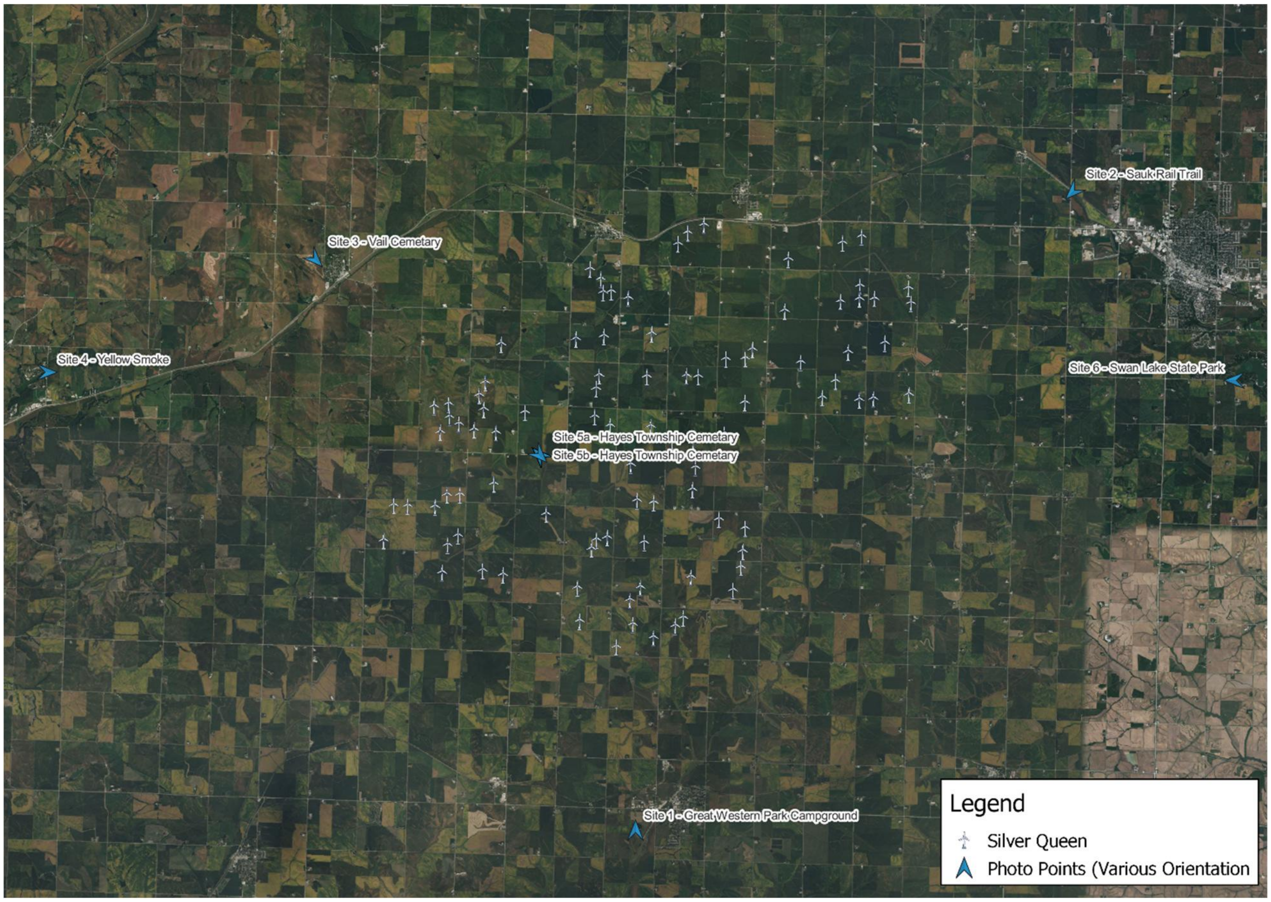

Figure 1: Photomontage Locations

This model is still likely to produce results higher than those which will actually be experienced. Factors that will lower the impact, but were not modeled, include:

- Obstacles (like trees or buildings) are not considered in the analysis;
- Alternate turbines not being constructed; and
- Cloud cover and/or dust which reduce visibility.

7. Modeling Results

Appendix I shows the spatial mapping for ZVI. Appendix II shows the before and after photos of the turbine rendering.

8. Conclusions

The ZVI modeling indicates that a significant portion of the area has at least 1 turbine tip visible although this is currently the case based on existing operational projects.

The photomontage renderings show the visual impact in select sensitive areas of the Project. Visual impact on sensitive areas identified is generally minimal with no impact at locations 4 and 6, minimal impact at locations 1, 2 and 3, and moderate impact at location 5 as this location is within the project area.

9. References

[1] D

[2] United States Geological Survey. “The U.S. Wind Turbine Database.” Retrieved from https://eerscmap.usgs.gov/uswtdb/.

[3] AWS Truepower. (Feb 2017). OpenWind User Manual v1.8. Retrieved from http://ww2.awstruepower.com/openwind_user_manual.

[4] EMD International A/S. (Apr 2019). WindPRO 3.3 User Manual – 6 Environment. Retrieved from http://help.emd.dk/WindPRO/content/windPRO3.3/c6-UK_WindPRO3.3-Environment.pdf.

