WHOOPING CRANE LIKELIHOOD OF OCCURRENCE REPORT

FOR

DICKINSON WIND ENERGY CENTER

STARK COUNTY, NORTH DAKOTA

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EXECUTIVE SUMMARY

NextEra Energy Resources, LLC (NextEra) contracted Tetra Tech, Inc. (Tetra Tech) to conduct a landscape-scale analysis to assess the potential occurrence of whooping cranes at the Dickinson Wind Energy Center (Project). The likelihood of whooping cranes occurring on land within the boundary of the Project (Project Area) is low, despite higher proportion of suitable wetlands within the Project Area compared to the surrounding area. The major factor that contributed to this low likelihood finding was the position of the Project Area in the western portion of the whooping crane migration corridor; the majority of whooping crane sightings occur farther east in central North Dakota. The two most likely impacts of wind development on whooping cranes are: 1) whooping cranes' avoidance of the area around the facility; or 2) direct mortality of whooping cranes due to collisions with transmission lines, turbines, or other facilities. Each Project site is unique with respect to the relationship of the facilities with potential whooping crane habitat. Overall, the higher proportion of wetlands within the Project Area compared to the Surrounding Area (35-miles outside of the Project Area) may potentially serve as an attractant, but, based on the location of the Project Area in the migration corridor, migrating cranes likelihood of occurrence is low.

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1.0 INTRODUCTION

NextEra Energy Resources, LLC (NextEra), proposes to develop the Dickinson Wind Energy Center (Project) in Stark County, North Dakota (Figure 1). One concern when developing wind energy facilities in parts of the Great Plains is the federally endangered whooping crane (*Grus americana*). The whooping crane migrates through the western and central portions of North Dakota during spring and fall. Whooping cranes have been killed by collisions with power lines, and the whooping crane recovery plan lists construction of power lines, fences, and other structures in the migration corridor as a threat to the species (CWS and USFWS 2007). Thus, the construction of wind turbines may pose a risk to whooping cranes through avoidance of areas or direct mortality where turbines are located.

NextEra contracted Tetra Tech, Inc. (Tetra Tech) to conduct a landscape-scale analysis to assess the potential occurrence of whooping cranes within the lands of the Project and associated transmission line (Project Area). The objective of this likelihood of occurrence analysis is to evaluate the biological and landscape features within the Project Area to determine the potential for whooping cranes to occur during migration. Certain landscape features may increase the likelihood of whooping crane occurrence during migration. Thus, Tetra Tech developed a likelihood index to evaluate the Project Area based on its location in the migration corridor, the presence of feeding and roosting sites, and the availability of habitat within the Project Area compared to the surrounding landscape. The likelihood index does not predict how many whooping cranes may occur in the Project Area; rather, it scores the site based on a suite of variables that are related to whooping crane occurrence. Higher scores denote higher potential likelihood of occurrence. This assessment tool is not intended to replace field surveys. However, the low probability of detecting a whooping crane during field surveys minimizes the utility of field surveys in documenting presence in or absence from a given area. As a consequence, this assessment tool was designed to take advantage of available data, with an emphasis on habitat.

2.0 LEGAL STATUS OF THE WHOOPING CRANE IN THE UNITED STATES

The whooping crane is protected by both federal and state laws in the United States. It was considered endangered in the United States in 1970 and the endangered listing was 'grandfathered' into the Endangered Species Act (ESA) of 1973, which prohibits "take" (CWS and USFWS 2007). "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct (16 U.S.C. §1532(19)). "Incidental take" occurs when a fatality of an ESA-listed species occurs as an unintended consequence of an otherwise legal activity, as would be the case in the unlikely event of a fatality occurring at a wind farm. To Tetra Tech's knowledge, no whooping crane fatality has occurred at a wind energy facility. North Dakota does not have state endangered or threatened species list, but instead defers to the USFWS federal listing of endangered and threatened species that occur within North Dakota (NDGF 2012).

The whooping crane population in North America sharply declined and disappeared from most of its historic range (CWS and USFWS 2007). The number of whooping cranes in North America prior to 1870 is estimated to have been between 500 and 1,400 individuals (Allen 1952, Banks 1978), but some biologists suggest that the population may have numbered as many as 10,000 individuals (CWS and USFWS 2007). Activities such as habitat destruction, hunting, and displacement due to anthropogenic activities likely led to widespread population declines (CWS and USFWS 2007). One self-sustaining wild population of whooping cranes currently exists in the world. Members of this population breed primarily within the boundaries of Wood Buffalo National Park in Canada and migrate through the central United States to wintering grounds at the Aransas National Wildlife Refuge along the Gulf Coast of Texas (Figure 2). This flock is referred to as the Aransas-Wood Buffalo National Park Population. Due to intensive management, this population has increased from 15 birds in 1941 to an estimated 304 birds (with a 95% probability of actual flock size being between 260–354 birds) as of the 2013/2014 winter whooping crane survey conducted by USFWS (USFWS 2014a). Aerial surveys for the winter of 2014/2015 have been completed but the results will likely not be released until March 2015 (USFWS 2014b).

3.0 ENVIRONMENTAL SETTING AND PROJECT AREA DESCRIPTION

3.1 Environmental Setting

The Project Area is located in the Missouri Plateau subregion of the Northwestern Great Plains Ecoregion (Bryce et al. 1996). The region is mostly used for dryland farming and cattle grazing. The topography of the region is a semiarid rolling plain (Bryce et al. 1996). Vegetation in the region was historically mixed-grass prairie with blue grama (*Bouteloua gracilis*), little bluestem (*Schizachyrium scoparium*), prairie sandreed (*Calamovilfa longifolia*) and a wheatgrass-needlegrass association (Bryce et al. 1996). Native grasslands occur in areas of steep topography.

3.2 Project Area Description

The Project Area is located on privately-owned lands in southwest North Dakota and consists of 143,380 acres. The proposed Project turbines will be located approximately 11 miles east of Dickinson in eastern Stark County, and the associated 230-kilovolt (kV) overhead transmission line would run west from the Project Area south of Dickinson approximately 31 miles (Figure 1). The Project has a proposed nameplate capacity of approximately 150 megawatts (MW), consisting of 80 GE 1.7 MW Xle wind turbine generators and 7 GE 1.7 MW Xle wind turbine generators. Additional facilities include access roads, electrical collection systems and cabling, a collection substation, an operation and maintenance (O&M) building, a switchyard, and two construction laydown areas. Three guyed temporary meteorological towers have been installed for the Project Area and up to three additional temporary towers are planned. Up to two of the towers may be converted to permanent meteorological towers, depending on offtaker requirements.

The existing land use in the Project Area is primarily cattle production and agriculture. The area contains numerous small wetlands that vary from shallow vegetated depressions, man-made cattle ponds, and intermittent creeks. There are few wetlands evident that are not associated with a stream system. Residences and a few abandoned farmsteads are scattered throughout the Project Area. The Project Area is a mix of cattle pastures, agriculture, and remnant native prairie. Whooping cranes have been documented to occur at Lake Sakakawea (approximately 45 miles to the north), Ilo National Wildlife Refuge (approximately 30 miles to the north), and Pretty Rock National Wildlife Refuge (approximately 43 miles to the southeast) during its annual migration periods (Figure 1; Austin and Richert 2001).

4.0 WHOOPING CRANE BIOLOGY

The whooping crane is a long-lived species that may reach 28 years old in the wild (Binkley and Miller 1983). Individuals reach sexual maturity at 3 to 5 years of age and form life-long breeding pairs while on the wintering grounds or during spring migration (Stehn 1997; CWS and USFWS 2007). Whooping cranes have low annual reproductive output. Females typically lay two eggs, but only 10 percent of families arrive on the winter grounds with two chicks because the smaller chick usually dies within the first two weeks after hatching (CWS and USFWS 2007). The juveniles become independent of the parents on the wintering ground prior to spring migration. Sexually immature individuals (i.e., subadults) return to the breeding grounds where they may remain solitary or congregate in small groups on the periphery of breeding pairs (CWS and USFWS 2007).

4.1 Reasons for the Population Decline

Populations of long-lived species with low annual reproductive output such as the whooping crane are sensitive to changes in adult survival (Stahl and Oli 2006). Hunting, especially during spring migration, from 1870 to 1930 resulted in 274 documented whooping crane fatalities (Allen 1952). In addition, Hahn (1963) tallied 309 mounts and 9 skeletons in museum collections throughout the world. Because many of these specimens do not contain information regarding the date and location of collection, it is unlikely that the majority were collected by museum personnel. It is possible that mortality from shooting exceeded annual production of juveniles during the early 1900s (CWS and USFWS 2007).

Degradation and loss of breeding habitat eliminated the whooping crane from much of its core breeding range in North America. Whooping cranes once bred from the southern edge of Lake

Michigan north through southern Minnesota to northeastern North Dakota through Manitoba, Saskatchewan, and Alberta (Allen 1952). Conversion of prairie and pothole ecosystems to agriculture and ranching made much of the breeding habitat unsuitable (CWS and USFWS 2007). Due to their high degree of site fidelity, members of the Aransas-Wood Buffalo Population are unlikely to naturally recolonize the historic whooping crane range in North America.

4.2 Threats to Whooping Cranes

Several factors threaten the whooping crane because of its small population size and concentration of all members of the Aransas-Wood Buffalo National Park population at single breeding and wintering locations. Threats to the whooping crane identified in the recovery plan that are related to wind power development include collision with power lines, fences, and other structures, and loss and degradation of stop-over and wintering habitat through avoidance (CWS and USFWS 2007; USFWS 2009).

Power lines pose a major threat to whooping cranes when they are located in the vicinity of foraging or roosting habitat because individuals often fly at low altitudes (33 to 49 feet above the ground) when moving among sites (CWS and USFWS 2007; Stehn and Wassenich 2008). The majority of documented fatalities during migration are due to collisions with power lines. Since 1956, 46 whooping cranes have been killed or seriously injured as a result of collisions with power lines (Stehn and Wassenich 2008). Collisions with power lines have resulted in fatalities of whooping cranes in other experimental populations that are maintained by the introduction of captive-reared young (Stehn and Wassenich 2008). Fourteen individuals from the Florida non-migratory population and one individual in the migratory Wisconsin population have died from colliding with power lines (Stehn and Wassenich 2008).

Although whooping crane mortality has not been attributed to wind turbines, the whooping crane recovery plan considers wind power development within the whooping crane migration corridor a threat because of the construction of power lines and associated structures (CWS and USFWS 2007). Both sandhill and whooping cranes have been seen in the vicinity of operational wind turbines, and Nagy et al. (2012) showed that the cranes either flew above or around the turbines, therefore minimizing the likelihood of turbine collision. Other studies have documented sandhill cranes gradually climbing as they approach marked power lines (Morkill and Anderson 1991, Murphy et al. 2009). The USFWS (2009) believes that whooping cranes will avoid stopping at areas with operational wind turbines. Thus, behavioral avoidance of wind farms by whooping cranes may reduce the probability of collision but may result in loss of stop-over habitat.

5.0 WHOOPING CRANE MIGRATION

Whooping cranes undertake a 5,000-mile round-trip migration from the breeding area in Canada to the wintering area in Texas every year. Individuals depart the breeding ground in Canada and travel south through Alberta, Canada, North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, and Texas to the wintering ground at Aransas National Wildlife Refuge on the Texas coast. The migration route is well-defined and 95 percent of all observations occur within a 200-mile wide corridor during spring and fall migration (USFWS 2010; Figure 2). Whooping cranes may occasionally travel with sandhill cranes during migration, and stop-over sites used by sandhill cranes may indicate potential whooping crane stop-over areas (CWS and USFWS 2007).

During migration, whooping cranes can occur where suitable habitat is available. Four sites in the migration corridor are used consistently by whooping cranes and have high annual use: the Platte River in Nebraska, Cheyenne Bottoms Wildlife Management Area and Quivira National Wildlife Refuge in Kansas, and the Salt Plains National Wildlife Refuge in Oklahoma. Additionally, Aransas National Wildlife Refuge in Texas is used yearly by whooping cranes as the wintering grounds. These five sites are designated as critical habitat under the Endangered Species Act (Figure 2; CWS and USFWS 2007). The Platte River is the closest of these four sites to the Project Area and is located over 450 miles to the south.

5.1 Fall Migration

Whooping cranes depart the breeding grounds at Wood Buffalo National Park in mid-September and parents with young are usually the last to depart. Birds may travel alone, in pairs, in family groups, or in small flocks (Johns 1992). The birds first travel southeast about 300 miles to a major staging area in Saskatchewan, where they may remain for 2 to 4 weeks before resuming migration. During fall migration, birds may stay at traditional stop-over sites for 7 to 10 days, but stays as long as 6 weeks have been documented at Quivira National Wildlife Refuge (CWS and USFWS 2007). The majority of whooping cranes reach the wintering grounds by mid-November. In North Dakota, most sightings occur from late September to early November with peak migration occurring in mid-October (Austin and Richert 2001).

