# Appendix D
# Triple H Wind Project Tier 2 Site Characterization Study

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# Triple H Wind Resource Area
# Hughes and Hyde Counties, South Dakota

**Prepared for:**

**Infinity Wind Power, LLC**
3760 State Street, Suite 200
Santa Barbara, California 93105

Western EcoSystems Technology, Inc.

**June 28, 2016**

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This document or presentation includes Whooping Crane migration use data from the Central Flyway stretching from Canada to Texas, collected, managed and owned by the U.S. Fish and Wildlife Service. Data were provided to Western Ecosystems Technology, Inc. as a courtesy for their use. The U.S. Fish and Wildlife Service has not directed, reviewed, or endorsed any aspect of the use of these data. Any and all data analyses, interpretations, and conclusions from these data are solely those of Western Ecosystems Technology, Inc.

# EXECUTIVE SUMMARY

The Triple H Wind Resource Area (THWRA or Project) is approximately 39,069 acres (ac; 15,811 hectares [ha]) located in the Northwestern Glaciated Plains Level III Ecoregion of Hughes and Hyde Counties, South Dakota. Land ownership in and around the THWRA is primarily private. Dominant land cover types are grassland and crop. The most abundant cover types within the THWRA are herbaceous lands followed by croplands: corn, sunflower, and spring wheat. Wetlands, individual trees, isolated tree stands, and deciduous tree lines are scattered throughout the THWRA.

Grasslands scattered throughout the THWRA may provide stopover habitat for migrant or individual birds. Harvested grain crops, such as corn and sunflower (observed during the 2016 site visit), could serve as feeding areas for migrating water birds, waterfowl, and other birds. The intermittent and perennial streams and emergent wetlands provide important stopover habitat for migrating water birds, waterfowl, and shorebirds, and may be attractive to raptors that hunt birds concentrated at waterbodies. These types of habitats are found throughout the region and, therefore, their presence in the THWRA are unlikely to disproportionally concentrate bird use compared to the surrounding areas.

There are two State Trust Lands within the boundary of the THWRA, and there are 3 protected areas within 10 miles of the THWRA with the potential to attract wildlife to the general region. The closest area likely to attract wildlife is Hyde County Waterfowl Production Area that is adjacent to the southern edge of the project boundary.

Wildlife species associated with grasslands and tilled agricultural landscapes are expected to be the most common species at the THWRA. Data from the two closest US Geological Survey (USGS) Breeding Bird Survey (BBS) routes from 2011 to 2014 include 86 bird species, with brown-headed cowbird, western meadowlark, common grackle, dickcissel, red-winged blackbird, mourning dove, and cliff swallow being the most commonly recorded species. A great horned owl nest and a total of 11 avian species and one mammal species, were recorded during the February 26, 2016 site visit, .with snow goose and horned lark being the most commonly observed species.

Seven federally-listed endangered, threatened, or candidate species have the potential to occur within the counties containing the THWRA based on geographic ranges: northern long-eared bat, whooping crane, red knot, piping plover, interior least tern, Sprague's pipit, and pallid sturgeon. Occurrence of any of these species within the actual THWRA is unknown, but unlikely.

The following diurnal raptor and vulture species may occur in the THWRA: bald eagle, broad-winged hawk, Cooper's hawk, ferruginous hawk, golden eagle, northern goshawk, northern harrier, osprey, red-tailed hawk, rough-legged hawk, sharp-shinned hawk, and Swainson's hawk, three of which were documented during the winter 2016 site visit: golden eagle, northern

harrier, and great horned owl. Non-breeding golden eagles are known to occur in the vicinity of the THWRA; bald eagles may occur year-round in the Project area. Nocturnal owl species that could be found in the Project area include the long-eared owl, short-eared owl, great horned owl, eastern screech owl, northern saw-whet owl, and burrowing owl.

One occupied great horned owl nest was recorded during the winter 2016 site. Potential raptor nesting areas were also documented in the winter 2016 site visit. Suitable raptor nesting habitat is present in the form of living and dead trees, buildings, and utility poles. Grassland areas could provide nesting habitat for ground-nesting raptors. Two prairie dog colonies were observed on the southern and eastern boundaries of the Project during the site visit. Prairie dog towns have the potential to concentrate raptor use. Other potential raptor prey species such as rodents, shrews, cottontails, and other birds are also present within the THWRA. Wetlands also serve to concentrate prey resources during most times of the year, but especially during migration and winter. With raptor roost sites (e.g., trees and power poles) and food available, it is likely that some raptors will use the THWRA for foraging.

Six of the eight bat species, based on range maps, that potentially occur in or around the THWRA have been documented as fatalities at wind energy facilities: big brown bat, eastern red bat, hoary bat, little brown bat, northern long-eared bat (federally-threatened and a State SGCN), and silver-haired bat. The other two bat species, the Townsend's big-eared bat (a State SGCN) and the western small-footed myotis, are unlikely to occur within the THWRA. Some suitable roosting and foraging bat habitat was found in the THWRA during the February 2016 site visit. Development and operation of the THWRA would likely result in fatalities of some bats with peak fatalities likely occurring during the fall season; however, fatalities should be within the average range of bat mortalities found at wind farms throughout the Midwest and South Dakota.

Information about sensitive species presence and locations may be requested from South Dakota Department of Game, Fish, and Parks (SDDGFP) and the US Fish and Wildlife Service (USFWS); however, a search of the USFWS iPaC database has been conducted and is included in the report.

## INTRODUCTION

Knowledge of biological resource issues early in the development phase of wind energy facilities helps the industry identify, avoid, and minimize future impacts potentially resulting from project construction and operations. This report describes biological resources present within the proposed Triple H Wind Resource Area (THWRA or Project) and evaluates these general characteristics relative to potential or known impacts on the resources from the proposed Project. This Site Characterization Study (SCS) is intended to meet the requirements of a Tier 2 Site Characterization of the Land-based Wind Energy Guidelines (USFWS 2012a) by describing biological issues and potential risks that development may pose to species of concern or their habitats.

## STUDY AREA

The THWRA located in Hughes and Hyde Counties, approximately 2 miles (mi; 3.2 kilometers [km]) south of the city of Holabird, South Dakota (Figure 1). The THWRA is located within the Northwestern Glaciated Plains Level III Ecoregion, a transitional region between the generally more level, moister, more agricultural Northern Glaciated Plains to the east and the generally more irregular, dryer, Northwestern Great Plains to the west and southwest. This ecoregion is characterized by significant surface irregularity and high concentrations of seasonal and semi-permanent wetlands (prairie potholes). Land use is transitional between the intensive dryland farming to the east and the predominance of cattle ranching and farming to the west (Bryce et al. 1996). Mean temperatures in the area range between 14 – 60 Fahrenheit degrees (°F) (-10 and 16 Celsius degrees [°C]) and annual precipitation ranges from 9.8 to 21.6 inches (in) (250 to 550 mm; Bryce et al. 1996). The topography within the THWRA consists of rolling hills, with elevations ranging from 558 to 642 meters (m; 1,830 to 2,106 feet [ft]) above sea level (ASL; Figures 2 and 3; US Geological Survey [USGS] Digital Elevation Model [DEM] 2013). Land ownership in and around the THWRA is primarily private.

The primary land use/cover within the THWRA is herbaceous lands followed by cultivated crops, especially corn (*Zea mays*), sunflower (*Helianthus sp*.), and spring wheat (*Triticum aestivum*). All other land use/cover types represent a small percentage of the total area (Figure 4; US Geological Survey [USGS] National Land Cover Data [NLCD] 2011). Native plant communities are present within the THWRA, but non-native grasses are the most abundant grass type. The THWRA also contains open water areas, farmsteads, tree rows, wooded areas along streams, wind breaks, and wooded patches behind residences. Wetlands, especially freshwater emergent wetlands, are dispersed throughout the (Figure 5; USFWS NWI 2015, US Geological Service [USGS] National Hydrography Dataset [NHD] 2015). Appendix A includes representative photographs of the THWRA.

## METHODS

Biological resources within the THWRA were evaluated through a reconnaissance-level site visit and a desktop search of publicly available data. Several sources of data were used to identify biological resources within the Project area, including published literature, field guides, prior assessments of the area, agency reports, data available from the US Fish and Wildlife Service (USFWS), the South Dakota Game, Fish, and Parks Department (SDDGFP), the USFWS National Wetlands Inventory (NWI), and public data sets. Information about sensitive species presence and locations was found online using the SDGFPD's list of Rare Animals and Plants (SDDGFP 2009, 2016a), the SDGFP's list of Threatened, Endangered, and Candidate Species (SDDGFPD 2015), and the USFWS Information, Planning, and Conservation (IPaC) System (USFWS 2016a, Appendix B).

The reconnaissance-level site visit conducted as part of this evaluation entailed an examination of the site from accessible public roads on February 26, 2016. Biological features and potential wildlife habitat, including plant communities, creeks, wetlands, topographic features, potential raptor nesting habitat, and potential raptor prey populations were evaluated during this visit. All wildlife species observed during the site visit were recorded (see Observed Wildlife section below), and photos were taken of the THWRA (Appendix A).