Appendix I – Maps

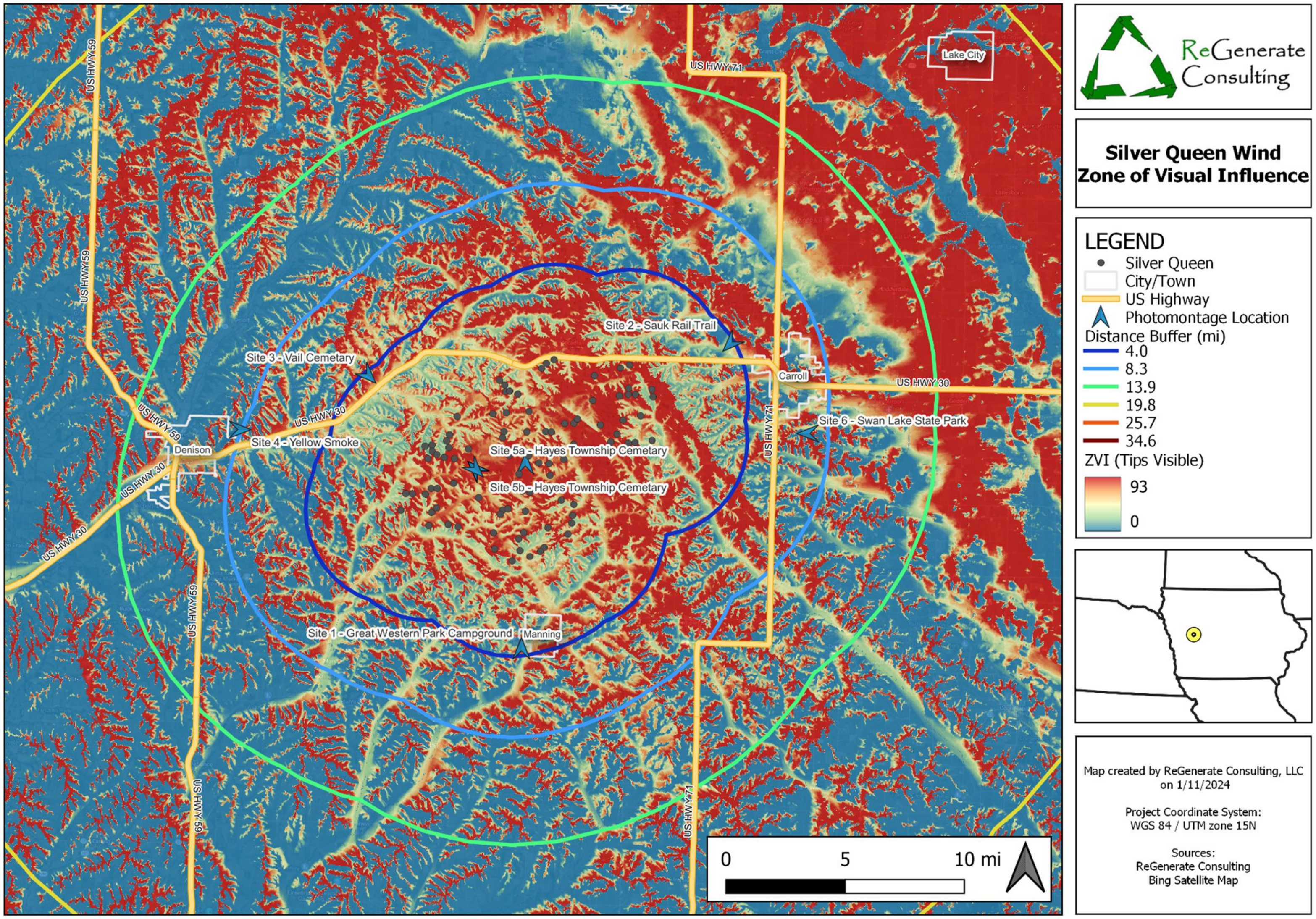

Figure 2: ZVI Map of Tips Visible from Silver Queen Project

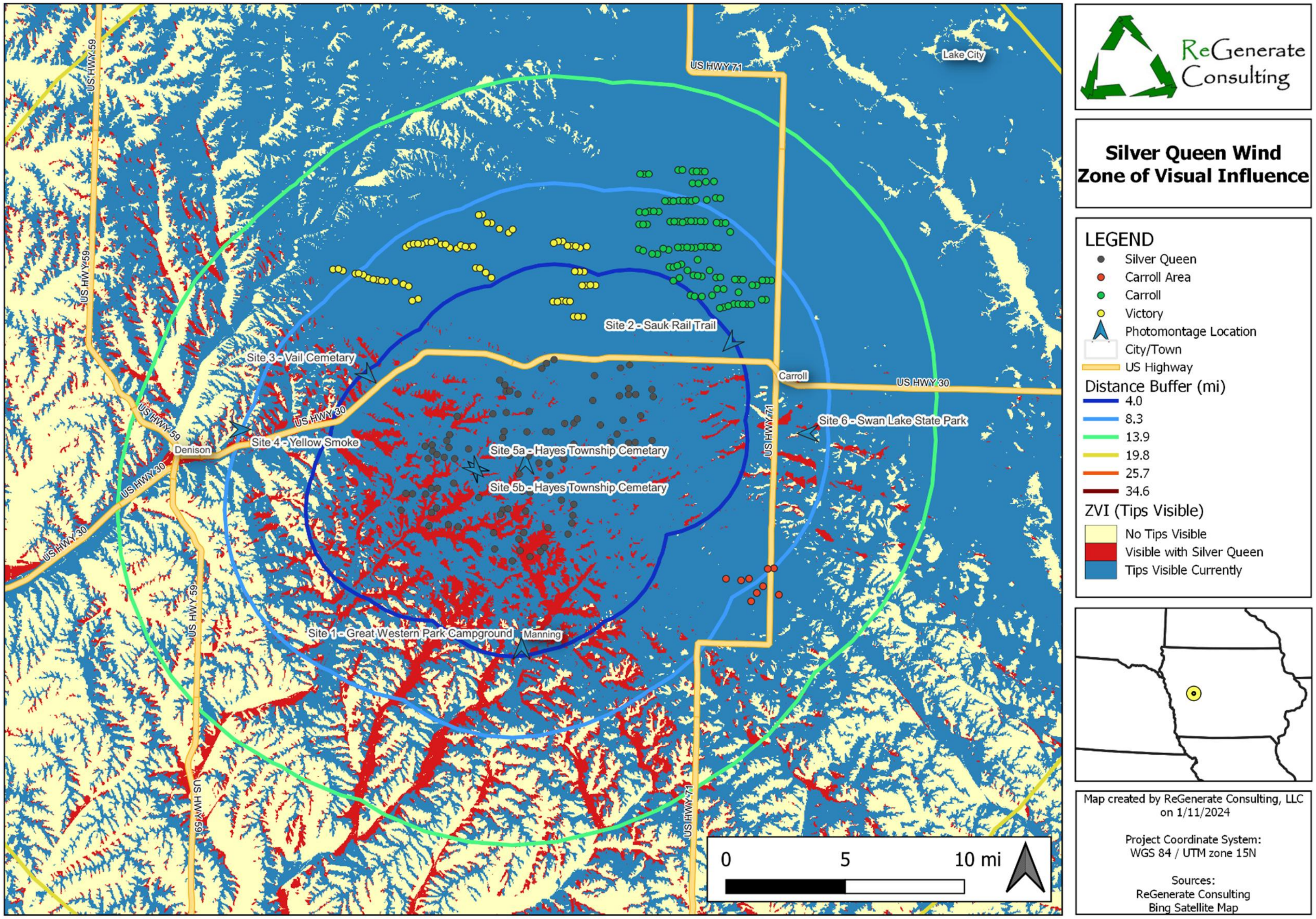

Figure 3: ZVI Map of at Least One Tip Visible

Appendix II – Photomontage Rendering

Before

After

Figure 4: Photomontage at Location 1

Before

After

Figure 5: Photomontage at Location 2

Before

After

Figure 6: Photomontage at Location 3

Before

After

Figure 7: Photomontage at Location 4

Before

After

Figure 8: Photomontage at Location 5a

Before

After

Figure 9: Photomontage at Location 5b

Before

After

Figure 10: Photomontage at Location 6

Appendix III – Project Turbine Coordinates (UTM WGS84 Zone 15)