5.2 Spring Migration

Whooping cranes depart the wintering grounds in late March; the last birds depart in May. Breeding pairs are typically first to depart and migration is facilitated by winds from the southeast. There is no known staging area in spring as there is in fall, and migration is completed in 2 to 4 weeks. Traditional stop-over sites that are used in fall are also used in spring. However, individuals spend fewer days at stop-over sites during spring migration. Whooping cranes travel through North Dakota from mid-April to early May with peak migration in late April (Austin and Richert 2001).

5.3 Migration Flight Behavior

Whooping cranes are diurnal migrants and primarily fly by using static soaring, but low-level flapping flight may be used when conditions dictate. Migration is initiated after the air has warmed and thermal updrafts are present. Individuals spiral upwards on thermals of warm air to heights of 1,000 to 6,000 feet (Kyut 1992), then enter into long, descending glides. This process is repeated throughout the day until suitable habitat is reached. Static soaring is energy efficient as birds seldom flap after they are airborne. Whooping cranes may travel up to 500 miles per day in ideal conditions; during average conditions they may travel 250 miles per day (Stehn and Wassenich 2008). During the end of the migration flight, individuals will enter long descending glides and use flapping flight at lower altitudes until they reach suitable roosting and feeding habitat. Whooping cranes do not regularly migrate during unfavorable weather conditions such as a strong headwind, rain or other precipitation, or overcast conditions. When visibility is poor, individuals use flapping flight at lower altitudes until they reach suitable roosting or feeding habitat.

5.4 Stop-over Habitat Characteristics

Whooping cranes require roosting habitat when they stop during migration. They often select sites with unobstructed visibility (Austin and Richert 2001). Palustrine wetlands (freshwater wetlands characterized by emergent vegetation) are most often used as roosting sites, but individuals have been found roosting at lacustrine wetlands (wetlands around a lake), and riverine wetlands (wetlands along a river). The size of wetlands used during spring and fall migration ranges from 0.4 hectare to over 500 hectares, and no seasonal use patterns are evident (Austin and Richert 2001); 75 percent of recorded roost wetlands were smaller than 4 hectares (10 acres). Although size of the wetlands used for roosting varies, water depth ranges 18 to 20 inches and little variability is found among sites.

Whooping cranes forage in wetlands and agricultural fields during migration and may commute between roosting and feeding areas. Palustrine wetlands are used most often when whooping cranes forage in wetlands, but lacustrine and riverine wetlands have also been used as feeding sites (Austin and Richert 2001). Among agricultural crops used as feeding sites, the use of winter wheat was higher than other crop types in the fall and the use of row-crop stubble (comprised mostly of corn) was higher in the spring than other crop types (Austin and Richert 2001). Whooping cranes have also been observed feeding in sorghum, sunflower, and soybean stubble (Austin and Richert 2001). Feeding sites are often located adjacent to roosting sites. For example, 94.9 and 72.9 percent of roosting sites were within 0.62 mile of feeding sites in spring and fall, respectively (Johns et al. 1997; USFWS 2009).

6.0 ASSESSMENT OF WHOOPING CRANE LIKELIHOOD OF OCCURENCE

The primary threats of wind energy development to whooping cranes are mortality due to collision with transmission lines, associated structures and loss of habitat due to avoidance. Because of the high level of concern regarding whooping cranes, the ability to evaluate the risk to whooping cranes at an individual Project Area and a 35-mile buffer of the Project Area excluding the Project Area (Surrounding Area; Figure 3) is a critical component to understanding the environmental impacts of a proposed wind energy facility. Here, Tetra Tech presents a method used to evaluate the likelihood of whooping cranes to occur at the Project Area located in southwest North Dakota. This evaluation method considers the location of the Project Area in the migration corridor, the presence of feeding and roosting sites, and the availability of habitat within the Project Area compared to the surrounding landscape (Table 1). Tetra Tech expects whooping cranes to be more likely to occur over the life of a Project at Project Areas with high scores. For the purposes of this analysis, the scores calculated for each parameter were entered into a formula and the resulting score represented the likelihood of occurrence for whooping cranes in the Project Area which was ranked as: Low (less than 5); Moderate (5-10); High (greater than 10). This assessment tool is not intended to replace field surveys. However, the low probability of detecting a whooping crane during field surveys minimizes the utility of field surveys in documenting presence or absence from a given area. As a consequence, this assessment tool was designed to take advantage of available data. A description of each of the three factors included in this analysis (location in the migration corridor, attractiveness of the landscape, and presence of foraging and roosting sites) and how scores are assigned for each is provided in Table 1.

Table 1. Summary of parameters used in the likelihood index calculation.

Parameter	Score	Justification
Location in the Migration Corridor (L)		
Within the 75-percent buffer	7.5	75 percent of all whooping crane observations occur within the 75-percent buffer
Between the 75-percent and 95-percent buffers	2.0	20 percent of all observations occur between 75-percent and 95-percent buffers
Outside the 95-percent buffer	0.5	5 percent of observations occur outside the 95-percent buffer
Attractiveness on the Landscape (A)		
Ratio of wetlands per total acreage for Project Area / wetland per total acreage for the Surrounding Area	Actual ratio	Indicates if the Project Area is similar (=), less (<), or more (>) attractive than the surrounding landscape to migrating cranes searching for roosting habitat
Presence of Foraging and Roosting Habitat (W)		
Proportion of Project Area that is a wetland-agricultural matrix	Actual proportion	Indicates the proportion of the Project Area that is favored by cranes for foraging and roosting habitat

6.1 Location of a Project Area in the Migration Corridor (L)

Biological Justification

The location of a potential wind facility influences the likelihood of whooping crane occurrence due to the well-defined migratory pattern of the cranes. The median location of all crane observations was statistically derived and was used to describe the migration route from the breeding grounds to the wintering grounds (CWS and USFWS 2007). Buffers were then calculated based on the percentage of observations (Figure 3). For example, 75 percent of all observations occurred within the 75-percent buffer. If two sites are compared, whooping cranes are more likely to stop over at a site within the 75-percent buffer than at a site outside the 95-percent buffer.

Scoring

Tetra Tech developed scores for the location of a Project Area based on the percent of observations within each buffer. If a Project Area fell within the 75-percent buffer, it was given a score of 7.5. If a Project Area fell between the 75-percent and 95-percent buffers, it was given a score of 2.0 because 20 percent of all observations occur between these buffers. If a Project Area fell outside of the 95-percent buffer, it was given a score of 0.5 because 5 percent of all observations occur outside the 95-percent buffer.

Assumptions

- The likelihood of whooping crane occurrence in the future will not deviate from the patterns observed through 2010 which is the most current available data (USFWS 2010).
- If a portion of the Project Area fell on the boundary of a buffer or in two buffers, the Project Area was assumed to be within the buffer closer to the middle of the migratory corridor.

6.2 Attractiveness of the Landscape (A)

Biological Justification and Data Source

Wetlands are used by whooping cranes for feeding and roosting and the amount of wetlands within a given area compared to the surrounding landscape may influence whooping crane use of a site during migration. After whooping cranes have descended from migration flight altitudes, they may travel up to 35 miles in search of suitable roosting habitat. Therefore, Tetra Tech determined that if a Project Area contained a higher proportion of wetlands than was found within the 35 miles surrounding the Project Area, the Project Area would be more attractive than the surrounding area. A site visit on December 16 – 19, 2014 to the Project

Area was made by Tetra Tech staff to perform a wetland reconnaissance survey of existing wetlands and waterways within the Project Area.

Scoring

Tetra Tech used National Wetlands Inventory (NWI) data (USFWS 2014c) and National Land Cover Database (NLCD) data (USGS 2014) to determine the total acreage of wetlands within the Project Area and within 35 miles of the Project Area. The use of multiple data sources helped to avoid the limitations of any one data source (e.g., Stahlecker 1992). Tetra Tech then calculated the proportion of the total acreage of the Project Area that was comprised of wetlands and the proportion of the total acreage of the area withinthe Surrounding Area. Tetra Tech divided the proportion of the Project Area that was wetlands by the proportion of Surrounding Area that was wetlands to determine if the Project Area contained a higher proportion of wetlands than the surrounding area. Tetra Tech used the ratio as the score in the likelihood index equation. If the ratio was greater than 1, the Project Area contained more wetlands and was considered to be more attractive than the Surrounding Area. If the ratio was equal to 1, the Project Area contained a similar proportion of wetlands and was considered to be as attractive as the Surrounding Area. If the ratio was less than 1, the Project Area contained a lower proportion of wetlands and was considered to be less attractive than the Surrounding Area.

Assumptions

- The wetlands in the 35-mile buffer shown in the NWI and NLCD Database were accurate and are considered useable by Whooping Cranes.
- 35 miles is an appropriate scale to examine whooping crane habitat use.

6.3 Presence of Foraging and Roosting Sites (W)

Biological Justification

Whooping cranes often make low altitude flights between roosting and foraging habitat and are thus at risk of collision with power lines and other structures (CWS and USFWS 2007; Stehn and Wassenich 2008; USFWS 2009).

Austin and Richert (2001) found the majority of foraging sites were upland crops (73.8 percent) adjacent to wetland roosting sites. Wetland roosting sites were defined in three broad categories as palustrine (58.2 percent), riverine (33.3 percent), or lacustrine (7.8 percent) roost sites (Austin and Richert 2001). For the upland crop foraging sites; 83 percent of grain stubble was wheat stubble, 75 percent of row-crop stubble was corn, and 80 percent of green crops was winter wheat (Austin and Richert 2001). The distances traveled between roost to foraging sites varied by wetland systems with 75 percent feeding sites being 0.8 km (0.5 miles) or less from the palustrine roost sites to over 50 percent of riverine roost sites being 1.2 km or greater from foraging sites (Austin and Richert 2001). Therefore Tetra Tech used an average of 1 km (0.62 miles) to assess the presence of foraging and roosting sites within the Project Area and a 56.3 km (35 mile) buffer area around the Project Area. Tetra Tech considered wetlands located within 0.62 mile of agricultural crops to form a wetland-agricultural matrix that may be used by whooping cranes during migration (Austin and Richert 2001). Tetra Tech used GIS to calculate the proportion of the Project Area that was comprised of this wetland-agricultural crop matrix, using a minimum 1-acre patch size for both wetlands and crops. The 1-acre minimum for wetlands was used to avoid including wetlands unusable by whooping cranes (e.g., borrow pits). The 1-acre minimum size for agriculture was used because the majority of whooping crane observations occurred in agriculture patches larger than 1.0 acre (Austin and Richert 2001).

Scoring

To quantify the amount of roosting and foraging habitat in the Project Area, geographic information system (GIS) land cover data (NLCD data) was obtained for North Dakota (USGS 2014). Water features and the spatial extent of waters were verified with NWI data (USFWS 2014c). The GIS analysis was designed to calculate the total area of wetland-agricultural matrix, which may have included other habitat types between patches of wetlands and agriculture. Thus, based on the size restrictions and spatial configuration, the total acres of wetland-agricultural matrix could be greater or less than the sum of the acres of wetland and agriculture. Tetra Tech calculated the proportion of the Project Area that was wetland-agricultural matrix by dividing the total acres of wetland-agricultural matrix by the total acres of the Project Area. Tetra Tech used the proportion as the score in the likelihood index; therefore, scores could range from 0 to 1.

Assumptions

- The average distance of foraging habitat from roosting habitat is 0.62 mile.
- Habitats not classified as wetlands or agriculture are of neutral value and do not influence the availability of wetlands or agriculture on the landscape.

6.4 Likelihood Index Formula (LI)

The likelihood index of whooping cranes occurring at the Project Area was calculated by evaluating the landscape features in and around the Project Area. Tetra Tech used the following formula to calculate the likelihood index:

$$LI = (L \times A) + W$$

Where L = location of Project Area in relation to the migration corridor score, A = attractiveness score, or the ratio of wetlands in a Project Area to wetlands in a 35-mile area around a Project Area, and W = wetland-agricultural matrix score. The equation places the most weight on the location in the migration corridor because of the wide range of scores for each feature in the likelihood index. Thus, a Project Area within the 75-percent corridor will tend to score higher than a Project Area within the 95-percent corridor unless the attractiveness score for the Project Area within the 75-percent corridor is low (e.g., <0.50) or the attractiveness score for the Project Area within the 95-percent corridor is high (>4.0), when other values are equal. Project Areas located outside of the 95-percent corridor will tend to score low unless the attractiveness score is high because the location score is less than 1.0.

7.0 PROJECT AREA ASSESSMENT AND SUMMARY

The Project is located within the 95-percent buffer which is on the outskirts of the whooping crane migration corridor; therefore, the Location (L) parameter was 2.0. The proportion of wetlands within the Project is higher than the surrounding 35-mile buffer area, with a calculated Attractiveness on the Landscape (A) value of 1.51. Fifty-five percent of the Project consists of suitable wetland-agriculture matrix habitat, making the Presence of Foraging and Roosting Sites (W) value 0.55 (Figure 4). The likelihood index score was 3.57 for the Project Area (Table 2) implying low likelihood of occurrence. Thus, the overall likelihood index score was driven by the Attractiveness on the Landscape (A) value, which indicates that whooping cranes migrating in the vicinity of the Project Area would be more likely to stop-over inside of the Project because of the higher proportion of wetland habitat compared to outside of the Study Area.

Table 2. Likelihood index scores for the Dickinson Wind Energy Center.

