DRAFT

Whooping Crane Likelihood of Occurrence Report

Wilton IV Wind Energy Center

Burleigh County, North Dakota

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Executive Summary

The likelihood of whooping cranes occurring in the Wilton IV Wind Energy Center Project Area is low, despite the Project Area's position in the central portion of the whooping crane migration corridor. The major factor that contributed to this assessment was the lower proportion of suitable wetland habitat within the Project Area than the surrounding area. There are no recorded historical observations of whooping cranes within the Project Area. A total of 81 observations occurred within the 35-mile buffer area around the Project Area. The majority of these observations occurred along the Missouri River to the west, Lake Audubon to the northwest and Long Lake to the southeast of the Project Area. The two most likely impacts of wind development on whooping cranes are: 1) direct mortality of whooping cranes due to collisions with transmission lines, turbines, or other facilities; or 2) whooping cranes' avoidance of the area around the facility. Each project site is unique with respect to the relationship of the facilities with potential whooping crane habitat. The whooping crane observations should be used for general inference regarding use of an area and cannot be used for micrositing features away from whooping crane sightings because some of the observations may lack precise locations.

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1.0 INTRODUCTION

Wilton Wind IV, LLC (Wilton IV) proposes to develop the Wilton IV Wind Energy Center, a 99 megawatt (MW) wind energy facility in Burleigh County, North Dakota (Project; Figure 1). The current layout (project boundary and turbine layout dated September 21, 2011) includes 62 GE 1.6 MW xle turbines, two alternate turbine locations, and one substation. No new transmission lines would be constructed as part of this project; a 240-foot overhead tie line will be constructed to connect the Project substation with an existing transmission line. 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 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 (Canadian Wildlife Service [CWS] and United States Fish and Wildlife Service [USFWS] 2007). Thus, the construction of wind turbines may pose a risk to whooping cranes through direct mortality or avoidance of areas where turbines are located.

To continue their efforts to identify areas where they can minimize impacts, Wilton IV contracted Tetra Tech EC, Inc. (Tetra Tech) to conduct a landscape-scale analysis to assess the potential occurrence of whooping cranes for the Project. 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. Despite the small population size of whooping cranes, 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 locations of historical observations of whooping cranes, 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 will 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, given the low probability of detecting a whooping crane during field surveys, thereby minimizing their utility to document presence or absence from a given area, this assessment tool was designed to take advantage of available data.

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 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 and no utility has been prosecuted for crane collisions with transmission lines, despite at least 46 known fatalities or serious injuries. The whooping crane is also considered a level III Species of Conservation Priority by the North Dakota Game and Fish Department (Hagen et al. 2005). Under the North Dakota comprehensive wildlife conservation strategy guide, a level three species of conservation priority is a species of moderate priority but are believed to be peripheral or non-breeding in North Dakota (Hagen et al. 2005).

The whooping crane population in North America has experienced sharp declines and disappearance 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 lead 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 in route to the wintering grounds at Aransas National Wildlife Refuge along the Gulf Coast of Texas. 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 279 as of the end of spring migration in 2011 (WCCA 2011).

3.0 ENVIRONMENTAL SETTING AND PROJECT AREA DESCRIPTION

3.1 Environmental Setting

The Project Area is located within the Northwestern Great Plains. This landscape includes the western mixed-grass prairie, short-grass prairie, and associated wetlands of the Missouri Slope and River Breaks regions. This semiarid, unglaciated region of North Dakota includes level to rolling plains topography with isolated sandstone buttes or badlands formations. Native grasslands persist in areas of steep or broken topography, but they have been largely replaced by spring wheat and alfalfa over most of the ecoregion. Land use is predominantly dry-land farming of spring and winter wheat, barley, sunflowers and corn, interspersed with cattle grazing.

3.2 Project Area Description

The Project Area is located on privately owned lands in central North Dakota, consists of 15,752 acres, and is located approximately 18 miles north of Bismarck in Burleigh County (Figure 1). The Project Area is characteristic of the upland portion of this region, with the majority of the land surface currently covered by agriculture and rangelands with patches of native prairie. The area contains numerous small wetlands that vary from shallow vegetated depressions, fens, and intermittent creeks. Residences and abandoned farmsteads are scattered throughout the Project Area. Patches of trees and shrubs exist throughout the Project Area, and are found primarily between agricultural fields, in drainages, and as shelter belts around homesteads and between agricultural fields.

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 2 eggs, but only 10 percent of families arrive on the winter grounds with 2 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 exceed 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 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 (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 collision 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. Fourteen individuals from the Florida non-migratory population and 1 individual in the migratory Wisconsin population have died from colliding with power lines.

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). It is unknown how whooping cranes will respond to the presence of wind turbines. The USFWS (2009) holds the opinion 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 amount to 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 reach the wintering ground on the Texas coast. The migration route is well defined and 94 percent of all observations occur within a 200-mile wide corridor during spring and fall migration (CWS and USFWS 2007, 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. Some sites in the migration corridor are used consistently and have high annual use. Four traditional stop-over sites are found in Nebraska (Platte River), Kansas (Cheyenne Bottoms Wildlife Management Area, Quivira National Wildlife Refuge), and Oklahoma (Salt Plains National Wildlife Refuge). These sites are designated as critical habitat under the Endangered Species Act (CWS and USFWS 2007).