Turbine ID	X [m]	Y [m]	Turbine Model	Type
S01	327672	4650089	GE 3.4-140 LNTE h98	Primary
S02	327883	4653831	GE 3.4-140 LNTE h98	Primary
S04	322544	4655255	GE 3.4-140 LNTE h98	Primary
S05	323055	4656491	GE 3.4-140 LNTE h98	Primary
S06	325924	4658930	GE 3.4-140 LNTE h98	Primary
S08	327911	4656829	GE 3.4-140 LNTE h98	Primary
S09	332209	4657567	GE 3.4-140 LNTE h98	Primary
S10	334257	4656238	GE 3.4-140 LNTE h98	Primary
S11	335442	4656529	GE 3.4-140 LNTE h98	Primary
S12	336218	4654864	GE 3.4-140 LNTE h98	Primary
S13	336286	4657820	GE 3.4-140 LNTE h98	Primary
S15	332324	4659246	GE 3.4-140 LNTE h98	Primary
S16	334078	4659777	GE 3.4-140 LNTE h98	Primary
S17	334695	4659981	GE 3.4-140 LNTE h98	Primary
T01	326772	4646703	GE 3.4-140 LNTE h98	Primary
T02	327967	4647005	GE 3.4-140 LNTE h98	Primary
T03	328674	4647373	GE 3.4-140 LNTE h98	Primary
T05	325585	4647536	GE 3.4-140 LNTE h98	Primary
T06	327300	4647426	GE 3.4-140 LNTE h98	Primary
S07	326273	4658610	GE 3.4-140 LNTE h98	Primary
T08	325515	4648627	GE 3.4-140 LNTE h98	Primary
T09	327546	4648637	GE 3.4-140 LNTE h98	Primary
T10	329178	4648972	GE 3.4-140 LNTE h98	Primary
T11	330534	4648546	GE 3.4-140 LNTE h98	Primary
T12	330793	4649286	GE 3.4-140 LNTE h98	Primary
T14	330930	4650550	GE 3.4-140 LNTE h98	Primary
T15	330086	4650837	GE 3.4-140 LNTE h98	Primary
T16	326479	4650249	GE 3.4-140 LNTE h98	Primary
T18	325972	4649883	GE 3.4-140 LNTE h98	Primary
T20	323114	4649045	GE 3.4-140 LNTE h98	Primary
T21	322449	4649187	GE 3.4-140 LNTE h98	Primary
T22	321145	4649117	GE 3.4-140 LNTE h98	Primary
T24	321661	4650312	GE 3.4-140 LNTE h98	Primary
T25	319258	4650156	GE 3.4-140 LNTE h98	Primary
T26	319586	4651289	GE 3.4-140 LNTE h98	Primary
T27	320033	4651271	GE 3.4-140 LNTE h98	Primary

Turbine ID	X [m]	Y [m]	Turbine Model	Type
T28	320918	4651241	GE 3.4-140 LNTE h98	Primary
T29	321306	4651631	GE 3.4-140 LNTE h98	Primary
T30	321720	4651633	GE 3.4-140 LNTE h98	Primary
T31	322819	4651983	GE 3.4-140 LNTE h98	Primary
T32	327440	4651443	GE 3.4-140 LNTE h98	Primary
T33	327980	4651375	GE 3.4-140 LNTE h98	Primary
T34	327234	4652595	GE 3.4-140 LNTE h98	Primary
T35	329230	4651790	GE 3.4-140 LNTE h98	Primary
T37	328568	4653353	GE 3.4-140 LNTE h98	Primary
T38	329256	4653310	GE 3.4-140 LNTE h98	Primary
T39	330256	4653599	GE 3.4-140 LNTE h98	Primary
T40	321087	4653649	GE 3.4-140 LNTE h98	Primary
T43	321686	4653916	GE 3.4-140 LNTE h98	Primary
T44	322179	4653728	GE 3.4-140 LNTE h98	Primary
T46	322490	4654389	GE 3.4-140 LNTE h98	Primary
T49	326570	4653861	GE 3.4-140 LNTE h98	Primary
T50	326075	4654151	GE 3.4-140 LNTE h98	Primary
T52	326220	4655478	GE 3.4-140 LNTE h98	Primary
T53	327760	4655448	GE 3.4-140 LNTE h98	Primary
T54	329036	4655468	GE 3.4-140 LNTE h98	Primary
T55	329416	4655450	GE 3.4-140 LNTE h98	Primary
T56	330924	4654608	GE 3.4-140 LNTE h98	Primary
T57	330312	4656012	GE 3.4-140 LNTE h98	Primary
T59	331169	4656319	GE 3.4-140 LNTE h98	Primary
T60	332724	4655908	GE 3.4-140 LNTE h98	Primary
T61	333422	4654765	GE 3.4-140 LNTE h98	Primary
T62	334618	4654693	GE 3.4-140 LNTE h98	Primary
T63	335072	4654732	GE 3.4-140 LNTE h98	Primary
T64	333849	4655297	GE 3.4-140 LNTE h98	Primary
T65	325469	4656659	GE 3.4-140 LNTE h98	Primary
T66	326370	4656748	GE 3.4-140 LNTE h98	Primary
T68	326606	4658206	GE 3.4-140 LNTE h98	Primary
T69	327153	4657993	GE 3.4-140 LNTE h98	Primary
T73	328763	4659741	GE 3.4-140 LNTE h98	Primary
T74	329079	4660102	GE 3.4-140 LNTE h98	Primary
T75	329598	4660353	GE 3.4-140 LNTE h98	Primary
T76	334009	4657883	GE 3.4-140 LNTE h98	Primary
T77	334622	4657963	GE 3.4-140 LNTE h98	Primary
T79	335104	4657970	GE 3.4-140 LNTE h98	Primary