Location in the Migration Corridor (*L*)[1]	Attractiveness on the Landscape (*A*)[2]	Presence of Foraging and Roosting Habitat (*W*)[3]	Likelihood Index Score (*LI*)[4]	Likelihood Index Category[5]
2.0	1.56	0.55	3.57	Low

1. Location in the Migration Corridor (L) values: 7.5 = within the 75% buffer, 2.0 = between the 75% and 95% buffers, or 0.5 = outside of the 95% buffer
2. Attractiveness on the Landscape (A) value: Ratio of wetlands per total acreage for Project Area / wetland per total acreage for 35-mile area not including Project Area
3. Presence of Foraging and Roosting Habitat (W) value range: Proportion of Project Area that is a wetland-agricultural matrix
4. Likelihood Index Score (LI): LI = (L×A) + W
5. Likelihood Index Category values: Low = less than 5, Medium = 5-10 , High = greater than 10

Overall, based on the location of the Project Area within the migration corridor, whooping cranes could occur in the vicinity of the Project Area. The higher proportion of wetlands in the Project Area compared to the Surrounding Area may be an attractant to migrating cranes; however, the location of the Project on the western edge of the migration corridor in the 95 percent buffer indicates that there is a low likelihood of whooping cranes stopping over within the Project Area because the majority of whooping crane sightings (90 percent) occur closer to the center of the migration corridor and further away from the Project Area.

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Transportation
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State Highway
Rail
Jurisdiction
U.S. Fish and Wildlife Service
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Miles
Scale is 1:300,000 when printed at 22 x 34
CANADA
North Dakota
SD
Williston
Minot
Grand Forks
Dickinson
Mandan
Bismarck
Jamestown
Fargo
TETRA TECH
NEXTera ENERGY RESOURCES
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OLIVER COUNTY
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Medora
Belfield
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Dickinson
Taylor
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Hebron
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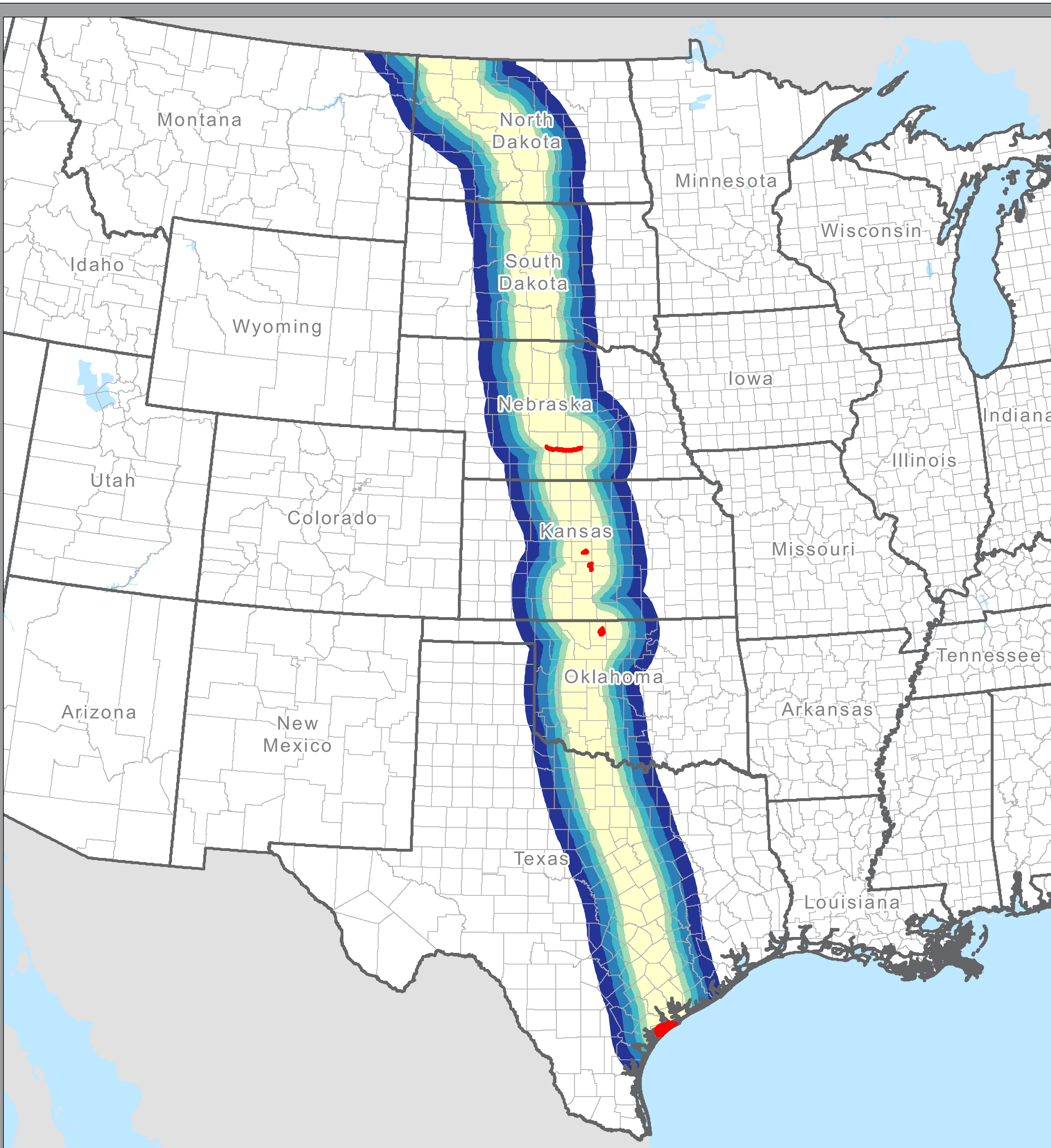
Regent
Mott
Elgin
New Leipzig
Carson
Leith
Marmarth
Rhame
Bowman
Scranton
PRETTY ROCK NWR



Legend

(red)	Whooping Crane Critical Habitat
(outline)	State Border
(light outline)	County Border

Percentage of Sightings Within the Whooping Crane Migration Corridor

- 75%
- 80%
- 85%
- 90%
- 95%

0 100 200 Miles

Scale is 1:13,000,000 when printed at 8.5x11"

Dickinson Wind Energy Center

Stark County, ND

Figure 2 Whooping Crane Migration Corridor

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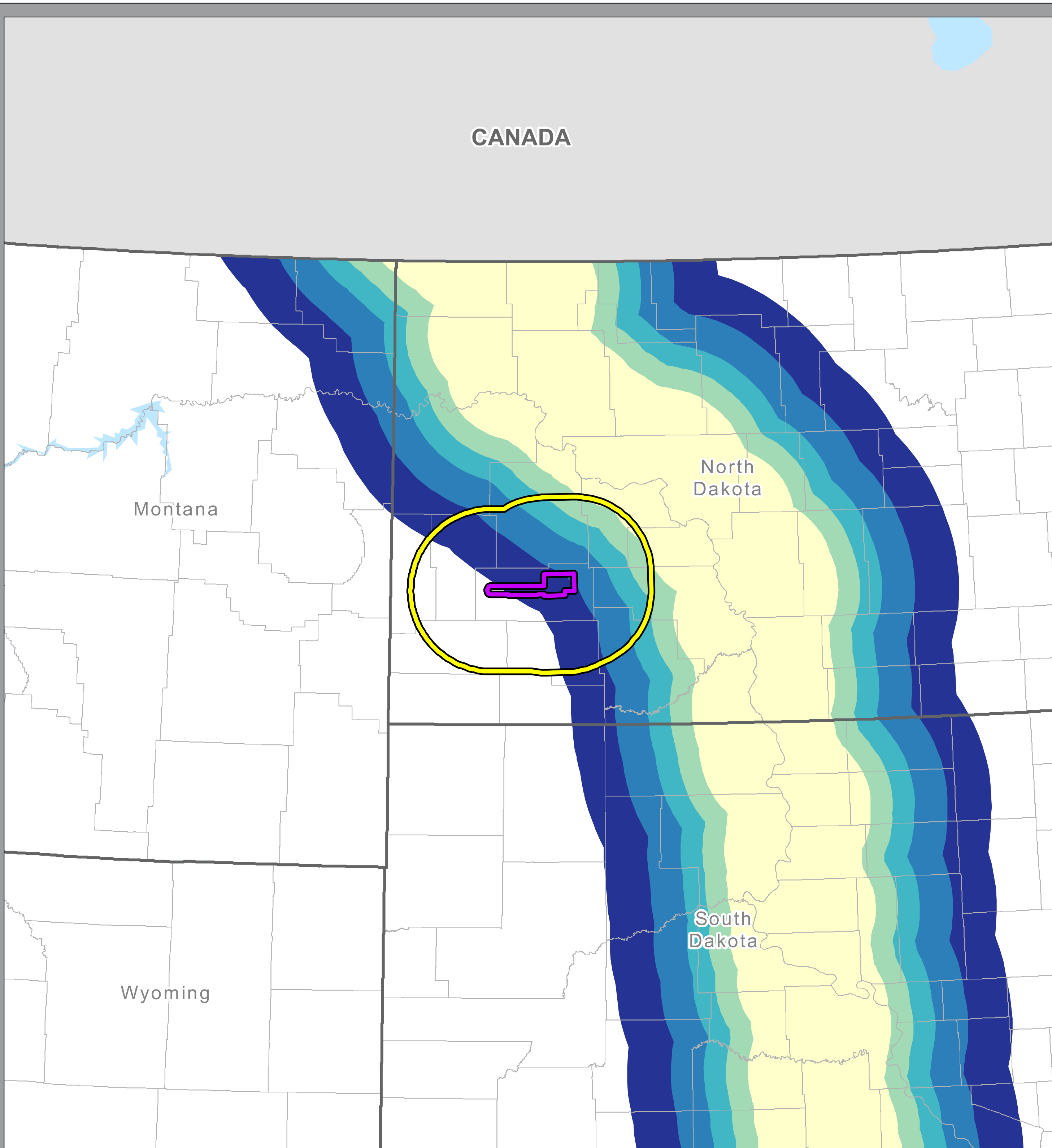

Legend

- Project Area
- Project Area, 35-mile Buffer
- State Border
- County Border

Percentage of Sightings Within the Whooping Crane Migration Corridor

- 75%
- 80%
- 85%
- 90%
- 95%

0 30 60 Miles

Scale is 1:4,000,000 when printed at 8.5x11"

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Stark County, ND

Figure 3
Whooping Crane Migration: North Dakota

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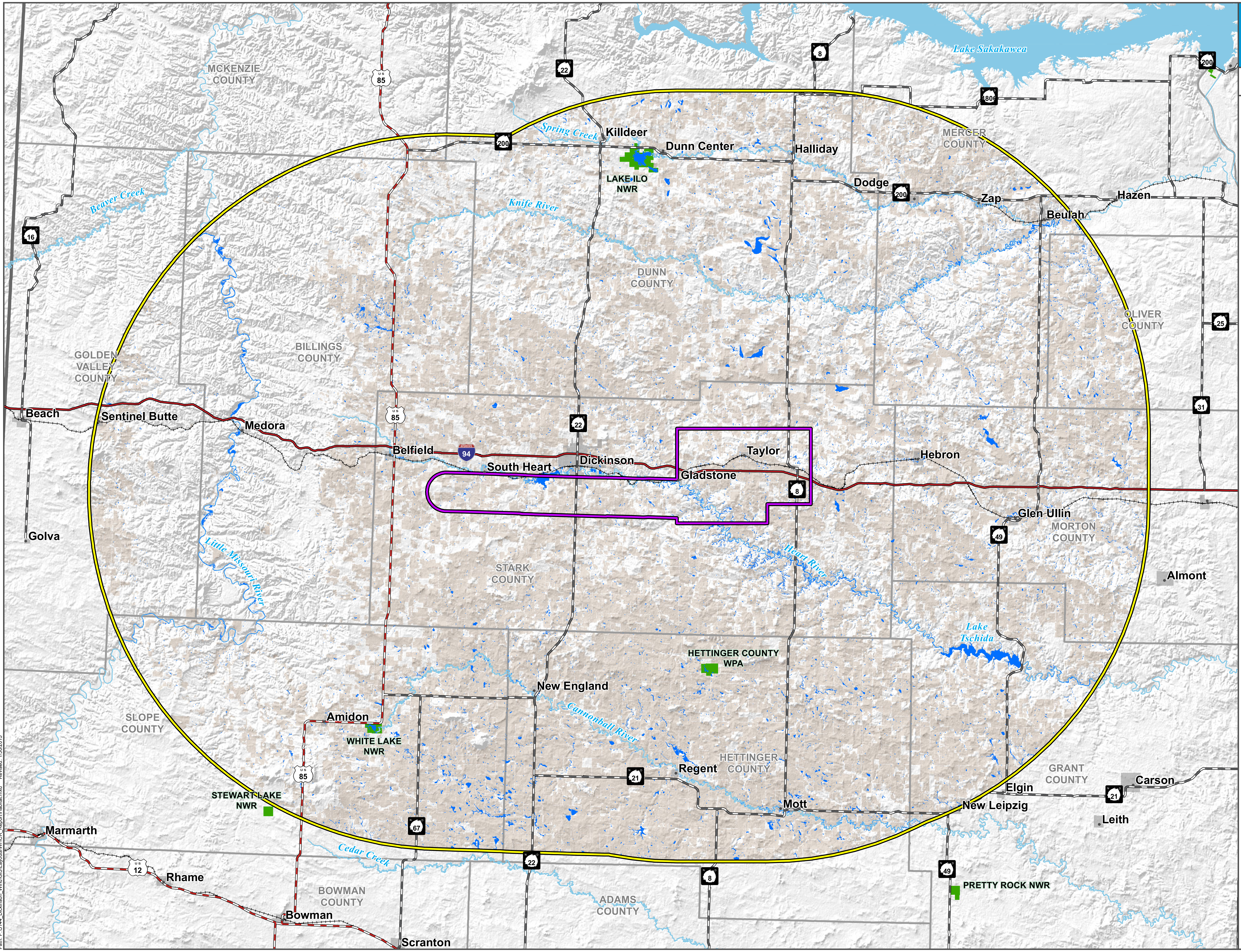
Dickinson Wind Energy Center