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). Individuals travel southeast about 300 miles to the 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 early October to early November; peak migration occurs around October 18 (Austin and Richert 2001).

5.2 Spring Migration

Whooping cranes depart the wintering ground at Aransas National Wildlife Refuge 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 early April to late April; peak migration occurs around April 19 (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 used 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). Size of wetlands used during spring and fall migration ranges from 0.4 hectare (ha) to over 500 ha, and no seasonal use patterns are evident (Austin and Richert 2001); 75 percent of recorded roost wetlands were smaller than 4 ha (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 have also been used as feeding sites (Austin and Richert 2001). Among agricultural crops used as feeding sites, use of winter wheat was higher than other crop types in fall and use of row-crop stubble (comprised mostly of corn) was higher in 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 found 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 CRANES LIKELIHOOD OF OCCURENCE

The primary threats of wind energy development to whooping cranes are mortality due to collision with transmission lines and associated structures and loss of habitat. Because of the high levels of concern regarding whooping cranes, the ability to evaluate the risk to whooping cranes at individual Project Area areas is a critical component to understanding the environmental impacts of a proposed wind facility. Here, Tetra Tech presents a method used to evaluate the likelihood of whooping cranes to occur at a Project Area located in central North Dakota. This evaluation method incorporates the location of the Project Area in the migration corridor, the presences 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 Area at Project Areas with high scores. For the purposes of this report, the scores calculated for each parameter were totaled and the likelihood of occurrence for whooping cranes in the Project Area was ranked accordingly: Low (0-4); Moderate (5-10); High (10+). This assessment tool is not intended to replace field surveys. However, given the low probability of detecting a whooping crane during field surveys, thereby minimizing their utility to document presence or absence from a given area, this assessment tool was designed to take advantage of available data.

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 scored 7.5. If a Project Area fell between the 75-percent and 95-percent buffers, it was scored 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 scored 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 2009 which is the most current available data.

- 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 on the Landscape (A)

Biological Justification

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 if a Project Area contained a higher proportion of wetlands than was found within the 35 miles surrounding the Project Area to determine if the Project Area is more attractive than the surrounding area. This included a one-day site visit, August 9, 2011, to the Project Area to verify existing wetlands within the Project Area and evaluate the potential use by whooping cranes.

Scoring

Tetra Tech used GAP data for North American (Strong et al. 2005) in conjunction with National Wetlands Inventory (NWI) data (USFWS 2006) and National Land Cover Database data (USGS 2007) 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 will help 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 a 35-mile area around the Project Area that was wetlands (excluding the Project Area). Tetra Tech divided the proportion of the Project Area that was wetlands by the proportion of the 35-mile buffer that was wetlands to determine if the Project Area contained more 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 is more attractive than the surrounding 35-mile buffer. If the ratio was equal to 1, the Project Area contained a similar proportion of wetlands and is as attractive as the surrounding 35-mile buffer. If the ratio was less than 1, the Project Area contained less wetlands and is less attractive than the surrounding 35-mile buffer.

Assumptions

- The distribution of wetlands in the Geographic Information System (GIS) data is an accurate representation of the location of wetlands in the Project Area.
- 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 that agricultural crops, especially corn, sorghum, and winter wheat were the habitat most often contiguous to roosting areas and that most cranes traveled 0.62 miles from a roosting site to a foraging site. Therefore, wetlands located within 0.62 mile of agricultural crops form a wetland-habitat matrix that is often used by whooping cranes during migration (Austin and Richert 2001). Tetra Tech determined the proportion of the Project Area that was comprised of wetland-agricultural matrix. Tetra Tech included water bodies of any type (hereafter wetlands), but restricted the analysis to wetlands greater than 1 acre to eliminate inclusion of unusable wetland (e.g., borrow pits). Tetra Tech limited the analysis to crop agriculture because it is most often used for feeding habitat and restricted the analysis to agriculture greater than 1 acre because most observations of cranes occurred in agriculture greater 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 (GAP data) was obtained for North Dakota (Strong et al. 2005). Water features and the spatial extent of waters were verified with NWI data (USGS 2007). The GIS analysis was designed to calculate the total area of wetland-agricultural matrix, which may include 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 may range from 0 to 1.

Assumptions

- The optimal 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:

$$LI_i = (L_i \times A_i) + W_i$$

Where L_i = location of Project Area in relation to the migration corridor score, A_i = attractiveness score, or the ratio of wetlands in a Project Area to wetlands in a 35-mile area around a Project Area, H_i = historical observation score, and W_i = wetland-agricultural matrix score. The equation places the most weight on the location in the migration corridor because of the wide range of scores. 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 WILTON IV ASSESSMENT AND SUMMARY

