# Appendix A –
# Department of Defense Preliminary Screening Tool Results

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Federal Aviation Administration

« OE/AAA

## DoD Preliminary Screening Tool

**Disclaimer:**

- The DoD Preliminary Screening Tool enables developers to obtain a preliminary review of potential impacts to Long-Range and Weather Radar(s), Military Training Route(s) and Special Airspace(s) prior to official OE/AAA filing. This tool will produce a map relating the structure to any of the DoD/DHS and NOAA resources listed above. The use of this tool is **100 % optional** and will provide a first level of feedback and single points of contact within the DoD/DHS and NOAA to discuss impacts/mitigation efforts on the military training mission and NEXRAD Weather Radars. **The use of this tool does not in any way replace the official FAA processes/procedures.**

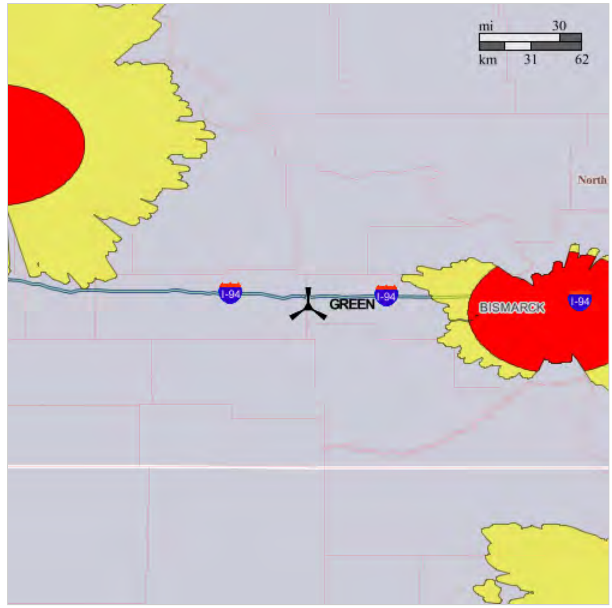
**Instructions:**

- Select a screening type for your initial evaluation. Currently the system supports pre-screening on:
  -Air Defense and Homeland Security radars(Long Range Radar)
  -Weather Surveillance Radar-1988 Doppler radars(NEXRAD)
  -Military Operations
- Enter either a single point or a polygon and click submit to generate a long range radar analysis map.
- Military Operations is only available for a single point.
- At least three points are required for a polygon, with an optional fourth point.
- The largest polygon allowed has a maximum perimeter of 100 miles.

**Screening Type:** Long Range Radar **Geometry Type:** Single Point

| Point | Latitude Deg | Min | Sec | Dir | Longitude Deg | Min | Sec | Dir |
|---|---|---|---|---|---|---|---|---|
| 1 | 46 | 49 | 24.54 | N | 102 | 5 | 6.31 | W |

**Horizontal Datum:** NAD83




**Map Legend:**

- **Green:** No anticipated impact to Air Defense and Homeland Security radars. Aeronautical study required.
- **Yellow:** Impact likely to Air Defense and Homeland Security radars. Aeronautical study required.
- **Red:** Impact highly likely to Air Defense and Homeland Security radars. Aeronautical study required.

Federal Aviation Administration

« OE/AAA

## DoD Preliminary Screening Tool

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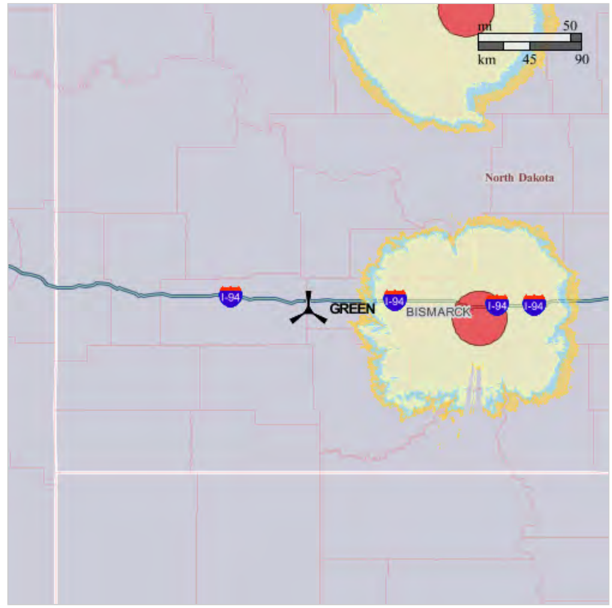
**Instructions:**

- Select a screening type for your initial evaluation. Currently the system supports pre-screening on:
  -Air Defense and Homeland Security radars(Long Range Radar)
  -Weather Surveillance Radar-1988 Doppler radars(NEXRAD)
  -Military Operations
- Enter either a single point or a polygon and click submit to generate a long range radar analysis map.
- Military Operations is only available for a single point.
- At least three points are required for a polygon, with an optional fourth point.
- The largest polygon allowed has a maximum perimeter of 100 miles.

**Screening Type:** NEXRAD **Geometry Type:** Single Point

| Point | Latitude Deg | Min | Sec | Dir | Longitude Deg | Min | Sec | Dir |
|---|---|---|---|---|---|---|---|---|
| 1 | 46 | 49 | 24.54 | N | 102 | 5 | 6.31 | W |

**Horizontal Datum:** NAD83




For more information, or to discuss the screening results, please contact NOAA at wind.energy.matters@noaa.gov

**Map Legend:**

- **Green:** Minimal to no impact to Weather Surveillance Radar-1988 Doppler (WSR-88D) weather radar operations. National Telecommunications & Information Administration (NTIA) notification advised.
- **Yellow:** RLOS Coverage At or Below 130m AGL. Impact likely to WSR-88D weather radar operations. Turbines likely in radar line of sight. Impact study required. NTIA notification advised.
- **Blue:** RLOS Coverage At or Below 160m AGL. Impact likely to WSR-88D weather radar operations. Turbines likely in radar line of sight. Impact study required. NTIA notification advised.
- **Gold:** RLOS Coverage At or Below 200m AGL. Impact likely to WSR-88D weather radar operations. Turbines likely in radar line of sight. Impact study required. NTIA notification advised.
- **Red:** Impact highly likely to WSR-88D weather radar operations and wind turbine electronics. Turbines likely in radar line of sight. Aeronautical study required. NTIA notification strongly advised.

Federal Aviation Administration

« OE/AAA

## DoD Preliminary Screening Tool

**Disclaimer:**

- The DoD Preliminary Screening Tool enables developers to obtain a preliminary review of potential impacts to Long-Range and Weather Radar(s), Military Training Route(s) and Special Airspace(s) prior to official OE/AAA filing. This tool will produce a map relating the structure to any of the DoD/DHS and NOAA resources listed above. The use of this tool is **100 % optional** and will provide a first level of feedback and single points of contact within the DoD/DHS and NOAA to discuss impacts/mitigation efforts on the military training mission and NEXRAD Weather Radars. **The use of this tool does not in any way replace the official FAA processes/procedures.**

**Instructions:**

- Select a screening type for your initial evaluation. Currently the system supports pre-screening on:
  -Air Defense and Homeland Security radars(Long Range Radar)
  -Weather Surveillance Radar-1988 Doppler radars(NEXRAD)
  -Military Operations
- Enter either a single point or a polygon and click submit to generate a long range radar analysis map.
- Military Operations is only available for a single point.
- At least three points are required for a polygon, with an optional fourth point.
- The largest polygon allowed has a maximum perimeter of 100 miles.

**Screening Type:** Military Operations **Geometry Type:** Single Point

| Point | Latitude | | | | Longitude | | | |
|---|---|---|---|---|---|---|---|---|
| | Deg | Min | Sec | Dir | Deg | Min | Sec | Dir |
| 1 | 46 | 49 | 24.54 | N | 102 | 5 | 6.31 | W |

**Horizontal Datum:** NAD83

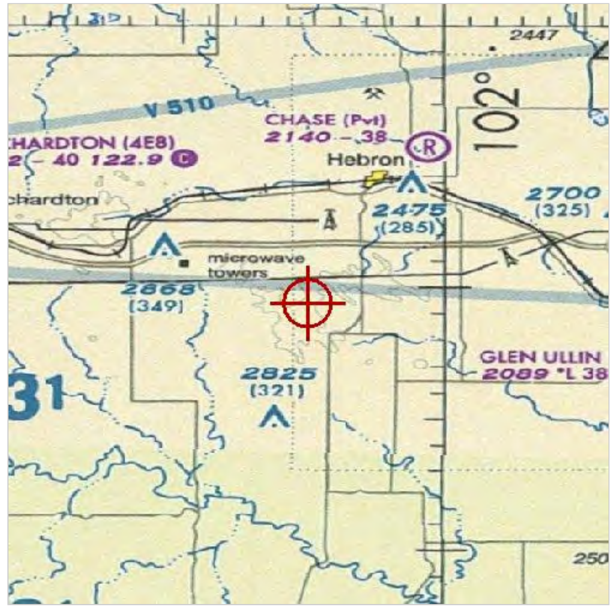
The preliminary review of your proposal does not return any likely impacts to military airspace. Please contact Dr. Thomas (Thom) H. Rennie at the USAF Regional Enviromental Coordinator at (214)767-4678 for confirmation and documentation.

The preliminary review of your proposal does not return any likely impacts to military airspace. Please contact Anthony M. Parisi, PE at the USN Regional Enviromental Coordinator at (805)989-9209 for confirmation and documentation.

The preliminary review of your proposal does not return any likely impacts to military airspace. Please contact LTC Pete Kowal at the USA Regional Enviromental Coordinator at (425)227-2955 for confirmation and documentation.

The preliminary review of your proposal does not return any likely impacts to military airspace. Please contact Mr. Pat Christman at the USMC Regional Enviromental Coordinator at (760)725-2674 for confirmation and documentation.

**This is a preliminary review of your proposal and does not preclude official FAA processes.**
Your search data is not retained and the privacy of all your searches is assured.




Any questions interpreting the map, please email Steve Sample with your question/s and phone number at steven.sample@pentagon.af.mil

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# Appendix B –
# Economic Coal Deposit Maps

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North Dakota Geological Survey
100K Series: Dksn - c

# Lignite Reserves
## Dickinson 100K Sheet, North Dakota

Edward C. Murphy, State Geologist
Lynn D. Helms, Director Dept. of Mineral Resources


Adjoining 100K Maps


## Edward C. Murphy
### 2005

There are just over one billion tons of economically mineable lignite within the Dickinson 100k Sheet (Murphy et al., in press). As much as 800 million tons of this reserve may be attributable to the Lehigh bed which extends throughout the northwestern corner of this map sheet. The Lehigh coal is more than 25 feet thick north of Dickinson (JK Ranch Deposit) and is 15 to 17 feet thick in the South Heart area (Murphy et al., 2000). JK Ranch (356 million tons), Belfield (201 million tons), West Dickinson (158 million tons), and Duck Creek (92 million tons) are the largest deposits in this map sheet (Murphy et al., in press).

The Lehigh bed is overlain by the Dickinson bed, both seams were mined in the Dickinson area. Underground mining began in the Lehigh area in the 1880s and switched to surface mining in the 1940s. The last coal mine to operate in Stark County was the JK Ranch mine which ceased operation in 1990. Great Northern Properties is currently studying the feasibility of establishing a coal mine and constructing a power plant south of the town of South Heart.

References


Murphy, E.C., Kruger, N.W., and Goven, G.E., 2000, The major coals in Billings, Golden Valley, and Stark counties, North Dakota: North Dakota Geological Survey Open-File Report 00-1, 42 p.

Murphy, E.C., 2006, in press. The Lignite Reserves of North Dakota, North Dakota Geological Survey Report of Investigation No. 104.


Study Area (HDR)

### UNIT DESCRIPTIONS

**Geology Undifferentiated**

**Area of Mined Lignite**

**Economic Coal Deposits**

Economic coal deposits are those that meet the minimum criteria established by coal companies operating surface mines in North Dakota. These economic criteria include a minimum cumulative coal thickness of ten feet-typicallyoccuring in less than two beds, a minimum individual bed thickness of at least 2.5 feet, a ratio of overburden to coalthickness of not more than 10:1, a minimum of 25 feet of overburden, and a maximum depth to coal of approximately 150 feet.

**Geologic Symbols**

Extent of Local Lignite Reserves

Data Points

Includes coal exploration NDGS/USGS drill holes, sub-surface mineral drill holes, oil & gas wells, and NDSWC drill holes.

**Other Features**

| | |
|---|---|
| Water | County Boundary |
| Water - Intermittent | Interstate Highway |
| Water - Inundated | State Highway |
| River/Stream - Perennial | Paved Road |
| River/Stream - Intermittent | Unpaved Road |
| Section Corners | |

Scale 1:100,000

0 1 2 3 4

Miles

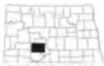
Mercator Projection    1927 North American Datum
Standard parallel 46°30′    Central meridian 102°30′
USGS NED Shaded Relief - Vertical Exaggeration 9x

The North Dakota Geological Survey can publish on demand 1:24,000 scale quadrangle maps (24k - c series) of the mineable coal deposits in the Dickinson 100k sheet. These maps would include information on mineable coal thicknesses.


This project was supported, in part, by the U.S. Geological Survey, Department of Interior, under assistance awards 02ERAG0016 and 05ERAG0053.


Cartographic Compilation: Elroy L. Kadrmas

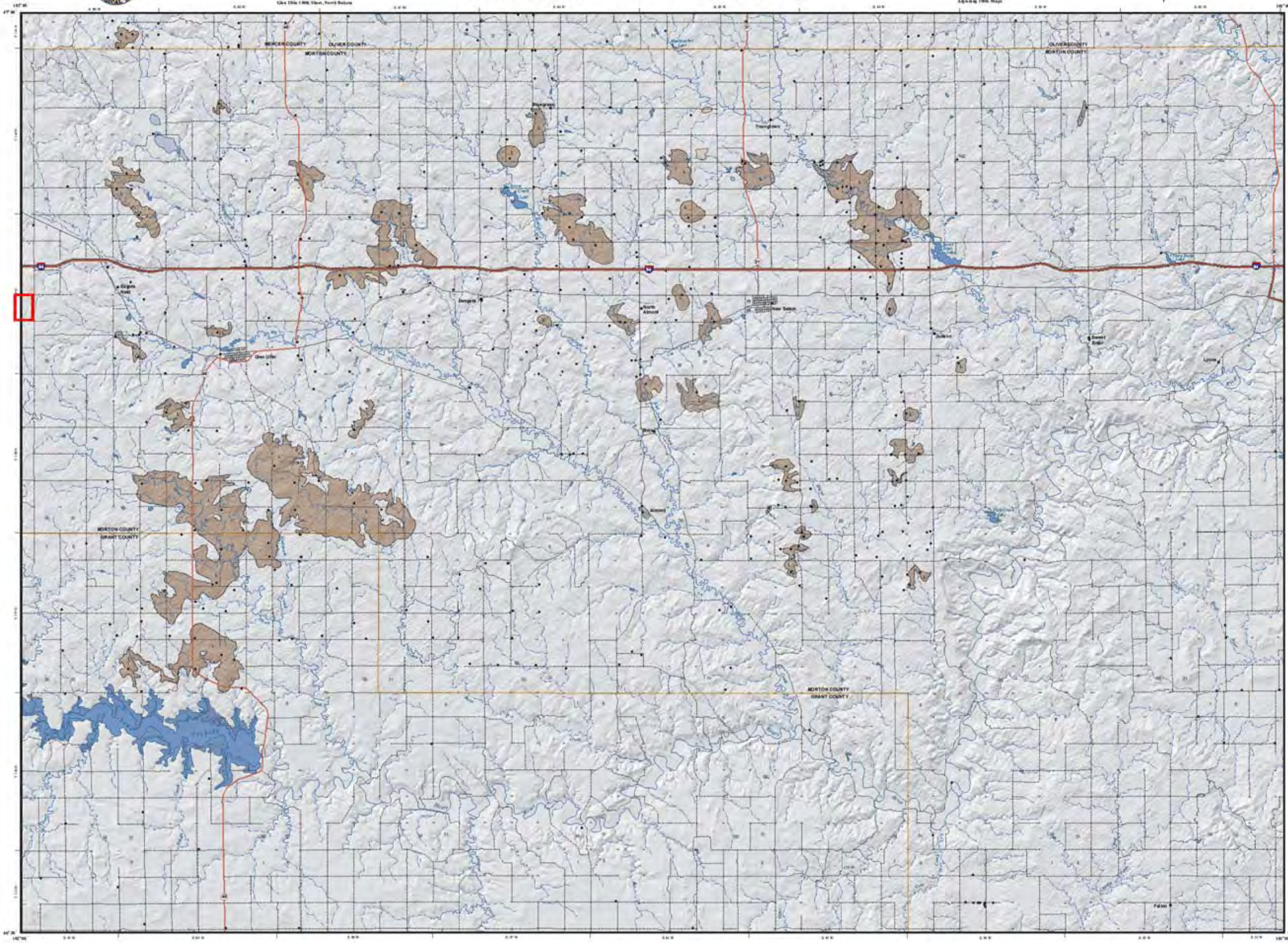
North Dakota Geological Survey
100K Series: GlnU - c


Glen Ullin 100K Sheet, North Dakota

# Lignite Reserves
## Glen Ullin 100K Sheet, North Dakota


Adjoining 100K Maps

Edward C. Murphy, State Geologist
Lynn D. Helms, Director Dept. of Mineral Resources



## Edward C. Murphy

**2006**

The Glen Ullin 100k sheet contains approximately 726 million tons of economically mineable lignite. The Heart Butte Creek (T137N, Rs 88 & 89W in Grant County) and Heart Butte Creek North (T138N, Rs 88 & 89W in Morton County) deposits account for approximately one-third of the mineable coal (275 million tons) in this map sheet. The Sweet Briar deposit, west-northwest of Sweet Briar Lake, contains about 90 million tons and is the second largest deposit in this area. The Twin Buttes deposit, three miles northwest of Dengate, is the only other deposit in the Glen Ullin sheet that exceeds 50 million tons (59 million). The thickest known coal within this sheet is twelve feet.

The Sentinel Butte and Bullion Creek Formations are the dominant rock units at the surface throughout this map sheet. According to the records of the North Dakota Public Service Commission, approximately 75 coal mines operated at one time or another in this area. Many of the mines operated for a short period of time and produced less than 100 tons of coal per year. The earliest coal mine in North Dakota was opened near Sims in 1873. The McCormick Coal Company, later the Deep Mine Coal Company, mined a nine-foot-thick coal at a depth of 200 feet by underground methods along the western outskirts of the town of New Salem. The mine operated from 1922 to 1951. Coal mining ceased within the Glen Ullin sheet in the 1960s when the Richter Mine (T139N, R88W, Section 13) and Carbon Mine near Almont closed.

References
Murphy, E.C., 2006. The Lignite Reserves of North Dakota: North Dakota Geological Survey Report of Investigation No. 104.

Study Area (HDR)

### UNIT DESCRIPTIONS

**Geology Undifferentiated**

**Geology Undifferentiated**

L **Economic Coal Deposits**

Economic coal deposits are those that meet the minimum criteria established by coal companies operating surface mines in North Dakota. These economic criteria include a minimum cumulative coal thickness of ten feet-typicallyoccuring in less than two beds, a minimum individual bed thickness of at least 2.5 feet, a ratio of overburden to coalthickness of not more than 10:1, a minimum of 25 feet of overburden, and a maximum depth to coal of approximately 150 feet.

**Geologic Symbols**

Extent of Local Lignite Reserves

Data Points

Includes coal exploration NDGS/USGS drill holes, sub-surface mineral drill holes, oil & gas wells, and NDSWC drill holes.

**Other Features**

Water
Water - Intermittent
Water - Inundated
River/Stream - Perennial
River/Stream - Intermittent
Section Corners
County Boundary
Interstate Highway
State Highway
Paved Road
Unpaved Road

Scale 1:100,000

0 1 2 3 4
Miles

Mercator Projection 1927 North American Datum
Standard parallel 46°30' Central meridian 101°30'
USGS NED Shaded Relief - Vertical Exaggeration 9x

The North Dakota Geological Survey can publish on demand 1:24,000 scale quadrangle maps (24k - c series) of the mineable coal deposits in the Glen Ullin 100k sheet. These maps would include information on minable coal thicknesses.

This project was supported, in part, by the U.S. Geological Survey, Department of Interior, under assistance awards 02ERAG0016 and 05ERAG0053.

Cartographic Compilation: Elroy L. Kadrmas

# Appendix C –
# North American Breeding Bird Survey Results

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Patuxent Wildlife Research Center

# Species List

## North American Breeding Bird Survey Route

## GLEN ULLIN

| Species | Birds/route | Route Change | Regional Change | Id Tips |
|---|---|---|---|---|
| Pied-billed Grebe *Podilymbus podiceps* | 0.27 | Route Change | Regional Change | Id Tips |
| Double-crest. Cormorant *Phalacrocorax auritus* | 0.47 | Route Change | Regional Change | Id Tips |
| American Bittern *Botaurus lentiginosus* | 0.60 | Route Change | Regional Change | Id Tips |
| Turkey Vulture *Cathartes aura* | 0.07 | Route Change | Regional Change | Id Tips |
| Canada Goose *Branta canadensis* | 8.13 | Route Change | Regional Change | Id Tips |
| Gadwall *Anas strepera* | 1.33 | Route Change | Regional Change | Id Tips |
| Mallard *Anas platyrhynchos* | 22.27 | Route Change | Regional Change | Id Tips |
| Blue-winged Teal *Anas discors* | 1.47 | Route Change | Regional Change | Id Tips |
| Northern Shoveler *Anas clypeata* | 0.13 | Route Change | Regional Change | Id Tips |
| Northern Pintail *Anas acuta* | 0.67 | Route Change | Regional Change | Id Tips |
| Northern Harrier *Circus cyaneus* | 3.20 | Route Change | Regional Change | Id Tips |
| Cooper's Hawk *Accipiter cooperii* | 0.07 | Route Change | Regional Change | Id Tips |
| Swainson's Hawk *Buteo swainsoni* | 2.07 | Route Change | Regional Change | Id Tips |
| Red-tailed Hawk *Buteo jamaicensis* | 1.00 | Route Change | Regional Change | Id Tips |
| Ferruginous Hawk | 0.27 | Route Change | Regional Change | Id Tips |

| | | | | |
|---|---|---|---|---|
| *Buteo regalis* | | | | |
| American Kestrel<br>*Falco sparverius* | 0.47 | Route Change | Regional Change | Id Tips |
| Prairie Falcon<br>*Falco mexicanus* | 0.07 | Route Change | Regional Change | Id Tips |
| Gray Partridge<br>*Perdix perdix* | 0.93 | Route Change | Regional Change | Id Tips |
| Ring-necked Pheasant<br>*Phasianus colchicus* | 102.73 | Route Change | Regional Change | Id Tips |
| Sharp-tailed Grouse<br>*Tympanuchus phasianellus* | 2.60 | Route Change | Regional Change | Id Tips |
| Wild Turkey<br>*Meleagris gallopavo* | 0.67 | Route Change | Regional Change | Id Tips |
| Sora<br>*Porzana carolina* | 0.40 | Route Change | Regional Change | Id Tips |
| American Coot<br>*Fulica americana* | 0.47 | Route Change | Regional Change | Id Tips |
| Killdeer<br>*Charadrius vociferus* | 9.60 | Route Change | Regional Change | Id Tips |
| Willet<br>*Catoptrophorus semipalmatu* | 0.33 | Route Change | Regional Change | Id Tips |
| Upland Sandpiper<br>*Bartramia longicauda* | 16.67 | Route Change | Regional Change | Id Tips |
| Marbled Godwit<br>*Limosa fedoa* | 4.53 | Route Change | Regional Change | Id Tips |
| Common Snipe<br>*Gallinago gallinago* | 3.53 | Route Change | Regional Change | Id Tips |
| Wilson's Phalarope<br>*Phalaropus tricolor* | 0.80 | Route Change | Regional Change | Id Tips |
| Ring-billed Gull<br>*Larus delawarensis* | 0.73 | Route Change | Regional Change | Id Tips |
| Rock Dove<br>*Columba livia* | 2.47 | Route Change | Regional Change | Id Tips |
| Mourning Dove<br>*Zenaida macroura* | 84.87 | Route Change | Regional Change | Id Tips |
| Black-billed Cuckoo<br>*Coccyzus erythropthalmus* | 0.13 | Route Change | Regional Change | Id Tips |
| Great Horned Owl<br>*Bubo virginianus* | 0.53 | Route Change | Regional Change | Id Tips |
| Burrowing Owl<br>*Athene cunicularia* | 0.33 | Route Change | Regional Change | Id Tips |
| Short-eared Owl<br>*Asio flammeus* | 1.07 | Route Change | Regional Change | Id Tips |

| | | | | |
|---|---|---|---|---|
| Common Nighthawk *Chordeiles minor* | 0.80 | Route Change | Regional Change | Id Tips |
| Belted Kingfisher *Ceryle alcyon* | 0.13 | Route Change | Regional Change | Id Tips |
| Red-headed Woodpecker *Melanerpes erythrocephalus* | 0.07 | Route Change | Regional Change | Id Tips |
| Downy Woodpecker *Picoides pubescens* | 0.07 | Route Change | Regional Change | Id Tips |
| Hairy Woodpecker *Picoides villosus* | 0.07 | Route Change | Regional Change | Id Tips |
| Northern Flicker *Colaptes spp.* | 0.67 | Route Change | Regional Change | Id Tips |
| Willow Flycatcher *Empidonax traillii* | 0.47 | Route Change | Regional Change | Id Tips |
| Willow/Alder Flycatcher *Empidonax spp.* | 0.47 | Route Change | Regional Change | Id Tips |
| Least Flycatcher *Empidonax minimus* | 0.80 | Route Change | Regional Change | Id Tips |
| Say's Phoebe *Sayornis saya* | 1.53 | Route Change | Regional Change | Id Tips |
| Western Kingbird *Tyrannus verticalis* | 23.00 | Route Change | Regional Change | Id Tips |
| Eastern Kingbird *Tyrannus tyrannus* | 23.73 | Route Change | Regional Change | Id Tips |
| Loggerhead Shrike *Lanius ludovicianus* | 0.73 | Route Change | Regional Change | Id Tips |
| Warbling Vireo *Vireo gilvus* | 1.53 | Route Change | Regional Change | Id Tips |
| Red-eyed Vireo *Vireo olivaceus* | 0.07 | Route Change | Regional Change | Id Tips |
| Black-billed Magpie *Pica pica* | 0.33 | Route Change | Regional Change | Id Tips |
| American Crow *Corvus brachyrhynchos* | 1.47 | Route Change | Regional Change | Id Tips |
| Horned Lark *Eremophila alpestris* | 134.13 | Route Change | Regional Change | Id Tips |
| Tree Swallow *Tachycineta bicolor* | 1.07 | Route Change | Regional Change | Id Tips |
| N. Rough-winged Swallow *Stelgidopteryx serripennis* | 3.93 | Route Change | Regional Change | Id Tips |
| Bank Swallow *Riparia riparia* | 40.07 | Route Change | Regional Change | Id Tips |
| Cliff Swallow | 7.20 | Route Change | Regional Change | Id Tips |

| | | | | |
|---|---|---|---|---|
| *Petrochelidon pyrrhonota* | | | | |
| Barn Swallow<br>*Hirundo rustica* | 11.60 | Route Change | Regional Change | Id Tips |
| Black-capped Chickadee<br>*Poecile atricapillus* | 0.07 | Route Change | Regional Change | Id Tips |
| Rock Wren<br>*Salpinctes obsoletus* | 0.20 | Route Change | Regional Change | Id Tips |
| House Wren<br>*Troglodytes aedon* | 3.33 | Route Change | Regional Change | Id Tips |
| Sedge Wren<br>*Cistothorus platensis* | 0.20 | Route Change | Regional Change | Id Tips |
| Eastern Bluebird<br>*Sialia sialis* | 0.07 | Route Change | Regional Change | Id Tips |
| American Robin<br>*Turdus migratorius* | 12.40 | Route Change | Regional Change | Id Tips |
| Gray Catbird<br>*Dumetella carolinensis* | 0.07 | Route Change | Regional Change | Id Tips |
| Brown Thrasher<br>*Toxostoma rufum* | 1.33 | Route Change | Regional Change | Id Tips |
| European Starling<br>*Sturnus vulgaris* | 3.40 | Route Change | Regional Change | Id Tips |
| Sprague's Pipit<br>*Anthus spragueii* | 0.20 | Route Change | Regional Change | Id Tips |
| Cedar Waxwing<br>*Bombycilla cedrorum* | 1.53 | Route Change | Regional Change | Id Tips |
| Yellow Warbler<br>*Dendroica petechia* | 4.13 | Route Change | Regional Change | Id Tips |
| Common Yellowthroat<br>*Geothlypis trichas* | 3.73 | Route Change | Regional Change | Id Tips |
| Chipping Sparrow<br>*Spizella passerina* | 0.53 | Route Change | Regional Change | Id Tips |
| Clay-colored Sparrow<br>*Spizella pallida* | 3.27 | Route Change | Regional Change | Id Tips |
| Vesper Sparrow<br>*Pooecetes gramineus* | 4.53 | Route Change | Regional Change | Id Tips |
| Lark Sparrow<br>*Chondestes grammacus* | 1.00 | Route Change | Regional Change | Id Tips |
| Lark Bunting<br>*Calamospiza melanocorys* | 195.13 | Route Change | Regional Change | Id Tips |
| Savannah Sparrow<br>*Passerculus sandwichensis* | 15.93 | Route Change | Regional Change | Id Tips |
| Grasshopper Sparrow<br>*Ammodramus savannarum* | 23.67 | Route Change | Regional Change | Id Tips |

| | | | | |
|---|---|---|---|---|
| Baird's Sparrow *Ammodramus bairdii* | 5.53 | Route Change | Regional Change | Id Tips |
| Le Conte's Sparrow *Ammodramus leconteii* | 0.07 | Route Change | Regional Change | Id Tips |
| Song Sparrow *Melospiza melodia* | 0.27 | Route Change | Regional Change | Id Tips |
| Chestnut-col. Longspur *Calcarius ornatus* | 68.53 | Route Change | Regional Change | Id Tips |
| Black-headed Grosbeak *Pheucticus melanocephalus* | 0.13 | Route Change | Regional Change | Id Tips |
| Lazuli Bunting *Passerina amoena* | 0.07 | Route Change | Regional Change | Id Tips |
| Dickcissel *Spiza americana* | 1.40 | Route Change | Regional Change | Id Tips |
| Bobolink *Dolichonyx oryzivorus* | 16.87 | Route Change | Regional Change | Id Tips |
| Red-winged Blackbird *Agelaius phoeniceus* | 110.87 | Route Change | Regional Change | Id Tips |
| Western Meadowlark *Sturnella neglecta* | 193.73 | Route Change | Regional Change | Id Tips |
| Yellow-head. Blackbird *Xanthocephalus xanthocepha* | 3.40 | Route Change | Regional Change | Id Tips |
| Brewer's Blackbird *Euphagus cyanocephalus* | 10.00 | Route Change | Regional Change | Id Tips |
| Common Grackle *Quiscalus quiscula* | 47.53 | Route Change | Regional Change | Id Tips |
| Brown-headed Cowbird *Molothrus ater* | 113.47 | Route Change | Regional Change | Id Tips |
| Orchard Oriole *Icterus spurius* | 1.00 | Route Change | Regional Change | Id Tips |
| Baltimore Oriole *Icterus galbula* | 0.80 | Route Change | Regional Change | Id Tips |
| Bullock's Oriole *Icterus bullockii* | 0.13 | Route Change | Regional Change | Id Tips |
| American Goldfinch *Carduelis tristis* | 4.07 | Route Change | Regional Change | Id Tips |
| House Sparrow *Passer domesticus* | 33.53 | Route Change | Regional Change | Id Tips |

Use Back Arrow to Return to Browser

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# Appendix D –
# US Fish and Wildlife Service
# And
# North Dakota Fish and Game Department
# Response Letters

"VARIETY IN HUNTING AND FISHING"

**NORTH DAKOTA GAME AND FISH DEPARTMENT**

100 NORTH BISMARCK EXPRESSWAY BISMARCK, NORTH DAKOTA 58501-5095 PHONE 701-328-6300 FAX 701-328-6352

October 22, 2010

Bruce Moreira
Environmental Scientist
HDR Engineering, Inc.
701 Xenia Avenue South, Suite 600
Minneapolis, MN 55416

Dear Mr. Moriera:

RE: Antelope Hills Wind Project – Mercer County, North Dakota
Sunflower Wind Project – Morton & Stark Counties, North Dakota
Silver Sage Wind Project – Oliver County, North Dakota

The North Dakota Game and Fish Department has reviewed this project for wildlife concerns.

Our primary concern with wind power development is the disturbance of native prairie associated with construction of turbines, access roads, and other associated facilities. We ask that work within native prairie be avoided to the extent possible. This could include micro-siting turbines onto adjacent previously disturbed land, locating access roads on existing section line trails rather than across undisturbed native prairie, etc.

The Golden Valley Wildlife Management Area (WMA) is located in the west half of section 32, T146N, R89W, within the project boundary of the Antelope Hills Wind Project. The Wilbur Boldt WMA is located in the northeast quarter of section 34, T142N, R83W, immediately adjacent to the project boundary of the Silver Sage Wind Project. We ask that wind turbines be set-back from WMA's a sufficient distance to minimize possible disturbance to wildlife.

The National Wetland Inventory indicates numerous wetlands within the proposed project area. We recommend that any unavoidable wetland impacts be replaced in kind, above-ground appurtenances not be placed in wetland areas, and no alterations be made to existing drainage patterns.

We also recommend that routine monitoring for avian and bat mortality be included as part of the facility maintenance plan for the life of the project. We would appreciate being kept informed as this project progresses, and if possible, we would like the GPS coordinates for each turbine after the site has been established.

Sincerely,

Paul Schadewald

Paul Schadewald
Chief
Conservation & Communication Division

js

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services
3425 Miriam Avenue
Bismarck, North Dakota 58501

DEC 1 2010

Mr. Bruce Moreira
Environmental Scientist
HDR Engineering, Inc.
701 Xenia Avenue South, Suite 600
Minneapolis, Minnesota 55416

Re: Sunflower Wind Project, Morton, and Stark Counties
Antelope Hills Wind Project, Mercer County
Silver Sage Wind Project, Oliver County

Dear Mr. Moreira:

This is in response to your August 6, 2010, solicitation of views and comments letters for the proposed Sunflower, Antelope Hills, and Silver Sage Wind Projects. The proposed projects would be developed by Sunflower Wind Project, LLC, Antelope Hills Wind Project, LLC, and Silver Sage Wind Project, LLC, all subsidiaries of Infinity Wind Power (Infinity).

The projects would consist of typical wind project construction, including erecting wind turbines and constructing associated facilities such as gravel access roads, an underground electrical collector system, electrical collector substation, and overhead transmission lines. The final locations of the turbines, access roads, and the electrical collector system have not yet been identified.

The following areas may be affected by the project:

Sunflower Wind Project:
Morton County: T. 138 N., R. 90 W., Sections 4-6
T. 139 N., R. 90 W., Sections 16-23, 26-33
Stark County: T. 138 N., R. 91 W., Sections 1, 2
T. 139 N., R. 91 W., Sections 23-25, 35, 36

Antelope Hills Wind Project:
Mercer County: T. 145 N., R. 88 W., Section 6, 7
T. 145 N., R. 89 W., Section 1-12
T. 145 N., R. 90 W., Sections 1-2, 11, 12
T. 146 N., R. 89 W., Sections 29-32
T. 146 N., R. 86 W., Sections 14, 15, 21-28, 33-36

Silver Sage Wind Project:

Oliver County: T. 142 N., R. 83 W., Section 13, 14, 23-26, 35, 36
T. 142 N., R. 82 W., Sections 8, 16-18, 19-22, 27-34
T. 141 N., R. 82 W., Section 3, 4

We offer the following comments under the authority of and in accordance with the Migratory Bird Treaty Act (16 U.S.C. 703 et seq.), Bald and Golden Eagle Protection Act (BGEPA) (16 U.S.C. 668-668d, 54 Stat. 250), Executive Order 13186 "Responsibilities of Federal Agencies to Protect Migratory Birds", the Endangered Species Act (ESA) (16 U.S.C. 1531 et seq.), the National Wildlife Refuge System Improvement Act of 1997 (Public Law 105-57), and the National Environmental Policy Act (NEPA).

The U.S. Fish and Wildlife Service (Service) holds certain resources in trust and manages them for the benefit of the American people. These resources include migratory birds, inter-jurisdictional fish, federally-listed threatened and endangered species of plants and animals and their habitats, and units of the National Wildlife Refuge system. One goal of Service policy is that conservation of fish and wildlife resources receive equal consideration with other features of resource development, and that conservation actions are coordinated with those other forms of development. Another goal is to conserve, protect, and enhance fish and wildlife and their habitats to facilitate the balanced development of the Nation's natural resources.

**Migratory Birds**

Adequate consideration for avian and other wildlife resources early in the site evaluation process can help to minimize impacts and facilitate project review. Wind developers are encouraged to avoid impacts to prairie and other native habitats to the maximum extent practicable. Avoidance of impacts can be most effectively achieved by taking a landscape scale view, beginning with the process of prospecting for suitable sites for wind power development. Companies should assess not only those factors that indicate favorable conditions for development, such as a consistent wind resource, access to transmission, willing landowners, available financing, etc., but also anticipated impacts to wildlife and their habitats. Equal consideration should be accorded to wildlife resource conservation as to other features of development. When considering a project in a particular wind resource area, companies should use all available tools to ensure they have taken all practicable steps to avoid impacts to native habitats. This can be accomplished by utilizing GIS products depicting significant areas of contiguous prairie to site development in areas that are already impacted or fragmented. This analysis and potential site comparison should be accomplished prior to making any significant financial commitments, including entering into lease agreements with landowners. The Service's Interim Wind Turbine Siting Guidelines encourage project proponents to conduct a Potential Impact Index (PII) analysis on several potential sites within wind resource areas to assist in their selection of a wind power site that minimizes the potential to impact migratory birds and other wildlife. If the Service's interim guidelines were not used to evaluate potential sites for development, the project developer should indicate which method(s) they used to assess avian and other wildlife resource impacts before selecting this site for development. The alternatives analysis for the project should describe the potential project sites that were evaluated and why they were rejected based on potential trust resource impacts.

The Service has coordinated with the Avian Power Line Interaction Committee (APLIC) to develop guidelines to assist companies in formulating Avian Protection Plans (APP). The guidelines can be accessed from APLIC's website at http://www.aplic.org/. These plans are utility specific and designed to reduce operational risks that result from avian interactions with electric utility facilities, but we suggest they may be adapted to wind energy facilities. Wind energy projects have the potential to negatively affect bats as well as avian species. Therefore, we encourage project developers to formulate an Avian and Bat Protection Plan (ABPP) if bats migrate through or may be present in the project area. The Service has issued an August 03, 2010, white paper with guidance related to the development of project specific ABPPs (enclosed) for renewable energy facilities. Some of the things that the Service looks for in an APP or ABPP are typically a statement of company policy confirming the company's commitment to work cooperatively towards the protection of migratory birds and bats; identification of the process under which the company will obtain and comply with all necessary permits, including, but not limited to, nest relocation, temporary possession, depredation, salvage/disposal, and scientific collection; discussion of the company's plan for monitoring and reporting all incidents of avian or bat injury or mortality; a commitment to make all reasonable efforts to construct and modify infrastructure to reduce the incidence of avian and bat mortality; a mechanism to review existing practices, ensuring quality control and allowing for adaptive management; and a plan for providing adequate training for all appropriate utility personnel. An APP or ABPP reporting system is important to help the company pinpoint areas of concern by tracking both the specific locations where mortalities may be occurring, as well as the extent of such mortalities and the remedial actions taken/planned to address identified problem areas.

To minimize the electrocution hazard to birds, the Service, with support from the Rural Utilities Service, recommends that new or updated overhead power lines be constructed in accordance with the current guidelines for preventing raptor electrocutions. The recommended guidelines can be found in "2006 Suggested Practices for Avian Protection on Power Lines". To increase power line visibility and reduce bird fatalities resulting from collisions with power lines, the Service recommends all new power lines that cross or run adjacent to rivers or large wetlands be modified according to "Mitigating Bird Collisions with Power Lines: The State of the Art in 1994". Both publications can be obtained by writing or calling the Edison Electric Institute, P.O. Box 266, Waldorf, Maryland 20604-0266, (1-800-334-5453) or visiting their website at www.eei.org.

The MBTA prohibits the taking, killing, possession, and transportation, (among other actions) of migratory birds, their eggs, parts, and nests, except when specifically permitted. While the Act has no provision for allowing unintentional take, the Service realizes that some birds may be killed during wind project construction and operation even if all known reasonable and effective measures to protect birds are used. The Office of Law Enforcement (OLE) carries out its mission to protect migratory birds through investigations and enforcement, as well as by fostering relationships with individuals, companies, and industries that have taken effective steps to avoid take of migratory birds and by encouraging others to implement measures to avoid take of migratory birds. It is not possible to absolve individuals, companies, or agencies from liability even if they implement bird mortality avoidance or other similar protective measures. However, OLE focuses its resources on investigating and prosecuting individuals and companies that take migratory birds without identifying and implementing all reasonable, prudent, and effective measures to avoid that take. Companies are encouraged to work closely with Service biologists to identify available protective measures when developing project plans and/or avian protection plans, and to implement those measures prior to/during project construction and operation.

To the extent practicable, construction should be scheduled for late summer or fall/early winter so as not to disrupt waterfowl or other wildlife during the breeding season (February 1 to July 15). If work is proposed to take place during the breeding season or at any other time which may result in the take of migratory birds, their eggs, or active nests, the Service recommends that the project proponent take all practicable measures to avoid and minimize take, such as maintaining adequate buffers, to protect the birds until the young have fledged. The Service further recommends that if field surveys for nesting birds are conducted with the intent of avoiding take, that any documentation of the presence of migratory birds, eggs, and active nests, along with information regarding the qualifications of the biologist(s) performing the surveys, and any avoidance measures implemented at the project site be maintained. Should surveys or other available information indicate a significant impact to migratory birds, the Service requests that this office be contacted for further consultation on the extent of the impact and the long-term implications of the intended use of the project on migratory bird populations.

**Bald and Golden Eagles**

The BGEPA, prohibits anyone from taking bald eagles, including their parts, nests, or eggs without a permit issued by the Secretary of the Interior. The Act provides criminal and civil penalties for persons who take, possess, sell, purchase, barter, offer to sell, purchase or barter, transport, export or import, at any time or any manner, any bald eagle ... [or any golden eagle], alive or dead, or any part, nest, or egg thereof. The Act defines take as pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb. "Disturb means to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, 1) injury to an eagle, 2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior." In addition to immediate impacts, this definition also covers impacts that result from human-induced alterations initiated around a previously used nest site during a time when eagles are not present, if, upon the eagles return, such alterations agitate or bother an eagle to a degree that injures an eagle or substantially interferes with normal breeding, feeding, or sheltering habits and causes, or is likely to cause, a loss of productivity or nest abandonment.

While the bald eagle tends to be more closely associated with forested areas near water (Buehler 2000), they have been found nesting in single trees several miles from the nearest water body. Especially early in the nesting season, eagles can be very sensitive to disturbance near the nest site and may abandon their nest as a result of low disturbance levels, even from foot traffic. A buffer of at least 1/2 mile should be maintained for all bald and golden eagle nests. A permit is required for any take of golden eagles or their nests. Permits to take golden eagles or their nests are available only for legitimate emergencies and as part of a program to protect golden eagles.

The Service is not currently aware of any bald or golden eagle nests in the immediate vicinity of the project areas. There are numerous documented bald eagle nests in Mercer, Morton, and Oliver Counties. The Service recommends surveying for bald and golden eagle nests out ½ mile from the proposed project areas. If any nests are found during the survey, the Service recommends that Infinity document the location and contact the Service for further coordination. The Service has developed national guidelines regarding bald eagle management and recommends that Infinity review these guidelines during the project planning process. The guidelines are available at http://www.fws.gov/southdakotafieldoffice/NationalBaldEagle ManagementGuidelines.pdf.

**Threatened and Endangered Species**

A list of federally threatened and endangered species that may occur within the proposed project's area of influence is (enclosure 1). This list fulfills requirements of the Service under the ESA.

If a Federal agency authorizes, funds, or carries out a proposed action, the responsible Federal agency, or its delegated agent, is required to evaluate whether the action "may affect" listed species or critical habitat. This includes funding available from the U.S. Treasury Department under the American Recovery and Reinvestment Act. If the Federal agency or its designated agent determines the action "may affect, is likely to adversely affect" listed species or result in destruction or adverse modification of critical habitat, the responsible Federal agency shall request formal section 7 consultation with this office. If the evaluation shows a "no effect" determination for listed species or critical habitat, further consultation is not necessary. If a private entity receives Federal funding for a construction project, or if any Federal permit or license is required, the Federal agency may designate the fund recipient or permittee as its agent for purposes of informal section 7 consultation. The funding, permitting, or licensing Federal agency is responsible to ensure that it's actions comply with the ESA, including obtaining concurrence from the Service for any action that may affect a threatened or endangered species or result in the destruction or adverse modification of designated critical habitat.

The Aransas Wood Buffalo Population (AWBP) of whooping cranes is the only self sustaining migratory population of whooping cranes remaining in the wild. These birds breed in the wetlands of Wood Buffalo National Park in Alberta and the Northwest Territories of northern Canada, and overwinter on the Texas coast. Whooping cranes in the AWBP annually migrate through North Dakota during their spring and fall migrations.

Endangered whooping cranes have been documented using stopover habitat in the vicinity of this proposed project area. The proposed project areas are located within those portions of the whooping crane migration corridor that include 75-95% of all confirmed whooping crane sightings in North Dakota (enclosure 2). The presence of suitable roosting and feeding habitat for whooping cranes, and location within the whooping crane migration corridor, document the potential for whooping crane presence in the proposed project area. A wind energy project in this wind resource area has the potential to affect whooping cranes during their annual spring and fall migration through North Dakota. Potential effects may be direct (e.g. collision mortality) or indirect (e.g. avoidance of the site resulting in cranes seeking alternate habitat). The best available information indicates that whooping cranes avoid stopover habitat that is developed with wind energy appurtenances, particularly wind turbines. This avoidance may deny them the use of important habitat, and thus may result in an adverse effect in the form of harm by significant habitat modification. Whooping cranes use migration stopover habitat opportunistically and may not use the same stopovers annually. Whooping cranes often stop wherever they happen to be late in the day when they find conditions no longer suitable for migration. This tendency can make for a very unpredictable pattern of stopover use, depending on daily weather conditions. The Service recommends mapping wetlands at the project site within one (1) mile of all turbines, identifying potentially suitable whooping crane stopover habitat, and analyzing the potential effects to migrating whooping cranes from loss of use of this habitat for migration stopovers.

The interactions of whooping cranes with wind turbines and wind farms are currently not fully known, although it is expected that these large birds with relatively low maneuverability are susceptible to mortality via collisions with turbines. The highest known source of mortality to fledged whooping cranes is from striking power lines. Currently, collisions with power lines have accounted for the death or serious injury of at least 46 whooping cranes since 1956. If power lines will be constructed in association with this project, the Service recommends they be placed underground to avoid collision mortality. If underground construction is not practicable, we recommend installation and maintenance of visual marking devices on all new power lines within one mile of potentially suitable whooping crane stopover habitat, and an equal length of existing power line in the whooping crane migration corridor within one mile of potentially suitable whooping crane habitat.

Any party is responsible to ensure that their activities comply with pertinent Federal Laws, including the ESA, BGEPA, and the MBTA, even in the absence of a Federal nexus. If an activity is likely to result in "take" of a federally-listed species, the project proponent or landowner has the option of developing a Habitat Conservation Plan (HCP) in consultation with FWS. Using the voluntary guidelines referenced above will help to ensure compliance with the MBTA and BGEPA. The Service requests that Infinity respond to the Service indicating how Infinity intends to demonstrate compliance with applicable Federal wildlife laws. While the projects' potential for take has not yet been determined, Infinity should note that if "take" of any federally listed threatened or endangered species is anticipated, Infinity is advised to develop an HCP and apply for an Incidental Take Permit (ITP).

**Fish and Wildlife Service Property Interests**

The Service administers Waterfowl Production Areas owned in fee title as well as wetland and grassland easements throughout North Dakota. A review of Service realty records for the proposed project area indicates Service property interests are located in the proposed project area. Wetland easements are legal agreements with private landowners that permanently protect wetland basins from being drained, burned, leveled, or filled. Grassland easements are legal agreements with landowners that permanently protect grassland vegetation, primarily native prairie, from being destroyed or developed. Grassland easements prevent these grasslands from being converted to cropland. Mowing, haying, and grass seed harvesting must be delayed on grassland easements until after July 15 each year to protect grassland nesting birds. The primary responsibility in protecting these interests is to review all proposed uses to ensure that the requests are compatible with Service easement regulations and various laws and policies. These comments and suggestions are made in an attempt to accomplish three goals: 1) avoid impacts to Service grassland and wetland easements in the project area as much as possible; 2) if unavoidable, ensure that any proposed turbine and associated infrastructure impacts (roads, buried collection lines, transmission lines, sub-stations, etc.) on any Service easement areas are kept to an absolute minimum; and 3) investigate all potential alternatives to eliminate or reduce impacts to easement areas to protect the integrity of the easement.

**High Value Habitat Avoidance**

High value wildlife habitat types in North Dakota include native prairies, wetlands, wooded draws, and riparian forests. We recommend that construction of wind towers and appurtenant facilities in the above habitat types be avoided whenever possible.

Since the 1800s, North Dakota has lost approximately 75 percent of its native grasslands, primarily due to crop production. Native prairie has significant natural resource values including:

- Provides habitat for a number of migratory and resident grassland birds whose populations are declining.
- Provides nesting habitat for millions of waterfowl.
- Contains 200-300 plant species, which provide genetic diversity important to agriculture and medicine.
- Provides habitat for thousands of insects including the Dakota skipper, a candidate species for listing under the ESA, and other butterflies (Ex: Regal fritillary, Tawny crescent).
- Crucial for soil and water conservation.
- Provides recreational opportunities (hunting, bird watching/wildlife observation, hiking).
- Living laboratories for scientific research.

Our review of NWI maps indicates that wetland areas are located within the project areas. NWI data can be accessed directly by visiting their website at (wetlands.fws.gov). Section 404 of the Clean Water Act regulates placement of fill materials in certain wetlands. A Corps of Engineers' 404 permit may be required if fill material will be placed in aquatic sites, including wetlands.

The project proponent should contact Mr. Dan Cimarosti, Regulatory Office, Corps of Engineers, 1513 South 12th Street, Bismarck, North Dakota 58504 (701-255-0015), to determine their permit requirements. If a 404 permit is required, the Service will also provide recommendations on this project to the Corps.

Construction activities should be conducted in a manner that will minimize impacts to the wildlife and the existing habitat in the project area. To help avoid impacts, we recommend the project proponent:

- Reseed disturbed native prairie with a diverse native grass/forb seed mixture. Obtain seed stock from nurseries within 250 miles of the project area to insure the particular cultivars are well adapted to the local climate.
- Minimize grassland disturbance by using fewer, larger turbines, and limiting new road construction.
- Design meteorological towers to be self standing (no guywires). If towers must be guyed, install and maintain appropriate visual line marking devices to reduce the potential for avian collision mortality
- Locate appurtenant facilities to avoid placement of fill in wetlands along the route.
- Install and maintain appropriate erosion control measures to reduce sedimentation and water quality degradation of wetlands and streams near the project area.
- Replace unavoidable wetland losses with functionally equivalent wetlands.

**Research, Monitoring, and Assessment**

We recommend project proponents conduct collision monitoring studies designed to determine the effect of several factors, such as site selection, turbine designs, the layout of wind plants, wind plant operations, habitat alteration, and changes in available perching and nesting sites, on bird deaths. Annual reports outlining the results of these monitoring studies should be submitted to this office. The Avian Subcommittee of the National Wind Coordinating Committee (NWCC) has developed a guidance document to assist wind energy developers in designing studies that will produce credible and comparable results of avian interaction with wind power plants. The NWCC document, "Studying Wind Energy/Bird Interactions: A Guidance Document. Metrics and methods for determining or monitoring potential impacts on birds at existing and proposed wind energy sites," can be obtained by contacting the National Wind Coordination Committee, c/o RESOLVE, 1255 23rd Street, Suite 275, Washington, D.C. 20037, or by visiting their website at (www.nationalwind.org).

We wish to stress the importance of implementing the recommendations contained in this letter, and of coordinating in a substantive and ongoing way with this office as your project planning proceeds. The way in which your company implements the Service's recommendations will determine whether or not your projects can be certified as complying with Federal wildlife laws.

Thank you for the opportunity to provide comments. If you require further information as project planning proceeds, please contact Breanne Vander Naald of my staff, or contact me directly, at (701) 250-4481, or at the letterhead address.

Sincerely,

Jeffrey K. Towner

Jeffrey K. Towner
Field Supervisor
North Dakota Field Office

Enclosures (3)

cc: Army Corps of Engineers, Bismarck
(Attn: Dan Cimarosti)
Director, ND Game & Fish, Bismarck
(Attn: Paul Schadewald)

WEST Inc.

ENVIRONMENTAL & STATISTICAL CONSULTANTS

4007 State Street, Suite 109, Bismarck, ND 58503
Phone: 701-250-1756 ◆ www.west-inc.com ◆ Fax: 701-250-1761

July 11, 2013

Casey Willis
Sunflower Wind Project, LLC
3760 State Street, Suite 102
Santa Barbara, CA 93105

**RE: Sunflower Raptor Nest Surveys**

Dear Mr. Willis,

As part of agency approved baseline survey efforts, surveys for raptor nests were completed at the Sunflower Wind Energy Project (Project) on April 2, 2013 by a qualified biologist from Western EcoSystems Technology, Inc. Surveys were completed from the air in a helicopter before leaf out when raptors would be actively tending to a nest or incubating eggs. Aerial surveys were conducted in accordance with the guidance provided in the U.S. Fish and Wildlife Service (USFWS) Inventory and Monitoring Protocols (Pagel et al. 2010). An experienced raptor ecologist and a helicopter pilot skilled at this type of survey were used. Raptors are defined here as kites, accipiters, buteos, harriers, eagles, falcons, and owls. Surveys focused on locating large, stick nest structures in suitable raptor nesting substrate (trees, transmission lines, cliff faces, etc.) within the proposed Project and a one mile buffer. Additionally, a second buffer was surveyed out to 10 miles to document any eagle nests (Figure 1). Efforts were made to minimize disturbance to nesting raptors; the greatest possible distance at which the species could be identified was maintained, with distances varying depending upon nest location and wind conditions.

In general, all potential eagle and raptor nest habitat was surveyed, flying at speeds of 60-75 mph throughout the proposed Project and associated buffers. Additionally, one known bald eagle (*Haliaeetus leucocephalus*) nest location provided by the North Dakota Game and Fish Department (NDGFD 2013) was surveyed for nest status and condition. The survey was conducted between 0800 hours and 1700 hours. The locations of all potential raptor nests were recorded using a hand-held Global Positioning System (GPS); coordinates were set at Universal Transverse Mercator (UTMs) North American Datum (NAD) 83 unit. This included all confirmed and potential nests regardless of their activity status. To determine the status of a nest, the biologist relied on clues that included behavior of adults and presence of eggs, young, or

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whitewash. Attempts were made to identify the species of raptor associated with each active nest. Additionally, date, nest condition, and habitat were recorded. Nests located incidentally during ongoing avian point count surveys started in spring 2013 have also been included with the nest survey results reported below.

During the 2013 aerial survey and/or incidentally during avian point counts, 18 raptor nests representing five species were documented within the Project and associated buffers (Tables 1 and 2; Figures 1 indicates bald eagle nests and 10 mile buffer and Figure 2 indicates raptor nets within 1 mile buffer). Of these nests, the historic eagle nest noted by the NDGFD was confirmed as an occupied bald eagle nest, four nests were identified as potential inactive bald eagle nests (i.e. large enough for a bald eagle to use), one occupied/active burrowing owl (*Athene cunicularia*) nest, three occupied/active great horned owl (*Bubo virginianus*) nests, three occupied/active red-tailed hawk (*Buteo jamaicensis*) nests, three occupied/active Swainson's hawk (Buteo swainsoni) nests, and three inactive raptor nests (Table 1, Figures 1 and 2). No potential or occupied bald eagle nests were located within the project or 1 mile buffer, all were approximately 8 miles or more from the project boundary (Figure 1)

Incidental observations included seven separate sightings of bald eagles flying or perched within the 10-mile buffer, as well as a potential bald eagle winter roost site along the Heart River (Table 3, Figure 1). The potential bald eagle winter roost consisted of several bald eagles of different ages perched in trees along the river during the morning hours. It is not known if this is a regular roost location.

If you have any questions or require additional information, please feel free to call me at 701-250-1756.

