

Appendix E: Shadow Flicker Analysis



**Riverbend Wind Project
Shadow Flicker Study –
Speaker Township
Sanilac County, Michigan**

September 26, 2022

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Project No: 193709180

**RIVERBEND WIND PROJECT
SHADOW FLICKER STUDY – SPEAKER TOWNSHIP
SANILAC COUNTY, MICHIGAN**

September 26, 2022

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1.0 INTRODUCTION

Algonquin Power (MI Energy Developments) LLC, owned by Algonquin Power & Utilities Corp. (AQN), parent company of Liberty Power, is proposing to develop an approximately 300-megawatt (MW) wind power generation facility in Sanilac County, Michigan. The Riverbend Wind Energy Project (the “Project”) will include up to 50 wind turbine generator (“WTG” or “turbine”) locations within Fremont and Speaker Townships. The Project currently is permitting three layouts, Scenarios 25, 16 and 16a. The Project intends to construct up to 26 turbines within Speaker Township.

AQN retained Stantec Consulting Services Inc. (Stantec) to conduct an assessment of potential shadow flicker from operation of the Project wind turbines. The potential shadow flicker within approximately one (1) mile of proposed Project turbine sites was assessed. The analyses consider a 6.0-MW turbine with a 162-meter rotor diameter (162-6.0) and a 4.5-MW turbine with a 163-meter rotor diameter (163-4.5), such as those manufactured by Vestas.

This report summarizes the shadow flicker expected to affect Speaker residences due to the operation of the Project wind turbines under the various design layouts (Scenarios) as summarized in Table 1.

Table 1 Riverbend Wind Turbine Layout Designs (Scenarios)

Scenario	Total Turbine Pad Locations¹	Potential Turbine Pad Locations in Speaker
Scenario 25 (Sc25) – no alternate turbines	50 – 162-6.0 WTGs	24 – 162-6.0 WTGs
Scenario 16 (Sc16) – no alternate turbines	50 – 162-6.0 WTGs	24 – 162-6.0 WTGs
Scenario 16 (Sc16 wAlts) – with alternate turbines	56 – 162-6.0 WTGs	26 – 162-6.0 WTGs
Scenario 16a (Sc16a) – mixed WTG case, no alternate turbines	42 – 162-6.0 WTGs 8 – 163-4.5 WTGs	20 – 162-6.0 WTGs 4 – 163-4.5 WTGs
Scenario 16a (Sc16a wAlts) – mixed WTG case, with alternate turbines	48 – 162-6.0 WTGs 8 – 163-4.5 WTGs	22 – 162-6.0 WTGs 4 – 163-4.5 WTGs

¹ Note: in cases where the total turbine pad locations are greater than 50, only up to 50 will be built

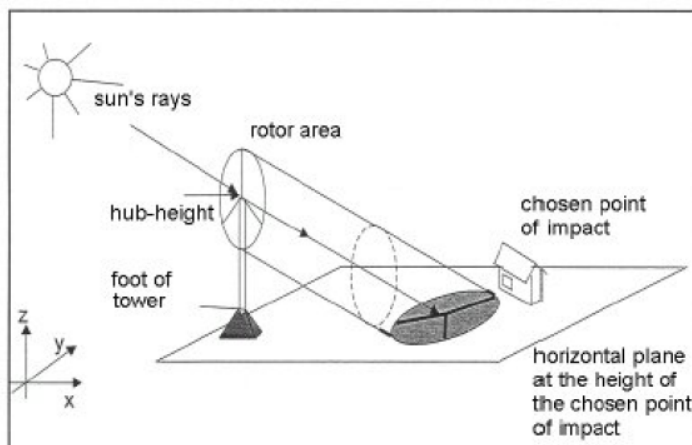
September 26, 2022

2.0 SHADOW FLICKER AND REGULATIONS

2.1 DESCRIPTION OF SHADOW FLICKER

Shadow flicker is a term used to describe the intermittent change in the intensity of light cast on an area resulting from the rotation of an operating wind turbine's blades. The presence and intensity of shadow flicker are dependent on many factors, including but not limited to the position of the sun in relation to the turbine and receptor, distance of receptor from turbine, physical characteristics of the turbine and blades, time of day, season of year and topography of the Project area. Shadow flicker will only occur during the daytime, when skies are not overcast or cloudy. Turbines must be operational, as the flicker effect is caused by rotation of the blades as they intercept the sunlight cast on a receptor. When a turbine is not operating it may cast a stationary shadow, similar to other objects such as trees or utility poles.

The amount of shadow flicker received in an area is dependent on the alignment of the rotor blades in relation to the sun and receptor. Maximum shadow flicker is received when both the sun and rotor plane are perpendicular to the receptor. This alignment occurs when the wind is blowing directly from a source turbine towards a receptor. At times when the wind is blowing from other directions, the shadow cast on the target receptor is diminished and the shadow flicker effect passes more quickly.



Shadow flicker diminishes as the distance between the source turbine and receptor increases. Shadow flicker becomes less pronounced with distance, due to dissipation and the relative ratio of the turbine blade to the sun disk area.

2.2 REGULATIONS WITHIN THE PROJECT AREA

The Speaker Township Ordinance No. 2021-02 (amended) Article XIA, Section 11.06.06 states the following. "Shadow flicker shall not exceed thirty (30) hours per year. Applicant/developer shall mitigate the effects of any period of shadow flicker that exceeds thirty (30) minutes in duration by shutting down the offending turbine or other appropriate measures as Speaker Township (the "Township") may approve."

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3.0 SHADOW FLICKER ANALYSIS

AQN has commissioned this study to better understand the shadow flicker impact on area receptors due to the normal operation of the Project. Shadow flicker has been considered when designing the Project, with the goal of minimizing potential flicker on occupied structures, also referred to in this report as sensitive receptors (e.g., residences, schools, hospitals, churches), to the extent practicable.

The potential amount of shadow flicker on sensitive receptors within the Project area can be modeled using software such as EMD's WindPRO, an application that considers the attributes and positions of the wind turbines in relation to receptors within the area. The model also considers the sun position as it passes through all 365 days per year and regional climatological information. The total nameplate generating capacity of the Project (50 turbines) will be approximately 300 MW.

Stantec assessed the potential expected shadow flicker due to operation of the Project under five design scenarios. The scenarios are summarized in Table 1 and described in more detail in Section 3.1.

3.1 SHADOW FLICKER ANALYSIS METHODS

The potential total annual time of shadow flicker on each receptor was estimated for the Project area using the Shadow module of WindPRO Version 3.4 software. WindPRO is an agency and industry-accepted modeling program that calculates the number of hours and days per year that any given receptor may receive shadow flicker from the source turbines.

A modeling analysis was completed to assess the expected shadow levels at receptors given the climatological conditions of the area. The shadow flicker calculation considers the percentage of sunshine based on local regional sunshine statistics; the alignment of the blades in relation to the receptor due to wind direction; and the amount of time that the blades would not be rotating due to wind speeds outside of the turbines operating parameters. The results of the analysis provide the number of annual hours that shadow flicker is expected to occur at the defined receptor. The analysis also provides an estimate of the maximum amount of time that a receptor may receive shadow flicker on any given day. The shadow flicker analysis uses a conservative 90% operational time for purposes of calculating the expected hours of shadow flicker.

The results provided in this report include the expected amount of shadow flicker annually on each receptor, given the climatological conditions of the area. The amount of time that shadow flicker may occur on a receptor on any single day is dependent on the local weather conditions on that day. Shadow flicker may be expected to be present on a day that has cloud cover, resulting in reduced or no shadow flicker on that particular day. The analyses summarized in this report assumes the maximum shadow flicker per day without regard to the climatological conditions that were utilized to predict the annual shadow flicker hours. Climatological information was acquired from the National Climatic Data Center (NCDC) and regional meteorological stations. The percentage of sunshine probability was estimated from an analysis of sunshine statistics for the Project region.

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The climatologically based expected hours of sunshine for the Project area are presented in Table 1. The frequency of wind (hours per year) expected in 12 compass directions is summarized in Table 2. A graphical representation of the wind direction is provided below Table 3. The total number of hours that turbines are able to cause shadow flicker takes into account non-operational time due to low or high wind speeds. The turbine model that Riverbend Wind proposes will generally operate when winds at hub-height are between 3 and 30 meters per second.

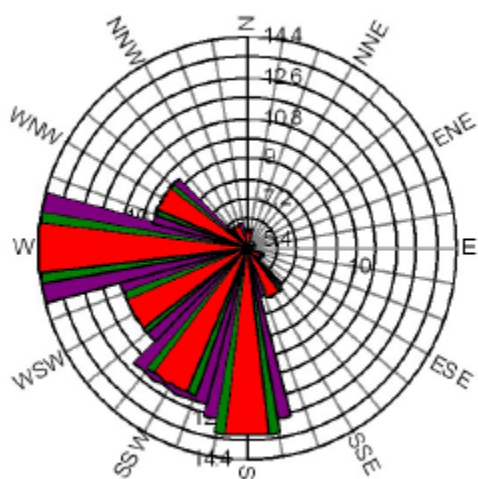
Table 2 Sunshine Probability (sun hours/possible sun hours)

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.35	0.43	0.49	0.52	0.57	0.63	0.67	0.67	0.64	0.56	0.42	0.31

Table 3 Turbine Operation Time per Sector (hours per year)

N	NNE	ENE	E	ESE	SSE	S	SSW	WSW	W	WNW	NNW	TOTAL
461	406	395	415	456	571	1,003	962	860	1,131	741	483	7,884

Wind Directional Distribution



The effect of shadow flicker is also dependent on the physical characteristics of the turbine and the distance between the source turbine and shadow receptor. The shadow flicker analyses summarized in this report are based on the Project design scenarios listed in Table 1 and described in this section utilizing turbines with the attributes listed in Table 4.

Table 4 Turbine Characteristics

Turbine Model	Turbine Nameplate (MW)	Hub Height (meters; feet)	Rotor Diameter (meters; feet)	Tip Height (meters; feet)
162-6.0	6.0	119.0; 390.4	162.0; 531.5	200.0; 656.2
163-4.5	4.5	118.5; 388.8	163.0; 534.8	200.0; 656.2

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Elevations for turbines and receptors located within approximately one (1) mile of the turbines were calculated using the National Elevation Dataset digitally acquired from the U.S. Geological Survey.

The individual locations of the wind turbines are based on the five current Project layout scenarios provided by Riverbend Wind.

- Scenario 25 (Sc25) – is a layout of 50 162-6.0 turbines, with 24 proposed pad locations in Speaker Township. This scenario does not include alternate turbine locations.
- Scenario 16 (Sc16) – is a proposed layout of 50 162-6.0 turbines, with 24 potential pad locations in Speaker Township. This scenario does not include alternate turbines.
- Scenario 16 with alternates (Sc16 wAlts) – is a version of Scenario 16 with a total of 56 162-6.0 turbines, with 26 potential pad locations in Speaker Township. This scenario includes 6 alternate turbines (2 located in Speaker Township). This scenario will result in higher shadow flicker impact than is expected in the final turbine design, as it includes impacts from the alternate turbines.
- Scenario 16a (Sc16a) – is a version of Scenario 16 with the 24 proposed turbines located in the same positions. However, in this scenario, 4 of the turbines proposed in Speaker Township would be 163-4.5 turbines on 118.5-meter hub heights. The shadow flicker for this scenario is nearly identical to the base Scenario 16 impacts.
- Scenario 16a with alternates (Sc16a wAlts) – is a version of the Scenario 16 “with alternates” case with the 26 potential pad locations in the same positions in Speaker Township. However, in this scenario 4 of the turbines proposed in Speaker Township, would be 163-4.5 turbines on 118.5-meter hub heights. This scenario includes 6 alternate turbines (2 located in Speaker Township). The shadow flicker for this scenario is nearly identical to the Scenario 16 “with alternates” impacts.

A total of 552 potential occupied or habitable structures (also referred to as receptors or sensitive receptors) within the surrounding area were identified by Riverbend Wind and Stantec utilizing aerial imagery and on-site reconnaissance in Speaker Township. Receptors in the analysis include occupied buildings within approximately one (1) mile of the turbine locations. There are 57 Project participants (landowners with land under Project leases/agreements) and 495 non-participants (landowners without Project leases/agreements). Participation status is noted in the assessment results. The coordinates (UTM Zone 17) of turbine locations for each scenario are included in Appendix A.

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

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

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3.2 SHADOW FLICKER ANALYSIS RESULTS

The amount of shadow flicker on receptors within the Project area was calculated based on the climatological history of wind speed, wind direction, and percentage of sunshine for the turbine models in operation. Figures 1 through 5 present maps of the Speaker Township Project area along with the 30-hour contours of expected shadow flicker hours per year.

Table 5 provides a summary of the five scenarios and the annual hours of shadow flicker expected on the identified non-participating potential sensitive receptors located in Speaker Township. The study includes 495 receptors within approximately one (1) mile of Project turbine sites. The analyses were completed without considering the blocking effects of vegetation between the turbines and receptors; therefore, the actual shadow flicker impact on many receptors will be less than the modeled result given. Receptor locations and detailed shadow flicker results are provided in Appendix B.

The analyses indicate that the majority of residences in Speaker Township will receive less than 10 hours of annual shadow flicker and no shadow flicker on most days of the year, due to the operation of the Project turbines (Table 5). Depending on the Project layout Scenario selected it is estimated that between 42 to 49 non-participating homes may experience shadow flicker for greater than 30 hours a year.

