

**Thunder Spirit Wind Energy Project
Thunder Spirit Wind, LLC
Adams County, North Dakota**

**AMENDMENT to the North Dakota Public Service Commission
for a Certificate of Site Compatibility (Updated September 9, 2013)**



Prepared for:
Thunder Spirit Wind, LLC
103 Front Street
Schenectady, NY 12305



Prepared by:
Tetra Tech, Inc.
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Boston, MA 02110



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Case No.: PU-11-601

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TABLE OF CONTENTS

1.	INTRODUCTION	1
2.	PSC SITING CRITERIA.....	3
2.1	Exclusion Areas	3
2.1.1	Avoidance Areas.....	4
2.1.2	Selection Criteria	6
2.1.3	Policy Criteria.....	8
3.	ENVIRONMENTAL ANALYSIS - UPDATE.....	9
3.1	Summary of Impacts	13
	POTENTIAL PERMITS AND APPROVALS	14

REVISED FIGURES (FIGURE NUMBERS WERE NOT CHANGED)

Figure 3	Project Area (Topographical)
Figure 5	Exclusion and Avoidance Areas
Figure 17	Residential Receptor Distances to Closest Wind Turbine
Figure 18	Project Layout with Adams County Zoning Setbacks
Figure A (new)	Turbine Adjustments

REVISED TABLES

Turbines Adjusted after the June Certificate Submission (Layout date of August 15, 2013).....	2
Exclusion Areas.....	3
Avoidance Areas	4
Selection Criteria	6
Policy Criteria	8
Summary of Impacts and Mitigation (Only those with changes are listed).....	13

REVISED APPENDICES

Appendix A	Studies and Assessments (Only those that were revised or were not provided in Certificate)
	<ul style="list-style-type: none">Revised Shadow Flicker Analysis Report Addendum (Tetra Tech, 2013)Revised Acoustic Modeling Analysis Memorandum (Tetra Tech, 2013)
Appendix B	Additional Agency Correspondence
Appendix C	Receptors Located Within ½ mile of a Turbine (Revised)

1. INTRODUCTION

On June 4, 2013, Thunder Spirit Wind, LLC (Thunder Spirit), an affiliate of Global Winds Harvest, Inc., submitted an application for a Certificate of Site Compatibility (Certificate) to construct the Thunder Spirit Wind Energy Project (the Project). Since the submission of the Certificate, there were some modifications to some turbine locations. In July, some turbines were further micrositied or removed to avoid environmentally sensitive areas and meet setback requirements. In August, further micrositied occurred to account for landowner requests, to avoid environmentally sensitive areas, and to meet county setback requirements. A total of 29 turbines were micrositied after the layout dated April 26, 2013. Details on these adjustments are further described in this Amendment.

The Certificate of Site Compatibility Application submitted in June 2013 included impact calculations for up to 85 turbines. The current layout (dated August 15, 2013) will utilize between 50 and 75 of the 78 turbine locations. Since the total number of turbines was not increased, rather it was decreased, there is no additional impact to those originally presented for native prairie, prime farmland, agricultural production and plant life and this total impact would be less than what was presented previously.

As mentioned in the Certificate, once the PSC issues the Certificate, Thunder Spirit will complete any additional studies that may be required by the Certificate or Thunder Spirit's siting process. Thunder Spirit will further evaluate the Project Area based on efficient construction of the Project. Thunder Spirit will seek further input from landowners regarding the location of wind turbines and associated facilities. Once these additional studies and communications are completed, turbine locations will be re-evaluated and any changes will be submitted to the PSC for approval prior to construction. A pre-construction meeting will be held with PSC staff to ensure that Thunder Spirit conforms to the Certificate requirements.

The table below lists the turbines that were moved and the old and new distance to the nearest receptor. Figure A shows the turbine relocations and differentiates between the locations submitted as part of the Application and the revised locations. Tables summarizing impacts (or lack thereof) relating to the latest round of layout adjustments are also included in this Amendment in the following section.

Turbines Adjusted after the June Certificate Submission (Layout date of August 15, 2013)

Turbine	Distance moved from original location	New Distance to Nearest Receptor (ft)	Previous Distance to Nearest Receptor (ft)	Distance moved closer or farther away from receptor
71	749	4,844	5,053	-209
A8	201	4,984	5,094	-109
26	89	3,133	3,216	-83
20	79	3,688	3,763	-74
A15	179	2,670	2,708	-38
A2	29	7,476	7,501	-26
37	142	6,343	6,363	-21
A1	19	7,483	7,502	-19
A3	21	3,944	3,942	1
A22	20	2,678	2,674	5
31	102	5,738	5,729	10
A33	364	5,135	5,103	33
17	109	6,725	6,687	38
A6	1,193	2,723	2,679	44
60	364	3,681	3,603	78
35	659	3,991	3,904	87
36	349	5,299	5,198	101
A11	429	6,439	6,329	110
A19	152	2,801	2,689	111
12	372	3,552	3,431	121
A21	998	2,923	2,743	179
13	297	3,728	3,457	270
34	REMOVED			
68	REMOVED			
72	REMOVED			
A32	REMOVED			
A30	REMOVED			
A5	REMOVED			
A20	REMOVED			

Red indicates turbine moved closer to a receptor.

2. PSC SITING CRITERIA

2.1 Exclusion Areas

In accordance with NDAC Section 69-06-08-01-1, the geographical areas listed in the following table shall be excluded in the consideration of a site for an energy conversion facility. Refer to the last column for any changes to Exclusion Areas.

Exclusion Areas

Exclusion Area	Present within Project Area?	Description	Turbine adjustment impacts?
Designated or registered national areas: parks; memorial parks; historic sites and landmarks; natural landmarks; historic districts; monuments; wilderness areas; wildlife areas; wild, scenic, or recreational rivers; wildlife refuges; and grasslands.	None	Of these exclusion areas, only native prairie (grasslands) are present within the Project Area; however, native prairie as mapped during field surveys represents 30 percent of the WEFP. These are not considered exclusion areas. They are considered avoidance areas.	No change* (*See Note in footer of table)
Designated or registered state areas: parks; forests; forest management lands; historic sites; monuments; historical markers; archaeological sites; grasslands; wild, scenic, or recreational rivers; game refuges; game management areas; management areas; and nature preserves.	Present	Cultural sites that are potentially eligible for the historic register will be avoided.	No change
County parks and recreational areas; municipal parks; parks owned or administered by other governmental subdivisions; hardwood draws; and enrolled woodlands.	None	N/A	No change
Prime farmland and unique farmland, as defined by the land inventory and monitoring division of the soil conservation service, United States department of agriculture, in 7 C.F.R. part 657; provided, however, that if the Commission finds that the prime farmland and unique farmland that will be removed from use for the life of the facility is of such small acreage as to be of negligible impact on agricultural productions, such exclusion shall not apply.	Present	Prime farmland has been avoided to the extent practical. Permanent impacts to prime farmland soils from turbine placement and access roads are expected to be up to 3 acres, which is a negligible percentage of the Project Area.	No change* (*See Note in footer of table)
Irrigated land	None	No agricultural irrigation is currently known to take place within the Project Area.	No change
Areas critical to threatened or endangered animal or plant species	None	N/A	No change
Areas where animal or plant species that are unique or rare to this state would be irreversibly damaged.	None	N/A	No change

Exclusion Area	Present within Project Area?	Description	Turbine adjustment impacts?
Areas within 1,200 feet of the geographic center of an intercontinental ballistic missile (ICBM) launch or launch control facility	None	N/A	No change
Setbacks from Interstate or state roadways ROW, railroads, transmission lines, non-participating landowners, and county or township roadways.	Present	<ul style="list-style-type: none"> 1.1 x height of turbine from interstate or state roadways ROW 1.1 x height of turbine from railroads 1.1 x height of turbine from transmission lines (over 115 kV) 1.1 x height of turbine from non-participating landowners 1.1 x height of turbine plus 75' from centerline of any county or maintained township roadways 	All turbines have been adjusted to meet these setbacks.
<p>Note: The Certificate of Site Compatibility Application submitted in June 2013 included impact calculations for up to 85 turbines. The current layout (dated August 15, 2013) will utilize between 50 and 75 of the 78 turbine locations. Since the total number of turbines was not increased, rather it was decreased, there is no additional impact to those originally presented for native prairie, prime farmland, agricultural production and plant life and this total impact would be less than what was presented previously.</p>			

2.1.1 Avoidance Areas

In accordance with NDAC Section 69-06-08-01-2, the geographical areas listed in the following table shall not be approved as a site for an energy conversion facility unless the applicant shows that, under the circumstances, there is no reasonable alternative. Refer to the last column for any changes to Avoidance Areas.

Avoidance Areas

Avoidance Areas	Present within Project Area?	Description and Proposed Buffer	Turbine adjustment impacts?
Historical resources which are not designated as exclusion areas	Present	A Class III cultural resources survey was completed for the Project. Sites with potential cultural significance will be avoided. A Class II Architectural survey was also conducted and a determination of No Historic Properties Affected was determined.	Turbines were relocated to ensure avoidance.
Areas within the city limits of a city or the boundaries of a military installation	None	N/A	No change
Areas within known floodplains as defined by the geographical boundaries of the 100-year flood	None	The Project Area is located in Flood Hazard Zone D: Areas in which flood hazards are undetermined, but possible.	No change
Areas that are geologically unstable	Present	Abandoned coal mines are present in and near the Project Area. Subsidence hazards related to	No change

Avoidance Areas	Present within Project Area?	Description and Proposed Buffer	Turbine adjustment impacts?
		the potential presence of abandoned underground coal mines will be mitigated through field studies and geotechnical analyses and subsequent micrositing.	
Wetlands	Present	Permanent impacts to wetlands will be avoided.	No change
Woodlands	None	The Project has 15.3 acres of deciduous forest mostly comprised of windbreaks around farming facilities.	No change
Native Prairie	Present	Native prairie as mapped during field surveys represents 30 percent of the WEFP. The Project Area has 4,527 acres (30% of the WEFP) of native prairie that may provide habitat suitable for sensitive species such as eagles, sharp tailed grouse, and Sprague's pipit.	No change* (*See Note in footer of table)
Areas of recreational significance which are not designated as exclusion areas	None	N/A	No change
Sound levels within 100' of an inhabited residence or a community building cannot exceed 50 dBA	None	The sound analysis was inclusive of this 100' buffer. There are no exceedances of this criterion.	No impacts
<p>Note: The Certificate of Site Compatibility Application submitted in June 2013 included impact calculations for up to 85 turbines. The current layout (dated August 15, 2013) will utilize between 50 and 75 of the 78 turbine locations. Since the total number of turbines was not increased, rather it was decreased, there is no additional impact to those originally presented for native prairie, prime farmland, agricultural production and plant life and this total impact would be less than what was presented previously.</p>			

2.1.2 Selection Criteria

In accordance with NDAC Section 69-06-08-01-3, a site shall be approved in an area only when it is demonstrated to the PSC by the applicant that any significant adverse effects resulting from the location, construction, and operation of the facility in that area, as they relate to the criteria listed in the following table. Refer to the last column for any changes to Selection Criteria.

Selection Criteria

Selection Criteria	Potential Adverse Effects	Turbine adjustment impacts?
The impact upon agriculture:		
Agricultural production	Approximately 92 acres of land will be affected by 85 turbines (up to 75 turbines will be constructed), associated access roads, O&M facility, and a substation during operation. Additional temporary impacts during construction for turbine installation, road construction, cable trenching, and laydown and contractor staging would be approximately 347 acres. These impacts represent a minor portion of the land area within the Project Area that is available for agricultural production. As a result, no adverse effects are expected.	No change* (*See Note in footer of table)
Family farms and ranches	The Project will comply with local setbacks as stipulated in the Adams Co. wind ordinance. Although some land area will be permanently converted to wind turbine foundations and pads, access roads, and a substation, wind lease payments to farmers will provide a compensatory source of income.	No change
Land which the owner demonstrates has soil, topography, drainage, and an available water supply that cause the land to be economically suitable for irrigation	Participating landowners have not expressed concerns related to economically suitable irrigation on their land. No agricultural irrigation is currently known to occur within the Project Area. No adverse effects are expected.	No change
Surface drainage patterns and ground water flow patterns	No adverse effects are expected.	No change
The agricultural quality of the cropland	No impacts to the agricultural quality of the cropland are anticipated (except for areas converted to wind energy facility use). Thunder Spirit will work with the landowners to alleviate the compaction of any soils which occurs during construction,	No change
The impact upon the availability and adequacy of:		
Law enforcement	No adverse effects are expected.	No change
School systems and education programs	No adverse effects are expected.	No change
Governmental services and facilities	No adverse effects are expected.	No change
General and mental health care facilities	No adverse effects are expected.	No change
Recreational programs and facilities	No adverse effects are expected.	No change
Transportation facilities and networks	During construction, an increase in vehicle trips per day is anticipated for the duration of the Project construction. During facility operation, no significant impacts are anticipated.	No change
Retail service facilities	Local services such as motels, restaurants, and convenience stores are likely to experience an increase in business during Project construction. During facility operation, no significant impacts are anticipated.	No change

Selection Criteria	Potential Adverse Effects	Turbine adjustment impacts?
Utility services	No significant impacts are anticipated. Thunder Spirit will purchase station service from both MDU (to satisfy power requirements at the turbines and substation) and from Slope Electric (for requirements at O&M offices). Utilities will suggest appropriate configurations for the electrical system, and Thunder Spirit will abide by the recommendations to prevent impacts to the transmission system.	No change
The impact upon:		
Local institutions	No impacts are anticipated.	No change
Noise sensitive land uses	The only noise sensitive land uses within the Project Area are the residences near turbine locations. No exceedances of the North Dakota 50 dBA criterion occurred.	See attachment for details
Rural residences and businesses	The Project will comply with local setback regulations, in accordance with the Adams Co. wind ordinance. No significant impacts are anticipated.	No change
Aquifers	No adverse effects are expected.	No change
Human health and safety	No impacts to human health and safety are anticipated based on the implementation of the mitigative measures discussed in Section 5.5.3 and maintenance schedules.	No change
Animal health and safety	No impacts to livestock are anticipated from construction or operation of the facility. Based on avian and bat surveys performed to date, mean avian raptor and non-raptor and bat use was generally low to low-moderate compared to other wind facilities. Thunder Spirit will implement measures to avoid and minimize impacts to wildlife by siting facilities away from active raptor nests and wetlands to the extent practicable. There will be no permanent impacts to wetlands, reducing impacts to migratory birds. In addition, Thunder Spirit will implement a minimum of one year of post-construction mortality monitoring for birds and bats.	No change
Plant life	The Project will result in approximately 176 acres of permanent impact. Project layout would permanently impact 27 acres of native grasslands.	No change* (*See Note in footer of table)
Temporary and permanent housing	No adverse impacts are anticipated. Temporary housing will be utilized during construction.	No change
Temporary and permanent skilled and unskilled labor	No adverse impacts are anticipated. Local contractors employed for construction will result in increased wages.	No change
The cumulative effect of the location of the facility in relation to existing and planned facilities and other industrial development	Wind energy development is anticipated to have a positive cumulative impact on air quality and minimal impacts to geology, soils, water, noise, safety and health issues, and cultural resources. Socioeconomic impacts are anticipated to be positive, as the rural economy and energy production is diversified. Wind energy development removes less total land from agricultural use than other forms of development.	No change
<p>Note: The Certificate of Site Compatibility Application submitted in June 2013 included impact calculations for up to 85 turbines. The current layout (dated August 15, 2013) will utilize between 50 and 75 of the 78 turbine locations. Since the total number of turbines was not increased, rather it was decreased, there is no additional impact to those originally presented for native prairie, prime farmland, agricultural production and plant life and this total impact would be less than what was presented previously.</p>		

2.1.3 Policy Criteria

Refer to the last column for any changes to Policy Criteria.

Policy Criteria

Policy Criteria	Suitable Policy or Practice of Applicant	Turbine adjustment impacts?
Recycling of the conversion byproducts and effluents	Not applicable. The Project would not create byproducts or effluent.	No change
Energy conservation through location, process, and design	Thunder Spirit is developing the site to maximize energy output and will develop a site layout that optimizes wind resources while minimizing the impact on land resources and any potentially sensitive areas.	No change
Training and utilization of available labor in this state for the general and specialized skills required	Thunder Spirit will use local labor to the extent practicable.	No change
Use of a primary energy source or raw material located within the state	The energy generated at the site will utilize the wind resources of the State of North Dakota.	No change
Non-relocation of residents	No residents will be relocated as a result of the Project.	No change
The dedication of an area adjacent to the facility to land uses such as recreation, agriculture, or wildlife management	The Project will not interfere with adjacent land uses. As such, it is not anticipated that areas adjacent will be dedicated to recreation, agriculture, or wildlife management issues.	No change
Economies of construction and operation	Thunder Spirit will utilize local contractors to the extent practicable.	No change
Secondary uses of appropriate associated facilities for recreation and enhancement of wildlife	None.	No change
Use of citizen coordinating committees	Thunder Spirit will continue to work with landowners of properties for the Project.	No change
A commitment of a portion of the energy produced for use in this state	Energy produced will be injected into the MDU 230 kV line at the Hettinger Substation.	No change
Labor relations	No labor relations will be affected.	No change
The coordination of facilities	Existing facilities and facility corridors were considered in the location of the wind farm and associated facilities.	No change
Monitoring of impacts	Thunder Spirit and the EPC contractor will employ best management practices (BMPs) during construction to monitor soil impacts and to segregate topsoil. Storm water prevention plans will be prepared for all disturbance sites exceeding size threshold. Environmental monitors will be onsite during construction to ensure there will be no impacts to wetlands and documented archeological sites that require avoidance.	No change

3. ENVIRONMENTAL ANALYSIS - UPDATE

This section provides any information relating to changes to the impacts as discussed in the Certificate due to the adjustments of the layout.

Shadow flicker

The shadow flicker modeling was conducted using the latest layout to ensure no additional impacts above the acceptable range.