Sincerely,

Clayton Derby
Senior Manager

WEST Inc.
ENVIRONMENTAL & STATISTICAL CONSULTANTS
4007 State Street, Suite 109, Bismarck, ND 58503
Phone: 701-250-1756 ◆ www.west-inc.com ◆ Fax: 701-250-1761

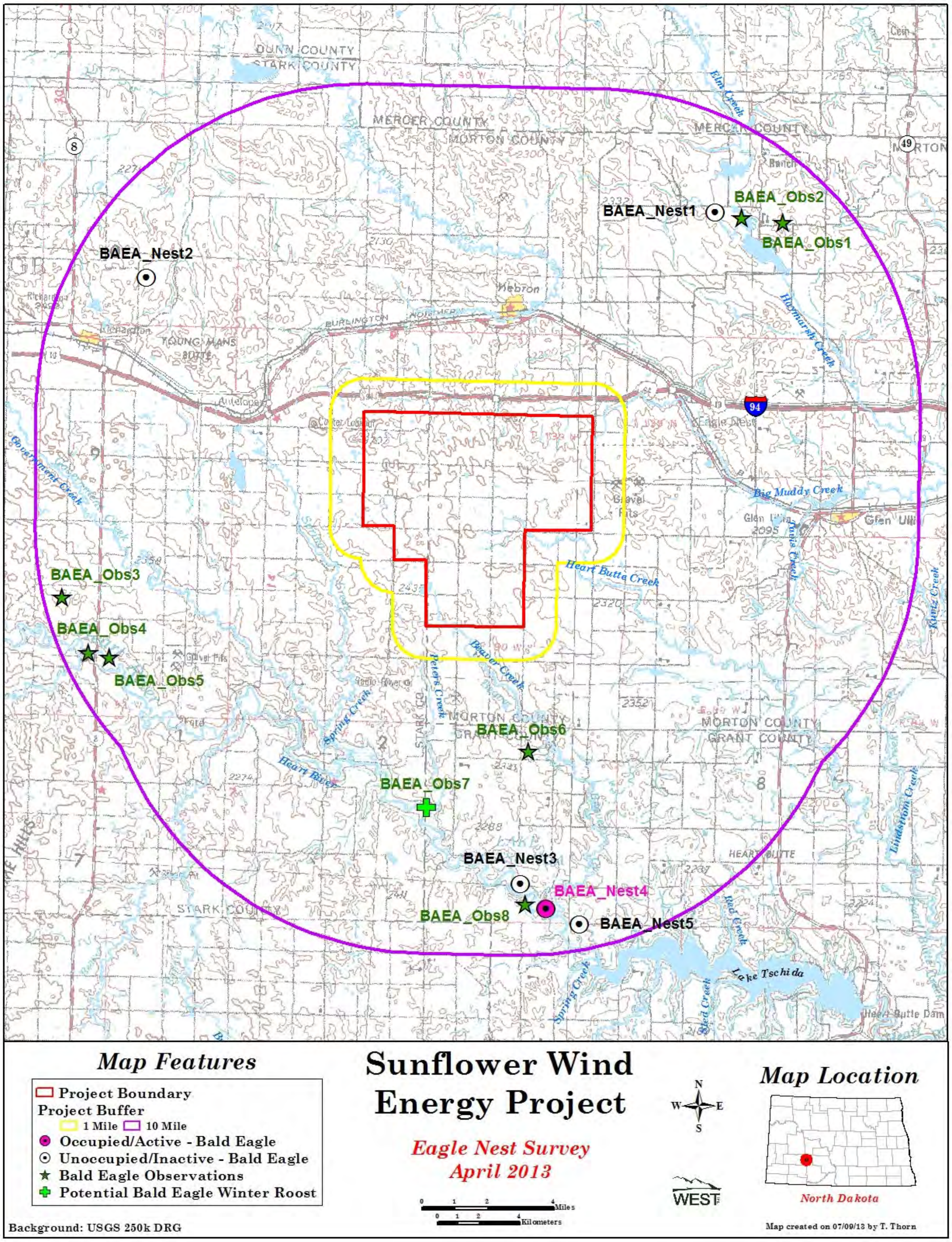


**Figure 1. Bald eagle nests and bald eagle incidental observations documented at the Sunflower Wind Energy Project and 10-mile buffer in spring 2013.**

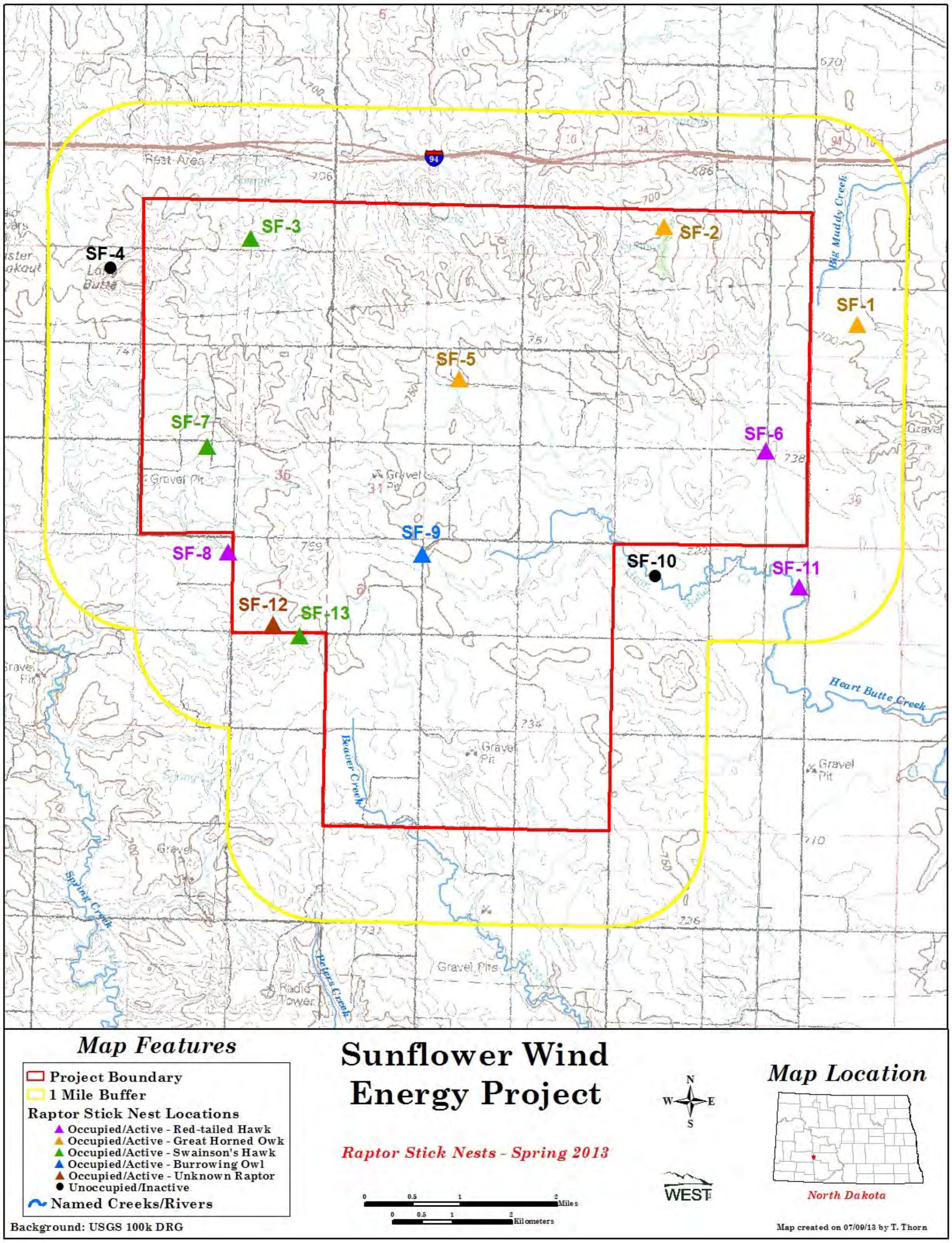


**Figure 2. Raptor nests documented at the Sunflower Wind Energy Project in spring 2013.**

WEST Inc.
ENVIRONMENTAL & STATISTICAL CONSULTANTS
4007 State Street, Suite 109, Bismarck, ND 58503
Phone: 701-250-1756 ◆ www.west-inc.com ◆ Fax: 701-250-1761

**Table 1. Bald eagle nests and potential bald eagle nests identified during the 2013 survey for the Sunflower Wind Energy Project (NAD83, Zone 13).**

| Unique ID | Northing | Easting | Species | Nest Substrate | Status at time of Survey | Condition | Comments |
|---|---|---|---|---|---|---|---|
| BAEA_Nest1 | 5203810 | 734794 | Potential Bald Eagle | Tree | Unoccupied – inactive | Good | Very large nest, eagle activity in the area |
| BAEA_Nest2 | 5198996 | 707105 | Potential Bald Eagle | Tree | Unoccupied – inactive | Good | Very large nest with potential to be used by an eagle |
| BAEA_Nest3 | 5170347 | 727116 | Potential Bald Eagle | Tree | Unoccupied – inactive | Good | Very large nest, eagle activity in the area |
| BAEA_Nest4 | 5169145 | 728457 | Bald Eagle | Tree | Historic Occupied – active | Good | One adult sitting low in nest and second perched in tree close by |
| BAEA_Nest5 | 5168496 | 730096 | Potential Bald Eagle | Tree | Unoccupied – inactive | Fair | Three nests stacked in one tree, eagle activity in the area |

**Table 2. Non-eagle raptor nests identified during the 2013 survey for the Sunflower Wind Energy Project (NAD83, Zone 14).**

| Unique ID | Northing | Easting | Species | Nest Substrate | Status at time of Survey | Condition |
|---|---|---|---|---|---|---|
| SF-1 | 5191511 | 272694 | Great Horned Owl | Tree | Occupied – active | Good |
| SF-2 | 5193220 | 269476 | Great Horned Owl | Tree | Occupied – active | Good |
| SF-3 | 5193152 | 262521 | Swainson's Hawk | Tree | Occupied – active | Good |
| SF-4 | 5192701 | 260147 | Unknown Raptor | Tree | Unoccupied – inactive | Good |
| SF-5 | 5190730 | 265989 | Great Horned Owl | Tree | Occupied – active | Good |
| SF-6 | 5189415 | 271112 | Red-tailed Hawk | Tree | Occupied – active | Good |
| SF-7 | 5189679 | 261729 | Swainson's Hawk | Tree | Occupied – active | Good |
| SF-8 | 5187890 | 262038 | Red-tailed Hawk | Tree | Occupied – active | Good |
| SF-9 | 5187793 | 265302 | Burrowing Owl | Ground | Occupied – active | Good |
| SF-10 | 5187352 | 269208 | Unknown Raptor | Tree | Unoccupied – inactive | Good |
| SF-11 | 5187127 | 271628 | Red-tailed Hawk | Tree | Occupied – active | Good |
| SF-12 | 5186667 | 262774 | Unknown Raptor | Tree | Occupied – active | Good |
| SF-13 | 5186465 | 263210 | Swainson's Hawk | Tree | Occupied – active | Good |

**Table 3. Nest density for the Sunflower Wind Energy Project, based on raptor nest surveys.**

| Species | # of nests within Project | # of nests within 1-mi buffer of Project | # of nests within 10-mi buffer of Project | Density | | |
|---|---|---|---|---|---|---|
| | | | | Project (# of nests/mi$^2$) | 1-mi buffer of Project (#nests/mi$^2$) | 10-mi buffer of Project (#nests/mi$^2$) |
| Bald Eagle – Occupied, active | 0 | 0 | 1 | 0 | 0 | < 0.01 |
| Potential Bald Eagle – Unoccupied, inactive | 0 | 0 | 4 | 0 | 0 | 0.01 |
| Burrowing Owl | 1 | 0 | 0 | 0.03 | 0 | 0 |
| Great horned Owl – Occupied, active | 2 | 1 | 0 | 0.06 | 0.02 | 0 |
| Red-tailed hawk – Occupied, active | 1 | 2 | 0 | 0.03 | 0.03 | 0 |
| Swainson's hawsk – Occupied, active | 2 | 1 | 0 | 0.06 | 0.02 | 0 |
| Unknown raptor – Occupied, active | 1 | 0 | 0 | 0.03 | 0 | 0 |
| Unknown raptor – Unoccupied, inactive | 0 | 2 | 0 | 0 | 0.03 | 0 |
| **Total** | **7** | **6** | **5** | **0.21** | **0.10** | **0.01** |

**Table 4. Bald eagle incidental observations during 2013 nest surveys for the Sunflower Wind Energy Project (NAD83, Zone 14).**

| Unique ID | Northing | Easting | Comments |
|---|---|---|---|
| BAEA_Obs1 | 5202750 | 281500 | 1 adult and 1 2nd year juvenile eating carrion |
| BAEA_Obs2 | 5203000 | 279500 | 1 adult perched in tree |
| BAEA_Obs3 | 5185000 | 245750 | 1 adult flying |
| BAEA_Obs4 | 5182250 | 247000 | 1 adult flying |
| BAEA_Obs5 | 5182000 | 248000 | 1 2nd year juvenile flying |
| BAEA_Obs6 | 5177000 | 268500 | 1 adult perched in tree |
| BAEA_Obs7 | 5175000 | 263000 | 1 2nd year juvenile and 8 adult eagles perched in the same tree, potential winter roost site |
| BAEA_Obs8 | 5169500 | 268200 | 2 adults flying |

# Wildlife Baseline Studies for the Sunflower Wind Project Morton and Stark Counties, North Dakota

## 2013 Sharp-tailed Grouse Lek Report

**Prepared for:**

Sunflower Wind Project, LLC,
a subsidiary of Infinity Wind Power
3760 State St., Suite 102
Santa Barbara, CA 93105


**Prepared by:**

**Clayton Derby and Terri Thorn**

Western EcoSystems Technology, Inc.
4007 State St., Suite 109
Bismarck, North Dakota


**June 22, 2013**

NATURAL RESOURCES ◆ SCIENTIFIC SOLUTIONS

# EXECUTIVE SUMMARY

Western EcoSystems Technology, Inc. conducted sharp-tailed grouse lek aerial surveys in April and May 2013 at the Sunflower Wind Project which is located in Morton and Stark Counties, North Dakota. This report presents results of those surveys.

Approximately 308.1 kilometers (191.5 miles) of transects were surveyed during each of three time periods (April 10-11, April 22-23, and May 6-7). Eight confirmed (birds observed in courtship behavior at the same location during more than one survey) and five possible (birds observed in courtship behavior during only one survey) leks were recorded during the three survey periods. Six confirmed and three possible leks were observed within the project boundary while two confirmed and two possible leks were recorded outside the Sunflower Wind Project.

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# INTRODUCTION

Sunflower Wind Project, LLC, a subsidiary of Infinity Wind Power (Infinity), is proposing to construct a wind energy facility in Morton and Stark Counties North Dakota referred to as the Sunflower Wind Project (SWP). Infinity contracted Western EcoSystems Technology, Inc. (WEST) to develop and implement a standardized protocol for baseline wildlife studies at the SWP to estimate impacts of the proposed wind energy facility on wildlife and to assist with siting turbines to minimize impacts to wildlife resources.

This report presents results of aerial sharp-tailed grouse (*Tympanuchus phasianellus*) lek surveys conducted during April and May 2013. Data includes sharp-tailed grouse lek locations, number observed, and lek status.

# STUDY AREA

The SWP, currently about 21,647 acres (ac; 89 square kilometers [$km^2$]; 34 square miles [$mi^2$]) is located in west-central North Dakota and more specifically western Morton and eastern Stark Counties. The landscape within the SWP is generally flat with more rolling lands in the northern third of the project area. Historically, the SWP's landscape was dominated by grasslands but has since been converted largely to agricultural use with crop production and livestock grazing the primary practices. Trees and shrubs can be found around farmsteads, within planted shelter belts, and along/within drainages. Wetlands are scattered throughout the SWP with many being man-made.

# METHODS

The objective of the aerial sharp-tailed grouse lek survey was to determine the approximate location of sharp-tailed grouse leks and provide a general sense of sharp-tailed grouse use within and immediately adjacent to the SWP during peak lekking activity (early April through mid-May). Survey methodology was similar to that used for greater prairie chickens (*Tympanuchus cupido*) in Oklahoma (Martin and Knopf 1981) and other wind sites in North and South Dakota.

North/south running transects started 800 meters (m; 0.5 miles [mi]) outside the east/west project boundary and were placed at 400 m (0.25 mi) intervals, covering the entire SWP (Figure 1). The length of each transect varied based on the project boundary but each transect extended 800 m (0.5 mi) beyond the boundary. Each transect was flown by fixed-winged aircraft at an approximate height of 30 to 45 m (100 – 150 feet) during three separate survey periods. Surveys were conducted approximately two weeks apart and occurred during the normal sharp-tailed grouse lekking period on the Northern Plains. Surveys began between 15 minutes before sunrise and sunrise depending on cloud cover and lasted for up to 2.5 hours.

The location of any sharp-tailed grouse observed was recorded with a global positioning system (GPS) unit. The number, activity, and lek status at each location was recorded.

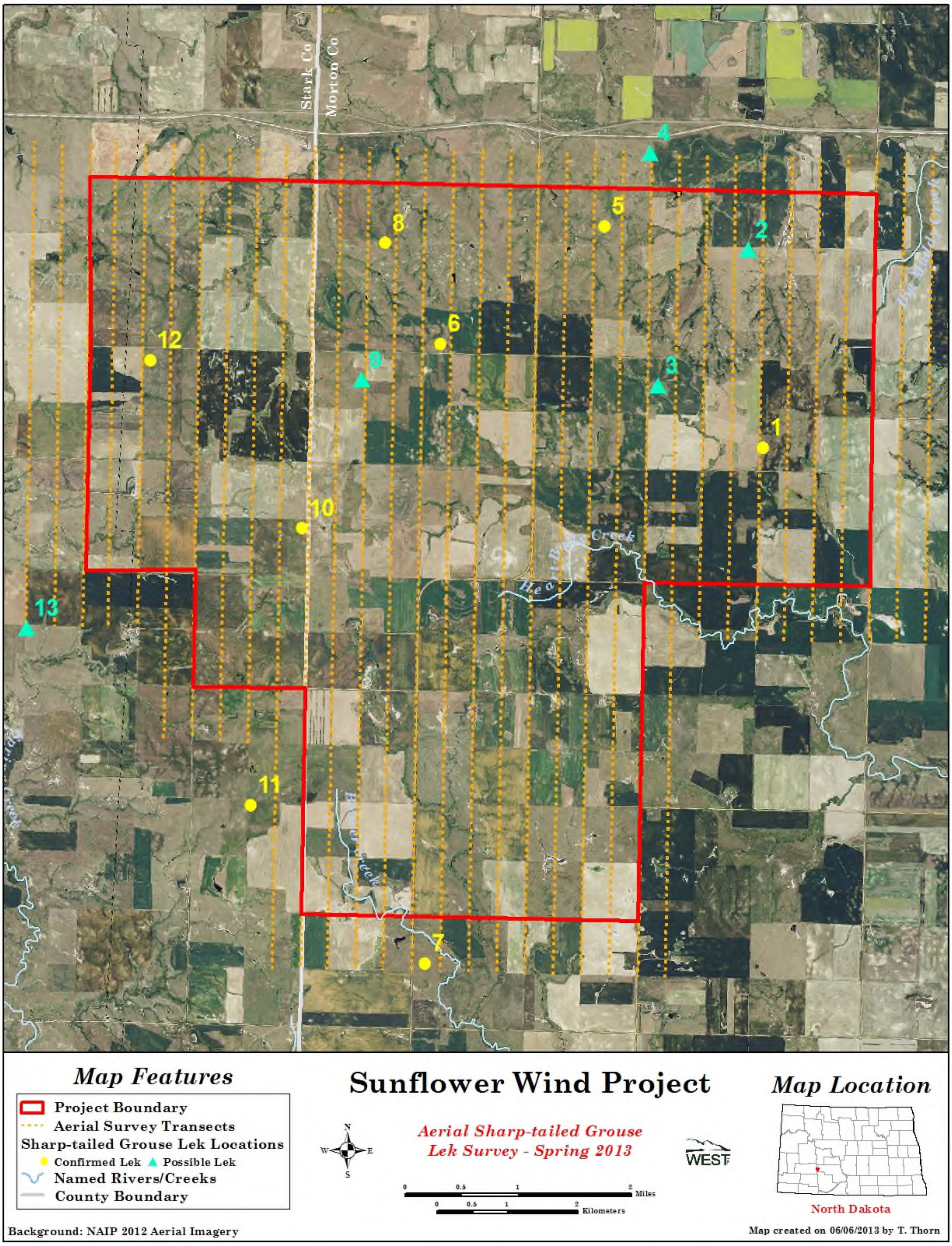


**Figure 1. Sharp-tailed grouse leks at the Sunflower Wind Project during spring 2013.**

# RESULTS

Approximately 308.1 km (191.5 mi) of transects were surveyed during each of three time periods: (April 10-11, April 22-23, and May 6-7). Eight confirmed (birds observed in courtship behavior at the same location during more than one survey) and five possible (birds observed in courtship behavior during only one survey) leks were recorded during the three survey periods (Table 1; Figure 1). Six confirmed and three possible leks were observed within the project boundary while two confirmed and two possible leks were recorded outside the SWP (Figure 1). The nine leks within the SWP yields a density of one lek per 3.8 $mi^2$. The maximum number of sharp-tailed grouse record on leks ranged from seven at lek nine to 30 at lek 12 (Table 1). The majority of leks were observed within the northern half of the study area (Figure 1). All leks were recorded within grassland/hayland habitat.

**Table 1. Summary of aerial sharp-tailed grouse lek surveys conducted during spring 2013 at the Sunflower Wind Project.**

| Lek ID | Date First Observed | Other Dates Observed | Highest Total | Lek |
|---|---|---|---|---|
| 1 | 4/10 | 4/22, 5/06 | 21 | confirmed |
| 2 | 4/10 | | 12 | possible |
| 3 | 4/10 | | 14 | possible |
| 4 | 4/22 | | 8 | possible |
| 5 | 4/10 | 4/22, 5/06 | 8 | confirmed |
| 6 | 4/10 | 4/22 | 9 | confirmed |
| 7 | 4/22 | 5/06 | 18 | confirmed |
| 8 | 4/10 | 4/22 | 16 | confirmed |
| 9 | 4/22 | | 7 | possible |
| 10 | 4/11 | 4/23, 5/07 | 25 | confirmed |
| 11 | 4/11 | 4/23, 5/07 | 29 | confirmed |
| 12 | 4/11 | 4/23, 5/07 | 30 | confirmed |
| 13 | 5/07 | | 18 | possible |

# DISCUSSION

The majority of the SWP was lightly snow covered during the first survey period. The SWP was heavily snow covered during the second survey period due to a major winter storm on April 13th and 14th. It did not appear that snow cover, even significant snow cover, deterred sharp-tailed grouse from mating activities as evidenced by the number of leks initially observed or confirmed during the first two survey periods (Table 1).

Considering the preferred habitat requirements of sharp-tailed grouse, it is not surprising that the majority of leks were found within or adjacent to short grass habitat. This habitat type is found mainly along the north and west side of the study area. This survey was not intended to estimate the sharp-tailed grouse population in and around the SWP but the relative large number of birds recorded at some leks (30 at lek 12, 29 at lek 11, and 25 at lek 10) may suggest a healthy sharp-tailed grouse population within the area.

## REFERENCES

Martin, S.A. and F.L. Knopf. 1981. Aerial Survey of Greater Prairie Chicken Leks. Wildlife Society Bulletin 9(3): 219-221.

# Wildlife Baseline Studies for the Sunflower Wind Resource Area Morton and Stark Counties, North Dakota

## FPIC Interim Report

## March 2013 – August 2013

**Prepared for:**

**Sunflower Wind Project, LLC**

a subsidiary of Infinity Wind Power
3760 State St., Suite 102
Santa Barbara, California 93105

**Prepared by:**


**Clayton Derby, Terri Thorn, and Kimberly Bay**

Western EcoSystems Technology, Inc.
4007 State Street, Suite 109
Bismarck, North Dakota 58503


**November 8, 2013**

# EXECUTIVE SUMMARY

Sunflower Wind Project, LLC, (Sunflower) a subsidiary of Infinity Wind Power, has proposed a wind energy facility in Morton and Stark Counties, North Dakota, referred to as the Sunflower Wind Project (SFWP). Sunflower contracted Western EcoSystems Technology, Inc. (WEST) to conduct surveys and monitor wildlife resources in the SFWP to estimate the impacts of facility construction and operations on wildlife. The following seasonal interim report contains results for fixed-point bird use surveys and incidental wildlife observations. Seasonal interim reports are designed to give Infinity an early warning of high wildlife use or if sensitive species are observed within the study area.

Fixed-point surveys included in this report were conducted from March 20, 2013, through August 21, 2013, at 10 points established throughout the SFWP. A total of 152 60-minute (min) fixed-point surveys were completed, and 65 unique bird species were identified; a total of 5,792 individual birds within 1,247 separate groups were recorded.

Passerines were the most abundant bird type observed, accounting for 84.2% of all observations. This was primarily due to relatively high numbers of Lapland longspurs (1,530 individuals but in only two groups). Waterbirds, represented almost entirely by sandhill cranes, were the second most abundant bird type observed in the study area, representing 6.1% of all observations. A total of 79 diurnal raptors were observed, accounting for 1.4% of all individuals recorded. Northern harrier and Swainson’s hawk were the most commonly observed raptor species (20 and 19 individuals, respectively). Two individual bald eagles were observed in the spring.

One bald eagle was observed from fixed-point two, soaring in a southeasterly direction for eight min before it was lost from sight. The other bald eagle observation was recorded flying into the survey plot at fixed-point one from the south. It remained perched on a transmission line tower for the remaining seven min of the 60-min survey period.

There were no federally listed endangered, threaten or candidate species observed. Sixteen unique sensitive species totaling 248 individuals were recorded during all surveys at the SFWP. Six North Dakota Level I sensitive species were observed along with 10 North Dakota Level II sensitive species.

Fourteen unique bird species and four unidentified bird categories were observed incidentally, totaling 958 birds within 69 separate groups during the study. Three species, tundra swan, prairie falcon, and Say’s phoebe, were only seen incidentally at the SFWP. Six mammal and one amphibian species were also recorded incidentally at the SFWP. Two North Dakota State Level I sensitive species (Swainson’s hawk and upland sandpiper) were recorded incidentally within the project area.

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## INTRODUCTION

In 2013, Sunflower Wind Project, LLC (Sunflower), a subsidiary of Infinity Wind Power, contracted Western EcoSystems Technology, Inc. (WEST) to conduct surveys and monitor wildlife resources for the Sunflower Wind Project (SFWP) to estimate the impacts of wind energy facility construction and operations on wildlife. The following document contains results for fixed-point bird use surveys and incidental wildlife observations during spring and summer 2013 at the SFWP.

The purpose of this interim report is to bring items of biological interest to Sunflower's attention, such as seasonal diurnal raptor use and the presence of sensitive species. This interim report presents preliminary data on number of observations by species and bird type, eagle use, and sensitive species observations. The final report will include results for all data collected.

## STUDY AREA

The SFWP is located in Morton and Stark Counties, North Dakota, approximately three miles (4.8 kilometers [km]) south of the town of Hebron (Figure 1). The baseline wildlife surveys included a 21,947 acre area (ac; 89 square kilometers [$km^2$]; 34 square miles [$mi^2$]) located in west-central North Dakota and more specifically western Morton and eastern Stark Counties. The SFWP project itself would be located on approximately 9,000 acres. The landscape within the SWP is generally flat with more rolling lands in the northern third of the project area. Elevation ranges from 679 meters (m; 2,228 feet [ft]) to 817 m (2,679 ft). Historically, the SFWP's landscape was dominated by grasslands, but has since been converted largely to agricultural use with crop production and livestock grazing being the primary practices. Trees and shrubs can be found around farmsteads, within planted shelter belts, and along/within drainages. Wetlands are scattered throughout the SFWP, with many being man-made.

Cultivated cropland and herbaceous/pasture/hay lands are approximately equal in amount and compose almost 95% of the study area. Of the remaining 5%, 3.5% is developed, while wetlands, forest, and barren lands, in that order, make up the rest of the landscape (USGS NLCD 2006, Fry et al. 2011). Common agricultural crops include small grains, corn (*Zea mays*), sunflowers (*Helianthus annuus*), and alfalfa (*Medigo sativa*).

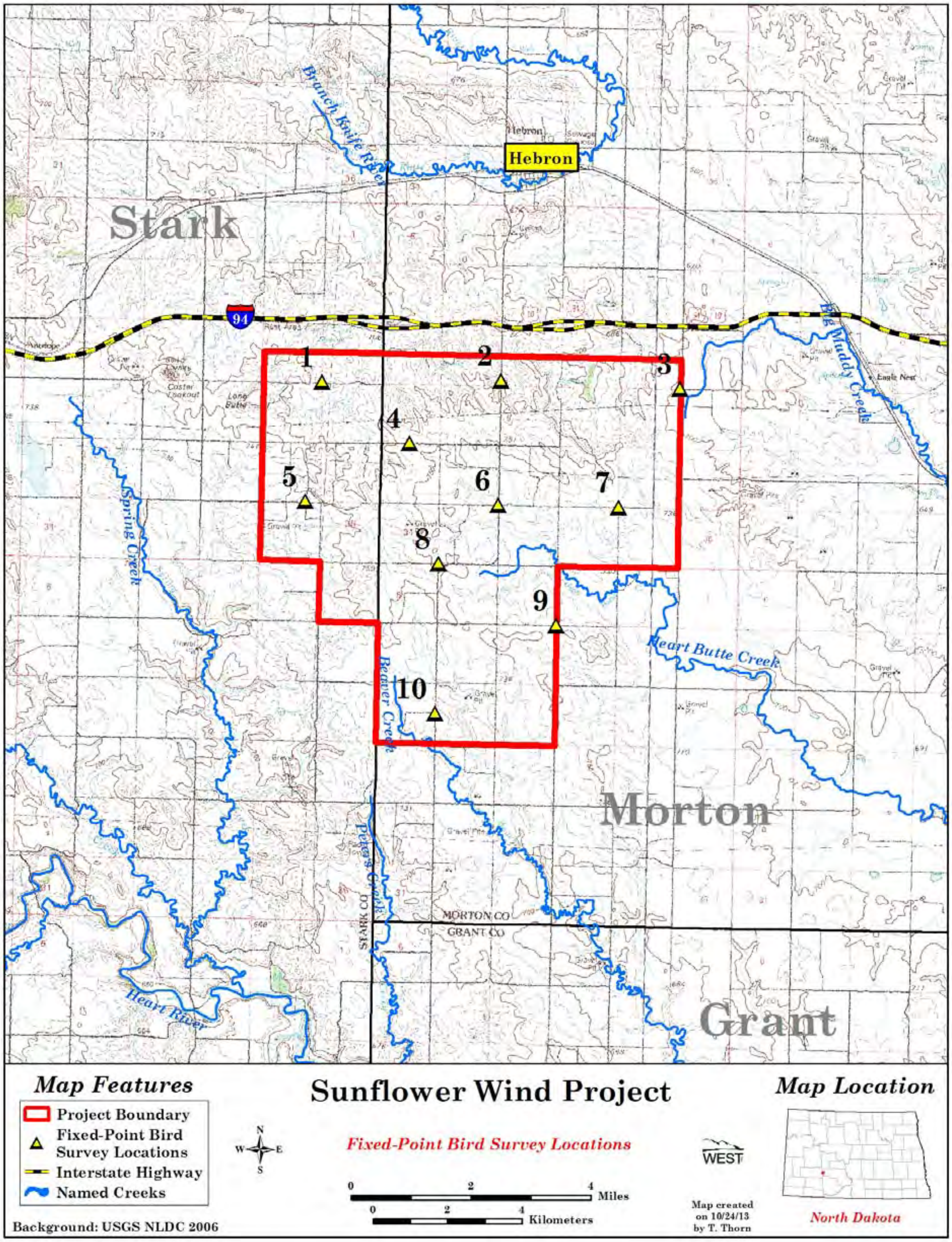


**Figure 1. Fixed-point bird survey locations at the Sunflower Wind Project.**

# METHODS

## Fixed-Point Bird Use Surveys

The objective of the fixed-point bird use surveys was to estimate the seasonal and spatial use of the study area by birds, particularly diurnal raptors (defined here as kites, accipiters, buteos, harriers, eagles, falcons, and osprey). Fixed-point bird surveys (variable circular plots) were conducted using methods described by Reynolds et al. (1980).

*Survey Plots*

Ten points were selected to survey representative habitats and topography of the SFWP, while achieving relatively even coverage of the study area (Figure 1). Each survey plot was a 1,600-m (5,250-ft or 1-mile) radius circle centered on the point.

*Survey Methods*

Each survey plot was surveyed for 60 minutes (min). Every bird observed during the first 20 min of each fixed-point bird use survey was recorded by a unique observation number. In some cases, the tally of observations may represent repeated sightings of the same individual. Observations of large birds beyond a 800-m (2,625-ft) radius were recorded, but were not included in statistical analyses. For small birds, observations beyond a 100 m (328 ft) radius were excluded. Large birds included waterbirds, waterfowl, rails and coots, grebes and loons, gulls and terns, shorebirds, diurnal raptors, owls, vultures, upland game birds, doves/pigeons, and large corvids (e.g., ravens, magpies, and crows), and goatsuckers. Passerines (excluding large corvids), kingfishers, swifts/hummingbirds, woodpeckers, and most cuckoos were considered small birds. During the next 40 min of the survey period, only eagles were recorded out to the 1,600-m radius.

The date, start and end time of the survey period, and weather information (e.g., temperature, wind speed, wind direction, and cloud cover) were recorded for each survey. Species or best possible identification, number of individuals, sex and age class (if possible), distance from plot center when first observed, closest distance, altitude above ground, activity (behavior), and habitat(s) were recorded for each observation. Bird behavior and habitat type were recorded based on the point of first observation. Approximate flight height and distance from plot center at first observation were recorded to the nearest 5-m (16-ft) interval. Other information recorded about the observation included whether or not the observation was auditory only and the 10-min interval of the 20-min survey in which it was first observed.  Eagle observations had distance from observer, activity and flight height recorded by minute for as long as they were observed within 60-min survey period. Flight direction was recorded on the field map.

*Observation Schedule*

Sampling intensity was designed to document bird use and behavior by habitat and season within the study area. Fixed-point bird use surveys were conducted from March 2013 through August 2013. Surveys were conducted approximately once per week during the spring (March through May) and every other week during the summer (June through August). Surveys were carried out during daylight hours and survey periods varied to approximately cover all daylight hours during a season. To the extent practical, each point was surveyed roughly the same number of times.

### Incidental Wildlife Observations

Incidental wildlife observations provide records of wildlife seen outside of the standardized surveys. All diurnal raptors, unusual or unique birds, sensitive species, mammals, reptiles, and amphibians were recorded in a similar fashion to standardized surveys. The observation number, date, time, species, number of individuals, sex/age class, distance from observer, activity, height above ground (for bird species) and habitat were recorded. The location of sensitive species was recorded by reference to site specific features and/or by Universal Transverse Mercator (UTM) coordinates using a hand-held Global Positioning System (GPS) unit.

## RESULTS

Surveys were completed within the SFWP from March 20, 2013, through August 21, 2013. Sixty-eight unique bird species, six mammal species, and one amphibian species were identified during the wildlife studies at the SFWP.

### Fixed-Point Bird Use Surveys

A total of 152 60-min fixed-point bird use surveys were conducted within SFWP during 17 visits from March to August, 2013. Ninety-eight fixed-point surveys were conducted in the spring during 11 visits, while 54 fixed-point surveys were conducted in summer through August 21 during six visits.  Not all point count locations were accessible during all surveys due to road conditions.

Sixty-five unique bird species were observed during fixed-point bird use surveys; a total of 5,792 individual birds were observed within 1,247 separate groups (defined as one or more individual) during the fixed-point surveys (Table 1). Passerines were the most abundant bird type observed, accounting for 84.2% of all observations. This was primarily due to relatively high numbers of Lapland longspurs (*Calcarius lapponicus*; 1,530 individuals but in only two groups). This species represents almost one-third of all passerines observed, but less than 1% of passerine groups recorded. Other common observed passerine species include common redpoll (*Acanthis flammea*; 642 individuals in 19 groups), horned lark (*Eremophila alpestris*; 627 individuals in 191 groups), and red-winged blackbirds (*Agelaius phoeniceus*; 653 individuals in 120 groups). Waterbirds, represented almost entirely by sandhill cranes (*Grus canadensis*), were the second most abundant bird type observed in the study area, representing 6.1% of all observations. A total of 79 diurnal raptors were observed, accounting for 1.4% of all individuals recorded. Northern harrier (*Circus cyaneus*) and Swainson's hawk (*Buteo swainsoni*) were the most commonly observed raptor species (20 and 19 individuals, respectively; Table 1). Two individual bald eagles (*Haliaeetus leucocephalus*) were observed in the spring (Table 1).

One bald eagle was observed from fixed-point two, soaring in a southeasterly direction for eight min before it was lost from sight. The other bald eagle observation was recorded flying into the survey plot at fixed-point one from the south. It remained perched on a transmission line tower for the remaining seven min of the 60-min survey period.

**Table 1. Summary of group and individual observations by species and bird type for summer, fall, and overall seasons during fixed-point bird use surveys at the Sunflower Wind Project[a] from March 20, 2013, to August 21, 2013.**

| | | Spring | | Summer | | Overall | |
|---|---|---|---|---|---|---|---|
| **Species** | **Scientific Name** | **# grps** | **# obs** | **# grps** | **# obs** | **# grps** | **# obs** |
| **Waterbirds** | | **2** | **352** | **0** | **0** | **2** | **352** |
| sandhill crane | *Grus canadensis* | 1 | 350 | 0 | 0 | 1 | 350 |
| unidentified waterbird | | 1 | 2 | 0 | 0 | 1 | 2 |
| **Waterfowl** | | **53** | **115** | **6** | **9** | **59** | **124** |
| blue-winged teal | *Anas discors* | 1 | 2 | 0 | 0 | 1 | 2 |
| Canada goose | *Branta canadensis* | 22 | 53 | 1 | 1 | 23 | 54 |
| gadwall | *Anas strepera* | 1 | 4 | 0 | 0 | 1 | 4 |
| mallard | *Anas platyrhynchos* | 15 | 26 | 2 | 2 | 17 | 28 |
| northern pintail | *Anas acuta* | 4 | 8 | 1 | 1 | 5 | 9 |
| northern shoveler | *Anas clypeata* | 0 | 0 | 1 | 1 | 1 | 1 |
| redhead | *Aythya americana* | 1 | 2 | 0 | 0 | 1 | 2 |
| unidentified duck | | 9 | 20 | 1 | 4 | 10 | 24 |
| **Shorebirds** | | **36** | **67** | **20** | **46** | **56** | **113** |
| Common snipe | *Gallinago gallinago* | 2 | 2 | 0 | 0 | 2 | 2 |
| killdeer | *Charadrius vociferus* | 13 | 15 | 10 | 35 | 23 | 50 |
| marbled godwit | *Limosa fedoa* | 1 | 2 | 1 | 1 | 2 | 3 |
| unidentified shorebird | | 6 | 22 | 0 | 0 | 6 | 22 |
| upland sandpiper | *Bartramia longicauda* | 6 | 6 | 8 | 9 | 14 | 15 |
| willet | *Catoptrophorus semipalmatus* | 4 | 14 | 0 | 0 | 4 | 14 |
| Wilson's snipe | *Gallinago delicata* | 4 | 6 | 1 | 1 | 5 | 7 |
| **Diurnal Raptors** | | **52** | **58** | **17** | **21** | **69** | **79** |
| *Accipiters* | | *1* | *1* | *0* | *0* | *1* | *1* |
| sharp-shinned hawk | *Accipiter striatus* | 1 | 1 | 0 | 0 | 1 | 1 |
| *Buteos* | | *21* | *25* | *9* | *11* | *30* | *36* |
| red-tailed hawk | *Buteo jamaicensis* | 11 | 12 | 3 | 3 | 14 | 15 |
| rough-legged hawk | *Buteo lagopus* | 2 | 2 | 0 | 0 | 2 | 2 |
| Swainson's hawk | *Buteo swainsoni* | 8 | 11 | 6 | 8 | 14 | 19 |
| *Northern Harrier* | | *16* | *17* | *3* | *3* | *19* | *20* |
| northern harrier | *Circus cyaneus* | 16 | 17 | 3 | 3 | 19 | 20 |
| *Eagles* | | *2* | *2* | *0* | *0* | *2* | *2* |
| bald eagle | *Haliaeetus leucocephalus* | 2 | 2 | 0 | 0 | 2 | 2 |
| *Falcons* | | *1* | *1* | *0* | *0* | *1* | *1* |
| American kestrel | *Falco sparverius* | 1 | 1 | 0 | 0 | 1 | 1 |
| *Other Raptors* | | *11* | *12* | *5* | *7* | *16* | *19* |
| unidentified hawk | | 3 | 3 | 0 | 0 | 3 | 3 |
| unidentified raptor | | 8 | 9 | 5 | 7 | 13 | 16 |
| **Owls** | | **5** | **7** | **4** | **7** | **9** | **14** |
| burrowing owl | *Athene cunicularia* | 3 | 5 | 4 | 7 | 7 | 12 |
| great horned owl | *Bubo virginianus* | 2 | 2 | 0 | 0 | 2 | 2 |
| **Vultures** | | **3** | **5** | **1** | **1** | **4** | **6** |
| turkey vulture | *Cathartes aura* | 3 | 5 | 1 | 1 | 4 | 6 |

**Table 1. Summary of group and individual observations by species and bird type for summer, fall, and overall seasons during fixed-point bird use surveys at the Sunflower Wind Project[a] from March 20, 2013, to August 21, 2013.**

| | | Spring | | Summer | | Overall | |
|---|---|---|---|---|---|---|---|
| **Species** | **Scientific Name** | **# grps** | **# obs** | **# grps** | **# obs** | **# grps** | **# obs** |
| **Upland Game Birds** | | **87** | **129** | **10** | **10** | **97** | **139** |
| ring-necked pheasant | *Phasianus colchicus* | 80 | 90 | 10 | 10 | 90 | 100 |
| sharp-tailed grouse | *Tympanuchus phasianellus* | 7 | 39 | 0 | 0 | 7 | 39 |
| **Doves/Pigeons** | | **24** | **38** | **20** | **29** | **44** | **67** |
| mourning dove | *Zenaida macroura* | 22 | 35 | 20 | 29 | 42 | 64 |
| rock pigeon | *Columba livia* | 2 | 3 | 0 | 0 | 2 | 3 |
| **Large Corvids** | | **6** | **10** | **0** | **0** | **6** | **10** |
| American crow | *Corvus brachyrhynchos* | 6 | 10 | 0 | 0 | 6 | 10 |
| **Passerines** | | **679** | **4548** | **211** | **327** | **890** | **4875** |
| American goldfinch | *Spinus tristis* | 0 | 0 | 1 | 1 | 1 | 1 |
| American robin | *Turdus migratorius* | 22 | 61 | 3 | 3 | 25 | 64 |
| American tree sparrow | *Spizella arborea* | 4 | 36 | 0 | 0 | 4 | 36 |
| bank swallow | *Riparia riparia* | 0 | 0 | 1 | 2 | 1 | 2 |
| barn swallow | *Hirundo rustica* | 8 | 14 | 6 | 19 | 14 | 33 |
| bobolink | *Dolichonyx oryzivorus* | 12 | 25 | 4 | 4 | 16 | 29 |
| Brewer's blackbird | *Euphagus cyanocephalus* | 7 | 24 | 1 | 4 | 8 | 28 |
| brown-headed cowbird | *Molothrus ater* | 58 | 288 | 9 | 15 | 67 | 303 |
| brown thrasher | *Toxostoma rufum* | 0 | 0 | 2 | 2 | 2 | 2 |
| chipping sparrow | *Spizella passerina* | 3 | 3 | 1 | 1 | 4 | 4 |
| clay-colored sparrow | *Spizella pallida* | 4 | 4 | 1 | 1 | 5 | 5 |
| cliff swallow | *Petrochelidon pyrrhonota* | 0 | 0 | 1 | 2 | 1 | 2 |
| common grackle | *Quiscalus quiscula* | 15 | 40 | 9 | 12 | 24 | 52 |
| common redpoll | *Acanthis flammea* | 19 | 642 | 0 | 0 | 19 | 642 |
| eastern kingbird | *Tyrannus tyrannus* | 7 | 7 | 31 | 43 | 38 | 50 |
| European starling | *Sturnus vulgaris* | 4 | 81 | 1 | 27 | 5 | 108 |
| field sparrow | *Spizella pusilla* | 1 | 1 | 0 | 0 | 1 | 1 |
| grasshopper sparrow | *Ammodramus savannarum* | 3 | 4 | 3 | 3 | 6 | 7 |
| horned lark | *Eremophila alpestris* | 169 | 586 | 22 | 41 | 191 | 627 |
| Lapland longspur | *Calcarius lapponicus* | 2 | 1530 | 0 | 0 | 2 | 1530 |
| lark bunting | *Calamospiza melanocorys* | 1 | 2 | 9 | 11 | 10 | 13 |
| loggerhead shrike | *Lanius ludovicianus* | 1 | 1 | 0 | 0 | 1 | 1 |
| red-winged blackbird | *Agelaius phoeniceus* | 87 | 611 | 33 | 42 | 120 | 653 |
| Savannah sparrow | *Passerculus sandwichensis* | 13 | 20 | 9 | 10 | 22 | 30 |
| snow bunting | *Plectrophenax nivalis* | 2 | 48 | 0 | 0 | 2 | 48 |
| song sparrow | *Melospiza melodia* | 8 | 10 | 0 | 0 | 8 | 10 |
| unidentified blackbird | | 0 | 0 | 2 | 3 | 2 | 3 |
| unidentified bluebird | | 2 | 2 | 0 | 0 | 2 | 2 |
| unidentified passerine | | 14 | 249 | 2 | 3 | 16 | 252 |
| unidentified sparrow | | 11 | 12 | 2 | 2 | 13 | 14 |
| vesper sparrow | *Pooecetes gramineus* | 3 | 3 | 7 | 8 | 10 | 11 |
| western kingbird | *Tyrannus verticalis* | 7 | 12 | 15 | 30 | 22 | 42 |
| western meadowlark | *Sturnella neglecta* | 190 | 227 | 35 | 37 | 225 | 264 |
| yellow-headed blackbird | *Xanthocephalus xanthocephalus* | 1 | 4 | 0 | 0 | 1 | 4 |
| yellow warbler | *Setophaga petechia* | 1 | 1 | 1 | 1 | 2 | 2 |
| **Goatsuckers** | | **0** | **0** | **1** | **1** | **1** | **1** |
| common nighthawk | *Chordeiles minor* | 0 | 0 | 1 | 1 | 1 | 1 |

**Table 1. Summary of group and individual observations by species and bird type for summer, fall, and overall seasons during fixed-point bird use surveys at the Sunflower Wind Project[a] from March 20, 2013, to August 21, 2013.**

| | | Spring | | Summer | | Overall | |
|---|---|---|---|---|---|---|---|
| **Species** | **Scientific Name** | **# grps** | **# obs** | **# grps** | **# obs** | **# grps** | **# obs** |
| **Woodpeckers** | | **7** | **7** | **1** | **3** | **8** | **10** |
| hairy woodpecker | *Picoides villosus* | 1 | 1 | 0 | 0 | 1 | 1 |
| northern flicker | *Colaptes auratus* | 5 | 5 | 1 | 3 | 6 | 8 |
| red-headed woodpecker | *Melanerpes erythrocephalus* | 1 | 1 | 0 | 0 | 1 | 1 |
| **Unidentified Birds** | | **2** | **2** | **0** | **0** | **2** | **2** |
| unidentified bird (small) | | 2 | 2 | 0 | 0 | 2 | 2 |
| **Total** | | **956** | **5,338** | **291** | **454** | **1247** | **5,792** |

[a] regardless of distance from observer.

*Sensitive Species Observations*

Sixteen unique sensitive species totaling 248 individuals were recorded during all surveys at the SFWP (Table 2). This tally may represent repeated observations of the same individual. There were no federally listed endangered, threaten or candidate species recorded. Six North Dakota Level I sensitive species (defined as species with declining status either in North Dakota or across their range) were observed, along with 10 North Dakota Level II sensitive species (defined as species with moderate level of conservation priority; Hagen et al. 2005; Table 2). Bald eagles are also protected under the Bald and Golden Eagle Protection Act (BGEPA 1940).

**Table 2. Summary of sensitive species observed at the Sunflower Wind Project during fixed-point bird use surveys (FP) and as incidental wildlife observations (Inc.) from March 20, 2013, to August 21, 2013.**

| | | | FP | | Inc. | | Total | |
|---|---|---|---|---|---|---|---|---|
| **Species** | **Scientific Name** | **Status** | **# grps** | **# obs** | **# grps** | **# obs** | **# grps** | **# obs** |
| sharp-tailed grouse | *Tympanuchus phasianellus* | S2 | 7 | 39 | 7 | 30 | 14 | 69 |
| northern harrier | *Circus cyaneus* | S2 | 19 | 20 | 9 | 13 | 28 | 33 |
| Swainson's hawk | *Buteo swainsoni* | S1 | 14 | 19 | 8 | 13 | 22 | 32 |
| bobolink | *Dolichonyx oryzivorus* | S2 | 16 | 29 | 0 | 0 | 16 | 29 |
| upland sandpiper | *Bartramia longicauda* | S1 | 14 | 15 | 1 | 3 | 15 | 18 |
| willet | *Catoptrophorus semipalmatus* | S1 | 4 | 14 | 0 | 0 | 4 | 14 |
| burrowing owl | *Athene cunicularia* | S2 | 7 | 12 | 1 | 1 | 8 | 13 |
| lark bunting | *Calamospiza melanocorys* | S1 | 10 | 13 | 0 | 0 | 10 | 13 |
| northern pintail | *Anas acuta* | S2 | 5 | 9 | 0 | 0 | 5 | 9 |
| grasshopper sparrow | *Ammodramus savannarum* | S1 | 6 | 7 | 0 | 0 | 6 | 7 |
| marbled godwit | *Limosa fedoa* | S1 | 2 | 3 | 0 | 0 | 2 | 3 |
| loggerhead shrike | *Lanius ludovicianus* | S2 | 1 | 1 | 1 | 1 | 2 | 2 |
| bald eagle | *Haliaeetus leucocephalus* | S2; EA | 2 | 2 | 0 | 0 | 2 | 2 |
| redhead | *Aythya americana* | S2 | 1 | 2 | 0 | 0 | 1 | 2 |
| prairie falcon | *Falco mexicanus* | S2 | 0 | 0 | 1 | 1 | 1 | 1 |
| red-headed woodpecker | *Melanerpes erythrocephalus* | S2 | 1 | 1 | 0 | 0 | 1 | 1 |
| **Total** | **16 species** | | **109** | **186** | **28** | **62** | **137** | **248** |

S1 = Level I state species of concern (Hagen et al. 2005); S2 = Level II state species of concern (Hagen et al. 2005); EA = Federal Bald and Golden Eagle Protection Act (BGEPA 1940).

### *Incidental Wildlife Observations*

Fourteen unique bird species and four unidentified bird categories were observed incidentally, totaling 958 birds within 69 separate groups during the study (Table 3). Over two-thirds of the total observations were of sandhill cranes. Three species, tundra swan (*Cygnus columbianus*), prairie falcon (*Falco mexicanus*), and Say's phoebe (*Sayornis saya*), were only seen incidentally at the SFWP. Six mammal and one amphibian species were also recorded incidentally at the SFWP (Table 3). Two North Dakota State Level I sensitive species (Swainson's hawk and upland sandpiper [*Bartramia longicauda*]) were recorded incidentally within the project (Table 2).

**Table 3. Incidental wildlife observed while conducting all surveys at the Sunflower Wind Project from March 20, 2013, to August 21, 2013.**

| Species | Scientific Name | # grps | # obs |
|---|---|---|---|
| sandhill crane | *Grus canadensis* | 9 | 654 |
| tundra swan | *Cygnus columbianus* | 1 | 2 |
| upland sandpiper | *Bartramia longicauda* | 1 | 3 |
| American kestrel | *Falco sparverius* | 6 | 7 |
| northern harrier | *Circus cyaneus* | 9 | 13 |
| prairie falcon | *Falco mexicanus* | 1 | 1 |
| red-tailed hawk | *Buteo jamaicensis* | 12 | 14 |
| Swainson's hawk | *Buteo swainsoni* | 8 | 13 |
| unidentified accipiter | | 1 | 1 |
| unidentified hawk | | 2 | 5 |
| unidentified raptor | | 3 | 4 |
| burrowing owl | *Athene cunicularia* | 1 | 1 |
| turkey vulture | *Cathartes aura* | 4 | 6 |
| gray partridge | *Perdix perdix* | 1 | 2 |
| sharp-tailed grouse | *Tympanuchus phasianellus* | 7 | 30 |
| loggerhead shrike | *Lanius ludovicianus* | 1 | 1 |
| Say's phoebe | *Sayornis saya* | 1 | 1 |
| unidentified crowned sparrow | | 1 | 200 |
| **Bird Subtotal** | | **69** | **958** |
| coyote | *Canis latrans* | 3 | 3 |
| mule deer | *Odocoileus hemionus* | 1 | 5 |
| porcupine | *Erethizon dorsatum* | 2 | 2 |
| pronghorn | *Antilocapra americana* | 11 | 57 |
| thirteen-lined ground squirrel | *Spermophilus tridecemlineatus* | 4 | 8 |
| white-tailed jackrabbit | *Lepus townsendii* | 1 | 1 |
| **Mammal Subtotal** | | **22** | **76** |
| western chorus frog | *Pseudacris triserata triseriata* | 2 | 20 |
| **Amphibian Subtotal** | | **2** | **20** |

## DISCUSSION

The surveys implemented at SFWP during spring and summer of 2013 are part of a larger study effort. Seasonal interim reports are designed to give Infinity an early warning if high wildlife use is documented during surveys or if a sensitive species is observed.

### Bird Use Surveys

Species diversity of birds observed reflected the grassland and agricultural habitat within the SFWP. Species of open grassland habitats were dominant, but species that utilize woodlands and wetlands were also observed interspersed within the study area.

By far, the spring season had the higher number of bird observations (5,338) compared to summer (454). Although the spring season had almost twice as many surveys conducted, it is unlikely that doubling the number of surveys in summer would have resulted in the total number of birds observed to approach those recorded in spring. Lapland longspur and common redpoll had the highest number of individuals recorded and were only observed in the spring. In total, there were 26 bird species that were recorded in spring that were not recorded in the summer, while there were only four species that were observed in the summer that were not recorded in the spring.

Overall, diurnal raptors were also more common in the spring; birds observed during the spring probably included migrating individuals. The Swainson's hawk was the most abundant diurnal raptor recorded during the summer (Table 1).

### Comparison of Seasonal Diurnal Raptor Use

Diurnal raptors have received much attention due to high rates of fatalities at the Altamont Pass wind energy facility in California, which has the highest recorded overall diurnal raptor fatality rate of any wind energy facility (Erickson et al. 2002b). Based on the results from other wind resource areas, mean diurnal raptor use (number of diurnal raptors divided by the number of 800-m plots and the total number of surveys) in the SFWP during both the spring and summer of 2013 was low to moderate (0.53 and 0.35 diurnal raptors/plot/20 min survey, respectively) relative to data collected at other existing and proposed wind energy facilities with data for spring or summer seasons (Figures 2 and 3).

### Sensitive Species

No federally endangered, threatened or candidate species were recorded during surveys within the SFWP. There were six North Dakota Level I and 10 Level II sensitive species recorded. Two State Level II bald eagles were observed during fixed-point surveys. Bald eagles are also legally protected under the Bald and Golden Eagle Protection Act (BGEPA 1940).