Turbine ID	X [m]	Y [m]	Turbine Model	Type
T80	323824	4654293	GE 3.4-140 LNTE h98	Primary
T81	322883	4653640	GE 3.4-140 LNTE h98	Primary
T82	324507	4651007	GE 3.4-140 LNTE h98	Primary
S03	321359	4654559	GE 3.4-140 LNTE h98	Alternate
S14	336205	4658312	GE 3.4-140 LNTE h98	Alternate
T04	328933	4647641	GE 3.4-140 LNTE h98	Alternate
T07	327208	4648216	GE 3.4-140 LNTE h98	Alternate
T13	330855	4649804	GE 3.4-140 LNTE h98	Alternate
T17	326130	4650176	GE 3.4-140 LNTE h98	Alternate
T23	321326	4650006	GE 3.4-140 LNTE h98	Alternate
T36	329324	4652508	GE 3.4-140 LNTE h98	Alternate
T41	320886	4654481	GE 3.4-140 LNTE h98	Alternate
T42	321387	4654138	GE 3.4-140 LNTE h98	Alternate
T47	322345	4654846	GE 3.4-140 LNTE h98	Alternate
T51	326122	4655055	GE 3.4-140 LNTE h98	Alternate
T58	330933	4656032	GE 3.4-140 LNTE h98	Alternate
T67	326346	4658179	GE 3.4-140 LNTE h98	Alternate
T78	334640	4658389	GE 3.4-140 LNTE h98	Alternate

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Shadow Flicker Assessment

PROJECT: SILVER QUEEN (IA)

DATE: DECEMBER 19, 2023

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Contents

1. Executive Summary 3
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5. Project Regulations 6
6. Modeling Procedures 6
7. Modeling Results 8
8. Conclusions 8
9. References 8

Appendix I – Maps 10

Appendix II – Project Turbine Coordinates (UTM WGS84 Zone 15) 11

Appendix III – Individual Receptor Results (UTM WGS84 Zone 15) 14

Revision History

Issue	Date	Revision Purpose
1	10-Nov-23	Original
2	19-Dec-23	Updated Turbine Layout/Receptors

1. Executive Summary

The Silver Queen Project in western Iowa has been studied for the impact of shadow flicker on surrounding residences. Modeling and topographic reviews were completed to determine potential maximum results at receptor locations in and around the project.

The Project consists of 93 GE 3.4-140 LNTE turbines at 98 m hub-height provided by Scout Clean Energy. These turbines can cause shadow flicker throughout the Project area and this effect was studied at sensitive locations (receptors) to quantify the impact before the proposed Project is constructed.

ReGenerate used windPRO software to model the impact of shadow flicker for the Silver Queen Wind Farm including 280 total receptors.

The effect on receptors has been quantified with the results shown in the table below.

Shadow Flicker [hr/yr]	# of Receptors	% of Receptors
0	146	52.14%
0.1 to 10	49	17.50%
10.1 to 20	52	18.57%
20.1 to 30	33	11.79%
30.1 or more	0	0.00%

The maximum value of shadow flicker at any receptor location was found to be 28.8 hr/yr. All receptors are under 30 hr/yr and it was found that Silver Queen Wind does not cause or contribute to exceedance of the standard.

Appendix I shows the spatial mapping for shadow flicker results. Appendix II shows turbine coordinates provided for the Silver Queen Wind Farm. Appendix III shows the results at each receptor analyzed for this study.

2. Introduction

The Silver Queen Wind Farm (Project) is being developed by Scout Clean Energy (Scout) in western Iowa. Western EcoSystems Technology, Inc. (WEST) (on behalf of Scout) retained ReGenerate Consulting (ReGenerate) to carry out an independent analysis of the potential shadow flicker effects caused by the proposed Project.

The objective of this assessment is to predict the total amount of shadow flicker generated by the project at all receptors within or near the project area, in accordance with any applicable regulations (as described in further detail later in the report). This report describes the Project site, modeling methodology and results of the analysis.

ReGenerate Consulting is an independent engineering consulting agency. The principal investigator for this report, Chris Nuckols, has 20 years of engineering and management experience and 15 years of wind and solar resource assessment experience for clients including renewable energy developers, owners, and OEMs. He has provided engineering support for more than 100 renewable energy projects -- large and small -- on five continents.

3. Background

The cumulative effects of turbine generated shadow flicker throughout the Project area were studied to determine the impact on sensitive receptors. Shadow flicker occurs when wind turbine blades cast a moving shadow across the ground and nearby structures, which is perceived as a flickering effect due to the constant rotation of the blades. Flicker occurs when the following conditions are met:

- Turbine is operating;
- Sun is shining with insignificant cloud cover;
- Turbine blades are positioned directly between the sun and receptor; and
- The receptor is close enough to distinguish the shadow created.

Calculation of potential shadow impact is carried out by simulating the position of the sun relative to the turbine rotor swept area with the resulting shadow calculated in steps of one minute throughout a complete year. If the shadow at any time casts a shadow reflection on the window defined for the receptor, this step will be registered as one minute of potential shadow impact. Information required in this calculation includes:

- Position of wind turbines;
- Turbine hub height and rotor diameter;
- Position of receptor;
- Terrain elevation;
- Window information (height, size, azimuth and tilt);
- Time zone and daylight saving time information; and

- A simulation model which holds information about the earth's orbit and rotation relative to the sun.

A diagram of this simulation is presented in the figure below.

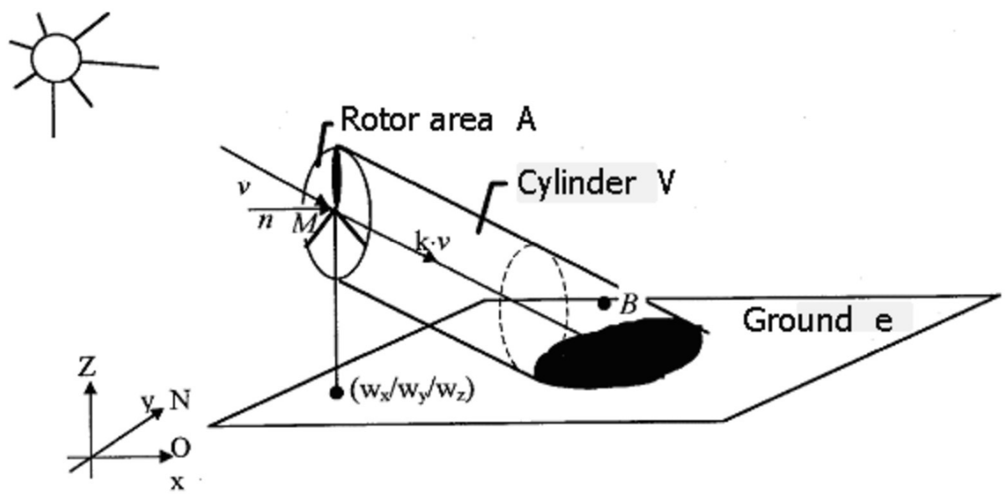

Figure 1: Diagram of Shadow Flicker Model Simulation [1]

This simulation will provide worst case results. To determine a more realistic scenario wind direction and cloud cover may be incorporated.