The WindPro model was used to update the shadow flicker impact analysis for the revised wind turbine layout design (dated 8/15/13) for the Thunder Spirit Wind Energy Project (Project). The revised layout design includes 78 potential turbine locations, compared to 85 locations considered in the original analysis. As described in the original report, only up to 75 turbines, depending on the turbine model selected, will be installed. A total of 7 turbines were dropped and 22 turbines changed positions ranging in distance from 1 to 270 feet. While predicted shadow flicker impacts at some of the house receptors modeled increased slightly, maximum predicted impacts were either unchanged or decreased for the new layout design. Tables below compare the top ten worst case WindPro predicted shadow flicker impacts for the original and revised turbine layouts and for the three Project turbine model options. Considering all turbine scenarios, only one of the 26 receptors modeled had expected shadow flicker impacts of more than 30 hours per year but this is an abandoned structure of a participating landowner. The maximum predicted shadow flicker impact at an occupied receptor is 25 hours 20 minutes per year (Receptor #23).

Table A: Comparison of WindPro Predicted Shadow Flicker Impacts for Original and Revised Turbine Layout Design for the Top Ten Predicted Impact Receptors – Turbine Scenario A (78 Vestas V100 2.0 Turbines)

Original Turbine Layout Design			Revised Turbine Layout Design		
Receptor ID*	Receptor Description	Shadow Hours per Year (expected) [hh:mm / year]	Receptor ID*	Receptor Description	Shadow Hours per Year (expected) [hh:mm / year]
28	Participating Landowner	58:20	67	Abandoned/Participating	26:54
67	Abandoned/Participating	26:52	23	Non-participating Receptor	16:40
23	Non-participating Receptor	16:37	10	Non-participating Receptor	11:48
2	Non-participating Receptor	13:06	14	Participating Landowner	9:07
9	Non-participating Receptor	9:29	11	Non-participating Receptor	8:36
10	Participating Landowner	9:26	8	Participating Landowner	8:34
14	Non-participating Receptor	9:10	15	Participating Landowner	7:55
11	Participating Landowner	8:35	28	Participating Landowner	7:13
8	Participating Landowner	8:31	30	Non-participating Receptor	7:12
3	Non-participating Receptor	8:14	7	Non-participating Receptor	6:44

Table B: Comparison of WindPro Predicted Shadow Flicker Impacts for Original and Revised Turbine Layout Design for the Top Ten Predicted Impact Receptors – Turbine Scenario B (78 Siemens SWT 2.3-108 Turbines)

Original Turbine Layout Design			Revised Turbine Layout Design		
Receptor ID*	Receptor Description	Shadow Hours per Year (expected) [hh:mm / year]	Receptor ID*	Receptor Description	Shadow Hours per Year (expected) [hh:mm / year]
28	Participating Landowner	65:20	67	Abandoned/Participating	30:26
67	Abandoned/Participating	30:25	23	Non-participating Receptor	19:05
23	Non-participating Receptor	19:03	10	Non-participating Receptor	11:02
2	Non-participating Receptor	14:32	14	Participating Landowner	10:55
10	Participating Landowner	11:07	11	Non-participating Receptor	9:42
14	Non-participating Receptor	10:59	8	Participating Landowner	8:14
11	Participating Landowner	9:42	15	Participating Landowner	7:57
7	Non-participating Receptor	9:23	7	Non-participating Receptor	7:24
9	Non-participating Receptor	8:27	28	Participating Landowner	6:55
8	Participating Landowner	8:15	13	Non-participating Receptor	6:48

Table C: Comparison of WindPro Predicted Shadow Flicker Impacts for Original and Revised Turbine Layout Design for the Top Ten Predicted Impact Receptors – Turbine Scenario C (78 Acciona AW116/3000 Turbines)

Original Turbine Layout Design			Revised Turbine Layout Design		
Receptor ID*	Receptor Description	Shadow Hours per Year (expected) [hh:mm / year]	Receptor ID*	Receptor Description	Shadow Hours per Year (expected) [hh:mm / year]
28	Participating Landowner	76:58	67	Abandoned/Participating	36:00
67	Abandoned/Participating	34:40	23	Non-participating Receptor	25:20
23	Non-participating Receptor	24:59	10	Non-participating Receptor	18:00
2	Non-participating Receptor	21:15	14	Participating Landowner	17:05
14	Non-participating Receptor	16:44	30	Non-participating Receptor	13:55
7	Non-participating Receptor	15:30	11	Non-participating Receptor	13:01
9	Non-participating Receptor	14:50	8	Participating Landowner	12:10
10	Participating Landowner	14:31	15	Participating Landowner	11:19
3	Non-participating Receptor	12:59	7	Non-participating Receptor	10:29
11	Participating Landowner	12:25	13	Non-participating Receptor	10:21

The primary mitigation measure used for wind turbines is setback distance. Thunder Spirit is committed to a minimum 2,640-foot setback distance from all non-participating existing occupied residential structures. Because no significant impacts are anticipated, no additional mitigation is proposed at this time.

Noise

Thunder Spirit submitted an acoustic analysis on May 29, 2013 for a Project layout consisting of 85 wind turbine generators and a supporting collector substation. Since that time the Project layout was modified and reduced to 78 turbines. The location of the collector substation also changed slightly. The sound analysis was modeling using the latest layout to ensure no additional impacts above the acceptable range.

The three candidate turbine types being considered for the Project remain the same as under the previous analysis. Tetra Tech evaluated the new Project layout configuration using the same methodology used in the May 29th submittal. This memo provides the results of this evaluation and an assessment of Project compliance with the U.S. Environmental Protection Agency (EPA) noise guidelines used in the previous analysis as well as the recently adopted state of North Dakota noise regulations for wind energy projects. The primary mitigative measure used for wind turbines is setback distance. As stated in the Certificate, to meet county zoning setbacks, Thunder Spirit is committed to a minimum 2,640-foot setback distance from all occupied residential structures.

The table below presents the modeling results and indicates that received sound levels under maximum rotation and maximum rotation during anomalous events may potentially exceed the EPA 48.6 dBA guideline at one or more receptors for each turbine model. The EPA guidelines are just that, guidelines and not regulatory limits; however, the State’s wind energy noise regulations require Project compliance. The EPA threshold exceedances are only provided for comparative purposes to the results in the May 29th memo. The Acciona turbine exhibited the worst case results. With respect to the EPA guidelines, there was 1 potential exceedance at maximum rotation and 2 potential exceedances at maximum rotation under anomalous meteorological conditions. However, these exceedances occurred at Receptors 67 and 183, which have both been identified as abandoned residences. With respect to the North Dakota Adams County Zoning Ordinance, there are no exceedances of the noise limits. All receptors are in compliance.

Summary of Project Sound Levels at Receptors by Turbine Model

Sound Level (dBA)	Number of Receptors Exceeding Sound Level Ranges								
	Acciona AW116/3000			Vestas V100 2.0			Siemens 2.3-108		
	Cut-in	Maximum	Maximum - Anomalous	Cut-in	Maximum	Maximum - Anomalous	Cut-in	Maximum	Maximum - Anomalous
> 50 North Dakota	0	0	0	0	0	0	0	0	0
> 48.6 EPA	0	1	2	0	0	1	0	0	2
>= 50	0	0	1	0	0	0	0	0	0
45 to 50	4	7	10	0	2	3	0	5	10
40 to 45	15	13	12	0	13	16	0	14	13
35 to 40	5	4	3	1	8	7	0	5	3
< 35	2	2	0	25	3	0	26	2	0

In conclusion, the acoustic modeling analysis, demonstrates the Project has been adequately designed inclusive of a number of conservative assumptions to generate sound levels below the EPA guidelines and North Dakota noise limit at all occupied non-participant receptors. If a complaint is registered and sound is measured above the 48.6 dBA level on more than a rare occasion, Thunder Spirit will provide improved insulation, landscaping, or other appropriate candidate mitigative measures. It should be noted that the acoustic model conservatively predicts outdoor sound levels and assumes no shielding or attenuation by trees or other vegetation.

Cultural, Archaeological, and Historic Architectural Impacts

Class II Historic Architecture Survey

The architectural historian reviewed the latest layout and determined that the revisions to the layout did not add or subtract properties from the Area of Potential Effect (APE). Results and recommendations were submitted to SHPO for review and acceptance. On August 20, 2013, a response was received which stated that the SHPO concurs with “*No Significant Sites Affected*” or “*No Historic Properties Affected*” provided that the project is of the nature stated and it takes place in the location plotted and described in the project documentation, and avoidance procedures are maintained (See attached letter).

Class III Pedestrian Survey

A Class III Pedestrian Survey of the APE based on the April 26, 2013 Project layout was conducted and as presented in the Certificate, some potentially eligible sites were identified. Revisions to the layout were necessary to ensure avoidance of sensitive resources which led to this Amendment. Should further revisions be necessary for project facilities, the areas will be revisited as necessary to determine if additional areas require avoidance. Results and recommendations were submitted to SHPO for review and acceptance. On August 14, 2013, a response was received which stated that the SHPO provisionally concurs with a “*No Significant Sites Affected*” and “*No Historic Properties Affected*” provided the project is of the nature stated and it takes place in the location plotted and described in the project documentation, and avoidance procedures are maintained (See attached letter).

Wetlands, Surface Water and Floodplain Resources

The wetland and other Waters of the United States (WoUS) delineation conducted in May 2013 included a buffer around the project components. WoUS and some wetlands were identified within the project area. The wetlands biologist reviewed the changes to the layout after the field effort and determined that there are no additional wetlands or WoUS that will be impacted therefore, the results of the wetlands and WoUS delineation submitted in August 2013 remain applicable. As stated in that report, Thunder Spirit has committed to avoiding all permanent impacts. If temporary impacts cannot be avoided, proper permits and notifications will be obtained/made as required. Therefore, information provided in the Certificate is still valid.

3.1 Summary of Impacts

The table below summarizes any changes to the impacts to the resources due to the revisions to the layout.

Summary of Impacts and Mitigation (Only those with changes are listed)

Resource	Impact	Mitigation
Noise	No impacts are anticipated to noise-sensitive resources (occupied residences).	Thunder Spirit has located turbines so the maximum level of 48.6 dBA is not exceeded at occupied residences. Thunder Spirit will also comply with the North Dakota 50 dBA criterion and the Adams County ordinance: Sustained noise of over 80 dB during the day and 70 dB at night is not allowed.
Cultural, Archaeological, and Historic Architecture	No impacts to previously identified cultural resources are anticipated.	Thunder Spirit has conducted Class I, II, and III inventories for the proposed Project. Turbines and other Project facilities will be microsituated to avoid impacts to newly documented archaeological sites that are potentially eligible to the NHRP. The sites that were identified during Project surveys will be evaluated for significance in consultation with SHPO and avoided as necessary.

4. POTENTIAL PERMITS AND APPROVALS

The table below lists an update to the potential Permits and Approvals Required for Construction and Operation of the Proposed Facility.

Agency	Type of Approval	Status*	Need and Further Details
Federal Approvals			
U.S. Army Corps of Engineers	Nationwide Permit	3	Wetland delineation was completed May 2013. Thunder Spirit has committed to no permanent impacts. If temporary impacts cannot be avoided, proper permits and notifications will be obtained/made.
Federal Aviation Administration	Determination of No Hazard to Air Navigation - Notice and approval are required for structures over 200 feet in height. FAA approval of lighting and marking of turbines is required.	1	Awaiting final FAA evaluation.
State of North Dakota			
Public Service Commission	Certificate of Site Compatibility	1	In process
North Dakota State Historic Preservation Office	Concurrence on results of Cultural Resources Inventory	1	Class I, Class II, and Class III surveys were completed May 2013; report submitted to SHPO for review. See attached concurrence letters.
North Dakota Department of Health	NPDES Permit: General Construction Storm Water	2	Will be prepared by Thunder Spirit or their contractor.
North Dakota Highway Patrol	Overheight/ Overweight Permit	2	Will be prepared by Thunder Spirit or their contractor.
North Dakota Department of Transportation	Road Approach/Access Permit	3	Will be prepared by Thunder Spirit or their contractor if necessary.
	Utility Permit/Risk Management Documents	3	Will be prepared by Thunder Spirit or their contractor if necessary.
Local Permits			
Adams County	Wind Energy Facility Siting Permit	1	Permit granted on September 9, 2013. Will forward once received.
	Building Permits	1	Permit granted. Adams County has determined that a single building permit will be issued for the entire proposed facility.
* Status Explanation: 1 Applied and/or Decision Pending 2 Will Apply Once Certificate is Received 3 Final Layout will Determine Whether Permit/Approval is Needed			

FIGURES













Revised Figure 3

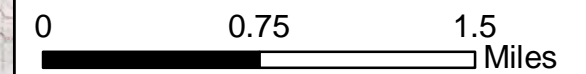
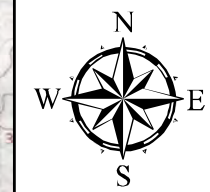
Project Area (Topographical)

Thunder Spirit Wind Energy Project
Thunder Spirit Wind, LLC
Adams County, North Dakota

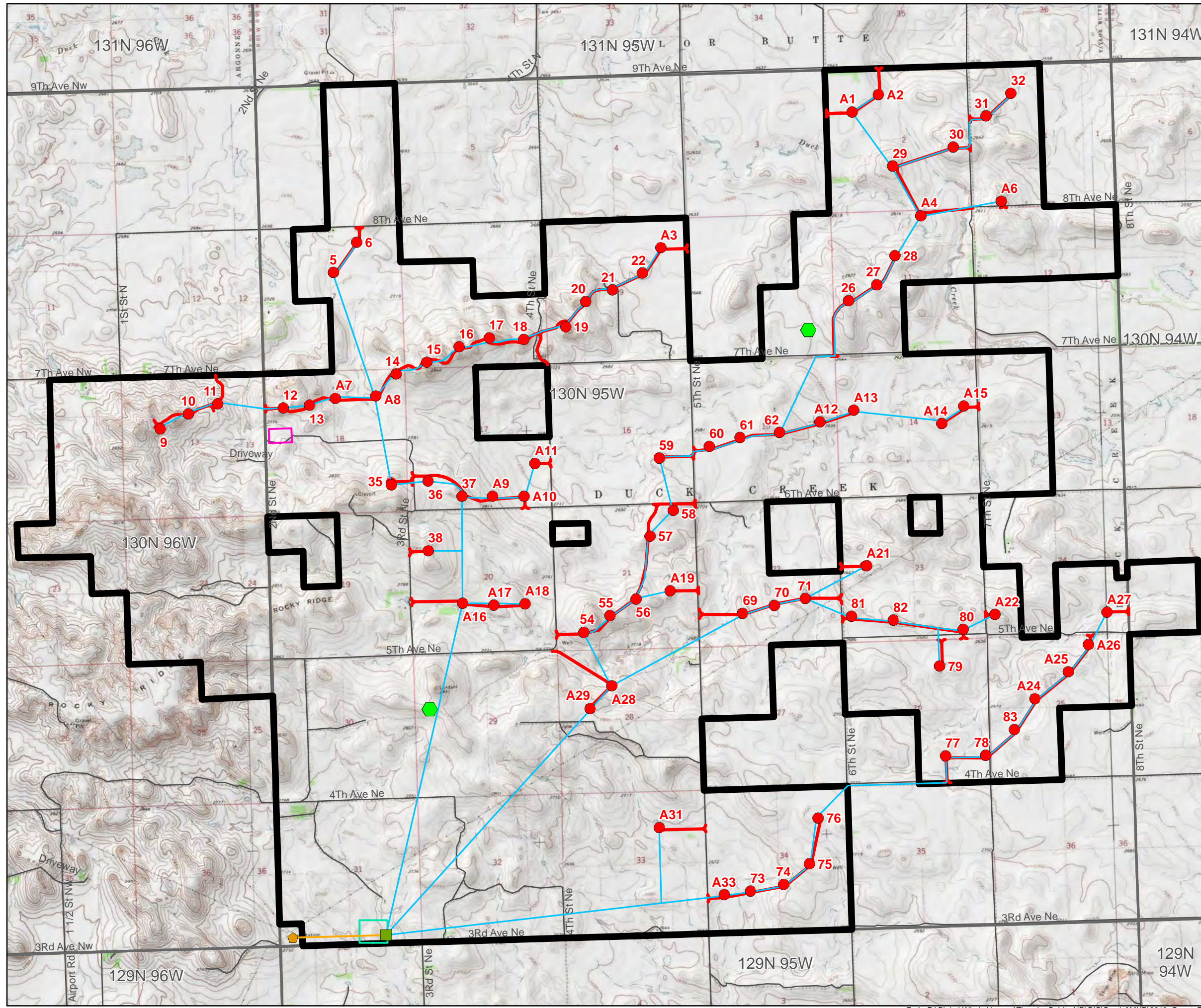
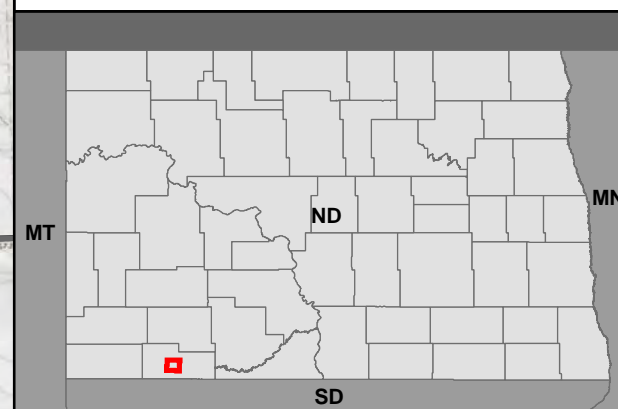
August 2013

Legend

-  Met Tower Location
-  Approximate POI
-  Proposed Turbine Location (8/15/2013)
-  Proposed Collector Substation (8/15/2013)
-  Overhead Line (4/8/2013)
-  Collection Line (8/15/2013)
-  Access Road (8/15/2013)
-  Construction Laydown Area (10 Acres)
-  Collection Substation, O&M Facility, and Additional Laydown Area
-  Wind Energy Facility Perimeter
-  Township Boundary
-  Road



REFERENCE MAP



Exclusion Areas

Prime Farmland

Avoidance Areas

Abandoned Mine

NWI Wetland

Native Prairie

Native Prairie

Native Prairie/Hayfields

NOTE: FEMA Special Flood Hazard Areas (avoidance area) data not available in this area of North Dakota.
NOTE: Archeological sites (exclusion area) not depicted.