Stark County, ND

Figure 4
Whooping Crane Habitat Map



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Legend

- Project Area
- Project Area 35-mile Buffer
- County Boundary
- Major River
- Municipal Boundary
- Wetland
- Wetland/Agricultural Matrix

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- U.S. Fish and Wildlife Service

Transportation

- Interstate Highway
- U.S. Highway
- State Highway
- Rail

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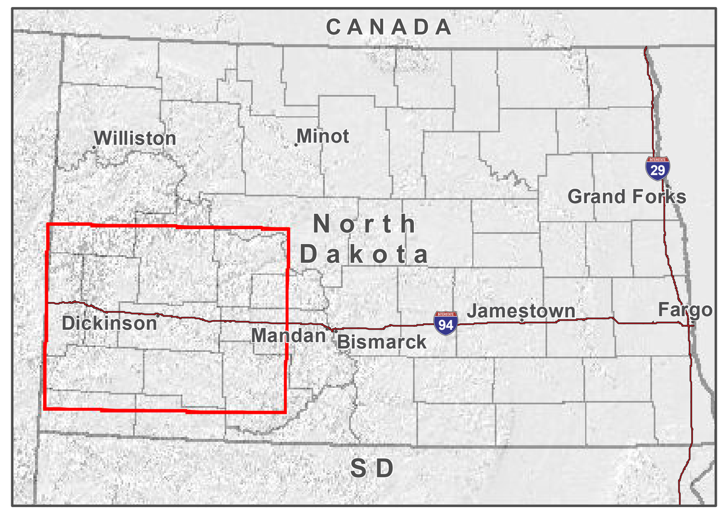

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Bat Habitat Assessment

Dickinson Wind Energy Center
Stark County, North Dakota

Confidential Business Information

Prepared for:

NextEra Energy Resources, LLC

700 Universe Blvd.

Juno Beach, Florida 33408

February 2015

TETRA TECH

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1.0 INTRODUCTION

NextEra Energy Resources, LLC (NextEra) is proposing to develop the Dickinson Wind Energy Center (Project) in Stark County, North Dakota, located in southwestern North Dakota near the town of Dickinson (Figure 1). The Project has a proposed nameplate capacity of approximately 150 megawatts (MW), anticipated to consist of 80 GE 1.7-MW Xle wind turbine generators and 7 GE 1.79-MW Xle wind turbine generators. The Project also includes a planned approximately 31-mile, 230-kilovolt (kV) overhead transmission interconnect line. Additional Project facilities include access roads, electrical collection systems and cabling, a collection substation, an operation and maintenance (O&M) building, and a construction laydown area. Three guyed temporary meteorological towers have been installed for the Project and up to three additional temporary towers are planned. Up to two of the towers may be converted to permanent meteorological towers.

NextEra contracted Tetra Tech, Inc. (Tetra Tech) to evaluate the suitability of habitat within the Project area for bats, with a focus on the northern long-eared bat (*Myotis septentrionalis*; NLEB). We evaluated the area where wind turbines are proposed and the associated transmission line corridor (Project Area; Figure 2) as well as a 1.5-mile buffer of the Project Area (Project Buffer; Figure 3)

The objectives of the habitat assessments were to:

- Evaluate habitat features within the Project Area and Project Buffer for bats, focusing specifically on NLEB;
- Assess the likelihood of NLEB and other bat species occurring within the Project Area and Project Buffer based on known distributions and habitat requirements of bat species in the region

In October 2013, the NLEB was proposed for listing as endangered under the federal Endangered Species Act (ESA) and a final listing determination is expected in April 2015 (USFWS 2013, USFWS 2014a). As part of NextEra’s environmental due diligence for the Project and compliance with U.S. Fish and Wildlife Service (USFWS) recommendations for NLEB impact assessments, Tetra Tech has prepared this bat habitat assessment. Tetra Tech examined publically available information and habitat requirements of NLEB and other bat species that may occur in the vicinity of the Project Area, the results of which are summarized in Section 3.0. Sections are subdivided into habitat suitability for NLEB and all bat species.

NextEra also contracted Tetra Tech to conduct a NLEB presence-absence study. This report provides the results of the habitat assessment only. Acoustic surveys are scheduled to occur in the Project Area from April 15 through June 15, 2015 to document use.

Letters were sent to both USFWS and NDGF on December 23, 2014 introducing the Project requesting information on sensitive biological resources. No responses have been received from the agencies to date.

2.0 BACKGROUND

This section describes the Project Area and includes background information on bats in the region, a summary of current information regarding bat interactions with wind energy projects, and a discussion of the legal and regulatory framework applicable to bats and wind energy.

2.1 Project Area Description

The 146,380-acre Project Area is located on privately-owned lands in southwestern North Dakota and is approximately 12 miles east of Dickinson in eastern Stark County (Figure 1). The Project Area is located in the Missouri Plateau subregion of the Northwestern Great Plains Ecoregion (Bryce et al. 1996). Bedrock geology in the ecoregion is primarily sandstone and shale and geology within the vicinity of the Project Area is sandstone and siltstone (Bryce et al. 1996, NDGS and NDDH 2001; Figure 4). Due to the local geology and topography, caves do not form regularly in the sandstone and siltstone of the Project Area and there no known caves within 20 miles of the Project Area (Murphy 2007).

Land use within the ecoregion is primarily dryland farming and cattle grazing. Coal mining in western North Dakota for lignite coal deposits is common and primarily done through surface mining although underground mines are also used (Figure 4; Murphy no date; NDPSC 2013). The topography of the region is a semiarid rolling plain (Bryce et al. 1996). Vegetation in the region was historically mixed-grass prairie with blue grama (*Bouteloua gracilis*), little bluestem (*Schizachyrium scoparium*), prairie sandreed (*Calamovilfa longifolia*) and a wheatgrass-needlegrass association (Bryce et al. 1996). Native grasslands occur in areas of steep topography. The existing land use in the Project Area is primarily cattle production and agriculture. The area contains numerous small wetlands that vary from shallow vegetated depressions, man-made cattle ponds, and intermittent creeks. There are few wetlands evident that are not associated with a stream system. Residences and a few abandoned farmsteads are scattered throughout the Project Area. The Project Area is a mix of cattle pastures, agriculture, and remnant native prairie. Trees and forested areas are restricted to riparian areas and windbreaks for houses and fields.

Based upon the National Land Cover Database (NLCD) information for the Project Area, the land cover is dominated by grassland which includes pastures, hayfields, and regional native grasslands (48.5 percent) and agricultural crops (39.8 percent; Figure 2; Jin et al. 2013). The topography within the Project Area is primarily rolling plains and lacks prominent landscape features (e.g. hills, valleys), with the exception of an area south of the transmission line route approximately 7 miles southwest of Dickinson, which has some more prominent elevation.

2.2 Wind Energy and Bats

Bat mortality associated with wind turbine operations has been reported at locations around the world, including wind energy facilities in the United States (Kunz et al. 2007, Arnett et al. 2008, Rydell et al. 2010, Hayes 2013). Rates of overall bat mortality from wind turbines vary by region (Arnett et al. 2008, Baerwald and Barclay 2009, Cryan 2011, Hein et al. 2013). The highest numbers of fatalities reported in the United States are from wind energy facilities in the eastern

U.S., particularly those located along forested ridges in the Appalachian region where annual mortality estimates have ranged from 20.8 to 69.6 bats per turbine per year, or 14.9 to 53.3 bats per MW per year (Arnett et al. 2008, Strickland et al. 2011). However, relatively high fatality estimates for bats also have been reported at wind energy facilities in agricultural settings in the central and Midwestern U.S. (Jain 2005, Gruver et al. 2009, Poulton 2010).

Bat mortality at wind energy facilities is caused primarily by direct collision with moving turbine blades (Horn et al. 2008). There is little information about the indirect causal factors that influence bat mortality at wind energy facilities, although several hypotheses have been proposed (Kunz et al. 2007, Arnett et al. 2008, Cryan and Barclay 2009, Rydell et al. 2010). The current leading hypotheses are that bats are attracted to turbines for several reasons including as potential roosting locations (Kunz et al. 2007), potential pairing or mating sites (Cryan and Barclay 2009), or the potential accumulation of migratory insects around turbine rotors (Rydell et al. 2010). Thus, variables that may contribute to bat fatalities from wind turbines include, but are not limited to: the biology of the bat species, season, region, and turbine design (Kunz et al. 2007). Regardless of the specific causes of bat fatalities, two general patterns of fatalities are consistent across nearly all wind energy facilities:

1. Migratory tree-roosting bats represent the majority of fatalities; and
2. The majority of bat fatalities occur during late summer and early fall, coinciding with the fall migratory movements of bats (Arnett et al. 2008, Cryan 2011).

Some migratory bats travel long distances at altitudes that may overlap with the height of wind turbine blades, making them more susceptible to collisions. The probability of mortality events may also increase during periods of poor weather, such as just before or after the passing of a storm front (Arnett et al. 2008).

Tree bats, such as eastern red bats (*Lasiurus borealis*), silver-haired bats (*Lasionycteris noctivagans*), and hoary bats (*Lasiurus cinereus*), make long latitudinal migrations to warmer climates, and peaks in fatality rates appear to coincide with increasing bat activity levels associated with the southward migration of these species (Cryan 2003, Arnett et al. 2008). *Myotis* species are not considered particularly susceptible to direct mortality from wind turbines, but individuals, mostly little brown bat (*Myotis lucifugus*), have been found during mortality searches (Arnett et al. 2008, BHE Environmental 2011, Grodsky and Drake 2011).

NLEB may be most susceptible to impacts during the summer residency period if roosting habitat is cleared during wind project construction, as well as during the spring and fall periods when migrating bats, more likely to be flying within the rotor swept area (RSA), could collide with operational turbines. Although there are less than 30 confirmed records of NLEB fatalities at wind energy facilities (USFWS 2013), the USFWS considers wind projects to be a threat to the species. The USFWS believes that the large decline in NLEB populations as a result of white-nose syndrome (WNS) may be compounded by the loss of even small numbers of the NLEB as a result of collision with wind turbines. USFWS has indicated that there "is no evidence suggesting effects from wind energy development in itself have led to population declines…" (USFWS 2013).

All known NLEB fatalities are from wind energy facilities located east of the Mississippi River. The greatest numbers of NLEB have been found at wind energy facilities on forested ridge tops in West Virginia, where a total of seven fatalities have been documented (Kerns and Kerlinger 2004, Young et al. 2009). NLEB mortality has also been documented in New York, Pennsylvania, and Ontario Canada (Arnett et al. 2005, Jacques Whitford 2009, Stantec 2011). In all cases, NLEB documented mortality rates at wind energy facilities are substantially lower than mortality rates of long-distance migratory species (i.e. migratory tree bats), and other *Myotis* species. Recently, WNS has caused large declines in populations of cave-hibernating species throughout eastern North America. WNS has been especially devastating to populations of species in the *Myotis* genus, including NLEB (*Myotis septentrionalis*), prompting proposed federal protection for this species by USFWS (USFWS 2013).

Table 1 summarizes publicly available regional bat mortality data reported from wind projects with habitat similar to the Project Area.

Table 1. Regional Estimates of Mean Bat Fatalities per Megawatt at Wind Facilities in the northern Great Plains and Midwest Regions with Publicly Available Data.

