NORTH DAKOTA PUBLIC SERVICE COMMISSION

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PUBLIC SERVICE COMMISSION

Siting Application Permit (Supplemental Information) September 2008

Chapter 49-22, NDCC

Energy Conversion and Transmission Facility Siting

LOGAN COUNTY WIND FARM A LARGE WIND ENERGY CONVERSION SYSTEM

PREPARED BY JUST WIND, LLC

16 PU-07-54 Filed: 9/8/2008 Pages: 107
Application for Siting Certificate and Supplemental Information

Just Wind, LLC

We will be referencing Data 1 and Data 2 throughout this application

- **Data 1** refers to our original submission of July 2008 labeled *North Dakota Public Service Commission Siting Application Permit.*
- **Data 2** refers to *Supplemental Information submitted September 2008* labeled *North Dakota Public Service Commission Siting Application Permit.*

COMPLIANCE WITH THE ENERGY CONVERSION AND TRANSMISSION FACILITY SITING ACT CHAPTER 49-22

The North Dakota Energy Conversion and Transmission Facility Siting Act requires an application for a Certificate to meet the criteria set forth in North Dakota Century Code (NDCC) 49-22. The siting of an energy conversion facility is to be made in an orderly manner compatible with environmental preservation and the efficient use of resources (NDCC 49-22-02).

To the extent available, Just Wind has presented information required by the North Dakota Energy Conversion and Transmission Facility Siting Act. Just Wind has considered exclusion areas, avoidance areas, the selection criteria, and the policy criteria in the design of the Project. In addition, sufficient project design, wind resource, and technical information have been provided for a thorough evaluation of the reasonableness of the proposed site.

This table outlines the information required to fulfill the requirements for a Certificate with the Commission and where these requirements are addressed in this document.

Certificate Completion Checklist

State Authority	Description	Reference
Chapter 49-22	PSC Guidelines: Energy Conversion and Transmission Facility Siting	1.1
Section A	Description	Section A
1.	Type: Describe the type of energy conversion facility proposed and provide a diagram of the major process system or a flow diagram.	**Data 1** Figures 1-5
2.	Product: Describe in general terms and technical terms the products to be produced by the proposed facility.	**Data 1** 2 **Data 2** A 3
3.	Size and Design: Provide the following description of the production capacity and design	**Data 1** 3 a-e **Data 2** A 3
a.	Gross design capacity;	**Data 1** 3 a **Data 2** A 3

State Authority	Description	Reference
b.	Net design capacity;	**Data 1** 3 b **Data 2** A 3
c.	Estimated thermal efficiency of the energy conversion process and the assumptions upon which the estimate is based;	**Data 1** **3 c** **Data 2** A 3
d.	The number of acres that the proposed facility will occupy; and	**Data 1** 4 a **Data 2** A 3
e.	One (1) copy of all design data reports separate from the application.	**Data 1** 3 e **Data 2** A 3
4.	Time Schedule: Provide the anticipated time schedule for the accomplishment of the following:	**Data 1** 4 a
a.	Certificate of Site Compatibility;	Sept. 2008
b.	Land acquisition complete;	June 2008
c.	Construction start date;	Oct./Nov. 2008
d.	Construction complete;	Summer /Fall 2010
e.	Test operations;	**Data 1** 4 a October 2009
f.	Commercial production date;	Nov. 2009
g.	100 percent capacity factor; and	**Data 1** 4 a Spring 2010
h.	Any expansion or additions.	**Data 1** 4 a
Section B	Studies	Section B
	Provide a copy of any evaluative studies or assessments of the environmental impact of the proposed facility submitted to any federal, regional, state or local agency.	**Data 2** B a
Section C	Need for Facility	Section C
1.	An analysis of the need for the proposed facility based on present and projected demand for the product or products to be produced by the proposed facility, including the most recent system studies supporting the analysis of the need.	**Data 1** 1 a
2.	A description of any feasible alternative methods of serving the need.	**Data 1** 1 a D 5
3.	A statement justifying any deviations from the most recent Ten-Year Plan which the proposed facility may present.	N/A

State Authority	Description	Reference
Section D	Location	Section D
1.	Select a study area, which includes the proposed facility site, of sufficient size to enable the Commission to evaluate the factors addressed in Section 49-22-09, NDCC.	**Data 2** B a Biological B a Physical B a Social D a, b, c
2.	Discuss the utility's policies and commitments to limit the environmental impact of its facilities, including copies of board resolutions and management directives.	**Data 2** D b
3.	Identify and map the criteria that led to the proposed facility location within the study area.	**Supplemental Map:** Exclusion Area Over All Map
4.	Discuss in detail the relative value of each criteria and how the proposed facility location was selected giving consideration to all criteria.	**Data 1 & 2** B
5.	The criteria to be evaluated shall include at a minimum all of the following which are within the study area:	
a.	Exclusion areas;	**Data 2** D a
b.	Avoidance areas;	**Data 2** D b
c.	Selection criteria;	**Data 2** D c
d.	Policy criteria;	**Data 2** D d
e.	Design and construction limitations; and	**Data 2** B a Biological B a Physical
f.	Economic considerations.	**Data 2** B a Biological B a Physical
6.	Discuss the mitigative measures that will be taken to minimize adverse impacts which result from the location, construction, and operation of the proposed facility.	**Data 1** 6
7.	List the qualifications of the people in the various disciplines that contributed to the facility site location study	**Data 1** 7
8.	Maps	**Data 1** 8 a
a.	Map the criteria within the study area showing the proposed facility location. Several different criteria may be shown on each map, depending on the map scale and the density and nature of the criteria. Minimum map scale shall be ½ inch = 1 mile. All maps shall be at the same scale unless otherwise specified.	**Data 1** 8 a