The results of the one-day site assessment of the wetlands within the Project Area found that all wetlands were present and counted as potential useable habitat for whooping cranes. The likelihood index score was 1.17 for the Project Area (Table 2) implying low likelihood of occurrence, despite the Project Area's location in the central portion of the whooping crane migration corridor. Fifty-two percent of the Project Area consists of suitable wetland-agriculture matrix habitat, making the Presence of Feeding and Roosting Sites (W) value 0.52 (Figure 4). The Project Area is located within the 75-percent buffer; therefore, the Location (L) parameter was 7.5. The percentage of available wetlands within the Project Area is lower than the surrounding 35-mile buffer area, with a calculated Attractiveness on the Landscape (A) value of 0.09. There were no recorded historical observations of whooping cranes documented within the proposed Project Area and three observations documented within 10-miles (Figure 4). A total of 81 observations occurred within the 35-mile buffer around the Project Area (Appendix 1). The majority of these observations occurred along the Missouri River to the west, Lake Audubon to the northwest and Long Lake to the southeast of the Project Area. The whooping crane observations should be used for general inference regarding use of an area and cannot be used for micrositing features away from whooping crane sightings because some of the observations may lack precise locations. Additionally, the absence of a sighting in a specific area should not be construed as a whooping crane having never occurred in that area.

8.0 RECOMMENDATIONS

Risk to whooping cranes inside the migration corridor can be minimized by selecting sites that are not as attractive as the surrounding landscape and that do not contain a high proportion of wetland-agricultural matrix habitat, although any wetland of suitable size may be utilized by whooping cranes. Conducting a broad scale analysis of the risks associated with potential Project Area sites is the first step to determining potential impacts to whooping cranes.

Determining the optimal mitigation plan for whooping cranes is challenging because the actual impacts associated with the construction and operation of a Project Area are not known. The two most likely possibilities are: 1) direct mortality of whooping cranes due to collisions with transmission lines, turbines, or other facilities; or 2) whooping cranes avoidance of the area around the facility. If avoidance of a previously utilized region occurs, the area occupied by the wind facility would constitute stop-over habitat loss. Therefore, in the former case, mitigation should be directed at increases in survival or reproduction of the cranes. In the latter case, mitigation could be directed at the creation or preservation of stopover habitat. In lieu of specific data about impacts, a range of mitigation options and additional research needed are presented below. As additional species and Project Area data become available, avoidance and minimization options can be refined.

Each Project Area is unique with respect to the relationship of the facilities with potential whooping crane habitat. Thus, avoidance and minimization strategies are site-specific and require detailed knowledge of the proposed Project Area and surrounding landscape as well as coordination with state and federal wildlife biologists. In the current political environment, the preferred method of avoidance and minimization may change rapidly as more information about whooping crane behavior and habitat availability becomes available.

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TABLES

Table 1. Parameters used in the likelihood index calculation.

Parameter	Score	Justification
Location in the Migration Corridor (L)		
Within the 75-percent buffer	7.5	75% of all whooping crane observations occur within the 75-percent buffer
Between the 75-percent and 95-percent buffers	2.0	20% of all observations occur between 75-percent and 95-percent buffers
Outside the 95-percent buffer	0.5	5% of observations occurred outside the 95-percent buffer
Attractiveness on the Landscape (A)		
Ratio of wetlands per total acreage for Project Area / wetland per total acreage for 35-mile area not including Project 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

Table 2. Likelihood index scores for the Wilton IV Project Area.

Location in the Migration Corridor (*L*)	Attractiveness on the Landscape (*A*)	Presence of Foraging and Roosting Habitat (*W*)	Likelihood Index Score (*LI*)
7.5	0.09	0.52	1.17 (Low)