Wind Facility[1]	State	Habitat	Turbine Model (turbine rotor-swept area)[2]	Estimated mean fatality/MW/year	Bat Species Recorded as Fatalities (in order of decreasing frequency)	Source
Cedar Ridge	Wisconsin	Agricultural cropland	Unknown, 1.6MW (5,281 m^2)	30.40 (per 169 days)	hoary, silver-haired, big brown, eastern red, little brown	Poulton 2010
Blue Sky Green Field	Wisconsin	Agricultural cropland	Vestas V-82, 1.65MW (5,281 m^2)	24.57	little brown, silver-haired, big brown, hoary, eastern red, unidentified	Gruver et al. 2009
Forward Energy	Wisconsin	Agricultural cropland	Not stated	15.63	hoary, silver-haired, eastern red, unidentified, little brown, big brown	Grodsky and Drake 2011
Judith Gap (2006/2007)	Montana	Agricultural cropland	GE 1.5SLE, 1.5MW (4,657 m^2)	8.9	Hoary, silver-haired, unidentified	TRC Environmental 2008
Top of Iowa (2004)	Iowa	Agricultural cropland	NEG Micon 52 (2,107.69 m^2)	7.94	hoary, little brown, eastern red , big brown, silver-haired	Jain 2005, Jain et al. 2011
Kewaunee County	Wisconsin	Agricultural cropland	Vestas 0.66MW (1,734 m^2)	6.45	eastern red bat, hoary bat	Howe et al. 2002
Top of Iowa (2003)	Iowa	Agricultural cropland	NEG Micon 52 (2,107.69 m^2)	4.94	hoary bat, little brown bat, eastern red bat, big brown bat, silver-haired bat	Jain 2005, Jain et al. 2011
Judith Gap (2009)	Montana	Agriculture and grassland	Unknown, 1.5MW (4,657 m^2)	4.8	hoary, silver-haired, *Myotis* sp, unidentified	Poulton and Erickson 2010
Ainsworth	Nebraska	Mixed grass prairie	Vestas V82 (5,281 m^2)	1.16	hoary bat, unidentified bat species, big brown bat, eastern red bat	Derby et al. 2007

[1] Facilities arranged by estimated mean fatality/MW/year

[2.] If varying models were used in the Project, the largest rotor-swept area is given.

2.3 Regulatory Framework

Although the majority of bird species in the U.S. are protected under the federal Migratory Bird Treaty Act, and selected bird species or groups of species are protected under other statutes, there are relatively few laws or regulations that protect bats. At the federal level, there are no laws or regulations specific to bats; existing environmental laws primarily address the protection of habitat favored by bats, such as caves, and prohibit wanton destruction of wildlife. Bat species determined to be at risk are listed under the federal ESA, or at the state level. Beyond that, federal land management agencies such as the U.S. Forest Service, USFWS, and the Bureau of Land Management have developed habitat management guidelines and other provisions to enhance or minimize disturbance to natural habitats, including bat habitats. In some cases these provisions have been established by regulations, such as the National Forest Management Act, while in other cases the protective provisions are implemented as agency policies lacking regulatory force. Habitat protections implemented by these federal agencies are applicable to federal lands administered by the respective agencies.

Federal Protection

Of the 45 species of bats known to occur in the continental U.S., seven species are currently federally listed as endangered and protected under the ESA (USFWS 2015a): gray bat (*Myotis grisescens*), Indiana bat (M. *sodalis*), Florida bonneted bat (*Eumops floridanus*), Ozark big-eared bat (*Corynorhinus townsendii ingens*), Virginia big-eared bat (*C. t. virginianus*), lesser long-nosed bat (Leptonycteris curasoae yerbabuenae), and Mexican long-nosed bat (L. *nivalis*). One additional species, NLEB, is proposed for listing as endangered (USFWS 2013, USFWS 2014a). None of the currently listed bat species are known to occur in North Dakota. North Dakota is within the western edge of the range of NLEB, although many areas of the state do not support suitable habitat for the species.

Northern Long-eared Bat

In July 2011, the USFWS was petitioned to list the NLEB as endangered or threatened and to designate critical habitat under the ESA (USFWS 2011). On October 2, 2013 USFWS released the results of their 12-Month Finding on the 2011 petition (USFWS 2013). The USFWS concluded that listing for the NLEB was warranted, and the species is now “proposed for listing as endangered.” The USFWS also concluded that critical habitat was not determinable for NLEB at this time. The public comment period on the proposed federal listing was originally scheduled to be closed on January 2, 2014, but on June 30, 2014 USFWS published a six-month extension (USFWS 2014a). On January 16, 2015, the USFWS proposed a rule under Section 4(d) of the Endangered Species Act for the NLEB (USFWS 2015b). The USFWS is still evaluating the listing of NLEB, and has not yet determined if the species will listed as endangered, threatened, or threatened with a Section 4(d) rule. If listed under a Section 4(d) rule, there would only be NLEB take prohibitions within counties affected by WNS and an additional 150-mile buffer around these counties (USFWS 2015c). All other take incidental to other lawful activities would not be prohibited in those areas of the NLEB range not in proximity to documented occurrence of WNS as identified by the USFWS (Figure 5). The Section 4(d) rule propose is currently in a 60-day public comment period. If, when the USFWS makes a listing decision in April 2015, the Section 4(d) rule is implemented, North Dakota, and the Project Area specifically, would fall outside of the area where take is prohibited (Figure 5).

State Protection

The protection and regulation of bat species not listed under the federal ESA is typically at the discretion of state wildlife agencies. North Dakota does not have a state endangered or threatened species list, but the North Dakota Game and Fish has identified 100 species of conservation priority, or those in greatest need of conservation in the State (Dyke 2014).

Species are categorized into three levels according to conservation need:

- Level I – species in greatest need of conservation;
- Level II – species in need of conservation, but have had support from other wildlife programs; and
- Level III – species in moderate need of conservation, but are believed to be on the edge of their range in North Dakota.

There are three bat species on the conservation priority list categorized as Level I: big brown bat (*Eptesicus fuscus*), little brown bat (*Myotis lucifugus*), and NLEB. Big brown bat and little brown bat are common throughout the state while the northern long-eared bat is considered to be on the western edge of its range and rare in the state.

There are no bat species on the conservation priority list categorized as Level II.

There are three bat species on the conservation priority list categorized as Level III: western small-footed bat (*Myotis ciliolabrum)*, long-eared bat (*Myotis evotis)*, and long-legged bat (*Myotis volans*). These species are known to occur in western North Dakota.

Voluntary Guidelines for Wind Power Projects

The USFWS has developed Land-Based Wind Energy Guidelines (USFWS 2012), a non-regulatory tiered framework for assessing risk and collecting data on wildlife for wind energy projects. These guidelines are voluntary. This bat habitat assessment is consistent with the USFWS recommendations for Tier 2 – Site Characterization in the Land-Based Wind Energy Guidelines. North Dakota has not developed state-specific siting guidelines for wind power developers and other stakeholders for the consideration of potential wind power projects located in North Dakota but defers to the USFWS guidelines (ASFWA 2010).

3.0 SPECIES EXPECTED TO OCCUR IN THE PROJECT VICINITY

Tetra Tech evaluated the potential for all bats known to occur in North Dakota to use the Project Area, but with a focus on NLEB. Tetra Tech considered the suitability of the Project Area's habitat and habitats within a 1.5-mile buffer around the Project Area to develop the list of species expected to occur in the Project Area and vicinity. The 1.5-mile buffer is based upon the Northern Long-eared bat Interim Conference and Planning Guidance from the USFWS as the foraging range from roosts used to estimate home ranges for NLEB (USFWS 2014b).

Identifying if a species' constituent habitat elements for roosting and foraging occur in an area is key to determining habitat suitability (Duchamp et al. 2004). Habitat variables evaluated in this assessment included the amount of suitable foraging and roosting habitat, as well as potential migration and movement corridors in and near the Project Area. Habitat variables reviewed in the assessment included identification of the bat species known to occur in the region surrounding the Project Area and their behavioral characteristics relative to roosting, foraging and migratory activity. This information was used to derive a high, moderate, or low likelihood of occurrence in the Project Area for each species with ranges overlapping the Project Area, and specifically the NLEB.

All Bat Species

A total of 10 bat species are known to occur in North Dakota (Table 2; Gullickson *no date*). Of these 10 species, available information about species-specific suitable habitat, known distribution ranges, and documented occurrences indicate that five species are expected to have a moderate or high potential to occur within, and in the vicinity of the Project Area, and the remaining five species are expected to have a low potential of occurrence.

Roosting colonies of big brown bat and little brown bat have a high probability of occurring within the Project Area because of their known association with edge habitats and human-made structures (Table 2). Little brown bats are thought to be the most common bat in North Dakota (Gullickson *no date*). In addition, big brown bats are known to forage in agricultural lands (Rogers et al. 2006). Both species have been documented as fatalities at wind energy projects (Arnett et al. 2008).

Eastern red bat, hoary bat, and silver-haired bat have a moderate likelihood of occurring in the Project Area, primarily during migration. These species have been the predominant species found during post-construction mortality studies at operational wind energy facilities in North America (Arnett et al. 2008). The eastern red bat, hoary bat, and silver-haired bat are all associated with forested habitats and would most likely occur in small woodlots while moving through the Project Area during migration (Table 2). Each of these species are found in North Dakota from May through September (Cryan 2003, Cryan and Veilleux 2007).

The remaining species found in North Dakota (fringed bat, long-eared bat, long-legged bat, western small-footed bat, and northern long-eared bat) are expected to have a low likelihood of occurrence in the Project Area based upon species range, known habitat associations, and occurrence of similar habitats within the Project Area.

Northern Long-eared Bats

NLEB are expected to have a low likelihood of occurrence within the Project Area and Project Buffer during the summer residency period and during migration. The species' range includes Stark County (USFWS 2013, USFWS2015b, BCI 2014).

Few data are available on NLEB in North Dakota; however, the species is believed to occur statewide in suitable habitats (Harvey et al. 2011; Gullickson *no date*). Surveys conducted in the summers of 2009, 2010, and 2011, confirmed the presence of NLEB in the Turtle Mountains, Missouri River Valley, and in the Badlands regions (USFWS 2013). All recorded instances of NLEB in the Dakotas have been in ecoregions (Turtle Mountains, Little Missouri Badlands, River Breaks) with more topographic relief and trees than the Missouri Plateau ecoregion of the Project Area and Project Buffer.

Table 2. Bat Species List and Likelihood of Occurrence at the Dickinson Wind Energy Center, Stark County, North Dakota.

Likelihood of Occurrence[1]	Common Name	Scientific Name	Habitat Association[2]	Wind-energy Fatalities
Low	Northern long-eared bat	*Myotis septentrionalis*	Forages along forested hillsides and ridges. Roosts in cavities, caves and mines, underneath bark, or in crevices of trees and snags; rarely roosting in barns. Hibernate in caves and mines.	Relatively few fatalities documented in North America (Arnett et al. 2008)
High	Eastern red bat	*Lasiurus borealis*	Migratory Species. Found in hardwood deciduous forests. Generally found in close association with riparian areas. Roosts in foliage of trees.	One of most common fatalities documented in North America; fatalities assumed to be migratory individuals (Johnson et al. 2002, Kunz et al. 2007)
High	Hoary bat	*Lasiurus cinereus*	Migratory Species. Forested upland habitats, including bottomland hardwoods. Roosts in foliage of trees along the edge of clearings.	Most common fatality documented in North America; fatalities assumed to be migratory individuals (Kunz et al. 2007, Arnett et al. 2008)
High	Little brown bat	*Myotis lucifugus*	Found in close proximity to a water source for foraging and in close proximity to human-made structures. Roosts in tree cavities, caves and human-occupied structures.	Relatively few fatalities documented in North America (Arnett et al. 2008)
Moderate	Big brown bat	*Eptesicus fuscus*	Habitat generalist found in deciduous forests, urban development, and agricultural croplands. Roosts in tree cavities, under loose bark, buildings, mines, bridges, caves, and crevices in cliff faces.	Relatively few fatalities documented in North America (Arnett et al. 2008).
Moderate	Silver-haired bat	*Lasionycteris noctivagans*	Migratory Species. Closely associated with conifer and mixed hardwood forests; Generally found in association with riparian areas. Roosts in foliage of trees.	One of most common fatalities in North America; fatalities assumed to be migratory individuals (Johnson et al. 2002, Kunz et al. 2007)
Low	Fringed bat	*Myotis thysanodes*	Found in a variety of habitats. Oak and pinyon woodlands are the most commonly used. Roosts in caves, mines, and buildings.	None documented
Low	Long-eared bat	Myotis evotis	Found associated with caves and mines, and closely associated with human-made structures	None documented
Low	Long-legged bat	*Myotis volans*	Found in rugged, rocky terrain in variety of habitats. Roosts in trees, rock crevices, and buildings.	None documented
Low	Western small-footed bat	*Myotis ciliolabrum*	Found in rugged, rocky terrain in variety of habitats. Roosts in rock crevices, caves, tunnels, buildings, and underneath bark.	None documented

[1] Likelihood of Occurrence: **High** = Suitable habitat, species range overlaps with the Project Area and known occurrences within and/or near the Project Area. **Moderate** = Species known to occur in habitat similar to the Project Area, species' range overlaps with Project Area, and known occurrences near the Project Area. **Low** = Marginally suitable habitat in the Project Area, species' range does not overlap with the Project Area, no known occurrences within and/or near the Project Area, and/or known as migratory species during spring and fall migration.

[2] Sources: Gullickson *no date,* Western Bat Working Group 2005, Harvey et al. 2011, Bat Conservation International (BCI) 2014, American Society of Mammologists 2015.

4.0 HABITAT ASSESSMENT

The habitat assessment was conducted via a desktop evaluation of land cover and land uses within the Project Area and a 1.5-mile buffer (Figures 2 and 3). Identification of suitable habitats in the Project Area, and the bat species that may use these habitats, may prove helpful when designing the Project to minimize interactions between wind turbines and bats (Duchamp et al. 2004).