State Authority	Description	Reference
b.	Furnish one Mylar map, separate from the application, of the same scale as the criteria maps and showing the same basic features as the criteria maps, including the study area, but not the proposed facility location.	**Available on the hearing date**
NDCC 49-22-09	Factors to be considered in evaluating applications and designation of sites, corridors, and routes.	
1.	Available research and investigations relating to the effects of the location, construction, and operation of the proposed facility on public health and welfare, natural resources, and the environment.	**Data 1** B a
2.	The effects of new energy conversion and transmission technologies and systems designed to minimize adverse environmental effects.	**Data 1** C 1 & 2
3.	The potential for beneficial uses of waste energy from a proposed energy conversion facility	N/A
4.	Adverse direct and indirect environmental effects which cannot be avoided should the proposed site or route be designated.	**Data 1** D 6 **Data 2** B a, b, c
5.	Alternatives to the proposed site, corridor or route which are developed during the hearing process and which minimize adverse effects.	**Data 1** D 6
6.	Irreversible and irretrievable commitments of natural resources should the proposed site, corridor, or route be designated.	**Data 1** D 6 **Data 2** B a, b, c
7.	The direct and indirect economic impacts of the proposed facility	**Data 1** B c Permits
8.	Existing plans of the state, local government, and private entities for other developments at or in the vicinity of the proposed site, corridor, or route.	N/A
9.	The effect of the proposed site or route on existing scenic areas, historic sites and structures, and paleontological or archaeological sites.	**Supplemental Map:** Exclusion Area Map
10.	The effect of the proposed site or route on areas which are unique because of biological wealth or because they are habitats for rare and endangered species	**Data 2** B a Biological B a Avian **Supplemental Map:** Avoidance Area Map
11.	Problems raised by federal agencies, other state agencies, and local entities	**Data 2** B a Social

Section A: Description

3. Size & Design

SWT-2.3-93
Technical Description

General
The following is a brief technical description of the main components of the SWT-2.3-93 wind turbine.

Rotor
The SWT-2.3-93 rotor is a three-bladed cantilevered construction, mounted upwind of the tower. The power output is controlled by pitch regulation. The rotor speed is variable and is designed to maximize the aerodynamic efficiency.

Blades
The B45 blades are made of fibreglass-reinforced epoxy in Siemens' proprietary IntegralBlade® manufacturing process. In this process the blades are cast in one piece to eliminate weaker areas at glue joints. The blades are mounted on pitch bearings and can be feathered 80 degrees for shutdown purposes. Each blade has its own independent pitching mechanism capable of feathering the blade under any operating condition. The blade pitch arrangement allows for optimization of the power output throughout the operating range, and the blades are feathered during standstill to minimize wind loads.

Rotor Hub
The rotor hub is cast in nodular cast iron and is fitted to the main shaft with a flange connection. The hub is sufficiently large to provide a comfortable working environment for two service technicians during maintenance of blade roots and pitch bearings from inside the structure.

Main Shaft and Bearing
The main shaft is forged in alloy steel and is hollow to facilitate the transfer of power and signals to the blade pitching system. The main shaft is supported by a self-aligning double spherical roller bearing which is shrunk onto the main shaft.

Gearbox
The gearbox is a custom-built three-stage planetary-helical design. The first high torque stage is of a helical planetary design. The two high-speed stages are of a normal helical design and provide the offset of the high speed shaft that is needed to allow passage of power and control signals to the pitch systems.

The gearbox is shaft-mounted and the main shaft torque is transferred to the gearbox by a shrink disk connection. The gearbox is supported on the nacelle with flexible rubber bushings.

The gearbox is fitted with an oil conditioning system. All bearings are lubricated with oil fed directly from a large in-line filter and is cleaned by an off-line filter unit.

The gearbox is fitted with sensors for monitoring temperature, oil pressure and vibration levels.

Generator
The generator is a fully enclosed asynchronous generator. The generator has a squirrel-cage rotor without slip-rings. The generator rotor construction and stator winding are designed for high efficiency at partial loads.
The generator is protected with thermal switches and analogue temperature measurement sensors.

The generator is fitted with a separate thermostat-controlled ventilation arrangement. Air is recirculated internally in the generator and heat is transferred through an air-to-air heat exchanger that separates the internal environment in the generator from the ambient air.

Mechanical Brake
The mechanical brake is fitted to the gearbox high-speed shaft and has two hydraulic calipers.

Yaw System
The yaw bearing is an externally geared ring with a friction bearing. Eight electric planetary gear motors drive the yawing.

Tower
The SWT-2.3-93 wind turbine is mounted on a tapered tubular steel tower. The tower has internal ascent and direct access to the yaw system and nacelle. It is equipped with platforms and internal electric lighting.

Controller
The wind turbine controller is a microprocessor-based industrial controller. The controller is complete with switchgear and protection devices. It is self-diagnosing and has a keyboard and display for easy readout of status and for adjustment of settings.

The NetConverter® power conversion system allows generator operation at variable speed, frequency and voltage while supplying power at constant frequency and voltage to the MV transformer. The power conversion system is a modular arrangement for easy maintenance and is water cooled.

SCADA
The SWT-2.3-93 wind turbine is equipped with the Siemens WebWPS SCADA system. This system offers remote control and a variety of status views and useful reports from a standard internet web browser. The status views present information including electrical and mechanical data, operation and fault status, meteorological data and grid station data.

Turbine Condition Monitoring
In addition to the Siemens WebWPS SCADA system, the SWT-2.3-93 wind turbine is equipped with the unique Siemens TCM condition monitoring system. This system monitors the vibration level of the main components and compares the actual vibration spectra with a set of established reference spectra. Result review, detailed analysis and reprogramming can all be carried out using a standard web browser.

Operation Systems
The wind turbine operates automatically. It is self-starting when the wind speed reaches an average about 3 to 5 m/s (about 10 mph). The output increases approximately linearly with the wind speed until the wind speed reaches 13 to 14 m/s (about 30 mph). At this point, the power is regulated at rated power.

If the average wind speed exceeds the maximum operational limit of 25 m/s (56 mph), the wind turbine is shut down by feathering of the blades. When the average wind speed drops back below the restart average wind speed, the systems reset automatically.

Siemens Wind Power A/S reserves the right to change the above specifications without previous notice.

Siemens WEB-WPS SCADA

The Siemens WEB-WPS SCADA system is a control system for supervision, data acquisition, control and reporting of wind farm performance.

Main Features
The WEB-WPS system has the following main features:
- On-line supervision and control accessible via Internet.
- Storage of historical data in database.
- Local storage at wind turbines and transfer to database if communication is interrupted.
- System access from anywhere using a standard web browser. No special client software licenses are required.
- Users are assigned individual user names and pass-words, and the administrator can assign a user level to each user name for added security
- E-mail function for fast alarm response for both turbine and substation alarms.
- Grid measurement with designated Grid Code functions.
- Park Pilot functions for enhanced control of the wind farm and for remote regulation.
- Condition monitoring integrated with the turbine controller using designated server.
- Power curve plots and efficiency calculations with pressure and temperature correction.
- MW control / Voltage Control / Ramp Rate Control / Ice Stop.
- Ethernet-based system with Serial and TCP/IP interface. MODBUS and OPC compatible.