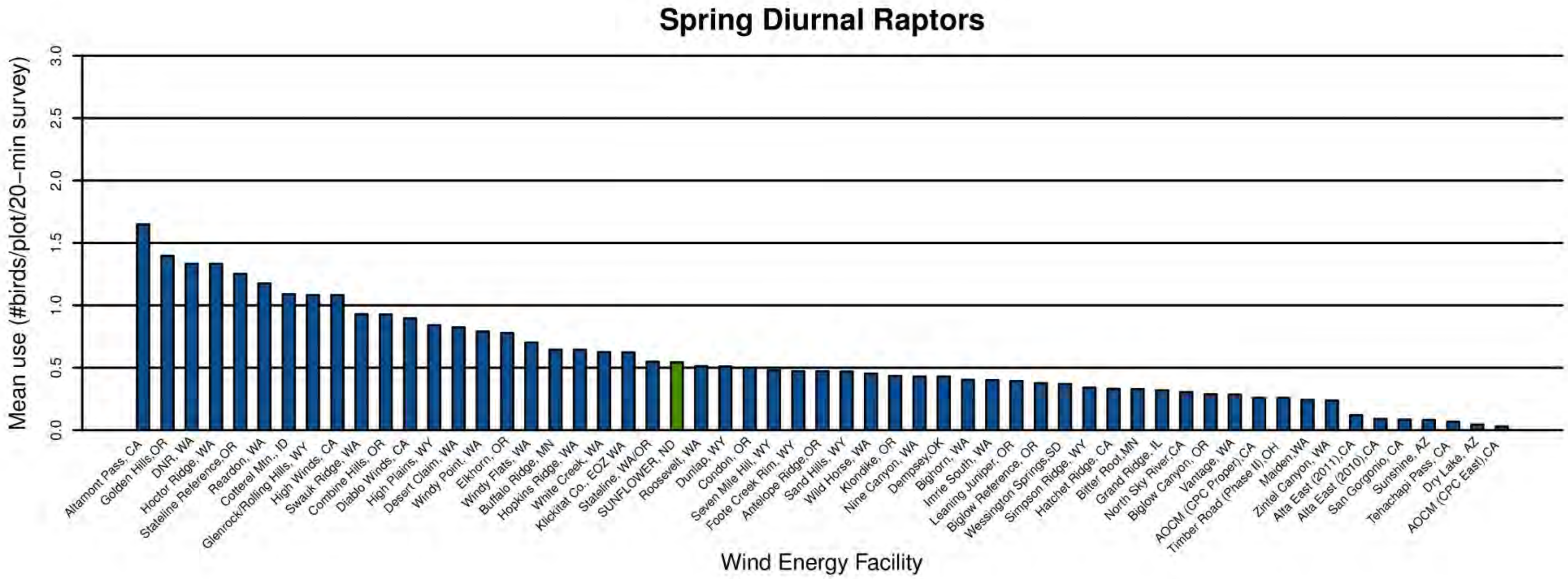


**Figure 2. Comparison of spring diurnal raptor use during fixed-point surveys at the Sunflower Wind Project from March 20, 2013, to August 21, 2013, and other US wind energy facilities.**

Data from the following sources:

| Study and Location | Reference | Study and Location | Reference | Study and Location | Reference |
|---|---|---|---|---|---|
| Sunflower Wind Project, ND | This study. | | | | |
| Altamont Pass, CA | Orloff and Flannery 1992 | White Creek, WA | NWC and WEST 2004 | Simpson Ridge, WY | Johnson et al. 2000b |
| Golden Hills, OR | Jeffrey et al. 2008 | Klickitat Co., EOZ WA | WEST and NWC 2003 | Hatchet Ridge, CA | Young et al. 2007a |
| DNR, WA | Johnson et al. 2006c | Stateline, WA/OR | Erickson et al. 2003a | Bitter Root, MN | Derby and Dahl 2009 |
| Hoctor Ridge, WA | Johnson et al. 2006d | Roosevelt, WA | NWC and WEST 2004 | Grand Ridge, IL | Derby et al. 2009 |
| Stateline Reference, OR | URS et al. 2001 | Dunlap, WY | Johnson et al. 2009a | North Sky River, CA | Erickson et al. 2011 |
| Reardon, WA | WEST 2005b | Condon, OR | Erickson et al. 2002b | Biglow Canyon, OR | WEST 2005c |
| Cotterel Mtn., ID | BLM 2006 | Seven Mile Hill, WY | Johnson et al. 2008b | Vantage, WA | WEST 2007 |
| Glenrock/Rolling Hills, WY | Johnson et al. 2008a | Foote Creek Rim, WY | Johnson et al. 2000b | AOCM (CPC Proper), CA | Chatfield et al. 2010 |
| High Winds, CA | Kerlinger et al. 2005 | Antelope Ridge, OR | WEST 2009 | Timber Road (Phase II), OH | Good et al. 2010 |
| Swauk Ridge, WA | Erickson et al. 2003b | Sand Hills, WY | Johnson et al. 2006a | Maiden, WA | Young et al. 2002 |
| Combine Hills, OR | Young et al. 2003c | Wild Horse, WA | Erickson et al. 2003d | Zintel Canyon, WA | Erickson et al. 2002a, 2003c |
| Diablo Winds, CA | WEST 2006 | Klondike, OR | Johnson et al. 2002 | Alta East (2011), CA | Chatfield et al. 2011 |
| High Plains, WY | Johnson et al. 2009b | Nine Canyon, WA | Erickson et al. 2001 | Alta East (2010), CA | Chatfield et al. 2011 |
| Desert Claim, WA | Young et al. 2003b | Dempsey, OK | Derby et al. 2010 | San Gorgonio, CA | Anderson et al. 2000, Erickson et al. 2002b |
| Windy Point, WA | Johnson et al. 2006b | Bighorn, WA | Johnson and Erickson 2004 | Sunshine, AZ | WEST and the CPRS 2006 |
| Elkhorn, OR | WEST 2005a | Imrie South, WA | Johnson et al. 2006e | Tehachapi Pass, CA | Anderson et al. 2000, Erickson et al. 2002b |
| Windy Flats, WA | Johnson et al. 2007b | Leaning Juniper, OR | Kronner et al. 2005 | Dry Lake, AZ | Young et al. 2007b |
| Buffalo Ridge, MN | Johnson et al. 2000a | Biglow Reference, OR | WEST 2005c | AOCM (CPC East), CA | Chatfield et al. 2010 |
| Hopkins Ridge, WA | Young et al. 2003a | Wessington Springs, SD | Derby et al. 2008 | | |

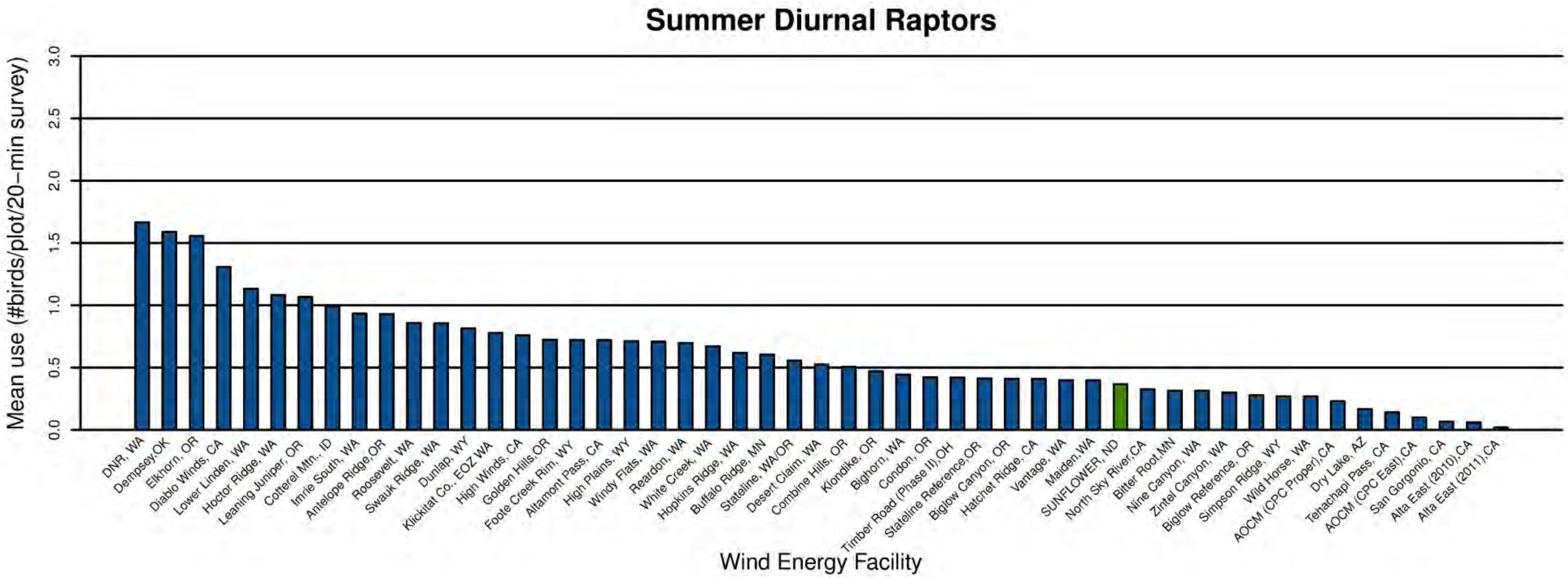


**Figure 3. Comparison of summer diurnal raptor use during fixed-point surveys at the Sunflower Wind Project from March 20, 2013, to August 21, 2013, and other US wind energy facilities.**

Data from the following sources:

| Study and Location | Reference | Study and Location | Reference | Study and Location | Reference |
|---|---|---|---|---|---|
| Sunflower Wind Project, ND | This study. | | | | |
| DNR, WA | Johnson et al. 2006c | Altamont Pass, CA | Orloff and Flannery 1992 | Vantage, WA | WEST 2007 |
| Dempsey, OK | Derby et al. 2010 | High Plains, WY | Johnson et al. 2009b | Maiden, WA | Young et al. 2002 |
| Elkhorn, OR | WEST 2005a | Windy Flats, WA | Johnson et al. 2007b | North Sky River, CA | Erickson et al. 2011 |
| Diablo Winds, CA | WEST 2006 | Reardon, WA | WEST 2005b | Bitter Root, MN | Derby and Dahl 2009 |
| Lower Linden, WA | Johnson et al. 2007a | White Creek, WA | NWC and WEST 2005 | Nine Canyon, WA | Erickson et al. 2001 |
| Hoctor Ridge, WA | Johnson et al. 2006d | Hopkins Ridge, WA | Young et al. 2003a | Zintel Canyon, WA | Erickson et al. 2002a, 2003c |
| Leaning Juniper, OR | Kronner et al. 2005 | Buffalo Ridge, MN | Johnson et al. 2000a | Biglow Reference, OR | WEST 2005c |
| Cotterel Mtn., ID | BLM 2006 | Stateline, WA/OR | Erickson et al. 2003a | Simpson Ridge, WY | Johnson et al. 2000b |
| Imrie South, WA | Johnson et al. 2006e | Desert Claim, WA | Young et al. 2003b | Wild Horse, WA | Erickson et al. 2003d |
| Antelope Ridge, OR | WEST 2009 | Combine Hills, OR | Young et al. 2003c | AOCM (CPC Proper), CA | Chatfield et al. 2010 |
| Roosevelt, WA | NWC and WEST 2004 | Klondike, OR | Johnson et al. 2002 | Dry Lake, AZ | Young et al. 2007b |
| Swauk Ridge, WA | Erickson et al. 2003b | Bighorn, WA | Johnson and Erickson 2004 | Tehachapi Pass, CA | Anderson et al. 2000, Erickson et al. 2002b |
| Dunlap, WY | Johnson et al. 2009a | Condon, OR | Erickson et al. 2002b | AOCM (CPC East), CA | Chatfield et al. 2010 |
| Klickitat Co., EOZ WA | WEST and NWC 2003 | Timber Road (Phase II), OH | Good et al. 2010 | San Gorgonio, CA | Anderson et al. 2000, Erickson et al. 2002b |
| High Winds, CA | Kerlinger et al. 2005 | Stateline Reference, OR | URS et al. 2001 | Alta East (2010), CA | Chatfield et al. 2011 |
| Golden Hills, OR | Jeffrey et al. 2008 | Biglow Canyon, OR | WEST 2005c | Alta East (2011), CA | Chatfield et al. 2011 |
| Foote Creek Rim, WY | Johnson et al. 2000b | Hatchet Ridge, CA | Young et al. 2007a | | |

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WEST Inc.

ENVIRONMENTAL & STATISTICAL CONSULTANTS

4007 State Street, Suite 109, Bismarck, ND 58503
Phone: 701-250-1756 ◆ www.west-inc.com ◆ Fax: 701-250-1761

February 11, 2014

Casey Willis
Sunflower Wind Project, LLC.
3760 State Street, Suite 102
Santa Barbara, CA 93105

**RE: Sunflower Avian Use Fall and Winter Update**

Dear Mr. Willis,

Western EcoSystems Technology, Inc. (WEST) was contracted to conduct avian use point counts at the proposed Sunflower project area in central North Dakota. See attached map, and corresponding point count locations currently being surveyed. Surveys started in mid-March 2013 and are continuing to date. Surveys were done weekly during the spring and fall migration periods and twice per month during the summer and winter period. Each point is surveyed for one hour during each visit.

WEST provided an interim report detailing observations and initial analysis of data from project start on March 20 through August 21, 2013. This memo updates information collected during surveys conducted between late August 2013 and early February 2014. During the fall and winter surveys to date, a total of 61 raptors observations were documented spread among seven species, including observations at all distances from the observer during point counts. The most common raptor species observed was northern harrier. One bald eagle and four golden eagles were observed during point counts. See the attached table for a complete list of species and observations made during the point counts from late August 2013 through early February 2014. The overall species and numbers appear to be reflective of a grassland landscape in central North Dakota.

Please let me know if you have any questions or need further details.

Sincerely,

Clayton Derby
Senior Manager

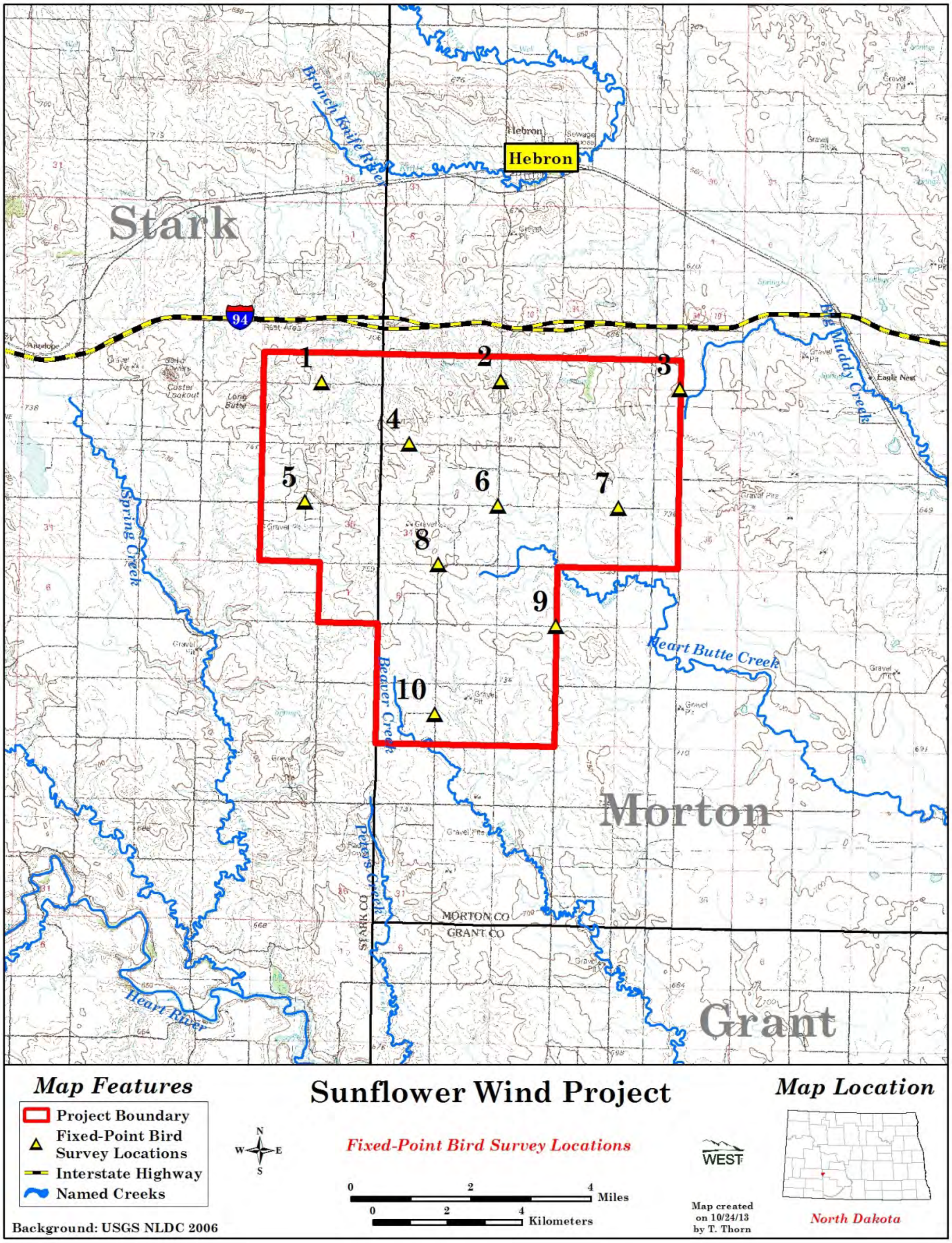


**Figure 1. Avian use survey points within the Sunflower project area.**

**Table 1. Species observed during avian point counts within the Sunflower project area, late August 2013 through early February 2014.**

| Common Name | Total Observations |
|---|---|
| American Crow | 1 |
| American Goldfinch | 15 |
| American Robin | 2 |
| Bald Eagle | 1 |
| Barn Swallow | 38 |
| Black-billed Magpie | 1 |
| Brown-headed Cowbird | 2 |
| Brewer's Blackbird | 30 |
| Canada Goose | 45 |
| Clay-colored Sparrow | 1 |
| Common Grackle | 10 |
| Ferruginous Hawk | 1 |
| Golden Eagle | 4 |
| Gray Partridge | 2 |
| Greater White-fronted Goose | 150 |
| Horned Lark | 216 |
| House Sparrow | 18 |
| Killdeer | 8 |
| Lincoln's Sparrow | 1 |
| Mourning Dove | 12 |
| Northern Flicker | 1 |
| Northern Harrier | 23 |
| Rough Legged Hawk | 10 |
| Ring-necked Pheasant | 102 |
| Red-tailed Hawk | 12 |
| Rusty Blackbird | 8 |
| Red-winged Blackbird | 22 |
| Sandhill Cranes | 35 |
| Savannah Sparrow | 12 |
| Snow Bunting | 97 |
| Snow Goose | 27 |
| Sharp-tailed Grouse | 26 |
| Swainson's Hawk | 10 |
| Turkey Vulture | 5 |
| Vesper Sparrow | 1 |
| Western Meadowlark | 48 |

WEST Inc.

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Phone: 701-250-1756 ◆ www.west-inc.com ◆ Fax: 701-250-1761

November 15, 2013

Casey Willis
Sunflower Wind Project, LLC
3760 State St., Suite 102
Santa Barbara, CA 93105

**RE: Sunflower Wind Project Habitat Mapping**

Dear Mr. Willis,

Vegetation types (or Habitat) were delineated using ArcGIS, ArcMap 10.1 within the Sunflower Wind Project (SFWP) and a one mile buffer (Buffer). Using 2012 USDA NAIP aerial imagery in combination with 2006 USGS NLCD land use/land cover, 2004 ND Gap land use/land cover, and 2010 and 2011 USDA NASS land classification, all land within the two areas was digitized and assigned one of seven habitat types (excluding National Wetland Inventory [NWI] wetlands; Table 1). NWI data was used to represent water within the two study areas. Those water features (mostly created stock dams and dugouts) visible on the aerial imagery but not in the NWI data were digitized as “water” habitat.

The SFWP, as described, contained slightly more than 21,980 acres and the one mile buffer contained approximately 3,000 less acres than the SFWP. Cropland and grassland made up the vast majority of land cover in both areas (96.8% of the SFWP and 93.5% of the Buffer) with cropland making up the highest percentage of both (Table 1). In descending order, the following habitat types made up the remaining area of the SFWP: developed, NWI wetlands, deciduous trees, shrubs, unknown trees, and water while the only difference in the Buffer was slightly more deciduous trees than NWI wetlands (Table 1). The percentage of each habitat type was similar between the two areas (Table 1).

Habitat types were spread out across the SFWP and Buffer (Figure 1). There was a slight predominance of larger grasslands tracts in the northern third of the SFWP and a higher amount of developed area (associated with Interstate 94) in the northern part of the Buffer (Figure 1).

Let me know if you have any questions or need further details.

Sincerely,

Clayton Derby
Senior Manager

**Table 1. Digitized Land Cover within the Sunflower Wind Project and 1 mile buffer.**

| | SFWP | | Buffer | |
|---|---|---|---|---|
| **Habitat Type** | **Acres** | **%** | **Acres** | **%** |
| Cropland | 12,940.3 | 58.9 | 9,978.2 | 53.0 |
| Grassland | 8,323.8 | 37.9 | 7,619.3 | 40.5 |
| Developed | 485.1 | 2.2 | 967.52 | 5.1 |
| NWI[a] Wetlands | 110.3 | 0.5 | 104.0 | 0.6 |
| Deciduous Trees | 102.5 | 0.5 | 135.7 | 0.7 |
| Shrubs | 16.8 | 0.1 | 14.7 | 0.1 |
| Unknown Trees | 2.7 | <0.1 | | |
| Water | 1.3 | <0.1 | 4.9 | <0.1 |
| **Total** | **21,982.8** | | **18,824.3** | |

[a] USFWS National Wetland Inventory

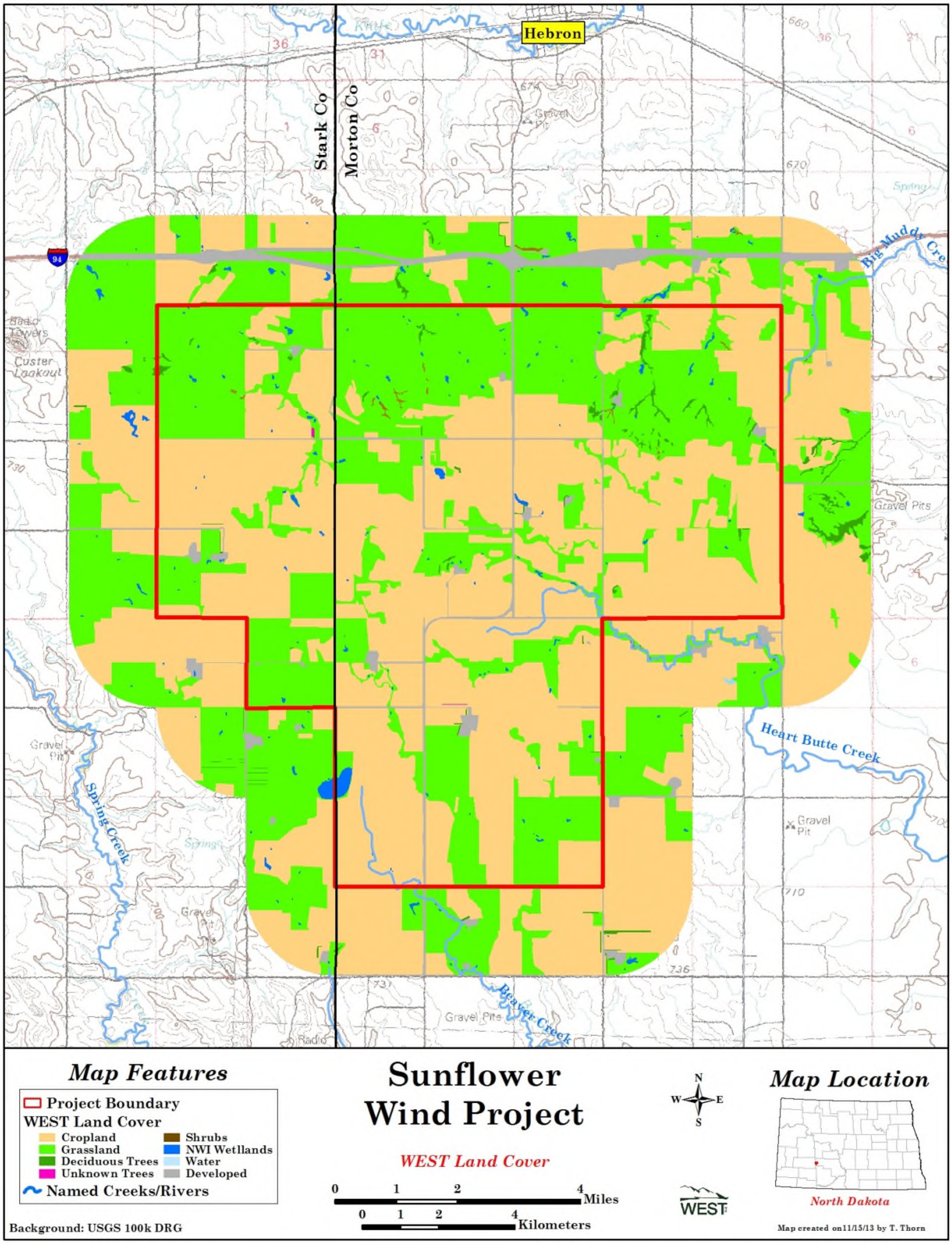


**Figure 1. Digitized Land cover within the Sunflower Wind Project and 1 mile buffer.**

# Bat Activity Studies for the Sunflower Wind Project, Morton and Stark Counties, North Dakota

## Final Report

## June 2013 – October 2013

**Prepared for:**

**Sunflower Wind Project, LLC**

3760 State Street, Suite 102
Santa Barbara, California 93105


**Prepared by:**

**Clayton Derby, Goniela Iskali, and Terri Thorn**

Western EcoSystems Technology, Inc.
415 West 17th Street, Suite 200
Cheyenne, Wyoming 82001


**December 10, 2013**

# EXECUTIVE SUMMARY

In June 2013, Western EcoSystems Technology, Inc. initiated a bat acoustic survey for the proposed Sunflower Wind Project (SWP) in Morton and Stark Counties, North Dakota. The bat acoustic survey conducted at the SWP was designed to estimate levels of bat activity within the SWP during summer and fall.

Acoustic surveys were conducted at three meteorological (met) tower stations in hay fields from June 12 through October 23, 2013. Four AnaBat™ SD2 detectors were utilized for the survey. Three acoustic monitoring stations were placed near the ground (one meter [m; 3.3 feet (ft)]) and one of these stations was paired with a detector unit with a microphone placed at approximately 45 m (147.6 ft) on the met tower using a modified bat-hat. All stations were monitored on a weekly or bi-monthly basis.

In total, AnaBat units recorded 537 bat passes in 477 detector-nights for a combined mean (± standard error) of 1.15 ± 0.12 bat passes per detector-night (Table 3). Ground detectors recorded 448 bat passes on 351 detector-nights for a mean of 1.30 ± 0.14 bat passes per detector-night, while the raised station recorded 89 bat passes on 126 detector nights for a mean of 0.71 ± 0.11 per detector-night.

Bat activity varied between seasons, with low activity in the summer and higher activity higher in the fall. Low-frequency bat pass rates peaked during late August, while high-frequency bat pass rates peaked during early August. Higher activity during the late summer and early fall may be due to the presence of both post-lactating adult female bats and newly volant juvenile bats as well as migrating bats.

For all detector locations, 54.6% of bat passes were classified as high-frequency (e.g., eastern red bats), while 45.4% of bat passes were classified as low-frequency (e.g., hoary bats and silver-haired bats).

Bat activity recorded at the SWP by ground detectors during the fall migration period (1.70 ± 0.20 bat passes per detector-night) was one of the lower call rates recorded when compared to all the facilities in the Midwest as well as compared with all facilities in North America which reported similarly-collected data.

## STUDY PARTICIPANTS

**Western EcoSystems Technology**

| | |
|---|---|
| Clayton Derby | Project Manager |
| Goniela Iskali | Bat Biologist and Report Compiler |
| Kimberly Bay | Data and Report Manager |
| Terri Thorn | GIS Technician |
| Andrea Palochak | Technical Editor |
| Cathy Clayton | Field Technician |

## REPORT REFERENCE

Derby, C., G. Iskali, and T. Thorn. 2013. Bat Activity Studies for the Sunflower Wind Project, Morton and Stark Counties, North Dakota. Final Report: June 2013 – October 2013. Prepared for Infinity Wind Power, Santa Barbara, California. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming.

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# INTRODUCTION

Sunflower Wind Project, LLC (Sunflower), a wholly owned subsidiary of Infinity Wind Power, is considering the development of a wind energy facility in the Sunflower Wind Project (SWP) in Morton and Stark Counties, North Dakota. Sunflower contracted Western EcoSystems Technology, Inc. (WEST) to complete a study of bat activity following the recommendations of the US Fish and Wildlife Service's (USFWS) Land-Based Wind Energy Guidelines (WEG; USFWS 2012) based on methods outlined in Kunz et al. (2007a). WEST conducted acoustic monitoring surveys to estimate levels of bat activity within the SWP during summer and fall. The following report describes the results of acoustic monitoring surveys conducted at the SWP between June 12 and October 23, 2013.

# STUDY AREA

The SWP is located in Morton and Stark Counties, North Dakota, approximately three miles (4.8 kilometers [km]) south of the town of Hebron (Figures 1 and 2). The SWP, currently about 21,983 acres (89 square kilometers [$km^2$]; 34 square miles [$mi^2$]) is located in west-central North Dakota, and more specifically western Morton and eastern Stark Counties. The landscape within the SWP is generally flat with more rolling lands in the northern third of the project area. Elevation ranges from 679 meters (m; 2,228 feet [ft]) to 817 m (2,679 ft). Historically, the SWP's landscape was dominated by grasslands but has since been converted largely to agricultural use with crop production and livestock grazing the primary practices. Trees and shrubs can be found around farmsteads, within planted shelter belts, and along/within drainages. Wetlands are scattered throughout the SWP with many being man-made.

Cultivated cropland and herbaceous/pasture/hay lands are approximately equal in amount and comprise almost 95% of the study area. Of the remaining 5%, 3.5% is developed, while wetlands, forest, and barren lands, in that order, make up the rest of the landscape (Table 1; Figure 2; USGS NLCD 2006, Fry et al. 2011). Common agricultural crops include small grains, corn (*Zea mays*), sunflowers (*Helianthus annuus*), and alfalfa (*Medicago sativa*).

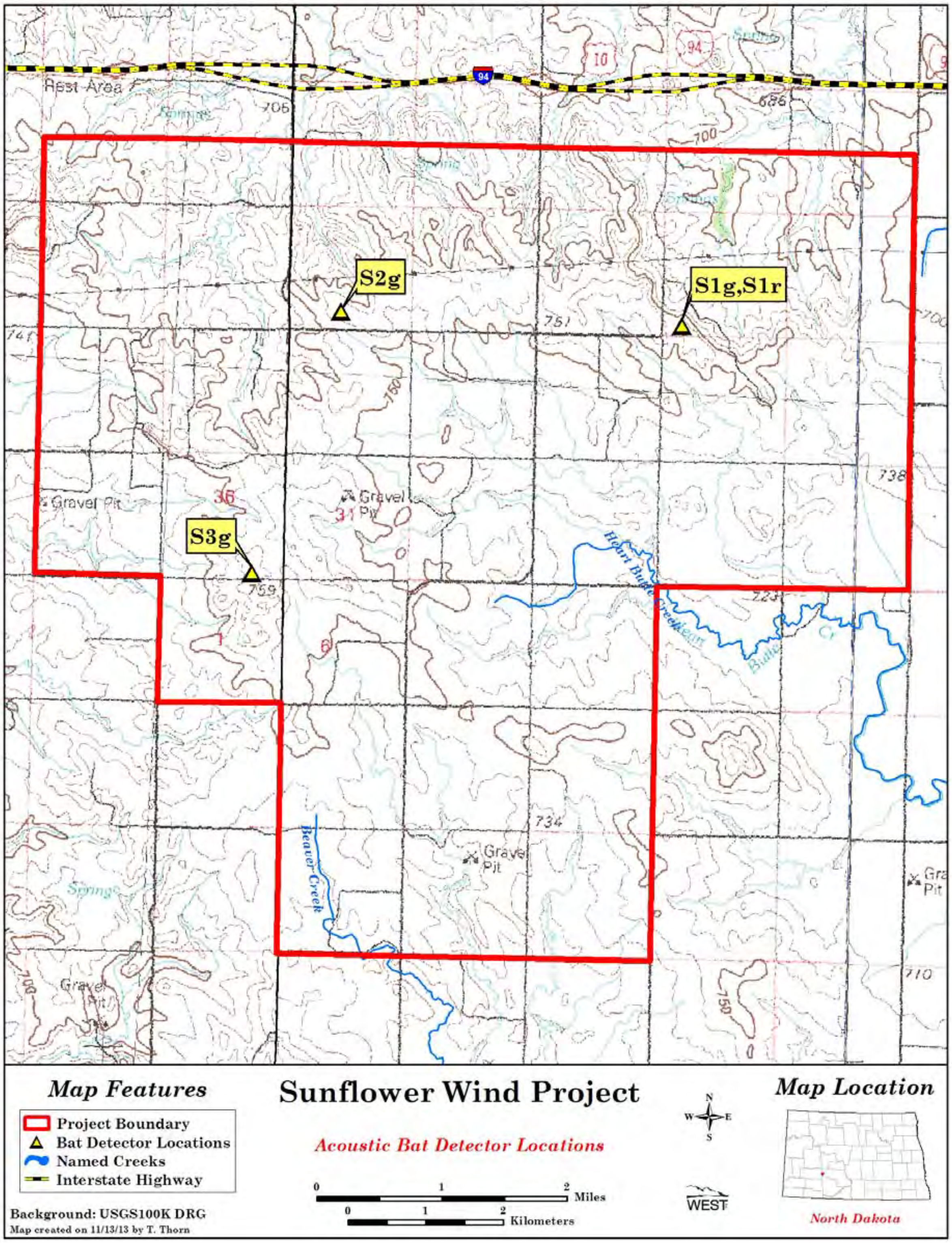


**Figure 1. Topographic map showing the location of the Sunflower Wind Project and AnaBat stations.**

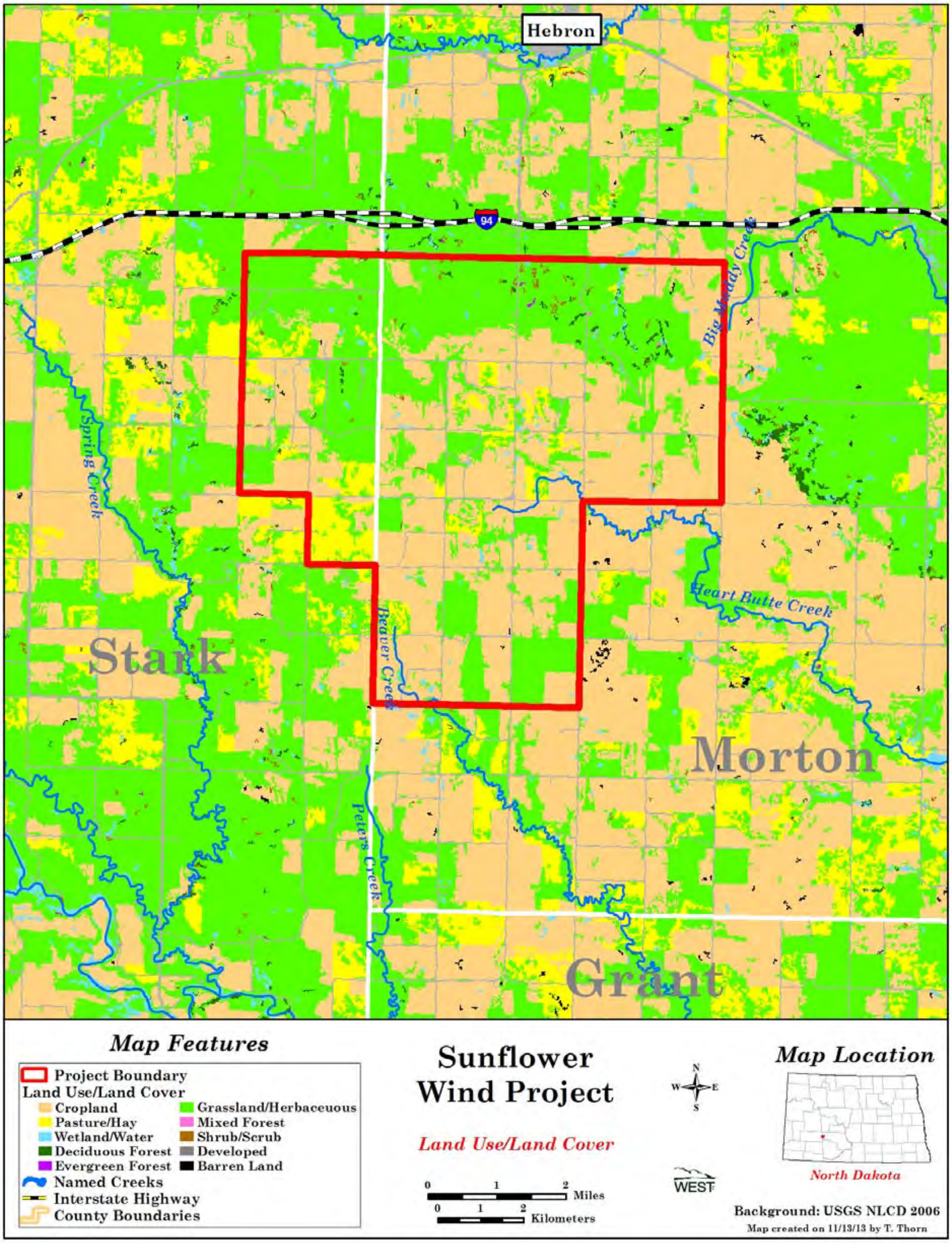


**Figure 2. Land cover in the Sunflower Wind Project (USGS NLCD 2006).**

**Table 1. Land cover in the Sunflower Wind Project according to the United States Geological Survey National Land Cover Dataset (USGS NLCD 2006).**

| Land Cover | Acres | % Composition |
|---|---:|---:|
| Cultivated Crops | 10,493.79 | 47.74 |
| Grassland/Herbaceous | 8,965.43 | 40.78 |
| Pasture/Hay | 1,394.77 | 6.34 |
| Developed, Open Space | 703.38 | 3.20 |
| Woody Wetlands | 110.59 | 0.50 |
| Deciduous Forest | 100.58 | 0.46 |
| Shrub/Scrub | 62.75 | 0.29 |
| Developed, Low Intensity | 58.52 | 0.27 |
| Emergent Herbaceous Wetland | 46.51 | 0.21 |
| Open Water | 30.93 | 0.14 |
| Barren Land (rock/sand/clay) | 8.23 | 0.04 |
| Evergreen Forest | 4.45 | 0.02 |
| Mixed Forest | 3.34 | 0.02 |
| **Total** | **21,983.27** | **100** |

**Overview of Bat Diversity**

Ten species of bats may potentially occur in North Dakota and in the SWP (Table 2). One of these, the northern long-eared bat, is a sensitive species that was recently proposed to be listed as endangered by the USFWS (2013). The northern long-eared bat, along with several once common and abundant bat species such as the little brown bat (*Myotis lucifugus*) are experiencing population declines due to the spread of white-nose syndrome (Frick et al. 2010; Center for Biological Diversity 2010). The northern long-eared bat uses caves and underground mines for hibernation. There are no karst regions or mines within the SWP for hibernation. The nearest karst region is approximately 130 miles from SWP and located in southeastern Montana (USGS 2013). During the summer, it relies upon forested habitat and it roosts in tree cavities and underneath exfoliating bark (BCI 2013) and forages over open water areas within and near forested areas. There are limited trees within the SWP (Figure 2); the closest area of denser tree growth around water is the Heart River, approximately 8 miles south of the SWP.

**Table 2. Bat species with potential to occur within the Sunflower Wind Project (Harvey et al. 1999, BCI 2003) categorized by echolocation call frequency.**

| Common Name | Scientific Name |
|---|---|
| **High-Frequency (> 30 kHz)** | |
| eastern red bat[1,3] | *Lasiurus borealis* |
| western small-footed bat | *Myotis ciliolabrum* |
| little brown bat[1] | *Myotis lucifugus* |
| western long-eared bat[1] | *Myotis evotis* |
| northern long-eared bat[1,2] | *Myotis septentrionalis* |
| long-legged bat[1] | *Myotis volans* |
| **Low-Frequency (< 30 kHz)** | |
| big brown bat[1] | *Eptesicus fuscus* |
| hoary bat[1,3] | *Lasiurus cinereus* |
| silver-haired bat[1,3] | *Lasionycteris noctivagans* |
| fringed bat | *Myotis thysanodes* |

[1] species known to have been killed at wind energy facilities (Species reported by Anderson et al. 2004, Kunz et al. 2007b, Baerwald 2008);
[2] proposed for listing as a federally endangered species (USFWS 2013); and
[3] long-distance migrant.

# METHODS

## Bat Acoustic Surveys

WEST conducted acoustic monitoring studies to estimate levels of bat activity throughout the SWP during summer and fall. Bat detectors are a primary acoustic survey tool used in baseline wind development surveys to calculate an index of bat activity; the levels of bat activity provide some insight into possible impacts of development on bats (Arnett 2007, Kunz et al. 2007a).

*Survey Stations*

Four AnaBat™ SD2 ultrasonic bat detectors (Titley Scientific™, Australia) were used during the study. Two AnaBat SD2 detectors were paired at one of the meteorological (met) towers, with one detector at ground level approximately 1 m (3.3 ft) above ground level (AGL) and another approximately 45 m (148 ft) AGL (Figure 1). The other two AnaBat units (ground level) were placed at two other met tower locations (Figure 1). Species activity levels and composition can vary with altitude (Baerwald and Barclay 2009, Collins and Jones 2009), so it is important to monitor at different heights (Kunz et al. 2007b). Ground-based detectors likely detect a more complete sample of the bat species present within the project area, whereas elevated detectors may give a more accurate assessment of risk to bat species flying at rotor swept heights (Kunz et al. 2007b).

Each AnaBat unit was inside a plastic weather-resistant container that had a hole cut in the side through which the microphone extended. Each microphone was encased in a 45-degree angle poly-vinyl chloride (PVC) tube, and holes were drilled in the PVC tube to allow water to drain. Raised AnaBat microphones were elevated on met towers using a pulley system. Bat-Hat weatherproof housing (EME Systems, Berkeley California) was modified by replacing the Plexiglas reflector plate with a 45-degree angle PVC elbow. The Bat-Hat was altered because detectors protected using un-modified Bat-Hats may detect lower activity and species richness than are present at a site, while detectors protected with a 45-degree PVC elbow have been found to detect similar numbers and quality of bat calls as detectors exposed to the environment (Britzke et al. 2010).

*Survey Schedule*

Bats were surveyed at the SWP from June 12 to October 23, 2013, and units were programmed to turn on approximately 30 minutes (min) before sunset and turn off approximately 30 min after sunrise each night.

**Data Collection and Call Analysis**

AnaBat detectors use a broadband high-frequency microphone to detect the echolocation calls of bats. Incoming echolocation calls are digitally processed and stored by the detector. Incoming echolocation calls are digitally processed and stored on a high capacity compact flash card. The resulting files can be viewed in appropriate software (i.e., Analook©) as digital sonograms that show changes in echolocation call frequency over time. Frequency versus time displays were used to separate bat calls from other types of ultrasonic noise (e.g., wind, insects, etc.) and to identify the call frequency classification and (when possible) the species of bat that generated the calls.

The detection range of AnaBat detectors depends on a number of factors (e.g., echolocation call characteristics, microphone sensitivity, habitat, the orientation of the bat, atmospheric conditions; Limpens and McCracken 2004), but is generally less than 30 m (98 ft) due to atmospheric absorption of echolocation pulses (Fenton 1991). To standardize acoustic sampling effort across the project, AnaBat units were calibrated and sensitivity levels were set to six (Larson and Hayes 2000), a level that balanced the goal of recording bat calls against the need to reduce interference from other sources of ultrasonic noise (Brooks and Ford 2005).

For each survey location, bat passes were sorted by their minimum frequency into two groups based on their minimum frequency that correspond roughly to species groups of interest. For example, most species of *Myotis* bats, as well as eastern red bats (*Lasiurus borealis*), echolocate at frequencies greater than 30 kilohertz (kHz), and are considered high-frequency bats (HF), whereas species such as the big brown bat (*Eptesicus fuscus*), silver-haired bat (*Lasionycteris noctivagans*), and hoary bat (*Lasiurus cinereus*) typically emit echolocation calls below 30 kHz and are considered low-frequency bats. To establish which species may have produced passes in each category, a list of species expected to occur in the study area was compiled from range maps (Table 2; BCI 2003).

**Statistical Analysis**

The standard metric used for measuring bat activity was the number of bat passes per detector-night, and this metric was used as an index of bat activity in the project area. A bat pass was defined as a sequence of at least two echolocation calls (pulses) produced by an individual bat with no pause between calls of more than one second (White and Gehrt 2001, Gannon et al. 2003). A detector-night was defined as one detector operating for one entire night. The terms bat pass and bat call are used interchangeably. Bat passes per detector-night was calculated for all bats, and for HF and LF categories. Bat pass rates represent indices of bat activity and do not represent numbers of individuals. The number of bat passes was determined by an experienced bat acoustic analyst using Analook. All multi-detector averages in this report were calculated by averaging the average activity of each detector.

The period of peak sustained bat activity was defined as the 7-day period with the highest average bat activity. If multiple 7-day periods equaled the peak sustained bat activity rate, all dates in these 7-day periods were reported. This and all multi-detector averages in this report were calculated as an un-weighted average of total activity at each detector.

To highlight seasonal activity patterns, the study was divided into two survey periods: summer (June 13 – July 31), and fall (August 1 – October 23). Mean bat activity was also calculated for a standardized fall migration period (FMP), defined here as July 30 – October 14. The FMP represents the period between dissolution of maternity colonies and onset of the swarming and hibernation seasons. This period was defined by WEST as a standard for comparison with activity from other wind energy facilities. During this time bats begin moving toward wintering areas, and many species of bats initiate reproductive behaviors (Cryan 2008). This period of increased landscape-scale movement and reproductive behavior is often associated with increased levels of bat fatalities at operational wind energy facilities (Arnett et al. 2008).

### Risk Assessment

To assess potential for bat fatalities, bat activity in the SWP was compared to existing data at other wind energy facilities in the Midwest. Among studies measuring both activity and fatality rates, most data were collected during the fall using AnaBat detectors placed at ground level near met towers. Therefore, to make valid comparisons to the publically available data, this report uses the activity rate recorded at ground detectors during the FMP as a standard for comparison with activity data from other wind energy facilities. Given the relatively small number of publicly-available studies and the significant ecological differences between geographically dispersed facilities, the risk assessment is qualitative, rather than quantitative.

## RESULTS

### Bat Acoustic Surveys

Bat activity was monitored at the three sampling locations between June 12 and October 23, 2013, resulting in a total of 477 detector-nights (89.7% of the potential sampling period; Figure 3). The primary causes of lost data were weather related when excessive wind knocked down two of the AnaBat detectors, and battery failure. AnaBat units at fixed ground stations recorded 448 bat passes on 351 detector-nights for a mean (± standard error) of 1.30 ± 0.14 bat passes per detector-night, while the raised station recorded 89 bat passes on 126 detector nights for a mean of 0.71 ± 0.11 per detector-night (Table 3, Figure 4). In total, AnaBat units recorded 537 bat passes on 477 detector-nights for a mean of 1.15±0.12 bat passes per detector-night (Table

3). In addition, excessive noise was detected for about three weeks from August 13 to September 3, 2013, likely due to bee hives that were installed near station S3g (Figure 5).

*Spatial Variation*

Bat activity in the SWP was consistently higher at the ground units (Figure 4, Table 3). On average, activity at ground detectors (1.30 ± 0.14) was nearly twice as high as at the raised detector (0.71 ± 0.11; Table 3, Figures 4 and 6). Bat activity varied between the four met tower locations. Among ground units, S3G recorded the fewest bat passes per detector-night (0.88 ± 0.17), while unit S1G recorded the most (1.65 ± 0.19; Table 3, Figure 4).

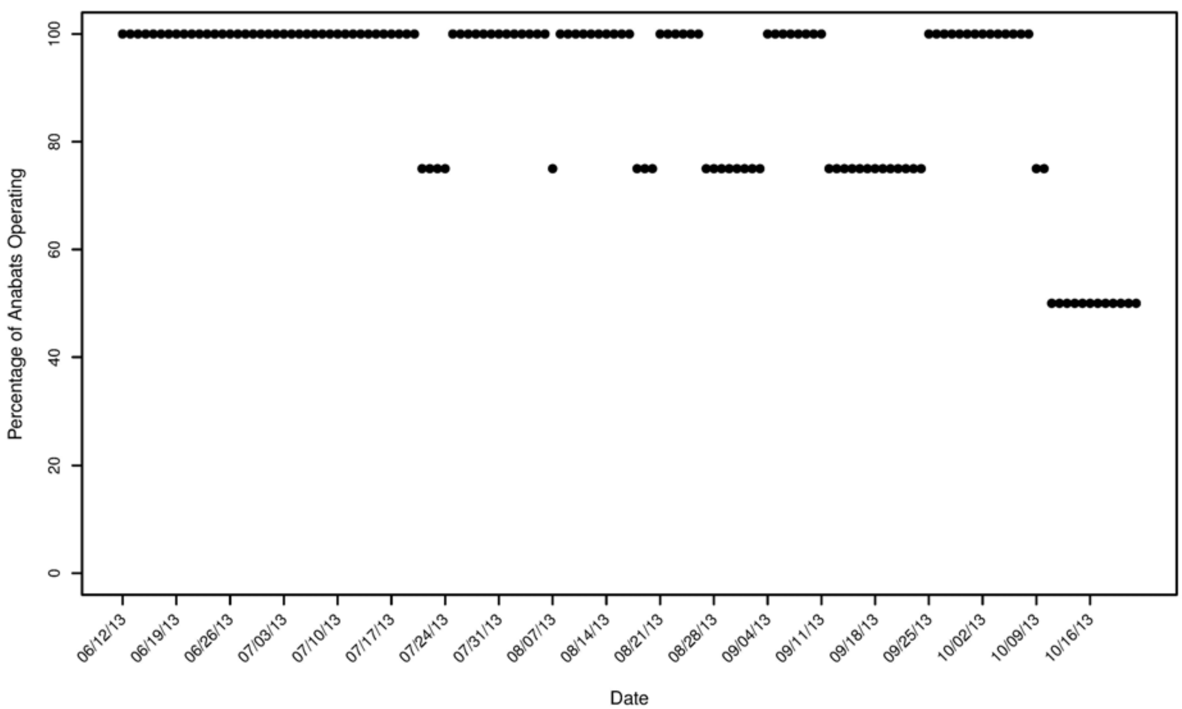


**Figure 3. Operational status of AnaBat detectors operating at the Sunflower Wind Project during each night of the study period June 12 to October 23, 2013.**

**Table 3. Results of acoustic bat surveys conducted at fixed stations within the Sunflower Wind Project from June 12 to October 23, 2013. Passes are separated by call frequency: high frequency (HF) and low frequency (LF).**

| AnaBat Station | Location | # of HF Bat Passes | # of LF Bat Passes | Total Bat Passes | Detector-Nights | Bat Passes/ Night* |
|---|---|---|---|---|---|---|
| S1G | ground | 105 | 81 | 186 | 113 | 1.65±0.19 |
| S1R | raised | 15 | 74 | 89 | 126 | 0.71±0.10 |
| S2G | ground | 90 | 56 | 146 | 106 | 1.38±0.18 |
| S3G | ground | 83 | 33 | 116 | 132 | 0.88±0.17 |
| **Total Ground** | | 278 | 170 | 448 | 351 | 1.30±0.14 |
| **Total Raised** | | 15 | 74 | 89 | 126 | 0.71±0.11 |
| **Total** | | 293 | 244 | 537 | 477 | 1.15±0.12 |

* ± bootstrapped standard error.

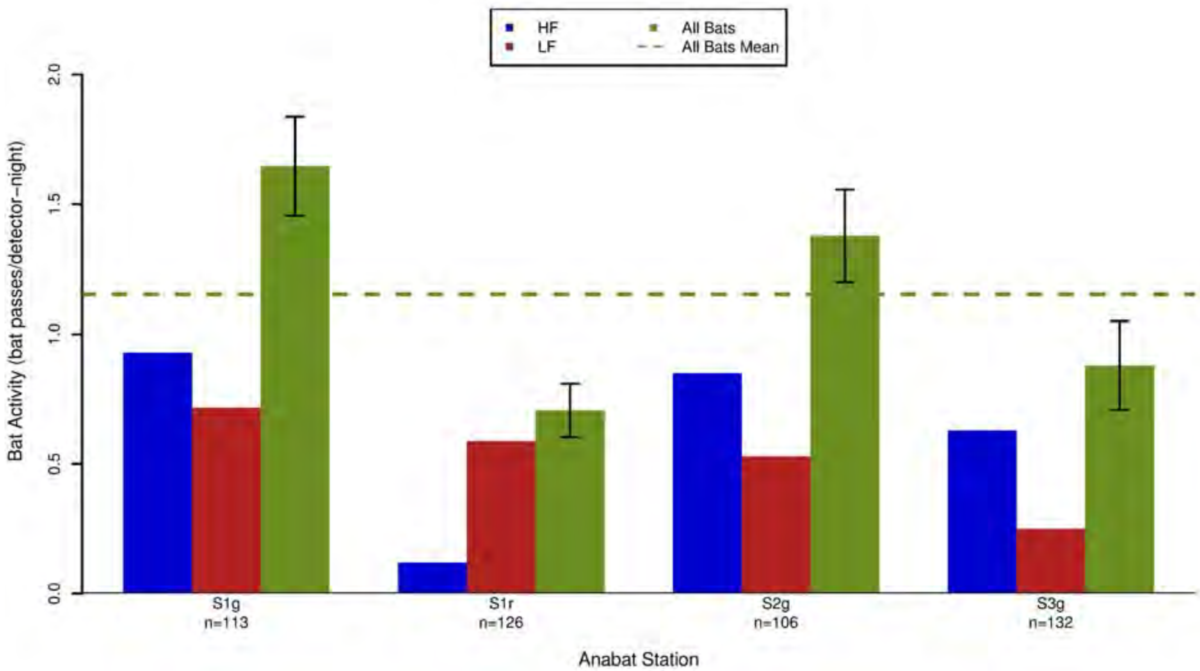


**Figure 4. Number of high-frequency (HF) and low-frequency (LF) bat passes per detector-night recorded at AnaBat stations in the Sunflower Wind Project between June 12 to October 23, 2013. The bootstrapped standard errors are represented by the black error bars on the 'All Bats' columns.**

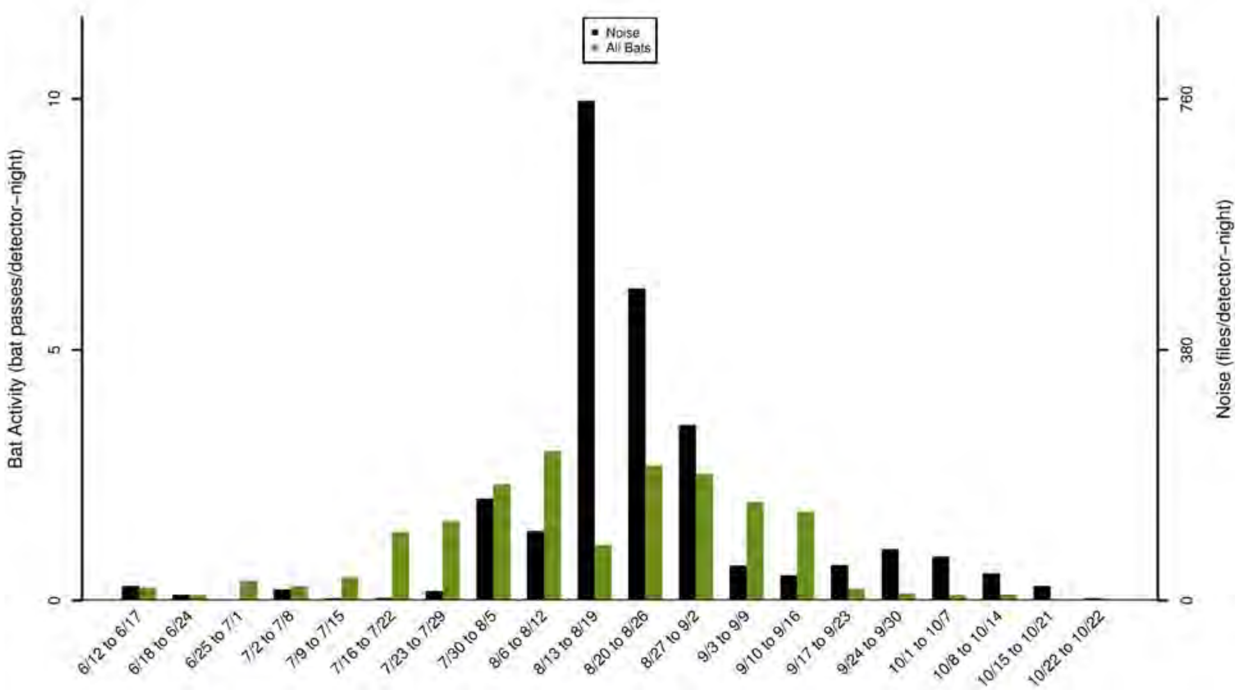


**Figure 5. Activity and noise comparison at fixed AnaBat stations for all bats in the Sunflower Wind Project from June 12 to October 23, 2013.**

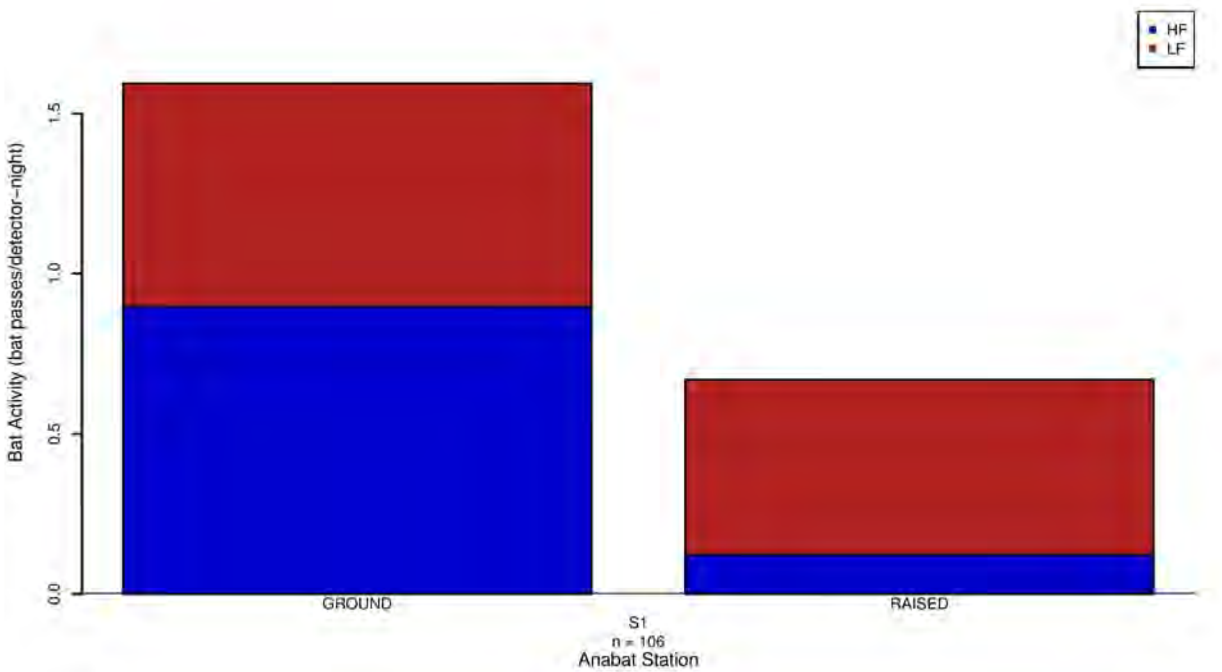


**Figure 6. Number of high-frequency (HF) and low-frequency (LF) bat passes per detector-night recorded at the paired AnaBat station (S1) between June 12 to October 23, 2013.**

*Temporal Variation*

Bat activity at fixed stations was relatively low in the summer and higher in the fall (Table 4; Figure 7). Bat activity peaked from August 4 to August 10 at 3.35 bat passes per detector-night (Table 5). After the peak, overall bat activity gradually decreased for the remainder of the study period (Figure 8). Comparing weekly activity at paired ground and raised detectors indicates a subtle shift during the course of the season; activity was generally higher at ground detectors throughout the summer and fall, but LF calls were higher at the raised station during the fall and FMP (Table 4; Figure 9).