Table 5 Summary of Results – Expected Annual Shadow Flicker Hours on Occupied Structures of Non-Participants

Expected Shadow Flicker (Annual Hours on Occupied Structures)	Scenario 25 (50 162-6.0 WTGs)	Scenario 16 (50 162-6.0 WTGs)	Scenario 16 wAlts (56 162-6.0 WTGs)	Scenario 16a (50 162-6.0/ 163-4.5 WTGs)	Scenario 16a wAlts (56 162-6.0/ 163-4.5 WTGs)
Less than 10	350	341	325	341	325
10 – 20	66	72	82	72	82
20 – 30	37	36	39	36	39
Greater than 30	42	46	49	46	49

Depending on the layout Scenario 207 to 238 non-participating sensitive receptors were modeled to potentially have days when they may experience more than 30 minutes of shadow flicker. However, the 30-minute statistic represents a daily total, not individual events, and the total duration times were not adjusted for the natural climatic variability and operational down-time due to low wind or turbine maintenance. Considering these factors, the number of events that a sensitive receptor would actually experience greater than 30 minutes of shadow flicker will be reduced by the following.

- The amount of cloud cover in the area depends on the season of the year. Cloud cover during daytime hours averages approximately 48% of the time in this region (Table 2). Cloud cover would drastically reduce the number of events greater than 30 minutes of shadow flicker at any given home.
- A conservative estimate of the turbines being operational for 90% of the year, due to low wind speed or turbine maintenance, was used in the modeling of shadow flicker. This would reduce the potential events of greater than 30 minutes per day by an additional 10%.

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- Finally, for any given shadow flicker the model assumes blades are always positioned to create the maximum duration of shadow flicker. Wind direction will dictate the position of the blades and during the majority of the times the duration of the predicted shadow flicker is less than the total modeled or may not occur.

Overall, these three variables will reduce the number of events with greater than 30 minutes of shadow flicker in the Project area.

Detailed tabular results of the analyses are provided in Appendix B and include the following information.

- Receptor identification number
- Coordinates of receptor location (UTM-Zone 17)
- Expected annual hours of shadow flicker under each scenario
- Maximum daily minutes of shadow flicker under each scenario

3.3 SHADOW FLICKER MITIGATION METHODS

It is understood that the Speaker Township ordinance restricts shadow flicker to no more than 30 hours per year. The ordinance also restricts shadow flicker to no more than 30 minutes at any given time and requires mitigation by “shutting down the offending turbine or other appropriate measures as the Township may approve”. AQN requests the Township consider the following appropriate measures as an alternative to shutting down the offending turbine:

AQN will submit a detailed shadow flicker avoidance/mitigation plan to the Township 60 days before operations commence. It would include consideration of the following:

- Allow for homeowner waiver of the shadow flicker provisions in the ordinance to be filed with the Township for participating landowners.
- In the United States shadow flicker annoyance has not been linked to the duration of the shadow flicker itself¹. Therefore, it is likely that not all residents that experience shadow flicker greater than 30 hours a year, or durations of more than 30 minutes at a time may be disturbed by the shadow flicker. In the event that they are disturbed by these events AQN suggests that the complaint resolution process be invoked and AQN would then be able to implement reasonable shadow flicker mitigation measures:
 - Planting of suitable trees / vegetation between the turbines and receptors to block the effects of shadow flicker.
 - Installation of awning, blinds, curtains, or other physical barriers suitable to the non-participating receptor that would interrupt the shadow flicker within the home.
 - Signed waiver of the shadow flicker provisions in the ordinance to be filed with the Township once resolution has been achieved.

¹ Haac, et al. *In the shadow of wind energy: Predicting community exposure and annoyance to wind turbine shadow flicker in the United States*; Energy Research & Social Science 87 (2022) 102471

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- Ultimately, if agreement with the non-participating receptor cannot be reached then curtailment of the offending wind turbine by shutting it down would be achieved for those events expected to last greater than 30 minutes in duration or for those receptors where greater than 30 annual hours of shadow flicker is predicted.

As stated earlier, the blocking effects of vegetation between the turbines and receptors has not been considered in this analysis; therefore, the actual shadow flicker impact on many receptors will be less than the modeled result given. The total shadow flicker impact on receptors in the Scenarios 16 and 16a, with alternates, also is higher than expected for the final Project, as it considers impacts from 56 turbines, rather than the 50 proposed to be built. AQN is committed to operating the Project consistent with the requirements described in this report and to limit actual annual shadow flicker on non-participating inhabited residences to 30 hours (or less) annually and 30 minutes or less per event. Upon completion of a Project design AQN will work with non-participating landowners, as needed, to identify, manage and mitigate shadow flicker overages using commercially reasonable mitigation measures. Mitigation measures that may be employed include, but are not limited to, the planting of trees and/or vegetative plantings, awning or curtain installation, and potential consideration of turbine curtailment.

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4.0 CONCLUSION

Potential shadow flicker from the operating Riverbend Wind Project on habitable structures and other sensitive receptors (e.g., schools, hospitals, churches) within one (1) mile of turbine locations was assessed using WindPRO's Version 3.4 Shadow Module software.

The majority of habitable structures in Speaker Township are expected to receive less than 10 hours of annual shadow flicker and no shadow flicker on most days of the year, under each of the proposed scenarios. There are several homes that could experience greater than 30 minutes of shadow flicker during a single event. Upon completion of Project construction AQN will work with non-participating landowners, as needed, to identify, manage and mitigate shadow flicker overages using commercially reasonable mitigation measures. AQN will offer mitigation measures to residences with greater than 30 hours of actual annual shadow flicker on the structure or more than 30 minutes of duration at a time. Based on the results of this analysis, no identified receptors within Speaker Township are expected to receive greater than 30 hours of shadow flicker per year after mitigation measures are employed.

FIGURES

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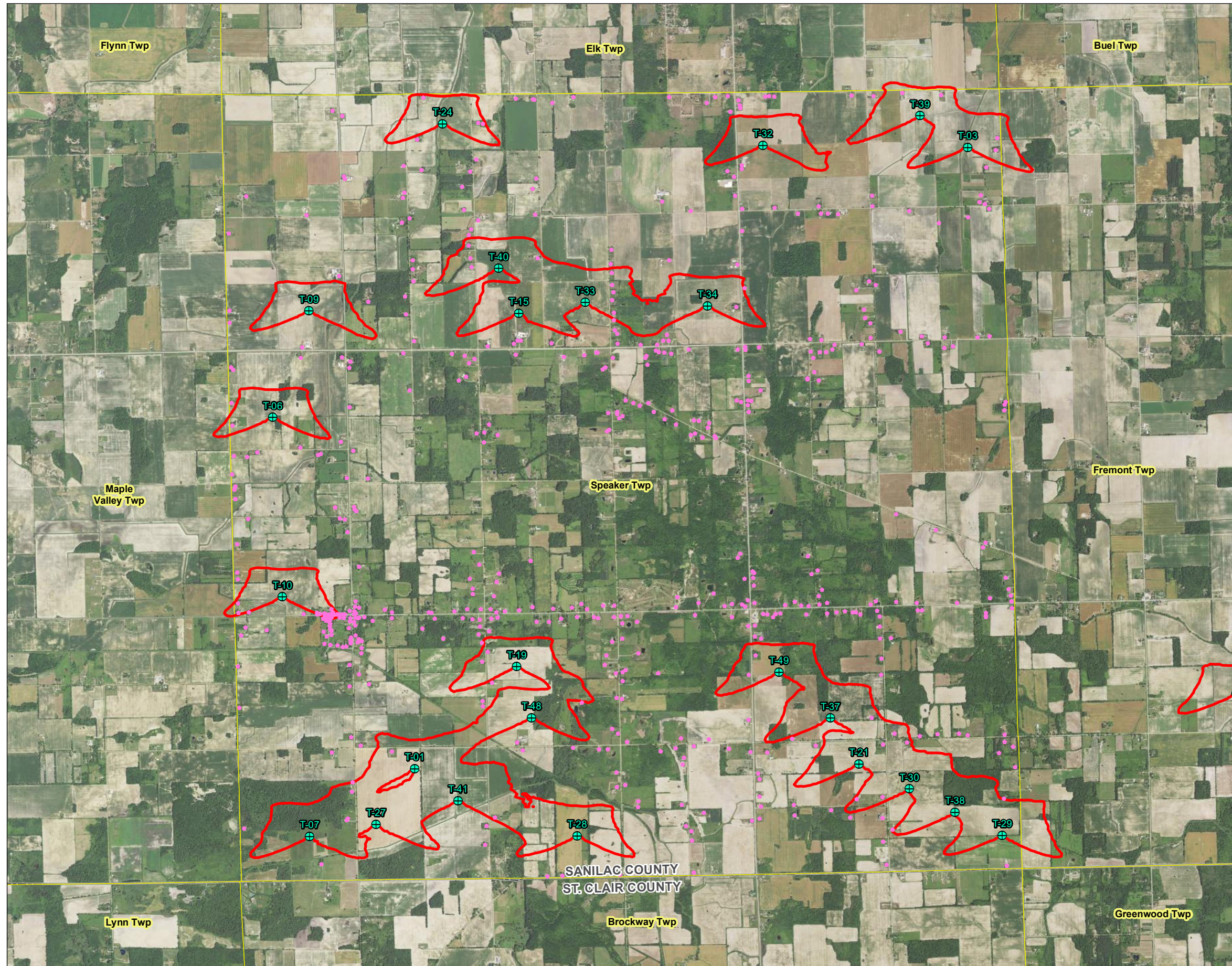


Figure No.

1

Title

Speaker Township Annual Expected Shadow Flicker - Scenario 25

Client/Project: Algonquin Power (MI Energy Developments) LLC Riverbend Wind Project 193709180

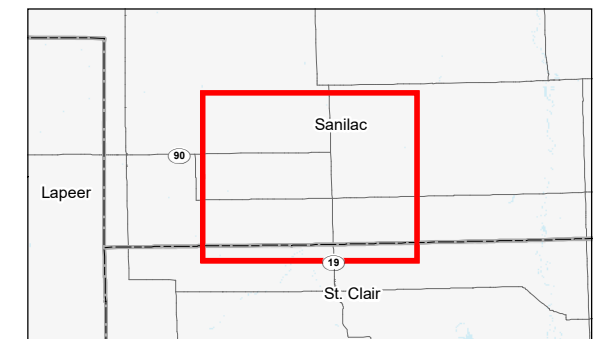
Project Location: Sanilac Co., MI Prepared by JM on 2022-09-13 TR by SF on 2022-09-13 IR by JB on 2022-09-13



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Legend

- Wind Turbine - Scenario 25
- Sensitive Receptor / Occupied Structure
- Township Boundary
- Expected Annual Shadow Hours**
- 30



Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Data Sources: Stantec, USGS, NADS
3. Background: 2020 NAIP



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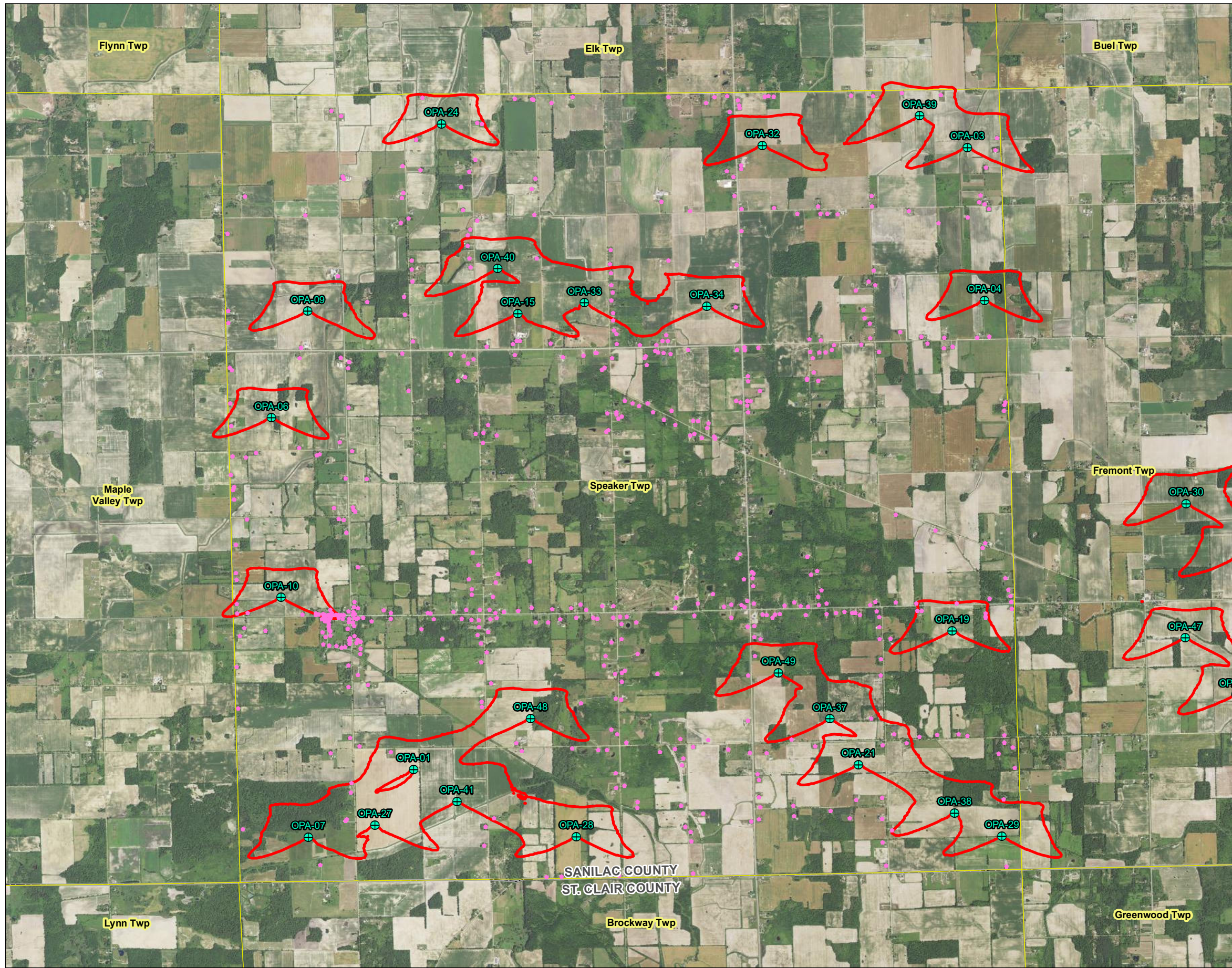