Wind Turbine Hardware
Components within the wind turbine are monitored and controlled by the individual local wind turbine controller (WTC). The WTC is capable of operating independently of the SCADA system, and turbine operation can continue autonomously in case of for example damage to communication cables.

A local turbine interface computer (I-box) placed at the tower base handles the interface between the WTC and the central WEB-WPS server. Data recorded at the turbine will be stored on this in the event that communication to the central server is interrupted temporarily. The I-box is configured with its own IP address and thus part of the wind farm network.

The I-box is supplied by Siemens as part of the WEB-WPS system package.

Communication Network in Wind Farm
The communication network in the wind farm must be established with optical fibers. The optimum network design is typically a function of the wind farm layout. Once the layout is selected Siemens will define the minimum requirements for the network design.

The supply, installation and termination of the communication network is carried out by Purchaser.

Wind Farm Server
The central WEB-WPS Server Panel is supplied by Siemens and is normally placed at the wind farm Substation or Control Building.

The Server Panel comprises:
- WEB-WPS server. The server can be configured with a RAID system (RAID 1 + 0, operating system, RAID 5 Data) to reduce the risk of data loss, or with a redundant server (optional upgrade) to further allow reliable operation when the SCADA system is required for grid code compliance.

- Network equipment. This includes all necessary switches and media converters.
- UPS back up battery with capacity for a minimum of 1 hour of operation
- LCD screen and keyboard

At the WEB-WPS server the data are presented on-line and simultaneously stored in a MS SQL database. From this SQL database numerous reports can be generated.

Connecting as a client to the system is a matter of connecting Purchasers PC to the Internet and establishing a point to point TCP/IP connection via VPN (Virtual Private Network).

Grid Measuring Station

The WEB-WPS system package can optionally be extended to include a Grid Measurement Station (GMS). A GMS is used for generating feed back signals for the regulating loop where wind farm regulation is required.

The heart of the GMS is the power quality measurement instrument. This instrument can be scaled to any arrangement of the grid connection. The instrument requires voltage and current signals from VTs and CTs fitted at the wind farm connection points. The GMS interfaces to the WEB-WPS server via a LAN network.

Signal exchange and communications with third party systems such as substation control system PLC's are also handled from the GMS. For communication with third party equipment a MODBUS and OPC compatible interface is available as option.

Where a GMS is required the instrument is supplied and installed by Siemens. Supply, installation and termination of VTs, CTs and internal LAN network is carried out by others

WEB-WPS Software

The normal WEB-WPS user interface presents on-line and historical data. The screen displays can be adjusted to meet individual customer requirements.

Historical data are stored in an MS SQL database as statistical values and can be presented directly on the screen or exported for processing in MS Access or Excel.

The WEB-WPS software can not only monitor but can also control and regulate the wind farm. Regulation is carried out with the Park Pilot function.

SWT-2.3-93
Design Climatic Conditions

The design climatic conditions are the boundary conditions at which the turbine can be applied without supplementary design review. Applications of the wind turbine in more severe conditions may be possible, depending upon the overall circumstances. A project site-specific review requires the completion by the Client of the "Project Climatic Conditions" form.

Subject	ID	Issue	Unit	Value
1. Wind, operation	1.1	Wind definitions	-	IEC 61400-1
	1.2	IEC class	-	IIA
	1.3	Air density, ρ	kg/m^3	1.225
	1.4	Mean wind speed, v_{avg}	m/s	8.5
	1.5	Weibull scale parameter, A	m/s	9.6
	1.6	Weibull shape parameter, k	-	2
	1.7	Wind shear exponent, α	-	0.20
	1.8	Mean turbulence intensity at 15 m/s, I_{15}	-	0.16
	1.9	Standard deviation of turbulence intensity, $\sigma(I_{15})$	-	0.02
	1.10	Standard deviation of wind direction	Deg	7.5
	1.11	Maximum flow inclination,	Deg	8
	1.12	Minimum turbine spacing, in rows	D	3
	1.13	Minimum turbine spacing, between rows	D	5
2. Wind, extreme	2.1	Wind definitions		IEC 61400-1
	2.2	Air density, ρ	kg/m^3	1.225
	2.3	Maximum hub height 10 min.wind, $v10_{max}$	m/s	42.5
	2.4	Maximum 2 s gust in hub height, $v_{hub,2s}$	m/s	59.5
	2.5	Maximum hub height power law index, α	-	0.20
3. Temperature	3.1	Temperature definitions	-	IEC 61400-1
	3.2	Minimum temperature, stand-still, $T_{min,s}$	Deg.C	-20
	3.3	Minimum temperature, operation, $T_{min,c}$	Deg.C	-10
	3.4	Maximum temperature, operation, $T_{max,o}$	Deg.C	35
	3.5	Maximum temperature, stand-still, $T_{max,s}$	Deg.C	45
4. Corrosion	4.1	Corrosion definitions	-	ISO 12944
	4.2	External corrosion class	-	C3
	4.3	Internal corrosion class	-	C2
	4.4	Internal climate control	-	Yes
5. Lightning	5.1	Lightning definitions	-	IEC 1024
	5.2	Annual number of strikes at tip height	-	0.1
6. Dust	6.1	Dust definitions	-	-
	6.2	Dust conditions, ground level	-	Normal DK
	6.3	Dust conditions, hub height	-	Normal DK
7. Hail	7.1	Maximum hail diameter	mm	20
	7.2	Maximum hail falling speed	m/s	20
8. Ice	8.1	Ice definitions	-	IEC 61400-1
	8.2	Ice conditions		Normal DK
9. Trees	9.1	If the height of trees within 500m of any turbine location height exceeds 1/3 of H – D/2 where H is the hub height and D is the rotor diameter then restrictions may apply. Please contact Siemens for information on the maximum allowable tree height with respect to the site and the turbine type.		