Habitat variables evaluated in this assessment included the amount of suitable foraging and roosting habitat, as well as potential migration and movement corridors in and near the Project Area.

Although there are still substantive information gaps on bat migration patterns across North America, there is speculation that bats migrate in a similar manner to some birds (i.e., possibly as broad front migration; Cryan 2003). Migratory bats moving through the area during migration may still be at risk of colliding with wind turbines regardless of habitat conditions. The likelihood of mortality or other impacts during migration to NLEB, and other bats, is difficult to determine based on available data.

4.1 Land Use and Land Cover

Land use and land cover types in the Project Area and Project Buffer were characterized using the National Land Cover Database in GIS (Jin et al. 2013). Habitats were compared between the Project Area and Project Buffer to understand if bats were potentially favoring or disfavoring the Project Area in the context of the surrounding landscape. For example, if the Project Area supported a relatively higher concentration of suitable habitat areas than the Project Buffer, it is possible the site would concentrate bats in densities slightly higher than the surrounding areas.

A comparison of the Project Area and Buffer Area demonstrates that percentages of different land uses and cover types in the Project Area are similar to those within the Buffer Area. The vast majority of cover within the Project Area is grassland including native grasslands and pasture/hayfields (51.3 percent), as is the majority of cover within the Buffer Area (57.7 percent). The percentage of suitable bat habitat cover types (shown in bold in Table 3) are similar between the Project Area and the Project Buffer (Table 3). Suitable bat habitat (open water, emergent herbaceous wetlands, deciduous forest, evergreen forest, mixed forest, shrub/scrub, and woody wetlands) comprises 3.7 percent of the total Project Area and 3.2 percent of the Project Buffer. Based on the percentage of cover types available in the Project Area versus the Project Buffer, it is unlikely that bats would favor the Project Area disproportionately for roosting or foraging, over other areas in the vicinity.

Table 3. Land Use and Land Cover Present in the Project Area and Project Buffer, Stark County, North Dakota.

Land Use/Land Cover Description	Acres in Project Area	Percent of Project Area	Acres in Project Buffer	Percent of Project Buffer
Grassland/Herbaceous	62,412	42.6	48,876	50.3
Cultivated Crops	58,267	39.8	31,649	32.6
Pasture/Hay	12,692	8.7	7,210	7.4
Developed, Open Space	5,870	4.0	3,982	4.1
Woody Wetlands	**1,940**	**1.3**	**835**	**0.9**
Developed, Low Intensity	1,343	0.9	1,390	1.4
Deciduous Forest	**1,163**	**0.8**	**541**	**0.6**
Shrub/Scrub	**990**	**0.7**	**660**	**0.7**
Open Water	**955**	**0.7**	**925**	**1.0**
Emergent Herbaceous Wetlands	**264**	**0.2**	**118**	**0.1**
Barren Land (Rock/Sand/Clay)	231	0.2	85	0.1
Developed, Medium Intensity	170	0.1	706	0.7
Mixed Forest	**43**	**Less than 0.1**	**20**	**Less than 0.1**
Evergreen Forest	**34**	**Less than 0.1**	**13**	**Less than 0.1**
Developed, High Intensity	7	Less than 0.1	118	0.1
Total	**146,380**		**97,129**	

Note: **Bold** text indicates habitat types that are most suitable for foraging and roosting habitat.

4.2 Roosting Habitat

Non-migratory bats use caves or similar habitat for winter hibernacula, and then disperse onto the landscape for the warmer seasons (typically April 15 – November 15) and shelter in "summer roosts". Similarly, migratory bats migrate north from wintering areas and use some of the same habitat features (e.g. tree cavities and bark) as non-migratory species during the summer. This section describes summer roosting habitat in the Project area, winter hibernacula are discussed in Section 4.3. Summer roosts are important to bats because they provide shelter from the environment and adverse weather, resting places during migration or regional movements, protection from predators, and are used for social interaction and rearing of young. Due to bats' dependence on roost structures during all stages of their life cycle; the preservation of summer roosting habitat, as well as winter hibernacula, has been identified as critical for the conservation of bats in North America (Kunz 1982, Kunz and Fenton 2003).

All Bat Species

Bats may roost in rock formations, caves, human-made structures, live trees (often in the foliage), dead trees (snags), and partially dead trees (partial snags) with cavities and loose bark. North Dakota's species can be broadly classified as tree-roosting bats (those that roost in live trees, snags and partial snags) and species adapted to roosting in multiple habitats (generalists that roost in natural habitat, but also frequently roost in human-made structures such as barns) (Harvey et al. 2011).

Tree-roosting species (NLEB, hoary bat, silver-haired bat, and eastern red bat) prefer larger trees in early stages of decay, which are often found in older forest stands (Crampton and Barclay 1998, Barclay and Brigham 1996). In the absence of mature forest stands, tree-roosting species may roost in living trees (although eastern red bats often prefer roosting in the foliage of live trees; Kunz 1982, Harvey et al. 2011). Suitable natural roosting habitats in the Project Area are limited to individual trees, windrows, woodlots and riparian zones. These wooded locations are generally near homes, along riparian corridors, or are planted windbreaks. The availability of tree-roosting habitat in the Project Area is limited due to the small size and fragmented nature of the wooded habitat and accounts for less than 2 percent of the Project Area. Therefore, roost tree availability is almost certainly a limiting factor to the occurrence of bats in the Project Area (Carter and Menzel 2007).

In addition to trees, potential roosting locations are also available in farmstead buildings (houses, barns, etc.) and in the abandoned mines within the Project Area and Project Buffer (Figure 4; NDPSC 2013). The suitability of these man-made structures have not been evaluated. However, they are present in the Project Area and Project Buffer and could be used by roosting bats.

Northern Long-eared Bats

During the spring, summer, and early fall, NLEB roost in suitable forest habitat typically within 50 miles of wintering sites (USFWS 2013). Like other North American forest bats, reproductive NLEB females will roost colonially during the late-spring and summer maternity period (approximately May to July). Maternity colonies (averaging 30–60 individuals) are most frequently found in mature forests, with a higher abundance of standing dead trees (snags), but the species also may roost in partially live or live mature trees. Both male and female NLEB generally prefer relatively large trees in early stages of decay, which are often found in older forest stands (Crampton and Barclay 1998, Barclay and Brigham 1996). Less commonly, NLEB summer day roost sites may also include human-made structures, including variety of shelters such as buildings, behind shutters, under live tree bark, and in small tree cavities (Harvey et al. 2011). Roosts are often used for a period of 2–11 nights, but maternity colonies may be occupied for longer. Because of NLEB's preference for switching roosts, multiple suitable roosting locations in a given forested patch may be indicative of higher quality summer habitat. Summer home ranges for females are estimated to be between 47 and 425 acres (USFWS 2013).

There is no significant interior forest habitat (at least 300 feet from non-forest land cover) in the assessment area with a total of eight acres of interior forest among three forested areas in the Project Area and none within the Project Buffer. The majority of forests within the Project Area are associated with riparian areas rather than ridges which are preferred by NLEB (USFWS 2014b). The only potentially suitable NLEB roosting habitat in the Project Area consists of trees associated with riparian features and small woodlots or windbreaks near homesteads. Although these sites do contain suitable roost trees, they are isolated and not connected with or contiguous to other forest patches and account for less than 4 percent of the Project Area. Average forest patch size in the Project Area is approximately 3.7 acres and the average forest patch size in the Buffer Area is approximately 2.9 acres. There is evidence suggesting that NLEB select forest patches with greater connectivity to other patches and larger forest patches with a closed canopy (mature forests) than those available in the Project Area (USFWS 2013).

4.3 Winter Habitat

Of the bat species with a moderate or high likelihood of occurring in the Project Area, silver-haired bat, hoary bat, and eastern red bat migrate to southern latitudes during winters. The remaining species, big brown bat, little brown bat, and NLEB, hibernate locally or regionally (typically within 168 miles of where they spend the summer). This section focuses on winter habitat for NLEB in the Project Area vicinity, and briefly touches on the suitability of winter habitat for other species as well.

Northern Long-eared Bats

NLEB do not undertake long-distance seasonal migrations between summer and winter ranges but do undertake shorter distance movements between summer roosts and winter hibernacula. These seasonal movements are generally between 35 miles and 55 miles, but may be substantially longer in some areas, perhaps as great as 168 miles (USFWS 2013). Information on habitat use during migration is limited, but individuals in transit are likely to use foraging habitats at least part of the time.

NLEB arrive at hibernacula in August or September, begin hibernation in October and November, and exit hibernacula in March or April (USFWS 2013). NLEB prefers hibernacula with large entrances such as caves and mines, as well as less traditional hibernacula including dams, dry wells, and other human-made structures. Individuals may hibernate in cracks and crevices in hibernacula walls, and as such, may be overlooked during winter surveys. Although NLEB are often found with other congeneric species (i.e. *Myotis* spp.), they generally prefer cooler temperatures and higher humidity (USFWS 2013). Hibernacula where NLEB occur may also be used by big brown bat and little brown bat, and possibly western small-footed bat (*Myotis ciliolabrum*; Brack et al. 2010).

There were no caves or other natural rock or crevice formations in the Project Area based on sources for the region that would be suitable hibernacula (Murphy 2007, NDGS and NDDH 2001). All known caves are greater than 20 miles from the Project Area. The closest caves are Bear Cave, approximately 23 miles to the southwest, and Lion’s Cave, approximately 25 miles to the west (Figure 4). Bear Cave extends only 12 feet and Lion’s cave is likely similar as both are located along caprock (Murphy 2007). In addition to natural formations, there are six abandoned underground mines within the Project Area and six abandoned underground mines within the Project Buffer that could provide potential roosting habitat for bats (NDPSC 2013); however, the suitability of these mines for roosting bats is unknown. No known hibernacula for NLEB have been documented in North Dakota, although a thorough assessment of potential hibernacula in western North Dakota has not been completed (USFWS 2013). The closest known hibernacula occur in the Black Hills of Wyoming and South Dakota over 150 miles to the southwest (USFWS 2013).

4.4 Foraging Habitat

Foraging habitats are not necessarily exclusive of roosting or migrating habitat. However, there are notable preferences among species for different foraging habitats, which are often different from preferred roosting locations (Harvey et al. 2011).

All Bat Species

All bats known to occur in North Dakota are insectivorous, and feed on a variety of prey, including moths, beetles, flies, and mosquitoes (Kunz and Fenton 2003). Bats typically forage in areas with high prey concentrations (i.e. high nocturnal insect densities) in riparian areas (Waldien and Hayes 2001), over waterbodies (Henry et al. 2002, Lacki et al. 2007), and along forest edges (Hayes and Gruver 2000, Rogers et al. 2006). Non-developed and non-agricultural types of habitats (open water, forested, wetlands, and scrub shrub) provide the best foraging opportunities for bats and account for less than 4 percent of the Project Area. Although there is some evidence to indicate that some species, such as the big brown bat, prefer foraging over agricultural lands (Rogers et al. 2006, BCI 2014), agricultural lands within the Project Area are typically the least suitable locations for foraging and account for approximately 40 percent of the Project Area.

Northern Long-eared Bats

Unlike other *Myotis* in the region that typically forage along streams and within floodplains, NLEB are adapted to gleaning and hawking for insects in the sub-canopy of deciduous and mixed forests and therefore typically forage along ridge tops and forested hillsides (Harvey et al. 2011). However, foraging may also occur in forest clearings, above roadways, and along trails or near water (USFWS 2013). Agricultural lands within the Project Area (approximately 40 percent of the land cover) are the least suitable locations for NLEB foraging. Suitable foraging habitat for NLEB includes forested areas, wind breaks, riparian corridors, and open water areas in the Project Area. This suitable foraging habitat accounts for less than 3 percent of the Project Area which is a small percentage of overall land cover.

4.5 Bat Migration and Movement Characteristics

Bat migration includes seasonal movement from summer residency areas to wintering areas. Wintering areas for long-distance migrants are typically in southern latitudes (Fleming and Eby 2003). Long-distance migratory bats such as the eastern red bat, silver-haired bat, and hoary bat undertake seasonal movements greater than 62 miles and less than 1,200 miles (Cryan 2003, Cryan 2011). Wintering areas for other species include natural or man-made hibernacula (Fleming and Eby 2003). NLEB, little brown bat, and others migrate short distances from summer colonies to winter hibernacula (i.e., partial or short-distance migration) (Fleming and Eby 2003). Most species, including NLEB, are thought to move along linear landscape features that connect habitats, such as horizontal forest features, (e.g., forest edges), vertical forest features (e.g., between forest canopy structures), or riparian corridors (Hayes and Gruver 2000, Downs and Racey 2006, Furmankiewicz and Kucharska 2009). Beyond these generalities, the current understanding of bat migration is limited (Baerwald and Barclay 2009, Cryan 2011).

NLEB and other species may fly thorough the Project Area during spring and fall migration en route to hibernacula. The Project Area contains small forested riparian corridors that bats could follow or utilize as day roosting sites, although these are not significant features from a regional perspective. The limited roosting habitat within the Project Area is a major limiting factor for use of the Project Area by migrating bats. Therefore, bat migration through the Project Area is likely low in magnitude.