Revised Figure 5

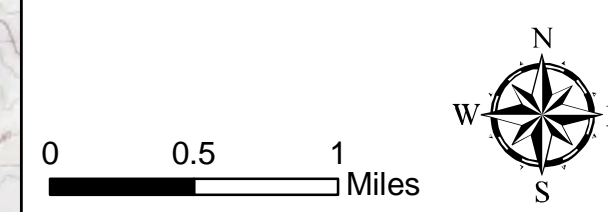
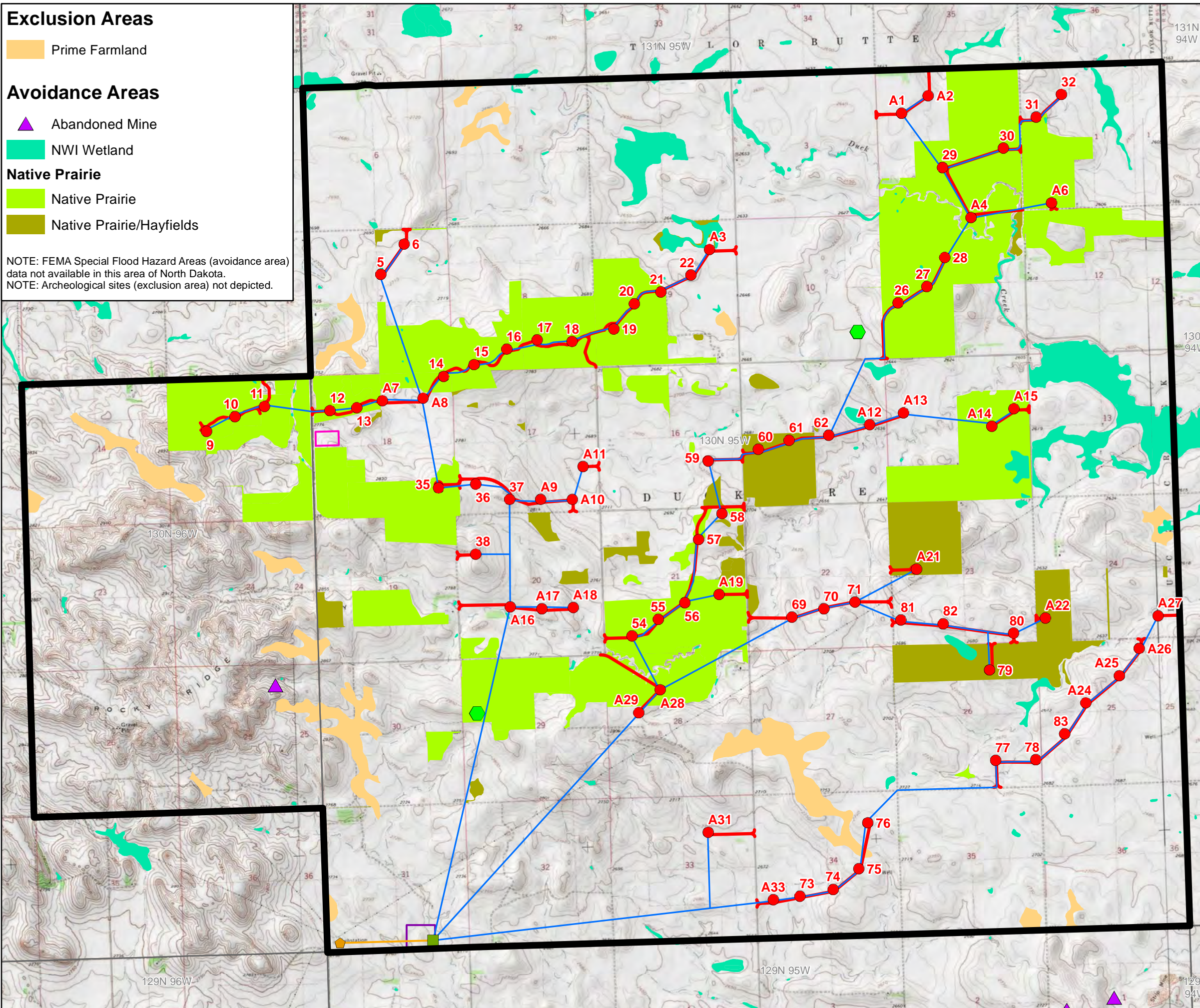
Exclusion and Avoidance Areas

Thunder Spirit Wind Energy Project
Thunder Spirit Wind, LLC
Adams County, North Dakota

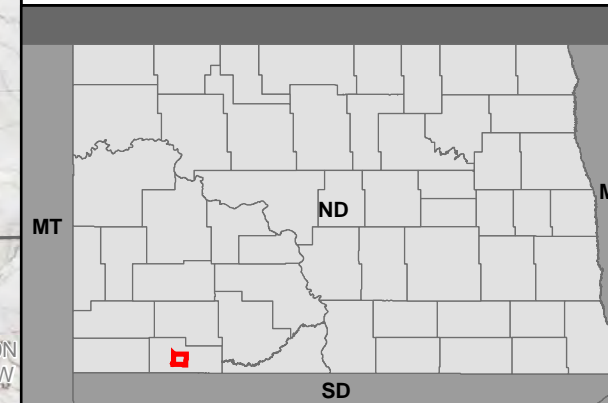
September 2013

Legend

- Proposed Turbine Location (8/15/2013)
- ◆ Met Tower Location
- ▲ Approximate POI
- Proposed Collector Substation (8/15/2013)
- Overhead Line (4/8/2013)
- Collection Line (8/15/2013)
- Access Road (8/15/2013)
- Construction Laydown Area (10 Acres)
- Collection Substation, O&M Facility, and Additional Laydown Area
- ▭ Project Area
- ▭ Township Boundary



REFERENCE MAP



Revised Figure 17

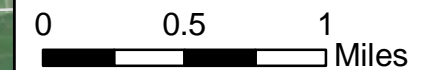
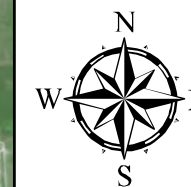
Residential Receptor Distances
to Closest Wind Turbine

Thunder Spirit Wind Energy Project
Thunder Spirit Wind, LLC
Adams County, North Dakota

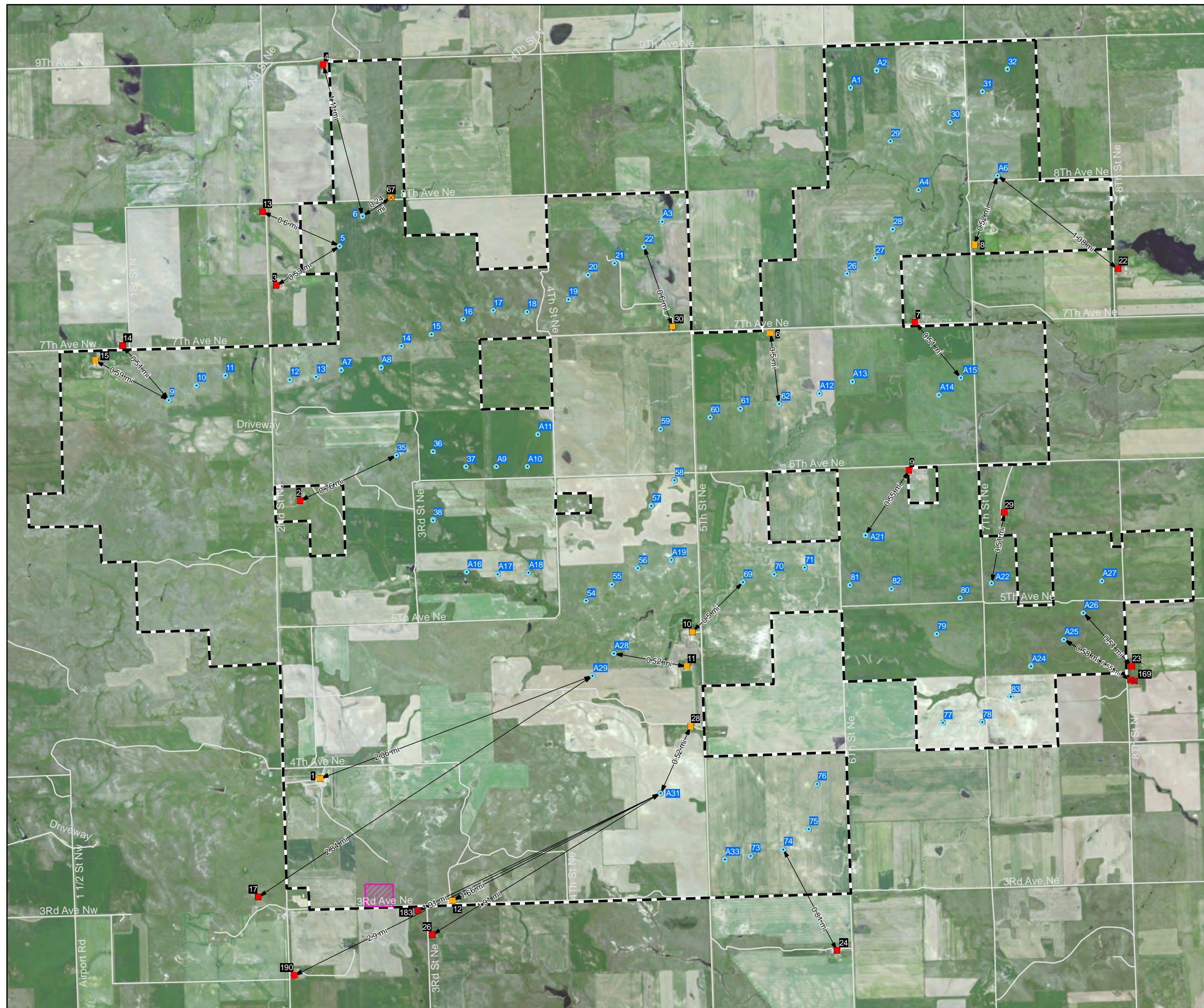
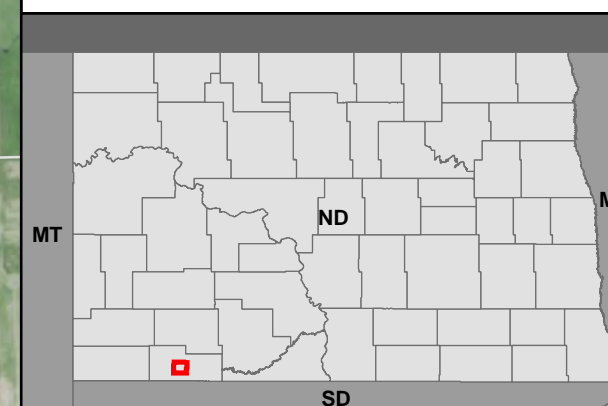
August 2013

Legend

- Proposed Turbine Location (8/15/2013)
- Signed Easement (Occupied)
- Signed Easement (Abandoned)
- Not Signed (Occupied)
- Not Signed (Abandoned)
- Distance Dimension (Residence to nearest turbine)
- Collector Substation Construction Footprint (20 Acres)
- Wind Energy Facility Perimeter
- Road



REFERENCE MAP

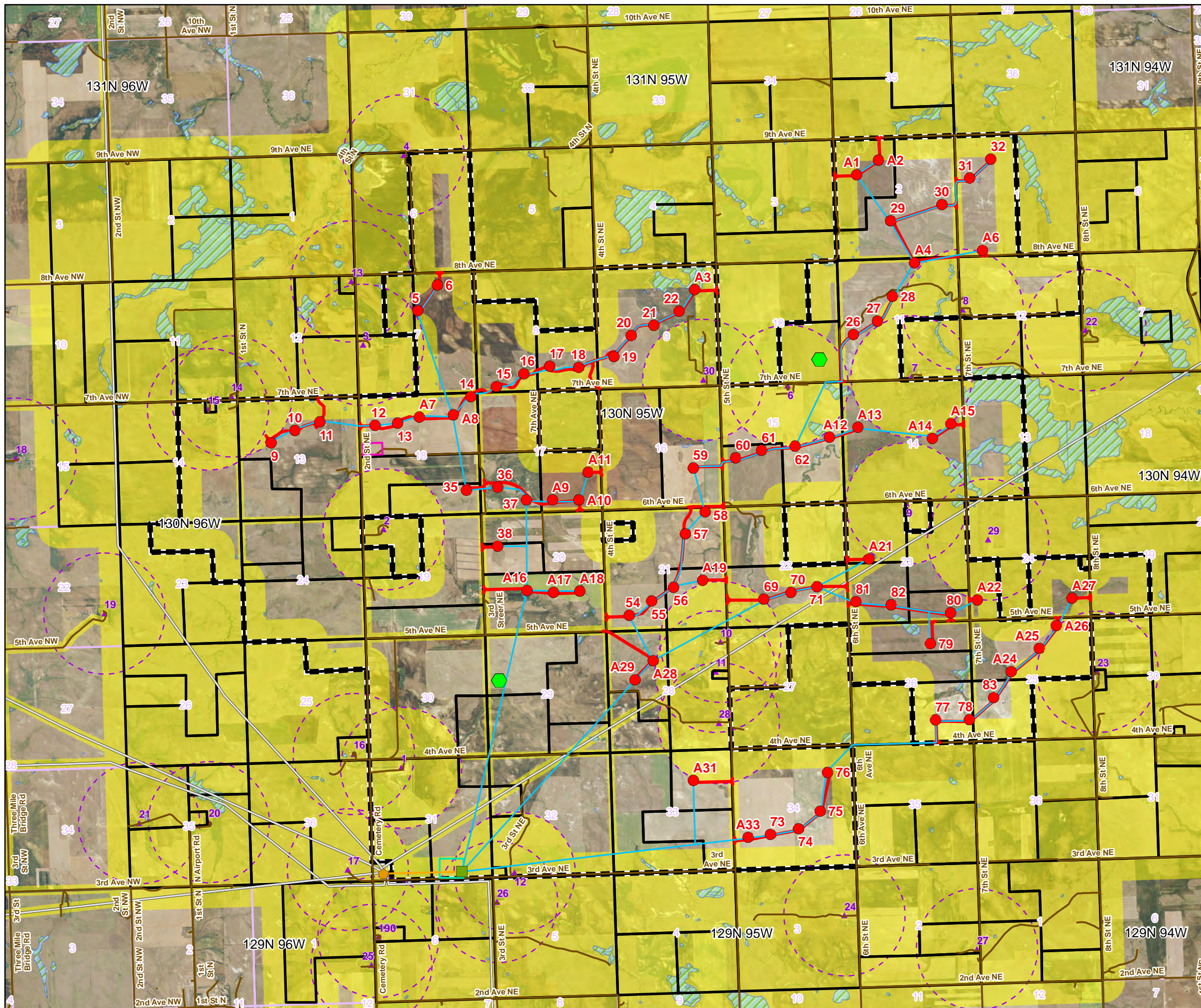


Revised Figure 18

Project Layout with
Adams County Zoning Setbacks

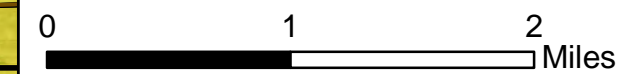
Thunder Spirit Wind Energy Project
Thunder Spirit Wind, LLC
Adams County, North Dakota

August 2013

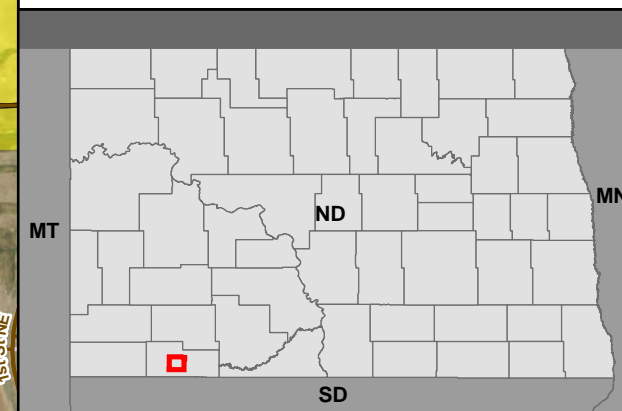


Legend

- Met Tower Location
- Approximate POI
- Proposed Turbine Location (8/15/2013)
- Proposed Collector Substation (8/15/2013)
- Overhead Line (4/8/2013)
- Collection Line (8/15/2013)
- Access Road (8/15/2013)
- Construction Laydown Area (10 Acres)
- Collection Substation, O&M Facility, and Additional Laydown Area
- Existing Road
- Existing Transmission Line
- Parcel Boundary
- PLSS Township
- PLSS Section Boundary
- Occupied Residence
- Occupied Residence Buffer (0.5 miles)
- Wind Energy Facility Perimeter
- NWI Wetland
- Setbacks (See Table 3 in County Application)