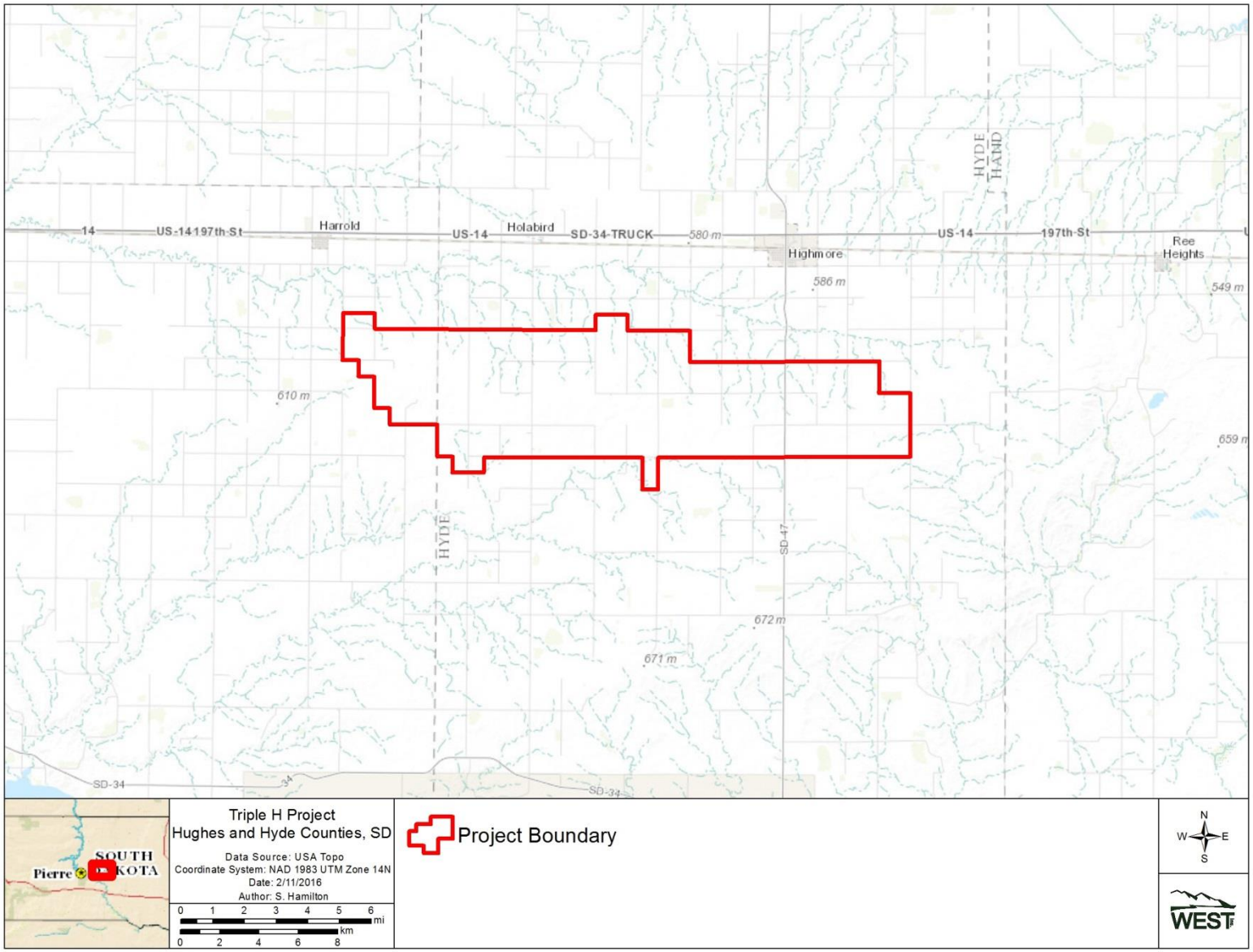


**Figure 1. General location of the Triple H Wind Resource Area in Hughes and Hyde Counties, South Dakota.**

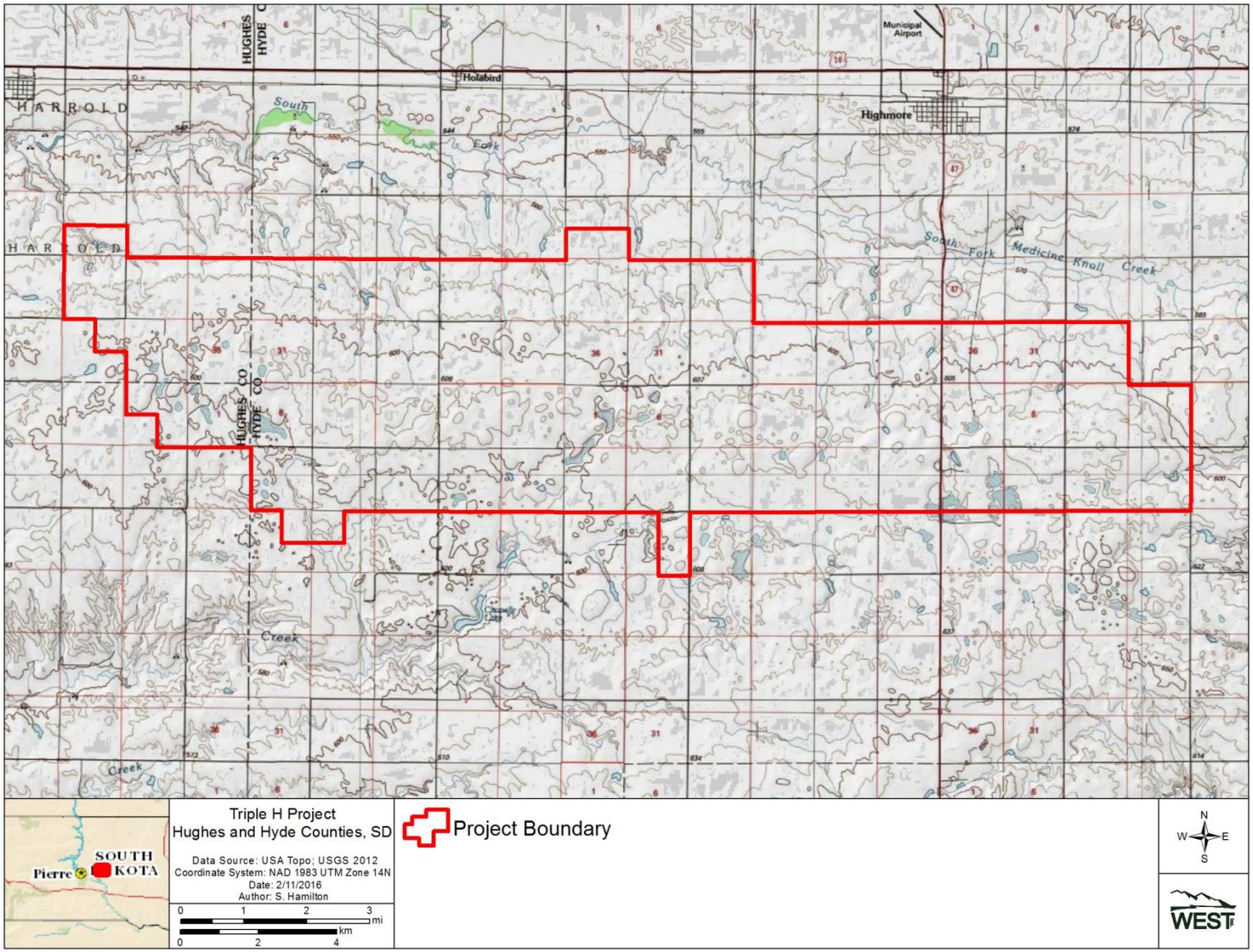


**Figure 2. Topography of the Triple H Wind Resource Area in Hughes and Hyde Counties, South Dakota.**

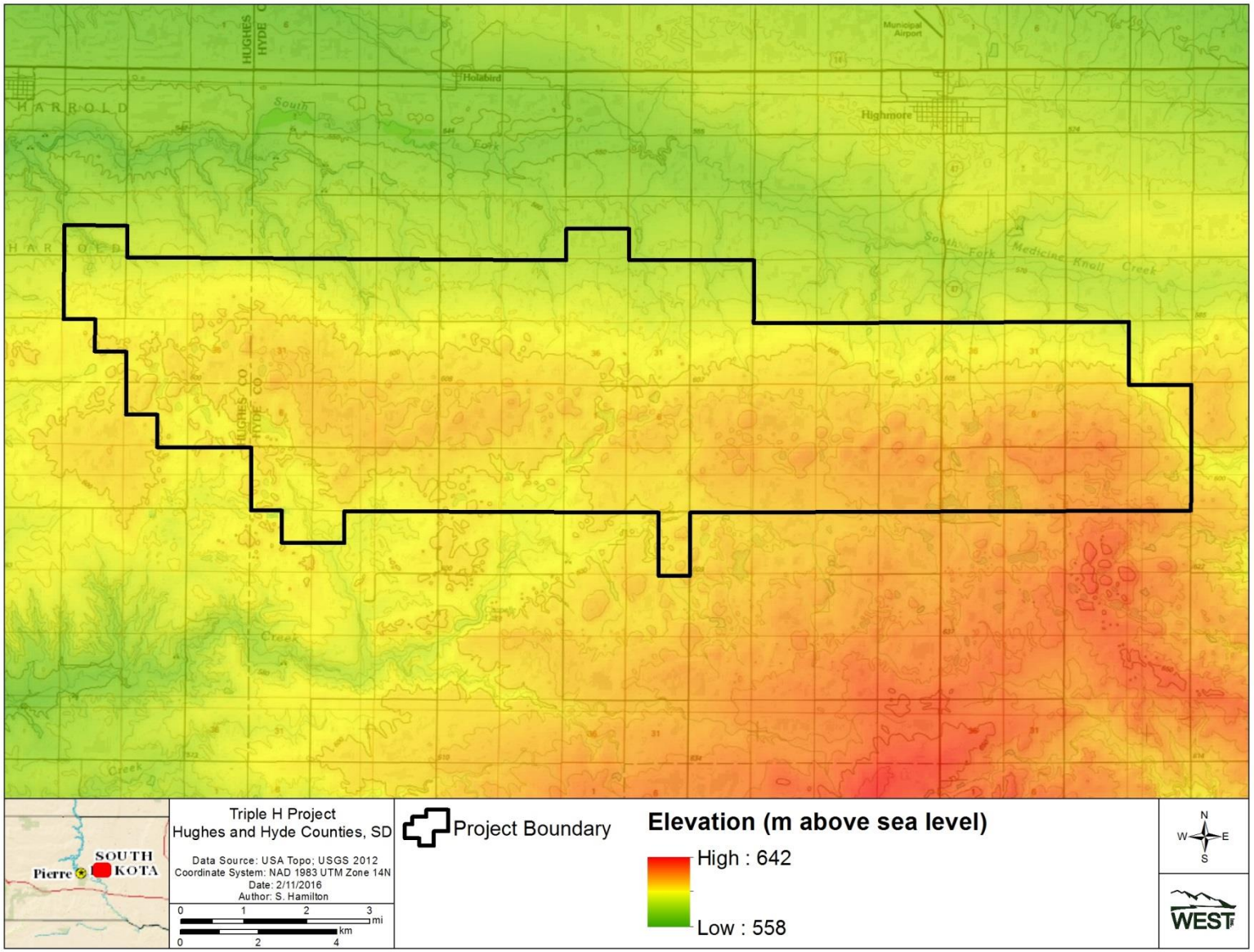


**Figure 3. Elevation in the Triple H Wind Resource Area in Hughes and Hyde Counties, South Dakota.**

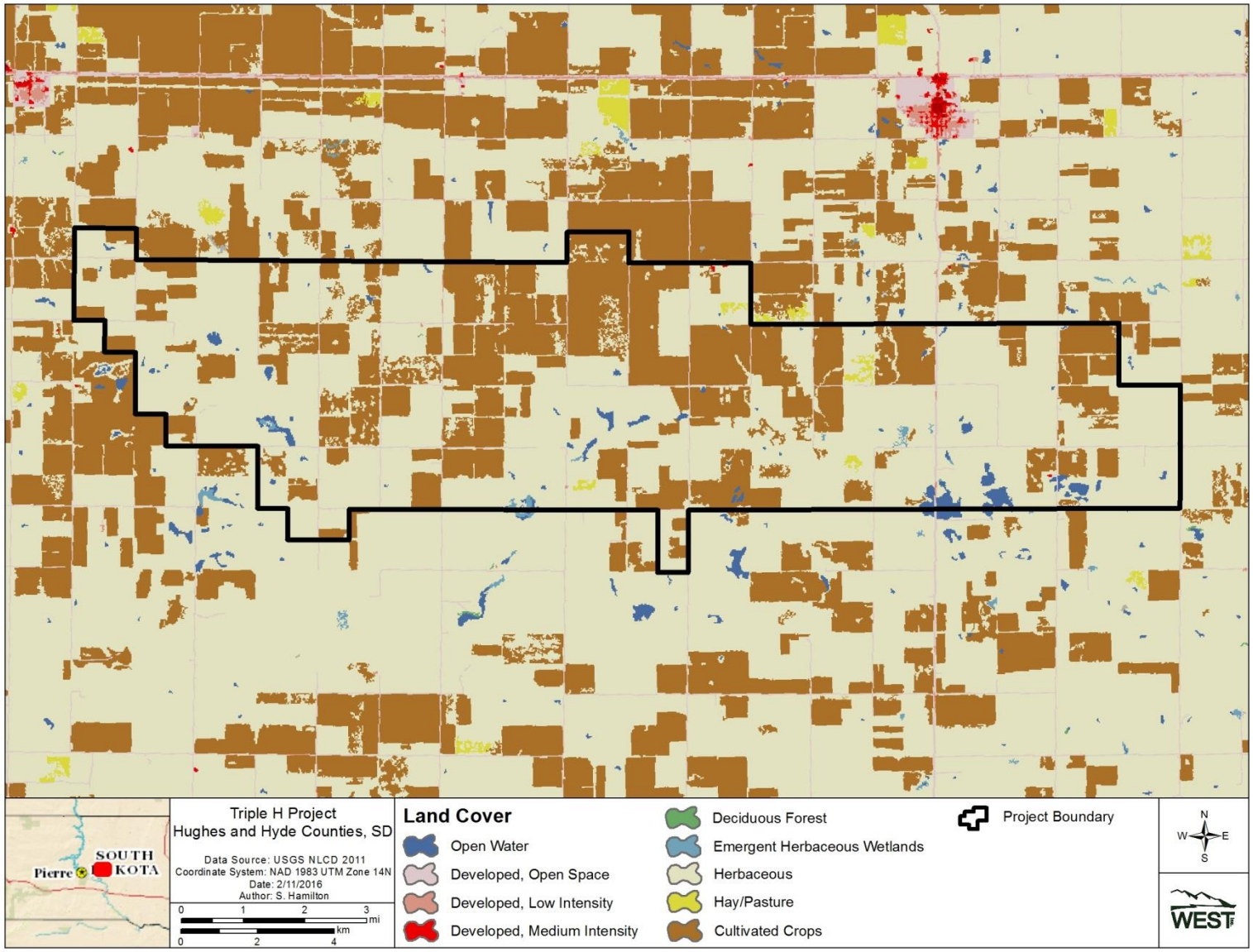


**Figure 4. Land cover/use within the Triple H Wind Resource Area in Hughes and Hyde Counties, South Dakota.**

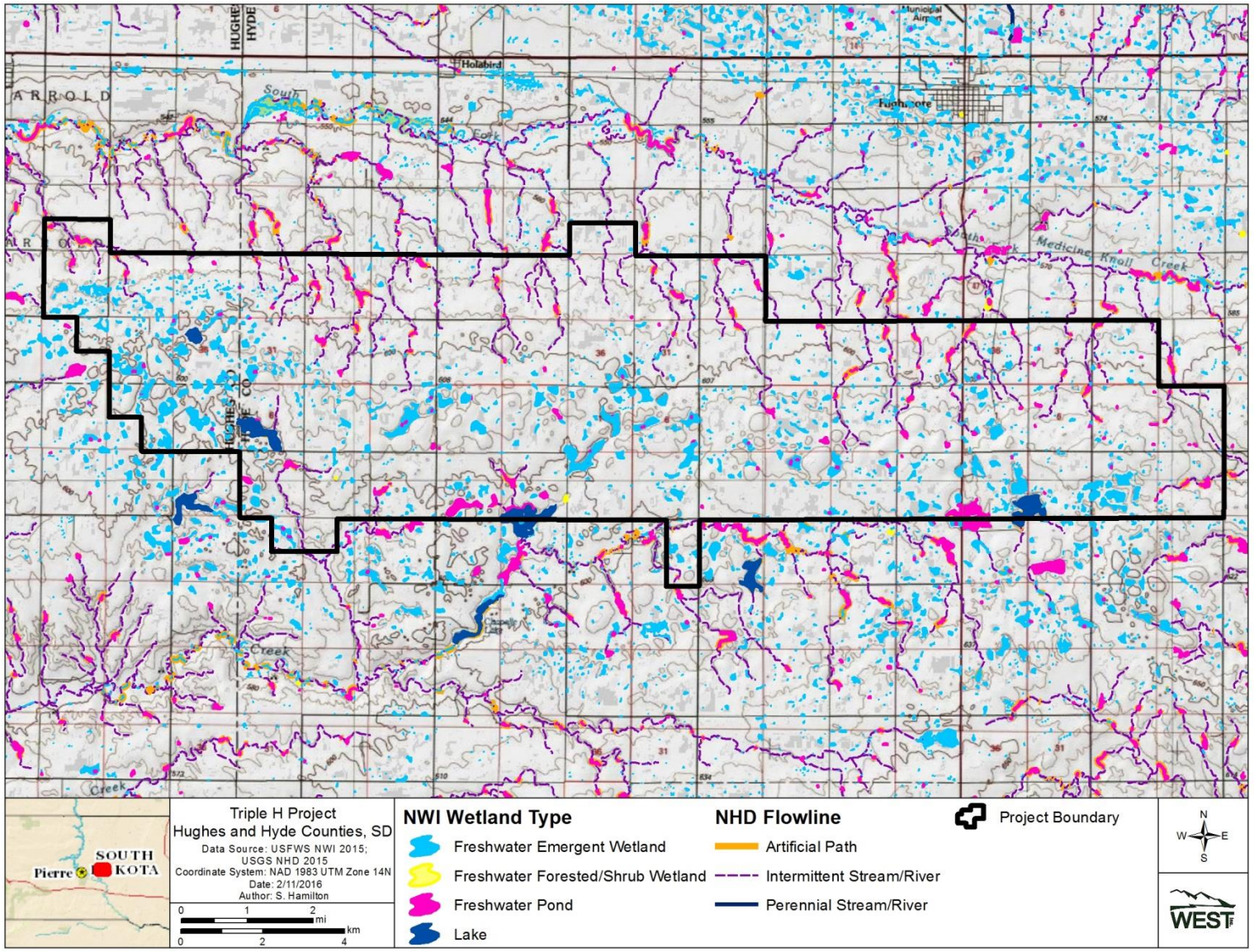


**Figure 5. National Wetland Inventory (NWI) and National Hydrography Dataset (NHD) rivers, streams, and wetlands within the Triple H Wind Resource Area in Hughes and Hyde Counties, South Dakota..**

# RESULTS OF TIER 2 ANALYSIS

## Land Cover

Approximately 62.3% of the THWRA is covered by herbaceous lands, followed by cultivated crops (33.4%); all other land cover/use types represent less than 5% of the total Project area (Table 1, Figure 4; USGS NLCD 2011). Although the "herbaceous" category does not differentiate between planted and native grass, the site visit indicated that herbaceous areas and hay/pasture areas included both native and introduced plant species such as Kentucky bluegrass (*Poa pratensis*), smooth brome (*Bromus inermis*), and blue grama (*Bouteloua gracilis*).