Wind direction data are generally gathered from on-site meteorological mast measurements or a nearby reference data set. In the absence of wind direction data, the model will assume that the rotor swept area is always perpendicular to the sun.

Measured monthly sunshine data from local data sources may be incorporated to account for cloud cover and visibility at times when the solar disk is not prominent enough to perceive shadow flicker.

Available scientific evidence suggests that shadow flicker impact from wind turbines is unlikely to affect human health. [2] It can, however, be considered a nuisance for homeowners near wind turbines.

4. Project Details

The Project is located near Westside, Iowa in agricultural land consisting primarily of rolling hills. There are scattered dwellings, farm buildings and trees throughout the project area.

Scout provided ReGenerate with the coordinates of proposed turbines and receptors for the Project. The layout features 93 GE 3.4-140 LNTE turbines at 98 m hub-height, including both primary and alternate locations. Turbine coordinates provided for the Project are shown in Appendix II.

Coordinates for individual receptors can be found in Appendix III.

Information on operational neighboring projects was reviewed as part of this analysis based upon the U.S. Wind Turbine Database by USGS. [3] Three nearby projects were found, including:

- Carroll: 100x GE 1.6-91 h80 COD 2008
- Carroll Area: 9x SWT 2.3-108 h80 COD 2015
- Victory: 66x GE 1.5-87 h80 COD 2017

None of these projects are close enough to the receptors under evaluation to have an impact on shadow flicker and are therefore excluded from the analysis.

5. Project Regulations

Scout provided the following language relating to shadow flicker, which they have committed to adhere to as part of permitting requirements: [4]

Developer agrees to site Project wind turbines so as to limit shadow flicker resulting from Project wind turbines at currently occupied residences to 30 hours per year or less, unless waived in writing by the owner of the occupied residence.

6. Modeling Procedures

ReGenerate used windPRO software [1] to model shadow flicker for this project. Modeling assumptions for the shadow flicker analysis include:

- Turbine is operating 100% of the time;
- Flicker is modeled out to ten times the rotor diameter from each respective turbine;
- Flicker is ignored if sun is less than 3° above horizon;
- Default observer eye level is 4 m;
- Receptors are perpendicular to all turbines (also known as greenhouse mode);
- Monthly sunshine probability has been modeled from nearest meteorological station;
- Turbine orientation is considered; and
- Obstacles (like trees or buildings) are not considered.

ReGenerate studied nearby meteorological reference stations available from usclimatedata.com (USCD) historical norms and from the Global Historical Climatology Network (GHCN) for this analysis (see the table below). [5,6]

Station	State	Data Source	Average Sunshine [hour/day]	Distance from Project [km]
DES MOINES	IA	GHCN	7.4	125
DES MOINES	IA	USCLIMATEDATA	7.4	128
SIOUX FALLS	SD	GHCN	7.4	220

Table 1: Meteorological reference stations

All stations show similar results and appear to be reasonable for this location of the country. With Des Moines being the nearest station in distance and the most similar in solar resource to the proposed project area, the Des Moines GHCN station was chosen as most representative for shadow flicker modeling. Monthly average sunshine hours per month for this station are shown in the table below.

Des Moines Average Sunshine [hour/month]											
Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
154	166	209	227	274	310	336	299	245	207	137	129

Table 2: Average sunshine hours per month

The wind direction frequency was considered to account for turbine orientation of the rotor area relative to the sun. This data was taken from reanalysis data near the Project at hub height. [7] The wind frequency rose is shown in the figure below.

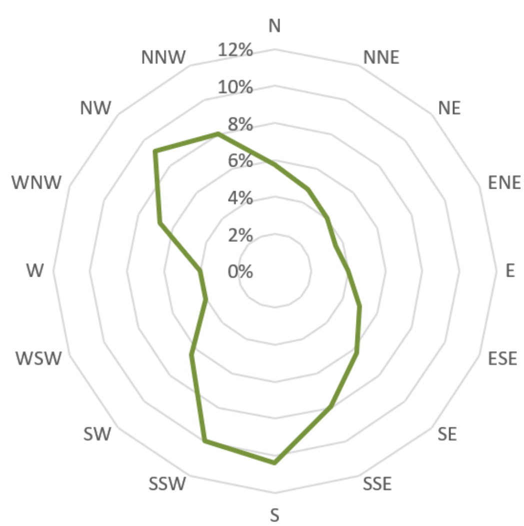

Figure 2: Wind frequency rose for Project

This model is still likely to produce estimates higher than those which will actually be experienced. Factors that will lower the impact, but were not modeled, include:

- Availability of the turbines;
- Turbines not operating below cut-in and above cut-out wind speeds;
- Alternate turbines not being constructed;
- Obstacles (like trees or buildings) obstructing shadow flicker; and
- Dust or aerosols in the air which reduce the impact of shadow flicker.

7. Modeling Results

The effect on receptors has been quantified using the methodology described above. The maximum value of shadow flicker at any receptor location was found to be 28.8 hr/yr. A summary of the results can be seen in the table below. Detailed results can be found in Appendix III.

Shadow Flicker [hr/yr]	# of Receptors	% of Receptors
0	146	52.14%
0.1 to 10	49	17.50%
10.1 to 20	52	18.57%
20.1 to 30	33	11.79%
30.1 or more	0	0.00%

Table 3: Shadow flicker results summary

8. Conclusions

The maximum value of shadow flicker at any receptor location was found to be 28.8 hr/yr. All receptors are under 30 hr/yr, and it was found that the Silver Queen Project does not cause or contribute to exceedance of the standard.

Appendix I shows the spatial mapping for shadow flicker results. Appendix II shows turbine coordinates provided for the Silver Queen Wind Farm. Appendix III shows the results at each receptor analyzed for this study.

9. References

[1] EMD International A/S. (Apr 2019). WindPRO 3.3 User Manual – 6 Environment. Retrieved from http://help.emd.dk/WindPRO/content/windPRO3.3/c6-UK_WindPRO3.3-Environment.pdf.

[2] Knopper, Loren D et al. “Wind turbines and human health.” Frontiers in public health vol. 2 63. 19 Jun. 2014, doi:10.3389/fpubh.2014.00063.

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[7] European Centre for Medium-Range Weather Forecasts. (Aug 2023). ECMWF Reanalysis v5 (ERA5). Retrieved from https://www.ecmwf.int/en/forecasts/dataset/ecmwf-reanalysis-v5.