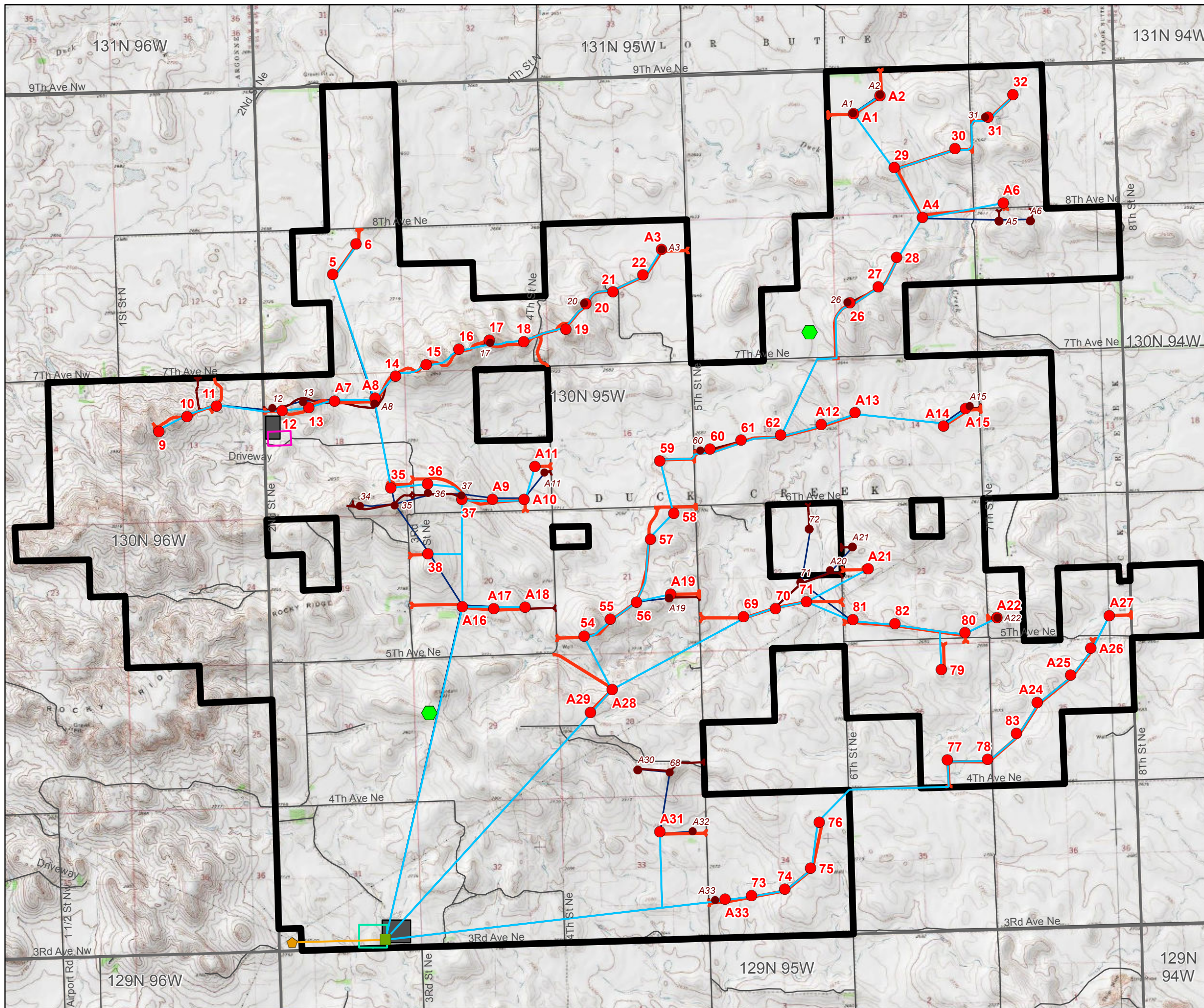
REFERENCE MAP



Layout Comparison
4/26/13 vs 8/15/13

Thunder Spirit Wind Energy Project
Thunder Spirit Wind, LLC
Adams County, North Dakota

August 2013



4/26/13 Layout

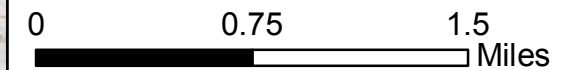
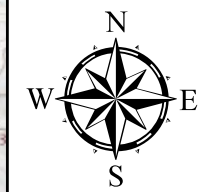
- Shifted/Eliminated 4/26/13 Turbine
- Collection Line (4/26/13)
- Access Road (4/26/13)
- Laydown Area/Substation/O&M Facility (4/26/13)

Revised 8/15/13 Layout

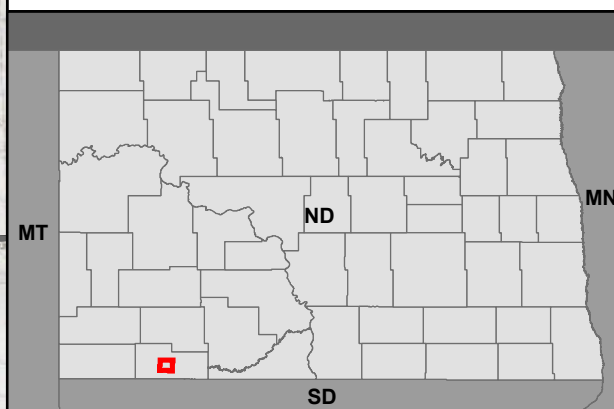
- Proposed Turbine Location (8/15/2013)
- Collection Line (8/15/2013)
- Access Road (8/15/2013)
- Construction Laydown Area (10 Acres)
- Collection Substation, O&M Facility, and Additional Laydown Area
- Wind Energy Facility Perimeter

Layout Features Unchanged since 4/26/13

- Overhead Line (4/8/2013)
- ◆ Met Tower Location
- ◆ Approximate POI
- Proposed Collector Substation (8/15/2013)
- Township Boundary
- Road



REFERENCE MAP



Appendix A
Studies and Assessments
Those that were revised or not submitted with Certificate

To: Global Winds Harvest Inc. and Thunder Spirit Wind, LLC
From: Tetra Tech, Inc.
Subject: Thunder Spirit Wind Farm –Revised Acoustic Modeling Analysis
Date: September 10, 2013

Global Winds Harvest Inc. and Thunder Spirit Wind, LLC (Thunder Spirit) are proposing to construct and operate the Thunder Spirit Wind Farm (the “Project”) in Adams County, North Dakota. Tetra Tech submitted an acoustic analysis on May 29, 2013 for a Project layout consisting of 85 wind turbine generators (WTGs) and a supporting collector substation. Since that time the Project layout was modified and reduced to 82 WTGs and an updated acoustic analysis was completed for the modified 82-WTG layout on August 6, 2013. The Project layout has now been further modified and reduced to 78 WTGs. The three candidate WTG types being considered for the Project remain the same as under the previous analysis. Tetra Tech evaluated the new Project layout configuration using the same methodology used in the May 29th submittal. This memo provides the results of this evaluation and an assessment of Project compliance with the U.S. Environmental Protection Agency (EPA) noise guidelines used in the previous analysis as well as the recently adopted state of North Dakota noise regulations for wind energy projects.

Applicable Noise Criteria

Tetra Tech completed a regulatory review that was summarized in the May 29th technical memo. This summary covered the Adams County Zoning Ordinance noise requirements and the EPA guidelines. The Adams County Zoning Ordinance prescribes a daytime and nighttime noise limit of 80 and 70 dBA, respectively. Recently adopted at the state level, North Dakota Chapter 69-06-08-01(4) specifies noise requirements:

“Additional avoidance areas for wind energy conversion facilities. A wind energy conversion facility site must not include a geographic area where, due to operation of the facility, the sound levels within one hundred feet of an inhabited residence or a community building will exceed fifty dBA. The sound level avoidance area criteria may be waived in writing by the owner of the occupied residence or the community building.”

The previously referenced EPA noise guidelines are slightly more conservative than the North Dakota regulations; therefore, adherence to the EPA thresholds, or received sound levels of no more than 48.6 dBA L_{eq} at noise sensitive receptors (NSRs), also results in compliance with the State’s noise regulations, or 50 dBA L_{eq} at NSRs.

Acoustic Model Results

Using the Project layout dated August 15, 2013, sound modeling was completed to address multiple operating scenarios; 1) cut-in (onset of WTG operation), 2) maximum rotation (full power), and 3) maximum rotation under anomalous meteorological conditions (i.e., full power during atypical conditions that affect long range propagation). Table 3 summarizes the number of NSRs within selected sound pressure level ranges under each of the identified operational conditions. The tabulated results are independent of the existing acoustic environment, (i.e. are representative of expected Project-generated sound levels only). In addition, in consideration of the North Dakota noise regulation, the analysis included a 100 foot buffer around each residential structure.

Table 3. Summary of Project Sound Levels at NSRs by WTG Model

Sound Level (dBA)	Number of NSRs Exceeding Sound Level Ranges								
	Acciona AW116/3000			Vestas V100 2.0			Siemens 2.3-108		
	Cut-in	Maximum	Maximum - Anomalous	Cut-in	Maximum	Maximum - Anomalous	Cut-in	Maximum	Maximum - Anomalous
> 50 North Dakota	0	0	0	0	0	0	0	0	0
> 48.6 EPA	0	1	2	0	0	1	0	0	2
>= 50	0	0	1	0	0	0	0	0	0
45 to 50	4	7	10	0	2	3	0	5	10
40 to 45	15	13	12	0	13	16	0	14	13
35 to 40	5	4	3	1	8	7	0	5	3
< 35	2	2	0	25	3	0	26	2	0

Table 3 presents the modeling results and indicates that received sound levels under maximum rotation and maximum rotation during anomalous events may potentially exceed the EPA 48.6 dBA guideline at one or more NSRs for each WTG model. There are no exceedances of the North Dakota noise regulation of the Adams County Zoning Ordinance noise limits. The EPA guidelines are just that, guidelines and not regulatory limits; however, the State's wind energy noise regulations require Project compliance. The EPA threshold exceedances are only provided for comparative purposes to the results in the May 29th memo. The Acciona WTG exhibited the worst case results, yielding the highest received sound levels at NSRs. With respect to the EPA guidelines, there were no exceedances at cut-in wind speed, 1 potential exceedance at maximum rotation and 2 potential exceedances at maximum rotation under anomalous meteorological conditions. However, these exceedances occurred at NSR IDs 67 and 183, which have both been identified as abandoned residences. With respect to the North Dakota regulation, all NSRs are in compliance. Attachment 1 presents the tabular results for the WTGs analyzed as well as sound contour figures for the WTGs analyzed at maximum rotation under anomalous meteorological conditions.

In conclusion, the acoustic modeling analysis, demonstrates the Project has been adequately designed inclusive of a number of conservative assumptions to generate sound levels below the EPA guidelines and North Dakota noise limit at all occupied non-participant NSRs.

ATTACHMENT 1

Tabulated Results and Sound Contour Figure

Received Sound Levels by NSR for each WTG Type

NSR ID	Receptor Type	Landowner Status	UTM Coordinates		Received Sound Level (dBA)								
			Easting (m)	Northing (m)	Acciona AW116/3000			Vestas V100-2.0			Siemens 2.3-108		
					Cut-in	Maximum	Anomalous Meteorological Conditions	Cut-in	Maximum	Anomalous Meteorological Conditions	Cut-in	Maximum	Anomalous Meteorological Conditions
1	Residence	Participant	684417	5101848	38.4	39.3	42.1	27.3	38.8	41.6	22.6	39.1	41.9
2	Residence	Non-Participant	684186	5105014	41.5	42.4	43.8	27.4	38.9	40.5	25.1	41.6	43.2
3	Residence	Non-Participant	683913	5107467	43.2	44.1	44.8	29.0	40.5	41.5	26.9	43.4	44.3
6	Residence	Participant	689550	5106924	45.0	45.9	46.7	31.0	42.5	43.5	28.8	45.3	46.2
7	Residence	Non-Participant	691200	5107045	44.9	45.8	46.4	30.9	42.4	43.1	28.6	45.1	45.9
8	Residence	Participant	691878	5107932	43.9	44.8	45.5	29.8	41.3	42.2	27.6	44.1	45.0
9	Residence	Non-Participant	691131	5105359	44.0	44.9	45.8	29.8	41.3	42.5	27.6	44.1	45.3
10	Residence	Participant	688659	5103520	45.6	46.5	47.1	31.5	43.0	43.8	29.2	45.7	46.6
11	Residence	Participant	688595	5103125	44.2	45.1	46.1	30.1	41.6	42.8	27.9	44.4	45.5
12	Residence	Participant	685925	5100457	38.7	39.6	42.3	27.6	39.1	41.8	22.9	39.4	42.1
13	Residence	Non-Participant	683758	5108307	40.4	41.3	42.4	26.3	37.8	39.1	24.1	40.6	41.8
14	Residence	Non-Participant	682164	5106780	41.3	42.2	42.8	27.3	38.8	39.5	25.1	41.6	42.3
15	Residence	Participant	681853	5106609	39.3	40.2	41.0	25.3	36.8	37.8	23.0	39.5	40.6
17	Residence	Non-Participant	683711	5100496	32.7	33.6	36.3	21.2	32.7	35.5	16.7	33.2	36.0
22	Residence	Non-Participant	693510	5107659	36.1	37.0	39.0	22.1	33.6	35.7	19.7	36.2	38.3
23	Residence	Non-Participant	693669	5103124	43.2	44.1	44.7	29.2	40.7	41.4	27.0	43.5	44.1
24	Residence	Non-Participant	690307	5099887	38.5	39.4	40.8	24.5	36.0	37.6	22.1	38.6	40.2
26	Residence	Non-Participant	685692	5100065	43.1	44.0	46.7	32.4	43.9	46.7	27.5	44.0	46.7
28	Residence	Participant	688638	5102441	42.9	43.8	44.9	28.8	40.3	41.7	26.5	43.0	44.4
29	Residence	Non-Participant	692214	5104878	43.2	44.1	45.1	29.1	40.6	41.8	26.9	43.4	44.5
30	Residence	Participant	688431	5107000	44.5	45.4	46.3	30.3	41.8	42.9	28.1	44.6	45.7
67	Residence - Abandoned	Participant	685223	5108470	48.3	49.2	49.5	34.0	45.5	45.8	31.9	48.4	48.7
166	Residence - Abandoned	Non-Participant	693657	5102971	42.5	43.4	44.1	28.5	40.0	40.9	26.2	42.7	43.6
169	Residence - Abandoned	Non-Participant	693696	5102962	42.1	43.0	43.8	28.1	39.6	40.6	25.9	42.4	43.3
183	Residence - Abandoned	Non-Participant	685531	5100343	46.6	47.5	50.0	36.0	47.5	49.9	31.0	47.5	49.9
190	Residence	Non-Participant	684117	5099602	32.6	33.5	36.3	21.4	32.9	35.8	16.8	33.3	36.1

Figure 1. Received Sound Levels –Acciona AW116/3000 WTG at Maximum Rotational Wind Speed under Anomalous Conditions

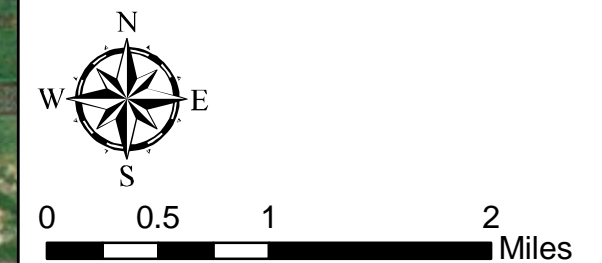
Figure 1

Received Sound Levels:
Acciona AW116/3000 WTG at
Maximum Rotational Wind Speed
under Anomalous Conditions
Thunder Spirit Wind Energy Project
Thunder Spirit Wind, LLC
Adams County, North Dakota

September 2013

Legend

- Proposed Turbine Location (8/15/2013)
- Collector Substation Construction Footprint (20 Acres)
- Project Area
- Isopleth Ranges (dBA)**
 - 35 - 40
 - 40 - 45
 - 45 - 50
 - 50 - 55
 - > 55
- Isopleth Range Exceeding EPA Guideline (>48.6 dBA)
- Receptor**
 - Signed Easement (Occupied)
 - Signed Easement (Abandoned)
 - Not Signed (Occupied)
 - Not Signed (Abandoned)