**Table 1. Land cover/use (acres and percent composition) present within the Triple H Wind Resource Area (THWRA). Source: USGS NLCD 2011.**

| Land Cover/Use | Acreage within the THWRA | % Composition within the THWRA |
|---|---|---|
| Herbaceous | 24,327.7 | 62.3 |
| Cultivated Crops | 13,040.5 | 33.4 |
| Developed, Open Space | 900.7 | 2.3 |
| Open Water | 565.5 | 1.4 |
| Hay/Pasture | 126.2 | 0.3 |
| Emergent Herbaceous Wetlands | 74.2 | 0.2 |
| Developed, Low Intensity | 20.2 | <0.1 |
| Developed, Medium Intensity | 8.9 | <0.1 |
| Deciduous Forest | 2.2 | <0.1 |
| **Total** | **39,066.1** | **100** |

## Wetlands and Riparian Areas

Broad-scale information about wetlands and riparian areas is based on USFWS NWI (2015), USGS NHD (2015) data (Table 2, Figure 5), topographic data (USGS DEM 2013), and aerial imagery (Figure 6; USDA 2014). Land cover/use data (Table 1, Figure 4, USGS NLCD 2011) are not a good representation of wetlands because they are not fine-scale enough to show the small wetland areas indicated in the USFWS NWI (2015) dataset. Therefore, there is a large discrepancy in the acreage of emergent wetlands reported in the NLCD and NWI datasets (74.2 ac and 1,979.8 ac, respectively). Although the NWI dataset likely overestimates the acreage of wetlands currently present within the Project area, it better represents the actual wetland cover at the THWRA as evidenced during the site visit on February 26, 2016.

According to NWI data, 1,115 features make up about 2,684 acres of wetlands and open water within the THWRA. Freshwater emergent wetlands are the dominant wetland type, making up about 73.8% of all NWI recorded wetlands in the THWRA (Table 2; USFWS NWI 2015). Freshwater ponds (13.8%), lakes (12.3%), and freshwater forested/shrub wetlands (0.1%) are the only other wetland feature types present within the THWRA.

**Table 2. Wetland types and acreage within the Triple H Wind Resource Area (THWRA). Source: USFWS NWI 2015.**

| Wetland Type | Wetland Acreage within the THWRA | % Composition of Wetlands within the THWRA |
|---|---|---|
| Freshwater Emergent Wetland | 1,979.8 | 73.8 |
| Freshwater Pond | 370.1 | 13.8 |
| Lake | 331.2 | 12.3 |
| Freshwater Forested/Shrub Wetland | 2.7 | 0.1 |
| **Total** | **2,683.8** | **100** |

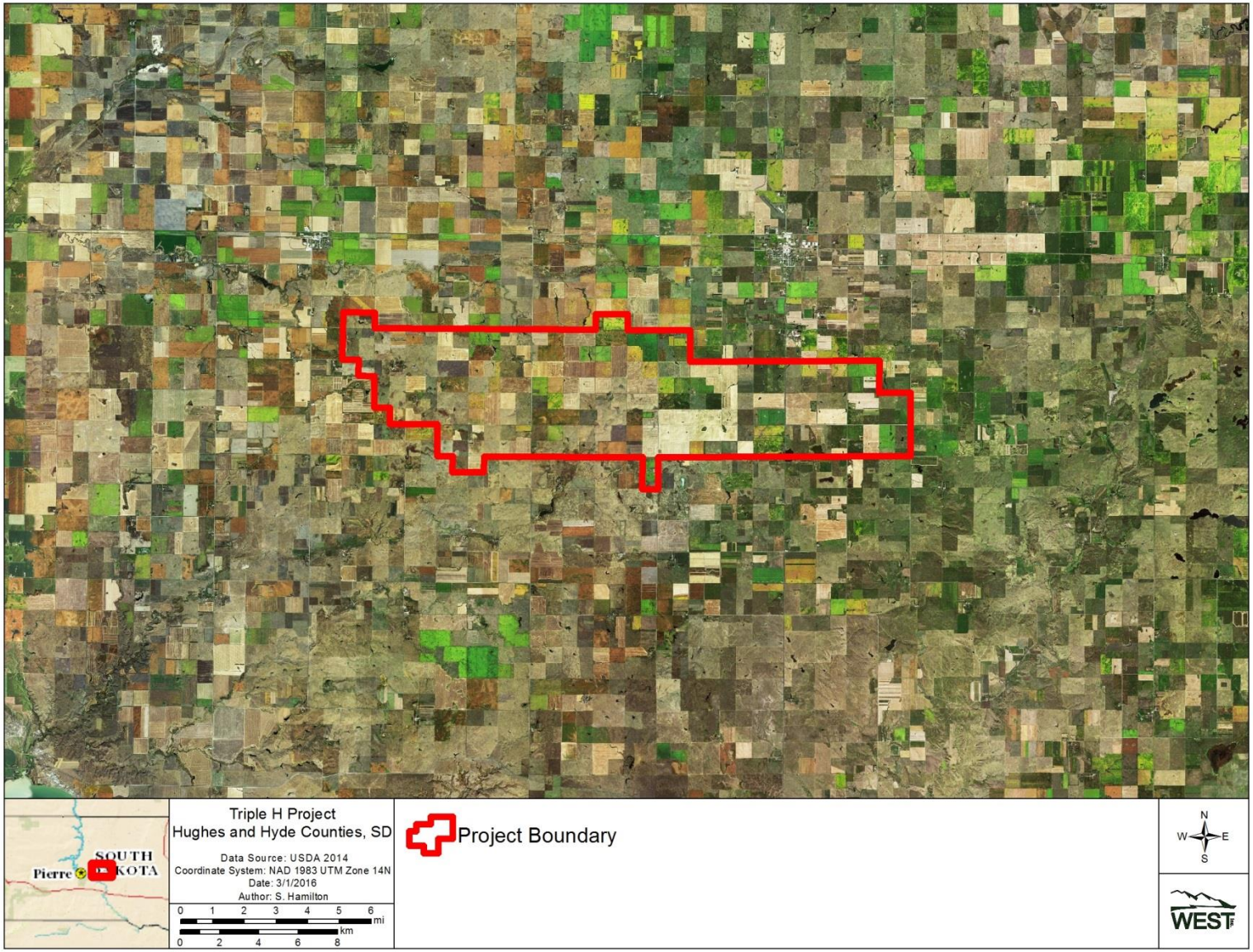


**Figure 6. Aerial imagery of the Triple H Wind Resource Area, Hughes and Hyde Counties, South Dakota.**

## Sensitive Habitats

State and federal agencies and organizations frequently purchase easements to conserve important habitats for migratory birds and other sensitive species. There are two State Trust Lands within the boundary of the THWRA, and two other protected areas within 10 mi (16 km) of the THWRA, with the potential to attract wildlife to the general region. Huron Wetland Management District - Waterfowl Production Area, adjacent to the southern edge of the Project boundary, is the closest protected area (Table 3).

**Table 3. Protected Areas within 10 miles of the Triple H Wind Resource Area. Sources: Landscape Assessment Tool 2016, TNC 2016, Google Earth 2016.**

| Protected Area | Governing Agency/ Organization | Approximate Distance from Project Area (mi) | Direction from Project Area |
|---|---|---|---|
| Huron Wetland Management District - Waterfowl Production Area | USFWS | 0 | S |
| Crow Creek Reservation | Crow Creek Tribe | 9.6 | S |
| Hand County Waterfowl Production Area 36 | USFWS | 9.9 | SE |

Some acreage within the Project area might be under contract with the U.S. Department of Agriculture – Farm Service Agency (USDA-FSA) and be managed in agreement under the US Conservation Reserve Program (CRP). Although some restrictions may apply to the properties under this program, which could affect construction or operational procedures, CRP lands do not exclude wind development. The Hughes County FSA office may be contacted to verify the US CRP (2004) information, in order to adjust Project activities if necessary, by avoiding installation of wind turbines on CRP lands within the THWRA to the extent possible, or by siting turbines along the edges of CRP lands so that associated development (access roads, facilities) can be built on non-CRP lands.

The presence of wind turbines may alter landscape structure so that animal habitat use patterns are altered, possibly displacing some wildlife, including species of concern, through the indirect effects of habitat fragmentation and degradation. The greatest concern with displacement impacts are for wind energy facilities placed on native grasslands, which may be present in some locations throughout the THWRA (Table 1; NLCD 2011). Because the THWRA contains some native grasslands, it is possible that some grassland-dependent species may be displaced. As the project becomes more defined in terms of layout and proposed ground disturbance, further investigation into sensitive species and habitats may be warranted.

Development of the Project facilities, infrastructure, roads, and transmission lines could result in temporary impacts to the plant community itself as well as permanent loss of some vegetation into its developed land use. Installation of buried and overhead electrical collector systems and concrete pads for turbine foundations will primarily only have temporary surface impacts as the majority of the disturbed area will undergo restoration and revegetation rather than remaining permanently converted.

## Wildlife

When exploring prospective sites for a wind energy facility, knowledge of wildlife and other biological resources helps the developer identify and avoid potential environmental problems early in the development process. The purpose of this section is to characterize wildlife resources within the proposed THWRA to determine if additional biological resource surveys are warranted, as well as to identify the timing of recommended future studies. Wildlife species associated with grasslands and cultivated croplands are expected to be the most common species at the THWRA. The federal Endangered Species Act (ESA) mandates protection of species listed as federally threatened or endangered and their associated habitats (ESA 1973).

### *Observed Wildlife*

Wildlife species and habitats likely to occur in the THWRA were examined through a search of existing data and the site visit. Available data used to identify wildlife resources within the THWRA included published literature, field guides, and public data sets, as well as the SDGFP and USFWS websites. Western EcoSystems Technology, Inc. (WEST) biologist conducted a site visit on February 26, 2016 to evaluate habitat, potential for bird migratory pathways, and to look for raptor nests, prey populations, and other biological resources, recording all wildlife species and habitat characteristics observed during the site visit.

A total of 11 avian species and a great horned owl nest were recorded during the site visit conducted in 2016 (Table 4), with snow goose and horned lark being the most common avian species observed. Numerous photographs were also taken of the THWRA (Appendix A).

**Table 4. Wildlife species observed at the Triple H Wind Resource Area and vicinity during the February 26, 2016 site visit .**

| Common Name | Scientific Name |
|---|---|
| **Passerines** | |
| horned lark | *Eremophila alpestris* |
| mourning dove | *Zenaida macroura* |
| red-winged blackbird | *Agelaius phoeniceus* |
| unknown sparrow | N/A |
| **Raptors** | |
| golden eagle | *Aquila chrysaetos* |
| great horned owl | *Bubo virginianus* |
| northern harrier | *Circus cyaneus* |
| unknown raptor | N/A |
| **Upland Game Birds** | |
| ring-necked pheasant | *Phasianus colchicus* |
| **Water Birds** | |
| snow goose | *Chen caerulescens* |
| unknown duck | N/A |
| **Mammals** | |
| black-tailed prairie dog | *Cynomys ludovicianus* |

### *Federally-Listed Species*

Six wildlife species listed as federally threatened (T) or endangered (E) under the ESA (ESA 1973) have been verified to occur or have the potential to occur in Hughes and Hyde Counties

(USFWS 2016b). This includes four federally listed avian species, one federally listed bat species, and one federally listed fish species (Table 5; USFWS 2016b). These six species are described in more detail below. One candidate (C) species possibly occurs as a migrant in Hyde County. Candidate species are not federally protected under the ESA, but some candidate birds are federally protected under the MBTA. However, since candidate species may become protected under the ESA within the life of the proposed project, they are addressed in this section (see Sprague's pipit).

**Table 5. Wildlife species listed as federally endangered (E), threatened (T), and candidate species by the US Fish and Wildlife Service (USFWS) with the potential to occur in the Triple H Wind Resource Area. Sources: Jennings et. al 2005; USFWS 2016b.**

| Common Name | Scientific Name | Federal Status | Likelihood of Occurrence in THWRA |
|---|---|---|---|
| **Mammals** | | | |
| northern long-eared bat | *Myotis septentrionalis* | T | Possible |
| **Birds** | | | |
| whooping crane[1] | *Grus americana* | E | Possible |
| red knot | *Calidris canutus rufa* | T | Unlikely |
| interior least tern[1] | *Sterna antillarum* | E | Possible |
| piping plover[1] | *Charadrius melodus* | T | Possible |
| Sprague's pipit | *Anthus spragueii* | C | Unlikely |
| **Fish** | | | |
| pallid sturgeon | *Scaphirhynchus albus* | E | No occurrence |

[1] Also listed as State threatened or endangered (SDDGFP 2015)

Northern Long-eared Bat

The northern long-eared bat (NLEB, *Myotis septentrionalis*) is found in the United States, from Maine to North Carolina on the Atlantic Coast, westward to eastern Oklahoma and north through part of South and North Dakota (USFWS 2016c). This species hibernates in caves and abandoned mines during winter. During the summer, individuals may roost alone or in small colonies beneath exfoliating bark, or in cavities or crevices of both live and dead trees (BCI 2015).

South Dakota contains 21 known northern long-eared bat hibernacula, all within the Black Hills, in western South Dakota, nine of which are abandoned mines (USFWS 2015d). Northern long-eared bats, including some pregnant females, have been captured during the summer along the Missouri River in South Dakota (Swier 2006, Kiesow and Kiesow 2010). Acoustic data recorded by bat monitoring stations operated by the South Dakota Department of Game, Fish, and Parks (SDDGFP) also detected the northern long-eared bat sporadically throughout the State (across 16 counties) in 2011 and 2012 (USFWS 2015d).

The USFWS recently determined that all operating wind facilities greater than 150 mi (241.4 km) from a cave with documented white-nose syndrome (WNS) would be exempt under rule 4d, and as currently understood, the Project falls within the 4d rule area for NLEB (greater than 150 mi from a cave with documented white nose syndrome; USFWS 2016k). The THWRA is located within the estimated range for the species (USFWS 2016c) and, as evidenced during to the site visit, suitable habitat features in the form of tall trees, abandoned buildings, riparian areas, and

caves are present throughout the proposed THWRA. Although WNS (caused by the fungus *Pseudogymnoascus destructans*) is the primary threat to northern long-eared bat populations (USFWS 2016c), there is additional concern about the impacts of wind facilities on bat species.

Due to its location, the presence of limited suitable habitat, and recorded occurrences of NLEB in the general vicinity of the Project, it is possible that this species occurs in the Project area during migration and/or summer (see Bats section).

Whooping Crane

The whooping crane (*Grus americana*) is a Federal and State endangered migratory species that prefers stopovers in croplands interspersed with palustrine wetlands (USFWS 2016e). The only self-sustaining wild population, with an estimated 308 whooping cranes (including 39 juveniles and 112 adult pairs) as of the winter of 2014-2015 (USFWS 2016e, USFWS 2016f), over-winters in the Texas Gulf Coast at the Aransas National Wildlife Refuge. The cranes then migrate north through Oklahoma, Kansas, Nebraska, and the Dakotas to breed in the Northwest Territories of Canada (USFWS 2016g). Each spring and fall, 95% of whooping crane sightings occur within a 180-mile (289-km) wide migration corridor along this route (Stehn 1998). The THWRA is within the 75 and 80% migration corridor (Figure 7; Stehn and Wassenich 2007).