5.0 SUMMARY

There is little suitable roosting or foraging habitat in the Project Area or within the Project Buffer for the NLEB. There is slightly more suitable roosting and foraging habitat for other bat species, primarily big brown bat and little brown bat, in the Project Area and the Project Buffer. The small size and small number of wooded parcels in the Project Area and the Project Buffer likely limits the density and diversity of bats in the Project Area. Because of this lack of forested habitat within the Project Area and Project Buffer and the location of the Project Area at the edge of the species range, NLEB have a low likelihood of occurring in the Project Area. There are no known NLEB hibernacula in North Dakota and the NLEB is considered to be rare in the state (USFWS 2013, Dyke 2014).

5.1 NLEB Habitat Suitability Conclusion

The NLEB Guidance (USFWS 2014a) includes a stepwise assessment approach with specific questions intended to facilitate review of potential impacts to the species. The following questions (in bold) and responses are based on our current knowledge of the Project Area and the results of the 2015 desktop habitat assessment. Sections 4.1 – 4.5 provide information requested by USFWS for habitat assessments, as part of the NLEB interim guidance (USFWS 2014b, USFWS 2014c).

Is the project within the range of NLEB?

Yes. The Project is within the range of NLEB (Gullickson *no date*, Harvey et al. 2011, USFWS 2014a, USFWS 2015c).

Is suitable summer or winter habitat present?

The proposed Project is located in the Northern Great Plains ecoregion, which has been intensively cultivated but historically consisted of prairie habitat. In this ecoregion forested habitat is almost exclusively associated with human development (e.g. wind breaks), lakesides, and riparian areas.

Less than 2 percent of the 146,380-acre Project Area is forested. Forested habitat in the Project Area (woody wetlands, evergreen forest, mixed forest, deciduous forest) is relegated to small woodlots that are disconnectedly distributed along riparian areas, as woody wetlands, and as windbreaks along fields or at homesteads. The majority of the forest habitat within the Project Area occurs in the northeastern portion of the Project Area where terrain is more variable. Trees in this location occur within drainages and slopes of the rolling terrain. The Heart River and associated tributaries in the southwestern portion of the Project Area have intermittent tree stands along the riparian corridor. Large, contiguous tracks of upland forested habitat, preferred by NLEB, are not present in the Project Area.

Based on the desktop habitat assessment, the NLEB has a low likelihood to occur in the Project Area during the summer residency period (approximately May 15–August 15) because of the lack of large contiguous woodlots and due to the species being uncommon in the far western extent of its range which includes the Project Area. The species could occur in the Project Area during seasonal movements to hibernacula. Although we have not assessed the Project Area for potential winter hibernacula, Tetra Tech is not aware of any available data that indicate the occurrence of NLEB hibernacula in western North Dakota and no hibernacula are known in the state (USFWS 2013).

Is lethal take during migration possible?

NLEB have been found during mortality searches at wind energy facilities (e.g., Arnett et al. 2005, Jacques Whitford 2009), so lethal take is possible if NLEB migrate through the Project. However, the occurrence of the species in North Dakota, including potential winter hibernacula, is poorly understood and NLEB are expected to be uncommon or rare in western North Dakota (USFWS 2013). Therefore, the likelihood of NLEB occurring in the Project Area during the summer residency period is low. No clear migratory pathways, or known hibernacula are in the Project Area or vicinity; however, migration patterns are poorly understood. The likelihood of the species occurring during the migration period (spring and fall) is expected to be very low because of distance to known hibernacula and low availability of suitable foraging or roosting habitat in the Project Area and Project Buffer. All records of NLEB mortality at wind energy facilities are from eastern North American projects.

Is there an existing summer or winter occurrence record near the Project Area (e.g., within 1.5 miles of a known roost tree, 3 miles of capture location, or 5 miles of a hibernaculum)?

Tetra Tech is not aware of any existing summer or winter occurrence records within 5 miles of the Project Area. Bat acoustic surveys for NLEB will be initiated in spring 2015. Winter habitat surveys are not planned.

Was the presence of NLEB documented during surveys?

Bat acoustic surveys for NLEB will be initiated in spring of 2015 and will continue through the summer. The objective of the bat acoustic surveys will be to estimate the seasonal distribution and spatial patterns of bat activity within the Project. The 2015 bat acoustic surveys will be conducted in accordance with NLEB Guidance from USFWS (USFWS 2014b, USFWS 2014c).

Is this an existing or ongoing project within the range of the Indiana bat with a prior determination for Indiana bat?

No. The Project Area is outside the range of the Indiana bat.

5.2 Critical Habitat for Listed Species

At the time this report was prepared, the USFWS has not designated or proposed any critical habitat for NLEB and no bats with designated critical habitat occur within the Project Area (USFWS 2013, USFWS 2015a). If USFWS were to designate critical habitat for NLEB, designated areas would likely consist of large well-known hibernacula, similar to critical habitat designated for the Indiana bat.

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FIGURES

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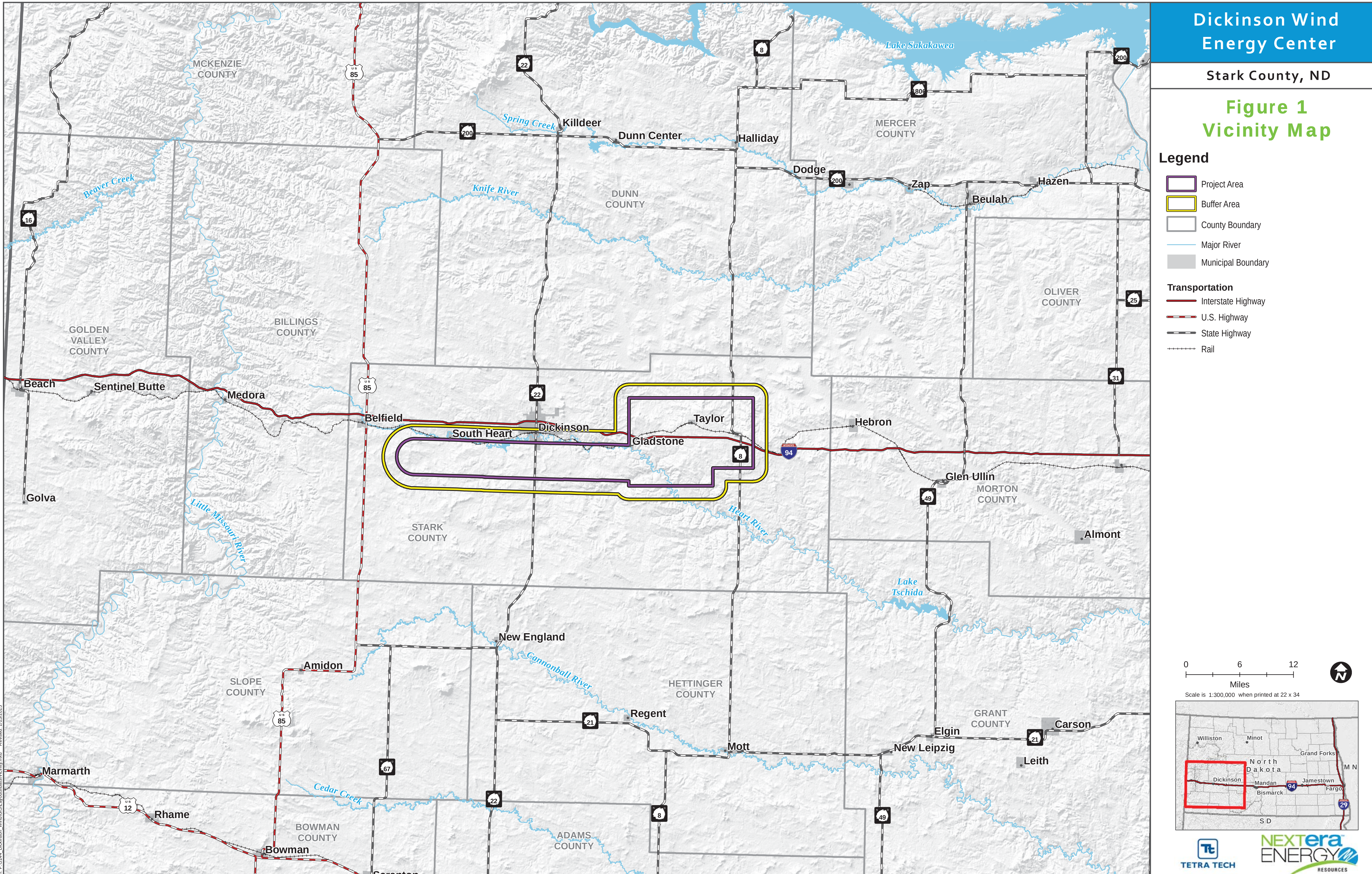
Stark County, ND

Figure 1
Vicinity Map



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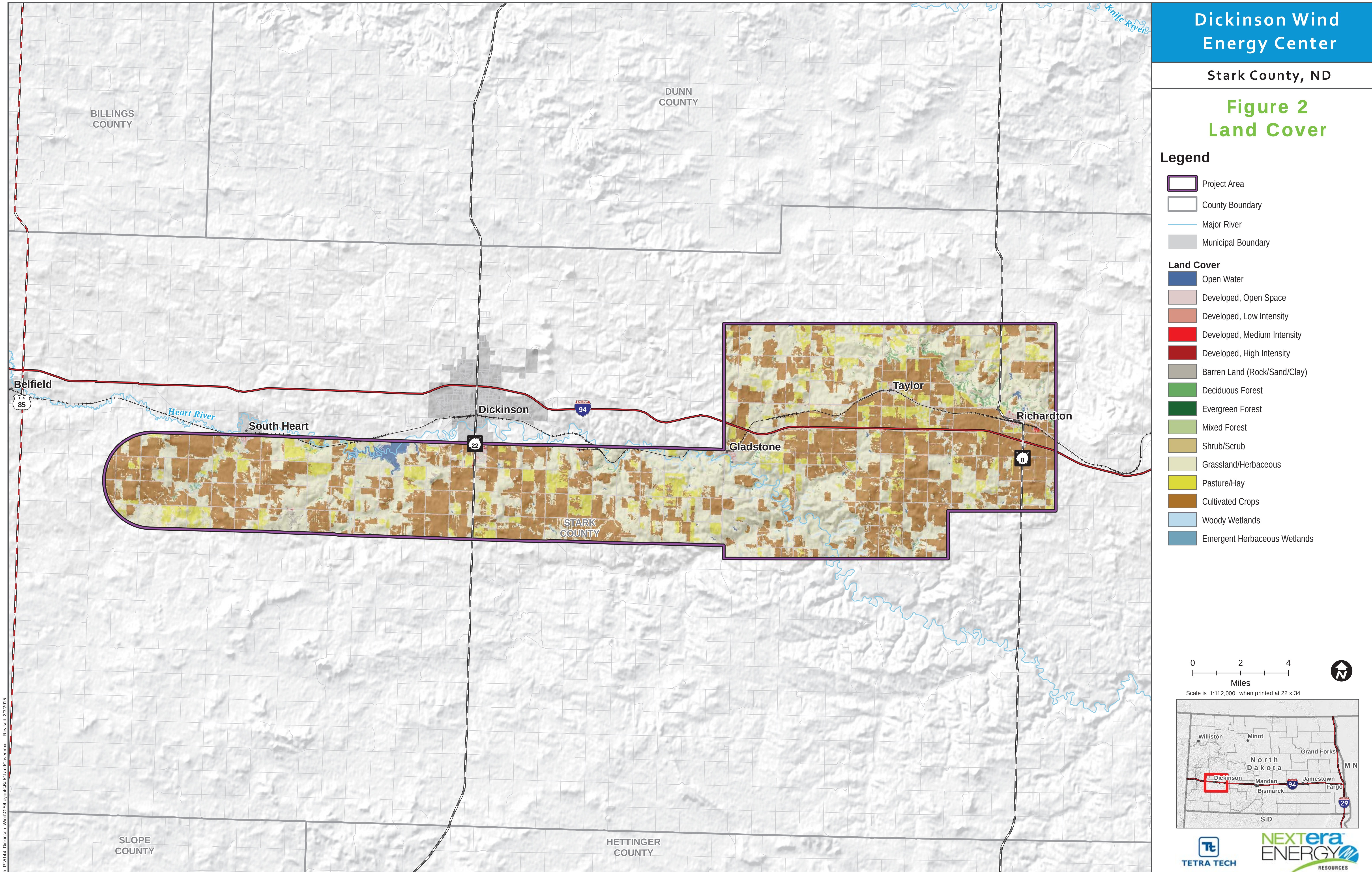
Dickinson Wind Energy Center