FIGURES

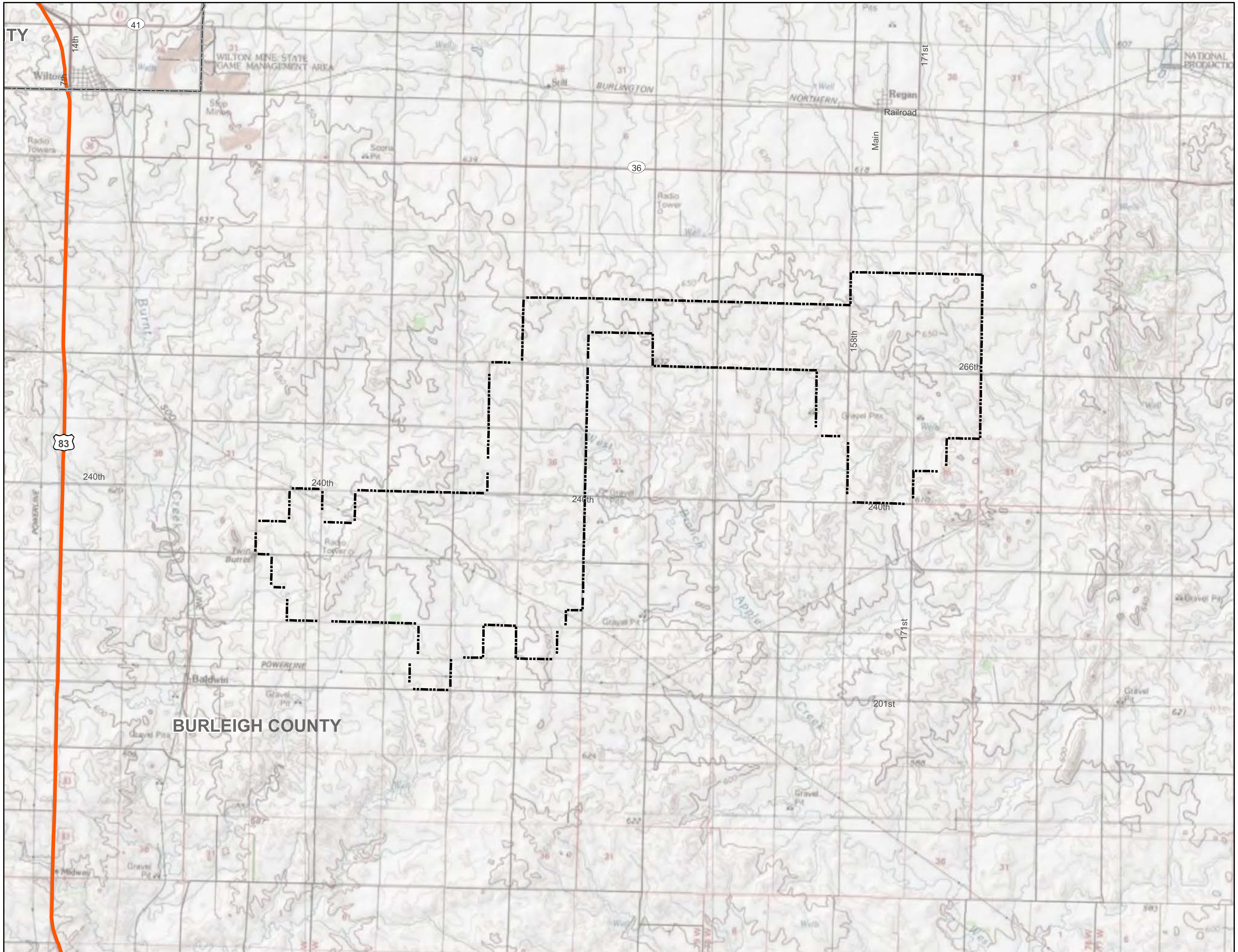


Figure 1.
Wilton IV
Wind Resource Area
Vicinity Map

Burleigh County
North Dakota

October 2011

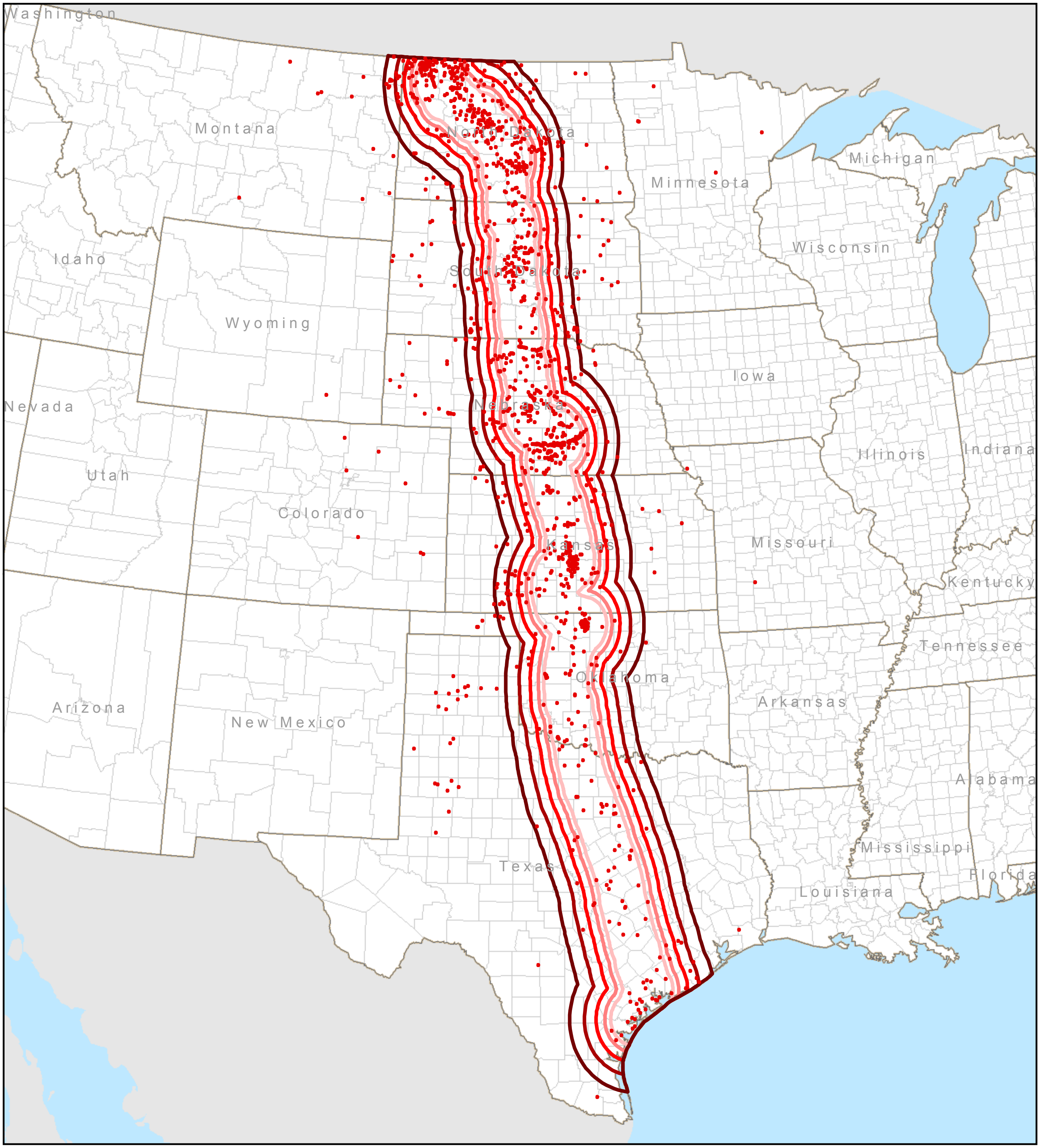
Wilton IV WRA
County Boundary
State Boundary
Highway
Major Road
Local Road