Whooping cranes occasionally migrate with sandhill cranes (*Grus canadensis*), so stop-over sites used by sandhill cranes may be used to identify potential whooping crane stop-over areas (Canadian Wildlife Service [CWS] and USFWS 2007). The THWRA provides potentially suitable habitat for both sandhill and whooping crane species as it is primarily composed of herbaceous cover and cropland (62.3% and 33.4%, respectively), with interspersed streams and areas of open water (1.4% of the Project Area; Table 1). Although no whooping crane sightings have been documented within the THWRA, there have been eight confirmed sightings between 1991 and 2011 within 10 miles (16 km) of the current Project boundary (Cooperative Whooping Crane Tracking Project [CWCTP] 2014). In the spring of 2010, during crane monitoring at the Titan I Wind Facility in Hand County, South Dakota, approximately 6 mi (9.25 km) northeast of the Project boundary, a group of five whooping cranes spent three days approximately 2 mi (3.22 km) from the project. The closest they ever were on the ground from a turbine was 1.2 mi (2 km; Stehn 2011).

Whooping cranes generally migrate at 1,000-5,000 ft (305-1,524 m), altitudes well above turbine height (Stehn and Wassenich 2007); thus, for the most part, whooping cranes are unlikely to collide with turbines. However, whooping cranes ascend and descend during landing, or in inclement weather, they may fly at lower altitudes, sometimes within rotor swept areas. Because whooping cranes are so rare, it is very difficult to predict the probability of whooping cranes colliding with proposed turbines. Generally, risk is considered low due to low population numbers and the little amount of time they spend flying during migration within the rotor swept heights. Due to its location, the habitat features observed during the site visit surrounded by agricultural and grassland cover types and freshwater emergent wetlands, and the documented whooping crane sightings in the general area, it is likely that this species occurs within the THWRA, but not to a greater degree than the surrounding areas with similar habitat.

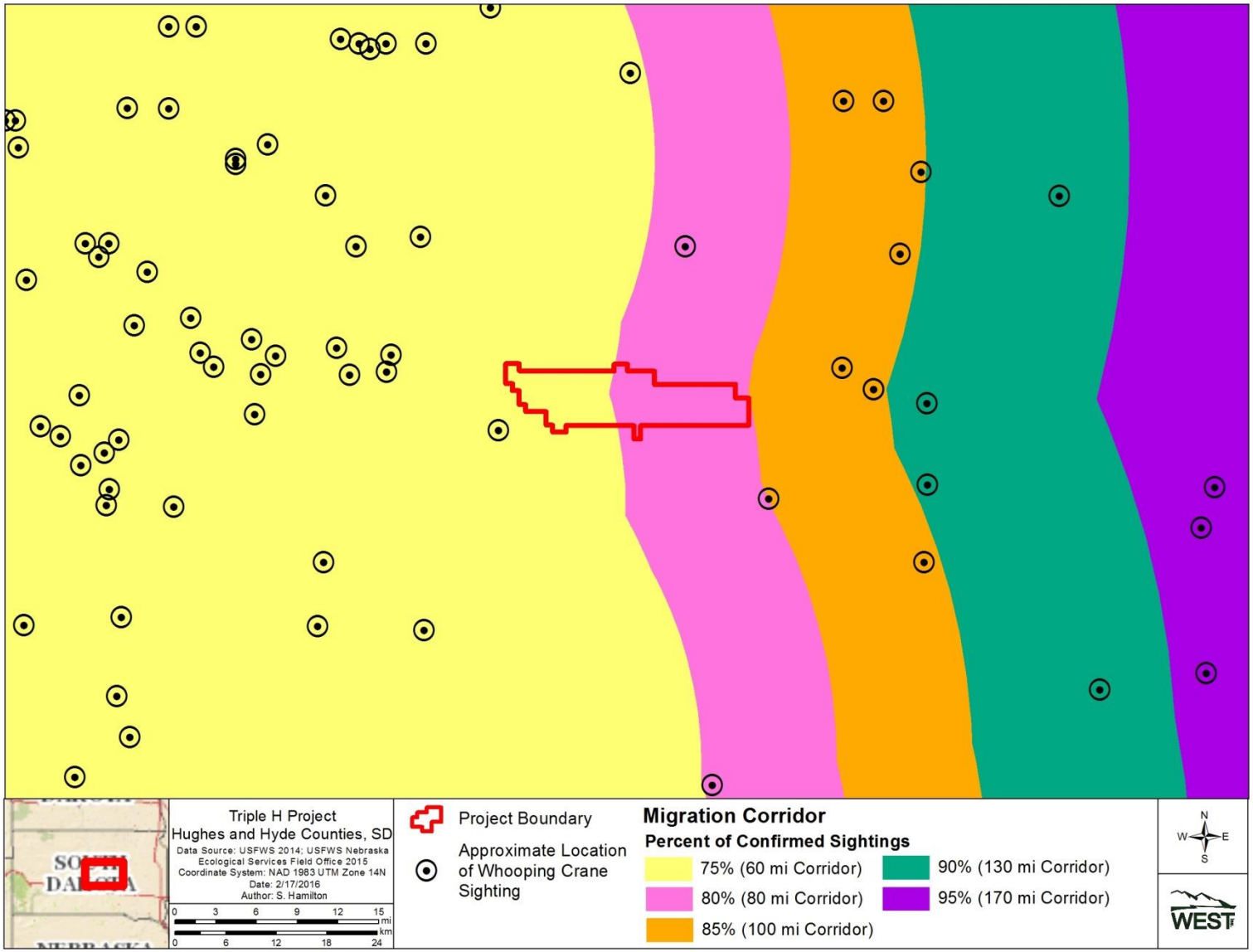


**Figure 7. Location of the Triple H Wind Resource Area, Hughes and Hyde Counties, South Dakota, in relation to the whooping crane migration corridor and whooping crane observations.**

Red Knot

The rufa red knot (*Calidris canutus rufa*) is a federally-listed threatened shorebird species that breeds in the tundra of the central Canadian Arctic and winters in Tierra del Fuego at the southern tip of South America (USFWS 2013b). Outside of its breeding grounds, it uses marine habitats such as estuaries and bays (USFWS 2015b). The red knot is a potential but infrequent migrant through the THWRA during spring and fall, however, potential of occurrence within the Project area is considered unlikely given the lack of confirmed observations in the region (eBird 2016) and lack of suitable stopover habitat within the THWRA.

Interior Least Tern

The Federally and State endangered least tern (*Sterna antillarum*), interior population, breeds along barren areas near water such as riverine inter-channel sandbars, salt marshes, or salt flats (NatureServe 2016a). These birds prefer open habitat, and tend to avoid thick vegetation and narrow beaches. Favorable nesting habitat includes sand and gravel bars within a wide unobstructed river channel or open flats along shorelines of lakes and reservoirs, away from disturbed areas and near plentiful sources of small fish, although they will forage up to 12 km (7.5. mi) from their nests (USFWS 2015c, NatureServe 2016). Ideal foraging areas include shallow water regions of lakes, ponds, and rivers (USFWS 2013a, NatureServe 2016a).

Least terns may occur anywhere in Hughes and Hyde Counties, South Dakota during migration or breeding along the Missouri River. Although no suitable nesting habitat was identified within the THWRA during the site visit conducted in February 2016, there is evidence of breeding activity of interior least terns within 13 mi (21 km) of the Project area (USFWS 2013a, 2015c). There is some potential for interior least terns to occur in the Project area when they migrate.

Piping Plover

The piping plover (*Charadrius melodus*) is a Federally and State threatened migratory shorebird that nests and forages along shorelines of small lakes, large beaches, river islands, or industrial pond shorelines. Wide beaches with sparse vegetation are preferred nesting habitat, while wintering habitat includes ocean beaches (NatureServe 2016b). The piping plover Northern Great Plains Distinct Population Segment (DPS) occupies sand and gravel bars and beaches along major rivers and around lakes, reservoirs, ponds, and alkali wetlands. In South Dakota, the species has been documented in Hughes County (SDDGFP 2015), one of the counties intersected by the THWRA.

Critical Habitat is designated along the Missouri River/Oahe Reservoir in Hughes County (USFWS 2002); this is the closest critical habitat to the THWRA (within about 20 mi [33 km] to the west of the Project boundary). There is very little information available about historic levels of breeding piping plovers prior to the 1980's. The 1988 Recovery Plan (USFWS 1988) documents historic breeding along the Missouri River and in alkaline wetlands in South Dakota. Although Oahe Reservoir supported approximately 19% of all Missouri River piping plovers from 1994 through 2004 (Aron 2005), recent surveys of off-river sites have found few birds nesting in alkaline wetlands throughout the State (USFWS 2009).

Inland nesting piping plovers are infrequently seen at suitable migration stopover points, indicating that they may fly non-stop to their Gulf of Mexico wintering areas (Johnson et al. 1997). Reports of piping plovers during migration are not common for the State, but do occur east and west of the THWRA (eBird.org 2016). Piping plovers are not known to breed within the THWRA, but they do breed in the vicinity of the Project along the Missouri River (Aron 2005). The February 2016 site visit indicated that emergent wetlands within the Project may provide limited suitable piping plover habitat during low water years (Table 2). Although unlikely, the potential for occurrence of breeding piping plovers exists based on suitable habitat present within and around the THWRA. Outside of the breeding period, this species may migrate over the Project area.

Sprague's Pipit

The Sprague pipit (*Anthus spragueii*), a former federal candidate species, is a declining ground nesting songbird that breeds and winters in open, contiguous grasslands that lack shrubs or trees. Breeding territories are established for both nesting and foraging, and are likely influenced by the size of grassland patches and the amount of grassland in the landscape (Jones 2010). Therefore, Sprague's pipit is an area sensitive species that is highly vulnerable to grassland degradation and fragmentation. Sprague's pipits may not be as tightly tied to native prairie in winter or migration as they are during the breeding season (Igl and Ballard 1999). The breeding range of Sprague's pipit in South Dakota is generally north of the THWRA; however the species may migrate through any portion of South Dakota using native and non-native habitats such as weedy fields, pastures, and grazed grasslands as stopover sites, and native, medium to intermediate height prairie with low visual obstruction as breeding territories (Davis 2004, USFWS 2014a).

Verified or potential occurrence of this species has been reported for Hyde County (USFWS 2016h, eBird 2016). The proposed Project might cause grassland habitat loss, alteration, and fragmentation, with negative effects on habitat suitability for Sprague's pipits. While large blocks of native prairie in the THWRA are limited and use of the Project area by breeding Sprague's pipits is unlikely, use of the Project area by migrant birds is possible.

Pallid Sturgeon

The pallid sturgeon (*Scaphirhynchus albus*) is a Federally and State endangered fish species adapted to sandy areas with fine substrates, floodplains, backwaters, chutes, sloughs, islands, sandbars, and main channel waters within large river ecosystems (USFWS 2014b). Major threats to this species are habitat alteration caused by channelization and dam construction, leading to the replacement of estuarine and flooded areas by permanent lakes and alteration of water flow and temperature. Although potential/verified occurrence of the pallid sturgeon has been reported for all counties that are contiguous with the Missouri River, including Hughes County, its geographic range falls outside the THWRA (USFWS 2013b). The pallid sturgeon can be found in the Missouri River, approximately 13.5 mi (21.7 km) southwest of the Project. Therefore, the pallid sturgeon will not be affected by the development and operations of the THWRA.

*South Dakota State-Listed Species*

Eight species ranked by the state of South Dakota as threatened or endangered are listed as occurring in Hughes and Hyde Counties (SDDGFP 2015), including three federally-listed avian species (whooping crane, interior least tern, and piping plover) and one federally-listed fish species (pallid sturgeon), discussed in the Federally-Listed Species section above. Of the remaining four species, two are mammals (swift fox [*Vulpes velox*] and northern river otter [*Lontra Canadensis*]), one is a fish (sicklefin chub [*Macrhybopsis meeki*]), and one is a reptile (false map turtle (*Graptemys pseudogeographica*; Table 6).

**Table 6. State of South Dakota threatened (T) or endangered (E) species with documented occurrence in Hughes and Hyde Counties. Sources: SDDGF 2015, USGS 2016.**

| Common Name | Scientific Name | State Status | Likelihood of Occurrence within the THWRA |
|---|---|---|---|
| **Mammals** | | | |
| Northern river otter | *Lontra canadensis* | T | Possible |
| swift fox | *Vulpes velox* | T | Unlikely |
| **Birds** | | | |
| whooping crane[1] | *Grus americana* | E | Possible |
| interior least tern[1] | *Sterna antillarum* | E | Possible |
| piping plover[1] | *Charadrius melodus* | T | Possible |
| **Fish** | | | |
| pallid sturgeon[1] | *Scaphirhynchus albus* | E | No occurrence |
| sicklefin chub | *Macrhybopsis meeki* | T | Unlikely |
| **Reptile** | | | |
| false map turtle | *Graptemys pseudogeographica* | T | Possible |

[1] Also a Federally listed species described in the Federally-listed Species section

Northern River Otter

The northern river otter (*Lontra canadensis*) can be found in various aquatic environments such as marshes, rivers, streams, and lakes. They require abundant riparian vegetation and prey, good water quality, limited disturbance, and year-round access to open water (SDDGFP 2016b).

Water development, fluctuating water levels in reservoirs, shoreline development, pesticide residue runoff and other contamination of wetlands, accumulation of toxic substances in otter prey, and alteration of riparian vegetation resulting in habitat loss and degradation, are considered major threats to the northern river otter (SDDGFP 2012). Waterbodies within the THWRA may provide marginal habitat for northern river otters. Whenever possible, project siting and development of the THWRA along waterbodies should consider minimization of ground disturbance and construction activity impacts by using already disturbed areas for placement of poles, avoiding removal of riparian vegetation, and avoiding construction of access roads adjacent to wetland and riparian habitats. With appropriate siting of infrastructure, any key features for otters can be avoided and negative effects can be minimized.

Swift Fox

The swift fox (*Vulpes velox*) relies on open, rolling mixed-grass and short grass prairies with little or no shrubs. They also inhabit areas of mixed agricultural use, but population densities are

lower in these areas. Prairie dog towns are a preferred habitat of swift fox, as they use burrows made by other mammals or dig their own burrows in sandy soils on high ground (NatureServe 2016c). Major threats to this species include loss of suitable native short and mixed-grass prairie due to conversion to agricultural and development. Herbaceous and agricultural areas within the THWRA, as well as prairie dog towns identified during the site visit, might provide suitable habitat for the swift fox. If swift foxes are present in prairie dog colonies immediately adjacent to the proposed Project area, direct impacts could include increased habitat loss and fragmentation from the disturbance of prairie dog colonies or complexes. Additional prairie dog town surveys are recommended within the proposed project area and, if found, they should be avoided to the extent possible to minimize disturbance to foxes and other species (i.e. raptors). Surveys for foxes may be required if the priaire dog complexes cannot be avoided by construction. However, based on a compilation of recent records and areas with established populations (Stratman 2015) and because the THWRA falls slightly outside of the species distribution (USGS 2016), it is unlikely that this species will occur in the THWRA.