**Table 4. The number of bat passes per detector-night recorded at met towers stations in the Sunflower Wind Project during each season in 2013, separated by call frequency: high-frequency (HF), low-frequency (LF), and all bats (AB).**

| Station | Call Frequency | Summer June 12 – Jul 31 | Fall Aug 1 – Oct 23 | Fall Migration Jul 30 – Oct 14 |
|---|---|---|---|---|
| S1g | LF | 0.38 | 0.98 | 1.00 |
| | HF | 0.66 | 1.14 | 1.14 |
| | AB | 1.04 | 2.13 | 2.14 |
| S1r | LF | 0.13 | 0.85 | 0.93 |
| | HF | 0.09 | 0.14 | 0.18 |
| | AB | 0.22 | 0.99 | 1.11 |
| S2g | LF | 0.18 | 0.84 | 0.83 |
| | HF | 0.74 | 0.95 | 0.95 |
| | AB | 0.92 | 1.79 | 1.78 |

**Table 4. The number of bat passes per detector-night recorded at met towers stations in the Sunflower Wind Project during each season in 2013, separated by call frequency: high-frequency (HF), low-frequency (LF), and all bats (AB).**

| Station | Call Frequency | Summer June 12 – Jul 31 | Fall Aug 1 – Oct 23 | Fall Migration Jul 30 – Oct 14 |
|---|---|---|---|---|
| S3g | LF | 0.06 | 0.37 | 0.39 |
| | HF | 0.56 | 0.67 | 0.8 |
| | AB | 0.62 | 1.04 | 1.2 |
| **Ground Totals** | **LF** | 0.21±0.06 | 0.73±0.11 | 0.74±0.11 |
| | **HF** | 0.65±0.12 | 0.92±0.13 | 0.96±0.13 |
| | **AB** | 0.86±0.16 | 1.65±0.20 | 1.70±0.20 |
| **Raised Totals** | **LF** | 0.13±0.06 | 0.85±0.16 | 0.93±0.17 |
| | **HF** | 0.09±0.05 | 0.14±0.04 | 0.18±0.05 |
| | **AB** | 0.22±0.09 | 0.99±0.18 | 1.11±0.19 |
| **Overall** | **LF** | 0.19±0.04 | 0.76±0.11 | 0.79±0.11 |
| | **HF** | 0.51±0.09 | 0.72±0.10 | 0.77±0.10 |
| | **AB** | 0.70±0.12 | 1.48±0.18 | 1.55±0.18 |

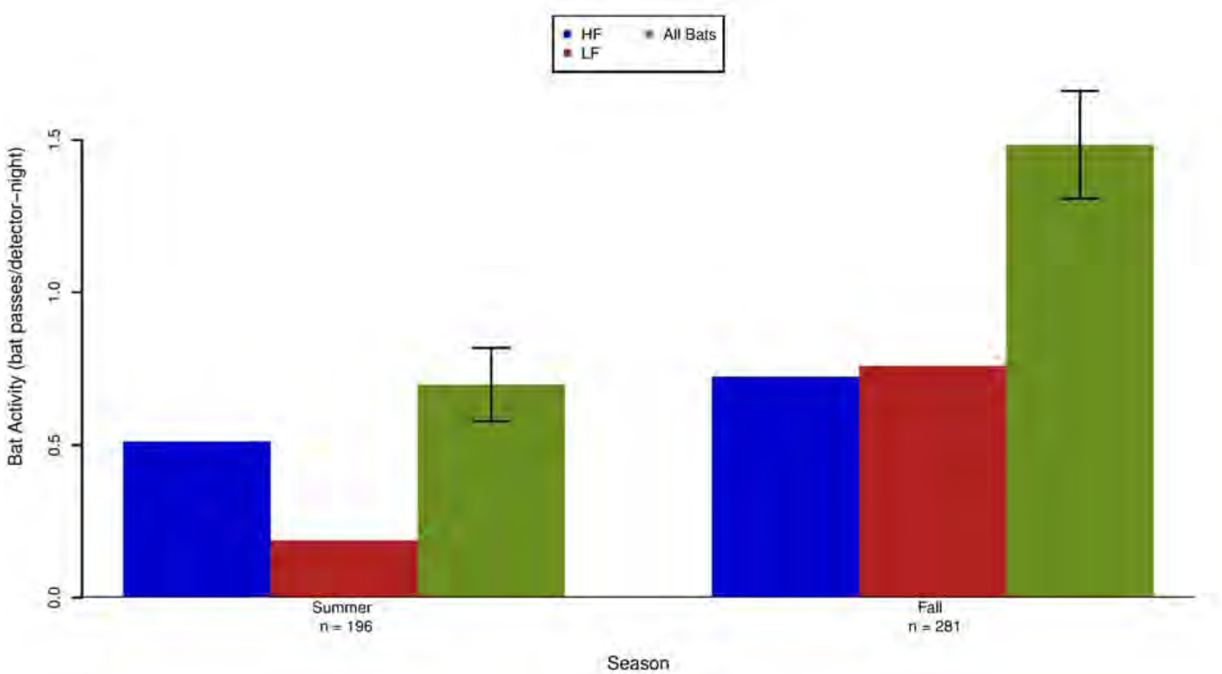


**Figure 7. Seasonal bat activity by high-frequency (HF), low-frequency (LF), and all bats at the Sunflower Wind Project from June 12 to October 23, 2013. The bootstrapped standard errors are represented by black bars on the 'All Bats' columns.**

**Table 5. Periods of peak activity for high-frequency (HF), low-frequency (LF), and all bats at the Sunflower Wind Project for the study period June 12 – October 23, 2013.**

| Species Group | Start Date of Peak Activity | End Date of Peak Activity | Bat Passes per Detector-Night |
|---|---|---|---|
| HF | August 4 | August 10 | 2.10 |
| LF | August 27 | September 04 | 1.76 |
| All Bats | August 4 | August 10 | 3.35 |

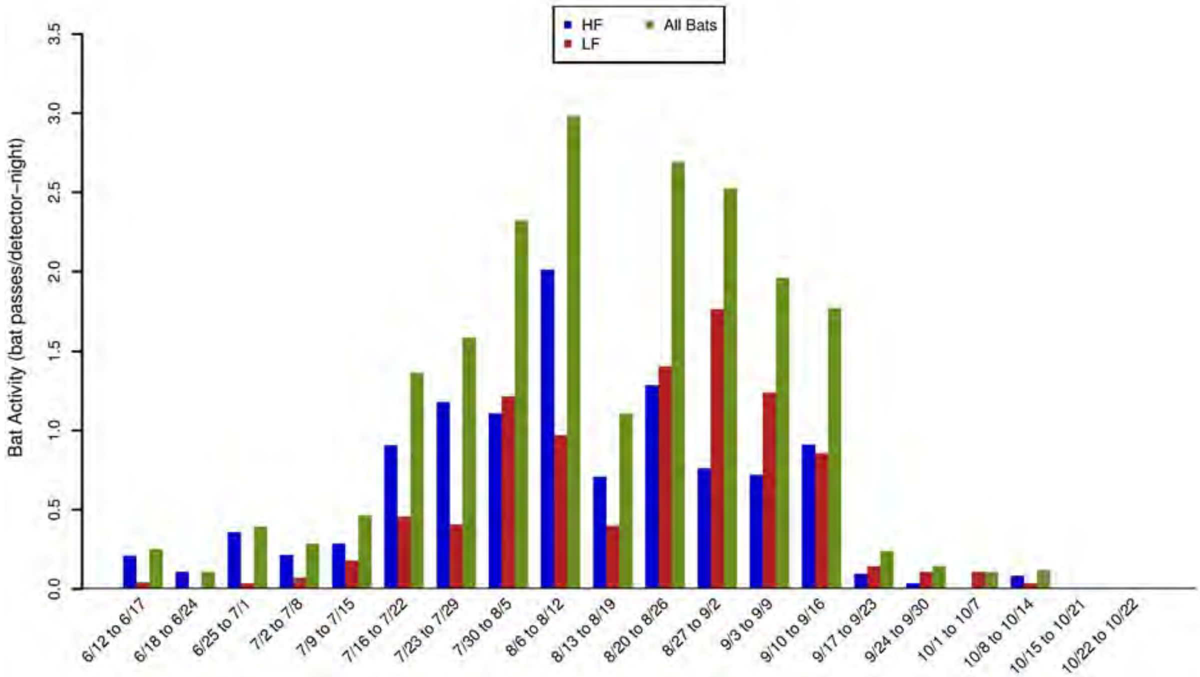


**Figure 8. Weekly patterns of bat activity by high-frequency (HF), low-frequency (LF), and all bats at the Sunflower Wind Project for the study period June 12 to October 23, 2013.**

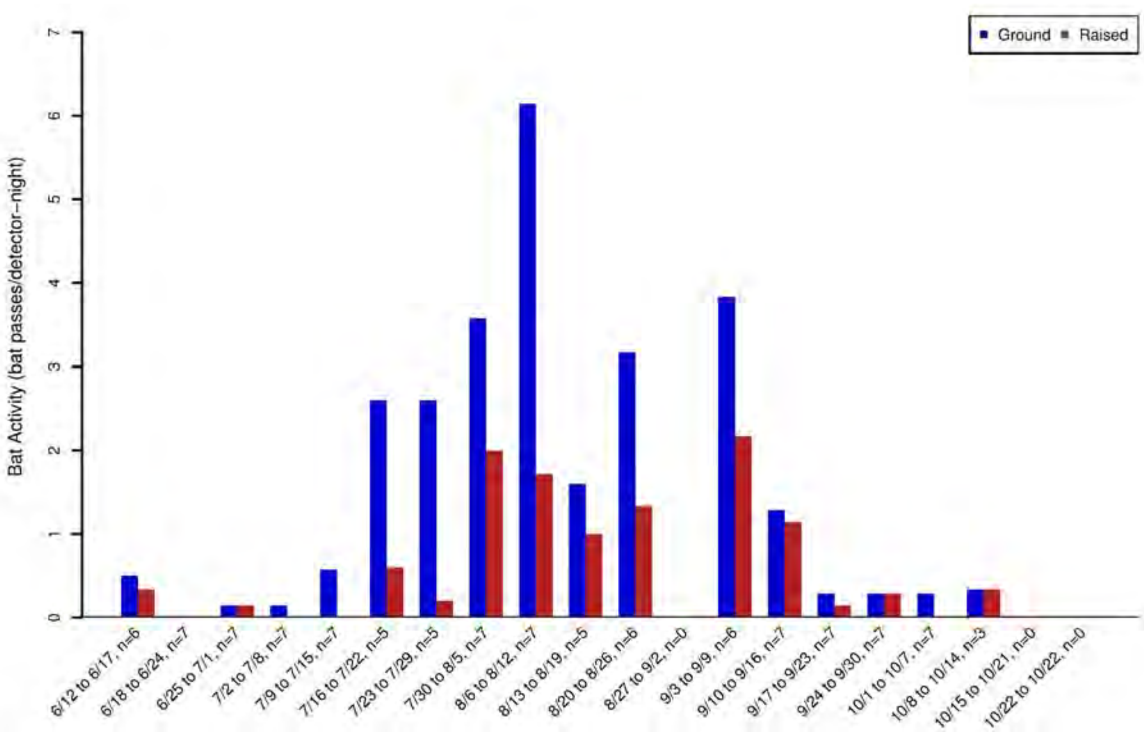


**Figure 9. Weekly patterns of bat activity from June 12 to October 23, 2013, at ground and raised met tower stations at the Sunflower Wind Project.**

# DISCUSSION

**Potential Bat Impacts**

Assessing the potential impacts of wind energy development on bats at the SWP is complicated because the causes of bat fatalities at turbines are poorly understood (Kunz et al. 2007a, 2007b; Baerwald et al. 2008; Cryan and Barclay 2009; Long et al. 2010a, 2010b) and monitoring elusive, night-flying animals is inherently difficult (O'Shea et al. 2003). Although installed capacity for wind energy has increased rapidly in recent years, release of study results from these existing wind energy facilities has lagged the influx of newly proposed facilities (Kunz et al. 2007b); therefore, it is often the case that information gleaned from existing wind energy facilities is not available to inform assessments at proposed facilities. To date, post-construction monitoring studies of wind energy facilities suggest that:

1) Bat fatality rates show a rough positive correlation with bat activity (Kunz et al. 2007b);

2) The majority of fatalities occur during the post-breeding or fall migration season (August and September; Johnson 2005, Arnett et al. 2008);

3) Migratory tree-roosting species (e.g., eastern red, hoary, and silver-haired bats) compose approximately 75% of reported bats killed (Arnett et al. 2008, Gruver et al. 2009), and;

4) The level of bat fatalities may depend on many variables, including local environmental characteristics and/or specific weather conditions, but no single predictive factor has yet been identified.

*Overall Bat Activity*

Among publicly-available studies of bat activity at wind energy facilities, most data were collected only during the fall using AnaBat detectors placed near the ground in vegetation cover typical of turbine placement, rather than near features attractive to bats. Therefore, to generate a standardized metric of activity for comparison, this report relies on mean bat activity for the ground detectors during the fall migration period (FMP) to compare activity at the SWP to other studies with similarly-collected data (Figure 10, Appendix A).

While inconsistencies among studies (e.g., differences in study period length and timing, type of equipment, placement of equipment, and presentation of data; Appendix A) complicate comparisons across studies, some generalizations can be made. Considering only the detectors near ground-level at the met towers, bat activity recorded within the SWP during the standardized FMP (1.70 bat passes per detector-night) was the lowest estimate out of all the facilities in Midwest and the third lowest out of all the facilities in North America with similarly-collected data (Appendix A). However, this includes estimates from facilities in different regions, with different habitats and different bat species.

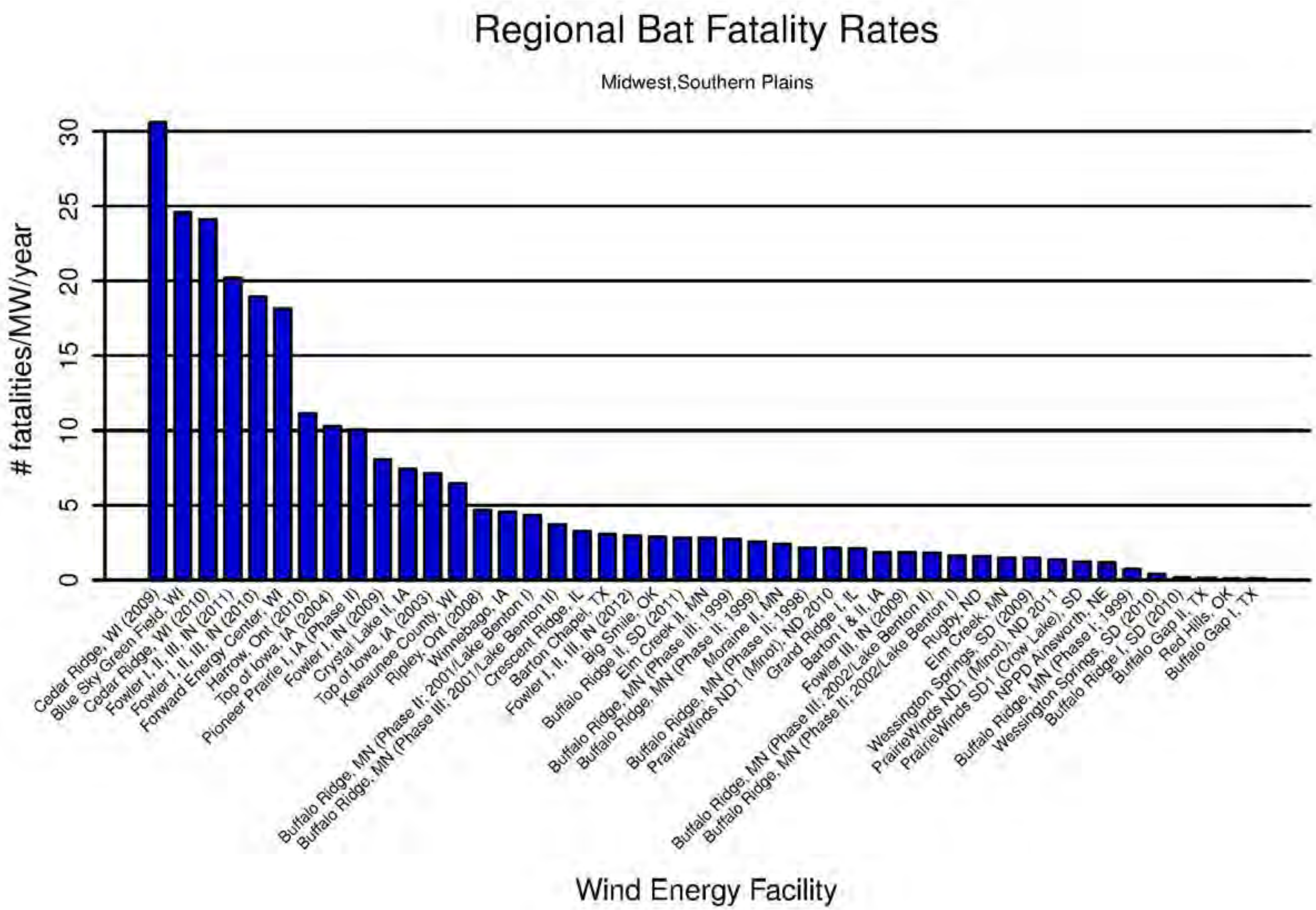


**Figure 10. Fatality rates for bats (number of bats per megawatt per year) from publicly-available studies at wind energy facilities in the Midwest and Southern Plains of North America.**

**Figure 10 (*continued*). Fatality rates for bats (number of bats per megawatt per year) from publicly-available studies at wind energy facilities in the Midwest and Southern Plains of North America.**

Data from the following sources:

| Wind Energy Facility | Reference | Wind Energy Facility | Reference | Wind Energy Facility | Reference |
|---|---|---|---|---|---|
| Cedar Ridge, WI (09) | BHE Environmental 2010 | Buffalo Ridge, MN (Ph. II; 01/Lake Benton I) | Johnson et al. 2004 | Fowler III, IN (09) | Good et al. 2011 |
| Blue Sky Green Field, WI | Gruver et al. 2009 | Buffalo Ridge, MN (Ph. III; 01/Lake Benton II) | Johnson et al. 2004 | Buffalo Ridge, MN (Ph. III; 02/Lake Benton II) | Johnson et al. 2004 |
| Cedar Ridge, WI (10) | BHE Environmental 2011 | Crescent Ridge, IL | Kerlinger et al. 2007 | Buffalo Ridge, MN (Ph. II; 02/Lake Benton I) | Johnson et al. 2004 |
| Fowler I, II, III, IN (11) | Good et al. 2012 | Barton Chapel, TX | WEST 2011 | Rugby, ND | Derby et al. 2011b |
| Fowler I, II, III, IN (10) | Good et al. 2011 | Fowler I, II, III, IN (12) | Good et al. 2013 | Elm Creek, MN | Derby et al. 2010c |
| Forward Energy Center, WI | Grodsky and Drake 2011 | Big Smile, OK | Derby et al. 2013a | Wessington Springs, SD (09) | Derby et al. 2010f |
| Harrow, Ont. (10) | NRSI 2011 | Buffalo Ridge II, SD (11) | Derby et al. 2012a | PrairieWinds ND1 (Minot), ND (11) | Derby et al. 2012c |
| Top of Iowa, IA (04) | Jain 2005 | Elm Creek II, MN | Derby et al. 2012b | PrairieWinds SD1 (Crow Lake), SD | Derby et al. 2012d |
| Pioneer Prairie, IA (Ph. II) | Chodachek et al. 2012 | Buffalo Ridge, MN (Ph. III; 99) | Johnson et al. 2000 | NPPD Ainsworth, NE | Derby et al. 2007 |
| Fowler I, IN (09) | Good et al. 2011 | Buffalo Ridge, MN (Ph. II; 99) | Johnson et al. 2000 | Buffalo Ridge, MN (Ph. I; 99) | Johnson et al. 2000 |
| Crystal Lake II, IA | Derby et al. 2010a | Moraine II, MN | Derby et al. 2010d | Wessington Springs, SD (10) | Derby et al. 2011d |
| Top of Iowa, IA (03) | Jain 2005 | Buffalo Ridge, MN (Ph. II; 98) | Johnson et al. 2000 | Buffalo Ridge I, SD (10) | Derby et al. 2010b |
| Kewaunee County, WI | Howe et al. 2002 | PrairieWinds ND1 (Minot), ND (10) | Derby et al. 2011c | Buffalo Gap II, TX | Tierney 2009 |
| Ripley, Ont (08) | Jacques Whitford 2009 | Grand Ridge I, IL | Derby et al. 2010g | Red Hills, OK | Derby et al. 2013b |
| Winnebago, IA | Derby et al. 2010e | Barton I & II, IA | Derby et al. 2011a | Buffalo Gap I, TX | Tierney 2007 |

It is unclear whether monitoring bat activity near ground level accurately represents activity at all heights (Hayes and Gruver 2000). Some research suggests that bat activity in the rotor-swept heights may be more representative of bat exposure to turbines (Baerwald and Barclay 2009). At the SWP, fall bat migration activity recorded by the 45 m detector (1.11 bat passes per detector-night; Table 4) was lower than at the 1 m detectors (1.70 bat passes per night). While bat activity at 45 m (148 ft) detectors might better represent activity in the rotor-swept height (RSH), it is not directly comparable to activity rates reported at other North American studies.

*Spatial Variation*

Detection rates at the ground detectors varied between met towers; however, the raised unit consistently recorded approximately half the number of bat calls as the corresponding ground detectors. The met towers were located in hay fields and represent potential turbine locations. Because bat activity was generally lower at the raised met tower station than ground level stations, there may a lower potential risk of collision with turbines than if the call rates were similar at both the ground and at the raised station.

*Temporal Variation*

The highest bat activity occurred within the SWP during the fall, with peak activity in early August (Table 5). Higher activity in early August likely corresponds with the reproductive seasons of bats, when pups are being weaned and foraging rates are high among adult females and newly volant juveniles as well as fall migration. When data collection for this report ended on October 23, 2013, there was a consistent trend of decreasing bat activity from previous weeks, indicating that additional peaks in bat activity after October 23 are unlikely (Figures 8 and 9).

Most bat fatality studies at wind energy facilities in the US have shown a peak in fatality in August and September (the fall migration period) and generally lower mortality earlier in the summer and very low mortality during the spring (Johnson 2005, Arnett et al. 2008). While the survey effort varied among the different studies, a general association between the timing of increased bat call rates and timing of mortality was suggested in the studies that combine AnaBat and fatality surveys, with both call rates and fatalities peaking during the FMP. Based on the available data, it is expected that bat fatalities at the SWP, while likely low overall, will be highest during late summer and early fall at potential turbine locations (i.e., met towers).

*Species Composition*

Eight of the ten bat species likely to occur in the SWP are known fatalities at wind energy facilities (Table 2). Approximately 54.6% of passes recorded at all met tower stations were by high-frequency bats, suggesting higher relative abundance of species such as eastern red bats and little brown bats as well as other potential species *(*Table 2). Met tower stations represent potential turbine locations and it is expected that bat species flying at RSH and detected at raised stations are the most vulnerable to collision with turbine blades. In some regions, eastern red bats compose the majority of bat fatalities found during searches (Arnett et al. 2008).

Low-frequency bats (e.g., hoary bat, silver-haired bat, and big brown bat) were the most common frequency group detected at the raised station during the fall and FMP (Table 4). Some LF species, such as hoary bat and silver-haired bat, have been found as fatalities in higher proportions than other species (Arnett et al. 2008). High-frequency species (e.g., eastern red bats and most *Myotis* species) were detected at the raised station less frequently (16.8% of calls; Table 3). Some HF bat carcasses (e.g., little brown bat) have been found in relatively high proportions during fatality monitoring studies (e.g., Kerns and Kerlinger 2004, Jain 2005, Brown and Hamilton 2006b, Gruver et al. 2009). However, *Myotis* species are typically less commonly recorded in the RSH or as fatalities at post-construction studies at wind energy facilities than other species, such as hoary and eastern red bats (Kunz et al. 2007b, Arnett et al. 2008).

**Potential Bat Fatality Rates**

Bat fatality rates from studies at wind energy facilities across North America have ranged from 0.08 (Chatfield et al. 2012) to 39.70 bat fatalities/MW/year (Fiedler et al. 2007; Appendix A). In general, fatality rates exhibit a high degree of variation for most regions. Thus far, bat fatality rates at wind energy facilities located in agricultural regions of the Dakotas, Illinois, Indiana, Iowa, Minnesota, Wisconsin, and Ontario have ranged from 0.16 to 30.61 bats/MW/year (Appendix A). The reports of moderate to high levels of bat fatalities in agricultural settings in Iowa (Jain 2005, Chodachek et al. 2012); Ontario, Canada (Natural Resource Solutions, Inc. [NRSI] 2011); and Wisconsin (Gruver et al. 2009; BHE Environmental 2010, 2011) suggest that the lack of forested areas does not guarantee low bat fatality rates at wind energy facilities.

Bat activity recorded at the SWP by ground detectors at met towers during the FMP (1.70 ± 0.20 bat passes per detector-night) was the lowest activity when compared to all publicly-available reports from facilities in Midwest and the third lowest when compared to all facilities in North America with similarly-collected activity data (Appendix A), potentially indicating low direct impacts to bats.  However, the efficacy of using pre-construction bat activity surveys to predict post-construction fatality rates is unclear. This may be due to a lack of consistent methodologies between projects. Some bat species may also be attracted to turbines out of curiosity, or for mating, foraging, or roosting opportunities (Cryan and Barclay 2009). These two factors further complicate the interpretation of existing data. The pre-construction bat studies completed at the SWP will add to the growing body of research regarding the impacts of wind energy development on bats and will provide a valuable comparison to post-construction studies to be completed at the SWP.

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# Appendix A. North American Fatality Summary Tables

**Appendix A1. Wind energy facilities in North America with comparable activity and fatality data for bats, separated by geographic region.**

| Wind Energy Facility | Bat Activity Estimate[A] | Bat Activity Dates | Fatality Estimate[B] | No. of Turbines | Total MW |
|---|---|---|---|---|---|
| **Sunflower, ND** | **1.70** | | | | |
| | ***Midwest*** | | | | |
| Cedar Ridge, WI (2009) | 9.97[C,D,E,F] | 7/16/07-9/30/07 | 30.61 | 41 | 67.6 |
| Blue Sky Green Field, WI | 7.7[F] | 7/24/07-10/29/07 | 24.57 | 88 | 145 |
| Cedar Ridge, WI (2010) | 9.97[C,D,E,F] | 7/16/07-9/30/07 | 24.12 | 41 | 68 |
| Fowler I, II, III, IN (2011) | | | 20.19 | 355 | 600 |
| Fowler I, II, III, IN (2010) | | | 18.96 | 355 | 600 |
| Forward Energy Center, WI | 6.97 | 8/5/08-11/08/08 | 18.17 | 86 | 129 |
| Harrow, Ont (2010) | | | 11.13 | 24 (four 6-turb facilities) | 39.6 |
| Top of Iowa, IA (2004) | 35.7 | 5/26/04-9/24/04 | 10.27 | 89 | 80 |
| Pioneer Prairie I, IA (Phase II) | | | 10.06 | 62 | 102.3 |
| Fowler I, IN (2009) | | | 8.09 | 162 | 301 |
| Crystal Lake II, IA | | | 7.42 | 80 | 200 |
| Top of Iowa, IA (2003) | | | 7.16 | 89 | 80 |
| Kewaunee County, WI | | | 6.45 | 31 | 20.46 |
| Ripley, Ont (2008) | | | 4.67 | 38 | 76 |
| Winnebago, IA | | | 4.54 | 10 | 20 |
| Buffalo Ridge, MN (Phase II; 2001/Lake Benton I) | 2.2[D] | 6/15/01-9/15/01 | 4.35 | 143 | 107.25 |
| Buffalo Ridge, MN (Phase III; 2001/Lake Benton II) | 2.2[D] | 6/15/01-9/15/01 | 3.71 | 138 | 103.5 |
| Crescent Ridge, IL | | | 3.27 | 33 | 49.5 |
| Fowler I, II, III, IN (2012) | | | 2.96 | 355 | 600 |
| Elm Creek II, MN | | | 2.81 | 62 | 148.8 |
| Buffalo Ridge II, SD (2011) | | | 2.81 | 105 | 210 |
| Buffalo Ridge, MN (Phase III; 1999) | | | 2.72 | 138 | 103.5 |
| Buffalo Ridge, MN (Phase II; 1999) | | | 2.59 | 143 | 107.25 |
| Moraine II, MN | | | 2.42 | 33 | 49.5 |
| Buffalo Ridge, MN (Phase II; 1998) | | | 2.16 | 143 | 107.25 |
| PrairieWinds ND1 (Minot), ND 2010 | | | 2.13 | 80 | 115.5 |
| Grand Ridge I, IL | | | 2.10 | 66 | 99 |
| Barton I & II, IA | | | 1.85 | 80 | 160 |
| Fowler III, IN (2009) | | | 1.84 | 60 | 99 |
| Buffalo Ridge, MN (Phase III; 2002/Lake Benton II) | 1.9[D] | 6/15/02-9/15/02 | 1.81 | 138 | 103.5 |
| Buffalo Ridge, MN (Phase II; 2002/Lake Benton I) | 1.9[D] | 6/15/02-9/15/02 | 1.64 | 143 | 107.25 |
| Rugby, ND | | | 1.6 | 71 | 149 |
| Elm Creek, MN | | | 1.49 | 67 | 100 |
| Wessington Springs, SD (2009) | | | 1.48 | 34 | 51 |
| PrairieWinds ND1 (Minot), ND 2011 | | | 1.39 | 80 | 115.5 |
| PrairieWinds SD1 (Crow Lake), SD | | | 1.23 | 108 | 162 |
| NPPD Ainsworth, NE | | | 1.16 | 36 | 20.5 |
| Buffalo Ridge, MN (Phase I; 1999) | | | 0.74 | 73 | 25 |
| Wessington Springs, SD (2010) | | | 0.41 | 34 | 51 |
| Buffalo Ridge I, SD (2010) | | | 0.16 | 24 | 50.4 |

**Appendix A1. Wind energy facilities in North America with comparable activity and fatality data for bats, separated by geographic region.**

| Wind Energy Facility | Bat Activity Estimate[A] | Bat Activity Dates | Fatality Estimate[B] | No. of Turbines | Total MW |
|---|---|---|---|---|---|
| ***Southern Plains*** | | | | | |
| Barton Chapel, TX | | | 3.06 | 60 | 120 |
| Big Smile, OK | | | 2.90 | 66 | 132 |
| Buffalo Gap II, TX | | | 0.14 | 155 | 233 |
| Red Hills, OK | | | 0.11 | 82 | 123 |
| Buffalo Gap I, TX | | | 0.10 | 67 | 134 |
| ***Northeast*** | | | | | |
| Mountaineer, WV (2003) | | | 31.69 | 44 | 66 |
| Mount Storm, WV (2009) | 30.09 | 7/15/09-10/7/09 | 17.53 | 132 | 264 |
| Noble Wethersfield, NY | | | 16.30 | 84 | 126 |
| Criterion, MD (2011) | | | 15.61 | 28 | 70 |
| Mount Storm, WV (2010) | 36.67[G] | 4/18/10-10/15/10 | 15.18 | 132 | 264 |
| Locust Ridge, PA (Phase II; 2010) | | | 14.38 | 51 | 102 |
| Locust Ridge, PA (Phase II; 2009) | | | 14.11 | 51 | 102 |
| Casselman, PA (2008) | | | 12.61 | 23 | 34.5 |
| Maple Ridge, NY (2006) | | | 11.21 | 120 | 198 |
| Cohocton/Dutch Hills, NY (2010) | | | 10.32 | 50 | 125 |
| Wolfe Island, Ont (July-December 2010) | | | 9.50 | 86 | 197.8 |
| Maple Ridge, NY (2007) | | | 9.42 | 195 | 321.75 |
| Cohocton/Dutch Hill, NY (2009) | | | 8.62 | 50 | 125 |
| Casselman, PA (2009) | | | 8.60 | 23 | 34.5 |
| Noble Bliss, NY (2008) | | | 7.80 | 67 | 100 |
| Criterion, MD (2012) | | | 7.62 | 28 | 70 |
| Mount Storm, WV (2011) | | | 7.43 | 132 | 264 |
| Mount Storm, WV (Fall 2008) | 35.2 | 7/20/08-10/12/08 | 6.62 | 82 | 164 |
| Wolfe Island, Ont (July-December 2009) | | | 6.42 | 86 | 197.8 |
| Maple Ridge, NY (2008) | | | 4.96 | 195 | 321.75 |
| Noble Clinton, NY (2009) | 1.9[C] | 8/1/09-09/31/09 | 4.50 | 67 | 100 |
| Casselman Curtailment, PA (2008) | | | 4.40 | 23 | 35.4 |
| Noble Altona, NY | | | 4.34 | 65 | 97.5 |
| Noble Ellenburg, NY (2009) | 16.1[C] | 8/16/09-09/15/09 | 3.91 | 54 | 80 |
| Noble Bliss, NY (2009) | | | 3.85 | 67 | 100 |
| Lempster, NH (2010) | | | 3.57 | 12 | 24 |
| Noble Ellenburg, NY (2008) | | | 3.46 | 54 | 80 |
| Noble Clinton, NY (2008) | 2.1[C] | 8/8/08-09/31/08 | 3.14 | 67 | 100 |
| Lempster, NH (2009) | | | 3.11 | 12 | 24 |
| Mars Hill, ME (2007) | | | 2.91 | 28 | 42 |
| Wolfe Island, Ont (July-December 2011) | | | 2.49 | 86 | 197.8 |
| Noble Chateaugay, NY | | | 2.44 | 71 | 106.5 |
| High Sheldon, NY (2010) | | | 2.33 | 75 | 112.5 |
| Beech Ridge, WV | | | 2.03 | 67 | 100.5 |
| Munnsville, NY (2008) | | | 1.93 | 23 | 34.5 |
| High Sheldon, NY (2011) | | | 1.78 | 75 | 112.5 |
| Stetson Mountain II, ME (2010) | | | 1.65 | 17 | 25.5 |
| Stetson Mountain I, ME (2009) | 28.5; 0.3[H] | 7/10/09-10/15/09 | 1.40 | 38 | 57 |
| Mars Hill, ME (2008) | | | 0.45 | 28 | 42 |
| Stetson Mountain I, ME (2011) | | | 0.28 | 38 | 57 |
| Kibby, ME (2011) | | | 0.12 | 44 | 132 |
| ***Southeast*** | | | | | |
| Buffalo Mountain, TN (2005) | | | 39.70 | 18 | 28.98 |
| Buffalo Mountain, TN (2000-2003) | 23.7[E] | | 31.54 | 3 | 1.98 |

**Appendix A1. Wind energy facilities in North America with comparable activity and fatality data for bats, separated by geographic region.**

| Wind Energy Facility | Bat Activity Estimate[A] | Bat Activity Dates | Fatality Estimate[B] | No. of Turbines | Total MW |
|---|---|---|---|---|---|
| | | ***Rocky Mountains*** | | | |
| Summerview, Alb (2008) | 7.65[D] | 07/15/06-07-09/30/06-07 | 11.42 | 39 | 70.2 |
| Summerview, Alb (2006) | | | 10.27 | 39 | 70.2 |
| Judith Gap, MT (2006/2007) | | | 8.93 | 90 | 135 |
| Foote Creek Rim, WY (Phase I; 1999) | | | 3.97 | 69 | 41.4 |
| Judith Gap, MT (2009) | | | 3.20 | 90 | 135 |
| Foote Creek Rim, WY (Phase I; 2001-2002) | 2.2[D,E] | 6/15/01-9/1/01 | 1.57 | 69 | 41.4 |
| Foote Creek Rim, WY (Phase I; 2000) | 2.2[D,E] | 6/15/00-9/1/00 | 1.05 | 69 | 41.4 |
| | | ***Southwest*** | | | |
| Dry Lake I, AZ | 8.8 | 4/29/10-11/10/10 | 3.43 | 30 | 63 |
| Dry Lake II, AZ | 11.5 | 5/11/11-10/26/11 | 1.66 | 31 | 65 |
| | | ***Pacific Northwest*** | | | |
| Biglow Canyon, OR (Phase II; 2009/2010) | | | 2.71 | 65 | 150 |
| Nine Canyon, WA | | | 2.47 | 37 | 48.1 |
| Stateline, OR/WA (2003) | | | 2.29 | 454 | 299 |
| Elkhorn, OR (2010) | | | 2.14 | 61 | 101 |
| White Creek, WA (2007-2011) | | | 2.04 | 89 | 204.7 |
| Biglow Canyon, OR (Phase I; 2008) | | | 1.99 | 76 | 125.4 |
| Leaning Juniper, OR | | | 1.98 | 67 | 100.5 |
| Big Horn, WA | | | 1.90 | 133 | 199.5 |
| Combine Hills, OR (Phase I; 04/05) | | | 1.88 | 41 | 41 |
| Linden Ranch, WA | | | 1.68 | 25 | 50 |
| Pebble Springs, OR | | | 1.55 | 47 | 98.7 |
| Hopkins Ridge, WA (2008) | | | 1.39 | 87 | 156.6 |
| Harvest Wind, WA (2010-2012) | | | 1.27 | 43 | 98.9 |
| Elkhorn, OR (2008) | | | 1.26 | 61 | 101 |
| Vansycle, OR | | | 1.12 | 38 | 24.9 |
| Klondike III (Phase I), OR | | | 1.11 | 125 | 223.6 |
| Stateline, OR/WA (2002) | | | 1.09 | 454 | 299 |
| Stateline, OR/WA (2006) | | | 0.95 | 454 | 299 |
| Tuolumne (Windy Point I), WA | | | 0.94 | 62 | 136.6 |
| Klondike, OR | | | 0.77 | 16 | 24 |
| Combine Hills, OR (2011) | | | 0.73 | 104 | 104 |
| Hopkins Ridge, WA (2006) | | | 0.63 | 83 | 150 |
| Biglow Canyon, OR (Phase I; 2009) | | | 0.58 | 76 | 125.4 |
| Biglow Canyon, OR (Phase II; 2010/2011) | | | 0.57 | 65 | 150 |
| Hay Canyon, OR | | | 0.53 | 48 | 100.8 |
| Klondike II, OR | | | 0.41 | 50 | 75 |
| Windy Flats, WA | | | 0.41 | 114 | 262.2 |
| Vantage, WA | | | 0.40 | 60 | 90 |
| Wild Horse, WA | | | 0.39 | 127 | 229 |
| Goodnoe, WA | | | 0.34 | 47 | 94 |
| Marengo II, WA (2009/2010) | | | 0.27 | 39 | 70.2 |
| Biglow Canyon, OR (Phase III; 2010/2011) | | | 0.22 | 76 | 174.8 |
| Marengo I, WA (2009/2010) | | | 0.17 | 78 | 140.4 |
| Klondike IIIa (Phase II), OR | | | 0.14 | 51 | 76.5 |
| Kittitas Valley, WA (2011-2012) | | | 0.12 | 48 | 100.8 |

**Appendix A1. Wind energy facilities in North America with comparable activity and fatality data for bats, separated by geographic region.**

| Wind Energy Facility | Bat Activity Estimate[A] | Bat Activity Dates | Fatality Estimate[B] | No. of Turbines | Total MW |
|---|---|---|---|---|---|
| | | ***California*** | | | |
| Shiloh I, CA | | | 3.92 | 100 | 150 |
| Shiloh II, CA | | | 2.72 | 75 | 150 |
| High Winds, CA (2004) | | | 2.51 | 90 | 162 |
| Dillon, CA | | | 2.17 | 45 | 45 |
| High Winds, CA (2005) | | | 1.52 | 90 | 162 |
| Alta Wind I, CA (2011) | 4.42[I] | 6/26/2009 - 10/31/2009 | 1.28 | 100 | 150 |
| Diablo Winds, CA | | | 0.82 | 31 | 20.46 |
| Alite, CA | | | 0.24 | 8 | 24 |
| Alta Wind II-V, CA (2011) | 0.78 | 6/26/2009 - 10/31/2009 | 0.08 | 190 | 570 |

A = Bat passes per detector-night
B = Number of fatalities per megawatt per year
C = Activity rate based on data collected at various heights all other activity rates are from ground-based units only
D = Activity rate was averaged across phases and/or years
E = Activity rate calculated by WEST from data presented in referenced report
F= Activity rate based on pre-construction monitoring; data for all other activity and fatality rates were collected concurrently
G = Activity rate based on data collected from ground-based units excluding reference stations during the spring, summer, and fall seasons
H = The overall activity rate of 28.5 is from reference stations located along forest edges which may be attractive to bats; the activity rate of 0.3 is from one unit placed on a nacelle
I = Average of ground-based detectors at CPC Proper (Phase I) for late summer/fall period only

**Appendix A1 (*continued*). Wind energy facilities in North America with comparable fatality data for bats.**

| Project, Location | Activity Reference | Fatality Reference | Project, Location | Activity Reference | Fatality Reference |
|---|---|---|---|---|---|
| Alite, CA | | Chatfield et al. 2010 | Kewaunee County, WI | | Howe et al. 2002 |
| Alta Wind I, CA (11) | Solick et al. 2010 | Chatfield et al. 2012 | Kibby, ME (11) | | Stantec 2012 |
| Alta Wind II-V, CA (11) | Solick et al. 2010 | Chatfield et al. 2012 | Kittitas Valley, WA (11-12) | | Stantec Consulting Services 2012 |
| Barton I&II, IA | | Derby et al. 2011a | Klondike, OR | | Johnson et al. 2003 |
| Barton Chapel, TX | | WEST 2011 | Klondike II, OR | | NWC and WEST 2007 |
| Beech Ridge, WV | | Tidhar et al. 2013 | Klondike III (Phase I), OR | | Gritski et al. 2010 |
| Big Horn, WA | | Kronner et al. 2008 | Klondike IIIa (Phase II), OR | | Gritski et al. 2011 |
| Big Smile, OK | | Derby et al. 2013a | Leaning Juniper, OR | | Gritski et al. 2008 |
| Biglow Canyon, OR (Ph. I; 08) | | Jeffrey et al. 2009a | Lempster, NH (09) | | Tidhar et al. 2010 |
| Biglow Canyon, OR (Ph. I; 09) | | Enk et al. 2010 | Lempster, NH (10) | | Tidhar et al. 2011 |
| Biglow Canyon, OR (Ph. II; 09/10) | | Enk et al. 2011a | Linden Ranch, WA | | Enz and Bay 2011 |
| Biglow Canyon, OR (Ph. II; 10/ 11) | | Enk et al. 2012b | Locust Ridge, PA (Ph. II; 09) | | Arnett et al. 2011 |
| Biglow Canyon, OR (Ph. III; 10/ 11) | | Enk et al. 2012a | Locust Ridge, PA (Ph. II; 10) | | Arnett et al. 2011 |
| Blue Sky Green Field, WI | Gruver 2008 | Gruver et al. 2009 | Maple Ridge, NY (06) | | Jain et al. 2007 |
| Buffalo Gap I, TX | | Tierney 2007 | Maple Ridge, NY (07) | | Jain et al. 2009a |
| Buffalo Gap II, TX | | Tierney 2009 | Maple Ridge, NY (08) | | Jain et al. 2009d |
| Buffalo Mountain, TN (00-03) | Fiedler 2004 | Nicholson et al. 2005 | Marengo I, WA (09) | | URS Corporation 2010b |
| Buffalo Mountain, TN (05) | | Fiedler et al. 2007 | Marengo II, WA (09) | | URS Corporation 2010c |
| Buffalo Ridge, MN (Ph. I; 99) | | Johnson et al. 2000 | Mars Hill, ME (07) | | Stantec 2008 |
| Buffalo Ridge, MN (Ph. II; 98) | | Johnson et al. 2000 | Mars Hill, ME (08) | | Stantec 2009a |
| Buffalo Ridge, MN (Ph. II; 99) | | Johnson et al. 2000 | Moraine II, MN | | Derby et al. 2010d |
| Buffalo Ridge, MN (Ph. II; 01/Lake Benton I) | Johnson et al. 2004 | Johnson et al. 2004 | Mount Storm, WV (Fall 08) | Young et al. 2009b | Young et al. 2009b |
| Buffalo Ridge, MN (Ph. II; 02/Lake Benton I) | Johnson et al. 2004 | Johnson et al. 2004 | Mount Storm, WV (09) | Young et al. 2009a, 2010b | Young et al. 2009a, 2010b |
| Buffalo Ridge, MN (Ph. III; 99) | | Johnson et al. 2000 | Mount Storm, WV (10) | Young et al. 2010a, 2011b | Young et al. 2010a, 2011b |
| Buffalo Ridge, MN (Ph. III; 01/Lake Benton II) | Johnson et al. 2004 | Johnson et al. 2004 | Mount Storm, WV (11) | | Young et al. 2011a, 2012b |
| Buffalo Ridge, MN (Ph. III; 02/Lake Benton II) | Johnson et al. 2004 | Johnson et al. 2004 | Mountaineer, WV (2003) | | Kerns and Kerlinger 2004 |
| Buffalo Ridge I, SD (10) | | Derby et al. 2010b | Munnsville, NY (08) | | Stantec 2009b |
| Buffalo Ridge II, SD (11) | | Derby et al. 2012a | Nine Canyon, WA | | Erickson et al. 2003 |
| Casselman, PA (08) | | Arnett et al. 2009a | Noble Altona, NY | | Jain et al. 2011b |
| Casselman, PA (09) | | Arnett et al. 2010 | Noble Bliss, NY (08) | | Jain et al.2009e |
| Casselman Curtailment, PA (08) | | Arnett et al. 2009b | Noble Bliss, NY (09) | | Jain et al. 2010a |
| Cedar Ridge, WI (09) | BHE Environmental 2008 | BHE Environmental 2010 | Noble Chateaugay, NY | | Jain et al. 2011c |
| Cedar Ridge, WI (10) | BHE Environmental 2008 | BHE Environmental 2011 | Noble Clinton, NY (08) | Reynolds 2010a | Jain et al. 2009c |
| Cohocton/Dutch Hill, NY (09) | | Stantec 2010 | Noble Clinton, NY (09) | Reynolds 2010a | Jain et al. 2010b |
| Cohocton/Dutch Hill, NY (10) | | Stantec 2011 | Noble Ellenburg, NY (08) | | Jain et al. 2009b |
| Combine Hills, OR | | Young et al. 2006 | Noble Ellenburg, NY (09) | Reynolds 2010b | Jain et al. 2010c |
| Combine Hills, OR (11) | | Enz et al. 2012 | Noble Wethersfield, NY | | Jain et al. 2011a |
| Crescent Ridge, IL | | Kerlinger et al. 2007 | NPPD Ainsworth, NE | | Derby et al. 2007 |
| Criterion, MD (11) | | Young et al. 2012a | Pebble Springs, OR | | Gritski and Kronner 2010b |
| Criterion, MD (12) | | Young et al. 2013 | Pioneer Prairie, IA (Ph. II) | | Chodachek et al. 2012 |
| Crystal Lake II, IA | | Derby et al. 2010a | PrairieWinds ND1 (Minot), ND | | Derby et al. 2011c |
| Diablo Winds, CA | | WEST 2006, 2008 | PrairieWinds ND1 (Minot), ND (11) | | Derby et al. 2012c |
| Dillon, CA | | Chatfield et al. 2009 | PrairieWinds SD1, SD | | Derby et al. 2012d |
| Dry Lake I, AZ | Thompson et al. 2011 | Thompson et al. 2011 | Red Hills, OK | | Derby et al. 2013b |
| Dry Lake II, AZ | Thompson and Bay 2012 | Thompson and Bay 2012 | Ripley, Ont (08) | | Jacques Whitford 2009 |
| Elkhorn, OR (08) | | Jeffrey et a. 2009b | Rugby, ND | | Derby et al. 2011b |
| Elkhorn, OR (10) | | Enk et al. 2011b | Shiloh I, CA | | Kerlinger et al. 2009 |
| Elm Creek, MN | | Derby et al. 2010c | Shiloh II, CA | | Kerlinger et al. 2010b |
| Elm Creek II, MN | | Derby et al. 2012b | Stateline, OR/WA (02) | | Erickson et al. 2004 |
| Foote Creek Rim, WY (Ph. I; 99) | | Young et al. 2003a | Stateline, OR/WA (03) | | Erickson et al. 2004 |
| Foote Creek Rim, WY (Ph. I; | Gruver 2002 | Young et al. 2003a, | Stateline, OR/WA (06) | | Erickson et al. 2007 |

**Appendix A1 (*continued*). Wind energy facilities in North America with comparable fatality data for bats.**

| Project, Location | Activity Reference | Fatality Reference | Project, Location | Activity Reference | Fatality Reference |
|---|---|---|---|---|---|
| 00) | | 2003b | | | |
| Foote Creek Rim, WY (Ph. I; 01-02) | Gruver 2002 | Young et al. 2003a, 2003b | Stetson Mountain, ME (09) | Stantec 2009c | Stantec 2009c |
| Forward Energy Center, WI | Watt and Drake 2011 | Grodsky and Drake 2011 | Stetson Mountain I, ME (11) | | Normandeau Associates 2011 |
| Fowler I, IN (09) | | Good et al. 2011 | Stetson Mountain II, ME (10) | | Normandeau Associates 2010 |
| Fowler III, IN (09) | | Good et al. 2011 | Summerview, Alb (06) | | Brown and Hamilton 2006b |
| Fowler I, II, III, IN (10) | | Good et al. 2011 | Summerview, Alb (08) | Baerwald 2008 | Baerwald 2008 |
| Fowler I, II, III, IN (11) | | Good et al. 2012 | Top of Iowa, IA (03) | | Jain 2005 |
| Fowler I, II, III, IN (12) | | Good et al. 2013 | Top of Iowa, IA (04) | Jain 2005 | Jain 2005 |
| Goodnoe, WA | | URS Corporation 2010a | Tuolumne (Windy Point I), WA | | Enz and Bay 2010 |
| Grand Ridge, IL | | Derby et al. 2010g | Vansycle, OR | | Erickson et al. 2000 |
| Harrow, Ont. (10) | | NRSI 2011 | Vantage, WA | | Ventus 2012 |
| Harvest Wind, WA (10-12) | | Downes and Gritski 2012a | Wessington Springs, SD (09) | | Derby et al. 2010f |
| Hay Canyon, OR | | Gritski and Kronner 2010a | Wessington Springs, SD (10) | | Derby et al. 2011d |
| High Sheldon, NY (10) | | Tidhar et al. 2012a | White Creek, WA (07-11) | | Downes and Gritski 2012b |
| High Sheldon, NY (11) | | Tidhar et al. 2012b | Wild Horse, WA | | Erickson et al. 2008 |
| High Winds, CA (04) | | Kerlinger et al. 2006 | Windy Flats, WA | | Enz et al. 2011 |
| High Winds, CA (05) | | Kerlinger et al. 2006 | Winnebago, IA | | Derby et al. 2010e |
| Hopkins Ridge, WA (06) | | Young et al. 2007 | Wolfe Island, Ont (Jul-Dec 09) | | Stantec Ltd. 2010b |
| Hopkins Ridge, WA (08) | | Young et al. 2009c | Wolfe Island, Ont (Jul-Dec 10) | | Stantec Ltd. 2011b |
| Judith Gap, MT (06-07) | | TRC 2008 | Wolfe Island, Ont (Jul-Dec 11) | | Stantec Ltd. 2012 |
| Judith Gap, MT (09) | | Poulton and Erickson 2010 | | | |

**Appendix A2. Fatality estimates for North American wind-energy facilities.**

| Project | Bat Fatalities (bats/MW/ year) | Predominant Habitat Type | Citation |
|---|---|---|---|
| Alite, CA | 0.24 | Shrub/scrub & grassland | Chatfield et al. 2010 |
| Alta Wind I, CA (2011) | 1.28 | Woodland, grassland, shrubland | Chatfield et al. 2012 |
| Alta Wind II-V, CA (2011) | 0.08 | Desert scrub | Chatfield et al. 2012 |
| Barton I & II, IA | 1.85 | Agriculture | Derby et al. 2011a |
| Barton Chapel, TX | 3.06 | Agriculture/forest | WEST 2011 |
| Beech Ridge, WV | 2.03 | Forest | Tidhar et al. 2013 |
| Big Horn, WA | 1.9 | Agriculture/grassland | Kronner et al. 2008 |
| Big Smile, OK | 2.9 | Grassland, agriculture | Derby et al. 2013a |
| Biglow Canyon, OR (Phase I; 2008) | 1.99 | Agriculture/grassland | Jeffrey et al. 2009a |
| Biglow Canyon, OR (Phase I; 2009) | 0.58 | Agriculture/grassland | Enk et al. 2010 |
| Biglow Canyon, OR (Phase II; 2009/2010) | 2.71 | Agriculture | Enk et al. 2011a |
| Biglow Canyon, OR (Phase II; 2010/2011) | 0.57 | Grassland/shrub-steppe, agriculture | Enk et al. 2012b |
| Biglow Canyon, OR (Phase III; 2010/2011) | 0.22 | Grassland/shrub-steppe, agriculture | Enk et al. 2012a |
| Blue Sky Green Field, WI | 24.57 | Agriculture | Gruver et al. 2009 |
| Buffalo Gap I, TX | 0.1 | Grassland | Tierney 2007 |
| Buffalo Gap II, TX | 0.14 | Forest | Tierney 2009 |
| Buffalo Mountain, TN (2000-2003) | 31.54 | Forest | Nicholson et al. 2005 |
| Buffalo Mountain, TN (2005) | 39.7 | Forest | Fiedler et al. 2007 |
| Buffalo Ridge, MN (Phase I; 1999) | 0.74 | Agriculture | Johnson et al. 2000 |
| Buffalo Ridge, MN (Phase II; 1998) | 2.16 | Agriculture | Johnson et al. 2000 |
| Buffalo Ridge, MN (Phase II; 1999) | 2.59 | Agriculture | Johnson et al. 2000 |
| Buffalo Ridge, MN (Phase II; 2001/Lake Benton I) | 4.35 | Agriculture | Johnson et al. 2004 |
| Buffalo Ridge, MN (Phase II; 2002/Lake Benton I) | 1.64 | Agriculture | Johnson et al. 2004 |
| Buffalo Ridge, MN (Phase III; 1999) | 2.72 | Agriculture | Johnson et al. 2000 |
| Buffalo Ridge, MN (Phase III; 2001/Lake Benton II) | 3.71 | Agriculture | Johnson et al. 2004 |
| Buffalo Ridge, MN (Phase III; 2002/Lake Benton II) | 1.81 | Agriculture | Johnson et al. 2004 |
| Buffalo Ridge I, SD (2010) | 0.16 | Agriculture/grassland | Derby et al. 2010b |
| Buffalo Ridge II, SD (2011) | 2.81 | Agriculture, grassland | Derby et al. 2012a |
| Casselman Curtailment, PA (2008) | 4.4 | Forest | Arnett et al. 2009a |
| Casselman, PA (2008) | 12.61 | Forest | Arnett et al. 2010 |
| Casselman, PA (2009) | 8.6 | Forest, pasture, grassland | Arnett et al. 2009b |

**Appendix A2. Fatality estimates for North American wind-energy facilities.**

| Project | Bat Fatalities (bats/MW/ year) | Predominant Habitat Type | Citation |
|---|---|---|---|
| Cedar Ridge, WI (2009) | 30.61 | Agriculture | BHE Environmental 2010 |
| Cedar Ridge, WI (2010) | 24.12 | Agriculture | BHE Environmental 2011 |
| Cohocton/Dutch Hill, NY (2009) | 8.62 | Agriculture/forest | Stantec 2010 |
| Cohocton/Dutch Hills, NY (2010) | 10.32 | Agriculture, forest | Stantec 2011 |
| Combine Hills, OR (Phase I; 04/05) | 1.88 | Agriculture/grassland | Young et al. 2006 |
| Combine Hills, OR (2011) | 0.73 | Grassland/shrub-steppe, agriculture | Enz et al. 2012 |
| Crescent Ridge, IL | 3.27 | Agriculture | Kerlinger et al. 2007 |
| Criterion, MD (2011) | 15.61 | Forest, agriculture | Young et al. 2012a |
| Criterion, MD (2012) | 7.62 | Forest, agriculture | Young et al. 2013 |
| Crystal Lake II, IA | 7.42 | Agriculture | Derby et al. 2010a |
| Diablo Winds, CA | 0.82 | NA | WEST 2006, 2008 |
| Dillon, CA | 2.17 | Desert | Chatfield et al. 2009 |
| Dry Lake I, AZ | 3.43 | Desert grassland/forested | Thompson et al. 2011 |
| Dry Lake II, AZ | 1.66 | Desert grassland/forested | Thompson and Bay 2012 |
| Elkhorn, OR (2008) | 1.26 | Shrub/scrub & agriculture | Jeffrey et al. 2009b |
| Elkhorn, OR (2010) | 2.14 | Shrub/scrub & agriculture | Enk et al. 2011b |
| Elm Creek, MN | 1.49 | Agriculture | Derby et al. 2010c |
| Elm Creek II, MN | 2.81 | Agriculture, grassland | Derby et al. 2012b |
| Foote Creek Rim, WY (Phase I; 1999) | 3.97 | Grassland | Young et al. 2003a |
| Foote Creek Rim, WY (Phase I; 2000) | 1.05 | Grassland | Young et al. 2003a |
| Foote Creek Rim, WY (Phase I; 2001-2002) | 1.57 | Grassland | Young et al. 2003a |
| Forward Energy Center, WI | 18.17 | Agriculture | Grodsky and Drake 2011 |
| Fowler I, IN (2009) | 8.09 | Agriculture | Good et al. 2011 |
| Fowler III, IN (2009) | 1.84 | Agriculture | Good et al. 2011 |
| Fowler I, II, III, IN (2010) | 18.96 | Agriculture | Good et al. 2011 |
| Fowler I, II, III, IN (2011) | 20.19 | Agriculture | Good et al. 2012 |
| Fowler I, II, III, IN (2012) | 2.96 | Agriculture | Good et al. 2013 |
| Goodnoe, WA | 0.34 | Grassland and shrub-steppe | URS Corporation 2010a |
| Grand Ridge I, IL | 2.1 | Agriculture | Derby et al. 2010g |
| Harrow, Ont (2010) | 11.13 | Agriculture | Natural Resource Solutions Inc. (NRSI) 2011 |
| Harvest Wind, WA (2010-2012) | 1.27 | Grassland/shrub-steppe | Downes and Gritski 2012a |
| Hay Canyon, OR | 0.53 | Agriculture | Gritski and Kronner 2010a |
| High Sheldon, NY (2010) | 2.33 | Agriculture | Tidhar et al. 2012a |
| High Sheldon, NY (2011) | 1.78 | Agriculture | Tidhar et al. 2012b |
| High Winds, CA (2004) | 2.51 | Agriculture/grassland | Kerlinger et al. 2006 |
| High Winds, CA (2005) | 1.52 | Agriculture/grassland | Kerlinger et al. 2006 |
| Hopkins Ridge, WA (2006) | 0.63 | Agriculture/grassland | Young et al. 2007 |
| Hopkins Ridge, WA (2008) | 1.39 | Agriculture/grassland | Young et al. 2009c |
| Judith Gap, MT (2006/2007) | 8.93 | Agriculture/grassland | TRC 2008 |

**Appendix A2. Fatality estimates for North American wind-energy facilities.**

| Project | Bat Fatalities (bats/MW/ year) | Predominant Habitat Type | Citation |
|---|---|---|---|
| Judith Gap, MT (2009) | 3.2 | Agriculture/grassland | Poulton and Erickson 2010 |
| Kewaunee County, WI | 6.45 | Agriculture | Howe et al. 2002 |
| Kibby, ME (2011) | 0.12 | Forest; commercial forest | Stantec 2012 |
| Kittitas Valley, WA (2011-2012) | 0.12 | Sagebrush-steppe, grassland | Stantec Consulting Services 2012 |
| Klondike, OR | 0.77 | Agriculture/grassland | Johnson et al. 2003 |
| Klondike II, OR | 0.41 | Agriculture/grassland | NWC and WEST 2007 |
| Klondike III (Phase I), OR | 1.11 | Agriculture/grassland | Gritski et al. 2010 |
| Klondike IIIa (Phase II), OR | 0.14 | Grassland/shrub-steppe and agriculture | Gritski et al. 2011 |
| Leaning Juniper, OR | 1.98 | Agriculture | Gritski et al. 2008 |
| Lempster, NH (2009) | 3.11 | Grasslands/forest/rocky embankments | Tidhar et al. 2010 |
| Lempster, NH (2010) | 3.57 | Grasslands/forest/rocky embankments | Tidhar et al. 2011 |
| Linden Ranch, WA | 1.68 | Grassland/shrub-steppe, agriculture | Enz and Bay 2011 |
| Locust Ridge, PA (Phase II; 2009) | 14.11 | Grassland | Arnett et al. 2011 |
| Locust Ridge, PA (Phase II; 2010) | 14.38 | Grassland | Arnett et al. 2011 |
| Maple Ridge, NY (2006) | 11.21 | Agriculture/forested | Jain et al. 2007 |
| Maple Ridge, NY (2007) | 9.42 | Agriculture/forested | Jain et al. 2009a |
| Maple Ridge, NY (2008) | 4.96 | Agriculture/forested | Jain et al. 2009d |
| Marengo I, WA (2009/2010) | 0.17 | Agriculture | URS Corporation 2010b |
| Marengo II, WA (2009/2010) | 0.27 | Agriculture | URS Corporation 2010c |
| Mars Hill, ME (2007) | 2.91 | Forest | Stantec 2008 |
| Mars Hill, ME (2008) | 0.45 | Forest | Stantec 2009a |
| Moraine II, MN | 2.42 | Agriculture/grassland | Derby et al. 2010d |
| Mount Storm, WV (Fall 2008) | 6.62 | Forest | Young et al. 2009b |
| Mount Storm, WV (2009) | 17.53 | Forest | Young et al. 2009a, 2010b |
| Mount Storm, WV (2010) | 15.18 | Forest | Young et al. 2010a, 2011b |
| Mount Storm, WV (2011) | 7.43 | Forest | Young et al. 2011a, 2012b |
| Mountaineer, WV (2003) | 31.69 | Forest | Kerns and Kerlinger 2004 |
| Munnsville, NY (2008) | 1.93 | Agriculture/forest | Stantec 2009b |
| Nine Canyon, WA | 2.47 | Agriculture/grassland | Erickson et al. 2003 |
| Noble Altona, NY | 4.34 | Forest | Jain et al. 2011b |
| Noble Bliss, NY (2008) | 7.8 | Agriculture/forest | Jain et al.2009e |
| Noble Bliss, NY (2009) | 3.85 | Agriculture/forest | Jain et al. 2010a |
| Noble Chateaugay, NY | 2.44 | Agriculture | Jain et al. 2011c |
| Noble Clinton, NY (2008) | 3.14 | Agriculture/forest | Jain et al. 2009c |
| Noble Clinton, NY (2009) | 4.5 | Agriculture/forest | Jain et al. 2010b |
| Noble Ellenburg, NY (2008) | 3.46 | Agriculture/forest | Jain et al. 2009b |
| Noble Ellenburg, NY (2009) | 3.91 | Agriculture/forest | Jain et al. 2010c |
| Noble Wethersfield, NY | 16.3 | Agriculture | Jain et al. 2011a |
| NPPD Ainsworth, NE | 1.16 | Agriculture/grassland | Derby et al. 2007 |
| Pebble Springs, OR | 1.55 | Grassland | Gritski and Kronner 2010b |
| Pioneer Prairie I, IA (Phase II) | 10.06 | Agriculture, grassland | Chodachek et al. 2012 |