Data Sources:
USGS Topo Quads
ESRI Streetmap 9.3

N

LOCATION MAP

File: P:\FPL Energy\Dakotas\Contract 4379 - Wilton IV\GIS\Spatial\MXD\20111026_CraneAnalysisFigures\20111026_Figure1_WiltonIV_VicinityMap.mxd
Drawn by: william.scales
Coordinate System: NAD 1983 UTM Zone 14N



- Whooping Crane Sighting

Percentage of Sightings

- 75.08%
- 79.44%
- 85.04%
- 89.83%
- 94.83%
- State Boundary
- County Boundary

Data Sources:
USFWS Whooping Crane Data
ESRI Streetmap 9.3

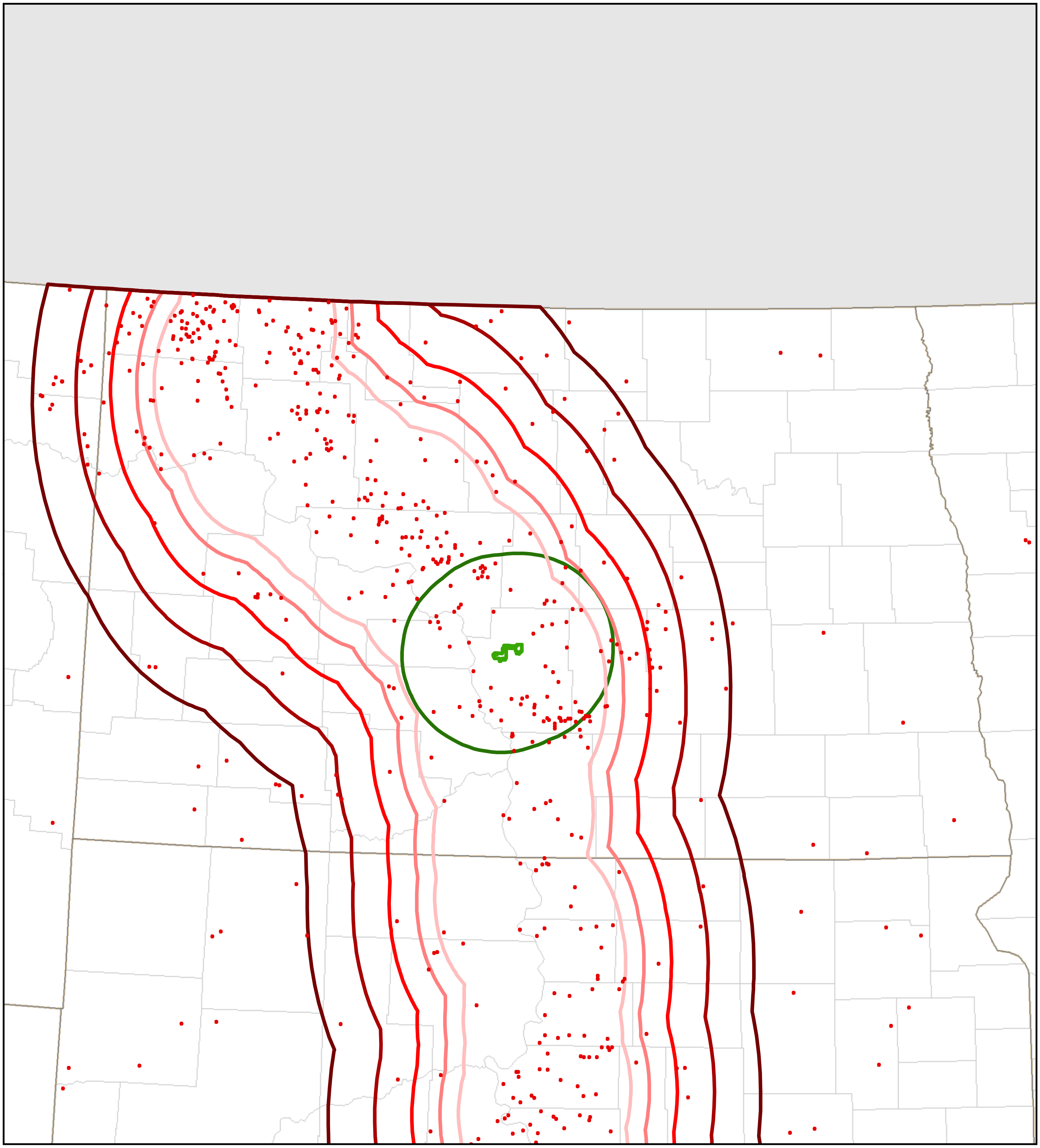
N

0 75 150 300 Miles

File: P:\FPL Energy\Dakotas\Contract 4379 - Wilton IV\
GIS\Spatial\MXD\20111026_CraneAnalysisFigures\
20111026_Figure2_WiltonIV_MigrationCorridor.mxd
Drawn by: william.scales
Coordinate System: NAD 1983 UTM Zone 14N