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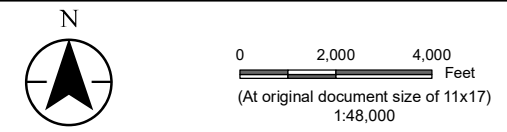
Title
Speaker Township Annual Expected Shadow Flicker - Scenario 16 (No Alternates)

Client/Project
Algonquin Power (MI Energy Developments) LLC
Riverbend Wind Project

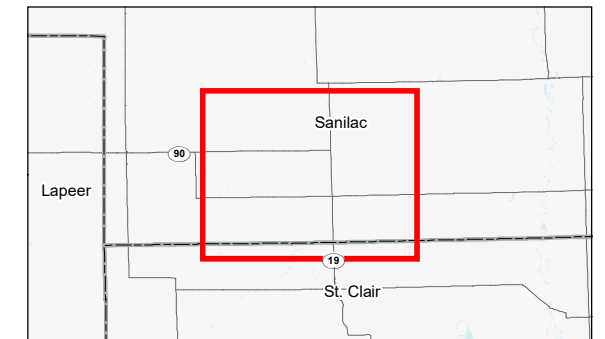
193709180

Project Location
Sanilac Co., MI

Prepared by JM on 2022-09-13
TR by SF on 2022-09-13
IR by JB on 2022-09-13



- Legend
- Wind Turbine - Scenario 16
 - Sensitive Receptor / Occupied Structure
 - Township Boundary
 - Expected Annual Shadow Hours
30



Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Data Sources: Stantec, USGS, NADS
3. Background: 2020 NAIP



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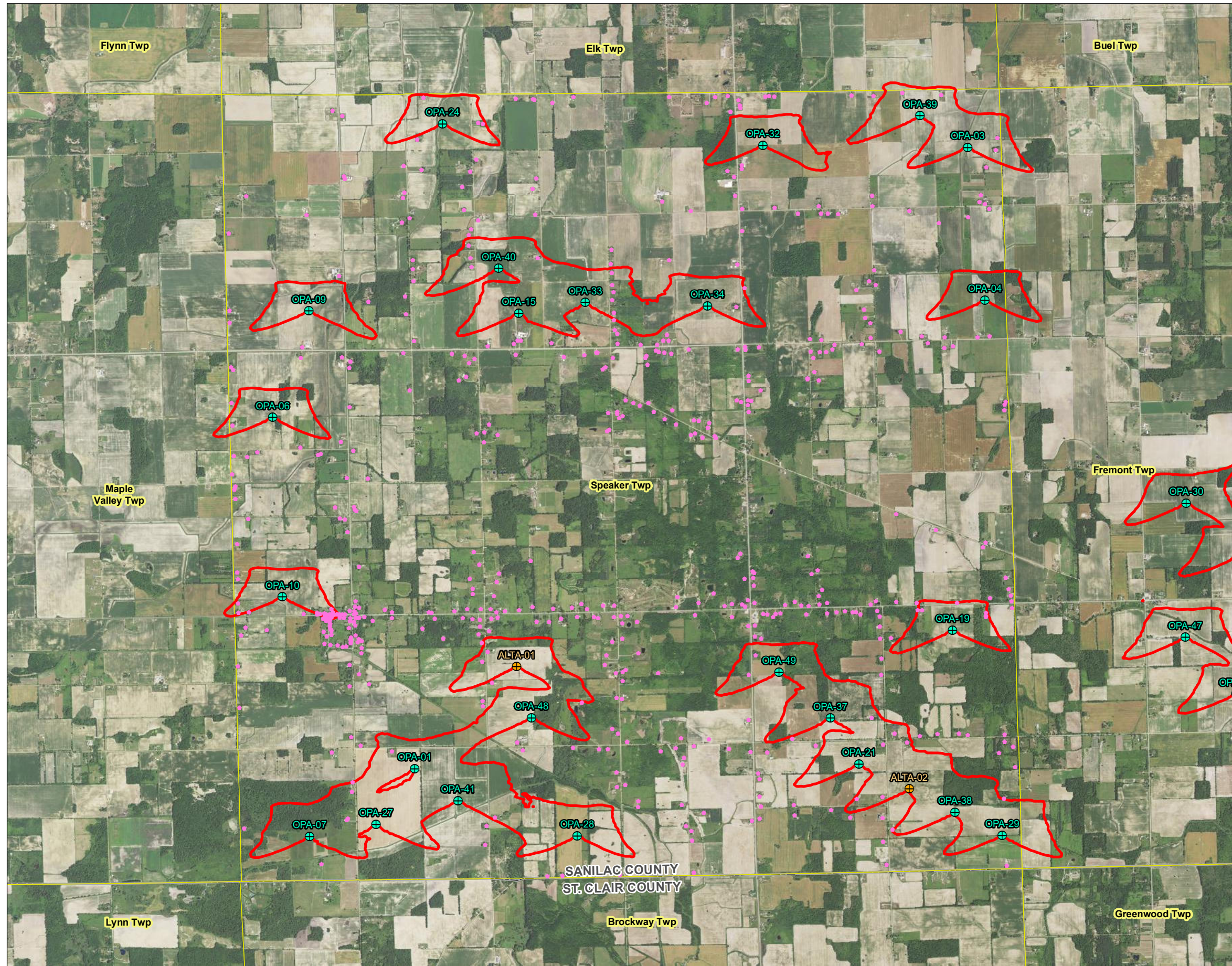


Figure No.

3

Title

**Speaker Township Annual Expected Shadow
Flicker - Scenario 16
(With Alternates)**

Client/Project: Algonquin Power (MI Energy Developments) LLC
Riverbend Wind Project

193709180

Project Location: Sanilac Co., MI

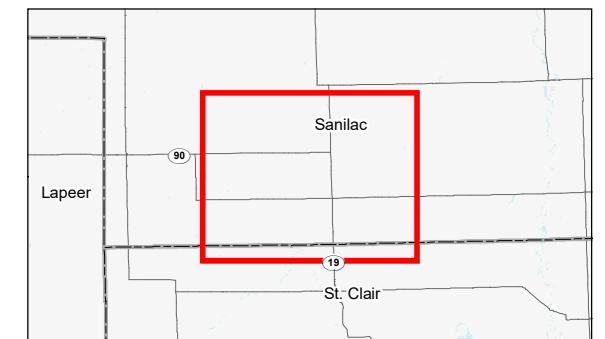
Prepared by JM on 2022-09-13
TR by SF on 2022-09-13
IR by JB on 2022-09-13



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Legend

- Wind Turbine - Scenario 16 (Primary)
- Wind Turbine - Scenario 16 (Alternate)
- Sensitive Receptor / Occupied Structure
- Township Boundary
- Expected Annual Shadow Hours
30



- Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
 2. Data Sources: Stantec, USGS, NADS
 3. Background: 2020 NAIP



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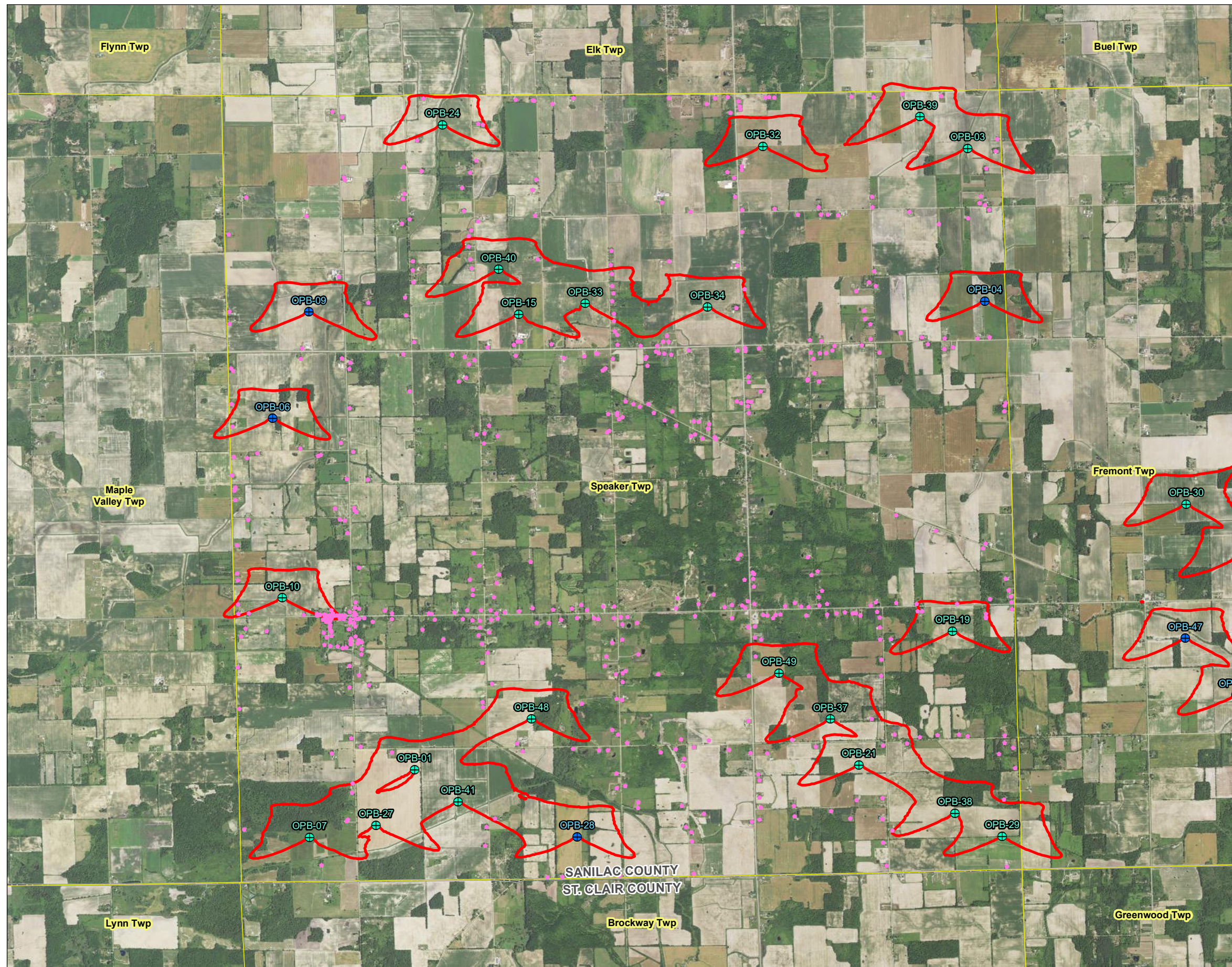


Figure No.

4

Title

**Speaker Township Annual Expected Shadow
Flicker - Scenario 16a
(No Alternates - 162-6.0 / 163-4.5 Mixed Layout)**

Client/Project
Algonquin Power (MI Energy Developments) LLC
Riverbend Wind Project

193709180

Project Location
Sanilac Co., MI

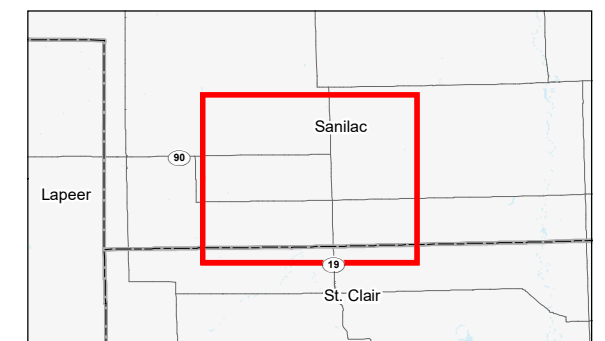
Prepared by JM on 2022-09-13
TR by SF on 2022-09-13
IR by JB on 2022-09-13



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Legend

- Wind Turbine - Scenario 16A (162-6.0)
- Wind Turbine - Scenario 16A (163-4.5)
- Sensitive Receptor / Occupied Structure
- Township Boundary
- Expected Annual Shadow Hours
30



- Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
 2. Data Sources: Stantec, USGS, NADS
 3. Background: 2020 NAIP