SWT-2.3-93, Americas Application
Technical Specifications

Rotor

Type	3-bladed, horizontal axis
Position	Upwind
Diameter	93 m
Swept area	6800 m²
Synchronous rotor speed	6-16 rpm
Power regulation	Pitch regulation with variable speed
Rotor tilt	6 degrees

Blade

Type	Self-supporting
Blade length	45 m
Tip chord	0 8 m
Root chord	3.5 m
Aerodynamic profile	NACA 63.xxx, FFAxxx
Material	GRE
Surface gloss	Semi-mat, < 30 / ISO2813
Surface colour	White, RAL 9010

Aerodynamic Brake

Type	Full span pitching
Activation	Active, hydraulic

Load-Supporting Parts

Hub	Nodular cast iron
Main bearing	Spherical roller bearing
Main shaft	Alloy steel
Nacelle bed plate	Steel

Transmission System

Coupling hub - shaft	Flange
Coupling shaft – gearbox	Shrink disc
Gearbox type	3-stage planetary/helical
Gearbox ratio	1 : 91
Gearbox lubrication	Splash / forced lubrication
Oil volume	Approx. 400 l
Gearbox oil filtering	Inline and offline
Gearbox cooling	Separate oil cooler
Gearbox designation	PEAB 4456 (Winergy) or EH851 (Hansen)
Coupling gear - generator	Double flexible coupling

Mechanical Brake

Type	Hydraulic disc brake
Position	High speed shaft
Number of callipers	2

Canopy

Type	Totally enclosed
Material	Steel
Surface Gloss	Silk mat, 30-40 / ISO2813
Colour	White, RAL 9010

Generator

Type	Asynchronous
Nominal power	2300 kW
Protection	IP 54
Cooling	Integrated heat exchanger
Insulation class	F
Generator designation	AMA 500L4 BAYH
Generator manufacturer	ABB

Grid Terminals (LV)

Nominal power	2300 kW
Voltage	690 V
Frequency	50 Hz or 60 Hz

Yaw System

Type	Active
Yaw bearing	Externally geared slewring
Yaw drive	Eight electric gear motors with frequency converter
Yaw brake	Passive friction brake

Controller

Type	Microprocessor
SCADA system	WPS via modem
Controller designation	KK WTC 3 0
Controller manufacturer	KK Electronic A/S

Tower

Type	Cylindrical and/or tapered tubular
Hub height	80 m or site specific
Corrosion protection	Painted
Surface gloss	Silk mat, 30-40 / ISO2813
Colour	White, RAL 9010

Operational Data

Cut-in wind speed	4 m/s
Nominal power at	13-14 m/s
Cut-out wind speed	25 m/s
Maximum 2 s gust	55 m/s (standard version) 60 m/s (special version)

Weights (approximately)

Rotor	60,000 kg
Nacelle	82,000 kg
Tower for 80 m hub height	162,000 kg

Siemens Wind Power A/S reserves the right to change the above specifications without previous notice.

SWT-2.3-93, 60 Hz Application
Electrical Specifications

Generator

Type	Asynchronous
Nominal power	2300kW
Speed range	600 - 1800 rpm
Nominal voltage	750V @ 1550 rpm
Nominal current	2070 A
Frequency	16,5 - 60 Hz
Protection	IP 54

Generator Protection

Insulation class	F
Winding temperatures	2 x 3 PT100 sensors
Bearing temperatures	1 PT100 at each bearing
Bearing insulation	Insulation at both bearings
Grounding brush	On drive end

Generator Cooling

Cooling system	Air to air
Ventilation	Shaft mounted fan
Ventilation type	Centrifugal
External flow direction	From D-end to N-end
Control parameter	Winding temperature

Frequency Converter

Operation	4Q Full scale converter
Switching	PWM
Switching frequency	1250/2500 Hz
Cooling	Liquid

Power Factor at 690 V and Nominal Grid Conditions

Power factor correction	Frequency converter control
Power factor range	0.9 cap. to 0.9 ind. at nominal balanced voltage

Main circuit protection

Short circuit protection	Circuit breaker
Surge arrester	100 kA varistors

Peak Power Levels

10 min average	100 % of nominal
30 sec average	104 % of nominal

Grid Requirements

Nominal grid frequency	60 Hz
Minimum voltage	90 % of nominal
Maximum voltage	110 % of nominal
Minimum frequency	95 % of nominal
Maximum frequency	103 % of nominal
Maximum current asym.	5%
Max 1 s. short circuit level at controller's grid Terminals (690 V)	40 kA
Min. 1 s short circuit level at controller's grid terminals (690 V)	5 x Pn
Grid error numbers	Max. 300 per year

Power Consumption from Grid (approximately)

At stand-by	5.0 kW
At stand-by, yawing	9.6 kW
Before cut-out (60 s)	18 kW
After cut-out (600 s)	18 kW

Earthing Requirements

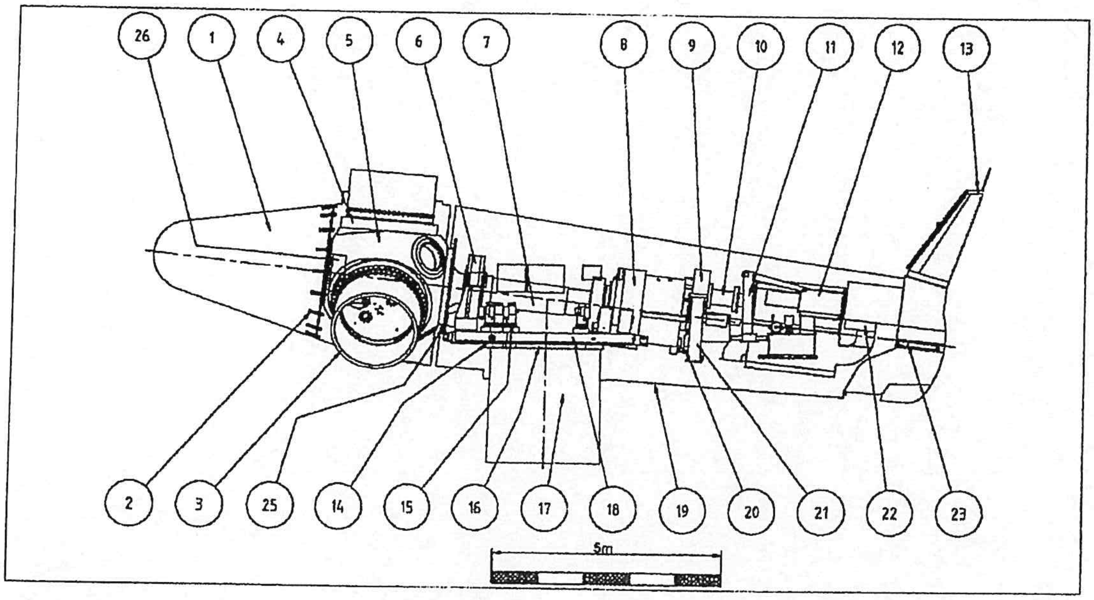
Earth system	Acc. To IEC62305-3 ED 1.0:2006
Depth electrodes	Min. 2 pcs 50 mm2 Cu, 120° separation
Inner ring electrode	50 mm2 Cu 1 m from tower
Outer ring electrode	50 mm2 Cu min. 10 m from tower
Foundation reinforcement	Must be connected to earth electrodes
Foundation terminals	Min. 6 stainless pads in two levels corresponding to ring electrodes, separated at 120°
HV connection	HV cable shield shall be connected to earthing system
Cable tray conductor	Min. 50 mm2 bare Cu parallel to HV cable

Transformer Requirements

Transformer impedance requirement	6 %
Secondary voltage	690 V
Vector group	Dyn 11 (star point earthed)

Siemens Wind Power A/S reserves the right to change the specifications without previous notice
All data are subject to tolerances in accordance with IEC.