Figure 2.
Wilton IV
Wind Resource Area
Whooping Crane Migration
Corridor

October 2011



Whooping Crane Sighting

Percentage of Sightings

75.08%

79.44%

85.04%

89.83%

94.83%

Wilton IV WRA

35-Mile Buffer

State Boundary

County Boundary

Data Sources:
USFWS Whooping Crane Data
ESRI Streetmap 9.3

N

0 20 40 80 Miles

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Drawn by: william.scales
Coordinate System: NAD 1983 UTM Zone 14N

Figure 3.
Wilton IV
Wind Resource Area
Whooping Crane Migration
Map: North Dakota

October 2011

NEXTera ENERGY RESOURCES

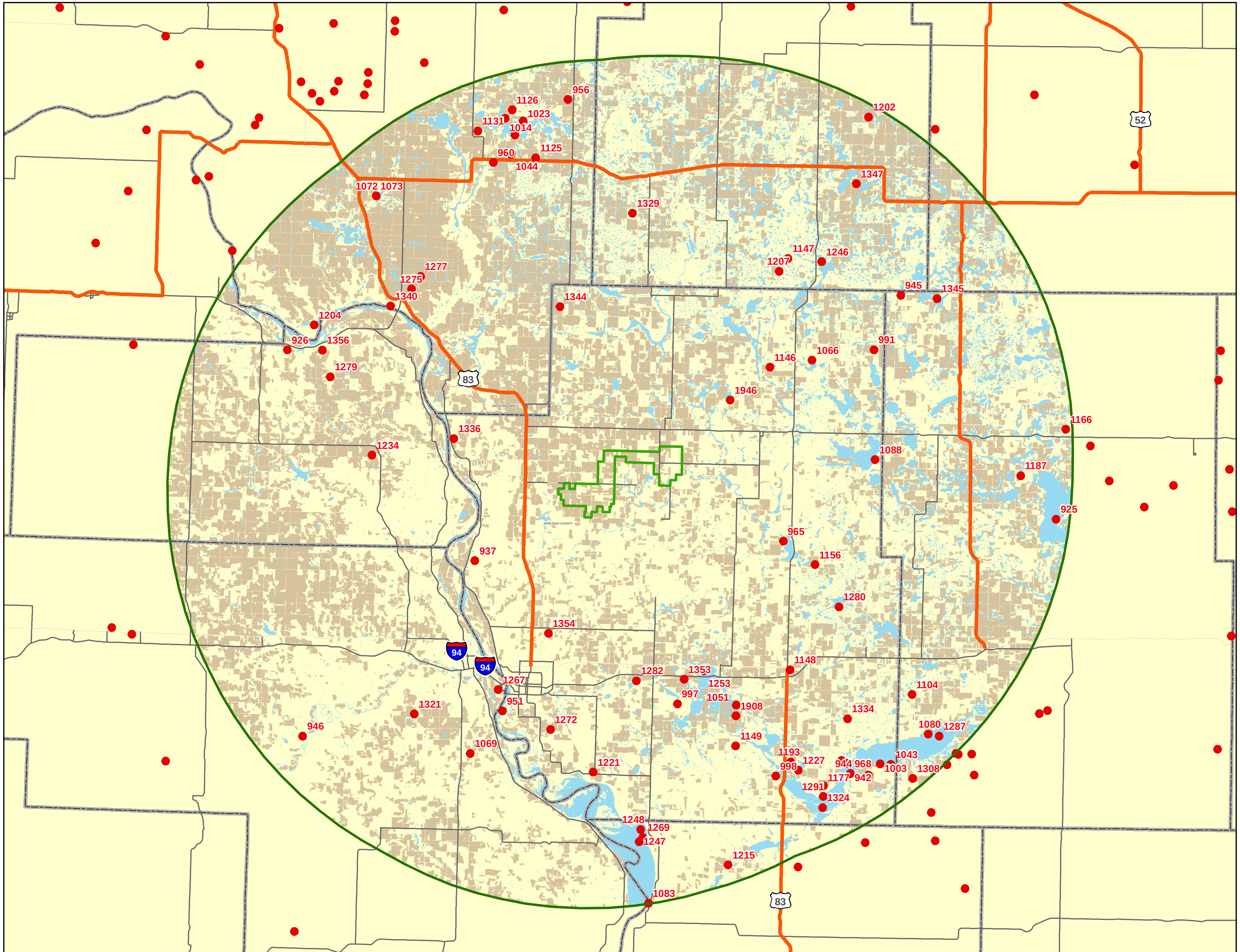


Figure 4.
Wilton IV
Wind Resource Area
Whooping Crane Habitat Map

Burleigh County
North Dakota

October 2011

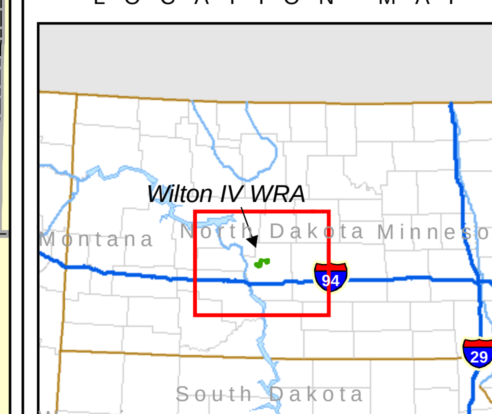
Wilton IV WRA
35-Mile Buffer
Whooping Crane Siting
Wetland
Wetland/Agricultural Matrix
Highway
Major Road
Local Road
County Boundary
State Boundary

Data Sources:
USGS Topo Quads
ESRI Streetmap 9.3

N

0 75 150 300 Miles

L O C A T I O N M A P



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Drawn by: william.scales
Coordinate System: NAD 1983 UTM Zone 14N

APPENDIX

Appendix 1. Whooping Crane sightings within 35 miles of the Wilton IV Project Area

Observation[1]	Adults	Juveniles	Total	Date	Year	County	Location Specifics
05A-15	2	0	2	4/30/1905	1905	MORTON	5SW MANDAN
06A-18	3	0	3	4/22/1906	1906	MCLEAN	MISSOURI RIVER, 2W WASHBURN
06A-23	1	0	1	5/5/1906	1906	KIDDER	12N TUTTLE
61B-1	1	0	1	9/22/1961	1961	KIDDER	HORSEHEAD LAKE
61B-2	1	0	1	9/24/1961	1961	OLIVER	FT. CLARK
64B-2	2	1	3	10/25/1964	1964	BURLEIGH	10N MANDAN
67A-3	2	0	2	4/13/1967	1967	BURLEIGH	LONG LAKE NWR
67A-5	2	0	2	4/27/1967	1967	BURLEIGH	LONG LAKE NWR
68A-1	2	1	3	4/16/1968	1968	KIDDER	12N,8E WING
68A-2	3	0	3	4/21/1968	1968	MORTON	6.5S,4E JUDSON
70A-3	2	0	2	5/3/1970	1970	BURLEIGH	3SW BISMARCK, MISSOURI RIVER