REFERENCE MAP

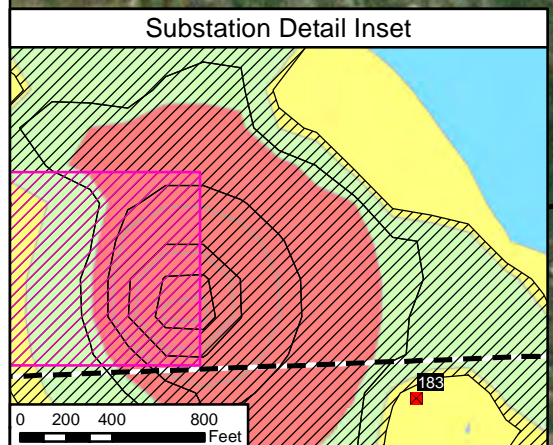
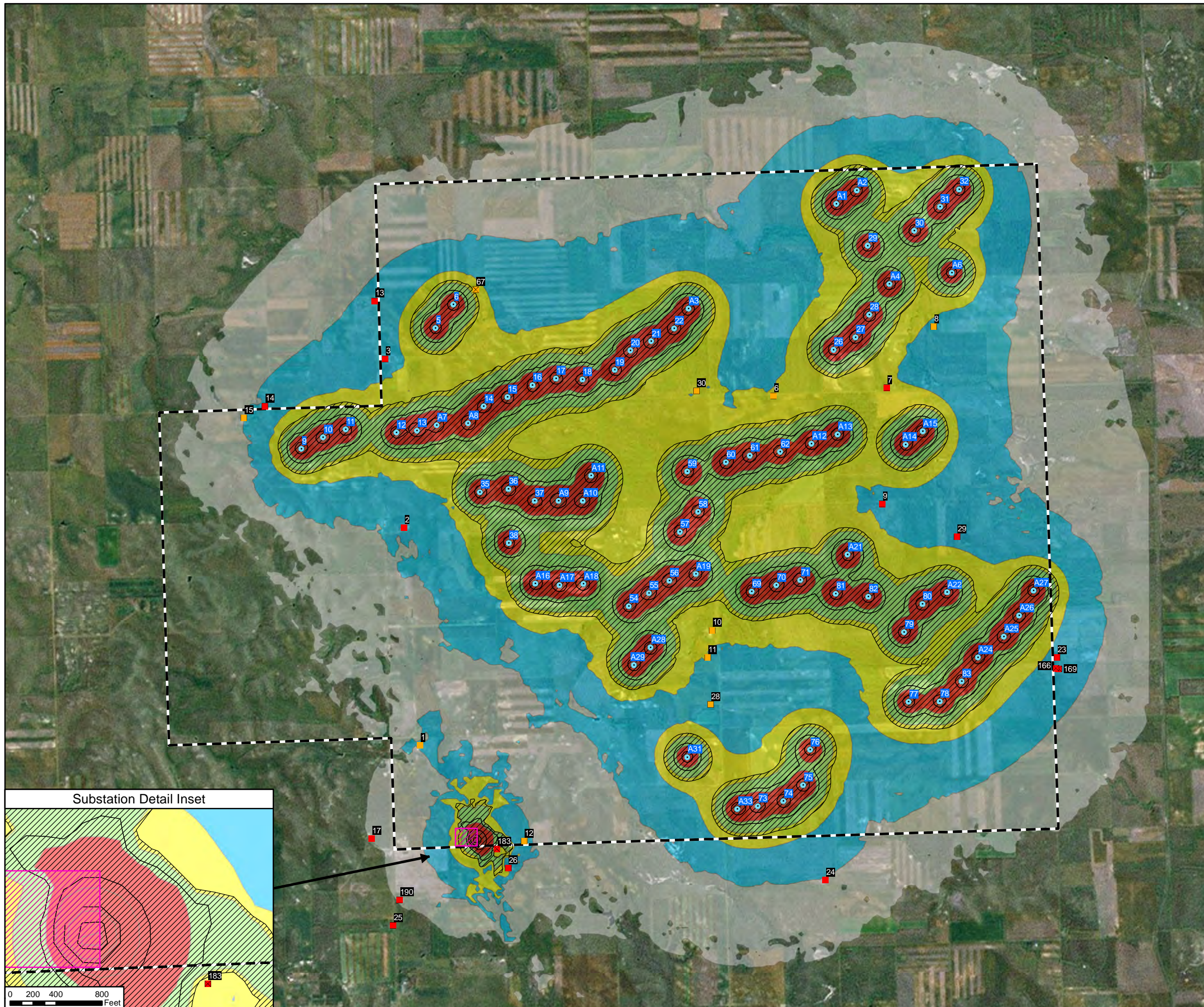
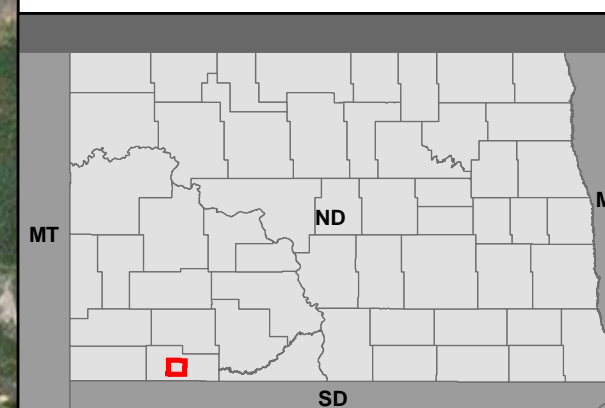















Figure 2. Received Sound Levels – Vestas V100-2.0MW WTG at Maximum Rotational Wind Speed under Anomalous Conditions

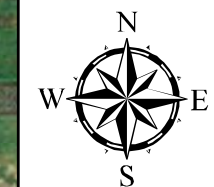
Figure 2

Received Sound Levels:
Vestas V100-2.0MW WTG at
Maximum Rotational Wind Speed
under Anomalous Conditions
Thunder Spirit Wind Energy Project
Thunder Spirit Wind, LLC
Adams County, North Dakota

September 2013

Legend

-  Proposed Turbine Location (8/15/2013)
-  Collector Substation Construction Footprint (20 Acres)
-  Project Area
- Isopleth Ranges (dBA)**
 -  35 - 40
 -  40 - 45
 -  45 - 50
 -  50 - 55
 -  > 55
-  Isopleth Range Exceeding EPA Guideline (>48.6 dBA)
- Receptor**
 -  Signed Easement (Occupied)
 -  Signed Easement (Abandoned)
 -  Not Signed (Occupied)
 -  Not Signed (Abandoned)



REFERENCE MAP

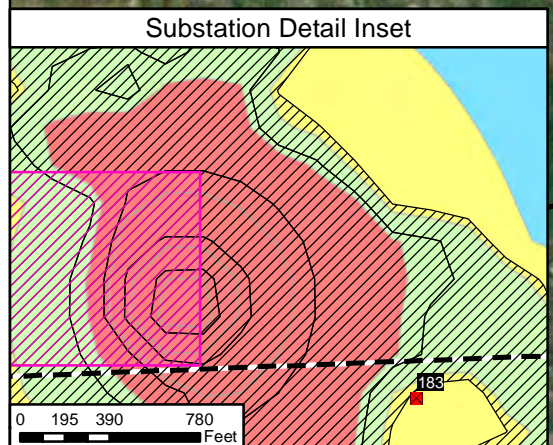
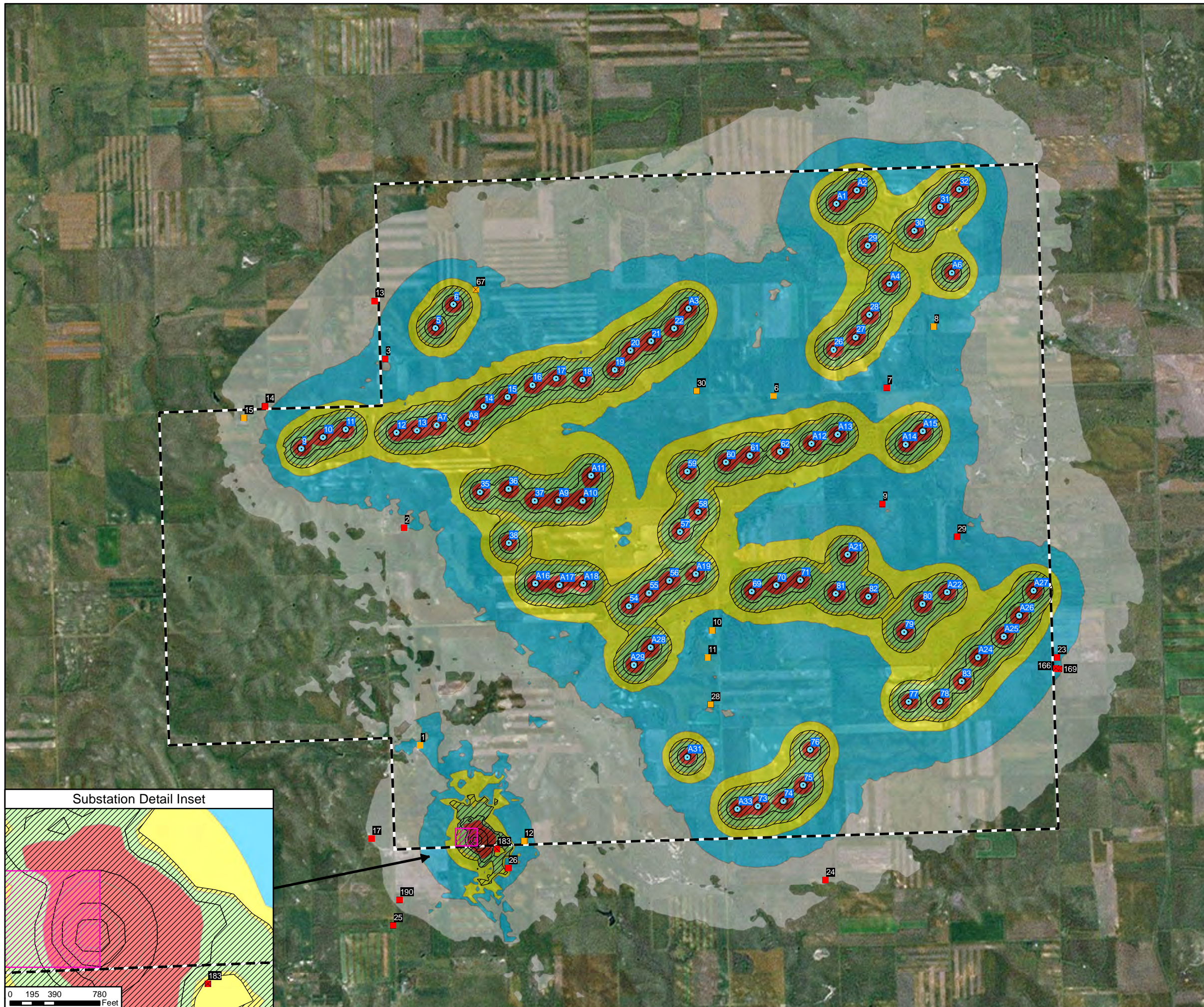
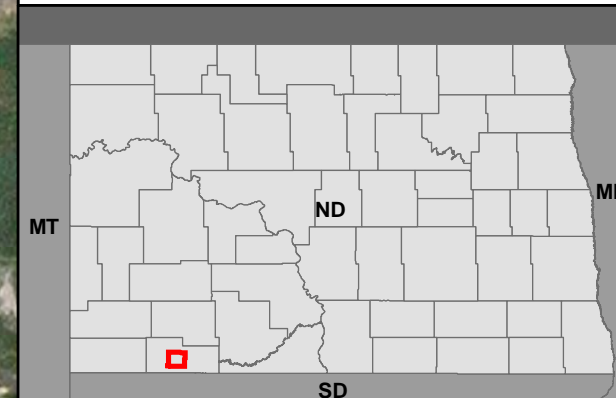


Figure 3. Received Sound Levels – Siemens 2.3-108 WTG at Maximum Rotational Wind Speed under Anomalous Conditions

Figure 3

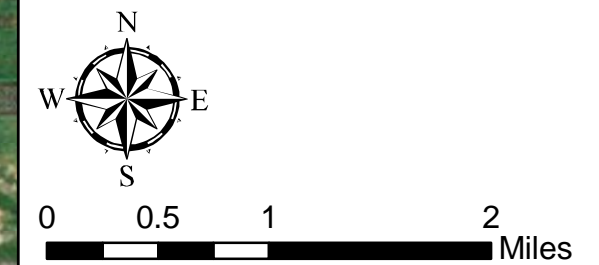
Received Sound Levels:
Siemens 2.3-108 WTG at
Maximum Rotational Wind Speed
under Anomalous Conditions

Thunder Spirit Wind Energy Project
Thunder Spirit Wind, LLC
Adams County, North Dakota

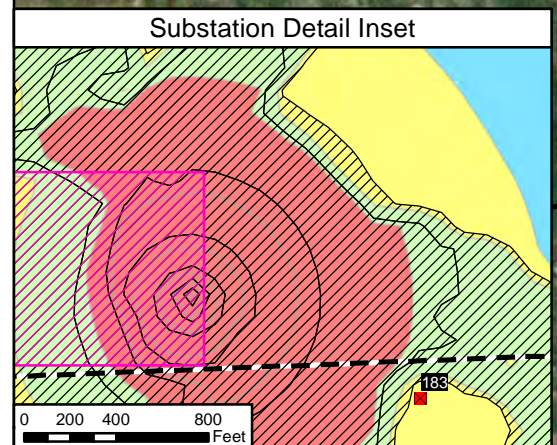
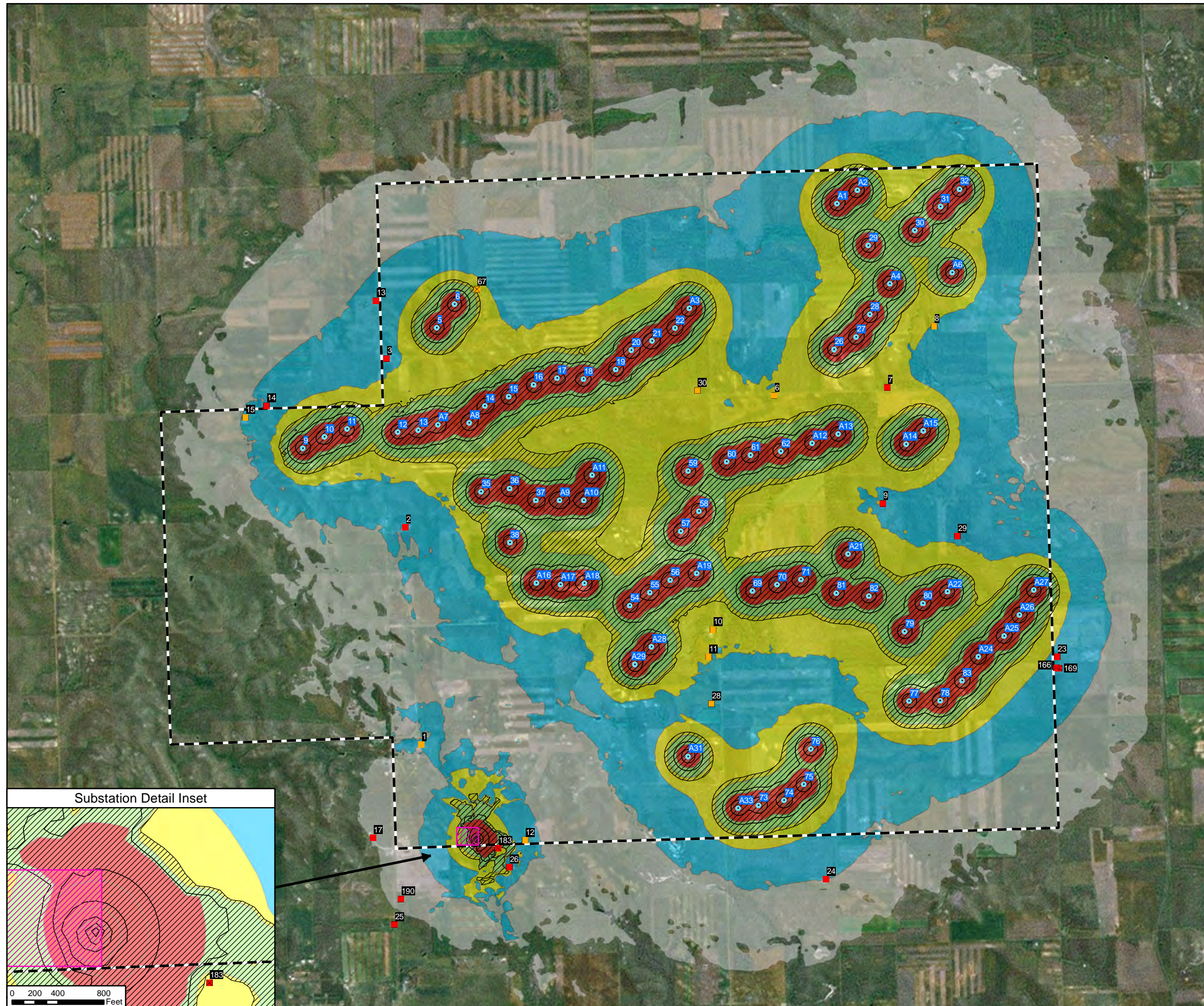
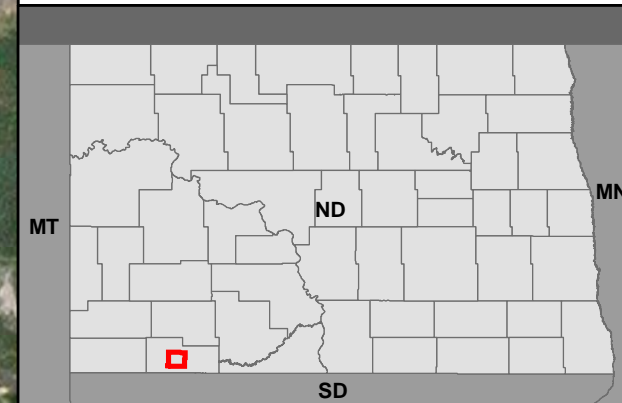
September 2013

Legend

- Proposed Turbine Location (8/15/2013)
 - Collector Substation Construction Footprint (20 Acres)
 - Project Area
- Isopleth Ranges (dBA)**
- 35 - 40
 - 40 - 45
 - 45 - 50
 - 50 - 55
 - > 55
- Isopleth Range Exceeding EPA Guideline (>48.6 dBA)
- Receptor**
- Signed Easement (Occupied)
 - Signed Easement (Abandoned)
 - Not Signed (Occupied)
 - Not Signed (Abandoned)



REFERENCE MAP



**Shadow Flicker Impact Analysis
for the
Thunder Spirit Wind Energy Project**
Adams County, North Dakota

Prepared for



Thunder Spirit Wind, LLC
103 Front Street
Schenectady, New York 12305

Prepared by



Tetra Tech, Inc.
160 Federal Street – 3rd Floor
Boston, Massachusetts 02110

May 2013
Revised September 2013

TABLE OF CONTENTS

1.0	OVERVIEW	1
2.0	WINDPRO SHADOW FLICKER ANALYSIS	3
3.0	SHADOW FLICKER ANALYSIS RESULTS.....	4
4.0	CONCLUSION	6
5.0	REFERENCES.....	7

TABLES

Table 1A.	WindPro Predicted Shadow Flicker Impacts for Receptors with Maximum Expected Impacts – Turbine Scenario A (78 Vestas V100 2.0 Turbines)	4
Table 1B.	WindPro Predicted Shadow Flicker Impacts for Receptors with Maximum Expected Impacts – Turbine Scenario B (78 Siemens SWT 2.3-108 Turbines)	5
Table 1C.	WindPro Predicted Shadow Flicker Impacts for Receptors with Maximum Expected Impacts – Turbine Scenario C (78 Acciona AW116/3000 Turbines)	5
Table 2A.	Statistical Summary of WindPro Predicted Shadow Flicker Impacts at Modeled Receptor Locations – Turbine Scenario A (78 Vestas V100 2.0 Turbines)	5
Table 2B.	Statistical Summary of WindPro Predicted Shadow Flicker Impacts at Modeled Receptor Locations – Turbine Scenario B (78 Siemens SWT 2.3-108 Turbines).....	6
Table 2C.	Statistical Summary of WindPro Predicted Shadow Flicker Impacts at Modeled Receptor Locations – Turbine Scenario C (78 Acciona AW116/3000Turbines)	6

FIGURES

Figure 1.	Receptors Modeled with WindPro to Predict Potential Shadow Flicker Impacts.....	8
Figure 2A.	WindPro Predicted Expected Shadow Flicker Impact Areas – Turbine Scenario A (78 Vestas V100 2.0 Turbines)	9
Figure 2B.	WindPro Predicted Potential Shadow Flicker Impact Areas – Turbine Scenario B (78 Siemens SWT 2.3-108 Turbines).....	10
Figure 2C.	WindPro Predicted Potential Shadow Flicker Impact Areas – Turbine Scenario C (78 Acciona AW116/3000 Turbines)	11

ATTACHMENT

Attachment A.	Detailed Summary of WindPro Shadow Flicker Analysis Results	
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1.0 OVERVIEW

A wind turbine's moving blades can cast a moving shadow on locations within a certain distance of a turbine. These moving shadows are called shadow flicker, and can be a temporary phenomenon experienced at nearby residences or public gathering places. The impact area depends on the time of year and day (which determine the sun's azimuth and altitude angles) and the wind turbine's physical characteristics (height, rotor diameter, blade width, and orientation of the rotor blades). Shadow flicker generally occurs during low angle sunlight conditions, typically during sunrise and sunset times of the day. However, when the sun angle gets very low (less than 3 degrees), sunlight passes through more atmosphere and becomes too diffused to form a coherent shadow. Shadow flicker will not occur when the sun is obscured by clouds or fog, at night, or when the source turbine(s) are not operating.