**Appendix A2. Fatality estimates for North American wind-energy facilities.**

| Project | Bat Fatalities (bats/MW/ year) | Predominant Habitat Type | Citation |
|---|---|---|---|
| PrairieWinds ND1 (Minot), ND 2010 | 2.13 | Agriculture | Derby et al. 2011c |
| PrairieWinds ND1 (Minot), ND 2011 | 1.39 | Agriculture, grassland | Derby et al. 2012c |
| PrairieWinds SD1 (Crow Lake), SD | 1.23 | Grassland | Derby et al. 2012d |
| Red Hills, OK | 0.11 | Grassland | Derby et al. 2013b |
| Ripley, Ont (2008) | 4.67 | Agriculture | Jacques Whitford 2009 |
| Rugby, ND | 1.6 | Agriculture | Derby et al. 2011b |
| Shiloh I, CA | 3.92 | Agriculture/grassland | Kerlinger et al. 2010a |
| Shiloh II, CA | 2.72 | Agriculture | Kerlinger et al. 2010b |
| Stateline, OR/WA (2002) | 1.09 | Agriculture/grassland | Erickson et al. 2004 |
| Stateline, OR/WA (2003) | 2.29 | Agriculture/grassland | Erickson et al. 2004 |
| Stateline, OR/WA (2006) | 0.95 | Agriculture/grassland | Erickson et al. 2007 |
| Stetson Mountain I, ME (2009) | 1.4 | Forest | Stantec 2009c |
| Stetson Mountain I, ME (2011) | 0.28 | Forested | Normandeau Associates 2011 |
| Stetson Mountain II, ME (2010) | 1.65 | Forested | Normandeau Associates 2010 |
| Summerview, Alb (2006) | 10.27 | Agriculture | Brown and Hamilton 2006b |
| Summerview, Alb (2008) | 11.42 | Agriculture/grassland | Baerwald 2008 |
| Top of Iowa, IA (2003) | 7.16 | Agriculture | Jain 2005 |
| Top of Iowa, IA (2004) | 10.27 | Agriculture | Jain 2005 |
| Tuolumne (Windy Point I), WA | 0.94 | Grassland/shrub-steppe, agriculture and forest | Enz and Bay 2010 |
| Vansycle, OR | 1.12 | Agriculture/grassland | Erickson et al. 2000 |
| Vantage, WA | 0.4 | Shrub-steppe, grassland | Ventus Environmental Solutions 2012 |
| Wessington Springs, SD (2009) | 1.48 | Grassland | Derby et al. 2010f |
| Wessington Springs, SD (2010) | 0.41 | Grassland | Derby et al. 2011d |
| White Creek, WA (2007-2011) | 2.04 | Grassland/shrub-steppe, agriculture | Downes and Gritski 2012b |
| Wild Horse, WA | 0.39 | Grassland | Erickson et al. 2008 |
| Windy Flats, WA | 0.41 | Grassland/shrub-steppe, agriculture | Enz et al. 2011 |
| Winnebago, IA | 4.54 | Agriculture/grassland | Derby et al. 2010e |
| Wolfe Island, Ont (July-December 2009) | 6.42 | Grassland | Stantec Ltd. 2010b |
| Wolfe Island, Ont (July-December 2010) | 9.5 | Grassland | Stantec Ltd. 2011b |
| Wolfe Island, Ont (July-December 2011) | 2.49 | Grassland | Stantec Ltd. 2012 |

**Appendix A3. All post-construction monitoring studies, project characteristics, and select study methodology.**

| Project Name | Total # of turbines | Total MW | Tower size (m) | Number turbines searched | Plot Size | Length of Study | Survey Frequency |
|---|---|---|---|---|---|---|---|
| Alite, CA | 8 | 24 | 80 | 8 | 200 m x 200 m | 1 year | Weekly (spring, fall), bi-monthly (summer, winter) |
| Alta Wind I, CA (2011) | 100 | 150 | 80 | 25 | 120-m radius circle | 12.5 months | Every two weeks |
| Alta Wind II-V, CA (2011) | 190 | 570 | NA | 41 | 120-m radius circle | 14.5 months | Every two weeks |
| Barton Chapel, TX | 60 | 120 | 78 | 30 | 200 m x 200 m | 1 year | 10 turbines weekly, 20 monthly |
| Barton I & II, IA | 80 | 160 | 100 | 35 (9 turbines were dropped in June 2010 due to landowner issues) 26 turbines were searched for the remainder of the study | 200 m x 200 m | 1 year | Weekly (spring, fall; migratory turbines), monthly (summer, winter; non-migratory turbines) |
| Beech Ridge, WV | 67 | 100.5 | 80 | 67 | 40 m radius | 7 months | Every two days |
| Big Horn, WA | 133 | 199.5 | 80 | 133 | 180 m x 180 m | 1 year | Bi-monthly (spring, fall), monthly (winter, summer) |
| Big Smile, OK | 66 | 132 | NA | 17 (plus one met tower) | 100 x 100 | 1 year | Weekly (spring, summer, fall), monthly (winter) |
| Biglow Canyon, OR (Phase I; 2008) | 76 | 125.4 | 80 | 50 | 110 m x 110 m | 1 year | Bi-monthly (spring, fall), monthly (winter, summer) |
| Biglow Canyon, OR (Phase I; 2009) | 76 | 125.4 | 80 | 50 | 110 m x 110 m | 1 year | Bi-monthly (spring, fall), monthly (winter, summer) |
| Biglow Canyon, OR (Phase II; 2009/2010) | 65 | 150 | 80 | 50 | 250 m x 250 m | 1 year | Bi-monthly (spring, fall), monthly (winter, summer) |
| Biglow Canyon, OR (Phase II; 2010/2011) | 65 | 150 | NA | 50 | 252 m x 252 m | 1 year | Bi-weekly(spring, fall), monthly (summer, winter) |
| Biglow Canyon, OR (Phase III; 2010/2011) | 76 | 174.8 | NA | 50 | 252 m x 252 m | 1 year | Bi-weekly(spring, fall), monthly (summer, winter) |

**Appendix A3. All post-construction monitoring studies, project characteristics, and select study methodology.**

| Project Name | Total # of turbines | Total MW | Tower size (m) | Number turbines searched | Plot Size | Length of Study | Survey Frequency |
|---|---|---|---|---|---|---|---|
| Blue Sky Green Field, WI | 88 | 145 | 80 | 30 | 160 m x 160 m | Fall, spring | Daily(10 turbines), weekly (20 turbines) |
| Buena Vista, CA | 38 | 38 | 45-55 | 38 | 75-m radius | 1 year | Monthly to bi-monthly starting in September 2008 |
| Buffalo Gap I, TX | 67 | 134 | NA | 21 | 215 m x 215 m | 10 months | Every 3 weeks |
| Buffalo Gap II, TX | 155 | 233 | 80 | 36 | 215 m x 215 m | 14 months | Every 21 days |
| Buffalo Mountain, TN (2000-2003) | 3 | 1.98 | 65 | 3 | 50-m radius | 3 years | Bi-weekly, weekly, bi-monthly |
| Buffalo Mountain, TN (2005) | 18 | 28.98 | V47 = 65; V80 = 78 | 18 | 50-m radius | 1 year | Bi-weekly, weekly, bi-monthly, and 2 to 5 day intervals |
| Buffalo Ridge, MN (1994/1995) | 73 | 25 | 37 | 1994:10 plots (3 turbines/plot), 20 addition plots in Sept & Oct 1994, 1995: 30 turbines search every other week (Jan-Mar), 60 searched weekly (Apr, July, Aug) 73 searched weekly (May-June and Sept-Oct), 30 searched weekly (Nov-Dec) | 100 x 100m | 20 months | Varies. See number turbines searched or page 44 of report |
| Buffalo Ridge, MN (Phase I; 1996) | 73 | 25 | 36 | 21 | 126 m x 126 m | 1 year | Bi-monthly (spring, summer, and fall) |
| Buffalo Ridge, MN (Phase I; 1997) | 73 | 25 | 36 | 21 | 126 m x 126 m | 1 year | Bi-monthly (spring, summer, and fall) |
| Buffalo Ridge, MN (Phase I; 1998) | 73 | 25 | 36 | 21 | 126 m x 126 m | 1 year | Bi-monthly (spring, summer, and fall) |
| Buffalo Ridge, MN (Phase I; 1999) | 73 | 25 | 36 | 21 | 126 m x 126 m | 1 year | Bi-monthly (spring, summer, and fall) |
| Buffalo Ridge, MN (Phase II; 1998) | 143 | 107.25 | 50 | 40 | 126 m x 126 m | 1 year | Bi-monthly (spring, summer, and fall) |

**Appendix A3. All post-construction monitoring studies, project characteristics, and select study methodology.**

| Project Name | Total # of turbines | Total MW | Tower size (m) | Number turbines searched | Plot Size | Length of Study | Survey Frequency |
|---|---|---|---|---|---|---|---|
| Buffalo Ridge, MN (Phase II; 1999) | 143 | 107.25 | 50 | 40 | 126 m x 126 m | 1 year | Bi-monthly (spring, summer, and fall) |
| Buffalo Ridge, MN (Phase II; 2001/Lake Benton I) | 143 | 107.25 | 50 | 83 | 60 m x 60 m | Summer, fall | Bi-monthly |
| Buffalo Ridge, MN (Phase II; 2002/Lake Benton I) | 143 | 107.25 | 50 | 103 | 60 m x 60 m | Summer, fall | Bi-monthly |
| Buffalo Ridge, MN (Phase III; 1999) | 138 | 103.5 | 50 | 30 | 126 m x 126 m | 1 year | Bi-monthly (spring, summer, and fall) |
| Buffalo Ridge, MN (Phase III; 2001/Lake Benton II) | 138 | 103.5 | 50 | 83 | 60 m x 60 m | Summer, fall | Bi-monthly |
| Buffalo Ridge, MN (Phase III; 2002/Lake Benton II) | 138 | 103.5 | 50 | 103 | 60 m x 60 m | Summer, fall | Bi-monthly |
| Buffalo Ridge I, SD (2010) | 24 | 50.4 | 79 | 24 | 200 m x 200 m | 1 year | Weekly (migratory), monthly (non-migratory) |
| Buffalo Ridge II, SD (2011) | 105 | 210 | 78 | 65 (60 road and pad, 5 turbine plots) | 100 x 100m | 1 year | Weekly (spring, summer, fall), monthly (winter) |
| Casselman, PA (2008) | 23 | 34.5 | 80 | 10 | 126 m x 120 m | 7 months | Daily |
| Casselman, PA (2009) | 23 | 34.5 | 80 | 10 | 126 m x 120 m | 7.5 months | Daily searches |
| Casselman Curtailment, PA (2008) | 23 | 35.4 | 80 | 12 experimental; 10 control | 126 m x 120 m | 2.5 months | Daily |
| Castle River, Alb (2001) | 60 | 39.6 | 50 | 60 | 50-m radius | 2 years | Weekly, bi-weekly |
| Castle River, Alb (2002) | 60 | 39.6 | 50 | 60 | 50-m radius | 2 years | Weekly, bi-weekly |
| Cedar Ridge, WI (2009) | 41 | 67.6 | 80 | 20 | 160 m x 160 m | Spring, summer, fall | Daily, every 4 days; late fall searched every 3 days |

**Appendix A3. All post-construction monitoring studies, project characteristics, and select study methodology.**

| Project Name | Total # of turbines | Total MW | Tower size (m) | Number turbines searched | Plot Size | Length of Study | Survey Frequency |
|---|---|---|---|---|---|---|---|
| Cedar Ridge, WI (2010) | 41 | 68 | 80 | 20 | 160 m x 160 m | 1 year | Five turbines were surveyed daily, 15 turbines surveyed every 4 days in rotating groups each day. All 20 surveyed every three days during late fall |
| Cohocton/Dutch Hill, NY (2009) | 50 | 125 | 80 | 17 | 130 m x 130 m | Spring, summer, fall | Daily (5 turbines), weekly (12 turbines) |
| Cohocton/Dutch Hills, NY (2010) | 50 | 125 | 80 | 17 | 120 m x 120 m | Spring, summer, fall | Daily, weekly |
| Combine Hills, OR (Phase I; 04/05) | 41 | 41 | 53 | 41 | 90-m radius | 1 year | Monthly |
| Combine Hills, OR (2011) | 104 | 104 | 53 | 52 (plus 1 MET tower) | 180 m x 180 m | 1 year | Bi-weekly(spring, fall), monthly (summer, winter) |
| Condon, OR | 84 | NA | NA | NA | NA | NA | NA |
| Crescent Ridge, IL | 33 | 49.5 | 80 | 33 | 70-m radius | 1 year | Weekly (fall, spring) |
| Criterion, MD (2011) | 28 | 70 | 80 | 28 | 40-50m radius | 7.3 months | Daily |
| Criterion, MD (2012) | 28 | 70 | 80 | 14 | 40-50m radius | 7.5 months | Weekly |
| Crystal Lake II, IA | 80 | 200 | 80 | 16 turbines through week 6, and then 15 for duration of study | 100 m x 100 m | Spring, summer, fall | 3 times per week for 26 weeks |
| Diablo Winds, CA | 31 | 20.46 | 50 and 55 | 31 | 75 m x 75 m | 2 years | Monthly |
| Dillon, CA | 45 | 45 | 69 | 15 | 200 m x 200 m | 1 year | Weekly, bi-monthly in winter |
| Dry Lake I, AZ | 30 | 63 | 78 | 15 | 160 m x 160 m | 1 year | Bi-monthly (spring, fall), monthly (winter, summer) |
| Dry Lake II, AZ | 31 | 65 | 78 | 31: 5 (full plot), 26 (road & pad) | 160 m x 160 m | 1 year | Twice weekly (spring, summer, fall), weekly (winter) |
| Elkhorn, OR (2008) | 61 | 101 | 80 | 61 | 220 m x 220 m | 1 year | Monthly |

**Appendix A3. All post-construction monitoring studies, project characteristics, and select study methodology.**

| Project Name | Total # of turbines | Total MW | Tower size (m) | Number turbines searched | Plot Size | Length of Study | Survey Frequency |
|---|---|---|---|---|---|---|---|
| Elkhorn, OR (2010) | 61 | 101 | 80 | 31 | 220 m x 220 m | 1 year | Bi-monthly (spring, fall), monthly (winter, summer) |
| Elm Creek, MN | 67 | 100 | 80 | 29 | 200 m x 200 m | 1 year | Weekly, monthly |
| Elm Creek II, MN | 62 | 148.8 | 80 | 30 | 200 x 200m (2 random migration search areas 100 x 100m) | 1 year | 20 searched every 28 days, 10 turbines every 7 days during migration) |
| Erie Shores, Ont | 66 | 99 | 80 | 66 | 40-m radius | 2 years | Weekly, bi-monthly, 2-3 times weekly (migration) |
| Foote Creek Rim, WY (Phase I; 1999) | 69 | 41.4 | 40 | 69 | 126 m x 126 m | 1 year | Monthly |
| Foote Creek Rim, WY (Phase I; 2000) | 69 | 41.4 | 40 | 69 | 126 m x 126 m | 1 year | Monthly |
| Foote Creek Rim, WY (Phase I; 2001-2002) | 69 | 41.4 | 40 | 69 | 126 m x 126 m | 1 year | Monthly |
| Forward Energy Center, WI | 86 | 129 | 80 | 29 | 160 m x 160 m | 2 years | 11 turbines daily, 9 every 3 days, 9 every 5 days |
| Fowler I, IN (2009) | 162 | 301 | 78 (Vestas), 80 (Clipper) | 25 | 160 m x 160 m | Spring, summer, fall | Weekly, bi-weekly |
| Fowler I, II, III, IN (2010) | 355 | 600 | Vestas = 80, Clipper = 80, GE = 80 | 36 turbines, 100 road and pads | 80 m x 80 m for turbines ; 40-m radius for roads and pads | Spring, fall | Daily, weekly |

**Appendix A3. All post-construction monitoring studies, project characteristics, and select study methodology.**

| Project Name | Total # of turbines | Total MW | Tower size (m) | Number turbines searched | Plot Size | Length of Study | Survey Frequency |
|---|---|---|---|---|---|---|---|
| Fowler I, II, III, IN (2011) | 355 | 600 | Vestas = 80, Clipper = 80, GE = 80 | 177 road and pads (spring), 9 turbines & 168 roads and pads (fall) | Turbines (80 m circular plot), roads and pads (out to 80 m) | Spring, fall | Daily, weekly |
| Fowler I, II, III, IN (2012) | 355 | 600 | Vestas = 80, Clipper = 80, GE = 80 | 118 roads and pads | Roads and pads (out to 80 m) | 2.5 months | Weekly |
| Fowler III, IN (2009) | 60 | 99 | 78 | 12 | 160 m x 160 m | 10 weeks | Weekly, bi-weekly |
| Goodnoe, WA | 47 | 94 | 80 | 24 | 180 m x 180 m | 1 year | 14 days during migration periods, 28 days during non-migration periods |
| Grand Ridge I, IL | 66 | 99 | 80 | 30 | 160 m x 160 m | 1 year | Weekly, monthly |
| Harrow, Ont (2010) | 24 (four 6-turb facilities) | 39.6 | NA | 12 in July, 24 Aug-Oct | 50-m radius from turbine base | 4 months | Twice-weekly |
| Harvest Wind, WA (2010-2012) | 43 | 98.9 | 80 | 32 | 180 m x 180 m & 240 m x 240 m | 2 years | Twice a week, weekly and monthly |
| Hay Canyon, OR | 48 | 100.8 | 79 | 20 | 180 m x 180 m | 1 year | Bi-monthly (spring, fall), monthly (winter, summer) |
| High Sheldon, NY (2010) | 75 | 112.5 | 80 | 25 | 115 m x 115 m | 7 months | Daily (8 turbines), weekly (17 turbines) |
| High Sheldon, NY (2011) | 75 | 112.5 | 80 | 25 | 115 m x 115 m | 7 months | Daily (8 turbines), weekly (17 turbines) |
| High Winds, CA (2004) | 90 | 162 | 60 | 90 | 75-m radius | 1 year | Bi-monthly |

**Appendix A3. All post-construction monitoring studies, project characteristics, and select study methodology.**

| Project Name | Total # of turbines | Total MW | Tower size (m) | Number turbines searched | Plot Size | Length of Study | Survey Frequency |
|---|---|---|---|---|---|---|---|
| High Winds, CA (2005) | 90 | 162 | 60 | 90 | 75-m radius | 1 year | Bi-monthly |
| Hopkins Ridge, WA (2006) | 83 | 150 | 67 | 41 | 180 m x 180 m | 1 year | Monthly, weekly (subset of 22 turbines spring and fall migration) |
| Hopkins Ridge, WA (2008) | 87 | 156.6 | 67 | 41-43 | 180 m x 180 m | 1 year | Bi-monthly (spring, fall), monthly (winter, summer) |
| Jersey Atlantic, NJ | 5 | 7.5 | 80 | 5 | 130 m x 120 m | 9 months | Weekly |
| Judith Gap, MT (2006/2007) | 90 | 135 | 80 | 20 | 190 m x 190 m | 7 months | Monthly |
| Judith Gap, MT (2009) | 90 | 135 | 80 | 30 | 100 m x 100 m | 5 months | Bi-monthly |
| Kewaunee County, WI | 31 | 20.46 | 65 | 31 | 60 m x 60 m | 2 years | Bi-weekly (spring, summer), daily (spring, fall migration), weekly (fall, winter) |
| Kibby, ME (2011) | 44 | 132 | 124 | 22 turbines | 75-m diameter circular plots | 22 weeks | Avg 5-day |
| Kittitas Valley, WA (2011-2012) | 48 | 100.8 | 80 | 48 | 100 m x 102 m | 1 year | Bi weekly from Aug 15 - Oct 31 and March 16 - May 15; every 4 weeks from Nov 1 - March 15 and May 16 - Aug 14 |
| Klondike, OR | 16 | 24 | 80 | 16 | 140 m x 140 m | 1 year | Monthly |
| Klondike II, OR | 50 | 75 | 80 | 25 | 180 m x 180 m | 1 year | Bi-monthly (spring, fall), monthly (summer, winter) |
| Klondike III (Phase I), OR | 125 | 223.6 | GE = 80; Siemens= 80, Mitsubishi = 80 | 46 | 240 m x 240 m (1.5MW) 252 m x 252 m (2.3MW) | 2 year | Bi-monthly (spring, fall migration), monthly (summer, winter) |

**Appendix A3. All post-construction monitoring studies, project characteristics, and select study methodology.**

| Project Name | Total # of turbines | Total MW | Tower size (m) | Number turbines searched | Plot Size | Length of Study | Survey Frequency |
|---|---|---|---|---|---|---|---|
| Klondike IIIa (Phase II), OR | 51 | 76.5 | GE = 80 | 34 | 240 m x 240 m | 2 years | Bi-monthly (spring, fall), monthly (summer, winter) |
| Leaning Juniper, OR | 67 | 100.5 | 80 | 17 | 240 m x 240 m | 2 years | Bi-monthly (spring, fall), monthly (winter, summer) |
| Lempster, NH (2009) | 12 | 24 | 78 | 4 | 120 m x 130 m | 6 months | Daily |
| Lempster, NH (2010) | 12 | 24 | 78 | 12 | 120 m x 130 m | 6 months | Weekly |
| Linden Ranch, WA | 25 | 50 | 80 | 25 | 110 m x 110 m | 1 year | Bi-weekly(spring, fall), monthly (summer, winter) |
| Locust Ridge, PA (Phase II; 2009) | 51 | 102 | 80 | 15 | 120m x 126m | 6.5 months | Daily |
| Locust Ridge, PA (Phase II; 2010) | 51 | 102 | 80 | 15 | 120m x 126m | 6.5 months | Daily |
| Madison, NY | 7 | 11.55 | 67 | 7 | 60-m radius | 1 year | Weekly (spring, fall), monthly (summer) |
| Maple Ridge, NY (2006) | 120 | 198 | 80 | 50 | 130 m x 120 m | 5 months | Daily (10 turbines), every 3 days (10 turbines), weekly (30 turbines) |
| Maple Ridge, NY (2007) | 195 | 321.75 | 80 | 64 | 130 m x 120 m | 7 months | Weekly |
| Maple Ridge, NY (2008) | 195 | 321.75 | 80 | 64 | 130 m x 120 m | 7 months | Weekly |
| Marengo I, WA (2009/2010) | 78 | 140.4 | 67 | 39 | 180 m x 180 m | 1 year | Bi-monthly (spring, fall), monthly (winter, summer) |
| Marengo II, WA (2009/2010) | 39 | 70.2 | 67 | 20 | 180 m x 180 m | 1 year | Bi-monthly (spring, fall), monthly (winter, summer) |
| Mars Hill, ME (2007) | 28 | 42 | 80.5 | 28 | 76-m diameter, extended plot 238-m diameter | Spring, summer, fall | Daily (2 random turbines), weekly (all turbines): extended plot searched once per season |

**Appendix A3. All post-construction monitoring studies, project characteristics, and select study methodology.**

| Project Name | Total # of turbines | Total MW | Tower size (m) | Number turbines searched | Plot Size | Length of Study | Survey Frequency |
|---|---|---|---|---|---|---|---|
| Mars Hill, ME (2008) | 28 | 42 | 80.5 | 28 | 76-m diameter, extended plot 238-m diameter | Spring, summer, fall | Weekly: extended plot searched once per season |
| McBride, Alb (2004) | 114 | 75 | 50 | 114 | 4 parallel transects 120-m wide | 1 year | Weekly, bi-weekly |
| Melancthon, Ont (Phase I) | 45 | NA | NA | 45 | 35m radius | 5 months | Weekly, twice weekly |
| Meyersdale, PA (2004) | 20 | 30 | 80 | 20 | 130 m x 120 m | 6 weeks | Daily (half turbines), weekly (half turbines) |
| Moraine II, MN | 33 | 49.5 | 82.5 | 30 | 200 m x 200 m | 1 year | Weekly (migratory), monthly (non-migratory) |
| Mount Storm, WV (2009) | 132 | 264 | 78 | 44 | Varied | 4.5 months | Weekly (28 turbines), daily (16 turbines) |
| Mount Storm, WV (2010) | 132 | 264 | 78 | 24 | 20 to 60 m from turbine | 6 months | Daily |
| Mount Storm, WV (2011) | 132 | 264 | 78 | 24 | Varied | 6 months | Daily |
| Mount Storm, WV (Fall 2008) | 82 | 164 | 78 | 27 | Varied | 3 months | Weekly (18 turbines), daily (9 turbines) |
| Mountaineer, WV (2003) | 44 | 66 | 80 | 44 | 60-m radius | 7 months | Weekly, monthly |
| Mountaineer, WV (2004) | 44 | 66 | 80 | 44 | 130 m x 120 m | 6 weeks | Daily, weekly |
| Munnsville, NY (2008) | 23 | 34.5 | 69.5 | 12 | 120 m x 120 m | Spring, summer, fall | Weekly |
| Nine Canyon, WA | 37 | 48.1 | 60 | 37 | 90-m radius | 1 year | Bi-monthly (spring, summer, fall), monthly (winter) |
| Noble Altona, NY | 65 | 97.5 | 80 | 22 | 120 m x 120 m | Spring, summer, fall | Daily, weekly |

Appendix A3. All post-construction monitoring studies, project characteristics, and select study methodology.

| Project Name | Total # of turbines | Total MW | Tower size (m) | Number turbines searched | Plot Size | Length of Study | Survey Frequency |
|---|---|---|---|---|---|---|---|
| Noble Bliss, NY (2008) | 67 | 100 | 80 | 23 | 120 m x 120 m | Spring, summer, fall | Daily (8 turbines), 3-day (8 turbines), weekly ( 7 turbines) |
| Noble Bliss, NY (2009) | 67 | 100 | 80 | 23 | 120 m x 120 m | Spring, summer, fall | Weekly, 8 turbines searched daily from July 1 to August 15 |
| Noble Chateaugay, NY | 71 | 106.5 | 80 | 24 | 120 m x 120 m | Spring, summer, fall | Weekly |
| Noble Clinton, NY (2008) | 67 | 100 | 80 | 23 | 120 m x 120 m | Spring, summer, fall | Daily (8 turbines), 3-day (8 turbines), weekly (7 turbines) |
| Noble Clinton, NY (2009) | 67 | 100 | 80 | 23 | 120 m x 120 m | Spring, summer, fall | Daily (8 turbines), weekly (15 turbines), all turbines weekly from July 1 to August 15 |
| Noble Ellenburg, NY (2008) | 54 | 80 | 80 | 18 | 120 m x 120 m | Spring, summer, fall | Daily (6 turbines), 3-day (6 turbines), weekly (6 turbines) |
| Noble Ellenburg, NY (2009) | 54 | 80 | 80 | 18 | 120 m x 120 m | Spring, summer, fall | Daily (6 turbines), weekly (12 turbines), all turbines weekly from July 1 to August 15 |
| Noble Wethersfield, NY | 84 | 126 | 80 | 28 | 120 m x 120 m | Spring, summer, fall | Weekly |
| NPPD Ainsworth, NE | 36 | 20.5 | 70 | 36 | 220 m x 220 m | Spring, summer, fall | Bi-monthly |
| Oklahoma Wind Energy Center, OK | 68 | 102 | 70 | 68 | 20m radius | 3 months (2 years) | Bi-monthly |
| Pebble Springs, OR | 47 | 98.7 | 79 | 20 | 180 m x 180 m | 1 year | Bi-monthly (spring, fall), monthly (winter, summer) |
| Pine Tree, CA | 90 | 135 | 65 | 40 | NA | 1 year | Bi-weekly |
| Pioneer Prairie I, IA (Phase II) | 62 | 102.3 | 80 | 62 (57 road/pad) 5 full search plots | 80 x 80m | 1 year | Weekly (spring and fall), every two weeks (summer), monthly (winter) |
| PrairieWinds ND1 (Minot), ND 2010 | 80 | 115.5 | 89 | 35 | Minimum of 100 m x 100 m | 3 seasons | Bi-monthly |
| PrairieWinds ND1 (Minot), ND 2011 | 80 | 115.5 | 80 | 35 | Minimum 100 x 100m | 3 season | Twice monthly |

Appendix A3. All post-construction monitoring studies, project characteristics, and select study methodology.

| Project Name | Total # of turbines | Total MW | Tower size (m) | Number turbines searched | Plot Size | Length of Study | Survey Frequency |
|---|---|---|---|---|---|---|---|
| PrairieWinds SD1 (Crow Lake), SD | 108 | 162 | 80 | 50 | 200 x 200m | 1 year | Twice monthly (spring, summer, fall), monthly (winter) |
| Prince Wind Farm, Ont (2006) | 126 | 189 | 80 | 38 | 63-m radius | 4 months | Daily, weekly |
| Prince Wind Farm, Ont (2007) | 126 | 189 | 80 | 38 turbines from January 1st - July 8th, 126 turbines from July 9th- October 31st | 63- to 45-m radius | 10 months | Daily, weekly |
| Prince Wind Farm, Ont (2008) | 126 | 189 | 80 | 126 | 45m radius | 6.5 months | Daily, 3x/week, 2x/week |
| Red Canyon, TX | 56 | 84 | 70 | 28 | 200 m x 200 m in fall and winter; 160 m x 160 m in spring and summer | 1 year | Every 14 days in fall and winter; 7 days in spring, 3 days in summer |
| Red Hills, OK | 82 | 123 | NA | 20 (plus one met tower) | 100 x 100 | 1 year | Weekly (spring, summer, fall), monthly (winter) |
| Ripley, Ont (2008) | 38 | 76 | 64 | 38 | 80 m x 80 m | Spring, fall | Twice weekly for odd turbines; weekly for even turbines. |
| Ripley, Ont (Fall 2009) | 38 | 76 | 64 | 38 | 80 m x 80 m | 6 weeks | Twice weekly for odd turbines; weekly for even turbines. |
| Rugby, ND | 71 | 149 | 78 | 32 | 200 m x 200 m | 1 year | Weekly (spring, fall; migratory turbines), monthly ( non-migratory turbines) |
| San Gorgonio, CA | 3000 | NA | 24.4-42.7 | NA | 50-m radius | 2 years | Quarterly |
| Searsburg, VT (2007) | 11 | 7 | 65 | 11 | 20- to 55-m radius | Spring, fall | Weekly (fall migration) |
| Shiloh I, CA | 100 | 150 | 65 | 100 | 105-m radius | 3 years | Weekly |

**Appendix A3. All post-construction monitoring studies, project characteristics, and select study methodology.**

| Project Name | Total # of turbines | Total MW | Tower size (m) | Number turbines searched | Plot Size | Length of Study | Survey Frequency |
|---|---|---|---|---|---|---|---|
| Shiloh II, CA | 75 | 150 | 33 turbs = 115; 42 turbs = 125 | 25 | 100m radius | 1 yr | Once/week |
| SMUD Solano, CA | 22 | 15 | 65 | 22 | 60-m radius | 1 year | Bi-monthly |
| Stateline, OR/WA (2002) | 454 | 299 | 50 | 124 | Minimum 126 m x 126 m | 17 months | Bi-weekly, monthly |
| Stateline, OR/WA (2003) | 454 | 299 | 50 | 153 | Minimum 126 m x 126 m | 1 year | Bi-weekly, monthly |
| Stateline, OR/WA (2006) | 454 | 299 | 50 | 39 | Variable turbine strings | 1 year | Bi-weekly |
| Stetson Mountain I, ME (2009) | 38 | 57 | 80 | 19 | 76-m diameter | 27 weeks (spring, summer, fall) | Weekly |
| Stetson Mountain I, ME (2011) | 38 | 57 | 80 | 19 | Varied | 6 months | Weekly |
| Stetson Mountain II, ME (2010) | 17 | 25.5 | 80 | 17 | Varied | 6 months | Weekly (3 turbines twice a week) |
| Summerview, Alb (2006) | 39 | 70.2 | 67 | 39 | 140 m x 140 m | 1 year | Weekly, bi-weekly (May to July, September) |
| Summerview, Alb (2008) | 39 | 70.2 | 65 | 39 | 52-m radius; 2 spiral transects 7 m apart | Summer, fall (2 years) | Daily (10 turbines), weekly (29 turbines) |
| Tehachapi, CA | 3300 | NA | 14.7 to 57.6 | 201 | 50-m radius | 20 months | Quarterly |
| Top of Iowa, IA (2003) | 89 | 80 | 71.6 | 26 | 76 m x 76 m | Spring, summer, fall | Once every 2 to 3 days |
| Top of Iowa, IA (2004) | 89 | 80 | 71.6 | 26 | 76 m x 76 m | Spring, summer, fall | Once every 2 to 3 days |

**Appendix A3. All post-construction monitoring studies, project characteristics, and select study methodology.**

| Project Name | Total # of turbines | Total MW | Tower size (m) | Number turbines searched | Plot Size | Length of Study | Survey Frequency |
|---|---|---|---|---|---|---|---|
| Tuolumne (Windy Point I), WA | 62 | 136.6 | 80 | 21 | 180 m x 180 m | 1 year | Monthly throughout the year, a sub-set of 10 turbines were also searched weekly during the spring, summer, and fall |
| Vansycle, OR | 38 | 24.9 | 50 | 38 | 126 m x 126 m | 1 year | Monthly |
| Vantage, WA | 60 | 90 | 80 | 30 | 240 m x 240 m | 1 year | Monthly, a subset of 10 searched weekly during migration |
| Wessington Springs, SD (2009) | 34 | 51 | 80 | 20 | 200 m x 200 m | Spring, summer, fall | Bi-monthly |
| Wessington Springs, SD (2010) | 34 | 51 | 80 | 20 | 200 m x 200 m | 8 months | Bi-weekly (spring, summer, fall) |
| White Creek, WA (2007-2011) | 89 | 204.7 | 80 | 89 | 180 m x 180 m & 240 m x 240 m | 4 years | Twice a week, weekly and monthly |
| Wild Horse, WA | 127 | 229 | 67 | 64 | 110 m from two turbines in plot | 1 year | Monthly, weekly (fall, spring migration at 16 turbines) |
| Windy Flats, WA | 114 | 262.2 | NA | 36 (plus 1 MET tower) | 180 m x 180 m (120m at MET tower) | 1 year | Monthly (spring, summer, fall, and winter), weekly (spring and fall migration) |
| Winnebago, IA | 10 | 20 | 78 | 10 | 200 m x 200 m | 1 year | Weekly (migratory), monthly (non-migratory) |
| Wolfe Island, Ont (May-June 2009) | 86 | 197.8 | 80 | 86 | 60-m radius | Spring | 43 twice weekly, 43 weekly |
| Wolfe Island, Ont (July-December 2009) | 86 | 197.8 | 80 | 86 | 60-m radius | Summer, fall | 43 twice weekly, 43 weekly |
| Wolfe Island, Ont (January-June 2010) | 86 | 197.8 | 80 | 86 | 60-m radius | 6 months | 43 twice weekly, 43 weekly |
| Wolfe Island, Ont (July-December 2010) | 86 | 197.8 | 80 | 86 | 50-m radius | 6 months | 43 twice weekly, 43 weekly |

Appendix A3. All post-construction monitoring studies, project characteristics, and select study methodology.

| Project Name | Total # of turbines | Total MW | Tower size (m) | Number turbines searched | Plot Size | Length of Study | Survey Frequency |
|---|---|---|---|---|---|---|---|
| Wolfe Island, Ont (January-June 2011) | 86 | 197.8 | 80 | 86 | 50-m radius | 6 months | 43 twice weekly, 43 weekly |
| Wolfe Island, Ont (July-December 2011) | 86 | 197.8 | 80 | 86 | 50-m radius | 6 months | 43 twice weekly, 43 weekly |

**Appendix A3 (*continued*). All post-construction monitoring studies, project characteristics, and select study methodology.**

Data from the following sources:

| Project, Location | Reference | Project, Location | Reference |
|---|---|---|---|
| Alite, CA | Chatfield et al. 2010 | Klondike II, OR | NWC and WEST 2007 |
| Alta Wind I, CA (11) | Chatfield et al. 2012 | Klondike III (Phase I), OR | Gritski et al. 2010 |
| Alta Wind II-V, CA (11) | Chatfield et al. 2012 | Klondike IIIa (Phase II), OR | Gritski et al. 2011 |
| Barton I & II, IA | Derby et al. 2011a | Leaning Juniper, OR | Gritski et al. 2008 |
| Barton Chapel, TX | WEST 2011 | Lempster, NH (09) | Tidhar et al. 2010 |
| Beech Ridge, WV | Tidhar et al. 2013 | Lempster, NH (10) | Tidhar et al. 2011 |
| Big Horn, WA | Kronner et al. 2008 | Linden Ranch, WA | Enz and Bay 2011 |
| Big Smile, OK | Derby et al. 2013a | Locust Ridge, PA (Phase II; 09) | Arnett et al. 2011 |
| Biglow Canyon, OR (Phase I; 08) | Jeffrey et al. 2009a | Locust Ridge, PA (Phase II; 10) | Arnett et al. 2011 |
| Biglow Canyon, OR (Phase I; 09) | Enk et al. 2010 | Madison, NY | Kerlinger 2002b |
| Biglow Canyon, OR (Phase II; 09/10) | Enk et al. 2011a | Maple Ridge, NY (06) | Jain et al. 2007 |
| Biglow Canyon, OR (Phase II; 10/11) | Enk et al. 2012b | Maple Ridge, NY (07) | Jain et al. 2009a |
| Biglow Canyon, OR (Phase III; 10/11) | Enk et al. 2012a | Maple Ridge, NY (08) | Jain et al. 2009d |
| Blue Sky Green Field, WI | Gruver et al. 2009 | Marengo I, WA (09) | URS Corporation 2010b |
| Buena Vista, CA | Insignia Environmental 2009 | Marengo II, WA (09) | URS Corporation 2010c |
| Buffalo Gap I, TX | Tierney 2007 | Mars Hill, ME (07) | Stantec 2008 |
| Buffalo Gap II, TX | Tierney 2009 | Mars Hill, ME (08) | Stantec 2009a |
| Buffalo Mountain, TN (00-03) | Nicholson et al. 2005 | McBride, Alb (04) | Brown and Hamilton 2004 |
| Buffalo Mountain, TN (05) | Fiedler et al. 2007 | Melancthon, Ont (Phase I) | Stantec Ltd. 2008 |
| Buffalo Ridge, MN (94/95) | Osborn et al. 1996, 2000 | Meyersdale, PA (04) | Arnett et al. 2005 |
| Buffalo Ridge, MN (Phase I; 96) | Johnson et al. 2000 | Moraine II, MN | Derby et al. 2010d |
| Buffalo Ridge, MN (Phase I; 97) | Johnson et al. 2000 | Mount Storm, WV (Fall 08) | Young et al. 2009b |
| Buffalo Ridge, MN (Phase I; 98) | Johnson et al. 2000 | Mount Storm, WV (09) | Young et al. 2009a, 2010b |
| Buffalo Ridge, MN (Phase I; 99) | Johnson et al. 2000 | Mount Storm, WV (10) | Young et al. 2010a, 2011b |
| Buffalo Ridge, MN (Phase II;98) | Johnson et al. 2000 | Mount Storm, WV (11) | Young et al. 2011a, 2012b |
| Buffalo Ridge, MN (Phase II; 99) | Johnson et al. 2000 | Mountaineer, WV (03) | Kerns and Kerlinger 2004 |
| Buffalo Ridge, MN (Phase II; 01/Lake Benton I) | Johnson et al. 2004 | Mountaineer, WV (04) | Arnett et al. 2005 |
| Buffalo Ridge, MN (Phase II; 02/Lake Benton I) | Johnson et al. 2004 | Munnsville, NY (08) | Stantec 2009b |
| Buffalo Ridge, MN (Phase III; 99) | Johnson et al. 2000 | Nine Canyon, WA | Erickson et al. 2003 |
| Buffalo Ridge, MN (Phase III; 01/Lake Benton II) | Johnson et al. 2004 | Noble Altona, NY | Jain et al. 2011b |
| Buffalo Ridge, MN (Phase III; 02/Lake Benton II) | Johnson et al. 2004 | Noble Bliss, NY (08) | Jain et al.2009e |
| Buffalo Ridge I, SD (10) | Derby et al. 2010b | Noble Bliss, NY (09) | Jain et al. 2010a |
| Buffalo Ridge II, SD (11) | Derby et al. 2012a | Noble Chateaugay, NY | Jain et al. 2011c |
| Casselman, PA (08) | Arnett et al. 2009a | Noble Clinton, NY (08) | Jain et al. 2009c |
| Casselman, PA (09) | Arnett et al. 2010 | Noble Clinton, NY (09) | Jain et al. 2010b |
| Casselman Curtailment, PA (08) | Arnett et al. 2009b | Noble Ellenburg, NY (08) | Jain et al. 2009b |
| Castle River, Alb (01) | Brown and Hamilton 2006a | Noble Ellenburg, NY (09) | Jain et al. 2010c |
| Castle River, Alb (02) | Brown and Hamilton 2006a | Noble Wethersfield, NY | Jain et al. 2011a |
| Cedar Ridge, WI (09) | BHE Environmental 2010 | NPPD Ainsworth, NE | Derby et al. 2007 |
| Cedar Ridge, WI (10) | BHE Environmental 2011 | Oklahoma Wind Energy Center, OK | Piorkowski and O'Connell 2010 |
| Cohocton/Dutch Hill, NY (09) | Stantec 2010 | Pebble Springs, OR | Gritski and Kronner 2010b |
| Cohocton/Dutch Hills, NY (10) | Stantec 2011 | Pine Tree, CA | BioResource Consultants 2010 |
| Combine Hills, OR | Young et al. 2006 | Pioneer Prairie I, IA (Phase II) | Chodachek et al. 2012 |
| Combine Hills, OR (11) | Enz et al. 2012 | PrairieWinds ND1 (Minot), ND | Derby et al. 2011c |
| Condon, OR | Fishman Ecological Services 2003 | PrairieWinds ND1 (Minot), ND (11) | Derby et al. 2012c |
| Crescent Ridge, IL | Kerlinger et al. 2007 | PrairieWinds SD1, SD | Derby et al. 2012d |
| Criterion, MD (11) | Young et al. 2012a | Prince Wind Farm, Ont (06) | Natural Resource Solutions 2009 |
| Criterion, MD (12) | Young et al. 2013 | Prince Wind Farm, Ont (07) | Natural Resource Solutions 2009 |
| Crystal Lake II, IA | Derby et al. 2010a | Prince Wind Farm, Ont (08) | Natural Resource Solutions 2009 |
| Diablo Winds, CA | WEST 2006, 2008 | Red Canyon, TX | Miller 2008 |
| Dillon, CA | Chatfield et al. 2009 | Red Hills, OK | Derby et al. 2013b |
| Dry Lake I, AZ | Thompson et al. 2011 | Ripley, Ont (08) | Jacques Whitford 2009 |
| Dry Lake II, AZ | Thompson and Bay 2012 | Ripley, Ont (Fall 09) | Golder Associates 2010 |
| Elkhorn, OR (08) | Jeffrey et a. 2009b | Rugby, ND | Derby et al. 2011b |
| Elkhorn, OR (10) | Enk et al. 2011b | San Gorgonio, CA | Anderson et al. 2005 |
| Elm Creek, MN | Derby et al. 2010c | Searsburg, VT (07) | Kerlinger 2002a |
| Elm Creek II, MN | Derby et al. 2012b | Shiloh I, CA | Kerlinger et al. 2009 |
| Erie Shores, Ont | James 2008 | Shiloh II, CA | Kerlinger et al. 2010b |
| Foote Creek Rim, WY (Phase I; 99) | Young et al. 2003a | SMUD Solano, CA | Erickson and Sharp 2005 |
| Foote Creek Rim, WY (Phase I; 00) | Young et al. 2003a | Stateline, OR/WA (02) | Erickson et al. 2004 |
| Foote Creek Rim, WY (Phase I; 01-02) | Young et al. 2003a | Stateline, OR/WA (03) | Erickson et al. 2004 |
| Forward Energy Center, WI | Grodsky and Drake 2011 | Stateline, OR/WA (06) | Erickson et al. 2007 |
| Fowler I, IN (09) | Good et al. 2011 | Stetson Mountain I, ME (09) | Stantec 2009c |
| Fowler I, II, III, IN (10) | Good et al. 2011 | Stetson Mountain I, ME (11) | Normandeau Associates 2011 |
| Fowler I, II, III, IN (11) | Good et al. 2012 | Stetson Mountain II, ME (10) | Normandeau Associates 2010 |

**Appendix A3 (*continued*). All post-construction monitoring studies, project characteristics, and select study methodology.**

Data from the following sources:

| Project, Location | Reference | Project, Location | Reference |
|---|---|---|---|
| Fowler I, II, III, IN (12) | Good et al. 2013 | Summerview, Alb (06) | Brown and Hamilton 2006b |
| Fowler III, IN (09) | Good et al. 2011 | Summerview, Alb (08) | Baerwald 2008 |
| Goodnoe, WA | URS Corporation 2010a | Tehachapi, CA | Anderson et al. 2004 |
| Grand Ridge I, IL | Derby et al. 2010g | Top of Iowa, IA (03) | Jain 2005 |
| Harrow, Ont (10) | Natural Resource Solutions 2011 | Top of Iowa, IA (04) | Jain 2005 |
| Harvest Wind, WA (10-12) | Downes and Gritski 2012a | Tuolumne (Windy Point I), WA | Enz and Bay 2010 |
| Hay Canyon, OR | Gritski and Kronner 2010a | Vansycle, OR | Erickson et al. 2000 |
| High Sheldon, NY (10) | Tidhar et al. 2012a | Vantage, WA | Ventus Environmental Solutions 2012 |
| High Sheldon, NY (11) | Tidhar et al. 2012b | Wessington Springs, SD (09) | Derby et al. 2010f |
| High Winds, CA (04) | Kerlinger et al. 2006 | Wessington Springs, SD (10) | Derby et al. 2011d |
| High Winds, CA (05) | Kerlinger et al. 2006 | White Creek, WA (07-11) | Downes and Gritski 2012b |
| Hopkins Ridge, WA (06) | Young et al. 2007 | Wild Horse, WA | Erickson et al. 2008 |
| Hopkins Ridge, WA (08) | Young et al. 2009c | Windy Flats, WA | Enz et al. 2011 |
| Jersey Atlantic, NJ | NJAS 2008a, 2008b, 2009 | Winnebago, IA | Derby et al. 2010e |
| Judith Gap, MT (06-07) | TRC 2008 | Wolfe Island, Ont (May-June 09) | Stantec Ltd. 2010a |
| Judith Gap, MT (09) | Poulton and Erickson 2010 | Wolfe Island, Ont (July-Dec 09) | Stantec Ltd. 2010b |
| Kewaunee County, WI | Howe et al. 2002 | Wolfe Island, Ont (Jan-June 10) | Stantec Ltd. 2011a |
| Kibby, ME (11) | Stantec 2012 | Wolfe Island, Ont (July-Dec 10) | Stantec Ltd. 2011b |
| Kittitas Valley, WA (11-12) | Stantec Consulting 2012 | Wolfe Island, Ont (Jan-June 11) | Stantec Ltd. 2011c |
| Klondike, OR | Johnson et al. 2003 | Wolfe Island, Ont (July-Dec 11) | Stantec Ltd. 2012 |

# Whooping Crane Habitat Review
# Sunflower Wind Project
# Morton and Stark Counties, North Dakota

**Prepared for:**

**Sunflower Wind Project, LLC**
3760 State Street, Suite 102

Santa Barbara, CA 93105

**Prepared by:**


**Clayton Derby and Terri Thorn**
Western EcoSystems Technology, Inc.
4007 State Street, Suite 109
Bismarck, ND 58503


**November 20, 2013**

NATURAL RESOURCES ◆ SCIENTIFIC SOLUTIONS

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## INTRODUCTION

The Sunflower Wind Project (SFWP) is proposed for development by Sunflower Wind Project LLC (Sunflower), a wholly owned subsidiary of Infinity Wind Power (Infinity), in Morton and Stark Counties, North Dakota. Sunflower requested that Western EcoSystems Technology, Inc. (WEST) implement a desktop review and analysis of potential whooping crane habitat resources within the SFWP and to compare these resources to areas outside of the project boundary to the north, south, east, and west. The habitat review and analysis evaluates whether or not the proposed SFWP area represents high, average, or low potential whooping crane habitat as compared to alternate locations. From this analysis all parties can then discuss what impacts there may be to whooping cranes from development of the SFWP.

## PROJECT AREA

The SFWP is located in Morton and Stark Counties, North Dakota, approximately three miles (mi; 4.8 kilometers [km]) south of the town of Hebron (Figure 1). The SFWP, currently about 21,947 acres (ac; 89 square kilometers [km2]; 34 square miles [mi2]) is located in west-central North Dakota and more specifically western Morton and eastern Stark Counties. The landscape within the SFWP is generally flat with more rolling lands in the northern third of the project area. Elevation ranges from 679 meters (m; 2,228 feet [ft]) to 817 m (2,679 ft). Historically, the SFWP’s landscape was dominated by grasslands but has since been converted largely to agricultural use with crop production and livestock grazing the primary practices. Trees and shrubs can be found around farmsteads, within planted shelter belts, and along/within drainages. Wetlands are scattered throughout the SFWP with many being man-made.

Cultivated cropland and herbaceous/pasture/hay lands are approximately equal in amount and comprise almost 95% of the study area. Of the remaining 5%, 3.5% is developed while wetlands, forest, and barren lands, in that order, make up the rest of the landscape (Fry et al. 2011; Figure 2). Common agricultural crops include small grains, corn, sunflowers, and alfalfa.

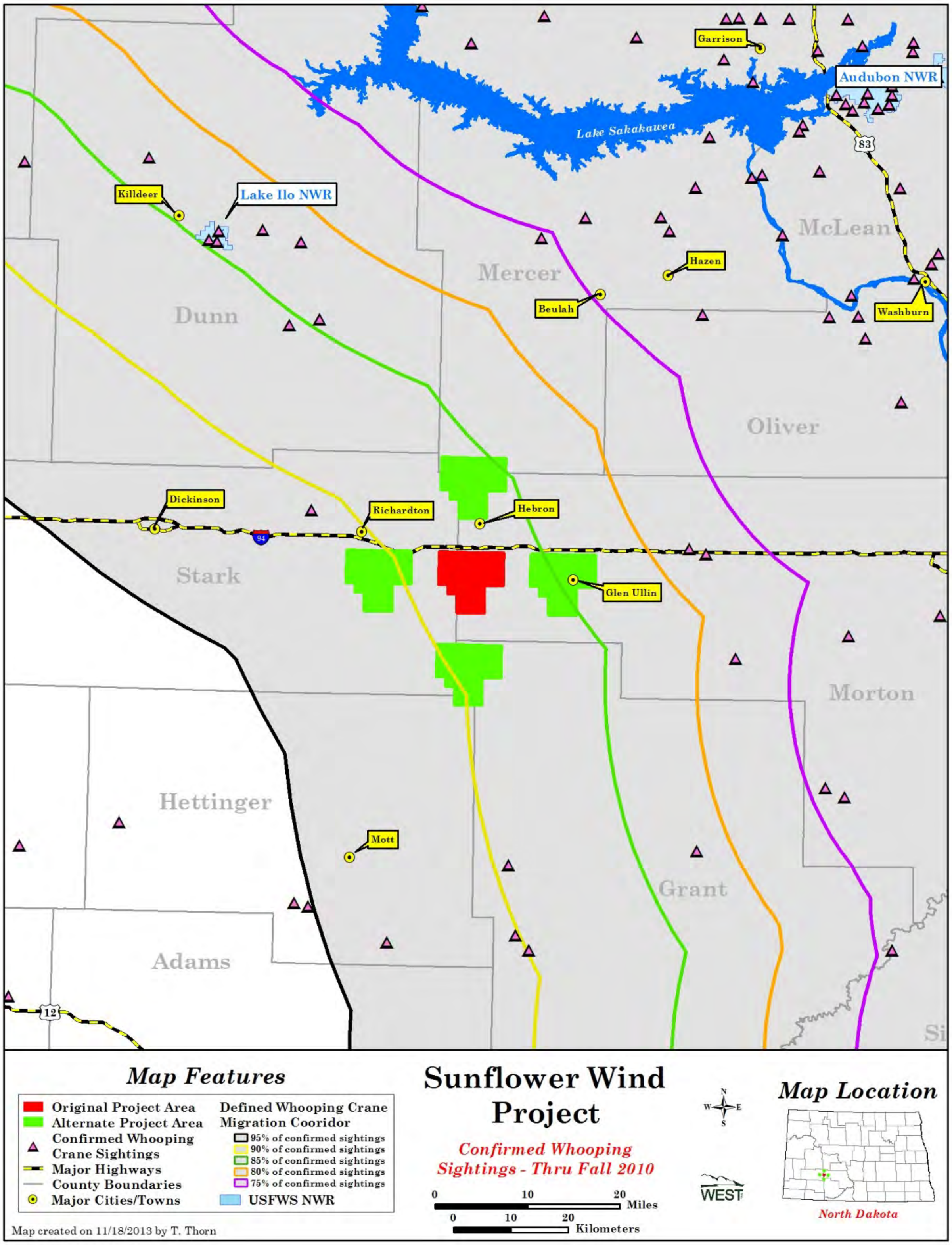


**Figure 1. Location of the Sunflower Wind Project, alternate areas, and whooping crane observations.**

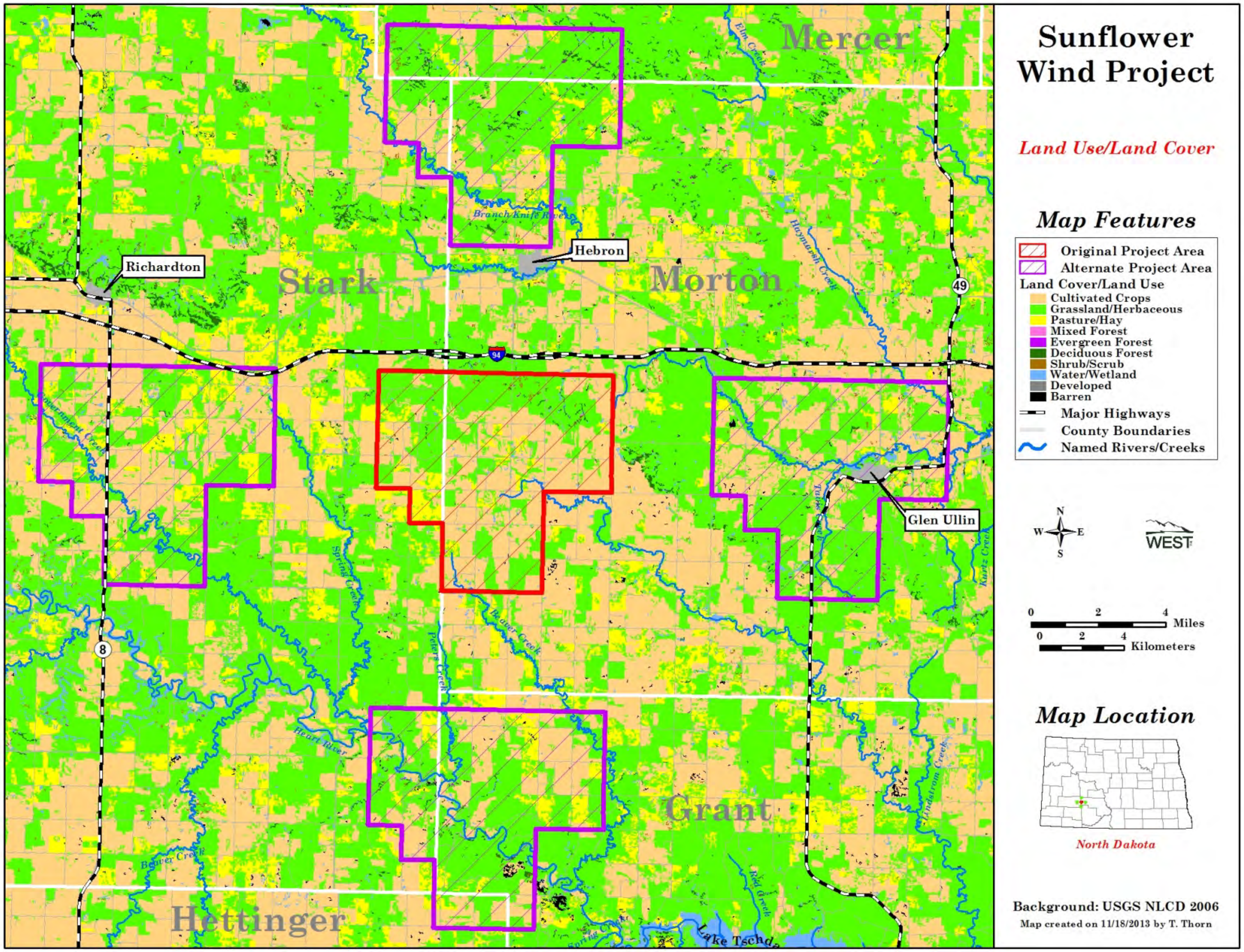


Figure 2. Land Use/Land Cover within and around the Sunflower Wind Project.