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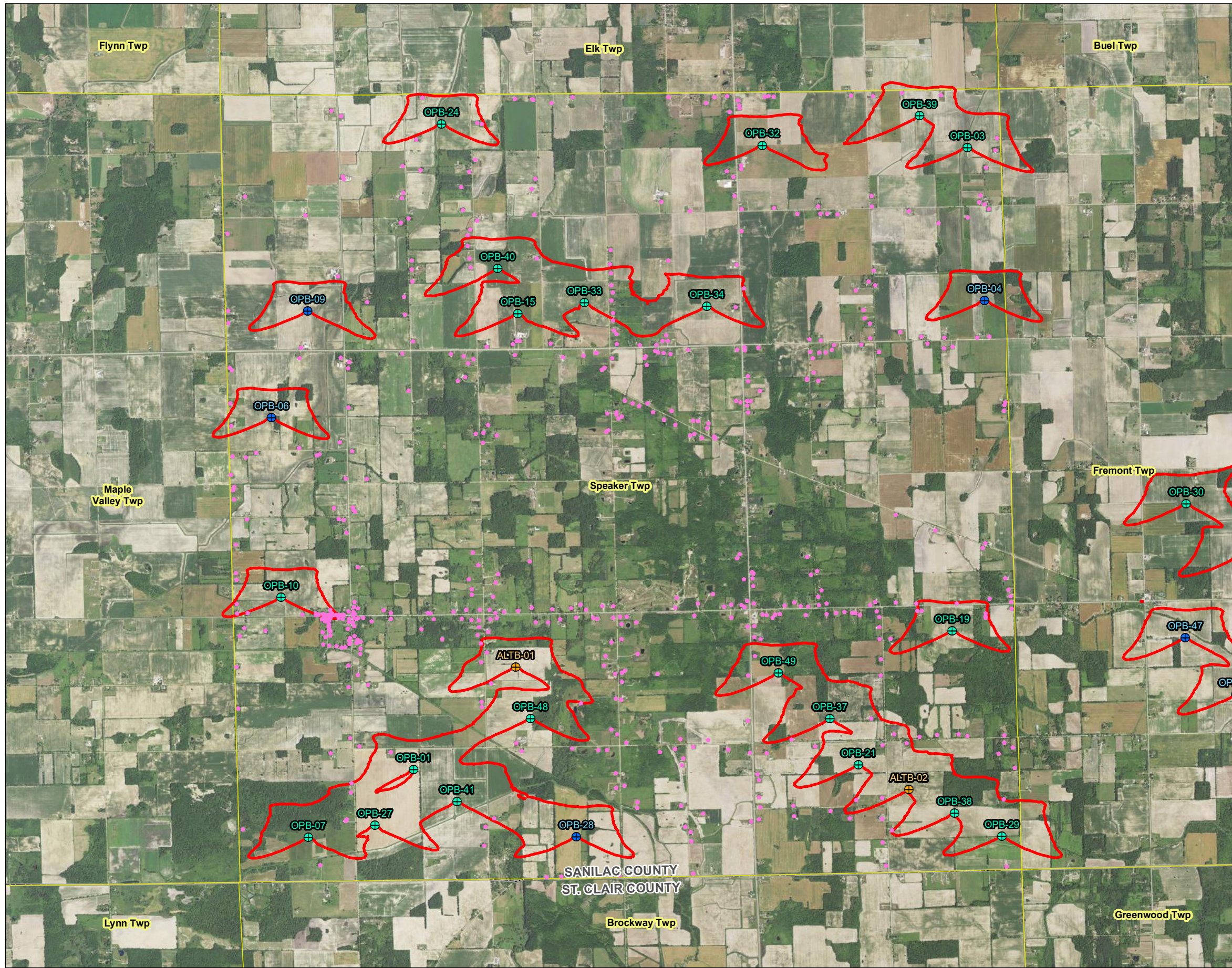
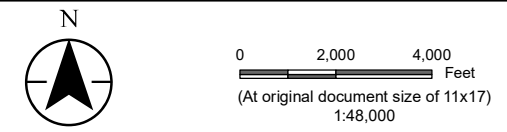


Figure No. **5**
Title
Speaker Township Annual Expected Shadow Flicker - Scenario 16a (With Alternates - 162-6.0 / 163-4.5 Mixed Layout)

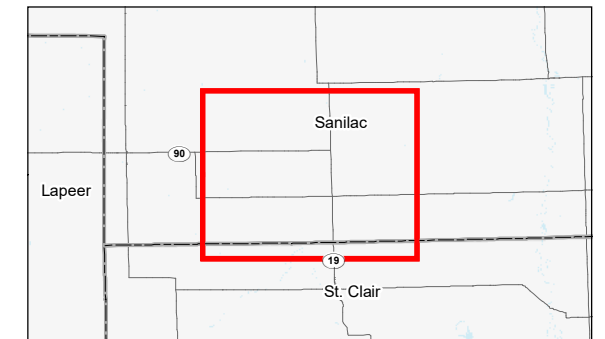
Client/Project
Algonquin Power (MI Energy Developments) LLC
Riverbend Wind Project

Project Location
Sanilac Co., MI

Prepared by JM on 2022-09-13
TR by SF on 2022-09-13
IR by JB on 2022-09-13



- Legend
- Wind Turbine - Scenario 16A Primary (162-6.0)
 - Wind Turbine - Scenario 16A Primary (163-4.5)
 - Wind Turbine - Scenario 16A Alternate (162-6.0)
 - Sensitive Receptor / Occupied Structure
 - Township Boundary
- Expected Annual Shadow Hours
- 30



- Notes
- Coordinate System: NAD 1983 UTM Zone 17N
 - Data Sources: Stantec, USGS, NADS
 - Background: 2020 NAIP



RIVERBEND WIND PROJECT
SHADOW FLICKER STUDY – SPEAKER TOWNSHIP
SANILAC COUNTY, MICHIGAN

APPENDICES

RIVERBEND WIND PROJECT
SHADOW FLICKER STUDY – SPEAKER TOWNSHIP
SANILAC COUNTY, MICHIGAN

Appendix A

TURBINE COORDINATES

Appendix A Riverbend Wind - Potential Turbine Locations (Scenario 25)

Turbine Identification (Scenario 25)	X (UTM 17)	Y (UTM 17)
T-01	349,477	4,781,358
T-02	360,829	4,785,484
T-03	356,167	4,788,880
T-04	365,366	4,788,768
T-05	362,476	4,787,146
T-06	347,755	4,785,610
T-07	348,205	4,780,537
T-08	365,628	4,781,507
T-09	348,194	4,786,899
T-10	347,873	4,783,436
T-11	365,725	4,781,012
T-12	364,228	4,785,565
T-13	360,540	4,787,080
T-14	363,996	4,782,374
T-15	350,735	4,786,871
T-16	365,145	4,785,573
T-17	363,562	4,787,881
T-18	362,028	4,784,081
T-19	350,709	4,782,594
T-20	359,415	4,782,262
T-21	354,852	4,781,415
T-22	365,649	4,784,035
T-23	360,931	4,787,774
T-24	349,812	4,789,164
T-25	365,232	4,787,858

Turbine Identification (Scenario 25)	X (UTM 17)	Y (UTM 17)
T-26	365,614	4,783,058
T-27	349,007	4,780,683
T-28	351,442	4,780,545
T-29	356,585	4,780,552
T-30	355,459	4,781,111
T-31	365,116	4,786,230
T-32	353,690	4,788,905
T-33	351,540	4,787,001
T-34	353,018	4,786,959
T-35	362,338	4,785,502
T-36	361,087	4,782,993
T-37	354,504	4,781,969
T-38	356,012	4,780,830
T-39	355,590	4,789,259
T-40	350,492	4,787,415
T-41	350,001	4,780,971
T-42	363,801	4,784,679
T-43	365,168	4,789,330
T-44	364,114	4,789,101
T-45	365,807	4,787,294
T-46	363,977	4,786,278
T-47	362,394	4,786,145
T-48	350,889	4,781,974
T-49	353,886	4,782,524
T-50	363,595	4,782,713

Appendix A Riverbend Wind - Potential Turbine Locations (Scenarios 16 and 16a with Alternates)

Turbine Identification (Scenario 16)	Turbine Identification (Scenario 16a)	X (UTM 17)	Y (UTM 17)
OPA-01	OPB-01	349,477	4,781,358
OPA-02	OPB-02	360,615	4,785,528
OPA-03	OPB-03	356,167	4,788,880
OPA-04	OPB-04	356,376	4,787,030
OPA-05	OPB-05	362,476	4,787,146
OPA-06	OPB-06	347,755	4,785,610
OPA-07	OPB-07	348,205	4,780,537
OPA-08	OPB-08	365,628	4,781,507
OPA-09	OPB-09	348,194	4,786,899
OPA-10	OPB-10	347,873	4,783,436
OPA-11	OPB-11	365,725	4,781,012
OPA-12	OPB-12	360,901	4,784,538
OPA-13	OPB-13	360,540	4,787,080
OPA-14	OPB-14	363,977	4,786,278
OPA-15	OPB-15	350,735	4,786,871
OPA-16	OPB-16	365,145	4,785,573
OPA-17	OPB-17	363,562	4,787,881
OPA-18	OPB-18	362,028	4,784,081
OPA-19	OPB-19	355,986	4,783,034
OPA-20	OPB-20	359,415	4,782,262
OPA-21	OPB-21	354,852	4,781,415
OPA-22	OPB-22	365,649	4,784,035
OPA-23	OPB-23	360,931	4,787,774
OPA-24	OPB-24	349,812	4,789,164
OPA-25	OPB-25	365,232	4,787,858
OPA-26	OPB-26	365,614	4,783,058
OPA-27	OPB-27	349,007	4,780,683
OPA-28	OPB-28	351,442	4,780,545
OPA-29	OPB-29	356,585	4,780,552
OPA-30	OPB-30	358,814	4,784,572
OPA-31	OPB-31	359,429	4,783,926
OPA-32	OPB-32	353,690	4,788,905
OPA-33	OPB-33	351,540	4,787,001
OPA-34	OPB-34	353,018	4,786,959
OPA-35	OPB-35	362,338	4,785,502
OPA-36	OPB-36	361,087	4,782,993
OPA-37	OPB-37	354,504	4,781,969
OPA-38	OPB-38	356,012	4,780,830
OPA-39	OPB-39	355,590	4,789,259
OPA-40	OPB-40	350,492	4,787,415

Appendix A Riverbend Wind - Potential Turbine Locations (Scenarios 16 and 16a with Alternates)

Turbine Identification (Scenario 16)	Turbine Identification (Scenario 16a)	X (UTM 17)	Y (UTM 17)
OPA-41	OPB-41	350,001	4,780,971
OPA-42	OPB-42	363,801	4,784,679
OPA-43	OPB-43	365,168	4,789,330
OPA-44	OPB-44	364,114	4,789,101
OPA-45	OPB-45	365,807	4,787,294
OPA-46	OPB-46	363,996	4,782,374
OPA-47	OPB-47	358,800	4,782,950
OPA-48	OPB-48	350,889	4,781,974
OPA-49	OPB-49	353,886	4,782,524
OPA-50	OPB-50	363,595	4,782,713
ALTA-01	ALTB-01	350,709	4,782,594
ALTA-02	ALTB-02	355,459	4,781,111
ALTA-03	ALTB-03	365,116	4,786,230
ALTA-04	ALTB-04	365,366	4,788,768
ALTA-05	ALTB-05	362,394	4,786,145
ALTA-06	ALTB-06	364,228	4,785,565

RIVERBEND WIND PROJECT
SHADOW FLICKER STUDY – SPEAKER TOWNSHIP
SANILAC COUNTY, MICHIGAN

Appendix B

RECEPTOR COORDINATES AND EXPECTED ANNUAL SHADOW FLICKER HOURS AND DAILY MINUTES

(SPEAKER TOWNSHIP)

Appendix B Riverbend Wind Project - Receptor Locations and Expected Shadow Results

Rec ID ("-P" is Particip- pant)	X (UTM 17)	Y (UTM 17)	Sc25 Annual (hr:min)	Sc16 Annual (hr:min)	Sc16 wAlts Annual (hr:min)	Sc16a Annual (hr:min)	Sc16a wAlts Annual (hr:min)	Sc25 Max per day (hr:min)	Sc16/16a no Alts Max per day (hr:min)	Sc16/16a wAlts Max per day (hr:min)
R-0016	350,137	4,786,266	4:31	4:31	4:31	4:31	4:31	0:18	0:18	0:18
R-0017	348,691	4,785,731	7:47	7:47	7:47	7:50	7:50	0:40	0:40	0:40
R-0018	348,517	4,784,520	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-0019	351,788	4,786,212	2:53	2:53	2:53	2:53	2:53	0:18	0:18	0:18
R-0035	347,471	4,783,245	26:07	26:07	26:07	26:07	26:07	1:14	1:14	1:14
R-0036	351,106	4,783,133	5:11	0:00	5:11	0:00	5:11	0:44	0:00	0:44
R-0039	354,998	4,783,345	5:31	11:29	11:29	11:29	11:29	0:29	0:36	0:36
R-0040	356,668	4,783,529	0:00	14:17	14:17	14:17	14:17	0:00	0:46	0:46
R-0055	353,519	4,786,113	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-0057	353,509	4,785,815	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-0070	349,201	4,781,567	64:26	64:26	64:26	64:26	64:26	1:44	1:44	1:44
R-0071	351,893	4,783,334	4:01	0:00	4:01	0:00	4:01	0:27	0:00	0:27
R-0088	349,417	4,785,936	1:35	1:35	1:35	1:36	1:36	0:19	0:19	0:19
R-0089	352,214	4,786,488	10:41	10:41	10:41	10:41	10:41	0:33	0:33	0:33
R-0090-P	353,374	4,786,943	83:07	83:07	83:07	83:07	83:07	1:40	1:40	1:40
R-0103-P	355,014	4,788,288	16:30	16:30	16:30	16:30	16:30	0:43	0:43	0:43
R-0105	350,113	4,783,287	2:45	0:00	2:45	0:00	2:45	0:31	0:00	0:31
R-0106	348,806	4,782,497	1:27	0:00	1:27	0:00	1:27	0:17	0:00	0:17
R-0108-P	353,519	4,781,946	10:45	10:45	10:45	10:45	10:45	0:38	0:38	0:38
R-0111	352,855	4,780,101	4:17	4:17	4:17	4:19	4:19	0:26	0:26	0:26
R-0112	352,835	4,780,481	3:33	3:33	3:33	3:35	3:35	0:27	0:27	0:27
R-0124	348,484	4,789,316	3:25	3:25	3:25	3:25	3:25	0:27	0:27	0:27
R-0130	350,205	4,786,315	5:47	5:47	5:47	5:47	5:47	0:22	0:22	0:22
R-0150	348,665	4,784,216	1:59	1:59	1:59	1:59	1:59	0:24	0:24	0:24
R-0152	352,874	4,783,218	5:21	5:21	5:21	5:21	5:21	0:32	0:32	0:32
R-0208	348,686	4,786,209	7:32	7:32	7:32	7:35	7:35	0:36	0:36	0:36
R-0209	347,279	4,786,179	8:15	8:15	8:15	8:19	8:19	0:51	0:51	0:51
R-0210	351,809	4,785,439	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-0222	350,062	4,783,176	10:39	0:00	10:39	0:00	10:39	0:47	0:00	0:47
R-0223	350,279	4,783,288	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-0224	352,169	4,783,135	3:36	1:21	3:36	1:21	3:36	0:34	0:17	0:34
R-0237-P	349,326	4,787,966	6:57	6:57	6:57	6:57	6:57	0:30	0:30	0:30
R-0269	351,496	4,783,352	2:29	0:00	2:29	0:00	2:29	0:28	0:00	0:28
R-0295	353,015	4,789,415	12:30	12:30	12:30	12:30	12:30	0:46	0:46	0:46
R-0308-P	350,304	4,782,109	23:02	23:02	23:02	23:02	23:02	1:01	1:01	1:01
R-0309	353,604	4,782,729	59:13	59:13	59:13	59:13	59:13	1:44	1:44	1:44
R-0310	352,639	4,781,599	4:15	4:15	4:15	4:16	4:16	0:33	0:33	0:33
R-0312-P	351,572	4,780,098	4:45	4:45	4:45	4:45	4:45	0:18	0:18	0:18
R-0317-P	356,645	4,780,178	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-0330	353,397	4,789,449	0:50	0:50	0:50	0:50	0:50	0:20	0:20	0:20