SWT-2.3-93
Nacelle Arrangement



Dansk
1 Spinner
2. Spinner beslag
3. Vinge
4 Pitchleje
5. Rotornav
6. Hovedleje
7. Hovedaksel
8. Hovedgear
9. Bremseskive
10. Kobling
11. Service kran
12. Generator
13. Meteorologiske sensorer
14. Krøjeleje
15 Krøjegear
16. Krøjering
17. Tårn
18. Maskinramme
19. Maskinskærm
20. Olie filter
21. Olie filter
22. Generatorblæser
23 Olie køler
25. Rotorlås
26. Navboks

English
1 Spinner
2. Spinner bracket
3. Blade
4 Pitch bearing
5. Rotor hub
6. Main bearing
7. Main shaft
8 Gearbox
9. Brake disc
10 Coupling
11. Service crane
12. Generator
13 Meteorological sensors
14. Yaw bearing
15. Yaw gear
16. Yaw ring
17. Tower
18. Nacelle bedplate
19. Canopy
20 Oil filter
21. Oil filter
22. Generator fan
23. Oil cooler
25. Rotor lock
26 Hub controller box

Deutsch
1. Spinner
2. Spinner beschlag
3. Rotorblatt
4. Pitchlager
5. Nabe
6. Hauptlager
7. Hauptwelle
8 Getriebe
9. Scheibenbremse
10. Kupplung
11. Kran
12. Generator
13. Windfane und Anemometer
14. Gleitführung
15. Windnachführung
16. Verzahnte Kranz
17. Turm
18. Maschinenrahmen
19. Gondel
20. Öl Filter
21. Öl Filter
22. Generator Kühlung
23. Öl Kühlung
25. Rotor Arretirung
26. Nabe controller box

SWT-2.3-93
Standard Power Curve Rev 1

The calculated power curve data are valid for standard air density conditions of 15 deg.C Air temperature, 1013 mBar air pressure and 1.225 kg/m3 air density, clean rotor blades, wind shear exponent less than 0.2, and horizontal, undisturbed air flow with 10% turbulence intensity.

Wind [m/s]	Power [kW]
0.0	0
1.0	0
2.0	0
3.0	0
4.0	98
5.0	210
6.0	376
7.0	608
8.0	914
9.0	1312
10 0	1784
11.0	2164
12.0	2284
13.0	2299
14.0	2300
15.0	2300
16.0	2300
17.0	2300
18.0	2300
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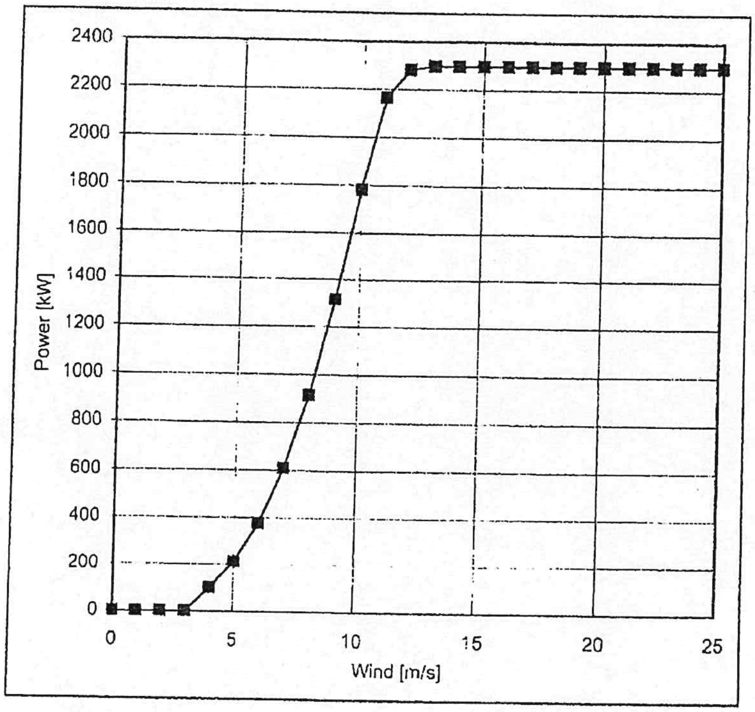
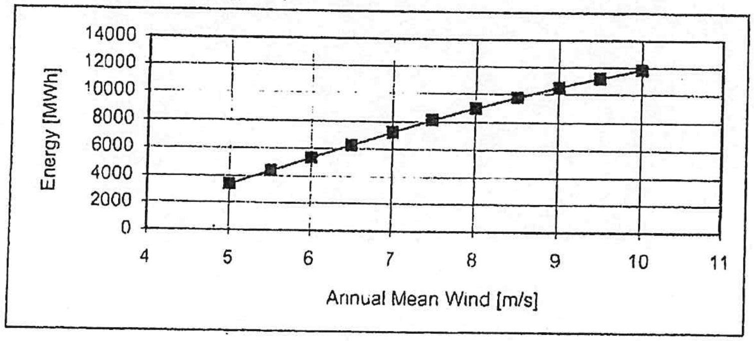
24.0	2300
25.0	2300



The annual energy production data for different annual mean wind speeds in hub height are calculated from the above power curve assuming a Rayleigh wind speed distribution, 100 percent availability, and no reductions d to array losses, grid losses, or other external factors affecting the production.

Wind [m/s]	Energy [MWh]
5.0	3385
5.5	4333
6.0	5295
6.5	6256
7.0	7207
7 5	8098
8 0	8964
8 5	9750
9.0	10491
9.5	11165
10.0	11774



Section B: Studies

a. Studies & Assessments

Biological

Biological Resources
Affected Environment and Environmental Consequences

1.0 Introduction

Just Wind, LLC is a Minnesota limited liability company formed to develop, partially own and manage a wind energy project in Logan County, North Dakota. The Owner of the project will be a wholly owned subsidiary of Just Wind, Logan County Wind Farm, LLC (LCWF). Phase I of the wind energy project will consist of 160 Siemens 2.3 wind turbine generators with a total nameplate capacity of 368 megawatts.