Sicklefin Chub

The sicklefin chub (*Macrhybopsis meeki*), adapted to gravel and sand runs of large rivers with low to moderate gradients, such as the Missouri River, has experienced population declines as the result of habitat alteration caused by channelization, water diversion, and dam construction (NatureServe 2016d). No large rivers run through the THWRA, and the Missouri River is located 13.5 mi (21.7 km) south of the Project; therefore, it is unlikely that the sicklefin chub will occur in the THWRA and no direct impacts are anticipated.

False Map Turtle

The false map turtle (*Graptemys pseudogeographica*) occupies large rivers and associated oxbows, lakes, ponds, reservoirs, sloughs, and wetland. This species needs areas with abundant vegetation and soft substrates, and sites that are protected from shore predators for basking (Bandas and Higgins 2004). The greatest threats to survival are destruction of nesting habitat and nests by camping tourists, agricultural practices, and pollution. In South Dakota, numbers are decreasing due to several possible factors, including water pollution, river channelization, impoundments, reduction of suitable nesting sites, and unlawful shooting (NatureServe 2016e). Although the wetlands and streams within the THWRA represent potential habitat for the false map turtle, impacts can be minimized by proper siting of infrastructure and avoiding wetlands and waterbodies to the extent possible; therefore it is unlikely that the false map turtle will be negatively impacted as a result of the Project activities.

*Sensitive and Special-Status Plant Species*

Two federally Threatened plant species, the Leedy's roseroot (*Rhodiola integrifolia leedyi*) and the western prairie fringed orchid (*Platanthera praeclara*), are known to occur in South Dakota, neither of which has been documented in Hughes or Hyde Counties (USFWS 2016i, j). There are no State Threatened or Endangered plant species in South Dakota (SDGFPD 2015), and no State Rare Plant species occur within the THWRA based on documented occurrences (SDDGFP 2009).

*Species of Greatest Conservation Need (SGCN)*

In addition to the Federally and State-listed species noted above, there are several species identified as Species of Greatest Conservation Need (SGCN) by the SDDGFP's Wildlife Action Plan (SDDGFP 2014) that have the potential to occur in the THWRA. Only bird and bat SGCN are presented in Table 7, as these are the two groups most likely to be impacted by a wind facility.

One bat SGCN, the northern long-eared bat (NLEB, *Myotis septentrionalis*), has the potential to occur in the THWRA (Table 7), while nineteen bird SGCN have the potential to occur in the THWRA. Most of these avian species are also protected under the Migratory Bird Treaty Act (MBTA 1918), the federal Bald and Golden Eagle Protection Act (BGEPA 1940), or listed as Birds of Conservation Concern (BCC; Appendix C; USFWS 2008).

**Table 7. Birds and bats listed as South Dakota Species of Greatest Conservation Need with the potential to occur in the Triple H Wind Resource Area, based on distribution range maps. Federally and State-listed bird and bat species are included. Source: Jennings et al. 2005; USGS GAP 2016.**

| Common Name | Scientific Name | Spring | Summer | Fall | Winter |
|---|---|---|---|---|---|
| **Bats** | | | | | |
| northern long-eared bat[2] | *Myotis septentrionalis* | | X | | |
| **Birds** | | | | | |
| American white pelican | *Pelecanus erythrorhynchos* | | X | | |
| Baird's sparrow | *Ammodramus bairdii* | X | | X | |
| bald eagle | *Haliaeetus leucocephalus* | X | X | X | X |
| black tern[1] | *Chlidonias niger* | | X | | |
| burrowing owl | *Athene cunicularia* | | X | | |
| chestnut-collared longspur[1] | *Calcarius ornatus* | | X | | |
| ferruginous hawk | *Buteo regalis* | X | X | X | X |
| greater prairie-chicken | *Tympanuchus cupido* | X | X | X | X |
| interior least tern[2] | *Sterna antillarum athalassos* | | X | | |
| lark bunting | *Calamospiza melanocorys* | | X | | |
| LeConte's sparrow | *Ammodramus leconteii* | X | | X | |
| marbled godwit[1] | *Limosa fedoa* | X | | X | |
| northern goshawk | *Accipiter gentilis* | | | | X |
| osprey | *Pandion haliaetus* | X | | X | |
| piping plover[2] | *Charadrius melodus* | | X | | |
| Sprague's pipit | *Anthus spragueii* | X | X | X | |
| whooping crane[2] | *Grus americana* | X | | X | |
| willet | *Catoptrophorus semipalmatus* | | X | | |
| Wilson's phalarope | *Phalaropus tricolor* | | X | | |

[1]Observed during BBS surveys in two closest routes (Pardieck et al. 2015)
[2]Also a Federal and/or State listed species described in the Federally-listed or State-listed Species section

*Raptors*

A desktop assessment of potential raptor roosting habitat, prey base, and species distributions was used to determine which raptor species have the potential to occur within the THWRA

(Table 8). Three raptor species (golden eagle, northern harrier, and great-horned owl) were observed during the February 2016 field visit.

Bald Eagle

The bald eagle (*Haliaeetus leucocephalus*), a species protected under the Bald and Golden Eagle Protection Act (BGEPA 1940), occurs in South Dakota as a resident (BirdLife International and NatureServe 2014), utilizing suitable areas year-round, with verified and potential occurrences reported for Hughes and Hyde Counties (eBirds 2016, NatureServe 2016f). Preferred nesting, foraging, and roosting bald eagle habitats include large, mature trees near water with abundant fish and waterfowl prey, especially in areas with little disturbance. Preferred perch sites include tall trees and snags located near nesting and foraging areas that provide good vantage points, while nests and foraging activities are usually associated with permanent water bodies (Buehler 2000, All About Birds 2016). There are multiple lakes and rivers within and/or adjacent to the Project that provide suitable nesting and wintering habitat for bald eagles. Furthermore, the Project is approximately 13.5 mi (21.7 km) northeast of the Missouri River, which serves as a migration corridor and provides suitable nesting and wintering habitat for bald eagles. Sightings of bald eagles are common along the Missouri River, near Oahe Reservoir (eBird 2016).

According to this desktop analysis, bald eagle use and/or nesting within the vicinity of the Project are likely. Surveys would be necessary to define actual eagle use, inform siting, and estimate potential impacts to bald eagles.

**Table 8. Raptor species with the potential to occur in the Triple H Wind Resource Area, based on range maps. Federally and State-listed bird species are included. Source: Jennings et al. 2005.**

| Common Name | Scientific Name | Spring | Summer | Fall | Winter |
|---|---|---|---|---|---|
| **Vultures** | | | | | |
| turkey vulture | *Cathartes aura* | | X | | |
| **Osprey, Eagles, Kites, and Hawks** | | | | | |
| bald eagle | *Haliaeetus leucocephalus* | X | X | X | X |
| broad-winged hawk | *Buteo platypterus* | X | | X | |
| Cooper's hawk | *Accipter cooperii* | | | | X |
| ferruginous hawk[1] | *Buteo regalis* | X | X | X | X |
| golden eagle* | *Aquila chrysaetos* | | | | X |
| northern goshawk[1] | *Accipiter gentilis* | | | | X |
| northern harrier* | *Circus cyaneus* | | X | | |
| osprey[1] | *Pandion haliaetus* | X | | X | |
| red-tailed hawk | *Buteo jamaicensis* | X | X | X | X |
| tough-legged hawk | *Buteo lagopus* | | | | X |
| sharp-shinned hawk | *Accipter striatus* | | | | X |
| Swainson's hawk[2] | *Buteo swainsoni* | | X | | |
| **Falcons** | | | | | |
| American kestrel | *Falco sparverius* | X | X | X | X |
| merlin | *Falco columbarius* | | | | X |
| peregrine falcon | *Falco peregrinus* | X | | X | |
| prairie falcon | *Falco mexicanus* | | | | X |
| **Owls** | | | | | |
| burrowing owl[1] | *Athene cunicularia* | | X | | |
| Eastern screech-owl | *Megascops asio* | X | X | X | X |
| great horned owl* | *Bubo virginianus* | X | X | X | X |
| long-eared owl | *Asio otus* | | X | | |
| Northern saw-whet owl | *Aegolius acadicus* | | | | X |
| short-eared owl | *Asio flammeus* | X | X | X | X |

*Observed during February 2016 site visit to THWRA
[1]SGCN birds
[2]Observed during BBS surveys in two closest routes (Pardieck et al. 2015)

Golden Eagle

The golden eagle (*Aquila chrysaetos*), a federally protected species under the BGEPA (1940), usually hunts on the rimrock terrain of open grassland areas and nest on cliffs near open foraging areas such as grasslands or shrublands (Kochert et al. 2002). Observations of golden eagles have been reported in South Dakota during spring, fall, and winter (eBird 2016), with the majority of sightings in the vicinity of the Project area reported during the winter season (National Audubon Society [Audubon] 2010). During the site visit, suitable foraging and roosting habitat for this raptor species, such as tall trees within open grasslands, was found in the THWRA. Additionally, one golden eagle was observed perched in a tree between a crop field and a grassland during the site visit to THWRA.

Potential impacts for this species resulting from project development and operation include loss or disturbance of nesting, roosting, and foraging habitat, loss of nests, and collision with turbines and/or transmission lines. There have been documented golden eagle fatalities at wind energy facilities in the United States (Erickson et al. 2001), and the USFWS has expressed increasing concern regarding the potential effects of wind energy development on golden eagle populations (Pagel et al. 2010). Results from this desktop analysis and site visit indicate a golden eagle use within the THWRA. Similar to bald eagles, field surveys would be required to determine actual use levels and inform potential impact assessments further.

Other Raptor Species with Potential to Occur in the Area

Sixteen diurnal raptors, one vulture, and six owls have the potential to occur as residents and/or migrant species in the THWRA at some point during the year. One of these diurnal raptors, the northern harrier, was observed during the site visit conducted in February 2016 (Table 4).

Of the 16 diurnal raptors with potential to occur in the THWRA, five species are likely to nest within or around the Project area (Jennings et al. 2005): Ferruginous hawk (*Buteo regalis*), northern harrier (*Circus cyaneus*), red-tailed hawk (*Buteo jamaicensis*), Swainson's hawk (*Buteo swainsoni*), and American kestrel (*Falco sparverius*). Turkey vultures (*Cathartes aura*) are also summer residents (Jennings et al. 2005; Table 8). Broad-winged hawk (*Buteo platypterus*), osprey (*Pandion haliaetus*), and peregrine falcon (*Falco peregrinus*) are possible migrants through the THWRA. In addition to the species listed above, raptor species that may occur within the THWRA outside of the breeding season (migration, winter, or post-breeding dispersal) include: bald eagle, Cooper's hawk (*Accipter cooperii*), golden eagle, northern goshawk (*Accipiter gentilis*), rough-legged hawk (*Buteo lagopus*), sharp-shinned hawk (*Accipter striatus*), merlin (*Falco columbarius*), and prairie falcon (*Falco mexicanus*). Several of these raptor species are considered Species of Greatest Conservation Need (SPGN) by the state of South Dakota (Tables 7 and 8).

Of the eight owl species potentially occurring in the Project area, five have the potential to nest within the THWRA or vicinity (Jennings et al. 2005): burrowing owl (*Athene cunicularia*), eastern screech-owl (*Megascops asio*), great horned owl (*Bubo virginianus*), long-eared owl (*Asio otus*), and short-eared owl (*Asio flammeus*). One great horned owl was observed sitting on a nest approximately three miles south of the project boundary during the February 2016 site visit. The northern saw-whet owl (*Aegolius acadicus*) is a possible winter resident (Jennings et al. 2005).

*Potential for Raptor Migration in the Area*

Several factors influence the migratory pathways of raptors, the most significant of which is geography. Two geographical features often used by raptors during migration are ridgelines and shorelines of large bodies of water (Liguori 2005). The up drafts formed as the wind hits the ridges and thermals created over land (but not water) make for energy-efficient travel for raptors over long distances (Liguori 2005). It is for this reason that raptors often follow corridors or pathways (e.g., along prominent ridges with defined edges) during migration. Topography in the THWRA is relatively flat to gently rolling hills (Figures 2 and 3). None of the features of the THWRA are likely to concentrate raptors; however, the THWRA is located within the Central

Flyway avian migratory corridor used by raptors, and wetlands and water impoundments may provide some stopover and/or foraging habitat for raptors that migrate through the area.

*Potential Raptor Nesting Habitat*

Within the THWRA, trees and woodland areas occur around wetlands, streams, and houses, providing potential nesting opportunities for some raptor species. Raptors may also nest on man-made structures, such as power poles associated with power lines and structures associated with transmission lines, both of which are present in the Project area. Ground-nesting raptors, such as burrowing owls and northern harriers, may nest in the grassland areas located throughout the THWRA. One great horned owl was observed sitting on a nest located approximately 3.5 mi (5 km) south of the Project boundary during the February 2016 site visit.

*Areas of Potentially High Prey Density within the Triple H Wind Resource Area*

Studies at some wind energy facilities indicate that individual raptor species appear to differ from one another in their susceptibility to collision (National Research Council [NRC] 2007). Results from the Altamont Pass Wind Energy Facility (APWRA) suggest that mortality for some species is not necessarily related to abundance, possibly implying that the variance in susceptibility may be in part due to behavioral differences between species (Orloff and Flannery 1992). Orloff and Flannery (1992, 1996) suggested that high golden eagle mortality at the APWRA was in part due to the apparently high densities of California ground squirrels (*Spermophilus beecheyi*) in the area (Thelander and Smallwood 2007). Continued research at APWRA revealed that the degree of aggregation of Botta's pocket gopher (*Thomomys bottae*) burrows around the turbines was positively correlated to red-tailed hawk fatality rates (Smallwood et al. 2001, Thelander and Smallwood 2007, Thelander et al. 2003).

Rodents and lagomorphs are the prey species most likely to occur within the THWRA as these types of prey are associated with grassland and prairie habitats. Prairie dog towns, as well as other areas of colonial small mammals (e.g., ground squirrels), are known to attract foraging raptors. Prairie dog colonies are important foraging grounds for several raptor species likely to occur at the site, including red-tailed hawk, northern harrier, and Swainson's hawk. Hunting raptors may be concentrated year-round in the vicinity of prairie dog towns. Black-tailed prairie dogs (*Cynomys ludovicianus*) and eastern cottontails (*Sylvilagus floridanus)* as well as other prey species have the potential to occur within the THWRA based on USGS GAP range maps (USGS GAP 2016).