Shadow flicker intensity is defined as the difference in brightness at a given location in the presence and absence of a shadow. Shadow flicker intensity diminishes with greater receptor-to-turbine separation distance. Shadow flicker intensity for receptor-to-turbine distances beyond 2,000 meters (6,562 feet) is very low and generally considered imperceptible. In general, increasing proximity to turbines may make shadow flicker more noticeable, with the largest number of shadow flicker hours, along with greatest shadow flicker intensity, occurring nearest the wind turbines.

Thunder Spirit Wind, LLC (Thunder Spirit), an affiliate of Global Winds Harvest, Inc., is proposing to install up to 75 wind turbines with a maximum nameplate capacity of 150 MW (the number of turbines depending on the size of turbine used) as part of the Thunder Spirit Wind Energy Project (the Project) in Adams County, North Dakota. Because the Project is using a minimum turbine siting setback requirement of 2,640 feet (805 meters) to all occupied residences, the most sensitive receptors (potentially occupied non-participating residences) are generally not located in potential shadow flicker impact zones.

The three wind turbine models being considered for the Project, and evaluated for potential shadow flicker impacts, have the following characteristics:

- **Vestas V100 2.0** – 3-blade 100-meter diameter rotor, with a hub height of 80 meters. The Vestas V100 2.0 has a normal high rotor speed of 14.9 rotations per minute (rpm) which translates to a blade pass frequency of 0.7 Hertz (Hz) which is less than 1 alternation per second. Although 78 Vestas turbines are included in this impact analysis to account for alternate locations that may be used, a maximum of 75 of these turbines will be constructed.
- **Siemens Energy, Inc. (Siemens) SWT 2.3-108** – 3-blade 108-meter diameter rotor, with a hub height of 80 meters. The Siemens SWT 2.3-108 has a normal high rotor speed of 16 rpm which translates to a blade pass frequency of 0.8 Hz (less than 1 alternation per second). Although 78 Siemens turbines are included in this impact analysis to account for alternate locations that may be used, a maximum of 65 of these turbines will be constructed.

- **Acciona AW116/3000** – 3-blade 116-meter diameter rotor, with a hub height of 92 meters. The Acciona AW116/3000 has a normal high rotor speed of 15.6 rpm which translates to a blade pass frequency of 0.8 Hz (less than 1 alternation per second). Although 78 Acciona turbines are included in this impact analysis to account for alternate locations that may be used, a maximum of 50 of these turbines will be constructed.

The project layout has been designed so that any of the three turbine models can be sited within the 78 locations. Because the layout has not been finalized, the shadow flicker impact analysis considered all 78 turbines, which represents 3 to 28 more turbines than will be constructed for the three scenarios.

Shadow flicker frequency is related to the wind turbine's rotor blade speed and the number of blades on the rotor. From a health standpoint, the low flicker frequencies associated with wind turbines, are harmless. For comparison, strobe lights used in discotheques have frequencies which range from about 3 Hz to 10 Hz (1 Hz = 1 flash per second). As a result, public concerns that flickering light from wind turbines can have negative health effects, such as triggering seizures in people with epilepsy are unfounded. Epilepsy Action (working name for the British Epilepsy Foundation) states that there is no evidence that wind turbines can cause seizures (Epilepsy Action 2008). However, they recommend that wind turbine flicker frequency be limited to 3 Hz. Since the proposed Project's wind turbine blade pass frequency is approximately 0.7-0.8 Hz (less than 1 alternation per second), no negative health effects to individuals with photosensitive epilepsy are anticipated.

Shadow flicker impacts are not regulated in applicable state or federal law, and there is no permitting threshold with regard to hours per year of anticipated impacts to a receptor from a wind energy project. Due to the significant growth of the wind energy industry in recent years, some states have published model bylaws for local governments to adopt or modify at their own discretion which sometimes include guidance and recommendations for shadow flicker levels and mitigation. In lieu of specific regulations, a general precedent has been established in the industry both abroad and in the United States that fewer than 30 hours per year of shadow flicker impacts is acceptable to receptors in terms of nuisance and well below health hazard concerns. In a German court case, for example, a judge found 30 hours of actual shadow flicker per year at a certain neighbor's property to be tolerable (WindPower 2003). The 30 hours per year threshold value has been widely used in the industry as a target value in the absence of formal guidelines. However, predicted shadow flicker greater than this threshold does not necessarily create a nuisance and is still well below concerns for impacts to health.

2.0 WINDPRO SHADOW FLICKER ANALYSIS

An analysis of potential shadow flicker impacts from the Project was conducted using the WindPro software package. The turbine array provided by Thunder Spirit (layout dated August 15, 2013), which includes 78 turbines, was included in the analysis. The analysis evaluated the following three turbine scenarios:

- Scenario A – 78 Vestas V100 2.0 turbines (only 75 of these turbines would be constructed)
- Scenario B – 78 Siemens SWT 2.3-108 turbines (only 65 of these turbines would be constructed)
- Scenario C – 78 Acciona AW116/3000 turbines (only 50 of these turbines would be constructed)

The WindPro analysis was conducted to determine shadow flicker impacts under realistic impact conditions (actual expected shadow). This analysis calculated the total amount of time (hours and minutes per year) that shadow flicker could occur at receptors out to one mile (5,280 feet). The realistic impact condition scenario is based on the following assumptions:

- The elevation and position geometries of the wind turbines and surrounding receptors (potentially occupied residences). Elevations were determined using United States Geological Survey (USGS) digital elevation model (DEM) data. Positions geometries were determined using geographic information system (GIS) and referenced to Universal Transverse Mercator (UTM) Zone 13 (NAD83).
- The position of the sun and the incident sunlight relative to the wind turbine and receptors on a minute-by-minute basis over the course of a year.
- Historical sunshine availability (percent of total hours available). Historical sunshine rates for the area (as summarized by the National Climatic Data Center (NCDC 2008) for nearby Bismarck, North Dakota) used in this analysis are as follows:

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
53%	53%	58%	58%	61%	64%	73%	72%	65%	58%	43%	47%

- Estimated wind turbine operations and orientation (based on approximately 1 year of wind data from June 2011 through May 2012 (wind speed / wind direction frequency distribution) measured at on-site meteorological towers).
- Receptor viewpoints (i.e., house windows) are assumed to always be directly facing turbine to sun line of sight (“greenhouse mode”).

WindPro incorporates terrain elevation contour information and the analysis accounts for terrain elevation differences. The sun’s path with respect to each turbine location is calculated by the software to determine the cast shadow paths every minute over a full year. Sun angles less than 3 degrees above the horizon were excluded, for the reasons identified earlier in this section.

It should be noted however, that WindPro provides a conservative estimate of shadow flicker as obstacles such as trees, haze, and visual obstructions (window facing, coverings) are not fully accounted despite the likelihood of their reducing or eliminating shadow flicker impacts to receptors. A total of 26 receptor locations (potentially occupied residences) were identified within one mile of proposed Project turbines. A receptor in the model is defined as a 1 meter squared area (approximate size of a typical window), 1 meter (3.28 feet) aboveground level. Approximate eye level is set at 1.5 meters (4.94 feet). Figure 1 shows the receptor locations and proposed Project turbines considered for Scenarios A, B, and C.

3.0 SHADOW FLICKER ANALYSIS RESULTS

As expected, WindPro predicts that shadow flicker impacts will be greatest at locations nearer to the wind turbines. Figures 2A, 2B, and 2C describe the WindPro predicted shadow flicker impact areas for turbine Scenarios A, B, and C, respectively. A detailed WindPro shadow flicker analysis summary, for each of the modeled receptor location, is provided in Attachment A. Tables 1A, 1B, and 1C present the WindPro predicted shadow flicker impacts for the top ten worst case receptors for turbine Scenarios A, B, and C, respectively. Considering all turbine scenarios, only 1 of the 26 receptors modeled had expected shadow flicker impacts of more than 30 hours per year which was an abandoned structure. The maximum predicted shadow flicker impact at a receptor is 36 hours 0 minutes per year (Receptor 67), which is approximately 0.8 percent of the potential available daylight hours. This is an abandoned structure on a participating landowner parcel.

Table 1A. WindPro Predicted Shadow Flicker Impacts for Receptors with Maximum Expected Impacts – Turbine Scenario A (78 Vestas V100 2.0 Turbines)

Receptor ID*	Receptor Description	Shadow Hours per Year (expected) [hh:mm / year]
67	Abandoned/Participating	26:54
23	Non-participating Receptor	16:40
10	Non-participating Receptor	11:48
14	Participating Landowner	9:07
11	Non-participating Receptor	8:36
8	Participating Landowner	8:34
15	Participating Landowner	7:55
28	Participating Landowner	7:13
30	Non-participating Receptor	7:12
7	Non-participating Receptor	6:44

Table 1B. WindPro Predicted Shadow Flicker Impacts for Receptors with Maximum Expected Impacts – Turbine Scenario B (78 Siemens SWT 2.3-108 Turbines)

Receptor ID*	Receptor Description	Shadow Hours per Year (expected) [hh:mm / year]
67	Abandoned/Participating	30:26
23	Non-participating Receptor	19:05
10	Non-participating Receptor	11:02
14	Participating Landowner	10:55
11	Non-participating Receptor	9:42
8	Participating Landowner	8:14
15	Participating Landowner	7:57
7	Non-participating Receptor	7:24
28	Participating Landowner	6:55
13	Non-participating Receptor	6:48

Table 1C. WindPro Predicted Shadow Flicker Impacts for Receptors with Maximum Expected Impacts – Turbine Scenario C (78 Acciona AW116/3000 Turbines)

Receptor ID*	Receptor Description	Shadow Hours per Year (expected) [hh:mm / year]
67	Abandoned/Participating	36:00
23	Non-participating Receptor	25:20
10	Non-participating Receptor	18:00
14	Participating Landowner	17:05
30	Non-participating Receptor	13:55
11	Non-participating Receptor	13:01
8	Participating Landowner	12:10
15	Participating Landowner	11:19
7	Non-participating Receptor	10:29
13	Non-participating Receptor	10:21

The shadow flicker impact prediction statistics are summarized in Tables 2A, 2B, and 2C.

Table 2A. Statistical Summary of WindPro Predicted Shadow Flicker Impacts at Modeled Receptor Locations – Turbine Scenario A (78 Vestas V100 2.0 Turbines)

Cumulative Shadow Flicker Time (expected)	Number of Receptors
Total	26
= 0 Hours	9
> 0 Hours < 10 Hours	14
≥ 10 Hours < 20 Hours	2
≥ 20 Hours < 30 Hours	1
≥ 30 Hours	0

Table 2B. Statistical Summary of WindPro Predicted Shadow Flicker Impacts at Modeled Receptor Locations – Turbine Scenario B (78 Siemens SWT 2.3-108 Turbines)

Cumulative Shadow Flicker Time (expected)	Number of Receptors
Total	26
= 0 Hours	10
> 0 Hours < 10 Hours	12
≥ 10 Hours < 20 Hours	3
≥ 20 Hours < 30 Hours	0
≥ 30 Hours	1

Table 2C. Statistical Summary of WindPro Predicted Shadow Flicker Impacts at Modeled Receptor Locations – Turbine Scenario C (78 Acciona AW116/3000Turbines)

Cumulative Shadow Flicker Time (expected)	Number of Receptors
Total	26
= 0 Hours	8
> 0 Hours < 10 Hours	8
≥ 10 Hours < 20 Hours	8
≥ 20 Hours < 30 Hours	1
≥ 30 Hours	1

The slightly higher shadow flicker impacts for Scenario C (Acciona turbines), can be explained by the difference in turbine design specifications (i.e., its taller tower and longer blades). Note: Although 78 turbines were used in the model, only 50 of these turbines will actually be constructed.

4.0 CONCLUSION

The analysis of potential shadow flicker impacts from the Project on nearby receptors shows that shadow flicker impacts within the area of study are expected to be minor and well within acceptable ranges for avoiding nuisance and/or health hazards. The one receptor that exceeded the target of 30 hours per year under the most conservative conditions is an abandoned structure of a participating landowner. The analysis assumes that the receptors all have a direct in-line view of the incoming shadow flicker sunlight and does not account for trees or other obstructions which may block sunlight. In reality, the windows of many houses will not face the sun directly for the key shadow flicker impact times. Adding to the analysis' conservatism is that potential shadow flicker impacts for wind turbines up to one mile (5,280 feet) away from a receptor were determined, and Thunder Spirit will only construct 150 MW (i.e. not all 78 turbines modeled will be constructed). For these reasons, shadow flicker impacts are expected to be considerably less than estimated in this conservative analysis, and shadow flicker is not expected to be a significant environmental impact. Mitigation measures such as strategic vegetative screening and/or installation of curtains and blinds on the windows facing the turbine casting the shadows are effective and economically viable options that Thunder Spirit could consider on an individual basis with landowners, if necessary.

5.0 REFERENCES

Epilepsy Action. 2008. British Epilepsy Association.

http://www.epilepsy.org.uk/info/photo_other.html. Accessed 3/1/10.

National Climatic Data Center (NCDC). 2008. Sunshine Average Percent of Possible.

<http://www.ncdc.noaa.gov/oa/climate/online/ccd/pctpos.txt>. Accessed 3/1/10

WindPower. 2003. Danish Wind industry Association. Shadow Casting From Wind Turbines.

<http://guidedtour.windpower.org/en/tour/env/shadow/index.htm>, Accessed 4/28/10

FIGURES

Figure 1. Receptors Modeled with WindPro to Predict Potential Shadow Flicker Impacts








Figure 1

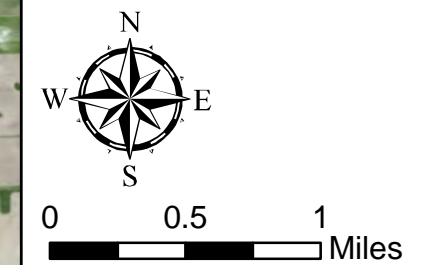
Residential Receptors Modeled
With WindPro to Predict Expected
Shadow Flicker Impacts

Thunder Spirit Wind Energy Project
Thunder Spirit Wind, LLC
Adams County, North Dakota

September 2013

Legend

-  Proposed Turbine Location (8/15/2013)
-  Collector Substation
Construction Footprint (20 Acres)
-  Project Area
- Receptor**
-  Signed Easement (Occupied)
-  Signed Easement (Abandoned)
-  Not Signed (Occupied)
-  Not Signed (Abandoned)



REFERENCE MAP

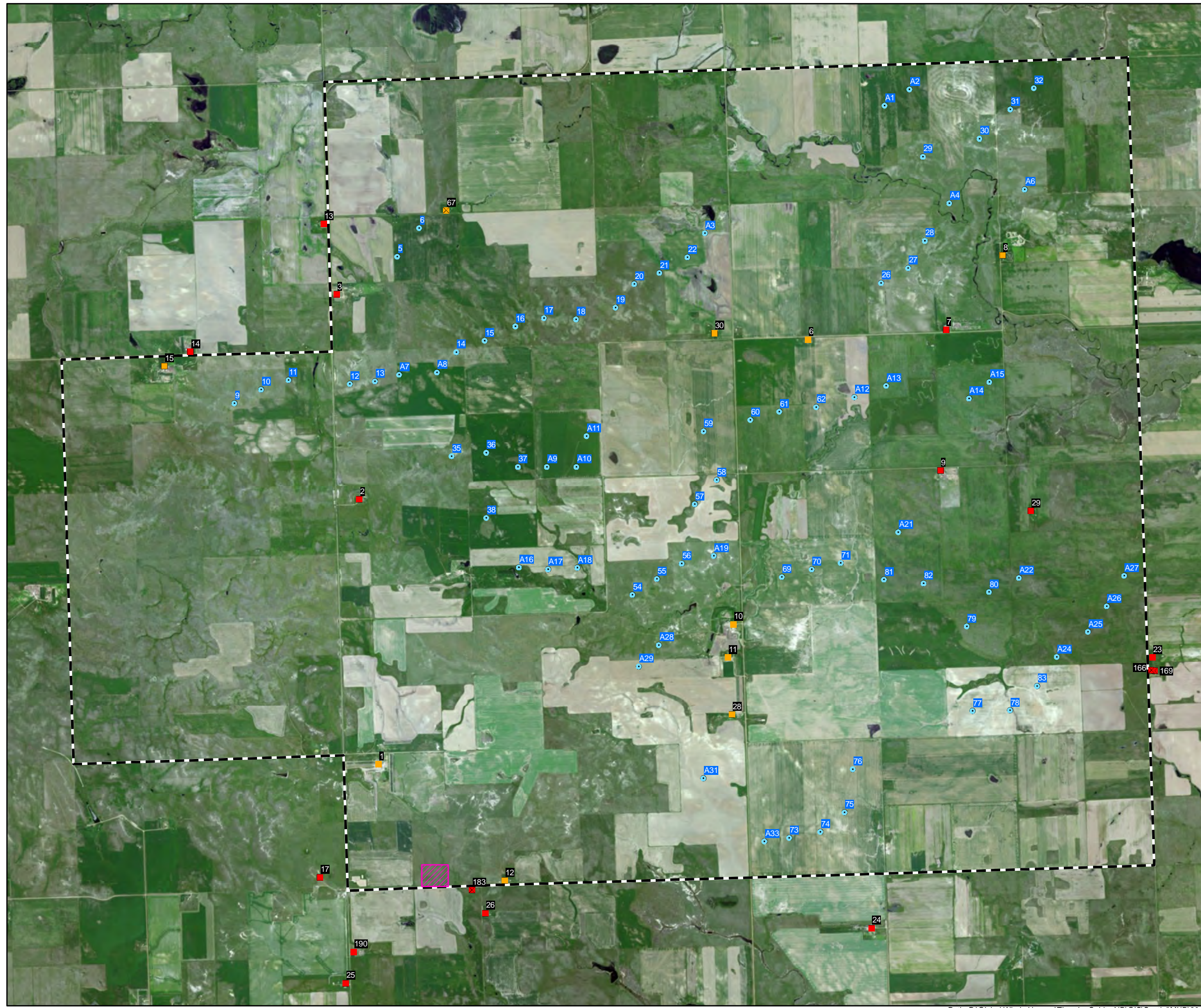
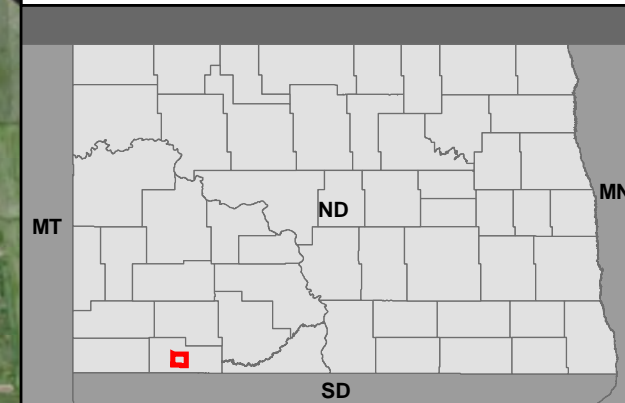