Appendix I – Maps

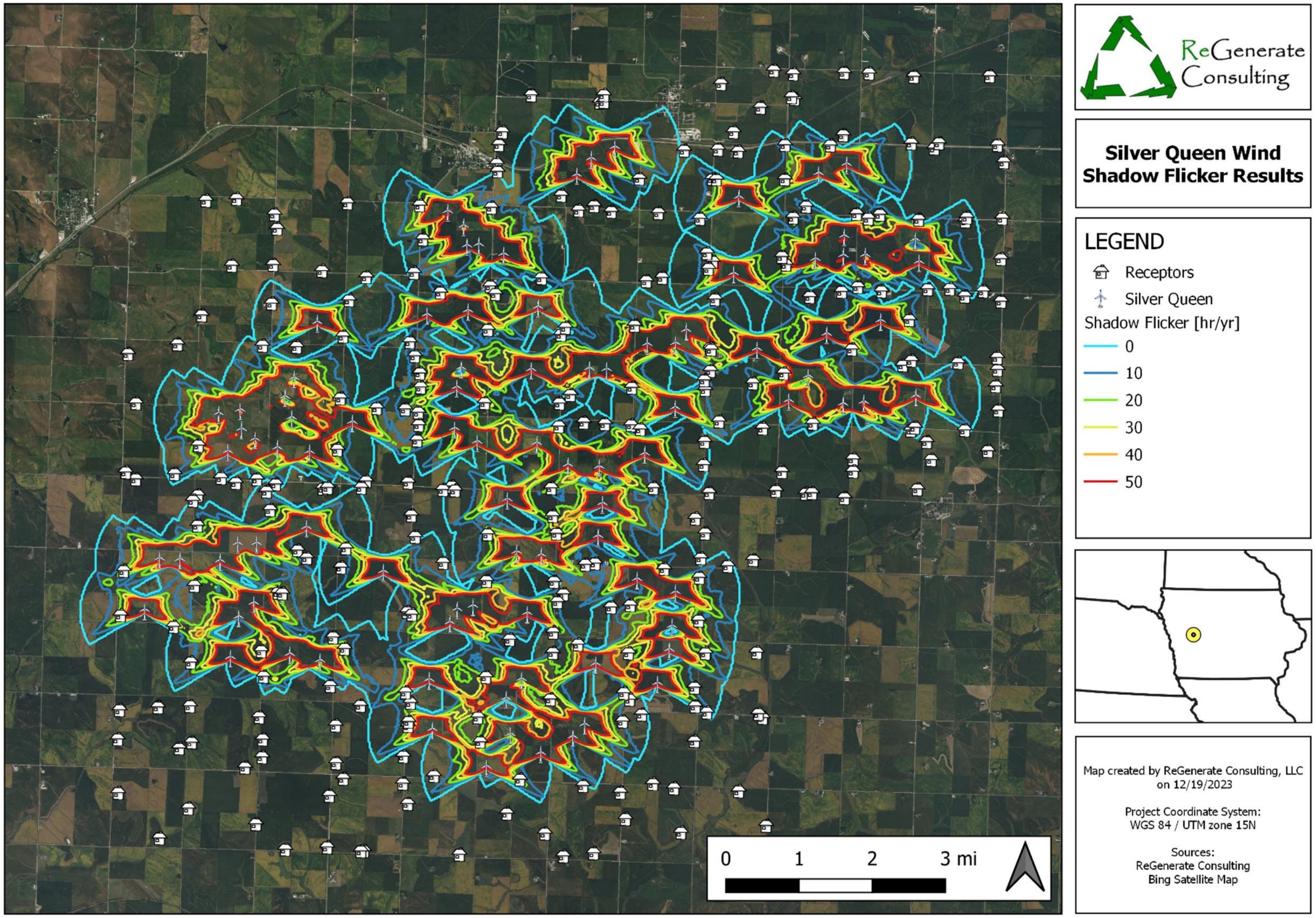

Figure 3: Shadow Flicker Map of Silver Queen Wind Project

Appendix II – Project Turbine Coordinates (UTM WGS84 Zone 15)

Turbine ID	X [m]	Y [m]	Turbine Model	Type
S01	327672	4650089	GE 3.4-140 LNTE h98	Primary
S02	327883	4653831	GE 3.4-140 LNTE h98	Primary
S04	322544	4655255	GE 3.4-140 LNTE h98	Primary
S05	323055	4656491	GE 3.4-140 LNTE h98	Primary
S06	325924	4658930	GE 3.4-140 LNTE h98	Primary
S08	327911	4656829	GE 3.4-140 LNTE h98	Primary
S09	332209	4657567	GE 3.4-140 LNTE h98	Primary
S10	334257	4656238	GE 3.4-140 LNTE h98	Primary
S11	335442	4656529	GE 3.4-140 LNTE h98	Primary
S12	336218	4654864	GE 3.4-140 LNTE h98	Primary
S13	336286	4657820	GE 3.4-140 LNTE h98	Primary
S15	332324	4659246	GE 3.4-140 LNTE h98	Primary
S16	334078	4659777	GE 3.4-140 LNTE h98	Primary
S17	334695	4659981	GE 3.4-140 LNTE h98	Primary
T01	326772	4646703	GE 3.4-140 LNTE h98	Primary
T02	327967	4647005	GE 3.4-140 LNTE h98	Primary
T03	328674	4647373	GE 3.4-140 LNTE h98	Primary
T05	325585	4647536	GE 3.4-140 LNTE h98	Primary
T06	327300	4647426	GE 3.4-140 LNTE h98	Primary
S07	326273	4658610	GE 3.4-140 LNTE h98	Primary
T08	325515	4648627	GE 3.4-140 LNTE h98	Primary
T09	327546	4648637	GE 3.4-140 LNTE h98	Primary
T10	329178	4648972	GE 3.4-140 LNTE h98	Primary
T11	330534	4648546	GE 3.4-140 LNTE h98	Primary
T12	330793	4649286	GE 3.4-140 LNTE h98	Primary
T14	330930	4650550	GE 3.4-140 LNTE h98	Primary
T15	330086	4650837	GE 3.4-140 LNTE h98	Primary
T16	326479	4650249	GE 3.4-140 LNTE h98	Primary
T18	325972	4649883	GE 3.4-140 LNTE h98	Primary
T20	323114	4649045	GE 3.4-140 LNTE h98	Primary
T21	322449	4649187	GE 3.4-140 LNTE h98	Primary
T22	321145	4649117	GE 3.4-140 LNTE h98	Primary
T24	321661	4650312	GE 3.4-140 LNTE h98	Primary
T25	319258	4650156	GE 3.4-140 LNTE h98	Primary
T26	319586	4651289	GE 3.4-140 LNTE h98	Primary
T27	320033	4651271	GE 3.4-140 LNTE h98	Primary