Black-tailed prairie dog towns provide hunting opportunities for eagles and may increase the risk for raptors. Some raptors are susceptible to collision with wind turbines, especially while hunting (Hoover and Morrison 2005). Prairie dog colonies are important foraging grounds for several raptor species likely to occur at the THWRA, including golden eagle, ferruginous hawk, red-tailed hawk, northern harrier, and Swainson's hawk. Foraging raptors may be concentrated in the vicinity of prairie dog towns year-round. Two prairie dog colonies were observed on the southern and eastern boundaries of the THWRA during the February 2016 site visit; one colony was located on the Huron Wetland Management District – Waterfowl Production Area, and the other was located on private property. Additionally, not all areas identified as potential habitat

were visible from existing, passable public roads. Placing setbacks from all prairie dog colonies may help reduce the risk of collision for raptors and eagles. It is generally recommended that active prairie dog colonies be avoided to the maximum extent possible when siting wind energy facilities.

In addition to lagomorphs and large colonial rodents, smaller rodent (e.g., mice, rats), bird, and shrew species associated with grassland/pasture or agricultural areas likely occur in the area. Ponds, wetlands, and flooded areas may concentrate waterfowl, waterbirds, and shorebirds in wet years when water is abundant. If flooded depressions are used by large concentrations of these species, then they may serve as an attractant to some foraging raptors, especially those that often feed on waterfowl and/or shorebirds (e.g., bald eagle, golden eagle, peregrine falcon, and prairie falcon). Because these water systems are heavily dependent on rainfall patterns, their ability to support concentration of prey species and foraging raptors will likely vary significantly from year to year.

It should also be noted that prey densities can fluctuate dramatically based on habitat and climatic factors, and are likely to change over time. With raptor roost sites (e.g., trees and power poles) and food available, it is likely that some raptors will use the THWRA for foraging.

*Bird Migration*

Most species of birds are protected by the Migratory Bird Treaty Act (MBTA 1918). Nocturnal migrating passerines are assumed to move in broad fronts across inland landscapes rather than along specific topographical features (Gauthreaux et al. 2003, NRC 2007). Large numbers of passerines have collided with lighted communication towers and buildings when foggy conditions and spring or fall migration coincide. Birds appear to become confused by the lights during foggy or low ceiling conditions and fly in circles around lighted structures until they become exhausted or collide with the structure (Erickson et al. 2001). Most collisions at communication towers are attributed to the guy wires on these structures, which wind turbines do not have.

Many species of songbirds migrate at night and may collide with tall man-made structures, though no large mortality events have been documented at wind energy facilities in North America on the same scale as those mortality events observed at communication towers (National Wind Coordinating Collaborative [NWCC] 2004).

The THWRA is located within the Central Flyway and it is likely that birds including passerines, raptors, and waterfowl migrate through the proposed Project area. Wetlands and grasslands found within the THWRA may provide stopover habitat for migrants or individuals during post-breeding dispersal. The combination of wetlands and grasslands found in the THWRA may be attractive to a broader suite of birds than when only one of these land cover types occurs. Additionally, corn fields, one of the harvested crops present within the THWRA, typically serve as feeding areas for migrating and wintering waterfowl. However, concentrated bird use within the Project area is unlikely as the habitats within the THWRA are similarly distributed throughout the immediate surrounding areas.

The Hyde County Waterfowl Production Area, located adjacent to the southern edge of the project boundary (Table 3), has the potential to attract waterfowl to the general area, which may result in increased risk of collision with turbines. Cultivated crop lands may provide food in the form of wasted grains for migrating birds, such as sandhill cranes and geese. Emergent wetlands and small ponds are also utilized for foraging and reproduction by resident bird species which have been observed on Breeding Bird Survey Routes (see Breeding Bird Section) near the THWRA. It's possible that large numbers of waterfowl may concentrate around the local waterbodies; therefore, locating turbines as far from lakes as possible will reduce the potential for collisions and will also minimize the risk of disturbing lakes and their complexes. Overall impacts are expected to be similar to other projects in the Midwest.

**Breeding Birds**

Displacement of grassland nesting birds is often one of the primary concerns wildlife agencies express regarding the placement of wind facilities in and near grassland areas. Recent research has focused on the potential displacement of grassland passerines at wind energy facilities, and some uncertainty currently exists over the effects of wind energy facilities on the breeding success of these birds. In Minnesota, researchers found that breeding passerine density on CRP grasslands was reduced in the immediate vicinity of turbines (Leddy et al. 1999), but changes in density at broader scales were not detected (Johnson et al. 2000). Piorkowski (2006) conducted a displacement study at a wind energy facility in Oklahoma where, of the grassland species present in the proposed wind resource area, only the western meadowlark showed significantly lower densities near turbines. Piorkowski (2006) suggested that habitat characteristics were more important to determining passerine breeding densities than the presence of wind turbines. Shaffer and Buhl (2015) documented some avoidance by some grassland nesting species out to 300 m (985 ft) at wind energy facilities in North and South Dakota. The proposed THWRA contains a grassland/herbaceous cover, with the potential to support grassland sensitive species that may be negatively affected by development. Species potentially affected include several grassland obligate species and area sensitive species such as the burrowing owl, McCown's longspur (*Calcaneus mccownii*), and Baird's sparrow (*Ammodramus bairdii*; Ribic et al. 2009).

*Important Bird Areas*

Passerines are the most abundant bird group in most terrestrial ecosystems and are the most often reported fatalities at wind energy facilities (NRC 2007). The National Audubon Society (Audubon) has identified Important Bird Areas (IBAs) that provide essential habitat for one or more bird species (Audubon 2015). The IBAs include sites for breeding, wintering, and/or migrating birds, and can range from only a few acres to thousands of acres in size. The closest IBA to the Project area is the Fort Pierre National Grassland located 22.1 mi (35.6 km) southwest of the Project boundary. Other IBAs within 35 mi (56 km) of the THWRA include: Pierre Missouri River Bottomlands, Stone Lake Outwash Area, and Wolsey Crane Stopover Area (Audubon 2015).

*USFWS Birds of Conservation Concern*

The USFWS lists 27 Birds of Conservation Concern (BCC) species within the Prairie Potholes Bird Conservation Region 11 (BCR 11; Appendix C; USFWS 2008). These species are protected under the Migratory Bird Treaty Act (MBTA 1918), but do not receive any greater protection than other migratory birds unless they are also listed by the USFWS under the ESA (1973) or BGEPA (1940). However, these species have been identified as vulnerable to population declines in the BCR by the USFWS (2008).

The potential exists for some of these species to breed within suitable habitats in the THWRA, including the American bittern (*Botaurus lentiginosus*), least bittern (*Ixobrychus exilis*), Swainson's hawk, upland sandpiper (*Bartramia longicauda*), marbled godwit (*Limosa fedoa*), black tern (*Chlidonias niger*), black-billed cuckoo (*Coccyzus erythropthalmus*), short-eared owl, red-headed woodpecker (*Melanerpes erythrocephalus*), Sprague's pipit (*Anthus spragueii*), grasshopper sparrow (*Ammodramus savannarum*), chestnut-collared longspur (*Calcarius ornatus*), and dickcissel (*Spiza Americana*; Jennings et al. 2005). Although not recently recorded along nearby routes during BBS, there is potential for breeding bald eagles within the Project area (see Bald Eagle Section). The remaining BCC raptor, the peregrine falcon, is not likely to breed in the THWRA (Jennings et al. 2005). The remaining BCC species (Appendix C) are a mix of shorebirds, marsh birds, waterfowl, and passerines.

*USGS Breeding Bird Survey*

The two nearest USGS Breeding Bird Survey (BBS) Routes to the THWRA are the Crow Creek Route to the southeast and the Fort Thompson Route to the south (Figure 8; USGS 2014). Each BBS route is about 24.5 mi (39.4 km) long, and all birds seen or heard are tallied for a 3-minute period at survey points located every half-mile (0.8 km) along the route (USGS 1998).

From 2011 to 2014, 86 bird species have been recorded along the two BBS Routes (Pardieck et al. 2015). No currently designated Federal or State endangered or threatened species has been recorded. In 2011, 2,242 individual birds of 80 species were observed along the two routes surveyed (1,146 individuals of 65 species in Crow Creek and 1,096 birds of 53 species in Fort Thompson; Pardieck et al. 2015). The most abundant species observed were the brown-headed cowbird (*Molothrus ater*; 290 individuals), western meadowlark (*Sturnella neglecta*; 244 individuals), common grackle (*Quiscalus quiscula;* 196 individuals), dickcissel (*Spiza americana*; 174 individuals), red-winged blackbird (*Agelaius phoeniceus*; 156 individuals), mourning dove (*Zenaida macroura*; 134 individuals), and cliff swallow (*Hirundo rustica*; 108 individuals).

Ten BCC (USFWS 2008) species have been observed along the Crow Creek and/or Fort Thompson route (American bittern, black tern, chestnut-collared longspur, dickcissel, grasshopper sparrow, marbled godwit, red-headed woodpecker, Swainson's hawk, upland sandpiper; Appendix C).

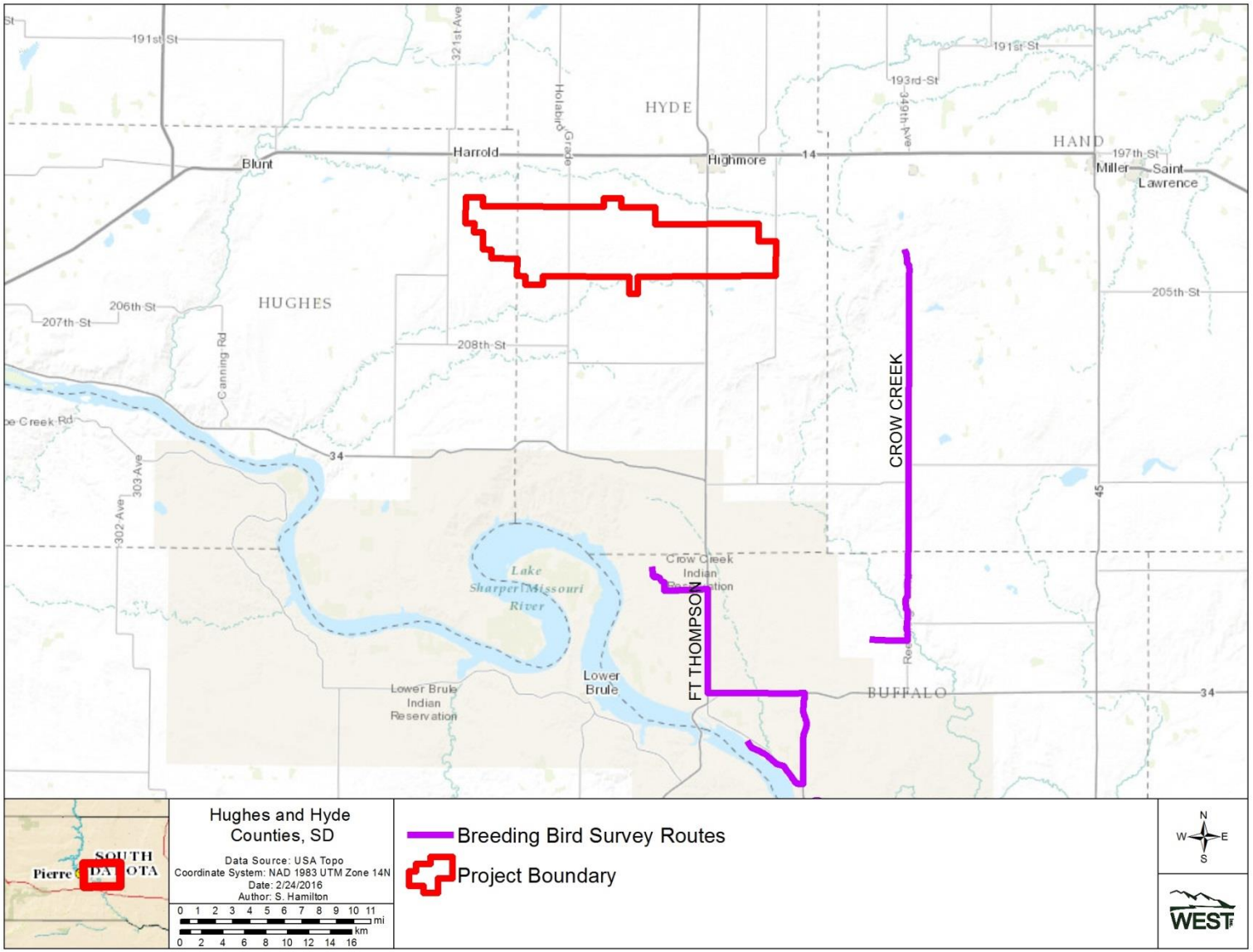


**Figure 8. Nearest US Geological Survey Breeding Bird Survey routes to the Triple H Wind Resource Area (USGS 2014).**

*Bats*

Based on range maps (BCI 2015; USGS GAP 2016), eight bat species are possible residents and/or migrants in the THWRA (Table 9). Two of the eight species in Table 9 are included due to range (BCI 2015), but are unlikely to occur in the THWRA based on habitat restrictions: the Townsend's big-eared bat (*Corynorhinus townsendii*) and the western small-footed myotis (*Myotis ciliolabrum*). The six remaining species that have potential to occur in the THWRA based on range maps (Table 9) have been documented as fatalities at wind energy facilities: big brown bat (*Eptesicus fuscus*), eastern red bat (*Lasiurus borealis*), hoary bat (*Lasiurus cinereus*), little brown bat (*Myotis lucifugus*), northern long-eared bat (*Myotis septentrionalis*), and silver-haired bat (*Lasionycteris noctivagans*; Table 9 and 10).