71B-1	1	0	1	9/23/1971	1971	MCLEAN	1NE BLUE LAKE
71B-5	1	0	1	10/16/1971	1971	MCLEAN	1E,2S TURTLE LAKE
72A-3	1	0	1	4/24/1972	1972	BURLEIGH	MIDDLE RICE LAKE
72B-2	1	0	1	9/27/1972	1972	BURLEIGH	LONG LAKE NWR
77A-33	7	0	7	4/19/1977	1977	BURLEIGH	10NE WING
77B-21	1	0	1	10/21/1977	1977	BURLEIGH	3S,1.5E MENOKEN
77B-22	1	0	1	10/28/1977	1977	BURLEIGH	22SW BISMARCK
77B-31	3	1	4	10/31/1977	1977	BURLEIGH	LONG LAKE NWR
78B-12	1	0	1	10/29/1978	1978	MCLEAN	LAKE WILLIAMS
79B-4	2	0	2	9/24/1979	1979	MCLEAN	2NE TURTLE LAKE
81B-2	1	0	1	9/29/1981	1981	MCLEAN	NEAR LAKE WILLIAMS
83B-6	1	0	1	10/13/1983	1983	MCLEAN	5W MERCER
83B-53	4	1	5	11/7/1983	1983	BURLEIGH	LONG LAKE NWR
84B-12	2	0	2	9/29/1984	1984	BURLEIGH	NEAR MCKENZIE SLOUGH
85B-4	1	0	1	9/26/1985	1985	BURLEIGH	LONG LAKE NWR,5.5E,2N MOFFIT
86B-9	1	0	1	9/21/1986	1986	BURLEIGH	NEAR LONG LAKE NWR
86B-11	1	0	1	9/26/1986	1986	BURLEIGH	6N,1E WING
87A-23	4	0	4	4/17/1987	1987	BURLEIGH	BISMARCK,MISSOURI RIVER
88A-11A	4	1	5	4/15/1988	1988	MCLEAN	3SE UNDERWOOD
88A-11B	0	1	1	4/15/1988	1988	MCLEAN	3SE UNDERWOOD
89A-21	1	0	1	5/4/1989	1989	KIDDER	LONG LAKE NWR
89B-13	6	1	7	11/1/1989	1989	EMMONS	19SE BISMARCK, MISSOURI RIVER
90A-10	1	0	1	5/7/1990	1990	BURLEIGH	2S,2E ARENA,LAKE ARENA WPA
90B-8	1	0	1	10/4/1990	1990	KIDDER	3S,6W STEELE
93B-3	1	0	1	9/29/1993	1993	MCLEAN	2S,4.5E,.25N TURTLE LAKE
93B-4	1	0	1	10/13/1993	1993	MCLEAN	2N,3E TURTLE LAKE
94B-3	1	0	1	10/25/1994	1994	MCLEAN	1/2W TURTLE LAKE
96B-2	4	0	4	10/1/1996	1996	BURLEIGH	3N STERLING
96B-3	1	0	1	10/3/1996	1996	BURLEIGH	5S,1E MCKENZIE
96B-11	1	0	1	10/13/1996	1996	BURLEIGH	3W,8N WING
96B-18	3	0	3	10/29/1996	1996	SHERIDAN	5N FLORENCE LAKE NWR
97B-1	1	0	1	10/3/1997	1997	BURLEIGH	9N,2.25E STERLING I-94 EXIT
97B-46	1	0	1	10/25/1997	1997	KIDDER	0.5S ROBINSON
98A-23	1	0	1	4/20/1998	1998	BURLEIGH	4E MOFFIT, LONG LAKE NWR
98B-16	4	0	4	10/17/1998	1998	KIDDER	4S,4W ROBINSON