# METHODS

A desktop review was completed using ArcGIS, ArcMap 10.1, land cover information from the National Land Cover Database (NLCD 2006), wetland data from the National Wetland Inventory (NWI), 2012 NAIP aerial imagery, and the current project boundary as provided by Sunflower. A site visit was not completed by WEST for this exercise specifically, but WEST has conducted other surveys at the SFWP and confirmed that the mapping generally agrees with current conditions.

The potential whooping crane habitat analysis included a comparison of land cover within the proposed SFWP boundary and four alternate areas of the same dimensions located adjacent (based on the SFWP's boundary extent) to the SFWP boundary in the four cardinal directions (see Figures 1, 2, and 3). A recently developed potentially suitable habitat assessment (Watershed Institute 2012) was also used to quantify and compare whooping crane habitat within the study areas. This assessment first screens all wetlands within the study areas for minimum size, visual obstructions, and disturbances. Those wetlands left are then quantified by their size, density of wetlands around them, distance to food, whether they are natural or man-made, and their water regime as a means to quantify suitability. This work was initially done in Kansas and the results were compared to Quivira National Wildlife Refuge, a traditional migratory stopover area. In Kansas, it was determined that a score of 12 or higher represented potentially suitable whooping crane habitat.

# RESULTS

There are 10,494 ac of cropland within the proposed project area, or 47.7% of the total area. Grass and herbaceous lands make up approximately 40.8% of the project area while pasture/hay and developed lands occupy another 6.3% and 3.5% respectively. Water, forest, shrub/scrub, and barren habitats comprise the remaining 1.7% of the SFWP (Table 1).

## *Croplands, Grasslands, and Other Habitats*

The percentage of cropland varied between the project area and comparison areas, with the SFWP containing the most (47.7%) and the north comparison area the least (25.2%; Table 1). The other three reference areas had cropland percentages ranging between 31.4% and 43.9% (Table 1). All cropland has the potential as foraging areas for whooping cranes but crop type could influence the extent of use of a particular field during any one migration season.

Percentages of grassland/herbaceous habitat also varied between analyzed areas with the north (62.1%) reference area having the most and the SFWP and west area the least (40.8% and 38.2% respectively; Table 1). The east and south reference areas had grassland/herbaceous percentages approximately in the middle of the high and low percentages calculated (Table 1). The influence of grassland habitats on migrating whooping crane behavior is unknown; however, short grasslands (i.e. grazed pasture) adjacent to wetlands may provide loafing areas and cranes may utilize grasslands to some degree for foraging.

All other habitat types comprised approximately 11.5% of the SFWP's area. This is at the low end of the range (11.3% - 17.9%) of other habitats occurring within the alternate areas (Table 1). Pasture/hay and developed lands made up the bulk of the remaining habitats in all areas (Table 1).

**Table 1. Land Use/Land Cover within the Sunflower Wind Project and adjacent areas.**

| | SFWP | | North | | East | | South | | West | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Habitat Type** | **Acres** | **%** | **Acres** | **%** | **Acres** | **%** | **Acres** | **%** | **Acres** | **%** |
| Cultivated Crops | 10,493.8 | 47.7 | 5,540.7 | 25.2 | 8,407.4 | 38.3 | 6,902.7 | 31.4 | 9,648.4 | 43.9 |
| Grassland/Herbaceous | 8,965.4 | 40.8 | 13,646.3 | 62.1 | 11,032.6 | 50.2 | 11,755.9 | 53.5 | 8,406.0 | 38.2 |
| Pasture/Hay | 1,394.8 | 6.3 | 1,460.6 | 6.6 | 566.6 | 2.6 | 1,818.2 | 8.3 | 2,701.6 | 12.3 |
| Developed | 761.9 | 3.5 | 374.9 | 1.7 | 1,144.6 | 5.2 | 753.5 | 3.4 | 901.8 | 4.1 |
| Water/Wetlands | 188.0 | 0.9 | 308.0 | 1.4 | 454.7 | 2.1 | 343.8 | 1.6 | 248.4 | 1.1 |
| Forests | 108.4 | 0.5 | 541.2 | 2.5 | 197.8 | 0.9 | 267.9 | 1.2 | 57.6 | 0.3 |
| Shrub/Scrub | 62.8 | 0.3 | 91.2 | 0.4 | 105.7 | 0.5 | 34.1 | 0.2 | 18.5 | 0.1 |
| Barren | 8.2 | <0.1 | 20.5 | 0.1 | 6.5 | <0.1 | 9.1 | <0.1 | 4.5 | <0.1 |

National Land Cover Database 2006; Fry et al. 2011.

### *Wetlands*

NWI wetland data was used for this analysis because it represents wetland features to a higher degree than the NLCD. For this analysis, it is assumed that all wetlands are potential whooping crane roosting areas under one water regime or another (e.g., drought, normal, or flood). The SFWP had the second lowest number, total acres, mean size, and size range of wetland basins compared to the reference areas (Table 2). The west reference area had the highest number of basins (194), total acres (393.6 ac) and largest size range (<0.1 to 200 ac). Wetland basins within the west area also had the second highest mean size (Table 2). The south reference area had the fewest number of wetland basins (61) but largest wetland mean size (4.1 ac; Table 2). These numbers are somewhat misleading due to the presence of the Heart River bisecting this reference area (Figure 3). The Heart River was one basin accounting for approximately 175 of the 250 total wetland acres within the area. The northern study area had the second highest number of wetland basins (164) but the lowest total wetland acres, smallest mean wetland size (0.6), and narrowest wetland size range (<0.1 to 5.0; Table 2). For the east reference area, the numbers for the four wetland statics were in the middle compared to the other reference areas and the SFWP (Table 2).

Freshwater emergent (52.8%) and freshwater ponds (44.4%) made up the highest percentages of wetland types in the SFWP, with freshwater forested/shrub and other wetlands making up the remaining approximately 2.8% of wetlands (Table 3). The north reference area had similar wetland types and percentages as the SFWP with a small amount of riverine and other wetlands (Table 3). Almost 70% of the south alternate area was comprised of riverine wetlands due to the presence of the Heart River. The bulk of the wetland types composing the east reference area were freshwater ponds (45.9%) and lakes (39.6%) while freshwater emergent wetlands dominated (93.2%) the type of wetlands in the western study area (Table 3). See Figure 3 for distribution of wetland types within the analyzed areas.

To summarize, the SFWP had the second lowest number, total acres, mean size, and size range of wetland basins compared to the reference areas and was dominated by freshwater emergent wetlands and ponds. The west alternate area had the highest number, total acres, and widest size range of wetlands of all the areas with the bulk of the wetlands being freshwater emergent. The north reference area had a relatively high number of freshwater emergent wetlands and freshwater ponds but they were small in size. The south study area contained the fewest wetland basins but these wetlands had the highest mean size. The Heart River, represented by a single riverine basin, comprised approximately 70% of the total wetland acres of this area. Wetland statistics for the east alternate area were basically in the middle of range for all study areas. This area was the only one to contain any NWI lake habitat.

**Table 2. Comparison of the number of wetland basins and mean size within the Sunflower Wind Project and adjacent areas.**

| Area | Basins | Total - acres | Mean Size - acres | Range - acres |
|---|---|---|---|---|
| SFWP | 126 | 110.3 | 0.9 | 0.1 – 28.4 |
| North | 164 | 106.3 | 0.6 | <0.1 – 5.0 |
| South | 61 | 250.0 | 4.1 | 0.1 – 174.6 |
| East | 139 | 206.7 | 1.5 | 0.1 – 38.9 |
| West | 194 | 393.6 | 2.0 | <0.1 – 200.0 |

Data Source: NWI data with wetland parts dissolved.

**Table 3. Wetland types within the Sunflower Wind Project and adjacent areas.**

| | SFWP | | North | | East | | South | | West | |
|---|---|---|---|---|---|---|---|---|---|---|
| Wetland Type | Acres | % | Acres | % | Acres | % | Acres | % | Acres | % |
| Freshwater Emergent | 58.2 | 52.8 | 43.5 | 41.0 | 28.7 | 13.9 | 48.2 | 19.3 | 366.7 | 93.2 |
| Freshwater Forested/Shrub | 0.9 | 0.8 | | | 0.5 | 0.2 | 10.0 | 4.0 | 4.0 | 1.0 |
| Freshwater Pond | 48.9 | 44.4 | 61.4 | 57.8 | 94.9 | 45.9 | 18.6 | 7.4 | 22.2 | 5.6 |
| Riverine | | | 0.2 | 0.2 | | | 173.1 | 69.3 | | |
| Lake | | | | | 81.8 | 39.6 | | | | |
| Other | 2.3 | 2.1 | 1.1 | 1.0 | 0.7 | 0.3 | 0.1 | <0.1 | 0.4 | 0.1 |

Data Source: NWI 2010.

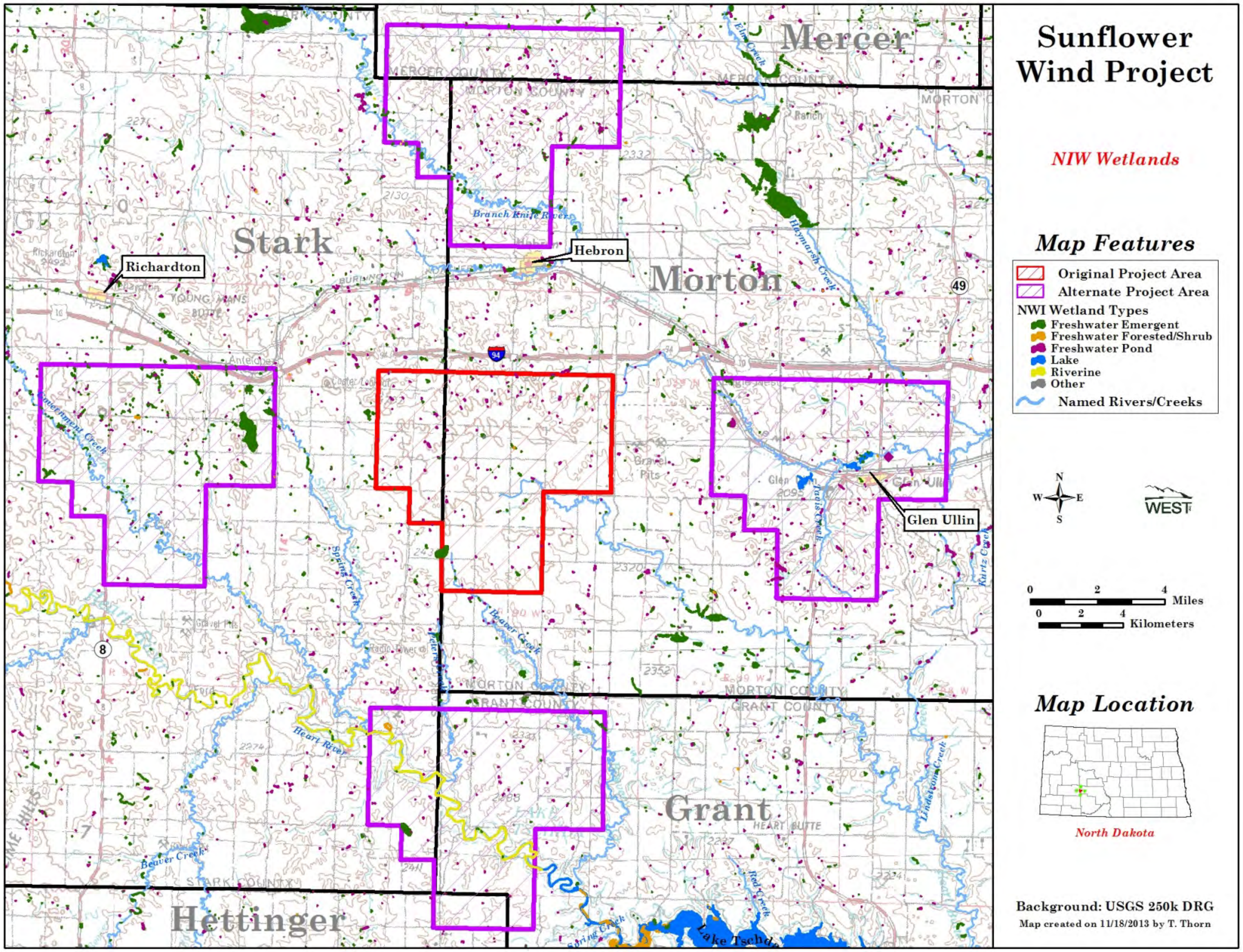


**Figure 3. NWI wetlands within and around the Sunflower Wind Project.**

*Whooping Crane Suitable Habitat Assessment*

The habitat assessment model identified 74 wetland basins within the SFWP as potentially suitable whooping crane roosting habitat. The mean suitability score for these wetlands was 8.5 with the scores ranging from four to 13 (Table 4). This mean suitability score and range was similar to the score and range for the four reference areas. The west reference area had the highest (9.0) mean suitability score (Table 4). The overall rankings are generally below what was determined as suitable potential habitat in Kansas (a mean score of 12 or more; Watershed Institute 2012).

**Table 4. Comparison of suitable whooping crane habitat within the Sunflower Wind Project and adjacent areas.**

| Area | Basins | Total - acres | Mean Score | Score range |
|---|---|---|---|---|
| SFWP | 74 | 91.7 | 8.5 | 4 – 13 |
| North | 68 | 66.9 | 8.2 | 5 – 11 |
| South | 34 | 39.8 | 8.1 | 6 – 13 |
| East | 54 | 102.9 | 8.6 | 6 – 14 |
| West | 54 | 274.8 | 9.0 | 7 – 14 |

Data Derived From: Potentially Suitable Habitat Assessment, Watershed Institute 2012.

*Whooping Crane Migration Corridor and Confirmed Sightings*

The SFWP and all four review areas are located inside the defined (95% of confirmed sightings) whooping crane migration corridor and no whooping cranes have been documented within these areas (CWCTP 2009; Figure 1). The closest confirmed sighting (through fall 2010) to the SFWP is approximately 15 mi (24.1 km) northwest of the boundary (Figure 1). This same sighting is approximately 6 mi (9.7 km) from the west alternative's boundary (Figure 1). It should be noted that reported whooping crane observations are mostly random events by the public or focused around refuges and other areas of management interest and not the result of a systematic search. Therefore, just because an area has no documented whooping crane sightings, does not mean that birds do not use the area.

## DISCUSSION

Whooping cranes are currently listed as endangered under the Endangered Species Act (32 FR 4001, 1967 March 11) except where nonessential experimental populations exist (66 FR 33903-33917, 2001 June 26; 62 FR 38932-38939, 1997 July 21; and 58 FR 5647-5658, 1993 January 22). In the US, the whooping crane was listed as threatened with extinction in 1967 and endangered in 1970 – both listings were "grandfathered" into the Endangered Species Act of 1973 (ESA 1973). The 2012 – 2013 winter population within the primary wintering grounds was estimated at 257 birds (178 – 362, 95% confidence interval.). There was another 22 whooping cranes thought to be outside of the primary wintering grounds when systematic surveys were conducted (USFWW 2013). Whooping cranes typically migrate from their breeding grounds in Wood Buffalo National Park, Canada to their wintering areas in Aransas National Wildlife Refuge, Texas. During the migration, most birds pass through central North Dakota.

The US Fish and Wildlife Service (USFWS) defined a migration corridor for whooping cranes based on the historical sightings of whooping cranes from the early 1960's through 2009 (CWCTP 2009). This corridor encompasses approximately 95% of the observations and is sub-divided into 5% increments starting at 75%. The SFWP is within the area encompassing 85% to 90% of confirmed whooping crane sightings and is approximately 71 mi (114.2 km) west of the migration corridor centerline (CWCTP 2009; Figure 1). The USFWS has expressed concern with wind and other above ground developments (e.g., transmission lines) that are built anywhere within the defined corridor, but with more emphasis placed on those projects within the region that encompasses 75% of the observations.

Confirmed whooping sightings to the north and south of the project indicates the potential for whooping cranes to fly through the area during migration. Whooping cranes generally migrate at 305-1830 m (1,000-6,000 ft) altitude, well above turbine height (Stehn 2007), and thus for the most part are unlikely to collide with turbines. However, as whooping cranes ascend and descend during takeoff and landing, or migrate during inclement weather, they may fly at lower altitudes and may fly at altitudes corresponding to the rotor-swept areas. In summary, low altitude flight is generally of short duration in the morning and evenings with more time and distance covered at higher elevation during typical migration flight; reducing potential risk to whooping cranes.

No whooping cranes have been reported as being killed or injured by wind turbines (NWCC 2004), but one sandhill crane (*Grus canadensis*) was reported at the Altamont wind energy facility in California (Smallwood and Karas 2009), it is unclear if this was a result of turbine collision or collision with a power line. Two sandhill cranes were also apparently struck by turbines during a recent study of wintering cranes in Texas (Navarrete and Griffis 2011a). It appears that cranes are not overly susceptible to collision with turbines given that 100,000's sandhill cranes migrate twice annually through the Great Plains and none have been documented as wind turbine collision fatalities in this region during migration (Derby et al. 2012).

Besides direct mortality, concern has also been raised regarding potential displacement impacts that wind facilities may have on whooping cranes. For example, if whooping cranes avoid wind facilities, the likelihood of impacts with turbines is further decreased but the availability of habitat in the project area may be diminished, causing cranes to have to fly further to find suitable habitat to roost and forage. To date, very little quantitative data is available to help address displacement impacts on whooping cranes or sandhill cranes. A recent presentation by Navarrete and Griffis (2011b) suggests that the mean density of sandhill cranes wintering in the high plains of Texas increased the further away from studied wind facilities and this distribution was not a random event. It is unclear if a similar pattern is found in cranes during migration or at other wintering areas.

Although developed for transmission line impacts on whooping crane habitat in Kansas, the Watershed Institute's (2012) potentially suitable habitat assessment for whooping cranes can help to quantify potential whooping crane habitat in and around a proposed wind energy project. This tool indicates that the range of scores and average score at the SFWP is similar to the four other study areas, indicate that overall the site is not unique in providing potential habitat for the species during migration. In addition, the average score and most of the individual wetland scores are much lower than the reference score of 12 developed for quality habitat at the Quivira National Wildlife Refuge.

## SUMMARY

In analyzing the potential for significant impacts from wind development on whooping crane stopover habitat, Stehn (2007) suggests assessing whether there is "lots of suitable stopover habitat in the general area … or is the proposed wind farm site the only suitable whooping crane stopover habitat for miles around". This issue was investigated by comparing the potential whooping crane stopover habitat (using wetlands as this indicator) in the project area to surrounding (in the four cardinal directions) areas of the same dimensions, located adjacent (based on the BWP's boundary extent) to the BWP boundary. A Geographic Information System (GIS) was used to calculate the amount of the various habitats and in the case of wetlands, number of individual basins and their type, in each of the areas compared to the proposed SFWP (Tables 1, 2, and 3). This analysis shows that both roosting (i.e. wetlands) and foraging (i.e. croplands) habitats are available in the SFWP and alternate areas. Potential whooping habitat within the SFWP appears to be most similar to that in the east and west reference areas and more suitable than that found in the north and south alternate areas. Based on results from suitable habitat assessment, potential whooping crane use wetlands are similar in attractiveness in all studied areas with the SFWP having the most potential basins (Table 4). While whooping cranes likely migrate over the SFWP and there is potential for roosting or foraging use at the SFWP, the SFWP does not provide significant potential habitat nor does it provide unique habitat compared to adjacent areas.

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# Screening Level Acoustic Assessment

# for the

# Sunflower Wind Project

# Stark and Morton Counties, North Dakota

*Prepared for*

**Sunflower Wind Project, LLC**

*Prepared by*

TETRA TECH

**February 2014**

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# Acronyms and Abbreviations

| | |
|---|---|
| BMPs | Best Management Practices |
| dB | decibel |
| dBA | A-weighted decibel |
| IEC | International Electrotechnical Commission |
| ISO | International Organization for Standardization |
| NSR | Noise Sensitive Receptor |
| PEIS | Programmatic Environmental Impact Statement |
| Project | Sunflower Wind Energy Project |
| Sunflower | Sunflower Wind Project, LLC |
| UGP | Upper Great Plains |
| WTG | wind turbine generator |

# 1.0 INTRODUCTION

Sunflower Wind Project, LLC (Sunflower) is proposing to construct and operate the Sunflower Wind Energy Project (Project) in accordance with the North Dakota Energy Conversion Facility Siting Criteria (North Dakota 2013). The Project is located approximately 3 miles south of Hebron, North Dakota, with portions of the Project Area in Morton and Stark counties, North Dakota. Tetra Tech has completed the following screening level acoustic assessment to determine the feasibility of the Project to operate within applicable noise criteria. Additionally, construction noise levels have been qualitatively assessed. The results of the acoustic assessment demonstrate that the Project would comply with regulatory limits and/or guidelines at all noise sensitive receptors (NSRs).

# 2.0 APPLICABLE REGULATION

Tetra Tech completed a review of regulations and identified the following laws, regulations, or guidelines applicable to the Project at the federal, state, and county levels.

North Dakota Chapter 69-06-08-01(4) provides for the State's noise requirements with respect to wind energy projects:

> *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 [A-weighted decibels]. The sound level avoidance area criteria may be waived in writing by the owner of the occupied residence or the community building.*

The Morton County Zoning Ordinance and the Stark County Zoning Ordinance provide additional regulations at the county level. The Morton County regulations are limited to a qualitative discussion; however, Stark County provides numeric sound level limits for sustained noise of 80 decibels (dB) during the day and 70 dB at night.

# 3.0 FACILITY CONSTRUCTION SOUND LEVELS

Project construction may cause short-term but unavoidable noise impacts. The sound levels resulting from construction activities vary significantly depending on several factors, such as the type and age of equipment, the specific equipment manufacturer and model, the operations being performed, and the overall condition of the equipment and exhaust system mufflers. The list of construction equipment that may be used on the Project and estimates of near and far sound source levels are presented in Table 1. No blasting or pile driving is anticipated during Project construction.

| Table 1. Estimated $L_{max}$ Sound Pressure Levels from Construction Equipment | | |
|---|---|---|
| **Equipment** | **Estimated Sound Pressure Level at 50 feet (dBA)** | **Estimated Sound Pressure Level at 2000 feet (dBA)** |
| Crane | 85 | 53 |
| Forklift | 80 | 48 |
| Backhoe | 80 | 48 |
| Grader | 85 | 53 |
| Man basket | 85 | 53 |
| Dozer | 83 - 88 | 51 - 56 |
| Loader | 83 - 88 | 51 - 56 |
| Scissor Lift | 85 | 53 |
| Truck | 84 | 52 |
| Welder | 73 | 41 |
| Compressor | 80 | 48 |
| Concrete Pump | 77 | 45 |

Data compiled in part from the following sources:

Federal Highway Administration, "Roadway Construction Noise Model User's Guide," Report FHWA-HEP-05-054 / DOT-VNTSC-FHWA-05-01, January 2006.

Power Plant Construction Noise Guide, Bolt Beranek and Newman, Inc. 1977.

Federal Highway Administration, "Procedures for Abatement of Highway Traffic Noise and Construction Noise." Code of Federal Regulations, Title 23, Part 772, 1992.

Construction activity would also generate traffic that would have potential noise effects, such as trucks travelling to and from the site on public roads. Sound generated by construction activities is generally exempt from state and local noise regulation. Construction would be limited to daytime hours between 7 a.m. and 7 p.m., and reasonable efforts would be made to minimize the impact of noise resulting from construction activities. The Project Engineering, Procurement and Construction (EPC) contractor would notify the community of the expected Project construction schedule and duration.

# 4.0 FACILITY OPERATIONAL SOUND LEVELS

Sound power level data are used in acoustic models to predict received sound pressure levels at observer locations. The Project has a nameplate (gross) generating capacity of 110 megawatts (MW) and the layouts under consideration include alternate wind turbine generator (WTG) locations to achieve this capacity. Table 2 includes the two WTG types, the number of WTGs under consideration to achieve the nameplate capacity, and the broadband sound power level associated with each. The Project layout utilized for this study includes more than the target number of turbine locations needed to meet the Project's nameplate capacity to account for alternate locations. All of these locations were used in the model; however, the actual number of WTGs used for the final Project design would be no greater than that indicated in Table 2.

| Table 2. WTG Candidates and Layout Configurations | | | | | | |
|---|---|---|---|---|---|---|
| **WTG Model** | **Maximum Number of WTG in Project** | **Number of WTG Locations Studied** | **MW per WTG** | **Hub Height (m)** | **Rotor Diameter (m)** | **Sound Power Level (dBA)1/** |
| GE 1.85-87 | 59 | 76 | 1.85 | 80 | 87 | 106.5 |
| Vestas V110-2.0 | 55 | 64 | 2.0 | 80 | 110 | 107.5 |

1/ A k-factor (or uncertainty factor) of 2 dBA was applied to the overall A-weighted sound power level.

WTG sound power levels are determined in accordance with International Electrotechnical Commission (IEC) Standard 61400-11, Wind Turbine Generator Systems—Part 11: Wind turbine generator systems – Acoustic Noise Measurement Techniques. This methodology has been developed to allow for comparison between WTG manufacturers using consistent reporting and measurement techniques. The IEC test is an accepted standard providing a uniform methodology for measuring the noise emissions of a WTG from cut-in through full rotational wind speeds. The IEC testing standard defines deviation values $\sigma_T$, $\sigma_R$ and $\sigma_P$ for measured apparent sound power levels as described by IEC/TS 61400-14, where $\sigma_T$ is the total standard deviation, $\sigma_R$ is the standard deviation for test reproducibility, and $\sigma_P$ is the standard deviation for product variation. To account for this inherent deviation associated with the IEC testing methodology, a confidence interval of k = 2 dBA was applied to the broadband dBA WTG sound power level values. The combination of the modeling parameters used and the inclusion of the 2 dBA term are expected to result in a reasonable and conservative assessment of Project sound levels.

Sound power specifications and octave band frequency data were obtained by Sunflower from the manufacturers of the WTGs under consideration. It is assumed that the WTGs for the Project would have similar sound power profiles as those used in the acoustic modeling; however, it is possible that the final manufacturer warranty values may vary slightly. Table 3 provides a summary of the sound power data correlated by wind speed for each WTG model at reference rotor hub height assuming a roughness length[1] coefficient of 0.05 meters. As shown in Table 3, generally wind speeds lower than those corresponding to full rated power also result in lower sound levels.

[1] The roughness length describes the change in wind speed at increased elevation and may vary based on site specific terrain conditions.

| Table 3. WTG Broadband Sound Power Levels (dBA) Correlated with Wind Speed | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| WTG Sound Power Level at Reference Wind Speed | | | | | | | | | | | |
| Wind Speed (m/s) | 3 m/s | 4 m/s | 5 m/s | 6 m/s | 7 m/s | 8 m/s | 9 m/s | 10 m/s | 11 m/s | 12 m/s | 13 m/s |
| GE 1.85-87 | 93.9 | 97.0 | 102.2 | 105.9 | 106.5 | 106.5 | 106.5 | 106.5 | 106.5 | 106.5 | 106.5 |
| Vestas V110-2.0 | 97.3 | 99.6 | 103.8 | 107.5 | 106.1 | 106.1 | 106.1 | 106.3 | 106.5 | 106.7 | 107.0 |

Source: GE 2013, Vestas 2013

The Project collector substation was not included in the acoustic assessment because setback distances to the nearest NSR are relatively large at 0.75-miles and it is assumed that received sound levels would attenuate to low levels at the nearest NSR. The Project substation and interconnection yard would be located immediately adjacent to Western’s existing 230 kilovolt transmission line, and no Project transmission line would be required.

# 5.0 ACOUSTIC MODELING METHODOLOGY

To assess the noise emission of a wind farm prior to construction and to estimate compliance status with permitting requirements, it is necessary to have prediction models with which a noise emission source level measured at a given reference point can be certified. A generally accepted approach for modeling a WTG as an idealized point source is described in the International Organization for Standardization (ISO) 9613-2, Attenuation of Sound during Propagation Outdoors. The standard specifies methods to enable noise levels in the community to be predicted from sources of known sound emission and provides a summary of existing knowledge on outdoor sound. The calculation methodologies described in the standard are relied on by professionals in the field of acoustics.

Standard acoustic engineering methods conforming to ISO 9613-2 were incorporated into the Project acoustic modeling using DataKustic GmbH’s CadnaA, the computer-aided noise abatement program (v 4.4.145). The engineering methods specified in this standard consist of full octave band algorithms that incorporate geometric spreading due to wave divergence, reflection from surfaces, atmospheric absorption, screening by topography and obstacles, ground effects, source directivity, heights of sources and receptors, seasonal foliage effects, and meteorological conditions. Operational broadband sound pressure levels were calculated assuming that all WTGs inclusive of the alternates are operating continuously and concurrently at the maximum manufacturer-rated sound level. The sound energy was then summed to determine the equivalent continuous A-weighted downwind sound pressure level at a given point of reception such as a NSR.

Topographical information was imported into the acoustic model using the official U.S. Geological Survey digital elevation dataset to accurately represent terrain in three dimensions. Terrain conditions, vegetation type, ground cover, and the density and height of foliage can also influence the absorption that takes place when sound waves travel over land. The ISO 9613-2 standard accounts for ground absorption rates by assigning a numerical coefficient of G=0 for acoustically hard, reflective surfaces and G=1 for absorptive surfaces and soft ground. In this case, the Project area agricultural lands used for cultivation are assumed to be moderately reflective and therefore a ground absorption factor of G=0.5 was applied. Sound attenuation through foliage and diffraction around and over existing structures such as buildings was ignored under all acoustic modeling scenarios. Sound attenuation by the atmosphere is not strongly dependent on temperature and humidity; however, a temperature of 10°C (50°F) and a relative humidity of 70 percent were selected as reasonably representative of conditions favorable to sound propagation.

Inherent to the ISO 9613-2 and IEC61400-11 standards are downwind conditions. That is, the WTG sound power levels and modeling methods are representative of when the wind is blowing from the WTG to the receptor. In fact, the ISO 9613-2 modeling method unrealistically assumes that downwind conditions exist in all directions, between each WTG and each receptor simultaneously, even though that is physically impossible. Therefore, lower levels are expected in the upwind direction. Conversely, there may be meteorological conditions from time to time that may aid in the long range propagation of sound. These anomalous meteorological conditions may include wind gradients that bend sound downwards, which principally affect long range sound propagation. Received sound levels during anomalous meteorological conditions were also estimated using a range dependent correction factor.

Sound power levels were modeled at each NSR within the Project Area and a minimum one-mile buffer area. Potential NSRs were identified based on the North Dakota standard quoted above as occupied residences or community buildings. Within the Project Area and the minimum one-mile buffer a total of 42 structures were identified, of which 16 are residential structures and are therefore potential NSRs. The 16 NSRs included residences known to be occupied and those whose occupancy status was not known, as well as one residential structure that is known to be unoccupied. Although the state noise standard is specific to occupied residences, this last one remains in the analysis because it may be occupied at some future point during the lifetime of the Project. There are no community buildings in the analysis area. Figures 1 through 4 show the location of all structures, and indicate the occupancy status of identified residences.

# 6.0 ACOUSTIC MODELING RESULTS

Acoustic modeling was completed for Project operation for two cases: (1) highest specified operational sound level according to the WTG manufacturer's specifications under typical downwind propagation conditions; and (2) highest specified operational sound level according to the WTG manufacturer's specifications under anomalous meteorological conditions. As mentioned above, the final Project layout design would consist of fewer WTGs than were analyzed, therefore this assessment is representative of the worse-case. Noise was modeled at a distance of 100 feet from each residential structure in consideration of the North Dakota noise standard quoted above.

The acoustic modeling results were compared to the State's numerical limits of 50 dBA. Table 4 summarizes the number of NSRs within selected sound pressure level ranges (in dBA) under each of the modeled operational conditions. The tabulated results are independent of the existing acoustic environment (i.e. are representative of expected Project-generated sound levels only). Table A-1 (Attachment 1) presents the received sound levels at each of the 16 individual NSRs for each WTG type by receptor ID and UTM coordinates. The assessment included prediction and plotting of sound level contours from the Project. Sound contour maps displaying the corresponding typical downwind and anomalous meteorological operational sound levels in color-coded isopleths are presented in Figures 1 to 4. Isopleths are projected onto scaled aerial photographs at a height of 5 feet above grade (i.e., at the approximate height of a person's ears while standing). In conclusion, modeling results, as shown in Tables 4 and A-1, indicate that the Project will comply with the applicable state noise limits for wind energy projects.

**Table 4. Number of NSRs by Sound Level Range and Exceedance Condition for each WTG Layout**

| Sound Level Range (dBA) | GE 1.85-87 | | Vestas V110-2.0 | |
|---|---|---|---|---|
| | Typical Downwind | Anomalous Meteorological | Typical Downwind | Anomalous Meteorological |
| **Less than 35** | 6 | 3 | 4 | 2 |
| **35 - 40** | 2 | 4 | 2 | 5 |
| **40 - 45** | 4 | 5 | 5 | 5 |
| **45-50** | 4 | 4 | 3 | 4 |
| **50-55+** | 0 | 0 | 0 | 0 |
| **>50 (North Dakota Limit)** | 0 | 0 | 0 | 0 |

# 7.0 REFERENCES

North Dakota 2013. North Dakota Energy Conversion Facility Siting Criteria.

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# ATTACHMENT 1: TABULATED RESULTS

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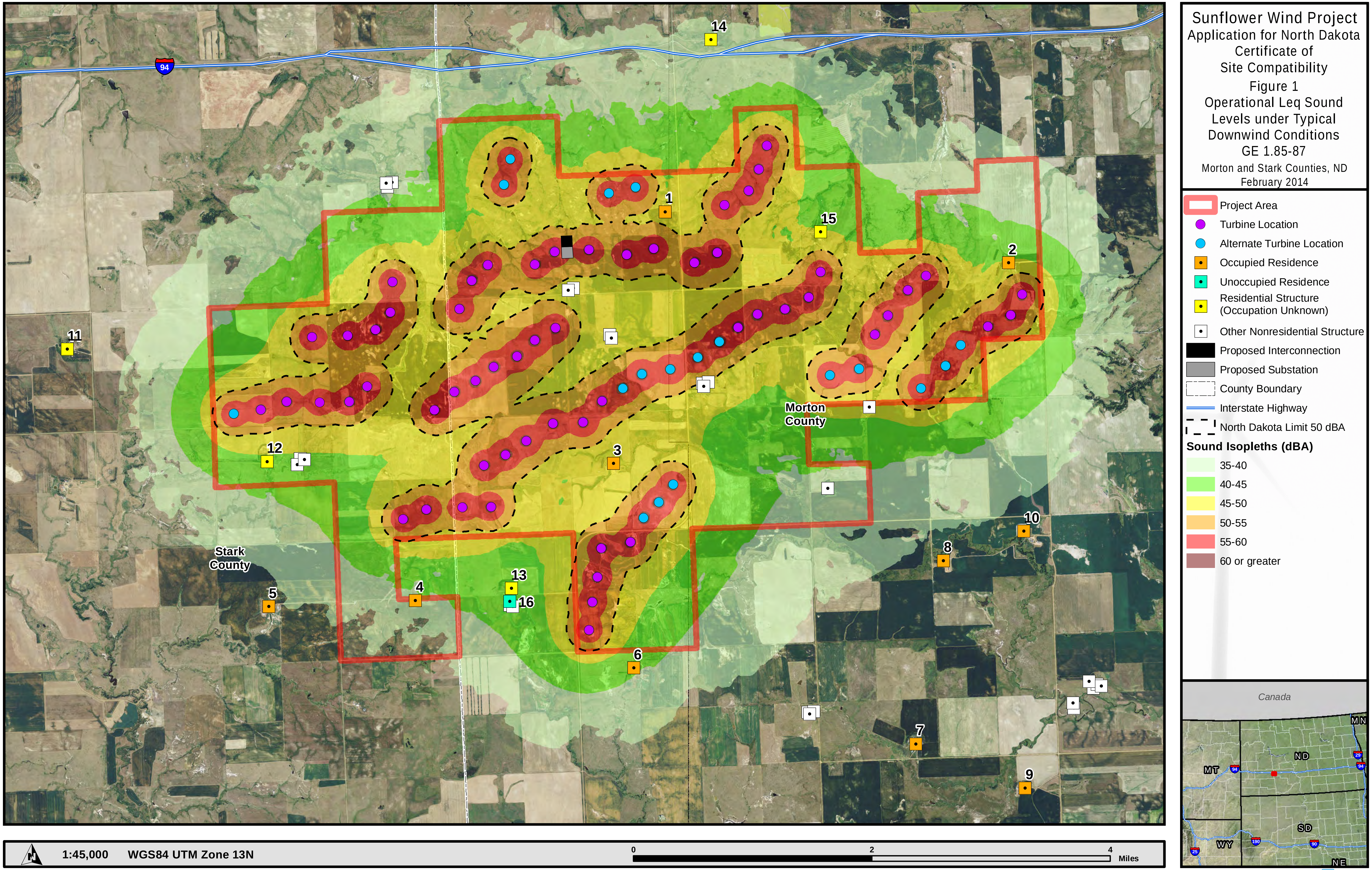
| Table A-1. Tabulated Acoustic Modeling Results | | | | | | |
|---|---|---|---|---|---|---|
| NSR ID | UTM Coordinates (m) | | Sound Levels (dBA $L_{eq}$) GE 1.85-87 | | Sound Levels (dBA $L_{eq}$) Vestas V110-2.0 | |
| | Easting | Northing | Typical Downwind | Anomalous Meteorological | Typical Downwind | Anomalous Meteorological |
| 1 | 724362 | 5191939 | 48 | 49 | 50 | 50 |
| 2 | 728996 | 5191251 | 46 | 47 | 43 | 44 |
| 3 | 723663 | 5188543 | 47 | 48 | 48 | 49 |
| 4 | 720993 | 5186693 | 39 | 41 | 40 | 42 |
| 5 | 719013 | 5186610 | 34 | 36 | 35 | 37 |
| 6 | 723940 | 5185782 | 41 | 42 | 42 | 42 |
| 7 | 727748 | 5184755 | 26 | 28 | 27 | 30 |
| 8 | 728120 | 5187231 | 34 | 37 | 35 | 37 |
| 9 | 729223 | 5184162 | 20 | 23 | 21 | 24 |
| 10 | 729204 | 5187628 | 34 | 36 | 34 | 36 |
| 11 | 716294 | 5190086 | 32 | 34 | 33 | 36 |
| 12 | 718990 | 5188568 | 44 | 45 | 45 | 46 |
| 13 | 722287 | 5186857 | 43 | 44 | 43 | 44 |
| 14 | 724981 | 5194263 | 36 | 38 | 37 | 39 |
| 15 | 726461 | 5191668 | 46 | 46 | 46 | 47 |
| 16 | 722267 | 5186683 | 42 | 43 | 42 | 44 |

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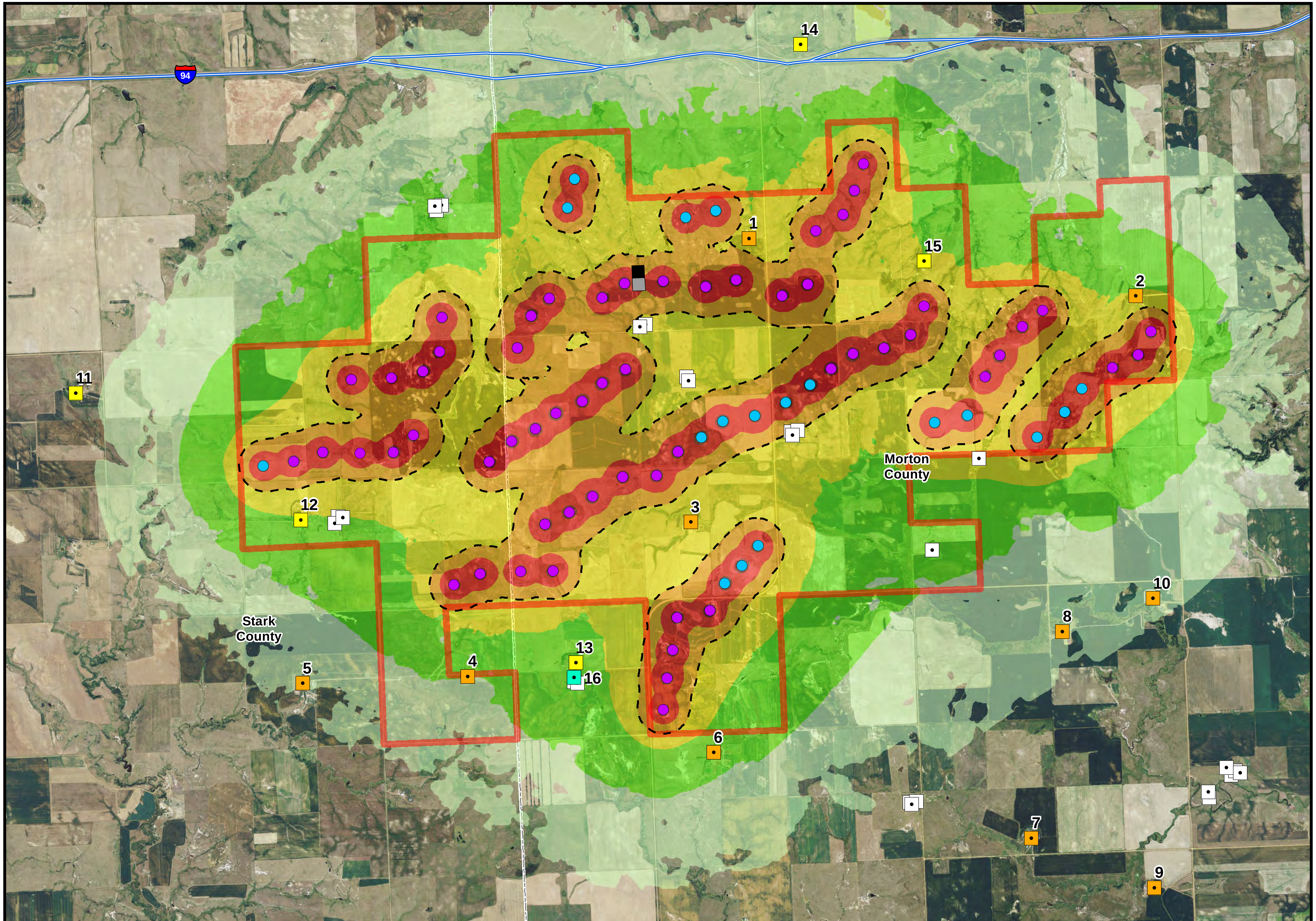
# Sunflower Wind Project
Application for North Dakota Certificate of Site Compatibility

Figure 2
Operational Leq Sound Levels under Anomalous Downwind Conditions
GE 1.85-87

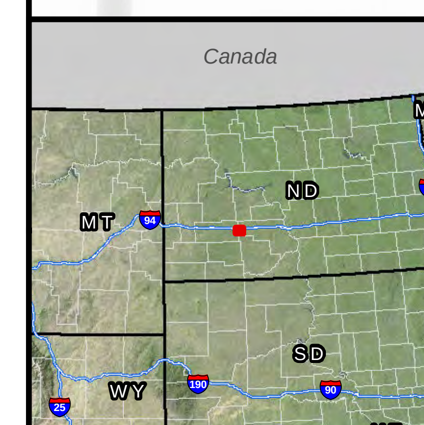
Morton and Stark Counties, ND
February 2014




- Project Area
- Turbine Location
- Alternate Turbine Location
- Occupied Residence
- Unoccupied Residence
- Residential Structure (Occupation Unknown)
- Other Nonresidential Structure
- Proposed Interconnection
- Proposed Substation
- County Boundary
- Interstate Highway
- North Dakota Limit 50 dBA

**Sound Isopleths (dBA)**

- 35-40
- 40-45
- 45-50
- 50-55
- 55-60
- 60 or greater




1:45,000 WGS84 UTM Zone 13N

0 2 4 Miles

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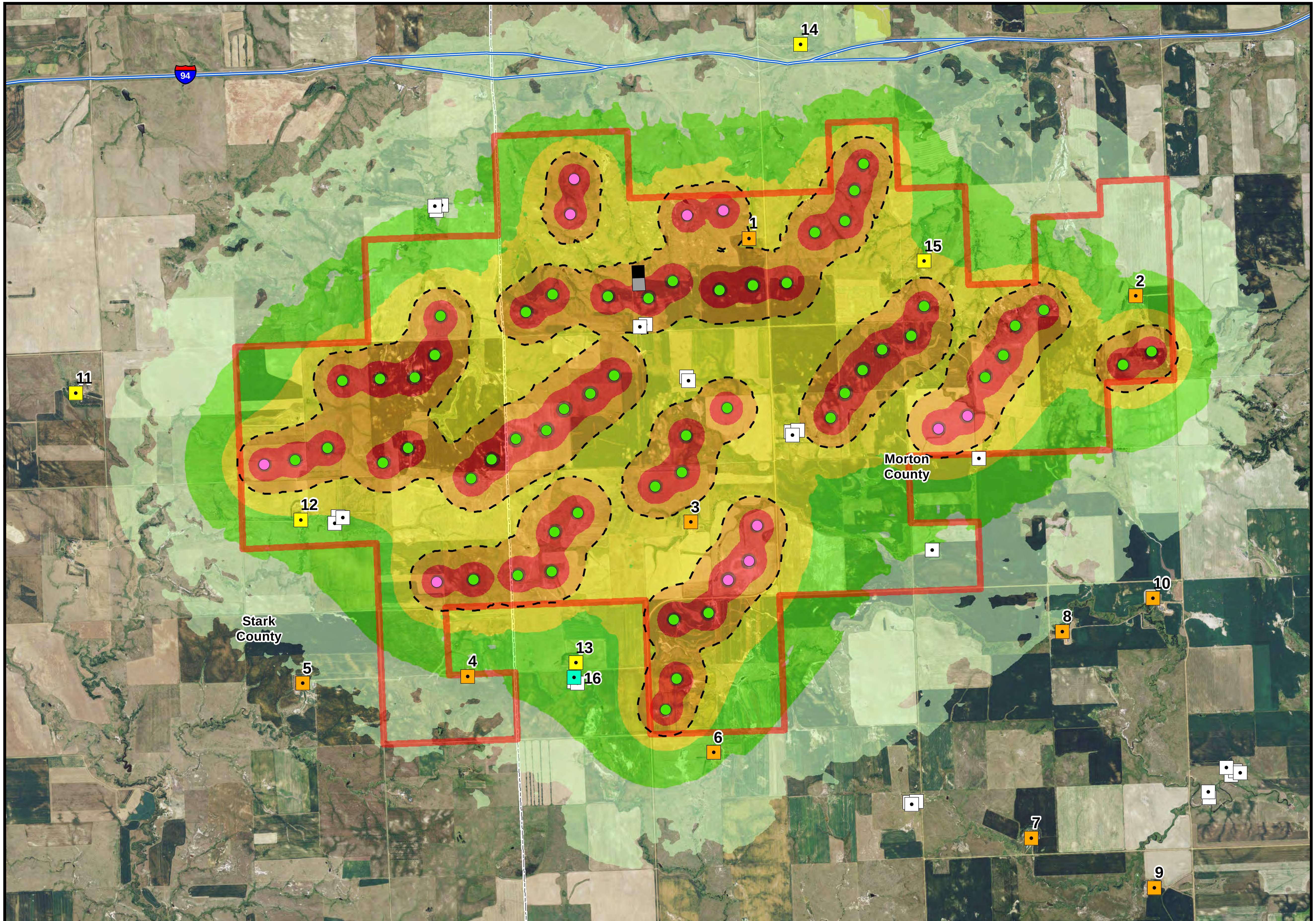
# Sunflower Wind Project
Application for North Dakota Certificate of Site Compatibility

Figure 3
Operational Leq Sound Levels under Typical Downwind Conditions
Vestas V110-2.0

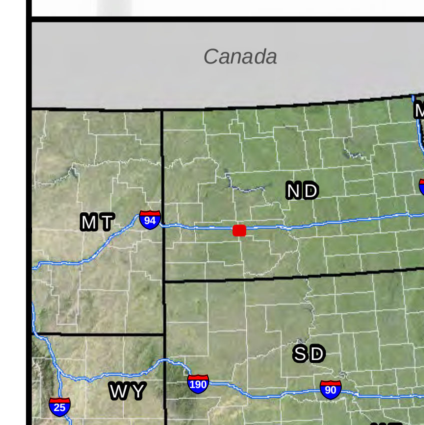
Morton and Stark Counties, ND
February 2014




- Project Area
- Turbine Location
- Alternate Turbine Location
- Occupied Residence
- Unoccupied Residence
- Residential Structure (Occupation Unknown)
- Other Nonresidential Structure
- Proposed Interconnection
- Proposed Substation
- County Boundary
- Interstate Highway
- North Dakota Limit 50 dBA

**Sound Isopleths (dBA)**

- 35-40
- 40-45
- 45-50
- 50-55
- 55-60
- 60 or greater




1:45,000 WGS84 UTM Zone 13N

0 2 4 Miles

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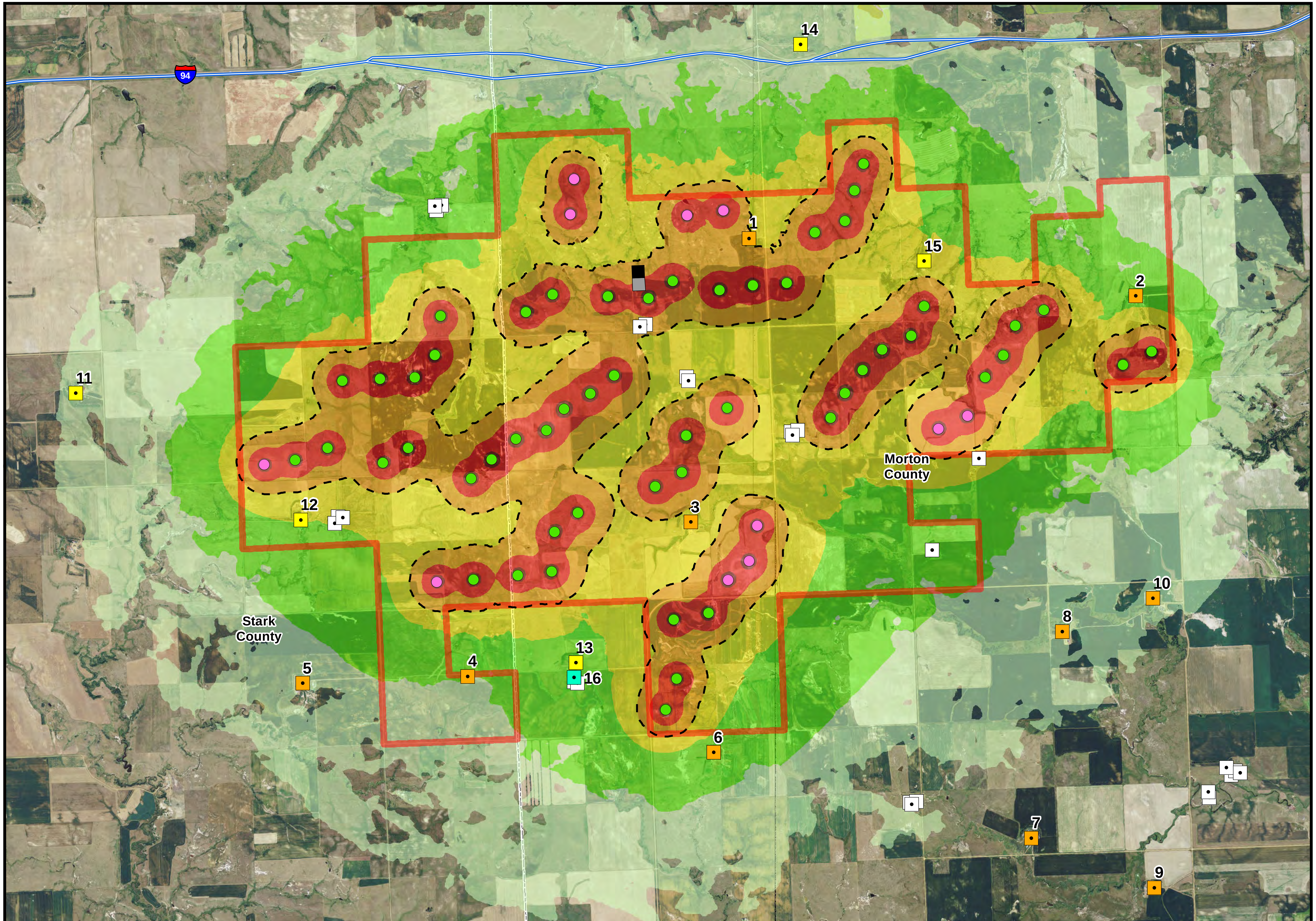
# Sunflower Wind Project
Application for North Dakota Certificate of Site Compatibility

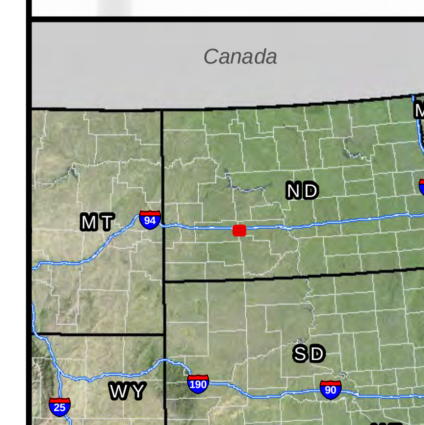
## Figure 4
Operational Leq Sound Levels under Anomalous Downwind Conditions Vestas V110-2.0

Morton and Stark Counties, ND
February 2014




Project Area
Turbine Location
Alternate Turbine Location
Occupied Residence
Unoccupied Residence
Residential Structure (Occupation Unknown)
Other Nonresidential Structure
Proposed Interconnection
Proposed Substation
County Boundary
Interstate Highway
North Dakota Limit 50 dBA

**Sound Isopleths (dBA)**
35-40
40-45
45-50
50-55
55-60
60 or greater




1:45,000 WGS84 UTM Zone 13N

0 2 4 Miles

TETRA TECH

# Shadow Flicker Impact Analysis

# for the

# Sunflower Wind Energy Project

# Stark and Morton Counties, North Dakota

*Prepared for*

**Sunflower Wind Project, LLC**

*Prepared by*

TETRA TECH

**February 2014**

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# Acronyms and Abbreviations

| | |
|---|---|
| Hz | Hertz |
| Project | Sunflower Wind Energy Project |
| rpm | rotations per minute |
| Sunflower | Sunflower Wind Project, LLC |
| UTM | Universal Transverse Mercator |

# 1.0 OVERVIEW

Sunflower Wind Project, LLC (Sunflower), is proposing to develop the Sunflower Wind Energy Project (Project) in Morton and Stark counties, North Dakota. The Project would install up to 59 wind turbines with a maximum nameplate capacity of 110 megawatts, with the number of turbines depending on the size and model of turbine used. Tetra Tech has conducted the following shadow flicker analysis for the Project to support the Project's application for a Certificate of Site Compatibility under the North Dakota Public Services Commission.

# 2.0 PROJECT COMPONENTS

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

- **Vestas V-110** – 3-blade, 110-meter diameter rotor, with a hub height of 80 meters and generating capacity of 2.0 MW. The Vestas V-110 has a normal high rotor speed of approximately 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. The Project would utilize up to 55 Vestas V-110 turbines; however, 64 potential Vestas turbine locations are included in this impact analysis to account for alternate locations that may be used.

- **General Electric (GE) 1.85-87** – 3-blade 87-meter diameter rotor, with a hub height of 80 meters and generating capacity of 1.85 MW. The GE 1.85-87 has a normal high rotor speed of 18.5 rpm which translates to a blade pass frequency of 0.93 Hz (less than 1 alternation per second). The Project would utilize up to 59 GE 1.85-87 turbines; however, 76 potential GE turbine locations are included in this impact analysis to account for alternate locations that may be used.

The 64 potential Vestas turbine locations and the 76 GE potential turbine locations overlap to a large degree, so that together they represent a total of 85 unique potential turbine locations. Because the layout has not been finalized, the shadow flicker impact analysis considered all 85 potential turbine locations.

# 3.0 SHADOW FLICKER BACKGROUND

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 impact to surrounding properties 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 2,500 meters (8,202 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.

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, and 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. (For comparison, strobe lights used in discotheques have frequencies which range from about 3 Hz to 10 Hz (1 Hz = 1 flash per second). Since the proposed Project's wind turbine blade pass frequency is approximately 0.7-0.93 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.

# 4.0 WINDPRO SHADOW FLICKER ANALYSIS

An analysis of potential shadow flicker impacts from the Project was conducted using the WindPro software package. The analysis evaluated the following two turbine scenarios:

- Scenario A – 64 potential Vestas V-110 turbine locations (only 55 of these turbines would be constructed)
- Scenario B – 76 potential GE 1.85-87 turbine locations (only 59 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 surrounding the Project. 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 US Geological Survey digital elevation model data. Positions geometries were determined using geographic information system 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 4 years of wind data, including 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 42 structures were identified within a minimum buffer of one mile of the proposed Project turbines; of these, 16 were residential structures and are considered potential shadow-flicker receptors for the purpose of this analysis. A receptor in the model is defined as a 1 meter squared area (approximate size of a typical window), 3.28 feet (1 meter) above ground level. Approximate eye level is set at 4.94 feet (1.5 meters). Figure 1 shows the locations of identified structures and the 16 potential shadow flicker receptors, along with the 85 potential turbine locations considered for Scenarios A and B.

# 5.0 SHADOW FLICKER ANALYSIS RESULTS

As expected, WindPro predicts that shadow flicker impacts will be greatest at locations nearer to the wind turbines. Figures 2A and 2B describe the WindPro predicted shadow flicker impact areas for turbine Scenarios A and B, respectively. A detailed WindPro shadow flicker analysis summary, for each of the modeled receptor location, is provided in Attachment A.

Tables 1 and 2 present the WindPro predicted shadow flicker impacts for the 16 identified receptors for each of the two turbines modelled. Because the Project is using a minimum turbine siting setback requirement of 1,320 feet (402 meters) to occupied residences, the most sensitive receptors are generally not located in the high potential shadow flicker impact zones. The maximum predicted shadow flicker impact at any occupied residence receptor is 36 hours 24 minutes per year (Receptor 1 in Scenario A), which is approximately 0.8 percent of the potential available daylight hours. This structure is owned by a landowner that is participating in the Project.