**Table 9. Bat species with the potential to occur in the Triple H Wind Resource Area based on range maps (BCI 2015).**

| Species | Scientific Name | Habitat | Likelihood of Occurrence |
|---|---|---|---|
| big brown bat[1] | *Eptesicus fuscus* | Common in most habitats; abundant in deciduous forests and suburban areas with agriculture; maternity colonies beneath bark, or in tree cavities, buildings, barns, or bridges. | Probable |
| eastern red bat[1] | *Lasiurus borealis* | Abundant tree bat; roosts in trees; solitary, prefers forested environments | Probable |
| hoary bat[1] | *Lasiurus cinereus* | Usually not found in human-made structures; roosts in trees along forest borders; very wide-spread. | Probable |
| little brown myotis[1] | *Myotis lucifugus* | Found in a wide variety of habitats. Especially associated with humans, often using buildings, attics, and other man-made structures for nursery colonies. Roost in tree cavities and crevices, and forage over meadows, farmland, and cliff faces. | Probable |
| northern long-eared bat[1,2,3] | *Myotis septentrionalis* | Found roosting beneath exfoliating bark and in tree cavities. Hibernates in caves and underground mines. | Possible |
| silver-haired bat[1] | *Lasionycteris noctivagans* | Common bat in forested areas, particularly old growth forests; maternity colonies in tree cavities or hollows; hibernates beneath exfoliating bark, in wood piles, and in cliff faces. | Probable |
| Townsend's big-eared bat[2] | *Corynorhinus townsendii* | Commonly found in arid desert scrub and pine forests; maternity colonies in mines, caves, and buildings; hibernates in caves and abandoned mines. | Unlikely |
| western small-footed myotis | *Myotis ciliolabrum* | Hibernates in caves or mines. Rears young in cliff-face crevices, erosion cavities, and beneath rocks on the ground. | Unlikely |

[1] Known wind energy facility fatality (Derby et al. 2010, Derby et al. 2012, DeWitt 2011, Fiedler et al. 2007, Hale and Karsten 2010, Johnson et al. 2000, 2004, Krenz et al. 2000, Miller 2008, Osborn et al. 1996, 2000, Piorkowski et al. 2010, Thompson 2011)

[2] Species of Greatest Conservation Need (SGCN; Aron 2005)

[3] Federally-listed Species (USFWS 2016)

Of the eight potentially occurring species listed in Table 9, two species of bats are considered Species of Greatest Conservation Need (SGCN) in South Dakota: Townsend's big-eared bat and northern long-eared bat (Table 7). While no known Townsend's big-eared bat fatalities at wind energy facilities have occurred, there are known northern long-eared bat wind facility fatalities (Table 10). The northern long-eared bat is also federally listed as threatened under the Endangered Species Act (ESA) by the USFWS (Table 5).

**Table 10. Summary of public cumulative bat fatalities (by species) from wind energy facilities in North America.**

| Common Name | Scientific Name | # Fatalities[1] | % Composition |
|---|---|---|---|
| hoary bat[2] | *Lasiurus cinereus* | 5,486 | 36.22 |
| eastern red bat[2] | *Lasiurus borealis* | 3,711 | 24.5 |
| silver-haired bat[2] | *Lasionycteris noctivagans* | 2,592 | 17.11 |
| little brown bat | *Myotis lucifugus* | 1,141 | 7.53 |
| tri-colored bat[2] | *Perimyotis subflavus* | 644 | 4.25 |
| big brown bat[2] | *Eptesicus fuscus* | 581 | 3.84 |
| Mexican free-tailed bat[2] | *Tadarida brasiliensis* | 515 | 3.4 |
| unidentified bat | *N/A* | 330 | 2.18 |
| northern long-eared bat | *Myotis septentrionalis* | 46 | 0.3 |
| unidentified Myotis | *N/A* | 39 | 0.26 |
| Seminole bat | *Lasiurus seminolus* | 14 | 0.09 |
| western red bat | *Lasiurus blossevillii* | 13 | 0.09 |
| Indiana bat | *Myotis sodalis* | 7 | 0.05 |
| evening bat[2] | *Nycticeius humeralis* | 7 | 0.05 |
| big free-tailed bat | *Nyctinomops macrotis* | 6 | 0.04 |
| western yellow bat | *Lasiurus xanthinus* | 3 | 0.02 |
| unidentified free-tailed bat | *N/A* | 3 | 0.02 |
| eastern small-footed bat | *Myotis leibii* | 2 | 0.01 |
| pocketed free-tailed bat | *Nyctinomops femorosaccus* | 2 | 0.01 |
| unidentified Lasiurus bat | *Lasiurus spp.* | 2 | 0.01 |
| canyon bat | *Parastrellus hesperus* | 1 | 0.01 |
| cave Myotis[2] | *Myotis velifer* | 1 | 0.01 |
| long-legged bat | *Myotis volans* | 1 | 0.01 |
| **Total** | **19** | **15,147** | **100** |

[1] These are raw data and are not corrected for searcher efficiency or scavenging.

[2] Potential resident or migrant in the WPWRA (BCI 2015).

Cumulative fatalities and species from data compiled by Western EcoSystems Technology, Inc. (WEST) from publicly available fatality documents (listed in Appendix D).

Additional notes on bat species and numbers:

Indiana bat fatalities in this table are also reported by USFWS (2010, 2011a). Three additional Indiana bat fatalities have been reported in USFWS Press releases (2011b, 2012b, 2012c), but are not included in this summary of bats found as fatalities.

One long-eared bat (*Myotis evotis*) was an incidental fatality recorded at Tehachapi, California (Anderson et al. 2004), but was not part of a formal search and is not included above.

An additional 677 bat fatalities (evening bat, eastern red bat, hoary bat, tricolored bat, Mexican free-tailed bat, and unidentified bat) have been found in Texas (Hale and Karsten 2010), but the number of fatalities by species is not reported.

Canyon bat formerly known as western pipistrelle (*Pipistrellus hesperus*; BCI 2015), and tricolored bat formerly known as eastern pipistrelle (*Pipistrellus subflavus*; BCI 2015).

The field visit conducted in February 2016 revealed some potential natural roosts in the form of mature tree stands with exfoliating bark near drainages (Appendix A). The larger cottonwood trees near streams may provide roosting habitat for several species which generally prefer to roost under the bark or in the foliage of larger trees. Numerous human-built barns, sheds, and other structures may provide suitable day, night, maternity, and bachelor roosts for bats during the summer or during migratory stop-overs. Several structures were located in close proximity to, or surrounded by, tree stands, providing alternate roosts for a bat colony. Although limited, several derelict man-made structures were also located near suitable drinking water sources in the form of still drainages, standing pooled water and flooded areas, and farm ponds. Stock tanks, found throughout the THWRA, also have potential to concentrate bats as they are usually reliable water sources year-round regardless of precipitation.

Bats generally forage over water and other open spaces, such as agricultural fields, grasslands, streams, and wetlands (Lee and McCracken 2002, Downs and Sanderson 2010). Because the THWRA is largely comprised of agricultural fields and grasslands, potential foraging habitat is present throughout the Project area. Insects often concentrate over wet areas associated with wetlands and streams, which may in turn concentrate foraging bats. Wooded areas adjacent to streams, open water areas, tree lines, and riparian areas provide areas of suitable foraging habitat for bats within the THWRA. Bat use is likely to be greatest in areas around ponds and wetlands when these areas have some available water, as bats would likely concentrate around these features to forage and drink. No bat hibernacula are known to occur in the area.

Bat casualties have been reported from most wind energy facilities where post-construction fatality data are publicly available. Reported estimates of bat mortality at wind energy facilities have ranged from 0.01 – 47.5 fatalities per turbine per year (0.9 – 43.2 bats per megawatt [MW] per year) in the US, with an average of 3.4 per turbine or 4.6 per MW (NWCC 2004). A majority of the bat casualties at wind energy facilities to date are migratory species that conduct long migrations between summer roosts and winter areas. The species most commonly found as fatalities at wind energy facilities include hoary bat, silver-haired bat (*Lasionycteris noctivagans*), and eastern red bat (*Lasiurus borealis*; Johnson 2005) (Table 10). To date, the highest numbers of bat fatalities found at wind energy facilities have occurred in eastern North America on ridge tops dominated by deciduous forest (NWCC 2004). However, Gruver et al. (2009), Barclay et al. (2007), and Jain (2005) recently reported relatively high fatality rates from facilities in Wisconsin, Canada, and Iowa that were located in grassland and agricultural habitats. Unlike the eastern U.S. wind energy facilities that reported higher bat fatality rates, the Wisconsin, Alberta and Iowa facilities are in open grasslands and crop fields. Based on data from other wind energy facilities in North America (Table 10), the most likely species to be impacted are the hoary bat and eastern red bat, with other migratory species also having some potential for impacts, although likely at lower levels.

Several studies have shown that bat fatalities peak in late summer and early fall, coinciding with the migration of many species (Johnson 2005; Kunz et al. 2007a; Arnett et al. 2008). A smaller spike in bat fatalities occurs during spring migration for some species at some facilities (Arnett et al. 2008). Operation of the proposed THWRA will likely result in some bat mortality. While the

magnitude of these fatalities and the degree to which bat species will be affected is difficult to determine, they should be within the average range of bat mortalities found throughout the Midwest and South Dakota based on general vegetation and landscape characteristics. Within the THWRA, the fall migration season will likely have the highest wind turbine-caused fatalities caused by collisions with moving turbine blades (Grodsky et al. 2011; Rollins et al. 2012) and barotrauma (Baerwald 2008).

## Summary

As described in the Final Land-based Wind Energy Guidelines (WEG) (USFWS 2012a), Tier 1 and 2 studies help to identify potential issues that may need to be addressed before further actions can be taken with the development or operations of a project. The following discussion provides answers to the WEG's Tier 1 and 2 questions for the THWRA.

1. *Are there known species of concern present on the proposed site, or is habitat (including designated critical habitat) present for these species?*

   Six species protected under the federal ESA (1973) have potential to occur within the counties containing the THWRA (SDDGFP 2015, USFWS 2016b; Appendix B): northern long-eared bat, piping plover, whooping crane, red knot, interior least tern, and pallid sturgeon. Of these, the whooping crane, piping plover, interior least tern, and red knot may possibly migrate through the area. The northern long-eared bat also has the potential to be a summer resident within the THWRA and occur during migration. The pallid sturgeon is unlikely to occur in the THWRA. Additionally, year-round bald eagle use is possible within the THWRA, while golden eagles are likely to use the Project area during the winter, as evidenced during the site visit. Avian use surveys are needed to define actual eagle use, inform siting, and estimate potential impacts to bald eagles.

   No designated critical habitat occurs within the THWRA. Further habitat assessment would delineate potential habitat for sensitive species in order to help inform siting decisions to avoid and minimize impacts.

2. *Does the landscape contain areas where development is precluded by law or designated as sensitive according to scientifically credible information?*

   The THWRA is located mostly on private land. There are two State Trust Lands within the boundary of the THWRA, and two other protected areas are located within 10 mi (16 km) of the THWRA. Huron Wetland Management District - Waterfowl Production Area, adjacent to the southern edge of the Project boundary, is the closest protected area. No other protected or conserved lands are known to be present within the Project.

3. *Are there plant communities of concern present or likely to be present at the site?*

   No State or Federally-listed plant species are known to occur within the counties intersected by the THWRA. There are large blocks of grasslands, some of which are

likely native grasslands and of regional importance and of concerns to the USFWS and SDGFP.

4. *Are there known critical areas of congregation of species of concern, including, but not limited to: maternity roosts, hibernacula, staging areas, winter ranges, nesting sites, migration stopovers or corridors, leks, or other areas of seasonal importance?*

   Prairie dog colonies and emergent wetlands with concentrated prey species could attract migrating and wintering raptors, including eagles, into the area. Wetlands may provide important stopover habitat for migrating water birds (including the federally-listed whooping crane), waterfowl, shorebirds, passerines, and raptors. The THWRA project area is within the delineated whooping crane migration corridor and historical records of whooping cranes have occurred within 2.5 miles of the Project area. However, avian use of the THWRA cannot be fully characterized based on the available data. Therefore, site-specific Tier 3 studies would be required to better address this question.

5. *Using best available scientific information, has the relevant federal, state, tribal, and/or local agency independently demonstrated the potential presence of a population of a species of habitat fragmentation concern?*

   The potential for area-sensitive species to occur in the THWRA exists as several grassland dependent species such as ferruginous hawks, Swainson's hawks, and loggerhead shrikes. Further bird use studies will be necessary to better address this question.

6. *Which species of birds and bats, especially those known to be at risk by wind energy facilities, are likely to use the proposed site based on an assessment of site attributes?*

   As discussed above, the Project is within the potential range of eight bat species. Bald and golden eagles may also use the Project area. Sixteen diurnal raptor species have the potential to occur as residents, migrants, or rare visitors in the THWRA. Six owl species and one vulture species may also occur in the area. There is some potential habitat for nesting raptors within the THWRA and surrounding areas, mainly in the form of trees, utility poles, and old barns. Open grassland habitat for ground-nesting species, such as northern harriers and burrowing owls, is present throughout the THWRA. A substantial portion of the THWRA is herbaceous, which generally provides suitable nesting, foraging, and stopover habitat for many avian species. Given this abundance of suitable habitat, further assessments may be warranted. However, these habitat types are not more abundant within the THWRA than in the surrounding area.

7. *Is there a potential for significant adverse impacts to species of concern based on the answers to the questions above, and considering the design of the proposed project?*

Given the Project's location, the area may receive use by some sensitive species during migration or throughout the year. The potential exists for diurnal raptors to occur during some or all seasons. Fixed-point avian use surveys may provide data that could aid in designing the project to avoid or minimize impacts to species of concern.

Additionally, the THWRA is in the whooping crane migration corridor. Whooping cranes have been observed within 2.5 miles of the THWRA. Further assessment of presence of whooping cranes during migration could help determine potential risks and inform design and operation decisions.