Appendix 1. Whooping Crane sightings within 35 miles of the Wilton IV Project Area							
Observation[1]	**Adults**	**Juveniles**	**Total**	**Date**	**Year**	**County**	**Location Specifics**
99A-17	3	0	3	4/14/1999	1999	BURLEIGH	2N,0.5E MOFFIT
99B-3	1	0	1	10/3/1999	1999	SHERIDAN	6E,8S MCCLUSKY
99B-19	1	0	1	10/25/1999	1999	SHERIDAN	6N,2W GOODRICH
99B-20	2	1	3	10/27/1999	1999	MCLEAN	9W WASHBURY, NEAR MISSOURI R.
00A-6	3	1	4	4/10/2000	2000	BURLEIGH	8SE BISMARCK
00A-13	2	0	2	4/16/2000	2000	EMMONS	8SW MOFFIT
00B-21	2	0	2	10/28/2000	2000	BURLEIGH	2N,2E MOFFIT
00B-43	8	1	9	11/3/2000	2000	OLIVER	10E CENTER
01B-09	4	0	4	10/22/2001	2001	BURLEIGH	15N,2E WING
01B-10	2	0	2	10/22/2001	2001	EMMONS	5S,12W MOFFIT
01B-11	2	1	3	10/23/2001	2001	EMMONS	5S,12W MOFFIT
02A-05	7	0	7	4/17/2002	2002	BURLEIGH	0.25W MCKENZIE,MCKENZIE SLOUGH
02B-6	3	0	3	10/16/2002	2002	MCLEAN	2N WASHBURN
02B-9	6	0	6	10/16/2002	2002	MCLEAN	4.5NE WASHBURN
02B-21	5	0	5	10/25/2002	2002	BURLEIGH	BISMARCK, SERTOMA PARK
02B-23	2	0	2	10/25/2002	2002	EMMONS	5S,12W MOFFIT
02B-34	2	0	2	10/25/2002	2002	BURLEIGH	BISMARCK AIRPORT
03A-7	2	0	2	4/6/2003	2003	BURLEIGH	2W MENOKEN
03A-13	3	0	3	4/13/2003	2003	OLIVER	9SW WASHBURN
03A-14	3	0	3	4/13/2003	2003	BURLEIGH	5N,3W DRISCOLL
03B-2	2	0	2	10/4/2003	2003	KIDDER	7S,4W STEELE
03B-8	2	0	2	10/16/2003	2003	BURLEIGH	LONG LAKE NWR,3E MOFFIT
04B-05	1	0	1	10/9/2004	2004	BURLEIGH	5NE MOFFIT
04B-10	1	0	1	10/10/2004	2004	KIDDER	12S STEELE
05B-02	1	0	1	9/30/2005	2005	BURLEIGH	LONG LAKE NWR, 3SE MOFFIT
05B-08	12	0	12	10/16/2005	2005	SHERIDAN	3S, 1.5W PICKARDVILLE
05B-29	2	1	3	11/3/2005	2005	BURLEIGH	4.5S, 1W DRISCOLL
05B-40	3	0	3	11/13/2005	2005	BURLEIGH	7W, 2S WILTON, MO RIVER BOTTOMS
06A-22	2	0	2	5/4/2006	2006	BURLEIGH	9N, 2E WILTON
06B-02	2	0	2	9/25/2006	2006	SHERIDAN	2W, 2S GOODRICH
07B-06	2	0	2	10/22/2007	2007	BURLEIGH	4S, 1.5E MCKENZIE
07B-38	4	1	5	11/03/2007	2007	BURLEIGH	W-NW OF WING
07A-23	1	0	1	4/15/2007	2007	BURLEIGH	2E MENOKEN, ALONG HWY 10
07A-24	20	0	20	4/15/2007	2007	BURLEIGH	SW BISMARCK
07A-32	3	0	3	5/22/2007	2007	MERCER	4S, 7W WASHBURN

[1]Observations correspond with each sighting within the 35-mile buffer in Figure 4.