Appendix B Riverbend Wind Project - Receptor Locations and Expected Shadow Results

Rec ID ("-P" is Particip- pant)	X (UTM 17)	Y (UTM 17)	Sc25 Annual (hr:min)	Sc16 Annual (hr:min)	Sc16 wAlts Annual (hr:min)	Sc16a Annual (hr:min)	Sc16a wAlts Annual (hr:min)	Sc25 Max per day (hr:min)	Sc16/16a no Alts Max per day (hr:min)	Sc16/16a wAlts Max per day (hr:min)
R-0331	353,266	4,789,501	2:05	2:05	2:05	2:05	2:05	0:29	0:29	0:29
R-0333	350,086	4,786,354	8:44	8:44	8:44	8:44	8:44	0:22	0:22	0:22
R-0352	348,743	4,783,136	15:40	14:46	15:40	14:46	15:40	0:43	0:43	0:43
R-0354	354,874	4,783,227	7:21	12:28	12:28	12:28	12:28	0:33	0:33	0:33
R-0388-P	349,118	4,783,284	5:53	4:13	5:53	4:13	5:53	0:29	0:29	0:29
R-0389	353,817	4,783,193	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-0391-P	355,263	4,780,620	28:47	28:47	28:47	28:47	28:47	0:50	0:50	0:50
R-0419	348,486	4,783,250	36:15	36:15	36:15	36:15	36:15	1:00	1:00	1:00
R-0420	353,588	4,783,723	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-0422	354,468	4,783,236	0:00	2:17	2:17	2:17	2:17	0:00	0:22	0:22
R-0423	356,387	4,784,093	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-0436	350,937	4,788,063	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-0437-P	348,118	4,786,454	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-0438	354,315	4,786,156	2:14	2:14	2:14	2:14	2:14	0:13	0:13	0:13
R-0453	351,801	4,782,725	10:23	5:08	10:23	5:08	10:23	0:34	0:34	0:34
R-0454	353,514	4,783,083	3:42	3:42	3:42	3:42	3:42	0:39	0:39	0:39
R-0455-P	352,712	4,780,919	3:37	3:37	3:37	3:38	3:38	0:29	0:29	0:29
R-0469	347,299	4,784,740	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-0470	347,308	4,784,769	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-0471	351,859	4,787,636	12:19	12:19	12:19	12:19	12:19	0:38	0:38	0:38
R-0472	352,029	4,785,815	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-0485	355,615	4,786,587	0:00	3:50	3:50	4:00	4:00	0:00	0:23	0:23
R-0494	348,471	4,783,231	37:04	37:04	37:04	37:04	37:04	1:02	1:02	1:02
R-0495	352,048	4,781,681	9:47	9:47	9:47	9:47	9:47	0:32	0:32	0:32
R-0515	354,368	4,788,162	2:29	2:29	2:29	2:29	2:29	0:16	0:16	0:16
R-0516	348,598	4,786,333	5:27	5:27	5:27	5:30	5:30	0:36	0:36	0:36
R-0533	355,890	4,786,580	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-0534	355,358	4,786,645	0:00	16:14	16:14	16:18	16:18	0:00	0:37	0:37
R-0541	348,545	4,782,847	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-0542-P	350,145	4,783,657	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-0543	353,595	4,783,091	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-0567	353,357	4,788,291	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-0569	352,282	4,786,353	3:05	3:05	3:05	3:05	3:05	0:22	0:22	0:22
R-0581	355,886	4,786,450	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-0582	354,283	4,783,708	0:00	1:25	1:25	1:25	1:25	0:00	0:18	0:18
R-0583	353,652	4,781,021	9:12	7:30	9:12	7:30	9:12	0:31	0:31	0:31
R-0584	353,654	4,781,230	7:03	5:30	7:03	5:30	7:03	0:31	0:31	0:31
R-0604	352,917	4,785,568	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-0613	355,993	4,786,470	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-0614-P	356,614	4,785,694	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00

Appendix B Riverbend Wind Project - Receptor Locations and Expected Shadow Results

Rec ID ("-P" is Particip- pant)	X (UTM 17)	Y (UTM 17)	Sc25 Annual (hr:min)	Sc16 Annual (hr:min)	Sc16 wAlts Annual (hr:min)	Sc16a Annual (hr:min)	Sc16a wAlts Annual (hr:min)	Sc25 Max per day (hr:min)	Sc16/16a no Alts Max per day (hr:min)	Sc16/16a wAlts Max per day (hr:min)
R-0619	353,699	4,783,231	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-0622	356,393	4,783,243	0:00	32:43	32:43	32:43	32:43	0:00	1:20	1:20
R-0644	353,300	4,789,305	22:02	22:02	22:02	22:02	22:02	1:11	1:11	1:11
R-0645	350,133	4,787,814	25:07	25:07	25:07	25:07	25:07	1:20	1:20	1:20
R-0664	353,320	4,783,350	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-0665	347,415	4,780,627	13:54	13:54	13:54	13:54	13:54	0:57	0:57	0:57
R-0694	351,952	4,785,593	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-0713-P	356,620	4,785,766	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-0718	348,649	4,782,834	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-0721-P	355,438	4,781,672	35:18	35:18	35:18	35:18	35:18	0:59	0:59	0:59
R-0742	352,497	4,786,393	4:32	4:32	4:32	4:32	4:32	0:18	0:18	0:18
R-0754	354,824	4,787,148	1:28	3:43	3:43	3:43	3:43	0:17	0:27	0:27
R-0761	348,415	4,783,184	29:59	29:59	29:59	29:59	29:59	1:07	1:07	1:07
R-0762	348,745	4,783,232	11:30	11:30	11:30	11:30	11:30	0:43	0:43	0:43
R-0787	353,721	4,789,493	1:11	1:11	1:11	1:11	1:11	0:15	0:15	0:15
R-0788	350,166	4,787,427	106:19	106:19	106:19	106:19	106:19	1:48	1:48	1:48
R-0789	351,753	4,786,189	0:05	0:05	0:05	0:05	0:05	0:02	0:02	0:02
R-0804	356,177	4,788,034	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-0808	347,330	4,783,732	18:22	18:22	18:22	18:22	18:22	1:01	1:01	1:01
R-0809	348,693	4,783,142	19:01	19:01	19:01	19:01	19:01	0:45	0:45	0:45
R-0810	348,790	4,783,177	11:44	10:46	11:44	10:46	11:44	0:40	0:40	0:40
R-0811	348,489	4,783,224	35:37	35:37	35:37	35:37	35:37	1:00	1:00	1:00
R-0813	351,470	4,780,102	3:10	3:10	3:10	3:10	3:10	0:15	0:15	0:15
R-0844	355,381	4,789,532	61:41	61:41	61:41	61:41	61:41	2:27	2:27	2:27
R-0854	353,594	4,782,955	15:53	15:53	15:53	15:53	15:53	1:14	1:14	1:14
R-0883-P	351,132	4,786,506	1:37	1:37	1:37	1:37	1:37	0:16	0:16	0:16
R-0884	351,822	4,785,663	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-0899	348,574	4,784,385	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-0902	348,391	4,783,181	27:29	27:29	27:29	27:29	27:29	1:07	1:07	1:07
R-0903	352,827	4,780,600	3:26	3:26	3:26	3:27	3:27	0:27	0:27	0:27
R-0941	348,712	4,781,733	11:00	11:00	11:00	11:00	11:00	0:45	0:45	0:45
R-0942	351,890	4,783,188	3:32	0:00	3:32	0:00	3:32	0:28	0:00	0:28
R-0943	352,457	4,781,570	5:21	2:39	5:21	2:39	5:21	0:22	0:22	0:22
R-0946	354,683	4,783,259	4:30	7:57	7:57	7:57	7:57	0:34	0:34	0:34
R-0963	348,563	4,787,320	20:07	20:07	20:07	20:14	20:14	1:11	1:12	1:12
R-0964	353,479	4,786,461	1:20	1:20	1:20	1:20	1:20	0:15	0:15	0:15
R-0985	348,134	4,783,230	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-0986	348,926	4,782,375	2:56	1:02	2:56	1:02	2:56	0:18	0:15	0:18
R-0987	351,996	4,782,525	8:45	5:08	8:45	5:08	8:45	0:37	0:30	0:37
R-0992	355,141	4,781,010	72:42	9:57	72:42	9:57	72:42	1:52	0:42	1:52

Appendix B Riverbend Wind Project - Receptor Locations and Expected Shadow Results

Rec ID ("-P" is Particip- pant)	X (UTM 17)	Y (UTM 17)	Sc25 Annual (hr:min)	Sc16 Annual (hr:min)	Sc16 wAlts Annual (hr:min)	Sc16a Annual (hr:min)	Sc16a wAlts Annual (hr:min)	Sc25 Max per day (hr:min)	Sc16/16a no Alts Max per day (hr:min)	Sc16/16a wAlts Max per day (hr:min)
R-1015-P	350,765	4,786,537	1:59	1:59	1:59	1:59	1:59	0:16	0:16	0:16
R-1016	351,690	4,786,390	24:22	24:22	24:22	24:22	24:22	1:02	1:02	1:02
R-1030	348,683	4,783,055	19:54	19:54	19:54	19:54	19:54	0:45	0:45	0:45
R-1031	348,335	4,783,229	35:56	35:56	35:56	35:56	35:56	1:17	1:17	1:17
R-1048-P	349,507	4,788,971	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-1053	352,640	4,785,522	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-1069	353,849	4,783,228	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-1070	356,692	4,783,453	0:00	12:15	12:15	12:15	12:15	0:00	0:47	0:47
R-1090	352,505	4,785,588	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-1101	354,603	4,788,070	6:54	6:54	6:54	6:54	6:54	0:18	0:18	0:18
R-1108	350,253	4,782,981	23:30	0:00	23:30	0:00	23:30	1:05	0:00	1:05
R-1109	350,347	4,780,661	9:30	9:30	9:30	9:32	9:32	0:55	0:55	0:55
R-1131	349,342	4,786,382	18:14	18:14	18:14	18:22	18:22	0:49	0:49	0:49
R-1133	351,851	4,787,471	21:52	21:52	21:52	21:52	21:52	1:01	1:01	1:01
R-1153	350,498	4,783,716	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-1154	348,691	4,782,611	1:05	0:00	1:05	0:00	1:05	0:14	0:00	0:14
R-1157	355,307	4,783,372	2:40	15:05	15:05	15:05	15:05	0:23	0:50	0:50
R-1175	352,433	4,786,394	2:05	2:05	2:05	2:05	2:05	0:19	0:19	0:19
R-1193	348,461	4,783,165	28:32	28:32	28:32	28:32	28:32	1:02	1:02	1:02
R-1194	350,467	4,783,250	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-1195	347,357	4,782,092	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-1196-P	352,423	4,782,513	6:13	4:33	6:13	4:33	6:13	0:40	0:23	0:40
R-1217	350,013	4,786,053	1:52	1:52	1:52	1:52	1:52	0:13	0:13	0:13
R-1231	348,408	4,783,147	20:31	20:31	20:31	20:31	20:31	1:00	1:00	1:00
R-1232	348,766	4,783,233	10:41	10:41	10:41	10:41	10:41	0:42	0:42	0:42
R-1233	349,574	4,783,050	8:48	4:39	8:48	4:39	8:48	0:31	0:22	0:31
R-1245-P	351,869	4,787,028	85:29	85:29	85:29	85:29	85:29	2:10	2:10	2:10
R-1269	348,789	4,782,891	7:39	6:29	7:39	6:29	7:39	0:27	0:27	0:27
R-1270	350,955	4,783,136	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-1272	355,057	4,783,386	4:57	11:43	11:43	11:43	11:43	0:28	0:38	0:38
R-1273	355,288	4,781,779	49:57	49:57	49:57	49:57	49:57	1:09	1:09	1:09
R-1315	348,477	4,783,188	32:36	32:36	32:36	32:36	32:36	1:01	1:01	1:01
R-1316	351,781	4,782,616	13:37	7:56	13:37	7:56	13:37	0:37	0:37	0:37
R-1317	352,181	4,780,895	11:05	11:05	11:05	11:13	11:13	0:47	0:47	0:47
R-1338	347,270	4,784,921	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-1339	348,340	4,785,165	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-1353	347,464	4,784,377	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-1358	355,076	4,783,267	4:16	11:42	11:42	11:42	11:42	0:28	0:40	0:40
R-1359	355,243	4,782,936	2:56	19:41	19:41	19:41	19:41	0:26	0:51	0:51
R-1374	350,320	4,785,425	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00