Figure 2A. WindPro Predicted Expected Shadow Flicker Impact Areas – Turbine Scenario A (78 Vestas V100 2.0 Turbines)













Figure 2A

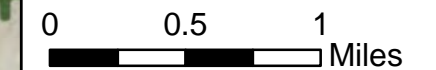
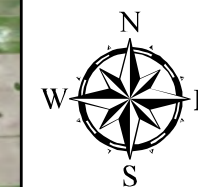
WindPro Predicted Expected
Shadow Flicker Impact Areas:
Vestas Turbines

Thunder Spirit Wind Energy Project
Thunder Spirit Wind, LLC
Adams County, North Dakota

September 2013

Legend

-  Proposed Turbine Location (8/15/2013)
-  Collector Substation
Construction Footprint (20 Acres)
- Shadow Flicker Iso Line (Vestas)**
 -  15 hrs/yr
 -  30 hrs/yr
 -  50 hrs/yr
 -  75 hrs/yr
 -  100 hrs/yr
-  Project Area
- Receptor**
 -  Signed Easement (Occupied)
 -  Signed Easement (Abandoned)
 -  Not Signed (Occupied)
 -  Not Signed (Abandoned)



REFERENCE MAP

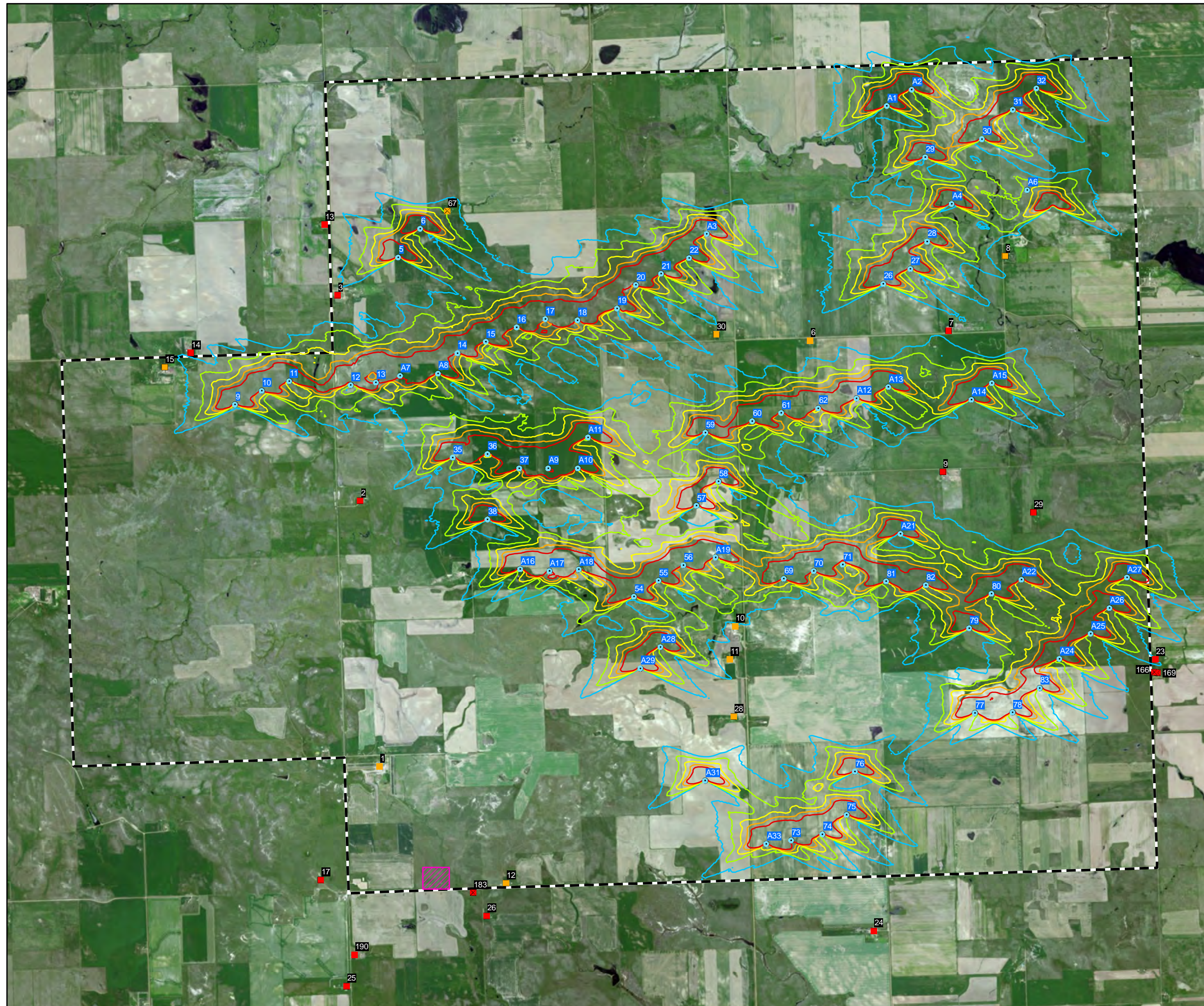
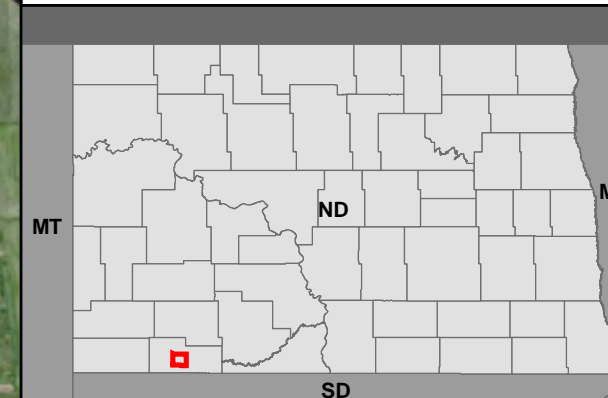


Figure 2B. WindPro Predicted Potential Shadow Flicker Impact Areas – Turbine Scenario B (78 Siemens SWT 2.3-108 Turbines)













Figure 2B

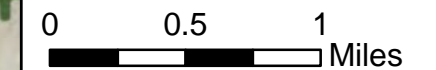
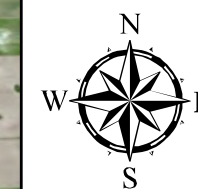
WindPro Predicted Expected
Shadow Flicker Impact Areas:
SiemensTurbines

Thunder Spirit Wind Energy Project
Thunder Spirit Wind, LLC
Adams County, North Dakota

September 2013

Legend

-  Proposed Turbine Location (8/15/2013)
-  Collector Substation
Construction Footprint (20 Acres)
- Shadow Flicker Iso Line (Siemens)**
 -  15 hrs/yr
 -  30 hrs/yr
 -  50 hrs/yr
 -  75 hrs/yr
 -  100 hrs/yr
-  Project Area
- Receptor**
 -  Signed Easement (Occupied)
 -  Signed Easement (Abandoned)
 -  Not Signed (Occupied)
 -  Not Signed (Abandoned)



REFERENCE MAP

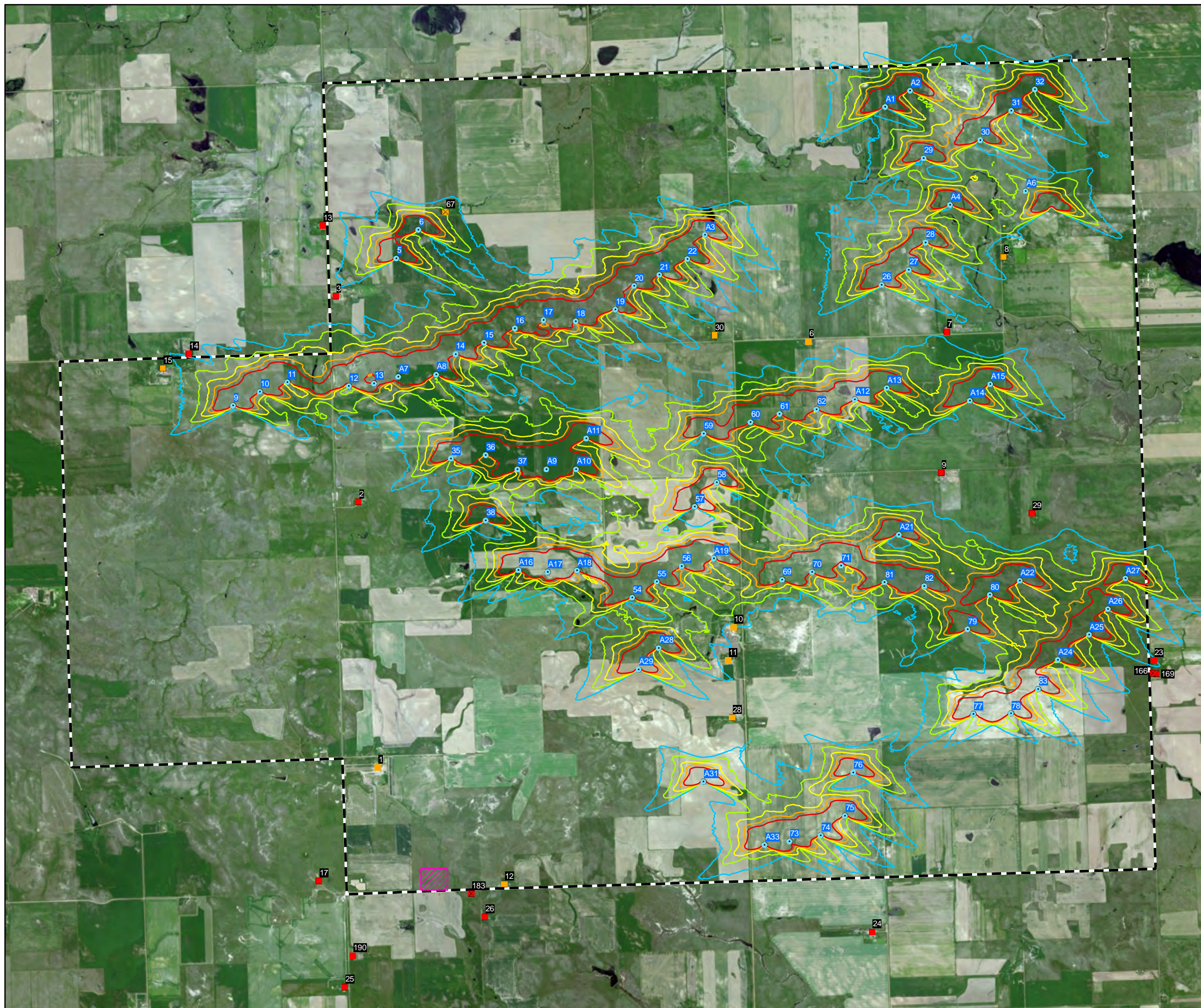
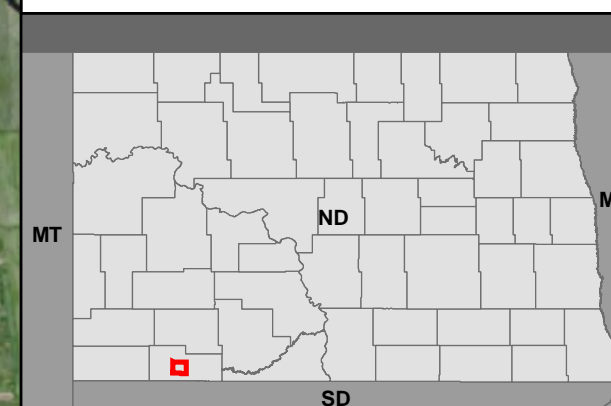


Figure 2C. WindPro Predicted Potential Shadow Flicker Impact Areas – Turbine Scenario C (78 Acciona AW116/3000 Turbines)













Figure 2C

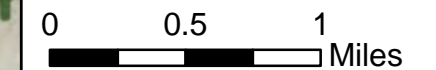
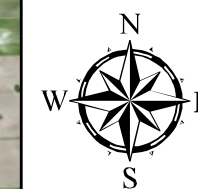
WindPro Predicted Expected
Shadow Flicker Impact Areas:
Acciona Turbines

Thunder Spirit Wind Energy Project
Thunder Spirit Wind, LLC
Adams County, North Dakota

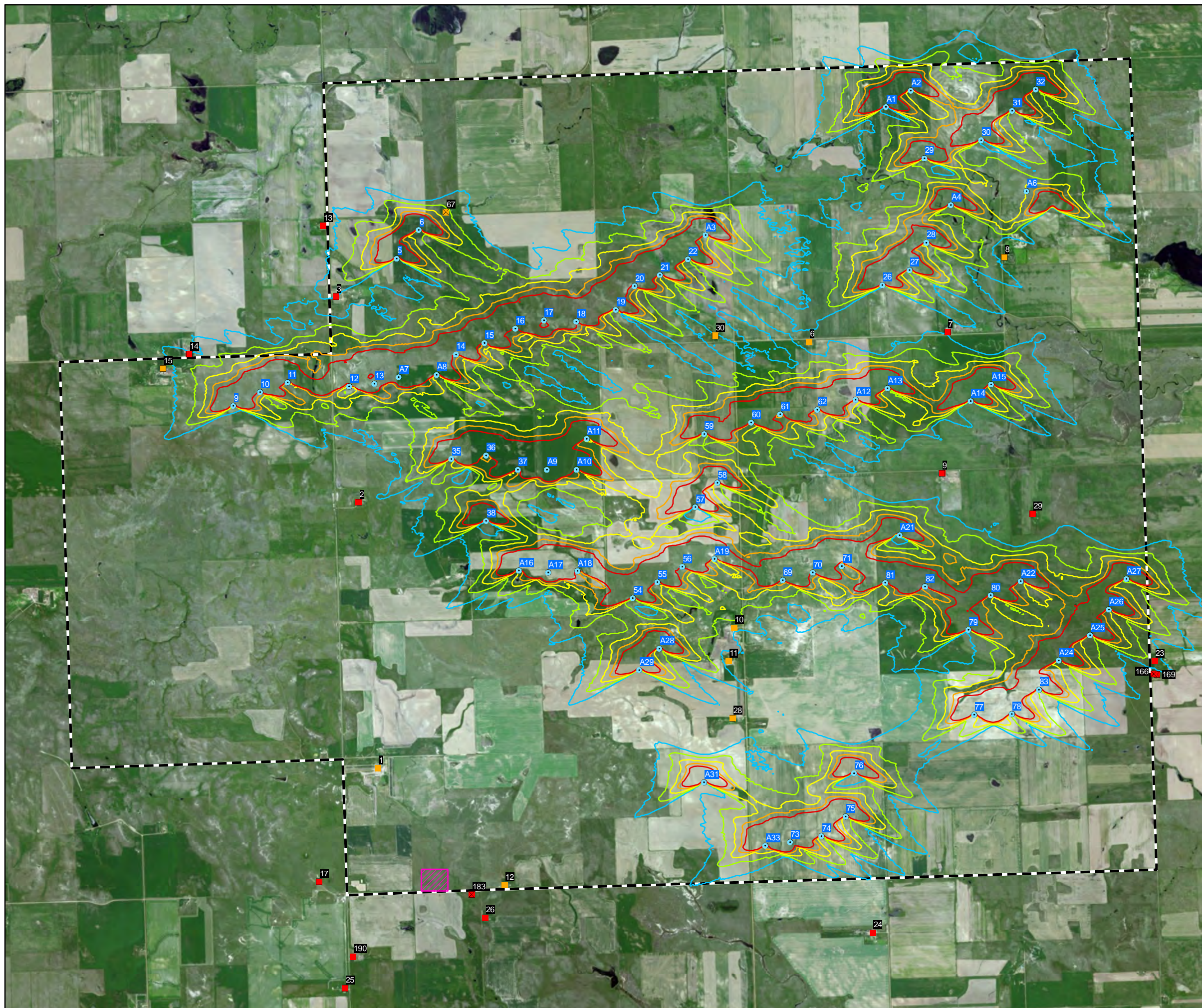
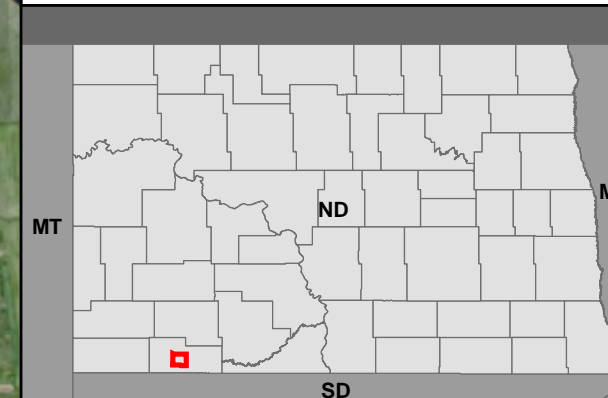
September 2013

Legend

-  Proposed Turbine Location (8/15/2013)
-  Collector Substation
Construction Footprint (20 Acres)
- Shadow Flicker Iso Line (Acciona)**
 -  15 hrs/yr
 -  30 hrs/yr
 -  50 hrs/yr
 -  75 hrs/yr
 -  100 hrs/yr
-  Project Area
- Receptor**
 -  Signed Easement (Occupied)
 -  Signed Easement (Abandoned)
 -  Not Signed (Occupied)
 -  Not Signed (Abandoned)



REFERENCE MAP



ATTACHMENT A.