The Siemens wind turbine generators will be located in Bryant Township, Glendale Township and Starkey Township. The proposed project will include all associated transmission infrastructure, including an underground electrical collection system, telemeter monitoring equipment, and a new project substation with a power generation capacity of 500 megawatts. The development of the LCWF Project will also include the turbine access roads and other associated equipment required for the successful operation of the wind farm.

The proposed wind energy project will be developed on approximately 57,700 acres of suitable agricultural land in Logan County, near the town of Napoleon. The existing land use is compatible with the development of the wind energy project, as is the existing infrastructure including a 345 kV transmission line.

The biological resource information will include a general description of the plant and animal communities for Phase I including the identification of any threatened and endangered species. This White Paper will deal with the affected environment and environmental consequences for the biological resources.

2.0 Vegetation

2.1 Affected Environment

The Phase I area for the proposed project includes a mix of cropland, pastureland, wooded areas, Natural Resources Conservation Reserve (NRCS) – Conservation Reserve Program (CRP) land, and a small urban area (see Attachment 1). The majority of the land is CRP-fallow cropland, or in small grains, hay, and sunflowers.

2.1.1 Native Vegetation

Native vegetation in the project area is mixed grass prairie of the Missouri Coteau and associated wetlands. This area is termed mixed grass because it contains a combination of tall grass species, typically found further east in the Drift Prairie region, and short grass species found further west in the Missouri Slope region. Native grass species in the mixed grass prairie typically consist of prairie junegrass, western wheat grass, blue gramma, green needlegrass, needle-and-thread, little bluestem and needle leaf sedge (National Cooperative Soil Survey). Tracts of woody vegetation are rare and limited to stands of aspen and willows. A more complete list of native vegetation commonly found in the region is listed below in Table 1.

Table 1. Predominant Natural Vegetation of the Mixed Grass Prairie (Missouri Coteau) (Hagen 2005).

Grasses	Forbs	
western wheat grass	Pasque flower	Gaura
blue gramma	Torch flower	Hairy puccoon
green needlegrass	Yarrow	Harebell
needle-and-thread	Gumweed	Goldenrod
Prairie junegrass	Golden aster	Smooth fleabane
Little bluestem	Prairie rose	Perennial ragweed
Porcupine grass	Missouri milkvetch	Purple coneflower
Priaire cordgrass	Purple loco	Upland wormwood
Northern reedgrass	Lead plant	Green sage
Plains muhly	Indian breadroot	Fringed sage
Kentucky bluegrass	Purple prairie-clover	

2.1.2 Existing Vegetation

Agriculture is by far the dominant land use with the project area and surrounding region. The lands within the region are generally managed either as rangeland for livestock production, for forage production, or it is annually tilled for the production of small grains and row crops. In much of the rangeland the stands of grass are managed for beef cattle production. These prairie ecosystems now contain both native and introduced species. Smooth brome grass (*Bromis inermis*) is the most common nonnative species. Approximately 42% of the region is crops, including durum wheat, spring wheat, corn, soybeans, barley, sunflowers, oats, safflower, flax, and grass-legume hay. The region does still have a considerable amount of native prairie. About 50% of the project area (approximately 29,082 acres) is comprised of pasture/range land, fallow cropland, and clover/wildflowers (See Attachment 1). The remaining lands are a mixture of wetlands and rural residences.

2.2 Environmental Consequences

2.2.1 Proposed Action

The proposed action will have minimal impacts on the vegetation except in the immediate areas where the turbines are located. These impacts will be localized and will not have significant impacts to the overall project areas.

3.0 Wildlife

3.1 Affected Environment

3.1.1 Birds

There are approximately 163 species of birds that live and nest in North Dakota during the breeding seasons of spring and summer. Table 2 lists the birds and shows the frequencies based on information from the *Birds of North Dakota Field Checklist*, compiled by Chad Grondahl, NDGF. In addition, the Patuxent Wildlife Research Center, a biological research center of the United State Geological Survey (USGS) has conducted bird surveys throughout the United States. Two of the survey routes, Lake George and Braddock, are located in close proximity to the project area. The Lake George route is located to the north of the project area, approximately 7 miles away, while the Braddock route is approximately 11 miles to the west. Table 2 also lists bird counts along the Lake George and Braddock survey route.

Table 2: Avian Species Sighting Frequencies

Species	Estimated Frequencies				Counts	
	Spring	Summer	Fall	Winter	Lake George*	Braddock*
[1] (Nelson's) Sharp-tailed sparrow	U	F	U		0.23	0.27
Alder flycatcher	R	R	R		1.84	4.82
[2] American avocet	C	C	C		0.13	2.91
[1] American bittern	F	F	F		1.58	0.73
American coot	Ab	Ab	Ab		7.55	4.55
American crow	C	F	C	R	1.61	11
American goldfinch	F	F	F	U	8	7.36
American kestrel	C	F	C	R	0.52	0.27
American Redstart	C	C	C			
American robin	Ab	C	Ab	R	4.61	11.73
[1] American white pelican	U	C	U		8.1	13
American wigeon	C	U	C	R	1.84	1.55
[1] Baird's sparrow	F	F	F		13.23	2.09
[2] Bald Eagle	U	R	U	R		
Bank swallow	C	C	Ab		2.81	6.73
Barn swallow	Ab	Ab	Ab		18.16	32.18
Belted kingfisher	F	F	F	R		0.18
[1] Black tern	C	C	Ab		4.26	0.91
Black-and-white warbler	F	F	F			
[2] Black-billed cuckoo	F	F	U		1.61	0.82
Black-billed magpie	F	C	C	F		
Black-capped chickadee	F	F	F	F	0.03	
Black-crowned night-heron	F	C	F		1.48	3.36
Black-headed grosbeak	F	F	F			
Blue jay	F	F	F	U	0.13	0.45
Blue-winged teal	Ab	Ab	Ab		17.23	23.27
[2] Bobolink	F	F	F		21.65	30.91
Brewer's blackbird	C	F	C	O	2.68	1.55