Appendix B Riverbend Wind Project - Receptor Locations and Expected Shadow Results

Rec ID ("-P" is Particip- pant)	X (UTM 17)	Y (UTM 17)	Sc25 Annual (hr:min)	Sc16 Annual (hr:min)	Sc16 wAlts Annual (hr:min)	Sc16a Annual (hr:min)	Sc16a wAlts Annual (hr:min)	Sc25 Max per day (hr:min)	Sc16/16a no Alts Max per day (hr:min)	Sc16/16a wAlts Max per day (hr:min)
R-1384	354,379	4,786,395	5:43	5:43	5:43	5:43	5:43	0:26	0:26	0:26
R-1411	353,429	4,785,799	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-1415-P	354,366	4,786,056	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-1418	348,708	4,782,944	8:58	8:01	8:58	8:01	8:58	0:31	0:31	0:31
R-1420	353,747	4,781,553	14:25	12:58	14:25	12:58	14:25	0:33	0:33	0:33
R-1421	351,960	4,780,075	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-1450	354,397	4,788,077	5:09	5:09	5:09	5:09	5:09	0:19	0:19	0:19
R-1451	349,375	4,786,854	17:19	17:19	17:19	17:21	17:21	0:58	0:58	0:58
R-1467	351,914	4,782,515	9:59	5:45	9:59	5:45	9:59	0:37	0:33	0:37
R-1490	350,360	4,786,469	11:42	11:42	11:42	11:42	11:42	0:31	0:31	0:31
R-1506	355,788	4,784,244	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-1509	348,620	4,783,179	25:29	25:29	25:29	25:29	25:29	0:50	0:50	0:50
R-1510	350,413	4,782,395	20:30	20:30	20:30	20:30	20:30	1:02	1:02	1:02
R-1511	351,383	4,783,309	1:34	0:00	1:34	0:00	1:34	0:23	0:00	0:23
R-1515	354,376	4,783,345	0:00	1:49	1:49	1:49	1:49	0:00	0:20	0:20
R-1517	356,745	4,781,373	16:49	13:17	16:49	13:17	16:49	0:44	0:44	0:44
R-1554	354,239	4,783,929	0:00	1:08	1:08	1:08	1:08	0:00	0:16	0:16
R-1579	347,256	4,786,218	5:52	5:52	5:52	5:54	5:54	0:44	0:44	0:44
R-1580	349,930	4,786,381	5:58	5:58	5:58	5:58	5:58	0:20	0:20	0:20
R-1581	348,659	4,784,874	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-1582	351,676	4,786,392	23:46	23:46	23:46	23:46	23:46	1:00	1:00	1:00
R-1599	347,347	4,783,242	36:10	36:10	36:10	36:10	36:10	1:11	1:11	1:11
R-1600	348,476	4,781,551	8:09	8:09	8:09	8:09	8:09	0:37	0:37	0:37
R-1633	351,973	4,783,203	3:56	0:54	3:56	0:54	3:56	0:26	0:14	0:26
R-1634-P	350,720	4,781,672	8:00	8:00	8:00	8:00	8:00	0:32	0:32	0:32
R-1651	350,908	4,789,458	4:41	4:41	4:41	4:41	4:41	0:33	0:33	0:33
R-1652	349,363	4,787,074	16:12	16:12	16:12	16:13	16:13	0:54	0:54	0:54
R-1654	353,386	4,786,433	1:39	1:39	1:39	1:39	1:39	0:16	0:16	0:16
R-1681	352,856	4,781,628	7:33	7:33	7:33	7:34	7:34	0:22	0:22	0:22
R-1683	356,356	4,784,033	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-1703-P	353,438	4,788,661	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-1704	352,873	4,785,415	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-1722	348,453	4,783,080	9:09	9:09	9:09	9:09	9:09	0:39	0:39	0:39
R-1723	348,371	4,783,172	22:41	22:41	22:41	22:41	22:41	1:04	1:04	1:04
R-1724	348,387	4,783,223	37:14	37:14	37:14	37:14	37:14	1:12	1:12	1:12
R-1725	352,701	4,781,726	3:28	3:28	3:28	3:28	3:28	0:31	0:31	0:31
R-1727	354,408	4,783,525	0:00	1:47	1:47	1:47	1:47	0:00	0:21	0:21
R-1744	350,481	4,785,391	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-1746	353,480	4,786,425	1:22	1:22	1:22	1:22	1:22	0:15	0:15	0:15
R-1761	354,889	4,786,492	1:37	5:55	5:55	5:56	5:56	0:16	0:23	0:23

Appendix B Riverbend Wind Project - Receptor Locations and Expected Shadow Results

Rec ID ("-P" is Particip- pant)	X (UTM 17)	Y (UTM 17)	Sc25 Annual (hr:min)	Sc16 Annual (hr:min)	Sc16 wAlts Annual (hr:min)	Sc16a Annual (hr:min)	Sc16a wAlts Annual (hr:min)	Sc25 Max per day (hr:min)	Sc16/16a no Alts Max per day (hr:min)	Sc16/16a wAlts Max per day (hr:min)
R-1764	348,804	4,783,801	6:55	6:55	6:55	6:55	6:55	0:38	0:38	0:38
R-1765	348,601	4,783,226	21:11	21:11	21:11	21:11	21:11	0:51	0:51	0:51
R-1784	353,767	4,789,495	1:17	1:17	1:17	1:17	1:17	0:16	0:16	0:16
R-1798	348,473	4,783,286	35:11	35:11	35:11	35:11	35:11	1:02	1:02	1:02
R-1819-P	353,262	4,788,590	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-1820	347,287	4,785,145	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-1831	355,040	4,787,392	0:00	2:52	2:52	2:53	2:53	0:00	0:26	0:26
R-1842-P	351,400	4,789,488	1:50	1:50	1:50	1:50	1:50	0:20	0:20	0:20
R-1844	351,930	4,785,674	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-1854	355,852	4,789,507	54:24	54:24	54:24	54:24	54:24	1:43	1:43	1:43
R-1855	356,438	4,786,593	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-1857	347,433	4,783,064	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-1858	350,484	4,783,184	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-1859	353,470	4,783,656	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-1860	353,320	4,783,189	3:21	3:21	3:21	3:21	3:21	0:34	0:34	0:34
R-1861	351,988	4,782,197	10:48	6:06	10:48	6:06	10:48	0:33	0:33	0:33
R-1876	349,583	4,789,478	38:46	38:46	38:46	38:46	38:46	1:39	1:39	1:39
R-1879	350,907	4,788,371	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-1881	354,261	4,786,558	5:52	5:52	5:52	5:52	5:52	0:30	0:30	0:30
R-1913	347,229	4,787,832	1:40	1:40	1:40	1:40	1:40	0:22	0:22	0:22
R-1919	352,126	4,785,781	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-1935	354,558	4,786,487	3:09	5:05	5:05	5:05	5:05	0:23	0:36	0:36
R-1966	347,241	4,786,755	9:36	9:36	9:36	9:40	9:40	0:39	0:40	0:40
R-1967	347,451	4,785,127	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-1968	351,928	4,786,623	20:49	20:49	20:49	20:49	20:49	0:37	0:37	0:37
R-1983	351,995	4,782,418	9:16	5:25	9:16	5:25	9:16	0:33	0:31	0:33
R-1999	348,600	4,789,256	4:25	4:25	4:25	4:25	4:25	0:30	0:30	0:30
R-2000	350,247	4,789,174	42:27	42:27	42:27	42:27	42:27	1:23	1:23	1:23
R-2016-P	356,395	4,788,635	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-2018	354,997	4,786,570	1:20	6:20	6:20	6:22	6:22	0:15	0:26	0:26
R-2021	348,762	4,782,964	14:12	13:09	14:12	13:09	14:12	0:39	0:39	0:39
R-2022	351,870	4,781,838	8:51	7:59	8:51	7:59	8:51	0:38	0:38	0:38
R-2023	353,283	4,781,595	8:58	8:58	8:58	8:58	8:58	0:30	0:30	0:30
R-2054	347,340	4,783,358	43:39	43:39	43:39	43:39	43:39	1:10	1:10	1:10
R-2055	350,470	4,783,617	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-2056	350,300	4,782,177	18:01	18:01	18:01	18:01	18:01	0:59	0:59	0:59
R-2057	352,738	4,781,487	8:02	8:02	8:02	8:02	8:02	0:27	0:27	0:27
R-2058	353,541	4,781,559	21:26	20:22	21:26	20:22	21:26	0:39	0:39	0:39
R-2073	348,734	4,785,206	16:16	16:16	16:16	16:24	16:24	0:38	0:38	0:38
R-2093	348,385	4,782,866	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00

Appendix B Riverbend Wind Project - Receptor Locations and Expected Shadow Results

Rec ID ("-P" is Particip- pant)	X (UTM 17)	Y (UTM 17)	Sc25 Annual (hr:min)	Sc16 Annual (hr:min)	Sc16 wAlts Annual (hr:min)	Sc16a Annual (hr:min)	Sc16a wAlts Annual (hr:min)	Sc25 Max per day (hr:min)	Sc16/16a no Alts Max per day (hr:min)	Sc16/16a wAlts Max per day (hr:min)
R-2094	350,179	4,783,166	9:07	0:00	9:07	0:00	9:07	0:51	0:00	0:51
R-2095	350,437	4,783,446	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-2096	348,720	4,781,077	61:27	61:27	61:27	61:27	61:27	2:13	2:13	2:13
R-2098-P	348,350	4,780,200	6:11	6:11	6:11	6:11	6:11	0:19	0:19	0:19
R-2102	355,112	4,782,928	3:46	15:02	15:02	15:02	15:02	0:29	0:43	0:43
R-2103	354,829	4,780,986	35:50	5:36	35:50	5:36	35:50	1:00	0:31	1:00
R-2116	349,346	4,788,650	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-2133	356,381	4,788,189	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-2136	349,960	4,783,262	7:47	0:00	7:47	0:00	7:47	0:41	0:00	0:41
R-2137	351,867	4,782,892	4:11	0:04	4:11	0:04	4:11	0:31	0:05	0:31
R-2161	351,878	4,786,326	16:05	16:05	16:05	16:05	16:05	0:43	0:43	0:43
R-2162	353,109	4,785,384	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-2173	354,915	4,786,915	1:25	4:28	4:28	4:28	4:28	0:17	0:24	0:24
R-2180	347,687	4,783,034	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-2181	348,839	4,782,901	11:03	9:47	11:03	9:47	11:03	0:33	0:33	0:33
R-2184	355,107	4,783,199	3:37	12:08	12:08	12:08	12:08	0:28	0:42	0:42
R-2208	347,310	4,784,619	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-2209	352,488	4,786,539	17:25	17:25	17:25	17:25	17:25	0:38	0:38	0:38
R-2210	352,594	4,785,693	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-2221	348,803	4,783,307	9:53	8:54	9:53	8:54	9:53	0:40	0:40	0:40
R-2222-P	350,570	4,783,258	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-2223	352,057	4,783,203	3:44	1:04	3:44	1:04	3:44	0:24	0:15	0:24
R-2224	353,593	4,783,360	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-2240	350,076	4,788,118	2:45	2:45	2:45	2:45	2:45	0:20	0:20	0:20
R-2243	352,413	4,786,490	9:59	9:59	9:59	9:59	9:59	0:31	0:31	0:31
R-2246-P	353,510	4,785,759	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-2247	353,524	4,786,051	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-2257	355,016	4,788,165	6:29	8:52	8:52	8:52	8:52	0:24	0:24	0:24
R-2266	348,460	4,783,042	1:10	1:10	1:10	1:10	1:10	0:15	0:15	0:15
R-2267	348,448	4,783,134	21:25	21:25	21:25	21:25	21:25	0:59	0:59	0:59
R-2268	350,182	4,783,471	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-2269	350,743	4,783,272	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-2270	354,245	4,783,327	0:00	1:29	1:29	1:29	1:29	0:00	0:18	0:18
R-2271	350,334	4,780,435	10:45	10:45	10:45	10:48	10:48	0:59	0:59	0:59
R-2291	352,373	4,785,675	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-2311	356,632	4,783,668	0:00	6:40	6:40	6:40	6:40	0:00	0:43	0:43
R-2331	349,453	4,787,508	12:57	12:57	12:57	12:57	12:57	0:51	0:51	0:51
R-2332	352,558	4,787,508	16:13	16:13	16:13	16:13	16:13	0:54	0:54	0:54
R-2342	356,529	4,788,990	56:35	56:35	56:35	56:35	56:35	1:33	1:33	1:33
R-2350	347,380	4,782,968	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00

Appendix B Riverbend Wind Project - Receptor Locations and Expected Shadow Results