Stark County, ND

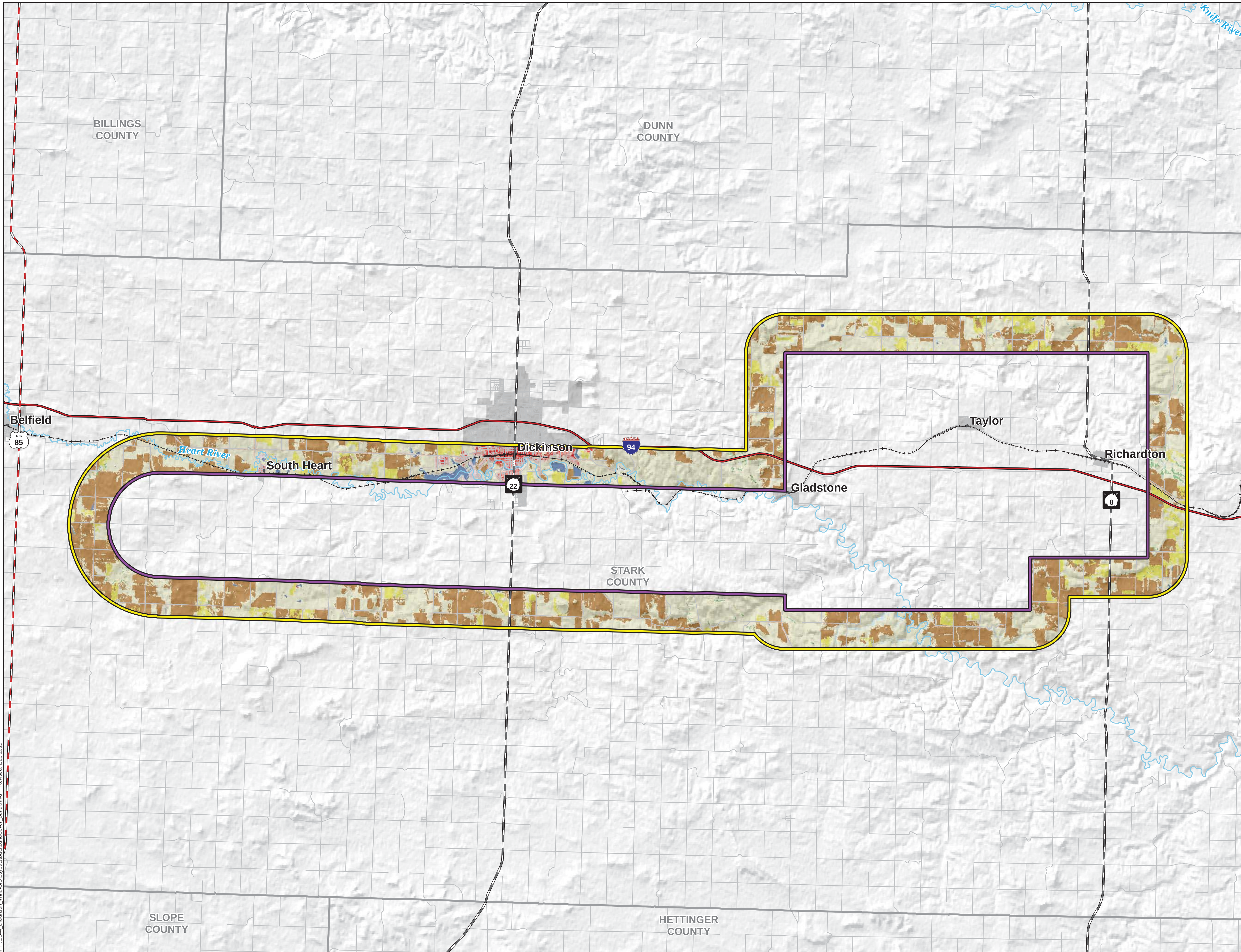
Figure 2
Land Cover



Dickinson Wind Energy Center

Stark County, ND

Figure 3
Land Cover Buffer



Legend

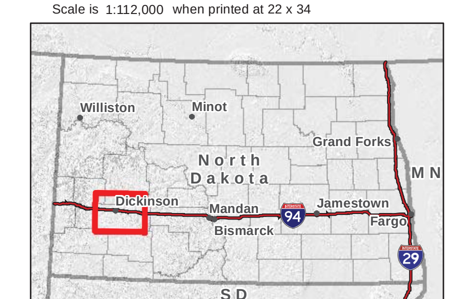
- Project Area
- Buffer Area
- County Boundary
- Major River
- Municipal Boundary

Land Cover

- Open Water
- Developed, Open Space
- Developed, Low Intensity
- Developed, Medium Intensity
- Developed, High Intensity
- Barren Land (Rock/Sand/Clay)
- Deciduous Forest
- Evergreen Forest
- Mixed Forest
- Shrub/Scrub
- Grassland/Herbaceous
- Pasture/Hay
- Cultivated Crops
- Woody Wetlands
- Emergent Herbaceous Wetlands

0 2 4
Miles

Scale is 1:112,000 when printed at 22 x 34



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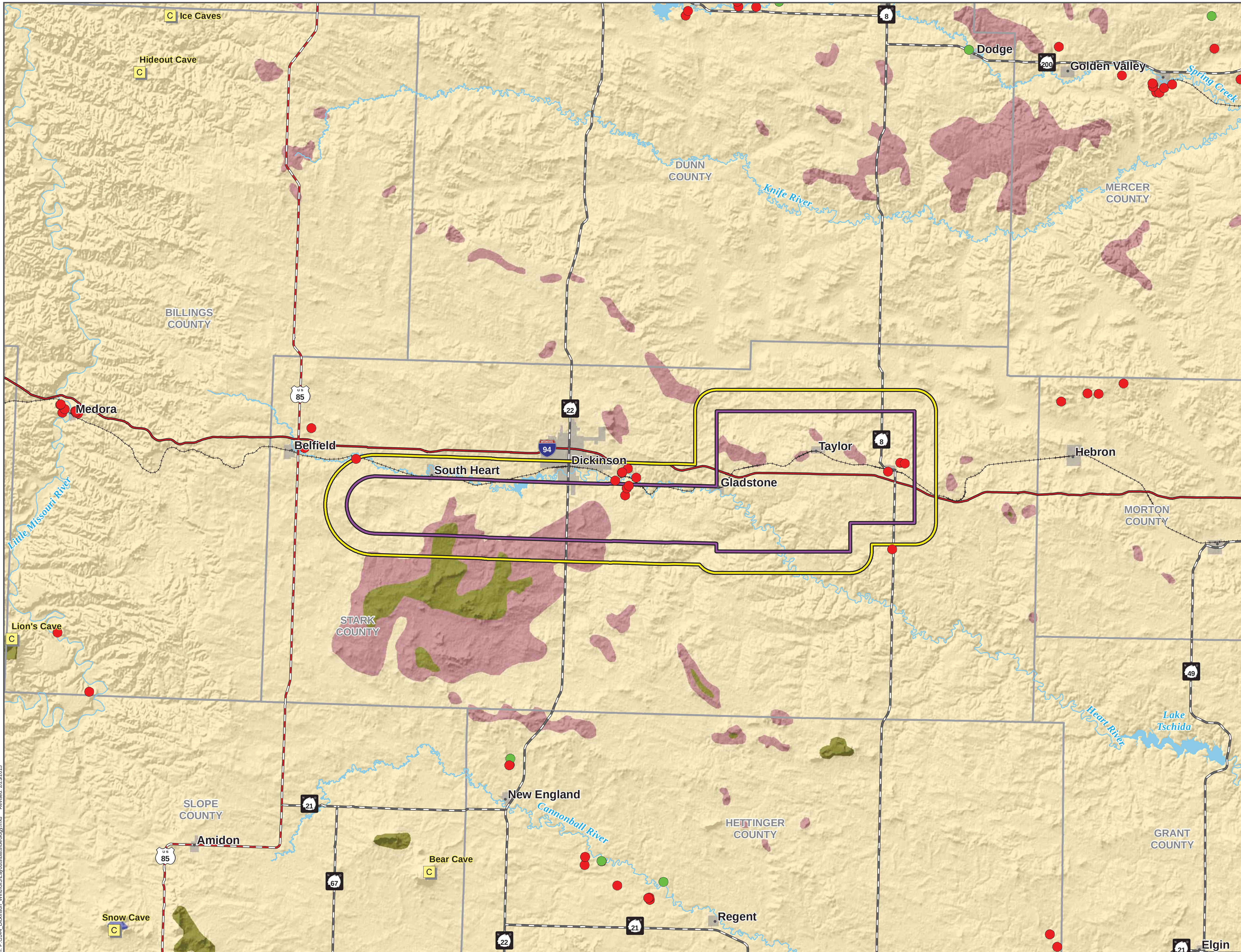
Stark County, ND

Figure 4 Geology



Legend

- Project Area
- Buffer Area
- County Boundary
- Major River
- Municipal Boundary
- Approximate Cave Location

Abandoned Mines

- Underground
- Underground/Surface

Bedrock Geology

- Micaceous Sandstone, Sand, Silt, Clay
- Sandstone or Limestone, Butte Caprock
- Silt, Sand, Clay, Sandstone, and Lignite
- Siltstone, Clay, Sand

0 5 10

Miles

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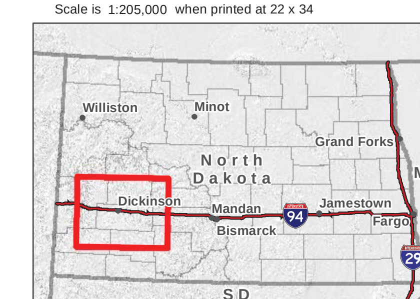

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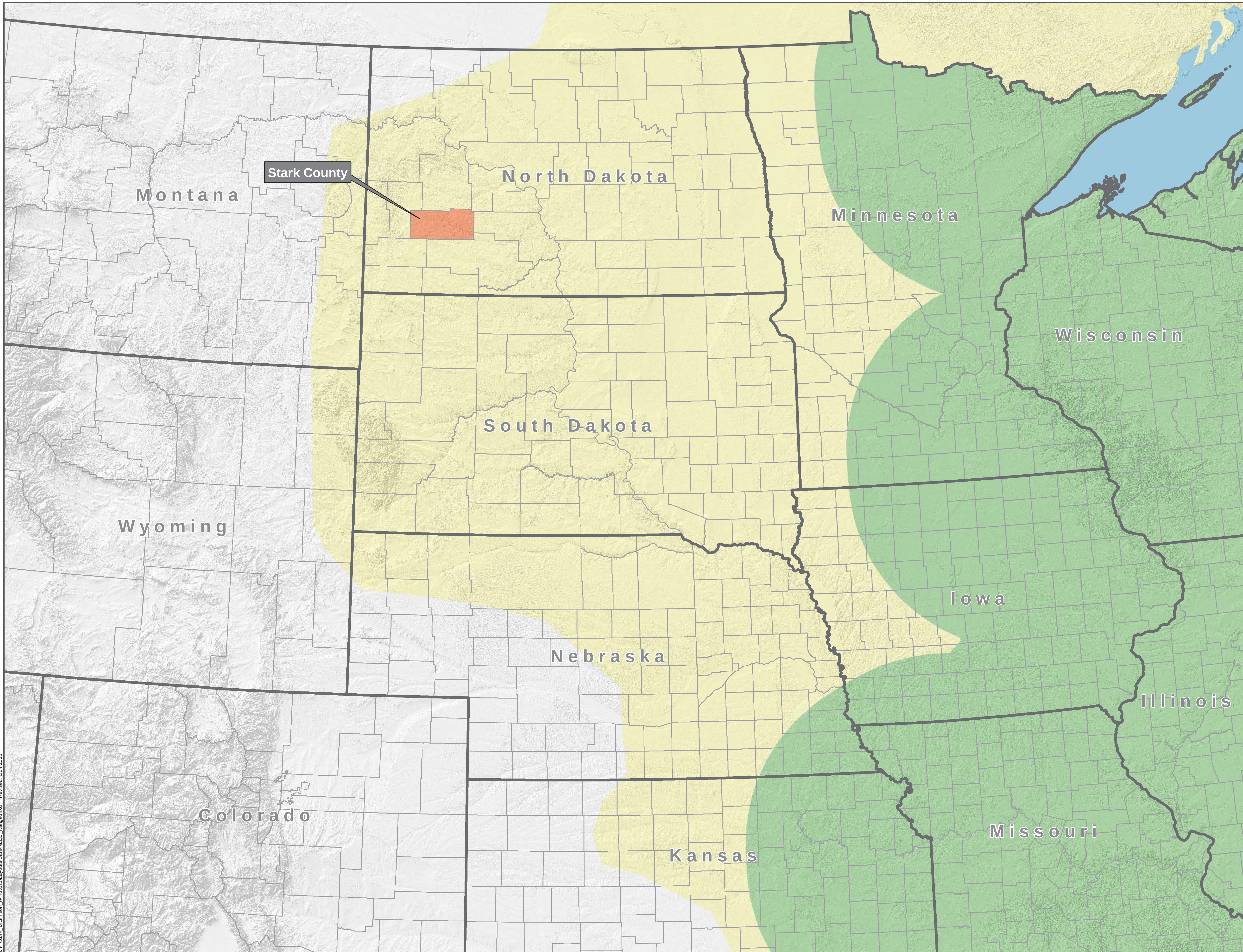
Dickinson Wind Energy Center

Stark County, ND

Figure 5
Northern Long-eared Bat Range and USFWS White-nose Syndrome Buffer



Legend

- USFWS White-nose Syndrome Buffer
- Northern Long-eared Bat Range
- State Boundary
- County Boundary

0 50 100
Miles
Scale is 1:2,500,000 when printed at 22 x 34

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