Turbine ID	X [m]	Y [m]	Turbine Model	Type
T28	320918	4651241	GE 3.4-140 LNTE h98	Primary
T29	321306	4651631	GE 3.4-140 LNTE h98	Primary
T30	321720	4651633	GE 3.4-140 LNTE h98	Primary
T31	322819	4651983	GE 3.4-140 LNTE h98	Primary
T32	327440	4651443	GE 3.4-140 LNTE h98	Primary
T33	327980	4651375	GE 3.4-140 LNTE h98	Primary
T34	327234	4652595	GE 3.4-140 LNTE h98	Primary
T35	329230	4651790	GE 3.4-140 LNTE h98	Primary
T37	328568	4653353	GE 3.4-140 LNTE h98	Primary
T38	329256	4653310	GE 3.4-140 LNTE h98	Primary
T39	330256	4653599	GE 3.4-140 LNTE h98	Primary
T40	321087	4653649	GE 3.4-140 LNTE h98	Primary
T43	321686	4653916	GE 3.4-140 LNTE h98	Primary
T44	322179	4653728	GE 3.4-140 LNTE h98	Primary
T46	322490	4654389	GE 3.4-140 LNTE h98	Primary
T49	326570	4653861	GE 3.4-140 LNTE h98	Primary
T50	326075	4654151	GE 3.4-140 LNTE h98	Primary
T52	326220	4655478	GE 3.4-140 LNTE h98	Primary
T53	327760	4655448	GE 3.4-140 LNTE h98	Primary
T54	329036	4655468	GE 3.4-140 LNTE h98	Primary
T55	329416	4655450	GE 3.4-140 LNTE h98	Primary
T56	330924	4654608	GE 3.4-140 LNTE h98	Primary
T57	330312	4656012	GE 3.4-140 LNTE h98	Primary
T59	331169	4656319	GE 3.4-140 LNTE h98	Primary
T60	332724	4655908	GE 3.4-140 LNTE h98	Primary
T61	333422	4654765	GE 3.4-140 LNTE h98	Primary
T62	334618	4654693	GE 3.4-140 LNTE h98	Primary
T63	335072	4654732	GE 3.4-140 LNTE h98	Primary
T64	333849	4655297	GE 3.4-140 LNTE h98	Primary
T65	325469	4656659	GE 3.4-140 LNTE h98	Primary
T66	326370	4656748	GE 3.4-140 LNTE h98	Primary
T68	326606	4658206	GE 3.4-140 LNTE h98	Primary
T69	327153	4657993	GE 3.4-140 LNTE h98	Primary
T73	328763	4659741	GE 3.4-140 LNTE h98	Primary
T74	329079	4660102	GE 3.4-140 LNTE h98	Primary
T75	329598	4660353	GE 3.4-140 LNTE h98	Primary
T76	334009	4657883	GE 3.4-140 LNTE h98	Primary
T77	334622	4657963	GE 3.4-140 LNTE h98	Primary
T79	335104	4657970	GE 3.4-140 LNTE h98	Primary

Turbine ID	X [m]	Y [m]	Turbine Model	Type
T80	323824	4654293	GE 3.4-140 LNTE h98	Primary
T81	322883	4653640	GE 3.4-140 LNTE h98	Primary
T82	324507	4651007	GE 3.4-140 LNTE h98	Primary
S03	321359	4654559	GE 3.4-140 LNTE h98	Alternate
S14	336205	4658312	GE 3.4-140 LNTE h98	Alternate
T04	328933	4647641	GE 3.4-140 LNTE h98	Alternate
T07	327208	4648216	GE 3.4-140 LNTE h98	Alternate
T13	330855	4649804	GE 3.4-140 LNTE h98	Alternate
T17	326130	4650176	GE 3.4-140 LNTE h98	Alternate
T23	321326	4650006	GE 3.4-140 LNTE h98	Alternate
T36	329324	4652508	GE 3.4-140 LNTE h98	Alternate
T41	320886	4654481	GE 3.4-140 LNTE h98	Alternate
T42	321387	4654138	GE 3.4-140 LNTE h98	Alternate
T47	322345	4654846	GE 3.4-140 LNTE h98	Alternate
T51	326122	4655055	GE 3.4-140 LNTE h98	Alternate
T58	330933	4656032	GE 3.4-140 LNTE h98	Alternate
T67	326346	4658179	GE 3.4-140 LNTE h98	Alternate
T78	334640	4658389	GE 3.4-140 LNTE h98	Alternate

Appendix III – Individual Receptor Results (UTM WGS84 Zone 15)

Receptor ID	X [m]	Y [m]	Shadow Flicker [hrs/yr]
1	319568	4645170	0
2	326164	4644809	0
3	325030	4645925	0
4	325295	4655401	17.3
5	326720	4654747	26.1
6	325260	4654537	8.8
7	325314	4655090	25.6
8	323481	4653724	18.9
9	324111	4653030	10.0
10	325037	4653003	0
11	325270	4654264	12.3
12	325998	4652917	2.9
13	325192	4651810	0
14	325802	4652842	0
15	326067	4652830	3.4
16	324008	4652890	0
17	325106	4652280	0
18	323669	4651561	27.0
19	323163	4652870	0
20	323266	4652890	0
21	322124	4652966	0.1
22	322607	4651512	9.0
23	322003	4652400	9.0
24	320413	4652722	0
25	321923	4652806	3.9
26	321246	4652995	0
27	320406	4652058	9.9
28	319048	4653076	0
29	320305	4652604	0
30	324062	4644891	0
31	324921	4646371	0
32	323610	4646477	0
33	323998	4644886	0
34	324345	4654634	22.2
35	325185	4655785	16.1
36	324974	4654609	19.3
37	318782	4651055	21.7
38	318711	4650078	25.9

Receptor ID	X [m]	Y [m]	Shadow Flicker [hrs/yr]
39	320335	4650728	13.3
40	322171	4650573	27.2
41	322270	4650557	20.0
42	322807	4651341	5.9
43	323560	4651130	6.5
44	325016	4650148	9.5
45	325807	4651233	1.9
46	325119	4650094	13.0
47	325087	4648153	0
48	326865	4659051	23.6
49	325360	4658355	15.3
50	323639	4649341	22.7
51	324979	4648382	23.2
52	325291	4659099	23.4
53	325167	4657616	6.4
54	323324	4648524	0
55	323388	4649592	5.8
56	321858	4648731	20.4
57	323704	4659149	0
58	322154	4658587	0
59	323142	4657658	0
60	321808	4649290	28.8
61	320257	4649042	9.0
62	322097	4658901	0
63	320589	4659206	0
64	321262	4659241	0
65	322068	4657792	0
66	321159	4657776	0
67	319878	4649828	20.5
68	323304	4646102	0
69	322334	4644923	0
70	323256	4644969	0
71	322586	4655988	0
72	323548	4654850	18.7
73	319536	4648057	0
74	320002	4647146	0
75	318691	4647994	0
76	318649	4647353	0
77	320277	4647279	0
78	321449	4646723	0
79	320239	4648081	0