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**Appendix A. Photographs of the Triple H Wind Resource Area from the Site Visit on February 26, 2016. Additional photographs are available upon request.**

**Photo 1. Untilled grassland with stock tank in the foreground. Grassland may be grazed.**

**Photo 2. Untilled grassland with wetland. Wetland is a potential attractant for migratory birds.**

**Photo 3. Hay pasture with tree rows in the background.**

**Photo 4. Harvested sunflower field within the THWRA. Harvested grain fields could serve as feeding areas for migrating water birds, waterfowl, and other birds.**

**Photo 5. Harvested corn field within the THWRA. Harvested grain fields could serve as feeding areas for migrating water birds, waterfowl, and other birds.**

**Photo 6. Trees in draw provide potential raptor nesting habitat and bat foraging and roosting habitat.**

**Photo 7. Black-tailed prairie dog colony found on the southern boundary of the THWRA, in the Huron Wetland Management District – Waterfowl Production Area. Prairie dog colonies provide hunting opportunities for eagles and raptors, and thereby, may attract eagles and raptors to the area. This may increase the risk of raptor and wind turbine collision.**

**Photo 8. Exfoliating bark on trees, such as this one, provide roosting habitat for bats.**

## Appendix B. US Fish and Wildlife Service iPaC online review

## Appendix C. Bird Species of Conservation Concern (USFWS BCC) within the Prairie Potholes Bird Conservation Region

**Appendix C. US Fish and Wildlife Service (USFWS) Birds Conservation Concern (BCC) within the Bird Conservation Region (BCR) 11 (Prairie Potholes) and their presence/absence in the vicinity of the Triple H Winds Resource Area (Pardieck et al. 2014, USFWS 2008).**

| Species | Recorded from 2011 to 2014 on Crow Creek Breeding Bird Survey Route? | Recorded in 2011 and 2013 on Fort Thompson Breeding Bird Survey Route? |
|---|---|---|
| Horned Grebe | No | No |
| American Bittern | Yes | No |
| Least Bittern | No | No |
| Bald Eagle | No | No |
| Swainson's Hawk | Yes | No |
| Peregrine Falcon | No | No |
| Yellow Rail | No | No |
| Mountain Plover | No | No |
| Solitary Sandpiper | No | No |
| Upland Sandpiper | Yes | Yes |
| Long-billed Curlew | No | No |
| Hudsonian Godwit | No | No |
| Marbled Godwit | Yes | Yes |
| Buff-breasted Sandpiper | No | No |
| Short-billed Dowitcher | No | No |
| Black Tern | Yes | No |
| Black-billed Cuckoo | No | No |
| Short-eared Owl | No | No |
| Red-headed Woodpecker | No | Yes |
| Sprague's Pipit | No | No |
| Grasshopper Sparrow | Yes | Yes |
| Baird's Sparrow | No | No |
| Nelson's Sharp-tailed Sparrow | No | No |
| McCown's Longspur | No | No |
| Smith's Longspur | No | No |
| Chestnut-collared Longspur | Yes | Yes |
| Dickcissel | Yes | Yes |

# Appendix D. Summary of Publicly-Available Studies from North American Wind Energy Facilities that have Reported Bat Fatalities

**Appendix D. Summary of publicly-available studies from North American wind energy facilities that report bat fatality data.**

Data from the following sources:

| Project, Location | Reference | Project, Location | Reference |
|---|---|---|---|
| Alite, CA (09-10) | Chatfield et al. 2010 | Klondike IIIa (Phase II), OR (08-10) | Gritski et al. 2011 |
| Alta Wind I, CA (11-12) | Chatfield et al. 2012 | Leaning Juniper, OR (06-08) | Gritski et al. 2008 |
| Alta Wind II-V, CA (11-12) | Chatfield et al. 2012 | Lempster, NH (09) | Tidhar et al. 2010 |
| Barton I & II, IA (10-11) | Derby et al. 2011a | Lempster, NH (10) | Tidhar et al. 2011 |
| Barton Chapel, TX (09-10) | WEST 2011 | Linden Ranch, WA (10-11) | Enz and Bay 2011 |
| Beech Ridge, WV (12) | Tidhar et al. 2013b | Locust Ridge, PA (Phase II; 09) | Arnett et al. 2011 |
| Big Horn, WA (06-07) | Kronner et al. 2008 | Locust Ridge, PA (Phase II; 10) | Arnett et al. 2011 |
| Big Smile, OK (12-13) | Derby et al. 2013b | Madison, NY (01-02) | Kerlinger 2002b |
| Biglow Canyon, OR (Phase I; 08) | Jeffrey et al. 2009a | Maple Ridge, NY (06) | Jain et al. 2007 |
| Biglow Canyon, OR (Phase I; 09) | Enk et al. 2010 | Maple Ridge, NY (07) | Jain et al. 2009a |
| Biglow Canyon, OR (Phase II; 09-10) | Enk et al. 2011a | Maple Ridge, NY (07-08) | Jain et al. 2009d |
| Biglow Canyon, OR (Phase II; 10-11) | Enk et al. 2012b | Maple Ridge, NY (12) | Tidhar et al. 2013a |
| Biglow Canyon, OR (Phase III; 10-11) | Enk et al. 2012a | Marengo I, WA (09-10) | URS Corporation 2010b |
| Blue Sky Green Field, WI (08; 09) | Gruver et al. 2009 | Marengo II, WA (09-10) | URS Corporation 2010c |
| Buena Vista, CA (08-09) | Insignia Environmental 2009 | Mars Hill, ME (07) | Stantec 2008 |
| Buffalo Gap I, TX (06) | Tierney 2007 | Mars Hill, ME (08) | Stantec 2009a |
| Buffalo Gap II, TX (07-08) | Tierney 2009 | McBride, Alb (04) | Brown and Hamilton 2004 |
| Buffalo Mountain, TN (00-03) | Nicholson et al. 2005 | Melancthon, Ont (Phase I; 07) | Stantec Ltd. 2008 |
| Buffalo Mountain, TN (05) | Fiedler et al. 2007 | Meyersdale, PA (04) | Arnett et al. 2005 |
| Buffalo Ridge, MN (94-95) | Osborn et al. 1996, 2000 | Moraine II, MN (09) | Derby et al. 2010d |
| Buffalo Ridge, MN (00) | Krenz and McMillan 2000 | Mount Storm, WV (Fall 08) | Young et al. 2009b |
| Buffalo Ridge, MN (Phase I; 96) | Johnson et al. 2000 | Mount Storm, WV (09) | Young et al. 2009a, 2010b |
| Buffalo Ridge, MN (Phase I; 97) | Johnson et al. 2000 | Mount Storm, WV (10) | Young et al. 2010a, 2011b |
| Buffalo Ridge, MN (Phase I; 98) | Johnson et al. 2000 | Mount Storm, WV (11) | Young et al. 2011a, 2012b |
| Buffalo Ridge, MN (Phase I; 99) | Johnson et al. 2000 | Mountaineer, WV (03) | Kerns and Kerlinger 2004 |
| Buffalo Ridge, MN (Phase II; 98) | Johnson et al. 2000 | Mountaineer, WV (04) | Arnett et al. 2005 |
| Buffalo Ridge, MN (Phase II; 99) | Johnson et al. 2000 | Munnsville, NY (08) | Stantec 2009b |
| Buffalo Ridge, MN (Phase II; 01/Lake Benton I) | Johnson et al. 2004 | Nine Canyon, WA (02-03) | Erickson et al. 2003 |
| Buffalo Ridge, MN (Phase II; 02/Lake Benton I) | Johnson et al. 2004 | Noble Altona, NY (10) | Jain et al. 2011b |
| Buffalo Ridge, MN (Phase III; 99) | Johnson et al. 2000 | Noble Bliss, NY (08) | Jain et al.2009e |
| Buffalo Ridge, MN (Phase III; 01/Lake Benton II) | Johnson et al. 2004 | Noble Bliss, NY (09) | Jain et al. 2010a |
| Buffalo Ridge, MN (Phase III; 02/Lake Benton II) | Johnson et al. 2004 | Noble Bliss/Wethersfield, NY (11) | Kerlinger et al. 2011 |
| Buffalo Ridge I, SD (09-10) | Derby et al. 2010b | Noble Chateaugay, NY | Jain et al. 2011c |

**Appendix D. Summary of publicly-available studies from North American wind energy facilities that report bat fatality data.**

Data from the following sources:

| Project, Location | Reference | Project, Location | Reference |
|---|---|---|---|
| Buffalo Ridge II, SD (11-12) | Derby et al. 2012a | (10) Noble Clinton, NY (08) | Jain et al. 2009c |
| Casselman, PA (08) | Arnett et al. 2009 | Noble Clinton, NY (09) | Jain et al. 2010b |
| Casselman, PA (09) | Arnett et al. 2010 | 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 (10) | Jain et al. 2011a |
| Cedar Ridge, WI (09) | BHE Environmental 2010 | NPPD Ainsworth, NE (06) | Derby et al. 2007 |
| Cedar Ridge, WI (10) | BHE Environmental 2011 | Oklahoma Wind Energy Center, OK (04; 05) | Piorkowski and O'Connell 2010 |
| Cohocton/Dutch Hill, NY (09) | Stantec 2010 | Pebble Springs, OR (09-10) | Gritski and Kronner 2010b |
| Cohocton/Dutch Hills, NY (10) | Stantec 2011 | PGC site 6-3 (07) | Capouillez and Librandi-Mumma 2008, Librandi-Mumma and Capouillez 2011 |
| Combine Hills, OR (Phase I; 04-05) | Young et al. 2006 | Pine Tree, CA (09-10) | BioResource Consultants 2010 |
| Combine Hills, OR (11) | Enz et al. 2012 | Pioneer Prairie I, IA (Phase II; 11-12) | Chodachek et al. 2012 |
| Condon, OR | Fishman Ecological Services 2003 | PrairieWinds ND1 (Minot), ND (10) | Derby et al. 2011c |
| Crescent Ridge, IL (05-06) | Kerlinger et al. 2007 | PrairieWinds ND1 (Minot), ND (11) | Derby et al. 2012c |
| Criterion, MD (11) | Young et al. 2012a | PrairieWinds SD1 (Crow Lake), SD (11-12) | Derby et al. 2012d |
| Criterion, MD (12) | Young et al. 2013 | PrairieWinds SD1 (Crow Lake), SD (12-13) | Derby et al. 2013a |
| Crystal Lake II, IA (09) | Derby et al. 2010a | Prince Wind Farm, Ont (06) | Natural Resource Solutions 2008 |
| Diablo Winds, CA (05-07) | WEST 2006, 2008 | Prince Wind Farm, Ont (07) | Natural Resource Solutions 2009 |
| Dillon, CA (08-09) | Chatfield et al. 2009 | Prince Wind Farm, Ont (08) | Natural Resource Solutions 2009 |
| Dry Lake I, AZ (09-10) | Thompson et al. 2011 | Red Canyon, TX (06-07) | Miller 2008 |
| Dry Lake II, AZ (11-12) | Thompson and Bay 2012 | Red Hills, OK (12-13) | Derby et al. 2013c |
| Elkhorn, OR (08) | Jeffrey et a. 2009b | Ripley, Ont (08) | Jacques Whitford 2009 |
| Elkhorn, OR (10) | Enk et al. 2011b | Ripley, Ont (08-09) | Golder Associates 2010 |
| Elm Creek, MN (09-10) | Derby et al. 2010c | Rugby, ND (10-11) | Derby et al. 2011b |
| Elm Creek II, MN (11-12) | Derby et al. 2012b | Searsburg, VT (97) | Kerlinger 2002a |
| Foote Creek Rim, WY (Phase I; 99) | Young et al. 2003 | Shiloh I, CA (06-09) | Kerlinger et al. 2009 |
| Foote Creek Rim, WY (Phase I; 00) | Young et al. 2003 | Shiloh II, CA (09-10) | Kerlinger et al. 2010a |
| Foote Creek Rim, WY (Phase I; 01-02) | Young et al. 2003 | SMUD Solano, CA (04-05) | Erickson and Sharp 2005 |
| Forward Energy Center, WI (08-10) | Grodsky and Drake 2011 | Stateline, OR/WA (01-02) | Erickson et al. 2004 |
| Fowler I, IN (09) | Johnson et al. 2010a | Stateline, OR/WA (03) | Erickson et al. 2004 |
| Fowler III, IN (09) | Johnson et al. 2010b | Stateline, OR/WA (06) | Erickson et al. 2007 |
| Fowler I, II, III, IN (10) | Good et al. 2011 | Steel Winds I, NY (07) | Grehan 2008 |

**Appendix D. Summary of publicly-available studies from North American wind energy facilities that report bat fatality data.**

Data from the following sources:

| Project, Location | Reference | Project, Location | Reference |
|---|---|---|---|
| Fowler I, II, III, IN (11) | Good et al. 2012 | Stetson Mountain I, ME (09) | Stantec 2009c |
| Fowler I, II, III, IN (12) | Good et al. 2013 | Stetson Mountain I, ME (11) | Normandeau Associates 2011 |
| Goodnoe, WA (09-10) | URS Corporation 2010a | Stetson Mountain II, ME (10) | Normandeau Associates 2010 |
| Grand Ridge I, IL (09-10) | Derby et al. 2010g | Summerview, Alb (05-06) | Brown and Hamilton 2006b |
| Harrow, Ont (10) | Natural Resource Solutions 2011 | Summerview, Alb (06; 07) | Baerwald 2008 |
| Harvest Wind, WA (10-12) | Downes and Gritski 2012a | Top of Iowa, IA (03) | Jain 2005 |
| Hay Canyon, OR (09-10) | Gritski and Kronner 2010a | Top of Iowa, IA (04) | Jain 2005 |
| High Sheldon, NY (10) | Tidhar et al. 2012a | Tuolumne (Windy Point I), WA (09-10) | Enz and Bay 2010 |
| High Sheldon, NY (11) | Tidhar et al. 2012b | Vansycle, OR (99) | Erickson et al. 2000 |
| High Winds, CA (03-04) | Kerlinger et al. 2006 | Vantage, WA (10-11) | Ventus Environmental Solutions 2012 |
| High Winds, CA (04-05) | Kerlinger et al. 2006 | Wessington Springs, SD (09) | Derby et al. 2010f |
| Hopkins Ridge, WA (06) | Young et al. 2007 | Wessington Springs, SD (10) | Derby et al. 2011d |
| Hopkins Ridge, WA (08) | Young et al. 2009c | White Creek, WA (07-11) | Downes and Gritski 2012b |
| Jersey Atlantic, NJ (08) | NJAS 2008a, 2008b, 2009 | Wild Horse, WA (07) | Erickson et al. 2008 |
| Judith Gap, MT (06-07) | TRC 2008 | Windy Flats, WA (10-11) | Enz et al. 2011 |
| Judith Gap, MT (09) | Poulton and Erickson 2010 | Winnebago, IA (09-10) | Derby et al. 2010e |
| Kewaunee County, WI (99-01) | Howe et al. 2002 | Wolfe Island, Ont (May-June 09) | Stantec Ltd. 2010a |
| Kibby, ME (11) | Stantec 2012 | Wolfe Island, Ont (July-December 09) | Stantec Ltd. 2010b |
| Kittitas Valley, WA (11-12) | Stantec Consulting 2012 | Wolfe Island, Ont (January-June 10) | Stantec Ltd. 2011a |
| Klondike, OR (02-03) | Johnson et al. 2003 | Wolfe Island, Ont (July-December 10) | Stantec Ltd. 2011b |
| Klondike II, OR (05-06) | NWC and WEST 2007 | Wolfe Island, Ont (January-June 11) | Stantec Ltd. 2011c |
| Klondike III (Phase I), OR (07-09) | Gritski et al. 2010 | Wolfe Island, Ont (July-December 11) | Stantec Ltd. 2012 |

Two Indiana bat fatalities are reported by USFWS (2010, 2011c), among other reports. Three additional Indiana bat fatalities have been reported (2011a, 2012b, 2012c), but are not included in this list of public reports. One incidental long-eared bat (*Myotis evotis*) was recorded at Tehachapi, California (Anderson et al. 2004), but is not included in this list of public reports. Additional bat fatalities (evening bat, eastern red bat, hoary bat, tricolored bat, Mexican free-tailed bat, and unidentified bat) have been found in Texas (Hale and Karsten 2010), but the number of fatalities by species is not reported.