Rec ID ("-P" is Particip- pant)	X (UTM 17)	Y (UTM 17)	Sc25 Annual (hr:min)	Sc16 Annual (hr:min)	Sc16 wAlts Annual (hr:min)	Sc16a Annual (hr:min)	Sc16a wAlts Annual (hr:min)	Sc25 Max per day (hr:min)	Sc16/16a no Alts Max per day (hr:min)	Sc16/16a wAlts Max per day (hr:min)
R-2351-P	350,906	4,783,312	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-2353	355,124	4,782,491	17:52	17:52	17:52	17:52	17:52	0:50	0:50	0:50
R-2354	354,471	4,783,359	0:00	2:07	2:07	2:07	2:07	0:00	0:22	0:22
R-2355	356,621	4,781,769	5:35	1:28	5:35	1:28	5:35	0:29	0:18	0:29
R-2381	354,765	4,789,505	16:28	16:28	16:28	16:28	16:28	0:44	0:44	0:44
R-2410	353,116	4,789,490	8:24	8:24	8:24	8:24	8:24	0:48	0:48	0:48
R-2411-P	348,103	4,786,332	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-2432	353,422	4,783,963	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-2453	347,272	4,785,511	53:30	53:30	53:30	54:07	54:07	1:17	1:18	1:18
R-2454	354,233	4,786,082	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-2455	353,126	4,785,358	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-2475	351,990	4,783,117	4:03	0:57	4:03	0:57	4:03	0:26	0:14	0:26
R-2525	353,573	4,783,669	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-2526	352,915	4,783,366	4:51	4:51	4:51	4:51	4:51	0:32	0:32	0:32
R-2527	354,157	4,783,333	0:00	1:17	1:17	1:17	1:17	0:00	0:16	0:16
R-2528	348,656	4,780,734	92:31	92:31	92:31	92:31	92:31	2:01	2:01	2:01
R-2532	355,590	4,781,749	21:15	21:15	21:15	21:15	21:15	0:47	0:47	0:47
R-2533	356,619	4,781,679	5:36	1:30	5:36	1:30	5:36	0:30	0:19	0:30
R-2571	354,399	4,786,542	4:17	5:38	5:38	5:38	5:38	0:26	0:38	0:38
R-2579	351,923	4,782,215	12:26	6:44	12:26	6:44	12:26	0:35	0:35	0:35
R-2581	355,189	4,780,192	3:51	3:51	3:51	3:51	3:51	0:25	0:25	0:25
R-2596	353,043	4,785,539	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-2609	349,825	4,782,929	11:19	3:56	11:19	3:56	11:19	0:40	0:26	0:40
R-2645	355,057	4,787,209	0:00	3:23	3:23	3:24	3:24	0:00	0:27	0:27
R-2650-P	350,362	4,782,773	42:34	0:00	42:34	0:00	42:34	1:32	0:00	1:32
R-2654	355,619	4,783,272	1:28	37:17	37:17	37:17	37:17	0:18	1:41	1:41
R-2677	350,703	4,789,467	7:37	7:37	7:37	7:37	7:37	0:40	0:40	0:40
R-2682	351,865	4,787,354	41:03	41:03	41:03	41:03	41:03	1:22	1:22	1:22
R-2696	350,267	4,783,163	6:17	0:00	6:17	0:00	6:17	0:47	0:00	0:47
R-2698	355,141	4,780,759	13:05	13:05	13:05	13:05	13:05	0:43	0:43	0:43
R-2722	347,237	4,786,899	8:16	8:16	8:16	8:18	8:18	0:39	0:39	0:39
R-2731	347,260	4,785,781	24:17	24:17	24:17	24:40	24:40	1:10	1:10	1:10
R-2774	353,642	4,786,455	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-2783	356,509	4,788,841	105:12	105:12	105:12	105:12	105:12	2:15	2:15	2:15
R-2791	348,698	4,782,919	5:34	4:38	5:34	4:38	5:34	0:23	0:23	0:23
R-2792	348,568	4,783,221	28:12	28:12	28:12	28:12	28:12	0:53	0:53	0:53
R-2794	351,939	4,781,784	7:24	7:04	7:24	7:04	7:24	0:35	0:35	0:35
R-2795-P	354,073	4,780,787	5:16	1:11	5:16	1:11	5:16	0:26	0:14	0:26
R-2796	354,776	4,783,251	6:40	10:50	10:50	10:50	10:50	0:36	0:36	0:36
R-2797	354,331	4,781,633	22:09	21:55	22:09	21:55	22:09	1:05	1:05	1:05

Appendix B Riverbend Wind Project - Receptor Locations and Expected Shadow Results

Rec ID ("-P" is Particip- pant)	X (UTM 17)	Y (UTM 17)	Sc25 Annual (hr:min)	Sc16 Annual (hr:min)	Sc16 wAlts Annual (hr:min)	Sc16a Annual (hr:min)	Sc16a wAlts Annual (hr:min)	Sc25 Max per day (hr:min)	Sc16/16a no Alts Max per day (hr:min)	Sc16/16a wAlts Max per day (hr:min)
R-2798	356,610	4,780,992	28:11	22:25	28:11	22:25	28:11	0:59	0:59	0:59
R-2818	352,825	4,785,394	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-2833	354,080	4,783,373	0:00	1:07	1:07	1:07	1:07	0:00	0:15	0:15
R-2872	351,154	4,783,289	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-2876	354,357	4,783,756	0:00	1:37	1:37	1:37	1:37	0:00	0:19	0:19
R-2896	350,702	4,786,366	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-2897	347,575	4,785,184	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-2912	353,906	4,783,238	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-2913	353,653	4,780,756	5:41	3:52	5:41	3:52	5:41	0:18	0:18	0:18
R-2937	352,473	4,788,224	3:04	3:04	3:04	3:04	3:04	0:16	0:16	0:16
R-2938	351,994	4,785,625	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-2940	353,027	4,785,480	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-2955	348,297	4,783,224	30:23	30:23	30:23	30:23	30:23	1:17	1:17	1:17
R-2958	356,040	4,783,365	0:00	30:39	30:39	30:39	30:39	0:00	1:53	1:53
R-2974-P	351,890	4,786,786	27:29	27:29	27:29	27:29	27:29	0:49	0:49	0:49
R-2989	348,410	4,783,224	37:42	37:42	37:42	37:42	37:42	1:09	1:09	1:09
R-3011	350,949	4,788,501	5:41	5:41	5:41	5:41	5:41	0:23	0:23	0:23
R-3028	348,827	4,781,636	16:13	16:13	16:13	16:13	16:13	0:53	0:53	0:53
R-3029	352,979	4,780,820	4:15	4:15	4:15	4:16	4:16	0:23	0:23	0:23
R-3043	349,457	4,787,400	13:43	13:43	13:43	13:44	13:44	0:52	0:52	0:52
R-3044	353,386	4,787,461	9:43	9:43	9:43	9:43	9:43	0:55	0:55	0:55
R-3045	354,270	4,786,406	8:59	8:59	8:59	8:59	8:59	0:29	0:29	0:29
R-3056-P	356,290	4,786,578	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-3065	348,634	4,784,374	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-3066	348,573	4,783,184	29:21	29:21	29:21	29:21	29:21	0:53	0:53	0:53
R-3067	353,441	4,783,344	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-3068	351,502	4,782,154	29:59	17:47	29:59	17:47	29:59	0:58	0:58	0:58
R-3070	356,171	4,781,764	12:28	5:22	12:28	5:22	12:28	0:41	0:27	0:41
R-3093	350,318	4,785,307	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-3107	350,398	4,783,286	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-3108	347,339	4,782,595	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-3109	351,266	4,780,062	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-3131	348,172	4,788,053	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-3136-P	348,919	4,787,009	17:45	17:45	17:45	17:53	17:53	1:05	1:05	1:05
R-3154	348,456	4,783,108	15:57	15:57	15:57	15:57	15:57	0:52	0:52	0:52
R-3170	348,623	4,788,524	4:49	4:49	4:49	4:49	4:49	0:21	0:21	0:21
R-3177	351,283	4,786,343	2:40	2:40	2:40	2:40	2:40	0:18	0:18	0:18
R-3178	352,533	4,786,608	15:48	15:48	15:48	15:48	15:48	0:37	0:37	0:37
R-3192	348,757	4,783,320	10:07	10:07	10:07	10:07	10:07	0:42	0:42	0:42
R-3193-P	350,452	4,780,766	47:50	47:50	47:50	47:53	47:53	1:31	1:31	1:31

Appendix B Riverbend Wind Project - Receptor Locations and Expected Shadow Results

Rec ID ("-P" is Particip- pant)	X (UTM 17)	Y (UTM 17)	Sc25 Annual (hr:min)	Sc16 Annual (hr:min)	Sc16 wAlts Annual (hr:min)	Sc16a Annual (hr:min)	Sc16a wAlts Annual (hr:min)	Sc25 Max per day (hr:min)	Sc16/16a no Alts Max per day (hr:min)	Sc16/16a wAlts Max per day (hr:min)
R-3221	347,439	4,788,286	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-3225	349,470	4,786,528	11:47	11:47	11:47	11:49	11:49	0:55	0:55	0:55
R-3226	348,092	4,785,241	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-3227	354,234	4,786,065	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-3249	348,471	4,783,029	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-3271	350,221	4,788,727	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-3276	352,858	4,785,575	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-3293	348,759	4,783,092	19:20	18:23	19:20	18:23	19:20	0:41	0:41	0:41
R-3295	348,550	4,783,224	30:19	30:19	30:19	30:19	30:19	0:55	0:55	0:55
R-3296	349,204	4,783,248	5:34	3:36	5:34	3:36	5:34	0:26	0:26	0:26
R-3297	353,568	4,783,744	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-3320	349,355	4,788,331	4:35	4:35	4:35	4:35	4:35	0:28	0:28	0:28
R-3323	352,397	4,786,421	2:12	2:12	2:12	2:12	2:12	0:20	0:20	0:20
R-3345	348,531	4,783,228	32:18	32:18	32:18	32:18	32:18	0:56	0:56	0:56
R-3346	348,747	4,783,264	10:59	10:59	10:59	10:59	10:59	0:43	0:43	0:43
R-3347	353,669	4,780,902	14:10	12:22	14:10	12:22	14:10	0:31	0:31	0:31
R-3348-P	353,636	4,781,297	6:35	5:05	6:35	5:05	6:35	0:31	0:31	0:31
R-3368	349,559	4,788,604	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-3386	348,726	4,781,190	29:47	29:47	29:47	29:47	29:47	1:04	1:04	1:04
R-3387	351,442	4,783,188	9:49	0:00	9:49	0:00	9:49	0:43	0:00	0:43
R-3388	353,510	4,783,398	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-3415	350,305	4,789,164	33:15	33:15	33:15	33:15	33:15	1:14	1:14	1:14
R-3419	350,229	4,785,414	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-3420	350,967	4,787,536	40:34	40:34	40:34	40:34	40:34	1:14	1:14	1:14
R-3435	355,102	4,786,407	0:00	8:23	8:23	8:25	8:25	0:00	0:27	0:27
R-3441	354,519	4,780,851	15:08	2:35	15:08	2:35	15:08	0:40	0:23	0:40
R-3457-P	349,420	4,788,018	6:25	6:25	6:25	6:25	6:25	0:32	0:32	0:32
R-3461	353,413	4,789,386	7:04	7:04	7:04	7:04	7:04	0:54	0:54	0:54
R-3479	354,458	4,786,397	4:24	6:03	6:03	6:05	6:05	0:24	0:37	0:37
R-3524	348,707	4,782,899	4:00	3:02	4:00	3:02	4:00	0:18	0:18	0:18
R-3525	348,454	4,783,183	31:25	31:25	31:25	31:25	31:25	1:03	1:03	1:03
R-3526	348,807	4,783,184	11:11	10:10	11:11	10:10	11:11	0:40	0:40	0:40
R-3527-P	348,972	4,783,146	8:02	6:40	8:02	6:40	8:02	0:33	0:33	0:33
R-3528-P	354,048	4,781,717	20:12	19:46	20:12	19:46	20:12	0:48	0:48	0:48
R-3545	351,902	4,786,667	20:54	20:54	20:54	20:54	20:54	0:42	0:42	0:42
R-3546	351,931	4,785,653	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-3560	355,691	4,786,508	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-3564	348,412	4,783,157	23:28	23:28	23:28	23:28	23:28	1:02	1:02	1:02
R-3568	356,699	4,783,385	0:00	11:49	11:49	11:49	11:49	0:00	0:48	0:48
R-3576	350,152	4,788,583	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00

Appendix B Riverbend Wind Project - Receptor Locations and Expected Shadow Results

Rec ID ("-P" is Particip- pant)	X (UTM 17)	Y (UTM 17)	Sc25 Annual (hr:min)	Sc16 Annual (hr:min)	Sc16 wAlts Annual (hr:min)	Sc16a Annual (hr:min)	Sc16a wAlts Annual (hr:min)	Sc25 Max per day (hr:min)	Sc16/16a no Alts Max per day (hr:min)	Sc16/16a wAlts Max per day (hr:min)
R-3578-P	353,343	4,788,518	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-3594	348,692	4,783,265	13:00	13:00	13:00	13:00	13:00	0:46	0:46	0:46
R-3595	350,183	4,783,533	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-3596	351,712	4,781,591	21:11	21:11	21:11	21:11	21:11	0:44	0:44	0:44
R-3597	355,150	4,781,651	84:47	81:12	84:47	81:12	84:47	2:22	1:51	2:22
R-3618	348,584	4,785,317	21:02	21:02	21:02	21:13	21:13	0:45	0:45	0:45
R-3619	354,305	4,786,328	10:11	10:11	10:11	10:11	10:11	0:28	0:28	0:28
R-3631	355,030	4,789,497	23:34	23:34	23:34	23:34	23:34	1:09	1:09	1:09
R-3635	347,328	4,784,072	5:47	5:47	5:47	5:47	5:47	0:43	0:43	0:43
R-3638	356,438	4,783,421	0:00	23:48	23:48	23:48	23:48	0:00	1:05	1:05
R-3666	347,339	4,783,650	20:30	20:30	20:30	20:30	20:30	1:04	1:04	1:04
R-3670	356,548	4,781,549	6:44	1:49	6:44	1:49	6:44	0:33	0:20	0:33
R-3687	353,440	4,788,131	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-3688	352,294	4,786,245	3:28	3:28	3:28	3:28	3:28	0:21	0:21	0:21
R-3708	348,610	4,782,829	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-3709	348,444	4,783,225	37:32	37:32	37:32	37:32	37:32	1:05	1:05	1:05
R-3710	350,383	4,783,024	17:41	0:00	17:41	0:00	17:41	1:14	0:00	1:14
R-3711	353,960	4,783,341	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-3736-P	351,147	4,789,414	2:58	2:58	2:58	2:58	2:58	0:26	0:26	0:26
R-3737-P	350,722	4,786,538	5:05	5:05	5:05	5:05	5:05	0:25	0:25	0:25
R-3756-P	349,202	4,783,177	5:40	3:41	5:40	3:41	5:40	0:26	0:26	0:26
R-3757	351,697	4,783,177	5:43	0:00	5:43	0:00	5:43	0:34	0:00	0:34
R-3759	354,817	4,783,252	7:03	11:33	11:33	11:33	11:33	0:35	0:35	0:35
R-3774-P	353,437	4,788,616	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-3775	353,837	4,788,146	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-3776-P	349,462	4,787,255	14:38	14:38	14:38	14:39	14:39	0:54	0:54	0:54
R-3777	348,750	4,784,493	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-3778	348,912	4,784,867	1:21	1:21	1:21	1:22	1:22	0:10	0:10	0:10
R-3798	353,232	4,783,327	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-3832	348,414	4,782,959	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-3833	349,682	4,783,244	6:08	1:22	6:08	1:22	6:08	0:32	0:16	0:32
R-3834	351,648	4,783,189	7:09	0:00	7:09	0:00	7:09	0:36	0:00	0:36
R-3835	355,109	4,783,080	3:43	13:15	13:15	13:15	13:15	0:29	0:43	0:43
R-3837	355,807	4,781,774	10:53	10:53	10:53	10:53	10:53	0:37	0:37	0:37
R-3855	350,248	4,787,995	3:41	3:41	3:41	3:41	3:41	0:24	0:24	0:24
R-3861	350,164	4,787,881	15:54	15:54	15:54	15:54	15:54	1:07	1:07	1:07
R-3862-P	350,680	4,786,496	2:39	2:39	2:39	2:39	2:39	0:17	0:17	0:17
R-3863	352,271	4,786,327	3:15	3:15	3:15	3:15	3:15	0:22	0:22	0:22
R-3864-P	351,889	4,786,875	72:04	72:04	72:04	72:04	72:04	1:43	1:43	1:43
R-3877	356,432	4,788,129	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00