Detailed Summary of WindPro Shadow Flicker Analysis Results

**Thunder Spirit Wind Energy Project
WindPro Shadow Flicker Analysis Results Summary
Turbine Scenario A (78 Vestas V100 2.0 Turbines)**

Thunder Spirit Receptor ID	UTM-E (m)	UTM-N (m)	WindPro Predicted Expected Shadow Flicker (Hours per Year)
1	684417	5101848	0:00
2	684186	5105014	3:08
3	683913	5107467	0:00
6	689550	5106924	4:14
7	691200	5107045	6:44
8	691878	5107932	8:34
9	691131	5105359	2:58
10	688659	5103520	11:48
11	688595	5103125	8:36
12	685925	5100457	0:00
13	683758	5108307	6:03
14	682164	5106780	9:07
15	681853	5106609	7:55
17	683711	5100496	0:00
22	693510	5107659	0:00
23	693669	5103124	16:40
24	690307	5099887	0:00
26	685692	5100065	0:00
28	688638	5102441	7:13
29	692214	5104878	4:19
30	688431	5107000	7:12
67	685223	5108470	26:54
166	693657	5102971	4:24
169	693696	5102962	5:23
183	685531	5100343	0:00
190	684117	5099602	0:00

**Thunder Spirit Wind Energy Project
WindPro Shadow Flicker Analysis Results Summary
Turbine Scenario B (78 Siemens SWT 2.3-108 Turbines)**

Thunder Spirit Receptor ID	UTM-E (m)	UTM-N (m)	WindPro Predicted Expected Shadow Flicker (Hours per Year)
1	684417	5101848	0:00
2	684186	5105014	2:37
3	683913	5107467	0:00
6	689550	5106924	3:05
7	691200	5107045	7:24
8	691878	5107932	8:14
9	691131	5105359	0:00
10	688659	5103520	11:02
11	688595	5103125	9:42
12	685925	5100457	0:00
13	683758	5108307	6:48
14	682164	5106780	10:55
15	681853	5106609	7:57
17	683711	5100496	0:00
22	693510	5107659	0:00
23	693669	5103124	19:05
24	690307	5099887	0:00
26	685692	5100065	0:00
28	688638	5102441	6:55
29	692214	5104878	2:48
30	688431	5107000	4:11
67	685223	5108470	30:26
166	693657	5102971	5:19
169	693696	5102962	6:10
183	685531	5100343	0:00
190	684117	5099602	0:00

**Thunder Spirit Wind Energy Project
WindPro Shadow Flicker Analysis Results Summary
Turbine Scenario C (78 Acciona AW116/3000 Turbines)**

Thunder Spirit Receptor ID	UTM-E (m)	UTM-N (m)	WindPro Predicted Expected Shadow Flicker (Hours per Year)
1	684417	5101848	0:00
2	684186	5105014	6:05
3	683913	5107467	0:00
6	689550	5106924	9:05
7	691200	5107045	10:29
8	691878	5107932	12:10
9	691131	5105359	7:46
10	688659	5103520	18:00
11	688595	5103125	13:01
12	685925	5100457	0:00
13	683758	5108307	10:21
14	682164	5106780	17:05
15	681853	5106609	11:19
17	683711	5100496	0:00
22	693510	5107659	0:35
23	693669	5103124	25:20
24	690307	5099887	0:00
26	685692	5100065	0:00
28	688638	5102441	9:02
29	692214	5104878	7:34
30	688431	5107000	13:55
67	685223	5108470	36:00
166	693657	5102971	8:29
169	693696	5102962	9:16
183	685531	5100343	0:00
190	684117	5099602	0:00

Appendix B
Additional Agency Correspondence



**STATE
HISTORICAL
SOCIETY
OF NORTH DAKOTA**

Jack Dalrymple
Governor of North Dakota

North Dakota
State Historical Board

Calvin Grinnell
New Town - President

A. Ruric Todd III
Jamestown - Vice President

Margaret Puetz
Bismarck - Secretary

Albert I. Berger
Grand Forks

Gereld Gerntholz
Valley City

Diane K. Larson
Bismarck

Chester E Nelson, Jr.
Bismarck

Sara Otte Coleman
Director
Tourism Division

Kelly Schmidt
State Treasurer

Alvin A. Jaeger
Secretary of State

Mark Zimmerman
Director
Parks and Recreation
Department

Grant Levi
Director
Department of Transportation

Merlan E. Paaverud, Jr.
Director

Accredited by the
American Alliance
of Museums since 1986

August 20, 2013

Mr. James Sexton, Ph. D.
Architectural Historian
Tetra Tech
1000 The American Road
Morris Plains, NJ 07950

NDSHPO REF.: 11-1854B PSC PU-11-601 "Thunder Spirit Wind Energy Center:
Class I and Class II Architectural Reconnaissance Survey in Adams County, North
Dakota"

Dear Mr. Sexton,

We reviewed correspondence and project document for: "Thunder Spirit Wind Energy
Center: Class I and Class II Architectural Reconnaissance Survey in Adams County,
North Dakota," by James Sexton (TetraTech July 2013 2013) and find it acceptable.

If consulted by a state or federal agency, we would concur with "*No Significant Sites
Affected*" or "*No Historic Properties Affected*" determinations provided the project is
of the nature stated and it takes place in the location plotted and described in the
project documentation, and avoidance procedures are maintained.

Thank you for the opportunity to review this project. If you have questions please
contact either Paul Picha at ppicha@nd.gov or (701) 328-3574 or Susan Quinnell at
squinnell@nd.gov or (701) 328-3576.

Sincerely,

Merlan E. Paaverud, Jr.
State Historic Preservation Officer (North Dakota)
and
Director, State Historical Society of North Dakota

c: Patrick Fahn, North Dakota PSC



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August 14, 2013

Adam C. Holven
Senior Archaeologist/Cultural Resources Project Manager
Tetra Tech
2001 Killebrew Drive
Suite 141
Bloomington, MN 55425

NDSHPO REF: 11-1854 PSC Global Harvest, Inc., Thunder Spirit Wind
Energy Center, LLC, Class III CRI Report

Dear Adam:

We have completed review of 11-1854 PSC Global Harvest, Inc., Thunder Spirit Wind LLC, Class III Cultural Resource Inventory Report, "Thunder Spirit Wind Energy Center, Adams County, North Dakota," by Adam C. Hoven (Tetra Tech, August 2013) and find the submitted project information acceptable.

We provisionally concur with a "*No Significant Sites Affected*," and if consulted by a Federal Agency "*No Historic Properties Affected*" determinations provided the proposed project is of the nature stated, it takes place in the location described, and avoids impacts as stipulated on i-ii, as reported and discussed in Section 7 and summarized in Table 8 (attached), and as buffered and mapped in the project documentation (Appendix A). We await forthcoming requested architectural documentation and reporting for the project and thus defer on issuing project determination of effects until that review is completed. If you have questions please contact either Susan Quinnell at squinnell@nd.gov (701) 328-3576 or Paul Picha at ppicha@nd.gov (701) 328-3574.

Sincerely,

Merlan E. Paaverud, Jr.
State Historic Preservation Officer (North Dakota)
and
Director, State Historical Society of North Dakota

Table 8: Summary of Recommendations for Avoidance

Site No.	Map Reference & Location	Recommendations ¹	Summary
32AD186	H2 Collection Line east of Substation	Avoid impacting the Euro-American artifact scatter, stone piles, and foundation and erect a snow fence along the 16-foot avoidance buffer	The site is currently inside the survey corridor and APE. The collection line should be re-routed around the avoidance buffer. Snow fencing should be placed around the site to ensure avoidance during construction.
32AD187	H3 Collection Line east of Substation	Avoid impacting the Native American stone circles and erect a snow fence along the 50-foot avoidance buffer	The site is currently inside the survey corridor and APE. The collection line should be re-routed around the avoidance buffer. Snow fencing should be placed around the site to ensure avoidance during construction.
32AD188	D2, D3, E2, E3 Turbines 34 - 37	Avoidance is recommended for the quarry area, lithic scatter, and the stone features in addition to a 50-foot buffer around the site.	Tetra Tech recommends that Turbines 34 and 35 and associated facilities in pastured areas be relocated. Subsurface testing is recommended to determine if intact archaeological materials are present below the surface within portions of Site 32AD188 in agricultural cropland (Turbines 36 and 37 and associated facilities). Any testing protocols should be approved by the SHPO before being undertaken. If subsurface testing is not an option, then Tetra Tech recommends relocating Turbines 36 and 37 and associated facilities.
32AD189	E2, E3 Collection Line south of Turbine 38	Avoid impacting the Native American lithic scatter and erect a snow fence along the 50-foot avoidance buffer	The site is currently inside the survey corridor and APE. If the collection line cannot be re-routed around the avoidance buffer, then subsurface testing is recommended to determine if intact archaeological materials are present within the subsurface.
32AD190	D1 Access road east of Turbine 11	Avoid impacting the Native American stone circle and erect a snow fence along the 50-foot avoidance buffer	The site currently extends into the survey corridor. No shifts in the current layout are recommended. Snow fencing around the avoidance buffer should allow construction to proceed around the site without impacts.
32AD191	D2 Turbine A8	Avoid impacting the Native American lithic scatter and erect a snow fence along the 50-foot avoidance buffer	Tetra Tech recommends that Turbine A8 and associated facilities be shifted at least 200 feet to the north of their current location to clear the avoidance buffer. Tetra Tech also recommends that the north-south collection line running through Turbine A8 be shifted to the east or west of the avoidance buffer. If avoidance is not possible, then subsurface testing is recommended to determine if intact archaeological materials are present below the surface.
32AD192	D2 Turbine 13	Avoidance is recommended for the quarry area and lithic scatter in addition to a 50-foot buffer around the site.	Tetra Tech recommends that Turbine 13 and associated facilities be shifted at least 150 feet to the north. No archaeological materials were observed in this area, which the landowner has already disturbed by removing surface rocks.
32AD193	B6 Access road west of Turbine 30	Avoid impacting the stone pile and erect a snow fence along the 16-foot avoidance buffer	The site is currently inside the survey corridor and APE. The collection line should be re-routed around the avoidance buffer. Snow fencing should be placed around the site to ensure avoidance during construction.

Summary

Recommendations

Site No. Map Reference & Location

Site No.	Map Reference & Location	Recommendations	Summary
32AD194	B6 Turbine A6	Avoid impacting the Euro-American artifact scatter and erect a snow fence along the 16-foot avoidance buffer	Avoidance may be achievable during construction activities without relocating the turbine. Tetra Tech recommends that the staging area and the access road to the turbine be shifted to the west to clear the avoidance buffer. Snow fencing around the site would allow for construction to occur within the area while reducing potential impacts.
32AD195	B6 Turbine A5	Avoid impacting the Native American lithic scatter and erect a snow fence along the 50-foot avoidance buffer	Tetra Tech recommends that Turbine A5 and associated facilities be shifted 100 to 200 feet west of their current location to clear the site and avoidance buffer.
32AD196	E4 Turbine A19	Avoid impacting the Native American stone circles and erect a snow fence along the 50-foot avoidance buffer	Tetra Tech also recommends that the collection line from Turbine A6 be relocated to the south of the site and associated avoidance buffer.
32AD197	F3 Turbine 54	Avoid impacting the Native American cairn and erect a snow fence along the 100-foot avoidance buffer	Tetra Tech recommends that Turbine A19 and associated facilities be shifted at least 175 feet to the north of their current location to clear the site and avoidance buffer.
32AD198	F4 Turbine A28	Avoid impacting the Native American stone circle and erect a snow fence along the 50-foot avoidance buffer	Avoidance may be achievable during construction activities without relocating the turbine. However, additional laydown areas may be needed to the east of the turbine and the access road and collection line east of the turbine should be relocated at least 150 feet south to clear the avoidance buffer.
32AD199	F4 Access road southwest of Turbine A28	Avoidance is recommended for the quarry area and lithic scatter in addition to a 50-foot buffer around the site.	Avoidance may be achievable during construction activities without relocating Project facilities. Tetra Tech recommends that the staging area be shifted to the west to clear the avoidance buffer. Snow fencing around the site would allow for construction to occur within the area while reducing potential impacts.
32AD200	F4 Access road southwest of Turbine A28	Avoid impacting the Native American cairns and erect a snow fence along the 100-foot avoidance buffer	Tetra Tech recommends the access road and collection line be relocated at least 500 feet to the east to clear the avoidance buffers for Site 32AD200 and Site 32AD199. Snow fencing around the site would allow for construction to occur within the area while reducing potential impacts.
32AD201	C3 Turbine 17	Avoid impacting the Native American cairn and erect a snow fence along the 100-foot avoidance buffer	Avoidance may be achievable during construction activities without relocating Project facilities. Tetra Tech recommends that the staging area be shifted to the west to clear the avoidance buffer. Snow fencing around the site would allow for construction to occur within the area while reducing potential impacts.
32AD202	D1 Laydown Area	Avoid impacting the Native American lithic scatter and erect a snow fence along the 50-foot avoidance buffer	Tetra Tech recommends that laydown area be shifted to the south or east its current location to clear the site and avoidance buffer. If avoidance is not possible, then subsurface testing is recommended to determine if intact archaeological materials are present below the surface.

Summary

Site No.	Map Reference & Location	Recommendations ¹	Summary
32AD203	E2 Turbine 34	Avoid impacting the former Euro-American clay pit and erect a snow fence along the 16-foot avoidance buffer	It is recommended that Turbine 34 be relocated to avoid to Site 32AD203 and Site 32AD188, which overlaps with Site 32AD203 in this area.

¹ Sites with "No Avoidance" recommendations are not presented.

Appendix C
Receptors Located Within ½ mile of a Turbine
(Revised)

All Receptors within 0.5 miles of a wind turbine (8/15 layout)

Receptor ID	Type	Signed Status	Township & Range	Section	Closest Turbine	Distance (miles)	Distance (feet)
67	Residence - Abandoned	Signed	T130N R95W	6	6	0.24	1272.0
66	Barn	Signed	T130N R95W	7	6	0.19	1023.4
132	Barn	Signed	T130N R95W	15	58	0.20	1078.4
131	Barn	Signed	T130N R95W	15	58	0.24	1253.1
130	Barn	Unsigned	T130N R95W	21	A10	0.41	2148.4
73	Barn	Signed	T130N R95W	12	A6	0.42	2213.2
63	Barn	Unsigned	T130N R95W	7	5	0.43	2261.6
152	Barn	Signed	T130N R95W	19	38	0.44	2314.6
61	Barn	Unsigned	T130N R95W	7	5	0.45	2373.1
209	Barn	Unsigned	T130N R95W	24	A22	0.45	2378.2
90	Barn	Signed	T130N R95W	14	A13	0.45	2388.4
74	Barn	Signed	T130N R95W	12	A6	0.46	2412.0
76	Barn	Signed	T130N R95W	12	A6	0.46	2442.8
207	Barn	Unsigned	T130N R95W	24	A22	0.48	2529.1
75	Barn	Signed	T130N R95W	12	A6	0.48	2539.6
97	Barn	Signed	T130N R95W	15	62	0.49	2574.3
72	Barn	Signed	T130N R95W	12	A6	0.49	2584.0
60	Barn	Unsigned	T130N R95W	7	5	0.50	2628.7
70	Barn	Signed	T130N R95W	12	A6	0.50	2637.5
65	Shed	Signed	T130N R95W	7	6	0.20	1054.9
154	Shed	Signed	T130N R95W	19	A16	0.42	2217.0
161	Shed	Signed	T130N R95W	28	A19	0.46	2413.5
208	Shed	Unsigned	T130N R95W	24	A22	0.46	2419.4
77	Shed	Signed	T130N R95W	12	A6	0.47	2481.9
98	Shed	Signed	T130N R95W	15	62	0.47	2505.3
80	Shed	Signed	T130N R95W	12	A6	0.48	2522.4
79	Shed	Signed	T130N R95W	12	A6	0.48	2534.1
78	Shed	Signed	T130N R95W	12	A6	0.48	2542.6
160	Shed	Signed	T130N R95W	28	A28	0.49	2603.2
48	Silo	Signed	T130N R95W	2	A2	0.17	913.9
49	Silo	Signed	T130N R95W	2	A2	0.18	931.8
202	Silo	Signed	T130N R95W	15	58	0.22	1138.3
153	Silo	Signed	T130N R95W	19	A16	0.38	2023.2
91	Silo	Signed	T130N R95W	14	A13	0.44	2325.0
64	Silo	Unsigned	T130N R95W	7	5	0.47	2502.8