Species	Estimated Frequencies				Counts	
	Spring	Summer	Fall	Winter	Lake George*	Braddock*
Broad-winged hawk	U	F	U			
Brown thrasher	F	F	F		4.94	6.36
Brown-headed cowbird	C	C	U		100.61	112
Bufflehead	F	R	F	O		0.55
[2] Burrowing owl	U	F	U		0.03	0.18
California gull	F	F	F	O	0.74	
Canada goose	Ab	F	Ab	R	10.26	3.27
[2] Canvasback	F	F	C	O	1.16	6
Cattle egret	R	R	R		1.19	
Cedar waxwing	F	F	F	U	0.19	0.91
[1] Chestnut-collared longspur	C	Ab	C		70.35	58
Chestnut-sided warbler	F	R	F			
Chimney swift	C	F	F			
Chipping sparrow	F	F	F		0.03	0.91
Clay-colored sparrow	C	Ab	C			17.18
Cliff swallow	Ab	Ab	Ab		1.81	178.09
Common grackle	Ab	Ab	Ab	R	60.65	117.36
Common merganser	F		F	U		
Common nighthawk	C	U	C		0.35	0.27
Common snipe	C	U	C		6.84	9.36
Common tern	U	F	U			0.73
Common yellowthroat	C	C	C			20.55
[2] Dickcissel	U	F	U		6.35	1.64
Double-crested cormorant	F	F	F		3.68	13.45
Downy woodpecker	F	F	F	F	0.1	0.09
Eared grebe	C	C	C		2.23	13.18
Eastern bluebird	F	F	U		0.35	0.09
Eastern kingbird	C	C	Ab		35.13	37.64
Eastern wood-pewee	C	C	C			
European Starling	F	F	F	F	9.1	5.82
[1] Ferruginous hawk	F	C	F		3.74	1.18
Forster's tern	U	F	U		1.13	0.18
Franklin's gull	Ab	C	Ab		3.39	24.55
Gadwall	C	C	C	O	15.68	28.82
[2] Golden eagle	F	F	F	F		
[1] Grasshopper sparrow	C	C	C		40.94	42
Gray catbird	C	F	C		0.74	0.55
Gray partridge	C	C	C	C	0.58	0.73
Great blue heron	F	F	F		0.19	0.27
Great crested flycatcher	F	F	F			
Great egret	R	R	U		0.03	
Great horned owl	F	F	F	F	0.29	0.91
[2] Greater prairie-chicken	U	U	U	U		
Green-winged teal	F	U	C		0.97	0.55
Hairy woodpecker	F	F	F	F		0.09

	Species	Estimated Frequencies				Counts	
		Spring	Summer	Fall	Winter	Lake George*	Braddock*
	Hooded merganser	U	F	U			
1	Horned Grebe	F	F	F			
	Horned lark	Ab	Ab	Ab	U	41.77	141.45
	House sparrow	C	C	C	C	22.68	95.27
	House wren	C	C	F		3.61	8.09
	Indigo bunting	F	F	F			
	Killdeer	C	C	C		15.87	23.36
	Lapland longspur	Ab		Ab	U		
1	Lark bunting	Ab	Ab	Ab		137.55	90.82
	Lark sparrow	F	F	F			
	Lazuli bunting	C	C	C			
2	Le Conte's sparrow	U	F	U		0.16	0.09
	Least flycatcher	C	C	C		2.23	1.09
	Lesser scaup	Ab	U	Ab	O	3.77	2.36
2	Loggerhead shrike	U	F	U		1.06	0.55
	Mallard	Ab	C	Ab	U	26	40.09
1	Marbled godwit	F	F	U		9.48	15.18
	Marsh wren	F	C	F		5.94	26.09
	Mountain bluebird	F	F	U			
	Mourning dove	Ab	C	Ab	R	53.19	101.82
	Mourning warbler	F	F	F			
	Northern flicker	C	C	C	R	1.42	1.73
	Northern goshawk	R	O	R	R		
2	Northern harrier	C	F	C	R	2.35	2.91
	Northern oriole (Baltimore)	F	F	F		1.81	1.64
2	Northern pintail	Ab	C	Ab	O	6.65	9.09
	Northern rough-winged swallow	F	F	F		0.29	0.09
	Northern shoveler	C	C	C		7.65	10.09
	Northern waterthrush	F	F	F			
	Orchard oriole	F	F	R		6.35	7.64
	Ovenbird	F	F	F		0.03	
	Pied-billed grebe	F	F	F		2.61	2.73
	Pine siskin	F	R	F	U		
2	Piping plover	U	U	U			
	Purple martin	F	F	F			0.18
	Red crossbill	U	R	U	U	1	
	Red-eyed vireo	C	C	C		0.03	0.18
2	Redhead	C	C	C	O	3.42	8
2	Red-headed woodpecker	F	F	F		0.03	
	Red-tailed hawk	C	F	C	R	2.03	2.18
	Red-winged blackbird	Ab	Ab	Ab	R	154.48	330.82
	Ring-billed gull	C	C	C	R	6.1	9.45
	Ring-necked duck	U	F	F		0.03	
	Ring-necked pheasant	C	C	C	C	1.87	42.55
	Rock dove	C	C	C	C	0.35	1

Species	Estimated Frequencies				Counts	
	Spring	Summer	Fall	Winter	Lake George*	Braddock*
Rock wren	U	F	U			
Rose-breasted grosbeak	C	C	C		0.06	
Ruddy duck	C	C	C		1.84	29.27
Ruffed grouse	F	F	F	F		
Rufous-sided towhee	F	C	U	O		
Sandhill crane	F	R	Ab			
Savannah sparrow	Ab	C	Ab		12.32	
Say's phoebe	U	U	U		0.16	0.09
Scarlet tanager	F	F	F		1.52	5.09
[2] Sedge wren	U	F	U			
Sharp-shinned hawk	F	U	F	O		
[2] Sharp-tailed grouse	C	C	C	C	0.87	0.73
[2] Short-eared owl	F	F	F	U	0.58	0.64
Song sparrow	C	C	C	O	0.87	5
Sora	C	C	C		2.45	2.27
Spotted sandpiper	U	U	U			0.64
[1] Sprague's pipit	U	F	F		0.58	0.18
[1] Swainson's hawk	C	C	C		4.16	3.55
Swamp sparrow	U	U	U			0.09
Tree swallow	C	F	F		1.45	2.55
Tundra swan	C		C			
Turkey Vulture	U	F	U			0.09
[1] Upland sandpiper	F	F	F		19.1	20.55
Veery	U	C	U			
Vesper sparrow	F	C	F	O	4.77	11.73
Virginia rail	F	F	F		0.06	0.36
Warbling Vireo					1.87	1
Western grebe	F	C	U		2.29	29.73
Western kingbird	C	C	Ab		47.45	61
Western meadowlark	Ab	Ab	Ab	R	166.48	179.36
White-breasted nuthatch	F	F	F	F		
White-faced ibis	O	O	O		0.1	
White-throated sparrow	C	U	C	R		
[3] Whooping crane	R		R			
Wild turkey	F	F	F	F	0.45	
[1] Willet	F	F	U		2.58	5.45
Willow flycatcher	F	F	F		1.84	4.82
[1] Wilson's phalarope	C	C	C		5.94	15.18
Wood duck	U	F	F		0.32	
[1] Yellow rail	R	R	R			
Yellow-bellied sapsucker	U	F	U			
Yellow-breasted chat	F	F	F			
Yellow-headed blackbird	Ab	Ab	Ab	R	85.74	191.64
Yellow-rumped warbler	Ab	U	Ab			