**Table 1. WindPro Predicted Shadow Flicker Impacts for Receptors – Scenario A (Vestas V-110 Turbines)**

| Receptor ID | Shadow Hours per Year (expected) [hh:mm / year] | Receptor Type | Receptor Occupation Status |
|---|---|---|---|
| 1 | 36:24 | Home | Yes |
| 2 | 5:04 | Home | Yes |
| 3 | 18:26 | Home | Yes |
| 4 | 0:00 | Home | Yes |
| 5 | 0:00 | Home | Yes |
| 6 | 0:00 | Home | Yes |
| 7 | 0:00 | Home | Yes |
| 8 | 0:00 | Home | Yes |
| 9 | 0:00 | Home | Yes |
| 10 | 0:00 | Home | Yes |
| 11 | 0:00 | Home | Unknown |
| 12 | 1:47 | Home | Unknown |
| 13 | 7:11 | Home | Unknown |
| 14 | 0:00 | Home | Unknown |
| 15 | 17:35 | Home | Unknown |
| 16 | 9:37 | Home | No |

| Table 2. WindPro Predicted Shadow Flicker Impacts for Receptors – Scenario B (GE 1.85-87 Turbines) | | | |
|---|---|---|---|
| **Receptor ID** | **Shadow Hours per Year (expected) [hh:mm / year]** | **Receptor Type** | **Receptor Occupation Status** |
| 1 | 31:17 | Home | Yes |
| 2 | 4:20 | Home | Yes |
| 3 | 17:41 | Home | Yes |
| 4 | 0:00 | Home | Yes |
| 5 | 1:19 | Home | Yes |
| 6 | 0:00 | Home | Yes |
| 7 | 0:00 | Home | Yes |
| 8 | 0:00 | Home | Yes |
| 9 | 0:00 | Home | Yes |
| 10 | 0:00 | Home | Yes |
| 11 | 0:00 | Home | Unknown |
| 12 | 0:59 | Home | Unknown |
| 13 | 6:57 | Home | Unknown |
| 14 | 0:00 | Home | Unknown |
| 15 | 6:49 | Home | Unknown |
| 16 | 7:56 | Home | No |

The shadow flicker impact prediction statistics are summarized in Tables 3 and 4.

| Table 3. Statistical Summary of WindPro Predicted Shadow Flicker Impacts at Modeled Receptor Locations – Scenario A (Vestas V-110 Turbines) | |
|---|---|
| **Cumulative Shadow Flicker Time (expected)** | **Number of Receptors** |
| Total | 16 |
| = 0 Hours | 9 |
| > 0 Hours < 10 Hours | 4 |
| ≥ 10 Hours < 20 Hours | 2 |
| ≥ 20 Hours < 30 Hours | 0 |
| ≥ 30 Hours | 1 |

**Table 4. Statistical Summary of WindPro Predicted Shadow Flicker Impacts at Modeled Receptor Locations – Scenario B (GE 1.85-87 Turbines)**

| Cumulative Shadow Flicker Time (expected) | Number of Receptors |
|---|---|
| Total | 16 |
| = 0 Hours | 8 |
| > 0 Hours < 10 Hours | 6 |
| ≥ 10 Hours < 20 Hours | 1 |
| ≥ 20 Hours < 30 Hours | 0 |
| ≥ 30 Hours | 1 |

The slightly higher shadow flicker impacts for Scenario A (Vestas turbines) can be explained by the longer blades for this turbine.

# 6.0 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 health hazards. Shadow flicker is not expected to be a significant environmental impact.

The analysis was deliberately conservative and actual shadow flicker is expected to occur for less than the modeled durations. The analysis assumes that the receptors all have a direct in-line view of the incoming shadow flicker sunlight and does not account for trees or other obstructions 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, Sunflower will construct fewer wind turbines than were included in the modeled results.

# 7.0 REFERENCES

Epilepsy Action. 2008. Information Web Page on Photosensitive Epilepsy. 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

# Attachment A: Detailed Summary of WindPro Shadow Flicker Analysis Results

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**Table A-1. WindPro Shadow Flicker Analysis Results Summary - Scenario A (Vestas V-110 Turbines)**

| Receptor ID | UTM-E (m) | UTM-N (m) | WindPro Predicted Expected Shadow Flicker (Hours per Year) | Receptor Type | Occupied Status |
|---|---|---|---|---|---|
| 1 | 724,362 | 5,191,938 | 36:24 | Home | Yes |
| 2 | 728,996 | 5,191,250 | 5:04 | Home | Yes |
| 3 | 723,663 | 5,188,542 | 18:26 | Home | Yes |
| 4 | 720,993 | 5,186,693 | 0:00 | Home | Yes |
| 5 | 719,013 | 5,186,609 | 0:00 | Home | Yes |
| 6 | 723,940 | 5,185,782 | 0:00 | Home | Yes |
| 7 | 727,748 | 5,184,755 | 0:00 | Home | Yes |
| 8 | 728,120 | 5,187,230 | 0:00 | Home | Yes |
| 9 | 729,223 | 5,184,161 | 0:00 | Home | Yes |
| 10 | 729,204 | 5,187,627 | 0:00 | Home | Yes |
| 11 | 716,294 | 5,190,086 | 0:00 | Home | Unknown |
| 12 | 718,990 | 5,188,567 | 1:47 | Home | Unknown |
| 13 | 722,287 | 5,186,857 | 7:11 | Home | Unknown |
| 14 | 724,981 | 5,194,263 | 0:00 | Home | Unknown |
| 15 | 726,461 | 5,191,667 | 17:35 | Home | Unknown |
| 16 | 722,267 | 5,186,682 | 9:37 | Home | No |

**Table A-2. WindPro Shadow Flicker Analysis Results Summary - Scenario B (GE 1.85-87 Turbines)**

| Receptor ID | UTM-E (m) | UTM-N (m) | WindPro Predicted Expected Shadow Flicker (Hours per Year) | Receptor Type | Occupied Status |
|---|---|---|---|---|---|
| 1 | 724,362 | 5,191,938 | 31:17 | Home | Yes |
| 2 | 728,996 | 5,191,250 | 4:20 | Home | Yes |
| 3 | 723,663 | 5,188,542 | 17:41 | Home | Yes |
| 4 | 720,993 | 5,186,693 | 0:00 | Home | Yes |
| 5 | 719,013 | 5,186,609 | 1:19 | Home | Yes |
| 6 | 723,940 | 5,185,782 | 0:00 | Home | Yes |
| 7 | 727,748 | 5,184,755 | 0:00 | Home | Yes |
| 8 | 728,120 | 5,187,230 | 0:00 | Home | Yes |
| 9 | 729,223 | 5,184,161 | 0:00 | Home | Yes |
| 10 | 729,204 | 5,187,627 | 0:00 | Home | Yes |
| 11 | 716,294 | 5,190,086 | 0:00 | Home | Unknown |
| 12 | 718,990 | 5,188,567 | 0:59 | Home | Unknown |
| 13 | 722,287 | 5,186,857 | 6:57 | Home | Unknown |
| 14 | 724,981 | 5,194,263 | 0:00 | Home | Unknown |
| 15 | 726,461 | 5,191,667 | 6:49 | Home | Unknown |
| 16 | 722,267 | 5,186,682 | 7:56 | Home | No |

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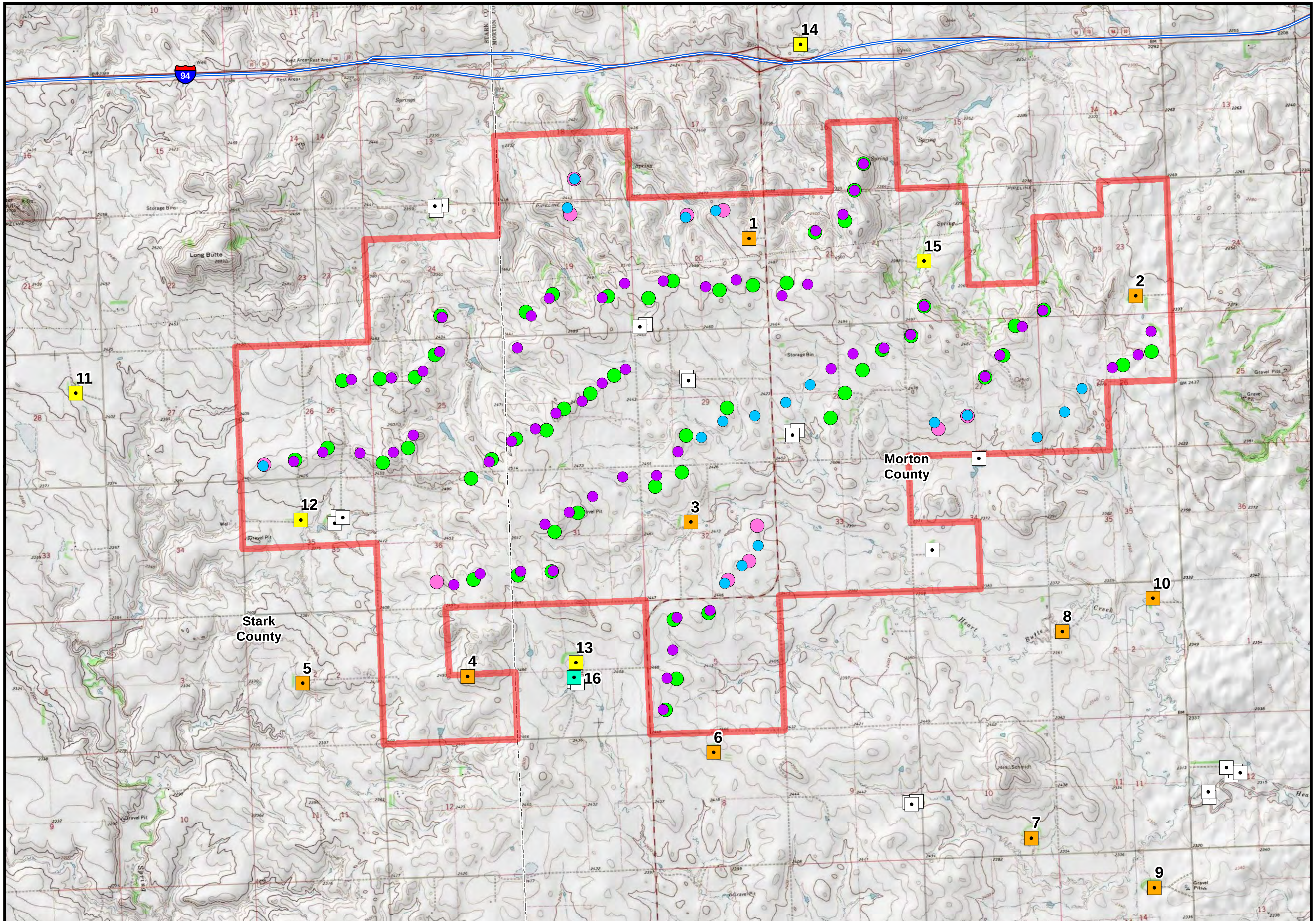
# Sunflower Wind Project
Application for North Dakota Certificate of Site Compatibility

Figure 1
Receptor Locations Modeled with WindPro to Predict Expected Shadow Flicker Impacts

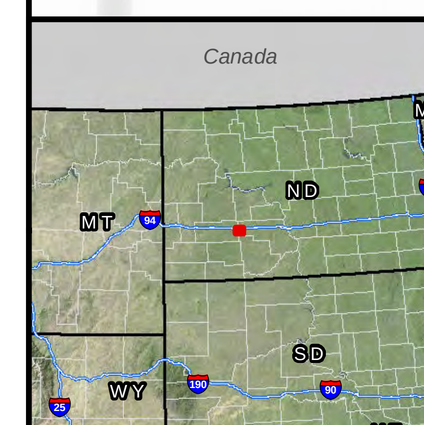
Morton and Stark Counties, ND
February 2014




- Project Area
- Occupied Residence
- Unoccupied Residence
- Residential Structure (Occupation Unknown)
- Other Nonresidential Structure

**GE**
- Turbine Location
- Alternate Turbine Location

**Vestas**
- Turbine Location
- Alternate Turbine Location
- County Boundary
- Interstate Highway




1:45,000 WGS84 UTM Zone 13N

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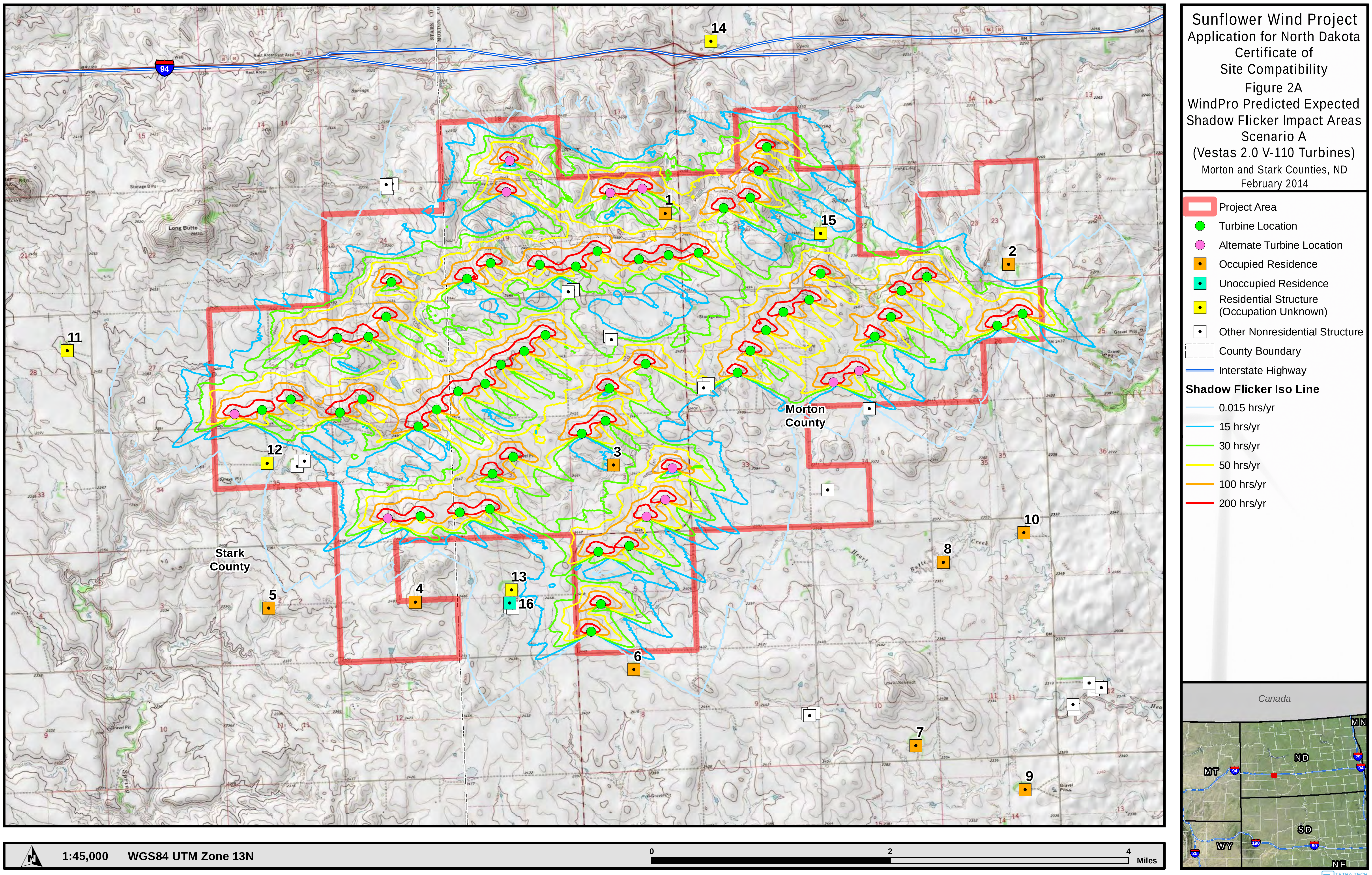


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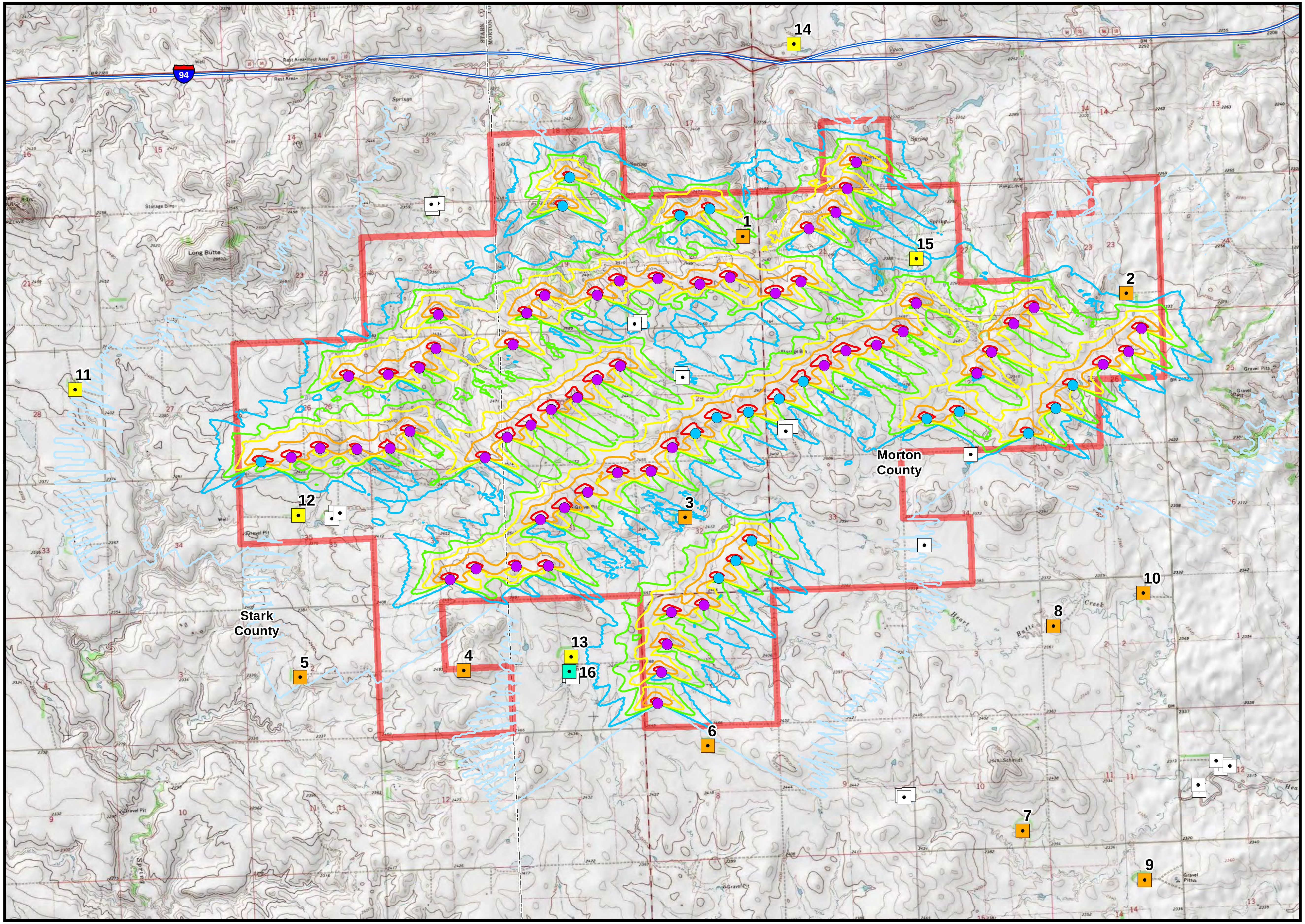



# Sunflower Wind Project

Application for North Dakota Certificate of Site Compatibility

Figure 2B

WindPro Predicted Expected Shadow Flicker Impact Areas

Scenario B

(GE 1.85-87 Turbines)

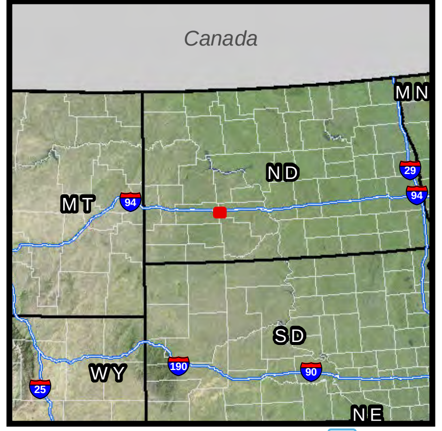
Morton and Stark Counties, ND

February 2014

- Project Area
- Turbine Location
- Alternate Turbine Location
- Occupied Residence
- Unoccupied Residence
- Residential Structure (Occupation Unknown)
- Other Nonresidential Structure
- County Boundary
- Interstate Highway

**Shadow Flicker Iso Line**

- 0.015 hrs/yr
- 15 hrs/yr
- 30 hrs/yr
- 50 hrs/yr
- 100 hrs/yr
- 200 hrs/yr




1:45,000 WGS84 UTM Zone 13N

0 2 4 Miles

TETRA TECH

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# Appendix B Agency Correspondence

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**APPENDIX B AGENCY CORRESPONDENCE**

CONTENTS:

- Request for Comment Letters Sent
- Map Attachment to Request for Comment Letters
- Agency Comments and Correspondence

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## Request for Comment Letters Sent

TETRA TECH

February 10, 2014 TTEC –PTLD-2014-019

Central Stark & Western Soil Conservation District
Bonnie Twogood
District Manager
2948 4th Ave. West, Room C
Dickinson, ND 58601

**RE: Application to the North Dakota Public Service Commission for Certificate of Site Compatibility for the Sunflower Wind Energy Project in Stark and MortonCounties, North Dakota (Case No. PU-11-601)**

Dear District Manager Twogood,

Tetra Tech has been contracted by Sunflower Wind Project, LLC to prepare an application for a Certificate of Site Compatibility, in accordance with Section 49-22-07 NDCC. The proposed Sunflower Wind Energy Project (Project) would be constructed on approximately 12,700 acres of leased private property. The north side of Project area boundary is located along I-94, and is approximately 3 miles south of Hebron, North Dakota. As currently planned, the Project would have a generating capacity of approximately 110 megawatts (MW) and would consist of up to 59 wind turbine generators as well as access roads, electrical collection systems and cabling, an operation and maintenance (O&M) building, a substation, and an interconnection yard where the Project will interconnect to the U.S. Department of Energy (DOE) Western Area Power Administration (Western)'s Dickinson-Mandan 230 kilovolt (kV) transmission line. The proposed Project area shown in the attached figure is the primary focus of our investigation.

Per Section 69-06-01-05 of the North Dakota Public Service Commission (PSC)'s administrative rules, we are consulting the Central Stark & Western Soil Conservation District for assistance in identifying concerns or issues within the boundaries of the tracts listed below that would influence a decision regarding the use of the land, as well as applicable permits that may be required from your office. This information will be used to help guide Project development in a manner that identifies and avoids impacts to sensitive resources where practicable.

We have sent similar query letters to other federal and state agencies regarding this proposal. We would appreciate a response by March 10, 2014. Please contact me at Dale.Bennett@tetratech.com or (503) 221.8683 if you have any questions.

Respectfully submitted,

TETRA TECH, INC

Dale W Bennett

Dale Bennett

Senior Project Manager

Cc: Casey Willis, Sunflower Wind, LLC

Tracey Dubuque, P.E., Tetra Tech

TETRA TECH

February 10, 2014 TTEC –PTLD-2014-019

Federal Aviation Administration
Laurie Suttmeier
District Manager Officer
Bismarck Airports District Office, BIS-ADO-600
2301 University Drive, Building 23B
Bismarck, ND 58504

**RE: Application to the North Dakota Public Service Commission for Certificate of Site Compatibility for the Sunflower Wind Energy Project in Stark and MortonCounties, North Dakota**
**(Case No. PU-11-601)**

Dear District Manager Officer Suttmeier,

Tetra Tech has been contracted by Sunflower Wind Project, LLC to prepare an application for a Certificate of Site Compatibility, in accordance with Section 49-22-07 NDCC. The proposed Sunflower Wind Energy Project (Project) would be constructed on approximately 12,700 acres of leased private property. The north side of Project area boundary is located along I-94, and is approximately 3 miles south of Hebron, North Dakota. As currently planned, the Project would have a generating capacity of approximately 110 megawatts (MW) and would consist of up to 59 wind turbine generators as well as access roads, electrical collection systems and cabling, an operation and maintenance (O&M) building, a substation, and an interconnection yard where the Project will interconnect to the U.S. Department of Energy (DOE) Western Area Power Administration (Western)'s Dickinson-Mandan 230 kilovolt (kV) transmission line. The proposed Project area shown in the attached figure is the primary focus of our investigation.

Per Section 69-06-01-05 of the North Dakota Public Service Commission (PSC)'s administrative rules, we are consulting the Federal Aviation Administration for assistance in identifying concerns or issues within the boundaries of the tracts listed below that would influence a decision regarding the use of the land, as well as applicable permits that may be required from your office. This information will be used to help guide Project development in a manner that identifies and avoids impacts to sensitive resources where practicable.

We have sent similar query letters to other federal and state agencies regarding this proposal. We would appreciate a response by March 10, 2014. Please contact me at Dale.Bennett@tetratech.com or (503) 221.8683 if you have any questions.

Respectfully submitted,

TETRA TECH, INC

Dale W Bennett

Dale Bennett

Senior Project Manager

Cc: Casey Willis, Sunflower Wind, LLC
Tracey Dubuque, P.E., Tetra Tech

TETRA TECH

February 10, 2014 TTEC –PTLD-2014-019

Morton County Highway Department
Michael Aubol
County Engineer
2916 37th St. NW
Mandan, ND 58554

**RE: Application to the North Dakota Public Service Commission for Certificate of Site Compatibility for the Sunflower Wind Energy Project in Stark and MortonCounties, North Dakota**
**(Case No. PU-11-601)**

Dear County Engineer Aubol,

Tetra Tech has been contracted by Sunflower Wind Project, LLC to prepare an application for a Certificate of Site Compatibility, in accordance with Section 49-22-07 NDCC. The proposed Sunflower Wind Energy Project (Project) would be constructed on approximately 12,700 acres of leased private property. The north side of Project area boundary is located along I-94, and is approximately 3 miles south of Hebron, North Dakota. As currently planned, the Project would have a generating capacity of approximately 110 megawatts (MW) and would consist of up to 59 wind turbine generators as well as access roads, electrical collection systems and cabling, an operation and maintenance (O&M) building, a substation, and an interconnection yard where the Project will interconnect to the U.S. Department of Energy (DOE) Western Area Power Administration (Western)'s Dickinson-Mandan 230 kilovolt (kV) transmission line. The proposed Project area shown in the attached figure is the primary focus of our investigation.

Per Section 69-06-01-05 of the North Dakota Public Service Commission (PSC)'s administrative rules, we are consulting the Morton County Highway Department for assistance in identifying concerns or issues within the boundaries of the tracts listed below that would influence a decision regarding the use of the land, as well as applicable permits that may be required from your office. This information will be used to help guide Project development in a manner that identifies and avoids impacts to sensitive resources where practicable.

We have sent similar query letters to other federal and state agencies regarding this proposal. We would appreciate a response by March 10, 2014. Please contact me at Dale.Bennett@tetratech.com or (503) 221.8683 if you have any questions.

Tetra Tech, Inc.
1750 Harbor Way, Suite 400, Portland, OR 97201
Tel 503.221.8696 Fax 503.227.1287 www.tetratech.com

Respectfully submitted,

TETRA TECH, INC

Dale W Bennett

Dale Bennett

Senior Project Manager

Cc: Casey Willis, Sunflower Wind, LLC
Tracey Dubuque, P.E., Tetra Tech

TETRA TECH

February 10, 2014 TTEC –PTLD-2014-019

Morton County Planning Commission
c/o Daniel Nairn
Director of Planning & Zoning
2916 37th St. NW
Mandan, ND 58554

**RE: Application to the North Dakota Public Service Commission for Certificate of Site Compatibility for the Sunflower Wind Energy Project in Stark and MortonCounties, North Dakota**
**(Case No. PU-11-601)**

Dear Director of Planning & Zoning Nairn,

Tetra Tech has been contracted by Sunflower Wind Project, LLC to prepare an application for a Certificate of Site Compatibility, in accordance with Section 49-22-07 NDCC. The proposed Sunflower Wind Energy Project (Project) would be constructed on approximately 12,700 acres of leased private property. The north side of Project area boundary is located along I-94, and is approximately 3 miles south of Hebron, North Dakota. As currently planned, the Project would have a generating capacity of approximately 110 megawatts (MW) and would consist of up to 59 wind turbine generators as well as access roads, electrical collection systems and cabling, an operation and maintenance (O&M) building, a substation, and an interconnection yard where the Project will interconnect to the U.S. Department of Energy (DOE) Western Area Power Administration (Western)'s Dickinson-Mandan 230 kilovolt (kV) transmission line. The proposed Project area shown in the attached figure is the primary focus of our investigation.

Per Section 69-06-01-05 of the North Dakota Public Service Commission (PSC)'s administrative rules, we are consulting the Morton County Planning Commission for assistance in identifying concerns or issues within the boundaries of the tracts listed below that would influence a decision regarding the use of the land, as well as applicable permits that may be required from your office. This information will be used to help guide Project development in a manner that identifies and avoids impacts to sensitive resources where practicable.

We have sent similar query letters to other federal and state agencies regarding this proposal. We would appreciate a response by March 10, 2014. Please contact me at Dale.Bennett@tetratech.com or (503) 221.8683 if you have any questions.

Tetra Tech, Inc.
1750 Harbor Way, Suite 400, Portland, OR 97201
Tel 503.221.8696 Fax 503.227.1287 www.tetratech.com

Respectfully submitted,

TETRA TECH, INC

Dale W Bennett

Dale Bennett

Senior Project Manager

Cc: Casey Willis, Sunflower Wind, LLC
Tracey Dubuque, P.E., Tetra Tech

TETRA TECH

February 10, 2014 TTEC –PTLD-2014-019

Morton County Soil Conservation District
Jim Hophauf
District Board Chair
3360 58th St.
Flasher, ND 58535

**RE: Application to the North Dakota Public Service Commission for Certificate of Site Compatibility for the Sunflower Wind Energy Project in Stark and MortonCounties, North Dakota**
**(Case No. PU-11-601)**

Dear District Board Chair Hophauf,

Tetra Tech has been contracted by Sunflower Wind Project, LLC to prepare an application for a Certificate of Site Compatibility, in accordance with Section 49-22-07 NDCC. The proposed Sunflower Wind Energy Project (Project) would be constructed on approximately 12,700 acres of leased private property. The north side of Project area boundary is located along I-94, and is approximately 3 miles south of Hebron, North Dakota. As currently planned, the Project would have a generating capacity of approximately 110 megawatts (MW) and would consist of up to 59 wind turbine generators as well as access roads, electrical collection systems and cabling, an operation and maintenance (O&M) building, a substation, and an interconnection yard where the Project will interconnect to the U.S. Department of Energy (DOE) Western Area Power Administration (Western)'s Dickinson-Mandan 230 kilovolt (kV) transmission line. The proposed Project area shown in the attached figure is the primary focus of our investigation.

Per Section 69-06-01-05 of the North Dakota Public Service Commission (PSC)'s administrative rules, we are consulting the Morton County Soil Conservation District for assistance in identifying concerns or issues within the boundaries of the tracts listed below that would influence a decision regarding the use of the land, as well as applicable permits that may be required from your office. This information will be used to help guide Project development in a manner that identifies and avoids impacts to sensitive resources where practicable.

We have sent similar query letters to other federal and state agencies regarding this proposal. We would appreciate a response by March 10, 2014. Please contact me at Dale.Bennett@tetratech.com or (503) 221.8683 if you have any questions.

Respectfully submitted,

TETRA TECH, INC

Dale W Bennett

Dale Bennett

Senior Project Manager

Cc: Casey Willis, Sunflower Wind, LLC
Tracey Dubuque, P.E., Tetra Tech

TETRA TECH

February 10, 2014 TTEC –PTLD-2014-019

Natural Resources Conservation Service
Mary Podoll
State Conservationist
North Dakota State Office
220 East Rosser Ave, Federal Building, Rm 270
Bismarck, ND 58501

**RE: Application to the North Dakota Public Service Commission for Certificate of Site Compatibility for the Sunflower Wind Energy Project in Stark and MortonCounties, North Dakota**
**(Case No. PU-11-601)**

Dear State Conservationist Podoll,

Tetra Tech has been contracted by Sunflower Wind Project, LLC to prepare an application for a Certificate of Site Compatibility, in accordance with Section 49-22-07 NDCC. The proposed Sunflower Wind Energy Project (Project) would be constructed on approximately 12,700 acres of leased private property. The north side of Project area boundary is located along I-94, and is approximately 3 miles south of Hebron, North Dakota. As currently planned, the Project would have a generating capacity of approximately 110 megawatts (MW) and would consist of up to 59 wind turbine generators as well as access roads, electrical collection systems and cabling, an operation and maintenance (O&M) building, a substation, and an interconnection yard where the Project will interconnect to the U.S. Department of Energy (DOE) Western Area Power Administration (Western)'s Dickinson-Mandan 230 kilovolt (kV) transmission line. The proposed Project area shown in the attached figure is the primary focus of our investigation.

Per Section 69-06-01-05 of the North Dakota Public Service Commission (PSC)'s administrative rules, we are consulting the Natural Resources Conservation Service for assistance in identifying concerns or issues within the boundaries of the tracts listed below that would influence a decision regarding the use of the land, as well as applicable permits that may be required from your office. This information will be used to help guide Project development in a manner that identifies and avoids impacts to sensitive resources where practicable.

We have sent similar query letters to other federal and state agencies regarding this proposal. We would appreciate a response by March 10, 2014. Please contact me at Dale.Bennett@tetratech.com or (503) 221.8683 if you have any questions.

Tetra Tech, Inc.
1750 Harbor Way, Suite 400, Portland, OR 97201
Tel 503.221.8696 Fax 503.227.1287 www.tetratech.com

Respectfully submitted,

TETRA TECH, INC

Dale W Bennett

Dale Bennett

Senior Project Manager

Cc: Casey Willis, Sunflower Wind, LLC
Tracey Dubuque, P.E., Tetra Tech

TETRA TECH

February 10, 2014 TTEC –PTLD-2014-019

North Dakota Aeronautics Commission
Kyle Wanner
Interim Director & Aviation Planner
PO Box 5020
Bismarck, ND 58502

**RE: Application to the North Dakota Public Service Commission for Certificate of Site Compatibility for the Sunflower Wind Energy Project in Stark and MortonCounties, North Dakota**
**(Case No. PU-11-601)**

Dear Interim Director & Aviation Planner Wanner,

Tetra Tech has been contracted by Sunflower Wind Project, LLC to prepare an application for a Certificate of Site Compatibility, in accordance with Section 49-22-07 NDCC. The proposed Sunflower Wind Energy Project (Project) would be constructed on approximately 12,700 acres of leased private property. The north side of Project area boundary is located along I-94, and is approximately 3 miles south of Hebron, North Dakota. As currently planned, the Project would have a generating capacity of approximately 110 megawatts (MW) and would consist of up to 59 wind turbine generators as well as access roads, electrical collection systems and cabling, an operation and maintenance (O&M) building, a substation, and an interconnection yard where the Project will interconnect to the U.S. Department of Energy (DOE) Western Area Power Administration (Western)'s Dickinson-Mandan 230 kilovolt (kV) transmission line. The proposed Project area shown in the attached figure is the primary focus of our investigation.

Per Section 69-06-01-05 of the North Dakota Public Service Commission (PSC)'s administrative rules, we are consulting the North Dakota Aeronautics Commission for assistance in identifying concerns or issues within the boundaries of the tracts listed below that would influence a decision regarding the use of the land, as well as applicable permits that may be required from your office. This information will be used to help guide Project development in a manner that identifies and avoids impacts to sensitive resources where practicable.

We have sent similar query letters to other federal and state agencies regarding this proposal. We would appreciate a response by March 10, 2014. Please contact me at Dale.Bennett@tetratech.com or (503) 221.8683 if you have any questions.

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Respectfully submitted,

TETRA TECH, INC

Dale W Bennett

Dale Bennett

Senior Project Manager

Cc: Casey Willis, Sunflower Wind, LLC
Tracey Dubuque, P.E., Tetra Tech

February 10, 2014 TTEC –PTLD-2014-019

North Dakota Attorney General
Wayne Stenehjem
State Capitol
600 E. Boulevard Ave., Dept 125
Bismarck, ND 58505

**RE: Application to the North Dakota Public Service Commission for Certificate of Site Compatibility for the Sunflower Wind Energy Project in Stark and MortonCounties, North Dakota**
**(Case No. PU-11-601)**

Dear Stenehjem,

Tetra Tech has been contracted by Sunflower Wind Project, LLC to prepare an application for a Certificate of Site Compatibility, in accordance with Section 49-22-07 NDCC. The proposed Sunflower Wind Energy Project (Project) would be constructed on approximately 12,700 acres of leased private property. The north side of Project area boundary is located along I-94, and is approximately 3 miles south of Hebron, North Dakota. As currently planned, the Project would have a generating capacity of approximately 110 megawatts (MW) and would consist of up to 59 wind turbine generators as well as access roads, electrical collection systems and cabling, an operation and maintenance (O&M) building, a substation, and an interconnection yard where the Project will interconnect to the U.S. Department of Energy (DOE) Western Area Power Administration (Western)'s Dickinson-Mandan 230 kilovolt (kV) transmission line. The proposed Project area shown in the attached figure is the primary focus of our investigation.

Per Section 69-06-01-05 of the North Dakota Public Service Commission (PSC)'s administrative rules, we are consulting the North Dakota Attorney General for assistance in identifying concerns or issues within the boundaries of the tracts listed below that would influence a decision regarding the use of the land, as well as applicable permits that may be required from your office. This information will be used to help guide Project development in a manner that identifies and avoids impacts to sensitive resources where practicable.

We have sent similar query letters to other federal and state agencies regarding this proposal. We would appreciate a response by March 10, 2014. Please contact me at Dale.Bennett@tetratech.com or (503) 221.8683 if you have any questions.

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Respectfully submitted,

TETRA TECH, INC

Dale W Bennett

Dale Bennett

Senior Project Manager

Cc: Casey Willis, Sunflower Wind, LLC
Tracey Dubuque, P.E., Tetra Tech

February 10, 2014 TTEC –PTLD-2014-019

North Dakota Department of Agriculture
Doug Goehring
Agriculture Commissioner
600 East Boulevard Avenue, Dept 602
Bismarck, ND 58505

**RE: Application to the North Dakota Public Service Commission for Certificate of Site Compatibility for the Sunflower Wind Energy Project in Stark and MortonCounties, North Dakota**
**(Case No. PU-11-601)**

Dear Agriculture Commissioner Goehring,

Tetra Tech has been contracted by Sunflower Wind Project, LLC to prepare an application for a Certificate of Site Compatibility, in accordance with Section 49-22-07 NDCC. The proposed Sunflower Wind Energy Project (Project) would be constructed on approximately 12,700 acres of leased private property. The north side of Project area boundary is located along I-94, and is approximately 3 miles south of Hebron, North Dakota. As currently planned, the Project would have a generating capacity of approximately 110 megawatts (MW) and would consist of up to 59 wind turbine generators as well as access roads, electrical collection systems and cabling, an operation and maintenance (O&M) building, a substation, and an interconnection yard where the Project will interconnect to the U.S. Department of Energy (DOE) Western Area Power Administration (Western)'s Dickinson-Mandan 230 kilovolt (kV) transmission line. The proposed Project area shown in the attached figure is the primary focus of our investigation.

Per Section 69-06-01-05 of the North Dakota Public Service Commission (PSC)'s administrative rules, we are consulting the North Dakota Department of Agriculture for assistance in identifying concerns or issues within the boundaries of the tracts listed below that would influence a decision regarding the use of the land, as well as applicable permits that may be required from your office. This information will be used to help guide Project development in a manner that identifies and avoids impacts to sensitive resources where practicable.

We have sent similar query letters to other federal and state agencies regarding this proposal. We would appreciate a response by March 10, 2014. Please contact me at Dale.Bennett@tetratech.com or (503) 221.8683 if you have any questions.

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Respectfully submitted,

TETRA TECH, INC

Dale W Bennett

Dale Bennett

Senior Project Manager

Cc: Casey Willis, Sunflower Wind, LLC

Tracey Dubuque, P.E., Tetra Tech

TETRA TECH

February 10, 2014 TTEC –PTLD-2014-019

North Dakota Department of Career and Technical Education
Wayne Kutzer
Director and Executive Officer
State Capitol, 15th Floor
600 E. Boulevard Ave., Dept 270
Bismarck, ND 58505

**RE: Application to the North Dakota Public Service Commission for Certificate of Site Compatibility for the Sunflower Wind Energy Project in Stark and MortonCounties, North Dakota**
**(Case No. PU-11-601)**

Dear Director and Executive Officer Kutzer,

Tetra Tech has been contracted by Sunflower Wind Project, LLC to prepare an application for a Certificate of Site Compatibility, in accordance with Section 49-22-07 NDCC. The proposed Sunflower Wind Energy Project (Project) would be constructed on approximately 12,700 acres of leased private property. The north side of Project area boundary is located along I-94, and is approximately 3 miles south of Hebron, North Dakota. As currently planned, the Project would have a generating capacity of approximately 110 megawatts (MW) and would consist of up to 59 wind turbine generators as well as access roads, electrical collection systems and cabling, an operation and maintenance (O&M) building, a substation, and an interconnection yard where the Project will interconnect to the U.S. Department of Energy (DOE) Western Area Power Administration (Western)'s Dickinson-Mandan 230 kilovolt (kV) transmission line. The proposed Project area shown in the attached figure is the primary focus of our investigation.

Per Section 69-06-01-05 of the North Dakota Public Service Commission (PSC)'s administrative rules, we are consulting the North Dakota Department of Career and Technical Education for assistance in identifying concerns or issues within the boundaries of the tracts listed below that would influence a decision regarding the use of the land, as well as applicable permits that may be required from your office. This information will be used to help guide Project development in a manner that identifies and avoids impacts to sensitive resources where practicable.

We have sent similar query letters to other federal and state agencies regarding this proposal. We would appreciate a response by March 10, 2014. Please contact me at Dale.Bennett@tetratech.com or (503) 221.8683 if you have any questions.

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Respectfully submitted,

TETRA TECH, INC

Dale W Bennett

Dale Bennett

Senior Project Manager

Cc: Casey Willis, Sunflower Wind, LLC

Tracey Dubuque, P.E., Tetra Tech

TETRA TECH

February 10, 2014 TTEC –PTLD-2014-019

North Dakota Department of Commerce
Al Anderson
Commissioner
1600 E. Century Ave.
Bismarck, ND 58503

**RE: Application to the North Dakota Public Service Commission for Certificate of Site Compatibility for the Sunflower Wind Energy Project in Stark and MortonCounties, North Dakota
(Case No. PU-11-601)**

Dear Commissioner Anderson,

Tetra Tech has been contracted by Sunflower Wind Project, LLC to prepare an application for a Certificate of Site Compatibility, in accordance with Section 49-22-07 NDCC. The proposed Sunflower Wind Energy Project (Project) would be constructed on approximately 12,700 acres of leased private property. The north side of Project area boundary is located along I-94, and is approximately 3 miles south of Hebron, North Dakota. As currently planned, the Project would have a generating capacity of approximately 110 megawatts (MW) and would consist of up to 59 wind turbine generators as well as access roads, electrical collection systems and cabling, an operation and maintenance (O&M) building, a substation, and an interconnection yard where the Project will interconnect to the U.S. Department of Energy (DOE) Western Area Power Administration (Western)'s Dickinson-Mandan 230 kilovolt (kV) transmission line. The proposed Project area shown in the attached figure is the primary focus of our investigation.

Per Section 69-06-01-05 of the North Dakota Public Service Commission (PSC)'s administrative rules, we are consulting the North Dakota Department of Commerce for assistance in identifying concerns or issues within the boundaries of the tracts listed below that would influence a decision regarding the use of the land, as well as applicable permits that may be required from your office. This information will be used to help guide Project development in a manner that identifies and avoids impacts to sensitive resources where practicable.

We have sent similar query letters to other federal and state agencies regarding this proposal. We would appreciate a response by March 10, 2014. Please contact me at Dale.Bennett@tetratech.com or (503) 221.8683 if you have any questions.

Tetra Tech, Inc.
1750 Harbor Way, Suite 400, Portland, OR 97201
Tel 503.221.8696 Fax 503.227.1287 www.tetratech.com

Respectfully submitted,

TETRA TECH, INC

Dale W Bennett

Dale Bennett

Senior Project Manager

Cc: Casey Willis, Sunflower Wind, LLC
Tracey Dubuque, P.E., Tetra Tech

TETRA TECH

February 10, 2014 TTEC –PTLD-2014-019

North Dakota Department of Health
Terry Dwelle
State Health Officer
Gold Seal Center
918 E. Divide Ave.
Bismarck, ND 58501

**RE: Application to the North Dakota Public Service Commission for Certificate of Site Compatibility for the Sunflower Wind Energy Project in Stark and MortonCounties, North Dakota**
**(Case No. PU-11-601)**

Dear State Health Officer Dwelle,

Tetra Tech has been contracted by Sunflower Wind Project, LLC to prepare an application for a Certificate of Site Compatibility, in accordance with Section 49-22-07 NDCC. The proposed Sunflower Wind Energy Project (Project) would be constructed on approximately 12,700 acres of leased private property. The north side of Project area boundary is located along I-94, and is approximately 3 miles south of Hebron, North Dakota. As currently planned, the Project would have a generating capacity of approximately 110 megawatts (MW) and would consist of up to 59 wind turbine generators as well as access roads, electrical collection systems and cabling, an operation and maintenance (O&M) building, a substation, and an interconnection yard where the Project will interconnect to the U.S. Department of Energy (DOE) Western Area Power Administration (Western)'s Dickinson-Mandan 230 kilovolt (kV) transmission line. The proposed Project area shown in the attached figure is the primary focus of our investigation.

Per Section 69-06-01-05 of the North Dakota Public Service Commission (PSC)'s administrative rules, we are consulting the North Dakota Department of Health for assistance in identifying concerns or issues within the boundaries of the tracts listed below that would influence a decision regarding the use of the land, as well as applicable permits that may be required from your office. This information will be used to help guide Project development in a manner that identifies and avoids impacts to sensitive resources where practicable.

We have sent similar query letters to other federal and state agencies regarding this proposal. We would appreciate a response by March 10, 2014. Please contact me at Dale.Bennett@tetratech.com or (503) 221.8683 if you have any questions.

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Respectfully submitted,

TETRA TECH, INC

Dale W Bennett

Dale Bennett

Senior Project Manager

Cc: Casey Willis, Sunflower Wind, LLC
Tracey Dubuque, P.E., Tetra Tech

TETRA TECH

February 10, 2014 TTEC –PTLD-2014-019

North Dakota Department of Human Services
Maggie Anderson
Executive Director
600 E. Boulevard Ave., Dept 325
Bismarck, ND 58505

**RE: Application to the North Dakota Public Service Commission for Certificate of Site Compatibility for the Sunflower Wind Energy Project in Stark and MortonCounties, North Dakota**
**(Case No. PU-11-601)**

Dear Executive Director Anderson,

Tetra Tech has been contracted by Sunflower Wind Project, LLC to prepare an application for a Certificate of Site Compatibility, in accordance with Section 49-22-07 NDCC. The proposed Sunflower Wind Energy Project (Project) would be constructed on approximately 12,700 acres of leased private property. The north side of Project area boundary is located along I-94, and is approximately 3 miles south of Hebron, North Dakota. As currently planned, the Project would have a generating capacity of approximately 110 megawatts (MW) and would consist of up to 59 wind turbine generators as well as access roads, electrical collection systems and cabling, an operation and maintenance (O&M) building, a substation, and an interconnection yard where the Project will interconnect to the U.S. Department of Energy (DOE) Western Area Power Administration (Western)'s Dickinson-Mandan 230 kilovolt (kV) transmission line. The proposed Project area shown in the attached figure is the primary focus of our investigation.

Per Section 69-06-01-05 of the North Dakota Public Service Commission (PSC)'s administrative rules, we are consulting the North Dakota Department of Human Services for assistance in identifying concerns or issues within the boundaries of the tracts listed below that would influence a decision regarding the use of the land, as well as applicable permits that may be required from your office. This information will be used to help guide Project development in a manner that identifies and avoids impacts to sensitive resources where practicable.

We have sent similar query letters to other federal and state agencies regarding this proposal. We would appreciate a response by March 10, 2014. Please contact me at Dale.Bennett@tetratech.com or (503) 221.8683 if you have any questions.

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Tel 503.221.8696 Fax 503.227.1287 www.tetratech.com

Respectfully submitted,

TETRA TECH, INC

Dale W Bennett

Dale Bennett

Senior Project Manager

Cc: Casey Willis, Sunflower Wind, LLC
Tracey Dubuque, P.E., Tetra Tech

TETRA TECH

February 10, 2014 TTEC –PTLD-2014-019

North Dakota Department of Labor
Bonnie Storbakken
Commissioner of Labor
600 E. Boulevard Ave., Dept 406
Bismarck, ND 58505

**RE: Application to the North Dakota Public Service Commission for Certificate of Site Compatibility for the Sunflower Wind Energy Project in Stark and MortonCounties, North Dakota**
**(Case No. PU-11-601)**

Dear Commissioner of Labor Storbakken,

Tetra Tech has been contracted by Sunflower Wind Project, LLC to prepare an application for a Certificate of Site Compatibility, in accordance with Section 49-22-07 NDCC. The proposed Sunflower Wind Energy Project (Project) would be constructed on approximately 12,700 acres of leased private property. The north side of Project area boundary is located along I-94, and is approximately 3 miles south of Hebron, North Dakota. As currently planned, the Project would have a generating capacity of approximately 110 megawatts (MW) and would consist of up to 59 wind turbine generators as well as access roads, electrical collection systems and cabling, an operation and maintenance (O&M) building, a substation, and an interconnection yard where the Project will interconnect to the U.S. Department of Energy (DOE) Western Area Power Administration (Western)'s Dickinson-Mandan 230 kilovolt (kV) transmission line. The proposed Project area shown in the attached figure is the primary focus of our investigation.

Per Section 69-06-01-05 of the North Dakota Public Service Commission (PSC)'s administrative rules, we are consulting the North Dakota Department of Labor for assistance in identifying concerns or issues within the boundaries of the tracts listed below that would influence a decision regarding the use of the land, as well as applicable permits that may be required from your office. This information will be used to help guide Project development in a manner that identifies and avoids impacts to sensitive resources where practicable.

We have sent similar query letters to other federal and state agencies regarding this proposal. We would appreciate a response by March 10, 2014. Please contact me at Dale.Bennett@tetratech.com or (503) 221.8683 if you have any questions.

Tetra Tech, Inc.
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Tel 503.221.8696 Fax 503.227.1287 www.tetratech.com

Respectfully submitted,

TETRA TECH, INC

Dale W Bennett

Dale Bennett

Senior Project Manager

Cc: Casey Willis, Sunflower Wind, LLC
Tracey Dubuque, P.E., Tetra Tech

TETRA TECH

February 10, 2014 TTEC –PTLD-2014-019

North Dakota Department of Transportation
Kevin Levi
District Engineer
Bismarck District
218 South Airport Road
Bismarck, ND 58504

**RE: Application to the North Dakota Public Service Commission for Certificate of Site Compatibility for the Sunflower Wind Energy Project in Stark and MortonCounties, North Dakota**
**(Case No. PU-11-601)**

Dear District Engineer Levi,

Tetra Tech has been contracted by Sunflower Wind Project, LLC to prepare an application for a Certificate of Site Compatibility, in accordance with Section 49-22-07 NDCC. The proposed Sunflower Wind Energy Project (Project) would be constructed on approximately 12,700 acres of leased private property. The north side of Project area boundary is located along I-94, and is approximately 3 miles south of Hebron, North Dakota. As currently planned, the Project would have a generating capacity of approximately 110 megawatts (MW) and would consist of up to 59 wind turbine generators as well as access roads, electrical collection systems and cabling, an operation and maintenance (O&M) building, a substation, and an interconnection yard where the Project will interconnect to the U.S. Department of Energy (DOE) Western Area Power Administration (Western)'s Dickinson-Mandan 230 kilovolt (kV) transmission line. The proposed Project area shown in the attached figure is the primary focus of our investigation.

Per Section 69-06-01-05 of the North Dakota Public Service Commission (PSC)'s administrative rules, we are consulting the North Dakota Department of Transportation for assistance in identifying concerns or issues within the boundaries of the tracts listed below that would influence a decision regarding the use of the land, as well as applicable permits that may be required from your office. This information will be used to help guide Project development in a manner that identifies and avoids impacts to sensitive resources where practicable.

We have sent similar query letters to other federal and state agencies regarding this proposal. We would appreciate a response by March 10, 2014. Please contact me at Dale.Bennett@tetratech.com or (503) 221.8683 if you have any questions.

Tetra Tech, Inc.
1750 Harbor Way, Suite 400, Portland, OR 97201
Tel 503.221.8696 Fax 503.227.1287 www.tetratech.com

Respectfully submitted,

TETRA TECH, INC

Dale W Bennett

Dale Bennett

Senior Project Manager

Cc: Casey Willis, Sunflower Wind, LLC
Tracey Dubuque, P.E., Tetra Tech

TETRA TECH

February 10, 2014 TTEC –PTLD-2014-019

North Dakota Department of Transportation
Larry Gangl
District Engineer
Dickinson District
1700 Third Avenue West, Suite 101
Dickinson, ND 58601

**RE: Application to the North Dakota Public Service Commission for Certificate of Site Compatibility for the Sunflower Wind Energy Project in Stark and MortonCounties, North Dakota**
**(Case No. PU-11-601)**

Dear District Engineer Gangl,

Tetra Tech has been contracted by Sunflower Wind Project, LLC to prepare an application for a Certificate of Site Compatibility, in accordance with Section 49-22-07 NDCC. The proposed Sunflower Wind Energy Project (Project) would be constructed on approximately 12,700 acres of leased private property. The north side of Project area boundary is located along I-94, and is approximately 3 miles south of Hebron, North Dakota. As currently planned, the Project would have a generating capacity of approximately 110 megawatts (MW) and would consist of up to 59 wind turbine generators as well as access roads, electrical collection systems and cabling, an operation and maintenance (O&M) building, a substation, and an interconnection yard where the Project will interconnect to the U.S. Department of Energy (DOE) Western Area Power Administration (Western)'s Dickinson-Mandan 230 kilovolt (kV) transmission line. The proposed Project area shown in the attached figure is the primary focus of our investigation.

Per Section 69-06-01-05 of the North Dakota Public Service Commission (PSC)'s administrative rules, we are consulting the North Dakota Department of Transportation for assistance in identifying concerns or issues within the boundaries of the tracts listed below that would influence a decision regarding the use of the land, as well as applicable permits that may be required from your office. This information will be used to help guide Project development in a manner that identifies and avoids impacts to sensitive resources where practicable.

We have sent similar query letters to other federal and state agencies regarding this proposal. We would appreciate a response by March 10, 2014. Please contact me at Dale.Bennett@tetratech.com or (503) 221.8683 if you have any questions.

Tetra Tech, Inc.
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Tel 503.221.8696 Fax 503.227.1287 www.tetratech.com

Respectfully submitted,

TETRA TECH, INC

Dale W Bennett

Dale Bennett

Senior Project Manager

Cc: Casey Willis, Sunflower Wind, LLC
Tracey Dubuque, P.E., Tetra Tech

TETRA TECH

February 10, 2014 TTEC –PTLD-2014-019

North Dakota Energy Infrastructure and Impact Office
Gerry Fisher
Assistant Director
PO Box 5523
Bismarck, ND 58506

**RE: Application to the North Dakota Public Service Commission for Certificate of Site Compatibility for the Sunflower Wind Energy Project in Stark and MortonCounties, North Dakota**
**(Case No. PU-11-601)**

Dear Assistant Director Fisher,

Tetra Tech has been contracted by Sunflower Wind Project, LLC to prepare an application for a Certificate of Site Compatibility, in accordance with Section 49-22-07 NDCC. The proposed Sunflower Wind Energy Project (Project) would be constructed on approximately 12,700 acres of leased private property. The north side of Project area boundary is located along I-94, and is approximately 3 miles south of Hebron, North Dakota. As currently planned, the Project would have a generating capacity of approximately 110 megawatts (MW) and would consist of up to 59 wind turbine generators as well as access roads, electrical collection systems and cabling, an operation and maintenance (O&M) building, a substation, and an interconnection yard where the Project will interconnect to the U.S. Department of Energy (DOE) Western Area Power Administration (Western)'s Dickinson-Mandan 230 kilovolt (kV) transmission line. The proposed Project area shown in the attached figure is the primary focus of our investigation.

Per Section 69-06-01-05 of the North Dakota Public Service Commission (PSC)'s administrative rules, we are consulting the North Dakota Energy Infrastructure and Impact Office for assistance in identifying concerns or issues within the boundaries of the tracts listed below that would influence a decision regarding the use of the land, as well as applicable permits that may be required from your office. This information will be used to help guide Project development in a manner that identifies and avoids impacts to sensitive resources where practicable.

We have sent similar query letters to other federal and state agencies regarding this proposal. We would appreciate a response by March 10, 2014. Please contact me at Dale.Bennett@tetratech.com or (503) 221.8683 if you have any questions.

Tetra Tech, Inc.
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Respectfully submitted,

TETRA TECH, INC

Dale W Bennett

Dale Bennett

Senior Project Manager

Cc: Casey Willis, Sunflower Wind, LLC

Tracey Dubuque, P.E., Tetra Tech

TETRA TECH

February 10, 2014 TTEC –PTLD-2014-019

North Dakota Game and Fish Department
Terry Steinwand
Director
100 N. Bismarck Expressway
Bismarck, ND 58501

**RE: Application to the North Dakota Public Service Commission for Certificate of Site Compatibility for the Sunflower Wind Energy Project in Stark and MortonCounties, North Dakota**
**(Case No. PU-11-601)**

Dear Director Steinwand,

Tetra Tech has been contracted by Sunflower Wind Project, LLC to prepare an application for a Certificate of Site Compatibility, in accordance with Section 49-22-07 NDCC. The proposed Sunflower Wind Energy Project (Project) would be constructed on approximately 12,700 acres of leased private property. The north side of Project area boundary is located along I-94, and is approximately 3 miles south of Hebron, North Dakota. As currently planned, the Project would have a generating capacity of approximately 110 megawatts (MW) and would consist of up to 59 wind turbine generators as well as access roads, electrical collection systems and cabling, an operation and maintenance (O&M) building, a substation, and an interconnection yard where the Project will interconnect to the U.S. Department of Energy (DOE) Western Area Power Administration (Western)'s Dickinson-Mandan 230 kilovolt (kV) transmission line. The proposed Project area shown in the attached figure is the primary focus of our investigation.

Per Section 69-06-01-05 of the North Dakota Public Service Commission (PSC)'s administrative rules, we are consulting the North Dakota Game and Fish Department for assistance in identifying concerns or issues within the boundaries of the tracts listed below that would influence a decision regarding the use of the land, as well as applicable permits that may be required from your office. This information will be used to help guide Project development in a manner that identifies and avoids impacts to sensitive resources where practicable.

We have sent similar query letters to other federal and state agencies regarding this proposal. We would appreciate a response by March 10, 2014. Please contact me at Dale.Bennett@tetratech.com or (503) 221.8683 if you have any questions.