Receptor ID	X [m]	Y [m]	Shadow Flicker [hrs/yr]
80	321762	4647840	0
81	320495	4656683	0
82	322036	4656941	6.0
83	321826	4646951	0
84	321838	4647348	0
85	323606	4656218	25.3
86	323450	4646819	0
87	323985	4648092	0
88	323443	4647655	0
89	324931	4646966	0
90	325072	4656094	4.6
91	324116	4657521	0
92	323739	4657015	13.2
93	325034	4647643	19.9
94	325046	4647737	20.4
95	326572	4647833	16.3
96	325602	4646538	4.3
97	326790	4656366	10.0
98	326841	4657322	3.7
99	325746	4657185	18.9
100	320203	4645825	0
101	321688	4645480	0
102	321834	4656016	8.0
103	318660	4646165	0
104	318876	4655834	0
105	319052	4654742	0
106	319964	4656046	0
107	318826	4653228	0
108	319900	4653190	9.1
109	320924	4653103	0
110	320424	4653817	27.4
111	321710	4653073	7.4
112	325235	4653927	16.0
113	327207	4645713	0
114	328043	4645273	0
115	328450	4644775	0
116	329116	4644842	0
117	328883	4646319	0
118	329703	4646172	0
119	329815	4645592	0
120	331035	4645293	0

Receptor ID	X [m]	Y [m]	Shadow Flicker [hrs/yr]
121	330881	4646266	0
122	332909	4645444	0
123	332304	4646202	0
124	332834	4647822	0
125	331607	4647941	7.5
126	332739	4647911	0
127	331575	4649244	18.6
128	332701	4649262	0
129	331565	4651886	0
130	332066	4651160	3.8
131	332624	4651296	0
132	331653	4652773	0
133	333124	4652820	0
134	332833	4654189	0
135	333256	4653236	0
136	333776	4652758	0
137	333917	4652772	0
138	334630	4652663	0
139	334819	4653515	0
140	334819	4653245	0
141	336235	4652857	0
142	336091	4654145	6.8
143	336540	4653500	0
144	336439	4653893	0
145	337784	4653695	0
146	337275	4654151	0
147	338015	4654584	0
148	337957	4655116	0
149	337996	4655476	0
150	337129	4655633	1.8
151	337989	4655749	0
152	338073	4656987	0
153	337276	4657097	0
154	336949	4657264	0
155	337681	4657211	0
156	338072	4657920	0
157	337290	4658750	3.7
158	337322	4658833	3.4
159	338102	4658812	0
160	338138	4660058	0
161	336607	4660362	0

Receptor ID	X [m]	Y [m]	Shadow Flicker [hrs/yr]
162	336710	4660477	0
163	337998	4660432	0
164	337825	4661952	0
165	336100	4660470	0
166	336156	4661938	0
167	335172	4662011	0
168	334605	4660653	0
169	334624	4662024	0
170	333505	4661996	0
171	333534	4661449	0
172	333467	4661488	0
173	332191	4660721	0
174	332785	4661258	0
175	333078	4662074	0
176	331917	4661780	0
177	329252	4661369	0
178	329341	4661384	0
179	329341	4661535	0
180	327745	4661529	0
181	327110	4660721	0
182	326623	4647291	28.0
183	327497	4646458	26.4
184	329754	4647744	11.6
185	330419	4646363	0
186	331330	4647306	0
187	330171	4647897	2.2
188	329907	4648225	16.9
189	331332	4648489	10.9
190	331347	4648076	8.7
191	329881	4649246	21.9
192	329780	4648369	14.1
193	328773	4649436	18.6
194	328165	4648233	20.1
195	326748	4648719	28.0
196	328218	4649253	10.6
197	327271	4649545	11.1
198	328227	4649698	8.8
199	326759	4650833	16.9
200	328246	4650816	0
201	328451	4650544	8.6
202	328319	4650371	12.4

Receptor ID	X [m]	Y [m]	Shadow Flicker [hrs/yr]
203	329498	4650254	0
204	329923	4650297	13.4
205	331426	4649963	16.7
206	331439	4650905	26.6
207	330667	4651096	15.3
208	331472	4651335	0
209	331352	4652210	0
210	329145	4651220	9.8
211	328932	4651191	10.0
213	328217	4652267	18.1
214	326786	4651869	18.4
215	328184	4652879	21.7
216	328349	4654235	19.4
217	328900	4654320	4.6
218	329364	4654286	10.2
219	329940	4654262	10.3
220	330431	4652883	11.2
221	331536	4653390	3.5
222	331555	4653896	2.65
223	330142	4654171	4.0
224	328364	4654741	0
225	328397	4656255	7.6
226	326956	4657152	24.3
227	336179	4654208	13.5
228	335914	4655577	0
229	333936	4654294	7.9
231	331872	4654343	8.0
232	332618	4655182	12.1
233	331683	4655454	12.2
234	331570	4655036	14.7
235	331550	4655246	1.4
236	328603	4654925	4.3
237	329955	4655083	22.2
238	328496	4656412	0
239	330014	4656456	21.5
240	331786	4657036	0
241	331675	4655960	15.6
242	331701	4655931	15.6
243	334795	4655934	25.5
244	334568	4657201	9.8
245	333870	4657089	0

Receptor ID	X [m]	Y [m]	Shadow Flicker [hrs/yr]
246	336105	4655681	0
247	336059	4656581	16.1
248	335445	4657210	0
249	334924	4657305	1.9
250	336461	4657257	6.8
251	336263	4658785	0
252	335154	4658809	23.4
253	333344	4657796	19.8
254	333504	4658831	10.4
255	331737	4657863	27.0
256	333256	4657969	16.9
257	330275	4657434	0
258	330625	4657509	0
259	331643	4657705	18.6
260	331609	4658048	19.7
261	331453	4658807	8.7
262	330542	4658930	0
263	329504	4658960	0
264	328785	4658988	0
265	327968	4657500	5.9
266	327033	4660439	0
267	326986	4660022	0
268	327004	4659850	0
269	328404	4659316	0
270	329125	4659086	0
271	330120	4659688	10.4
272	331106	4660315	0
273	331724	4659680	19.7
274	331815	4659671	24.2
275	331851	4660336	0
276	332293	4660292	0
277	333320	4659676	16.3
278	333322	4660436	9.9
279	333789	4659074	10.5
280	334898	4658908	0
281	334322	4660427	16.7
282	335410	4658895	24.4