Appendix B Riverbend Wind Project - Receptor Locations and Expected Shadow Results

Rec ID ("-P" is Particip- pant)	X (UTM 17)	Y (UTM 17)	Sc25 Annual (hr:min)	Sc16 Annual (hr:min)	Sc16 wAlts Annual (hr:min)	Sc16a Annual (hr:min)	Sc16a wAlts Annual (hr:min)	Sc25 Max per day (hr:min)	Sc16/16a no Alts Max per day (hr:min)	Sc16/16a wAlts Max per day (hr:min)
R-3880	350,267	4,783,075	14:40	0:00	14:40	0:00	14:40	1:02	0:00	1:02
R-3881	353,524	4,782,493	90:46	90:46	90:46	90:46	90:46	1:40	1:40	1:40
R-3884-P	354,750	4,780,769	22:21	5:27	22:21	5:27	22:21	0:49	0:29	0:49
R-3915	350,882	4,783,867	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-3916	351,565	4,783,288	6:59	0:00	6:59	0:00	6:59	0:37	0:00	0:37
R-3932	354,477	4,788,080	7:49	7:49	7:49	7:49	7:49	0:20	0:20	0:20
R-3938	348,633	4,783,227	17:46	17:46	17:46	17:46	17:46	0:49	0:49	0:49
R-3942	356,721	4,781,619	4:52	1:21	4:52	1:21	4:52	0:28	0:16	0:28
R-3958	353,443	4,787,863	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-3959	348,774	4,784,472	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-3994	348,743	4,784,522	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-3995	353,523	4,785,674	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-4016	350,298	4,782,652	46:45	4:02	46:45	4:02	46:45	1:26	0:37	1:26
R-4017	350,293	4,782,880	28:46	0:00	28:46	0:00	28:46	1:14	0:00	1:14
R-4018	351,990	4,782,929	5:33	2:21	5:33	2:21	5:33	0:32	0:18	0:32
R-4019	353,745	4,783,220	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-4021	351,815	4,781,588	19:24	19:24	19:24	19:24	19:24	0:40	0:40	0:40
R-4044	352,203	4,785,753	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-4058	348,839	4,782,822	4:00	2:39	4:00	2:39	4:00	0:16	0:16	0:16
R-4059	348,379	4,783,013	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-4060	350,260	4,783,823	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-4061	353,095	4,783,476	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-4062	353,584	4,783,575	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-4080	353,831	4,789,492	1:27	1:27	1:27	1:27	1:27	0:17	0:17	0:17
R-4081	352,584	4,786,381	7:01	7:01	7:01	7:01	7:01	0:23	0:23	0:23
R-4082	351,934	4,786,502	21:37	21:37	21:37	21:37	21:37	0:37	0:37	0:37
R-4100	348,702	4,782,875	1:34	0:37	1:34	0:37	1:34	0:13	0:07	0:13
R-4101	350,193	4,783,979	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-4102	350,404	4,783,168	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-4103	348,692	4,782,353	1:17	0:00	1:17	0:00	1:17	0:15	0:00	0:15
R-4126	350,135	4,787,687	40:31	40:31	40:31	40:31	40:31	1:46	1:46	1:46
R-4127	353,469	4,787,176	29:04	29:04	29:04	29:04	29:04	1:13	1:13	1:13
R-4141	348,697	4,783,183	15:22	15:22	15:22	15:22	15:22	0:45	0:45	0:45
R-4142	353,479	4,783,316	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-4143	350,787	4,781,575	13:55	13:55	13:55	13:55	13:55	0:41	0:41	0:41
R-4144	352,028	4,781,157	7:40	7:40	7:40	7:41	7:41	0:44	0:44	0:44
R-4164	349,337	4,788,265	4:42	4:42	4:42	4:42	4:42	0:27	0:27	0:27
R-4165	350,052	4,788,400	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-4168	351,886	4,787,125	60:20	60:20	60:20	60:20	60:20	2:15	2:15	2:15
R-4169	352,552	4,786,539	17:05	17:05	17:05	17:05	17:05	0:36	0:36	0:36

Appendix B Riverbend Wind Project - Receptor Locations and Expected Shadow Results

Rec ID ("-P" is Particip- pant)	X (UTM 17)	Y (UTM 17)	Sc25 Annual (hr:min)	Sc16 Annual (hr:min)	Sc16 wAlts Annual (hr:min)	Sc16a Annual (hr:min)	Sc16a wAlts Annual (hr:min)	Sc25 Max per day (hr:min)	Sc16/16a no Alts Max per day (hr:min)	Sc16/16a wAlts Max per day (hr:min)
R-4174	355,306	4,784,434	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-4181	349,650	4,783,250	5:52	1:28	5:52	1:28	5:52	0:31	0:16	0:31
R-4182	352,656	4,783,431	3:45	3:45	3:45	3:45	3:45	0:24	0:24	0:24
R-4183	351,395	4,781,607	3:13	3:13	3:13	3:13	3:13	0:22	0:22	0:22
R-4184	354,066	4,780,917	4:51	1:07	4:51	1:07	4:51	0:26	0:14	0:26
R-4187	354,367	4,783,447	0:00	1:41	1:41	1:41	1:41	0:00	0:20	0:20
R-4189	356,067	4,781,780	9:23	6:19	9:23	6:19	9:23	0:32	0:29	0:32
R-4229	352,186	4,782,755	6:53	4:30	6:53	4:30	6:53	0:39	0:24	0:39
R-4232	355,556	4,783,359	1:34	30:06	30:06	30:06	30:06	0:19	1:29	1:29
R-4253	352,795	4,786,431	9:13	9:13	9:13	9:13	9:13	0:28	0:28	0:28
R-4271	348,458	4,782,858	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-4272	348,386	4,783,234	39:22	39:22	39:22	39:22	39:22	1:12	1:12	1:12
R-4274	351,249	4,783,168	6:42	0:00	6:42	0:00	6:42	0:45	0:00	0:45
R-4275	351,926	4,781,133	6:56	6:56	6:56	6:58	6:58	0:44	0:44	0:44
R-4328	348,870	4,783,193	9:33	8:24	9:33	8:24	9:33	0:37	0:37	0:37
R-4330	353,550	4,785,812	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-4331-P	352,721	4,781,404	8:36	8:36	8:36	8:37	8:37	0:28	0:28	0:28
R-4332-P	353,560	4,780,727	6:19	4:46	6:19	4:46	6:19	0:20	0:20	0:20
R-4333	352,764	4,780,664	3:45	3:45	3:45	3:47	3:47	0:28	0:28	0:28
R-4334	354,928	4,786,809	1:25	4:41	4:41	4:42	4:42	0:16	0:24	0:24
R-4336	356,329	4,788,299	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-4511	353,390	4,783,909	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-4515	352,640	4,783,310	2:59	2:59	2:59	2:59	2:59	0:25	0:25	0:25
R-4519	351,757	4,783,333	6:04	0:00	6:04	0:00	6:04	0:31	0:00	0:31
R-4520	348,765	4,783,386	9:26	9:26	9:26	9:26	9:26	0:42	0:42	0:42
R-4521	348,310	4,785,152	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-4522	350,100	4,786,102	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-4523	348,698	4,786,281	7:39	7:39	7:39	7:41	7:41	0:35	0:35	0:35
R-4524	348,634	4,788,491	2:21	2:21	2:21	2:21	2:21	0:14	0:14	0:14
R-4528	355,148	4,780,474	22:47	22:47	22:47	22:47	22:47	0:43	0:43	0:43
R-4529-P	355,010	4,781,976	43:40	43:40	43:40	43:40	43:40	1:12	1:12	1:12
R-4530	354,585	4,783,252	2:15	5:07	5:07	5:07	5:07	0:27	0:27	0:27
R-4531-P	354,219	4,783,223	0:00	1:30	1:30	1:30	1:30	0:00	0:17	0:17
R-4532	352,030	4,782,552	8:15	4:56	8:15	4:56	8:15	0:39	0:29	0:39
R-4533	353,038	4,781,711	7:16	7:16	7:16	7:17	7:17	0:25	0:25	0:25
R-4534	351,923	4,781,314	2:55	2:55	2:55	2:55	2:55	0:15	0:15	0:15
R-4535	352,185	4,780,962	10:56	10:56	10:56	11:04	11:04	0:45	0:46	0:46
R-4536	348,671	4,780,754	89:35	89:35	89:35	89:35	89:35	2:07	2:07	2:07
R-4541	351,532	4,786,364	8:39	8:39	8:39	8:39	8:39	0:23	0:23	0:23
R-4542	352,306	4,785,781	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00

Appendix B Riverbend Wind Project - Receptor Locations and Expected Shadow Results

Rec ID ("-P" is Particip- pant)	X (UTM 17)	Y (UTM 17)	Sc25 Annual (hr:min)	Sc16 Annual (hr:min)	Sc16 wAlts Annual (hr:min)	Sc16a Annual (hr:min)	Sc16a wAlts Annual (hr:min)	Sc25 Max per day (hr:min)	Sc16/16a no Alts Max per day (hr:min)	Sc16/16a wAlts Max per day (hr:min)
R-4543	352,961	4,785,363	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-4544	351,830	4,785,455	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-4545	353,664	4,785,934	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-4546	353,375	4,785,816	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-4548	354,534	4,786,431	3:28	5:24	5:24	5:25	5:25	0:23	0:38	0:38
R-4549	354,979	4,787,255	1:03	3:48	3:48	3:49	3:49	0:15	0:34	0:34
R-4550-P	355,466	4,788,105	2:42	2:42	2:42	2:42	2:42	0:17	0:17	0:17
R-4551	354,116	4,788,074	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-4552	352,821	4,788,105	0:15	0:15	0:15	0:15	0:15	0:08	0:08	0:08
R-4553	353,421	4,789,352	12:01	12:01	12:01	12:01	12:01	1:08	1:08	1:08
R-4554	352,559	4,789,484	3:51	3:51	3:51	3:51	3:51	0:29	0:29	0:29
R-4561	350,376	4,785,522	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-4562	348,832	4,782,756	1:22	0:00	1:22	0:00	1:22	0:17	0:00	0:17
R-4563	348,470	4,782,978	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-4564	348,799	4,782,927	11:53	10:44	11:53	10:44	11:53	0:35	0:35	0:35
R-4584-P	356,630	4,785,800	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-4585	353,672	4,782,929	16:42	16:42	16:42	16:42	16:42	1:21	1:21	1:21
R-4586	348,763	4,783,185	12:36	11:40	12:36	11:40	12:36	0:41	0:41	0:41
R-4587	349,723	4,783,170	6:36	1:19	6:36	1:19	6:36	0:34	0:15	0:34
R-4588	351,086	4,780,056	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-4589	355,128	4,782,691	4:14	25:02	25:02	25:02	25:02	0:30	0:44	0:44
R-4590	355,566	4,783,274	1:35	30:48	30:48	30:48	30:48	0:19	1:29	1:29
R-4591	356,392	4,783,207	0:00	34:22	34:22	34:22	34:22	0:00	1:22	1:22
R-4592	356,391	4,783,188	0:00	35:16	35:16	35:16	35:16	0:00	1:23	1:23
R-4593	356,707	4,783,298	0:00	11:57	11:57	11:57	11:57	0:00	0:49	0:49
R-4594	356,315	4,788,216	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-4595	350,153	4,787,536	56:24	56:24	56:24	56:24	56:24	1:37	1:37	1:37
R-4596-P	351,868	4,787,214	59:20	59:20	59:20	59:20	59:20	2:06	2:06	2:06
R-4597	350,925	4,789,452	4:33	4:33	4:33	4:33	4:33	0:33	0:33	0:33
R-4598	355,823	4,787,962	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
R-4599	354,994	4,786,750	1:16	5:09	5:09	5:10	5:10	0:16	0:26	0:26
R-4600	348,298	4,783,242	36:58	36:58	36:58	36:58	36:58	1:22	1:22	1:22