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Respectfully submitted,

TETRA TECH, INC

Dale W Bennett

Dale Bennett

Senior Project Manager

Cc: Casey Willis, Sunflower Wind, LLC

Tracey Dubuque, P.E., Tetra Tech

TETRA TECH

February 10, 2014 TTEC –PTLD-2014-019

North Dakota Geologic Survey
Edward Murphy
State Geologist
600 East Boulevard Avenue
Bismarck, ND 58505

**RE: Application to the North Dakota Public Service Commission for Certificate of Site Compatibility for the Sunflower Wind Energy Project in Stark and MortonCounties, North Dakota**
**(Case No. PU-11-601)**

Dear State Geologist Murphy,

Tetra Tech has been contracted by Sunflower Wind Project, LLC to prepare an application for a Certificate of Site Compatibility, in accordance with Section 49-22-07 NDCC. The proposed Sunflower Wind Energy Project (Project) would be constructed on approximately 12,700 acres of leased private property. The north side of Project area boundary is located along I-94, and is approximately 3 miles south of Hebron, North Dakota. As currently planned, the Project would have a generating capacity of approximately 110 megawatts (MW) and would consist of up to 59 wind turbine generators as well as access roads, electrical collection systems and cabling, an operation and maintenance (O&M) building, a substation, and an interconnection yard where the Project will interconnect to the U.S. Department of Energy (DOE) Western Area Power Administration (Western)'s Dickinson-Mandan 230 kilovolt (kV) transmission line. The proposed Project area shown in the attached figure is the primary focus of our investigation.

Per Section 69-06-01-05 of the North Dakota Public Service Commission (PSC)'s administrative rules, we are consulting the North Dakota Geologic Survey for assistance in identifying concerns or issues within the boundaries of the tracts listed below that would influence a decision regarding the use of the land, as well as applicable permits that may be required from your office. This information will be used to help guide Project development in a manner that identifies and avoids impacts to sensitive resources where practicable.

We have sent similar query letters to other federal and state agencies regarding this proposal. We would appreciate a response by March 10, 2014. Please contact me at Dale.Bennett@tetratech.com or (503) 221.8683 if you have any questions.

Tetra Tech, Inc.
1750 Harbor Way, Suite 400, Portland, OR 97201
Tel 503.221.8696 Fax 503.227.1287 www.tetratech.com

Respectfully submitted,

TETRA TECH, INC

Dale W Bennett

Dale Bennett

Senior Project Manager

Cc: Casey Willis, Sunflower Wind, LLC
Tracey Dubuque, P.E., Tetra Tech

TETRA TECH

February 10, 2014 TTEC –PTLD-2014-019

North Dakota Indian Affairs Commission
Scott Davis
Executive Director
600 East Boulevard Avenue
1st Floor Judicial Wing, Rm 117
Bismarck, ND 58505

**RE: Application to the North Dakota Public Service Commission for Certificate of Site Compatibility for the Sunflower Wind Energy Project in Stark and MortonCounties, North Dakota
(Case No. PU-11-601)**

Dear Executive Director Davis,

Tetra Tech has been contracted by Sunflower Wind Project, LLC to prepare an application for a Certificate of Site Compatibility, in accordance with Section 49-22-07 NDCC. The proposed Sunflower Wind Energy Project (Project) would be constructed on approximately 12,700 acres of leased private property. The north side of Project area boundary is located along I-94, and is approximately 3 miles south of Hebron, North Dakota. As currently planned, the Project would have a generating capacity of approximately 110 megawatts (MW) and would consist of up to 59 wind turbine generators as well as access roads, electrical collection systems and cabling, an operation and maintenance (O&M) building, a substation, and an interconnection yard where the Project will interconnect to the U.S. Department of Energy (DOE) Western Area Power Administration (Western)'s Dickinson-Mandan 230 kilovolt (kV) transmission line. The proposed Project area shown in the attached figure is the primary focus of our investigation.

Per Section 69-06-01-05 of the North Dakota Public Service Commission (PSC)'s administrative rules, we are consulting the North Dakota Indian Affairs Commission for assistance in identifying concerns or issues within the boundaries of the tracts listed below that would influence a decision regarding the use of the land, as well as applicable permits that may be required from your office. This information will be used to help guide Project development in a manner that identifies and avoids impacts to sensitive resources where practicable.

We have sent similar query letters to other federal and state agencies regarding this proposal. We would appreciate a response by March 10, 2014. Please contact me at Dale.Bennett@tetratech.com or (503) 221.8683 if you have any questions.

Respectfully submitted,

TETRA TECH, INC

Dale W Bennett

Dale Bennett

Senior Project Manager

Cc: Casey Willis, Sunflower Wind, LLC
Tracey Dubuque, P.E., Tetra Tech

February 10, 2014 TTEC –PTLD-2014-019

North Dakota Industrial Commission, Renewable Energy Program
Karlene Fine
Industrial Commissioner
State Capitol, 14th Floor
600 E. Boulevard Ave., Dept 405
Bismarck, ND 58505

**RE: Application to the North Dakota Public Service Commission for Certificate of Site Compatibility for the Sunflower Wind Energy Project in Stark and MortonCounties, North Dakota**
**(Case No. PU-11-601)**

Dear Industrial Commissioner Fine,

Tetra Tech has been contracted by Sunflower Wind Project, LLC to prepare an application for a Certificate of Site Compatibility, in accordance with Section 49-22-07 NDCC. The proposed Sunflower Wind Energy Project (Project) would be constructed on approximately 12,700 acres of leased private property. The north side of Project area boundary is located along I-94, and is approximately 3 miles south of Hebron, North Dakota. As currently planned, the Project would have a generating capacity of approximately 110 megawatts (MW) and would consist of up to 59 wind turbine generators as well as access roads, electrical collection systems and cabling, an operation and maintenance (O&M) building, a substation, and an interconnection yard where the Project will interconnect to the U.S. Department of Energy (DOE) Western Area Power Administration (Western)'s Dickinson-Mandan 230 kilovolt (kV) transmission line. The proposed Project area shown in the attached figure is the primary focus of our investigation.

Per Section 69-06-01-05 of the North Dakota Public Service Commission (PSC)'s administrative rules, we are consulting the North Dakota Industrial Commission, Renewable Energy Program for assistance in identifying concerns or issues within the boundaries of the tracts listed below that would influence a decision regarding the use of the land, as well as applicable permits that may be required from your office. This information will be used to help guide Project development in a manner that identifies and avoids impacts to sensitive resources where practicable.

We have sent similar query letters to other federal and state agencies regarding this proposal. We would appreciate a response by March 10, 2014. Please contact me at Dale.Bennett@tetratech.com or (503) 221.8683 if you have any questions.

Respectfully submitted,

TETRA TECH, INC

Dale W Bennett

Dale Bennett

Senior Project Manager

Cc: Casey Willis, Sunflower Wind, LLC
Tracey Dubuque, P.E., Tetra Tech

TETRA TECH

February 10, 2014 TTEC –PTLD-2014-019

North Dakota Office of Management & Budget
Pam Sharp
Director
600 E. Boulevard Ave., Dept 110
Bismarck, ND 58505

**RE: Application to the North Dakota Public Service Commission for Certificate of Site Compatibility for the Sunflower Wind Energy Project in Stark and MortonCounties, North Dakota**
**(Case No. PU-11-601)**

Dear Director Sharp,

Tetra Tech has been contracted by Sunflower Wind Project, LLC to prepare an application for a Certificate of Site Compatibility, in accordance with Section 49-22-07 NDCC. The proposed Sunflower Wind Energy Project (Project) would be constructed on approximately 12,700 acres of leased private property. The north side of Project area boundary is located along I-94, and is approximately 3 miles south of Hebron, North Dakota. As currently planned, the Project would have a generating capacity of approximately 110 megawatts (MW) and would consist of up to 59 wind turbine generators as well as access roads, electrical collection systems and cabling, an operation and maintenance (O&M) building, a substation, and an interconnection yard where the Project will interconnect to the U.S. Department of Energy (DOE) Western Area Power Administration (Western)'s Dickinson-Mandan 230 kilovolt (kV) transmission line. The proposed Project area shown in the attached figure is the primary focus of our investigation.

Per Section 69-06-01-05 of the North Dakota Public Service Commission (PSC)'s administrative rules, we are consulting the North Dakota Office of Management & Budget for assistance in identifying concerns or issues within the boundaries of the tracts listed below that would influence a decision regarding the use of the land, as well as applicable permits that may be required from your office. This information will be used to help guide Project development in a manner that identifies and avoids impacts to sensitive resources where practicable.

We have sent similar query letters to other federal and state agencies regarding this proposal. We would appreciate a response by March 10, 2014. Please contact me at Dale.Bennett@tetratech.com or (503) 221.8683 if you have any questions.

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Respectfully submitted,

TETRA TECH, INC

Dale W Bennett

Dale Bennett

Senior Project Manager

Cc: Casey Willis, Sunflower Wind, LLC
Tracey Dubuque, P.E., Tetra Tech

TETRA TECH

February 10, 2014 TTEC –PTLD-2014-019

North Dakota Parks and Recreation Department
Mark Zimmerman
Director
1600 E. Century Ave, Suite 3
Bismarck, ND 58503

**RE: Application to the North Dakota Public Service Commission for Certificate of Site Compatibility for the Sunflower Wind Energy Project in Stark and MortonCounties, North Dakota (Case No. PU-11-601)**

Dear Director Zimmerman,

Tetra Tech has been contracted by Sunflower Wind Project, LLC to prepare an application for a Certificate of Site Compatibility, in accordance with Section 49-22-07 NDCC. The proposed Sunflower Wind Energy Project (Project) would be constructed on approximately 12,700 acres of leased private property. The north side of Project area boundary is located along I-94, and is approximately 3 miles south of Hebron, North Dakota. As currently planned, the Project would have a generating capacity of approximately 110 megawatts (MW) and would consist of up to 59 wind turbine generators as well as access roads, electrical collection systems and cabling, an operation and maintenance (O&M) building, a substation, and an interconnection yard where the Project will interconnect to the U.S. Department of Energy (DOE) Western Area Power Administration (Western)'s Dickinson-Mandan 230 kilovolt (kV) transmission line. The proposed Project area shown in the attached figure is the primary focus of our investigation.

Per Section 69-06-01-05 of the North Dakota Public Service Commission (PSC)'s administrative rules, we are consulting the North Dakota Parks and Recreation Department for assistance in identifying concerns or issues within the boundaries of the tracts listed below that would influence a decision regarding the use of the land, as well as applicable permits that may be required from your office. This information will be used to help guide Project development in a manner that identifies and avoids impacts to sensitive resources where practicable.

We have sent similar query letters to other federal and state agencies regarding this proposal. We would appreciate a response by March 10, 2014. Please contact me at Dale.Bennett@tetratech.com or (503) 221.8683 if you have any questions.

Respectfully submitted,

TETRA TECH, INC

Dale W Bennett

Dale Bennett

Senior Project Manager

Cc: Casey Willis, Sunflower Wind, LLC

Tracey Dubuque, P.E., Tetra Tech

TETRA TECH

February 10, 2014 TTEC –PTLD-2014-019

North Dakota Soild Conservation Committee
Scott Hochhalter
State Soil Specialist
NDSU Extension Service
2718 Gateway Ave., Ste 104
Bismarck, ND 58503

**RE: Application to the North Dakota Public Service Commission for Certificate of Site Compatibility for the Sunflower Wind Energy Project in Stark and MortonCounties, North Dakota**
**(Case No. PU-11-601)**

Dear State Soil Specialist Hochhalter,

Tetra Tech has been contracted by Sunflower Wind Project, LLC to prepare an application for a Certificate of Site Compatibility, in accordance with Section 49-22-07 NDCC. The proposed Sunflower Wind Energy Project (Project) would be constructed on approximately 12,700 acres of leased private property. The north side of Project area boundary is located along I-94, and is approximately 3 miles south of Hebron, North Dakota. As currently planned, the Project would have a generating capacity of approximately 110 megawatts (MW) and would consist of up to 59 wind turbine generators as well as access roads, electrical collection systems and cabling, an operation and maintenance (O&M) building, a substation, and an interconnection yard where the Project will interconnect to the U.S. Department of Energy (DOE) Western Area Power Administration (Western)'s Dickinson-Mandan 230 kilovolt (kV) transmission line. The proposed Project area shown in the attached figure is the primary focus of our investigation.

Per Section 69-06-01-05 of the North Dakota Public Service Commission (PSC)'s administrative rules, we are consulting the North Dakota Soild Conservation Committee for assistance in identifying concerns or issues within the boundaries of the tracts listed below that would influence a decision regarding the use of the land, as well as applicable permits that may be required from your office. This information will be used to help guide Project development in a manner that identifies and avoids impacts to sensitive resources where practicable.

We have sent similar query letters to other federal and state agencies regarding this proposal. We would appreciate a response by March 10, 2014. Please contact me at Dale.Bennett@tetratech.com or (503) 221.8683 if you have any questions.

Tetra Tech, Inc.
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Respectfully submitted,

TETRA TECH, INC

Dale W Bennett

Dale Bennett

Senior Project Manager

Cc: Casey Willis, Sunflower Wind, LLC

Tracey Dubuque, P.E., Tetra Tech

February 10, 2014 TTEC –PTLD-2014-019

North Dakota State Historic Preservation Office
Fern Swenson
Deputy State Historic Preservation Officer
612 East Boulevard Ave.
Bismarck, ND 58505

**RE: Application to the North Dakota Public Service Commission for Certificate of Site Compatibility for the Sunflower Wind Energy Project in Stark and MortonCounties, North Dakota**
**(Case No. PU-11-601)**

Dear Deputy State Historic Preservation Officer Swenson,

Tetra Tech has been contracted by Sunflower Wind Project, LLC to prepare an application for a Certificate of Site Compatibility, in accordance with Section 49-22-07 NDCC. The proposed Sunflower Wind Energy Project (Project) would be constructed on approximately 12,700 acres of leased private property. The north side of Project area boundary is located along I-94, and is approximately 3 miles south of Hebron, North Dakota. As currently planned, the Project would have a generating capacity of approximately 110 megawatts (MW) and would consist of up to 59 wind turbine generators as well as access roads, electrical collection systems and cabling, an operation and maintenance (O&M) building, a substation, and an interconnection yard where the Project will interconnect to the U.S. Department of Energy (DOE) Western Area Power Administration (Western)'s Dickinson-Mandan 230 kilovolt (kV) transmission line. The proposed Project area shown in the attached figure is the primary focus of our investigation.

Per Section 69-06-01-05 of the North Dakota Public Service Commission (PSC)'s administrative rules, we are consulting the North Dakota State Historic Preservation Office for assistance in identifying concerns or issues within the boundaries of the tracts listed below that would influence a decision regarding the use of the land, as well as applicable permits that may be required from your office. This information will be used to help guide Project development in a manner that identifies and avoids impacts to sensitive resources where practicable.

We have sent similar query letters to other federal and state agencies regarding this proposal. We would appreciate a response by March 10, 2014. Please contact me at Dale.Bennett@tetratech.com or (503) 221.8683 if you have any questions.

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Respectfully submitted,

TETRA TECH, INC

Dale W Bennett

Dale Bennett

Senior Project Manager

Cc: Casey Willis, Sunflower Wind, LLC
Tracey Dubuque, P.E., Tetra Tech

February 10, 2014 TTEC –PTLD-2014-019

North Dakota State Land Department
Lance Gaebe
Land Commissioner
1707 North 9th Street
PO Box 5523
Bismarck, ND 58506

**RE: Application to the North Dakota Public Service Commission for Certificate of Site Compatibility for the Sunflower Wind Energy Project in Stark and MortonCounties, North Dakota**
**(Case No. PU-11-601)**

Dear Land Commissioner Gaebe,

Tetra Tech has been contracted by Sunflower Wind Project, LLC to prepare an application for a Certificate of Site Compatibility, in accordance with Section 49-22-07 NDCC. The proposed Sunflower Wind Energy Project (Project) would be constructed on approximately 12,700 acres of leased private property. The north side of Project area boundary is located along I-94, and is approximately 3 miles south of Hebron, North Dakota. As currently planned, the Project would have a generating capacity of approximately 110 megawatts (MW) and would consist of up to 59 wind turbine generators as well as access roads, electrical collection systems and cabling, an operation and maintenance (O&M) building, a substation, and an interconnection yard where the Project will interconnect to the U.S. Department of Energy (DOE) Western Area Power Administration (Western)'s Dickinson-Mandan 230 kilovolt (kV) transmission line. The proposed Project area shown in the attached figure is the primary focus of our investigation.

Per Section 69-06-01-05 of the North Dakota Public Service Commission (PSC)'s administrative rules, we are consulting the North Dakota State Land Department for assistance in identifying concerns or issues within the boundaries of the tracts listed below that would influence a decision regarding the use of the land, as well as applicable permits that may be required from your office. This information will be used to help guide Project development in a manner that identifies and avoids impacts to sensitive resources where practicable.

We have sent similar query letters to other federal and state agencies regarding this proposal. We would appreciate a response by March 10, 2014. Please contact me at Dale.Bennett@tetratech.com or (503) 221.8683 if you have any questions.

Respectfully submitted,

TETRA TECH, INC

Dale W Bennett

Dale Bennett

Senior Project Manager

Cc: Casey Willis, Sunflower Wind, LLC

Tracey Dubuque, P.E., Tetra Tech

February 10, 2014 TTEC –PTLD-2014-019

North Dakota State Water Commission
Todd Sando
State Engineer
900 E. Boulevard Ave., Dept 770
Bismarck, ND 58505

**RE: Application to the North Dakota Public Service Commission for Certificate of Site Compatibility for the Sunflower Wind Energy Project in Stark and MortonCounties, North Dakota**
**(Case No. PU-11-601)**

Dear State Engineer Sando,

Tetra Tech has been contracted by Sunflower Wind Project, LLC to prepare an application for a Certificate of Site Compatibility, in accordance with Section 49-22-07 NDCC. The proposed Sunflower Wind Energy Project (Project) would be constructed on approximately 12,700 acres of leased private property. The north side of Project area boundary is located along I-94, and is approximately 3 miles south of Hebron, North Dakota. As currently planned, the Project would have a generating capacity of approximately 110 megawatts (MW) and would consist of up to 59 wind turbine generators as well as access roads, electrical collection systems and cabling, an operation and maintenance (O&M) building, a substation, and an interconnection yard where the Project will interconnect to the U.S. Department of Energy (DOE) Western Area Power Administration (Western)'s Dickinson-Mandan 230 kilovolt (kV) transmission line. The proposed Project area shown in the attached figure is the primary focus of our investigation.

Per Section 69-06-01-05 of the North Dakota Public Service Commission (PSC)'s administrative rules, we are consulting the North Dakota State Water Commission for assistance in identifying concerns or issues within the boundaries of the tracts listed below that would influence a decision regarding the use of the land, as well as applicable permits that may be required from your office. This information will be used to help guide Project development in a manner that identifies and avoids impacts to sensitive resources where practicable.

We have sent similar query letters to other federal and state agencies regarding this proposal. We would appreciate a response by March 10, 2014. Please contact me at Dale.Bennett@tetratech.com or (503) 221.8683 if you have any questions.

Tetra Tech, Inc.
1750 Harbor Way, Suite 400, Portland, OR 97201
Tel 503.221.8696 Fax 503.227.1287 www.tetratech.com

Respectfully submitted,

TETRA TECH, INC

Dale W Bennett

Dale Bennett

Senior Project Manager

Cc: Casey Willis, Sunflower Wind, LLC
Tracey Dubuque, P.E., Tetra Tech

February 10, 2014 TTEC –PTLD-2014-019

Office of the Governor
Jack Dalrymple
Governor
600 East Boulevard Avenue
Bismarck, ND 58505

**RE: Application to the North Dakota Public Service Commission for Certificate of Site Compatibility for the Sunflower Wind Energy Project in Stark and MortonCounties, North Dakota**
**(Case No. PU-11-601)**

Dear Governor Dalrymple,

Tetra Tech has been contracted by Sunflower Wind Project, LLC to prepare an application for a Certificate of Site Compatibility, in accordance with Section 49-22-07 NDCC. The proposed Sunflower Wind Energy Project (Project) would be constructed on approximately 12,700 acres of leased private property. The north side of Project area boundary is located along I-94, and is approximately 3 miles south of Hebron, North Dakota. As currently planned, the Project would have a generating capacity of approximately 110 megawatts (MW) and would consist of up to 59 wind turbine generators as well as access roads, electrical collection systems and cabling, an operation and maintenance (O&M) building, a substation, and an interconnection yard where the Project will interconnect to the U.S. Department of Energy (DOE) Western Area Power Administration (Western)'s Dickinson-Mandan 230 kilovolt (kV) transmission line. The proposed Project area shown in the attached figure is the primary focus of our investigation.

Per Section 69-06-01-05 of the North Dakota Public Service Commission (PSC)'s administrative rules, we are consulting the Office of the Governor for assistance in identifying concerns or issues within the boundaries of the tracts listed below that would influence a decision regarding the use of the land, as well as applicable permits that may be required from your office. This information will be used to help guide Project development in a manner that identifies and avoids impacts to sensitive resources where practicable.

We have sent similar query letters to other federal and state agencies regarding this proposal. We would appreciate a response by March 10, 2014. Please contact me at Dale.Bennett@tetratech.com or (503) 221.8683 if you have any questions.

Tetra Tech, Inc.
1750 Harbor Way, Suite 400, Portland, OR 97201
Tel 503.221.8696 Fax 503.227.1287 www.tetratech.com

Respectfully submitted,

TETRA TECH, INC

Dale W Bennett

Dale Bennett

Senior Project Manager

Cc: Casey Willis, Sunflower Wind, LLC
Tracey Dubuque, P.E., Tetra Tech

TETRA TECH

February 10, 2014 TTEC –PTLD-2014-019

Stark County Planning Commission
c/o Steven Josephson
Director of Planning
Stark County Courthouse
PO Box 130
Dickinson, ND 58601

**RE: Application to the North Dakota Public Service Commission for Certificate of Site Compatibility for the Sunflower Wind Energy Project in Stark and MortonCounties, North Dakota**
**(Case No. PU-11-601)**

Dear Director of Planning Josephson,

Tetra Tech has been contracted by Sunflower Wind Project, LLC to prepare an application for a Certificate of Site Compatibility, in accordance with Section 49-22-07 NDCC. The proposed Sunflower Wind Energy Project (Project) would be constructed on approximately 12,700 acres of leased private property. The north side of Project area boundary is located along I-94, and is approximately 3 miles south of Hebron, North Dakota. As currently planned, the Project would have a generating capacity of approximately 110 megawatts (MW) and would consist of up to 59 wind turbine generators as well as access roads, electrical collection systems and cabling, an operation and maintenance (O&M) building, a substation, and an interconnection yard where the Project will interconnect to the U.S. Department of Energy (DOE) Western Area Power Administration (Western)'s Dickinson-Mandan 230 kilovolt (kV) transmission line. The proposed Project area shown in the attached figure is the primary focus of our investigation.

Per Section 69-06-01-05 of the North Dakota Public Service Commission (PSC)'s administrative rules, we are consulting the Stark County Planning Commission for assistance in identifying concerns or issues within the boundaries of the tracts listed below that would influence a decision regarding the use of the land, as well as applicable permits that may be required from your office. This information will be used to help guide Project development in a manner that identifies and avoids impacts to sensitive resources where practicable.

We have sent similar query letters to other federal and state agencies regarding this proposal. We would appreciate a response by March 10, 2014. Please contact me at Dale.Bennett@tetratech.com or (503) 221.8683 if you have any questions.

Tetra Tech, Inc.
1750 Harbor Way, Suite 400, Portland, OR 97201
Tel 503.221.8696 Fax 503.227.1287 www.tetratech.com

Respectfully submitted,

TETRA TECH, INC

Dale W Bennett

Dale Bennett

Senior Project Manager

Cc: Casey Willis, Sunflower Wind, LLC
Tracey Dubuque, P.E., Tetra Tech

February 10, 2014 TTEC –PTLD-2014-019

Stark County Road Department
Al Heiser
Road Superintendent
Stark County Courthouse
PO Box 130
Dickinson, ND 58602

**RE: Application to the North Dakota Public Service Commission for Certificate of Site Compatibility for the Sunflower Wind Energy Project in Stark and MortonCounties, North Dakota**
**(Case No. PU-11-601)**

Dear Road Superintendent Heiser,

Tetra Tech has been contracted by Sunflower Wind Project, LLC to prepare an application for a Certificate of Site Compatibility, in accordance with Section 49-22-07 NDCC. The proposed Sunflower Wind Energy Project (Project) would be constructed on approximately 12,700 acres of leased private property. The north side of Project area boundary is located along I-94, and is approximately 3 miles south of Hebron, North Dakota. As currently planned, the Project would have a generating capacity of approximately 110 megawatts (MW) and would consist of up to 59 wind turbine generators as well as access roads, electrical collection systems and cabling, an operation and maintenance (O&M) building, a substation, and an interconnection yard where the Project will interconnect to the U.S. Department of Energy (DOE) Western Area Power Administration (Western)'s Dickinson-Mandan 230 kilovolt (kV) transmission line. The proposed Project area shown in the attached figure is the primary focus of our investigation.

Per Section 69-06-01-05 of the North Dakota Public Service Commission (PSC)'s administrative rules, we are consulting the Stark County Road Department for assistance in identifying concerns or issues within the boundaries of the tracts listed below that would influence a decision regarding the use of the land, as well as applicable permits that may be required from your office. This information will be used to help guide Project development in a manner that identifies and avoids impacts to sensitive resources where practicable.

We have sent similar query letters to other federal and state agencies regarding this proposal. We would appreciate a response by March 10, 2014. Please contact me at Dale.Bennett@tetratech.com or (503) 221.8683 if you have any questions.

Respectfully submitted,

TETRA TECH, INC

Dale W Bennett

Dale Bennett

Senior Project Manager

Cc: Casey Willis, Sunflower Wind, LLC
Tracey Dubuque, P.E., Tetra Tech

TETRA TECH

February 10, 2014 TTEC –PTLD-2014-019

State Historic Society of North Dakota
Merlan Paaverud, Jr.
Director
State Historic Preservation Office
612 East Bouleavard Avenue
Bismarck, ND 58505

**RE: Application to the North Dakota Public Service Commission for Certificate of Site Compatibility for the Sunflower Wind Energy Project in Stark and MortonCounties, North Dakota**
**(Case No. PU-11-601)**

Dear Director Paaverud, Jr.,

Tetra Tech has been contracted by Sunflower Wind Project, LLC to prepare an application for a Certificate of Site Compatibility, in accordance with Section 49-22-07 NDCC. The proposed Sunflower Wind Energy Project (Project) would be constructed on approximately 12,700 acres of leased private property. The north side of Project area boundary is located along I-94, and is approximately 3 miles south of Hebron, North Dakota. As currently planned, the Project would have a generating capacity of approximately 110 megawatts (MW) and would consist of up to 59 wind turbine generators as well as access roads, electrical collection systems and cabling, an operation and maintenance (O&M) building, a substation, and an interconnection yard where the Project will interconnect to the U.S. Department of Energy (DOE) Western Area Power Administration (Western)'s Dickinson-Mandan 230 kilovolt (kV) transmission line. The proposed Project area shown in the attached figure is the primary focus of our investigation.

Per Section 69-06-01-05 of the North Dakota Public Service Commission (PSC)'s administrative rules, we are consulting the State Historic Society of North Dakota for assistance in identifying concerns or issues within the boundaries of the tracts listed below that would influence a decision regarding the use of the land, as well as applicable permits that may be required from your office. This information will be used to help guide Project development in a manner that identifies and avoids impacts to sensitive resources where practicable.

We have sent similar query letters to other federal and state agencies regarding this proposal. We would appreciate a response by March 10, 2014. Please contact me at Dale.Bennett@tetratech.com or (503) 221.8683 if you have any questions.

Respectfully submitted,

TETRA TECH, INC

Dale W Bennett

Dale Bennett

Senior Project Manager

Cc: Casey Willis, Sunflower Wind, LLC
Tracey Dubuque, P.E., Tetra Tech

TETRA TECH

February 10, 2014 TTEC –PTLD-2014-019

U.S. Army Corps of Engineers, Omaha District
Daniel Cimarosti
Regulatory Program Manager
ND Regulatory Office
1513 South 12th Street
Bismarck, ND 58504

**RE: Application to the North Dakota Public Service Commission for Certificate of Site Compatibility for the Sunflower Wind Energy Project in Stark and MortonCounties, North Dakota**
**(Case No. PU-11-601)**

Dear Regulatory Program Manager Cimarosti,

Tetra Tech has been contracted by Sunflower Wind Project, LLC to prepare an application for a Certificate of Site Compatibility, in accordance with Section 49-22-07 NDCC. The proposed Sunflower Wind Energy Project (Project) would be constructed on approximately 12,700 acres of leased private property. The north side of Project area boundary is located along I-94, and is approximately 3 miles south of Hebron, North Dakota. As currently planned, the Project would have a generating capacity of approximately 110 megawatts (MW) and would consist of up to 59 wind turbine generators as well as access roads, electrical collection systems and cabling, an operation and maintenance (O&M) building, a substation, and an interconnection yard where the Project will interconnect to the U.S. Department of Energy (DOE) Western Area Power Administration (Western)'s Dickinson-Mandan 230 kilovolt (kV) transmission line. The proposed Project area shown in the attached figure is the primary focus of our investigation.

Per Section 69-06-01-05 of the North Dakota Public Service Commission (PSC)'s administrative rules, we are consulting the U.S. Army Corps of Engineers, Omaha District for assistance in identifying concerns or issues within the boundaries of the tracts listed below that would influence a decision regarding the use of the land, as well as applicable permits that may be required from your office. This information will be used to help guide Project development in a manner that identifies and avoids impacts to sensitive resources where practicable.

We have sent similar query letters to other federal and state agencies regarding this proposal. We would appreciate a response by March 10, 2014. Please contact me at Dale.Bennett@tetratech.com or (503) 221.8683 if you have any questions.

Respectfully submitted,

TETRA TECH, INC

Dale W Bennett

Dale Bennett

Senior Project Manager

Cc: Casey Willis, Sunflower Wind, LLC
Tracey Dubuque, P.E., Tetra Tech

TETRA TECH

February 10, 2014 TTEC –PTLD-2014-019

U.S. Environmental Protection Agency, Region 8
Shaun McGrath
Regional Administrator
EPA Region 8 (8EPR-N)
1595 Wynkoop St.
Denver, CO 80202

**RE: Application to the North Dakota Public Service Commission for Certificate of Site Compatibility for the Sunflower Wind Energy Project in Stark and MortonCounties, North Dakota**
**(Case No. PU-11-601)**

Dear Regional Administrator McGrath,

Tetra Tech has been contracted by Sunflower Wind Project, LLC to prepare an application for a Certificate of Site Compatibility, in accordance with Section 49-22-07 NDCC. The proposed Sunflower Wind Energy Project (Project) would be constructed on approximately 12,700 acres of leased private property. The north side of Project area boundary is located along I-94, and is approximately 3 miles south of Hebron, North Dakota. As currently planned, the Project would have a generating capacity of approximately 110 megawatts (MW) and would consist of up to 59 wind turbine generators as well as access roads, electrical collection systems and cabling, an operation and maintenance (O&M) building, a substation, and an interconnection yard where the Project will interconnect to the U.S. Department of Energy (DOE) Western Area Power Administration (Western)'s Dickinson-Mandan 230 kilovolt (kV) transmission line. The proposed Project area shown in the attached figure is the primary focus of our investigation.

Per Section 69-06-01-05 of the North Dakota Public Service Commission (PSC)'s administrative rules, we are consulting the U.S. Environmental Protection Agency, Region 8 for assistance in identifying concerns or issues within the boundaries of the tracts listed below that would influence a decision regarding the use of the land, as well as applicable permits that may be required from your office. This information will be used to help guide Project development in a manner that identifies and avoids impacts to sensitive resources where practicable.

We have sent similar query letters to other federal and state agencies regarding this proposal. We would appreciate a response by March 10, 2014. Please contact me at Dale.Bennett@tetratech.com or (503) 221.8683 if you have any questions.

Respectfully submitted,

TETRA TECH, INC

Dale W Bennett

Dale Bennett

Senior Project Manager

Cc: Casey Willis, Sunflower Wind, LLC
Tracey Dubuque, P.E., Tetra Tech

TETRA TECH

February 10, 2014 TTEC –PTLD-2014-019

U.S. Fish & Wildlife Service
Jeff Towner
Field Supervisor
North Dakota Field Office
3425 Miriam Avenue
Bismarck, ND 58501

**RE: Application to the North Dakota Public Service Commission for Certificate of Site Compatibility for the Sunflower Wind Energy Project in Stark and MortonCounties, North Dakota
(Case No. PU-11-601)**

Dear Field Supervisor Towner,

Tetra Tech has been contracted by Sunflower Wind Project, LLC to prepare an application for a Certificate of Site Compatibility, in accordance with Section 49-22-07 NDCC. The proposed Sunflower Wind Energy Project (Project) would be constructed on approximately 12,700 acres of leased private property. The north side of Project area boundary is located along I-94, and is approximately 3 miles south of Hebron, North Dakota. As currently planned, the Project would have a generating capacity of approximately 110 megawatts (MW) and would consist of up to 59 wind turbine generators as well as access roads, electrical collection systems and cabling, an operation and maintenance (O&M) building, a substation, and an interconnection yard where the Project will interconnect to the U.S. Department of Energy (DOE) Western Area Power Administration (Western)'s Dickinson-Mandan 230 kilovolt (kV) transmission line. The proposed Project area shown in the attached figure is the primary focus of our investigation.

Per Section 69-06-01-05 of the North Dakota Public Service Commission (PSC)'s administrative rules, we are consulting the U.S. Fish & Wildlife Service for assistance in identifying concerns or issues within the boundaries of the tracts listed below that would influence a decision regarding the use of the land, as well as applicable permits that may be required from your office. This information will be used to help guide Project development in a manner that identifies and avoids impacts to sensitive resources where practicable.

We have sent similar query letters to other federal and state agencies regarding this proposal. We would appreciate a response by March 10, 2014. Please contact me at Dale.Bennett@tetratech.com or (503) 221.8683 if you have any questions.

Respectfully submitted,

TETRA TECH, INC

Dale W Bennett

Dale Bennett

Senior Project Manager

Cc: Casey Willis, Sunflower Wind, LLC
Tracey Dubuque, P.E., Tetra Tech

February 20, 2014 TTEC –PTLD-2014-019

Chase Airstrip
Mr. Keith R. Chase
Owner
P.O. Box 48
Hebron, ND 58638

**RE: Application to the North Dakota Public Service Commission for Certificate of Site Compatibility for the Sunflower Wind Energy Project in Stark and MortonCounties, North Dakota**
**(Case No. PU-11-601)**

Dear District Manager Twogood,

Tetra Tech has been contracted by Sunflower Wind Project, LLC to prepare an application for a Certificate of Site Compatibility, in accordance with Section 49-22-07 NDCC. The proposed Sunflower Wind Energy Project (Project) would be constructed on approximately 12,700 acres of leased private property. The north side of Project area boundary is located along I-94, and is approximately 3 miles south of Hebron, North Dakota. As currently planned, the Project would have a generating capacity of approximately 110 megawatts (MW) and would consist of up to 59 wind turbine generators as well as access roads, electrical collection systems and cabling, an operation and maintenance (O&M) building, a substation, and an interconnection yard where the Project will interconnect to the U.S. Department of Energy (DOE) Western Area Power Administration (Western)'s Dickinson-Mandan 230 kilovolt (kV) transmission line. The proposed Project area shown in the attached figure is the primary focus of our investigation.

Per Section 69-06-01-05 of the North Dakota Public Service Commission (PSC)'s administrative rules, we are consulting the Central Stark & Western Soil Conservation District for assistance in identifying concerns or issues within the boundaries of the tracts listed below that would influence a decision regarding the use of the land, as well as applicable permits that may be required from your office. This information will be used to help guide Project development in a manner that identifies and avoids impacts to sensitive resources where practicable.

We have sent similar query letters to other federal and state agencies regarding this proposal. We would appreciate a response by March 20, 2014. Please contact me at Dale.Bennett@tetratech.com or (503) 221.8683 if you have any questions.

Respectfully submitted,

TETRA TECH, INC

Dale W Bennett

Dale Bennett

Senior Project Manager

Cc: Casey Willis, Sunflower Wind, LLC

Tracey Dubuque, P.E., Tetra Tech

TETRA TECH

February 20, 2014 TTEC –PTLD-2014-019

Glen Ullin Regional Airport
Mr. Gene Glasser
Manager
P.O. Box 306
Glen Ullin, ND 58631

**RE: Application to the North Dakota Public Service Commission for Certificate of Site Compatibility for the Sunflower Wind Energy Project in Stark and MortonCounties, North Dakota**
**(Case No. PU-11-601)**

Dear District Manager Officer Suttmeier,

Tetra Tech has been contracted by Sunflower Wind Project, LLC to prepare an application for a Certificate of Site Compatibility, in accordance with Section 49-22-07 NDCC. The proposed Sunflower Wind Energy Project (Project) would be constructed on approximately 12,700 acres of leased private property. The north side of Project area boundary is located along I-94, and is approximately 3 miles south of Hebron, North Dakota. As currently planned, the Project would have a generating capacity of approximately 110 megawatts (MW) and would consist of up to 59 wind turbine generators as well as access roads, electrical collection systems and cabling, an operation and maintenance (O&M) building, a substation, and an interconnection yard where the Project will interconnect to the U.S. Department of Energy (DOE) Western Area Power Administration (Western)'s Dickinson-Mandan 230 kilovolt (kV) transmission line. The proposed Project area shown in the attached figure is the primary focus of our investigation.

Per Section 69-06-01-05 of the North Dakota Public Service Commission (PSC)'s administrative rules, we are consulting the Federal Aviation Administration for assistance in identifying concerns or issues within the boundaries of the tracts listed below that would influence a decision regarding the use of the land, as well as applicable permits that may be required from your office. This information will be used to help guide Project development in a manner that identifies and avoids impacts to sensitive resources where practicable.

We have sent similar query letters to other federal and state agencies regarding this proposal. We would appreciate a response by March 20, 2014. Please contact me at Dale.Bennett@tetratech.com or (503) 221.8683 if you have any questions.

Respectfully submitted,

TETRA TECH, INC

Dale W Bennett

Dale Bennett

Senior Project Manager

Cc: Casey Willis, Sunflower Wind, LLC
Tracey Dubuque, P.E., Tetra Tech

## Map Attachment to Request for Comment Letters

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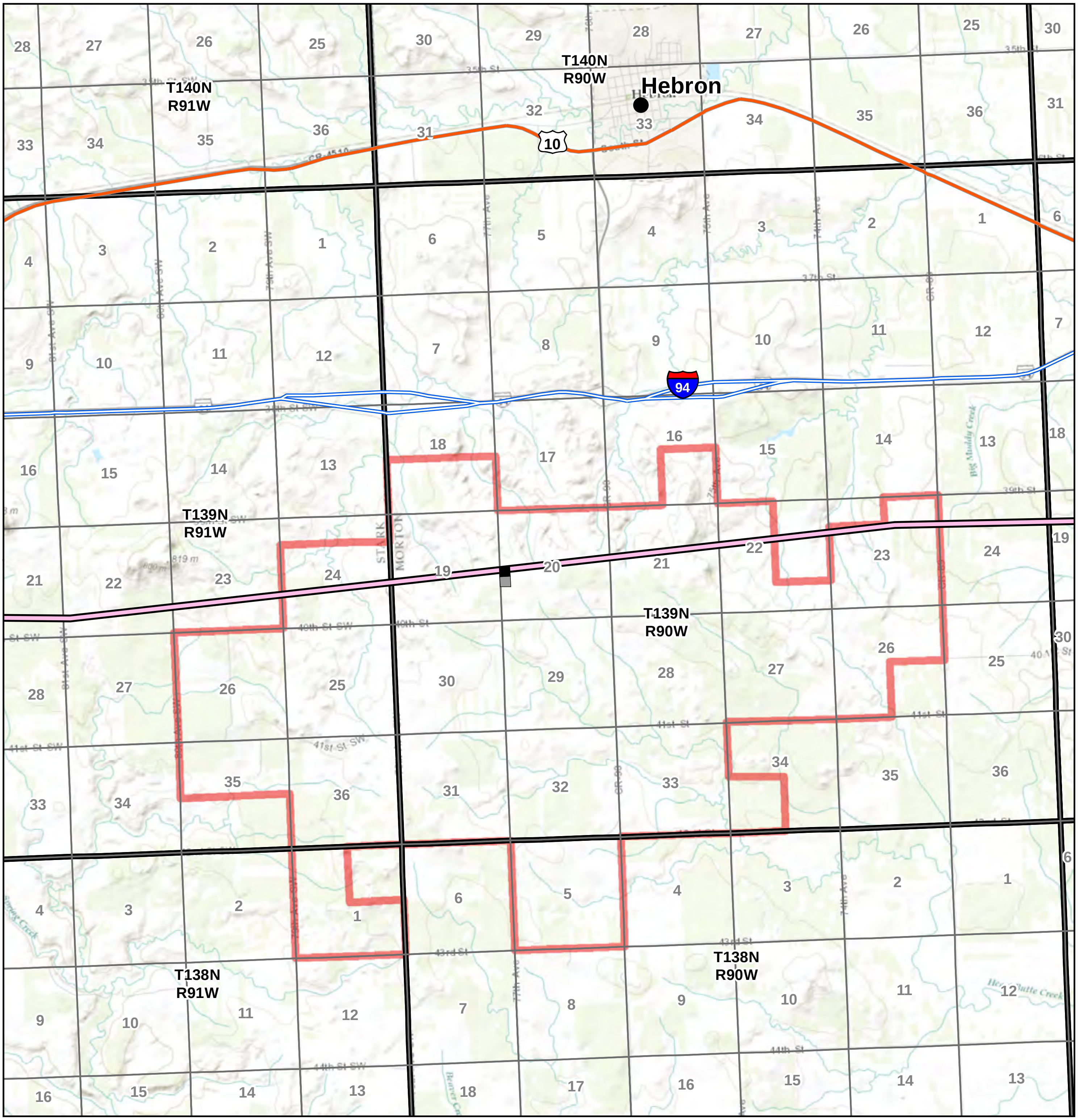



1:80,000 WGS84 UTM Zone 13N

0 0.5 1 1.5 Miles

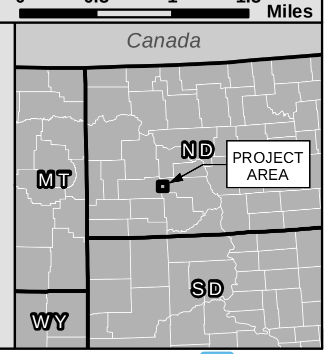
# Sunflower Wind Project

Application for North Dakota Certificate of Site Compatibility

Project Location

Morton and Stark Counties, ND
February 2014

- Project Area
- Proposed Interconnection
- Proposed Substation
- Township/Range
- Section
- Existing Transmission Line
- County Boundary
- Interstate Highway
- Federal Highway




TETRA TECH

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## Agency Comments and Correspondence

## DAvanzo, Jennifer

**From:** Wanner, Kyle C. <kcwanner@nd.gov>
**Sent:** Tuesday, February 18, 2014 2:47 PM
**To:** Bennett, Dale; DAvanzo, Jennifer
**Subject:** RE: Case No. PU-11-601

**Follow Up Flag:** Follow up
**Flag Status:** Flagged

Dale,

Thank-you for the information,

Could you please send the information on the wind farm to The Chase Airstrip and the Glen Ullin Municipal Airport to provide them an opportunity to comment as well? Providing them with the distance to the wind farm and updated project map would also be a good idea.

Thanks!

Kyle Wanner, Interim Director
North Dakota Aeronautics Commission
w (701) 328-9651
c (701) 425-5926
http://www.nd.gov/ndaero/

---

**From:** Bennett, Dale [mailto:Dale.Bennett@tetratech.com]
**Sent:** Tuesday, February 18, 2014 4:43 PM
**To:** Wanner, Kyle C.; DAvanzo, Jennifer
**Subject:** RE: Case No. PU-11-601

Kyle, Jennifer is in training today but here's the data you requested:

| Airport Name | Type | Distance from the Project Area (miles) |
|---|---|---|
| Chase Airstrip | Private | 4.4 |
| Glen Ullin Regional | Public | 5.75 |
| Richardton | Public | 10.7 |

Best - Dale

**Dale Bennett** | **Project Manager**
Direct: 503.721.7210 | Main: 503.221.8636 | Cell: 206.229.5161
Dale.Bennett@tetratech.com

**Tetra Tech EC** | **Sciences**
1750 SW Harbor Way | Portland, OR 97201 | www.tetratech.com



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**From:** Wanner, Kyle C. [mailto:kcwanner@nd.gov]
**Sent:** Tuesday, February 18, 2014 8:06 AM
**To:** DAvanzo, Jennifer
**Cc:** Bennett, Dale
**Subject:** RE: Case No. PU-11-601

Thank-you Jennifer,

This information is very helpful. Can you provide me with the straight line distance between the end of the project boundary and these three airports?:

- Glen Ullin Airport
- Richardton Airport
- Chase Airport

Thanks-

Kyle Wanner, Interim Director
North Dakota Aeronautics Commission
w (701) 328-9651
c (701) 425-5926
http://www.nd.gov/ndaero/

---

**From:** DAvanzo, Jennifer [mailto:Jennifer.Davanzo@tetratech.com]
**Sent:** Monday, February 17, 2014 9:29 PM
**To:** Wanner, Kyle C.
**Cc:** Bennett, Dale
**Subject:** FW: Case No. PU-11-601

To Mr. Wanner.

On behalf of Dale Bennett and Sunflower Wind Project LLC, thank you for a reponse to the Sunflower Wind Energy Project comment letter.

Please see the attached figure (Figure 1) per your request  and let us know if you would like us to request comments from others.

Kind regards,
Jennifer D'Avanzo

Jennifer D'Avanzo, PWS | Senior Biologist, Project Manager
Direct: 503.727.8073| Main: 503.221.8636 |Fax 503.227.1287
jennifer.davanzo@tetratech.com

**Tetra Tech** | 1750 SW. Harbor Way, Suite 400 | Portland, OR 97201 | www.tetratech.com



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**From:** Wanner, Kyle C. [mailto:kcwanner@nd.gov]
**Sent:** Thursday, February 13, 2014 8:05 AM
**To:** Bennett, Dale
**Subject:** Case No. PU-11-601

Dale,

This e-mail is being sent in regards to the letter my office received regarding the Application to the North Dakota Public Service Commission for Certificate of Site Compatibility for the Sunflower Wind Energy Project in Stark and Morton Counties, North Dakota.

Can your company identify which public and private airports are in the vicinity of the project site and send me a map showing the project location in relation to the public/private airports?

From a brief look at the location, it appears that the Glen Ullin Airport is in the vicinity.  A database of the private airports in North Dakota can be found at http://www.faa.gov/airports/airport_safety/airportdata_5010/

Depending on the location of the private and public airports, I may request that those individuals be allowed to comment on the proposal as well.

Thanks,

Kyle Wanner, Interim Director
North Dakota Aeronautics Commission
w (701) 328-9651
c (701) 425-5926
http://www.nd.gov/ndaero/

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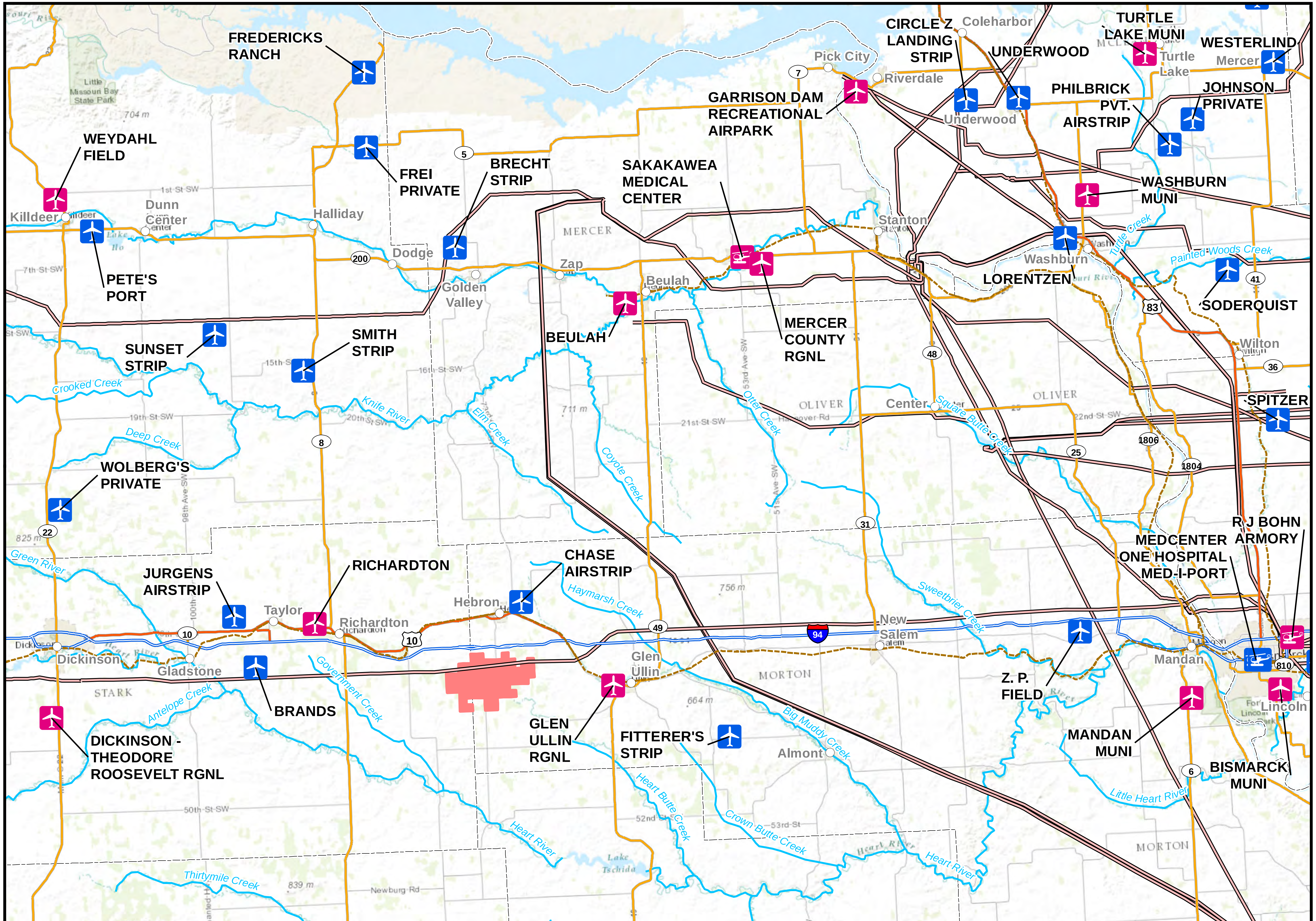



# Sunflower Wind Project

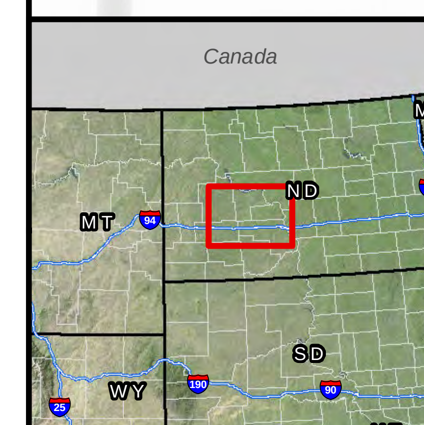
Application for North Dakota Certificate of Site Compatibility

## Figure 1
## Public and Private Airports

Morton and Stark Counties, ND

February 2014

- Project Area
- County Boundary
- Existing Transmission Line (Over 230 kV)
- Railroad
- Interstate Highway
- Federal Highway
- State Highway
- Stream or River
- City/Town
- Public Airport
- Private Airport
- Public Heliport
- Private Heliport




1:480,000 WGS84 UTM Zone 13N

0 10 20 Miles

P:\GIS_PROJECTS\Infinity_Wind_Power\Sunflower_NDPSC_CSC\MXDs\CSC\Infinity_SCSC_Fig_01_ProjectLocation_Airports_17i11i_20140217.mxd - Last Saved 2/17/2014

TETRA TECH

## DAvanzo, Jennifer

| | |
|---|---|
| **From:** | Bennett, Dale |
| **Sent:** | Friday, February 14, 2014 9:00 AM |
| **To:** | Daniel Nairn |
| **Cc:** | Casey Willis (cwillis@infinitywind.com); DAvanzo, Jennifer |
| **Subject:** | RE: Sunflower Wind Project |

Thanks for your communication regarding the Sunflower Wind Project. Please go ahead and forward the decision of the Morton County Board of County Commissioners on Sunflower's application for a Special Use Permit when the decision is final as you propose.

Best regards

**Dale Bennett** | **Project Manager**
Direct: 503.721.7210 | Main: 503.221.8636 | Cell: 206.229.5161
Dale.Bennett@tetratech.com

**Tetra Tech EC** | **Sciences**
1750 SW Harbor Way | Portland, OR 97201 | www.tetratech.com



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**From:** Daniel Nairn [mailto:Daniel.Nairn@mortonnd.org]
**Sent:** Friday, February 14, 2014 7:47 AM
**To:** Bennett, Dale
**Subject:** Sunflower Wind Project

Dale,

I received your letter requesting comment for the application to the Public Service Commission for the Sunflower Wind Project. An application for a Special Use Permit from Morton County has been filed for this project, and a public hearing will be held on February 27 with our Planning and Zoning Commission. The earliest the Board of County Commissioners could make a decision on the permit would be during their March 10 meeting.

After the Special Use Permit is reviewed by our board, I can send you a letter to communicate the decision. Obviously, I can't get this to you by the March 10 you've requested in the letter. If I sent you this letter by March 14, would that fit within your timeline?

Thanks,

**Daniel Nairn, AICP**
Director of Planning and Zoning
Morton County
2916 37th St. N.W. Mandan, ND 58554
701-667-3346

# STATE HISTORICAL SOCIETY OF NORTH DAKOTA



February 13, 2014

Mr. Dale W. Bennett
Senior Project Manager
Tetra Tech
1750 Harbor Way, Suite 400
Portland, OR 97201

**ND SHPO REF: 14-669 WAPA/PSC PU-13-847 Sunflower Wind Energy Project in Stark and Morton Counties, North Dakota**

Dear Mr. Bennett,

We reviewed your very preliminary information on ND SHPO REF: 14-669 WAPA/PSC PU-13-847 Sunflower Wind Energy Project in Stark and Morton Counties, North Dakota. There is potential for unrecorded and recorded cultural resource properties in a variety of physiographic settings in the overall project area. As a federal undertaking, we encourage early agency consultation as part of the review process. Early consultation should also include tribal nations, North Dakota Indian Affairs, ND DOT regarding any Scenic Byways, and any managers or owners of properties maintained for recreational or scenic value.

We recommend a Class II (reconnaissance) survey by a permitted architectural historian for standing structures in the visual Area of Potential Effect (APE), and Class III survey of those found to be fifty years of age or older by a permitted architectural historian. Class III archeological (pedestrian) surveys will be warranted for all areas directly impacted by the project, **including crane paths**, access roads, staging areas, transmissions lines and turbine pads. We encourage you to invite tribal monitors to survey the APE. As part of the Class III Inventory, NDCRS site updates should be submitted on all sites resurveyed. If the project APE changes, we will request additional inventories, surveys and consultation.

Thank you for the opportunity to review this project to date. We look forward to further review of cultural resource surveys and site forms, and updates as the project siting occurs. If you have any questions please contact Paul Picha, Chief Archaeologist (701) 328-3574 or Susan Quinnell, Review and Compliance Coordinator at (701) 328-3576, e-mail squinnell@nd.gov

Sincerely,

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

STATE HISTORICAL SOCIETY OF NORTH DAKOTA

RECEIVED
FEB 24 2014
By KL



February 18, 2014

Mr. Dale Bennett
Senior Project Manager
Tetra Tech
1750 Harbor Way, Suite 400
Portland, OR 97201

**ND SHPO REF: 13-1244 WAPA /ND Public Service Commission (PSC Case No. PU-11-601) Infinity Wind Power's Sunflower Wind Project, Stark and Morton Counties, North Dakota**

Dear Mr. Bennett,

We reviewed your preliminary information on ND SHPO REF: 13-1244 WAPA /ND Public Service Commission (PSC) Infinity Wind Power's Sunflower Wind Project Environmental Assessment (EA), Stark and Morton Counties, North Dakota. There is potential for unrecorded and recorded cultural resource properties in a variety of physiographic settings in the overall project area. We recommend a Class I (file search) cultural resource inventory followed by a Class II (reconnaissance) survey for standing structures in the visual Area of Potential Effect (APE). Class III (pedestrian) survey is also recommended of all the areas of direct impact including the turbine sites, power collections system, roads, and all other ground impacts. As part of the Class III Inventory, NDCRS site updates should be submitted on all sites resurveyed. Early consultation is also recommended with federal and tribal parties.

Thank you for the opportunity to review this project to date. We look forward to further review of cultural resource surveys and site forms. If you have any questions please contact Paul Picha, Chief Archaeologist (701) 328-3574 or Susan Quinnell, Review and Compliance Coordinator at (701) 328-3576, e-mail squinnell@nd.gov

Sincerely,

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

USDA FSA
United States Department of Agriculture
Farm Service Agency
North Dakota State Office
1025 $28^{th}$ St South
Fargo, ND 58103-2372
Phone: (701) 239-5224
FAX: (701) 239-5696

February 20, 2014

RECEIVED
FEB 24 2014
By KL

Tetra Tech, Inc.
C/O Dale Bennett, Senior Project Manager
1750 Harbor Way, Suite 400
Portland, OR 97201

Dear Mr. Bennett,

This letter is in response to your February 10, 2014 letter concerning the environmental assessment associated with the Sunflower Wind Energy Conversion Project ("Project") in Stark and Morton Counties of North Dakota.

Based on the information in your February $10^{th}$ letter, it is unknown if, at any time, the Project will be crossing land enrolled in the Conservation Reserve Program (CRP). Although the land enrolled in CRP is privately owned, FSA has administrative responsibilities to ensure the provisions of CRP are maintained throughout the contract period.

The land enrolled in CRP shall not have the cover disturbed during the Primary Nesting and Brood Rearing Season (PNS), which in North Dakota, is from April 15 through August 1. No activity is to take place on CRP during the PNS. However, there are exceptions to this provision. If disturbance of the existing cover is minimal, a waiver of this provision could be granted.

If the Project will need access to CRP during the PNS, a formal request to waive this provision must be submitted prior to any disturbance of CRP cover. Only the North Dakota State FSA Committee has the authority to grant a waiver of activity during the PNS. Therefore, if necessary, the request to disturb cover during the PNS shall be sent to the North Dakota State FSA Committee at the address provided on the letterhead of this letter. Such a request should include the proposed timeframe construction will occur, impact to the land enrolled in CRP and plans to restore CRP cover, if necessary.

If there are any questions, please contact this office.

Sincerely,

Aaron Krauter

Aaron Krauter
State Executive Director

Cc: Stark FSA County Office
Morton FSA County Office
Honeyman, District Director
Moszer, District Director