*These numbers reflect the abundance of the species near the survey route during the breeding season. They are averages of the total counts along the route for the period 1989-1998. The abundance estimate represents the number of birds that a very good birder would encounter in about 2.5 hours of roadside birding in the area near the BBS route. The locations of the Lake George and Braddock bird survey routes can be seen in Attachment 6.

[1] Level I species as defined by the North Dakota Game and Fish Department

[2] Level II species as defined by the North Dakota Game and Fish Department

[3] Level III species as defined by the North Dakota Game and Fish Department

Ab -ABUNDANT; a species that occurs in very large numbers and is easily observed.

C -COMMON; a species that occurs in large numbers.

F -FAIRLY COMMON; a species that occurs in moderate numbers.

U -UNCOMMON; a species that occurs in low numbers.

R -RARE; a species that occurs yearly somewhere in the state, but in very low numbers.

O -OCCASIONAL; a rare species that occurs at intervals of 3 - 5 years.

In addition to the birds that nest in North Dakota, there are approximately 60 species that migrate through the state in the spring and/or fall. A list of these birds is shown in Table 3.

Table 3: Migrating Avian Species

American tree sparrow	Eastern phoebe	Long-billed dowitcher	Ruby-crowned kinglet
Baird's sandpiper	Field sparrow	Magnolia warbler	Ruby-throated hummingbird
Bay-breasted warbler	Fox sparrow	Merlin	Semipalmated plover
Blackburnian warbler	Golden-crowned kinglet	Nashville warbler	Semipalmated sandpiper
Blackpoll warbler	Gray-cheeked thrush	Orange-crowned warbler	Smith's longspur
Black-throated green warbler	Greater white-fronted goose	Osprey	Snow bunting
Bohemian waxwing	Greater yellowlegs	Palm warbler	Solitary sandpiper
Bonaparte's gull	Harris' sparrow	Pectoral sandpiper	Stilt sandpiper
Brown creeper	Hermit thrush	Peregrine falcon	Swainson's thrush
Buff-breasted sandpiper	Herring gull	Poor-will	Tennessee warbler
Canada warbler	Hudsonian godwit	Purple finch	Water pipit
Common loon	Least sandpiper	Red-breasted merganser	Western tanager
Common redpoll	Lesser golden plover	Red-necked grebe	White-crowned sparrow
Dark-eyed junco	Lesser yellowlegs	Ross' goose	Wilson's warbler
Dunlin	Lincoln's sparrow	Rough-legged hawk	Yellow-bellied flycatcher

The *Birds of North Dakota Field Checklist* also lists approximately 71 additional species whose primary range of territory does not include North Dakota, but may be seen on occasion every few years. These birds are not included in the remaining discussion because they are typically not found in the area.

While there are over 200 species of birds that could potentially be found in the project area, it is not considered prime habitat land. Approximately 70% of the land is agriculture or pastoral land. Less than 1% of the land is forested, and less than 4% is water or wetlands. In addition, there are no waterfowl production areas located in the project area. The nearest major water body is Lake McKenna, located approximately one mile to the west. The Missouri River is approximately 40 miles west of Napoleon.

The National Wind Coordinating Committee (NWCC) completed a study comparing mortality of birds from wind farms with avian deaths caused by other man-made structures. The report state that: "Based on current estimates, windplant related avian collision fatalities probably represent from 0.01% to 0.02% of the annual avian collisions fatalities in the United States." Wind farms that have had relatively high instances of avian fatalities have occurred because the turbines were located in migratory paths. The primary migratory path in the area is along the Missouri River, and as stated previously, is approximately forty miles west of Napoleon.

In summary, one may conclude that avian collision fatalities occurring at the LCWF will likely be close to or less than the averages observed (0.01% to 0.02% of all avian fatalities) at other wind farms due to the lack of suitable habitat in the project area and distance from the main migration routes.

3.1.2 Bats

There are five species of bats with ranges that include the project area, that are shown in Table 4.

Table 4: Bat Species	
Big brown bat	Northern myotis
Hoary bat	Silver-haired bat
Little brown bat	

There are many factors that are not understood regarding bat mortality caused by wind turbines. A study by the University of Alberta found that 46% of the dead bats killed at a wind energy facility in southwestern Alberta did not show external injuries (Baerwald, Erin 2008). Of the total dead bats, a portion of them were necropsied in the field. Of the bats that were necropsied, 57% showed indications of internal haemorrhaging but no external injuries. The study concluded that the bats were not killed by direct collision with the turbine blades, but by pulmonary barotrauma, the lung damage caused by rapid pressure changes. The study theorized that when the bats flew into the low pressure areas caused by the turbine blades, the air in their lungs expanded too rapidly, causing the lungs to rupture. This study is the first to document barotrauma as a significant cause of bat mortality at wind farms. In contrast, a monitoring study conducted at the Buffalo Ridge Wind resource area in Minnesota in 2000 indicated that most of the dead bats found had trauma injuries consistent with collision with the turbine blades. While this study did not examine the bats for pulmonary barotrauma, there were physical indications that blunt trauma was the largest factor in their death.

Other factors have been correlated with bat mortality include weather conditions, migration and proximity to habitat, but the exact relationships are not understood. Most studies have indicated that like the birds, bat mortality due to wind turbines is small, particularly when compared to mortality caused by other man-made objects. However there are still many factors that are not understood that have caused higher than expected bat mortalities at some wind farms.

3.1.3 Other Mammals

Large game mammals found in the region include white-tailed deer and occasionally mule deer and antelope. Small game mammals that are commonly hunted include red fox, coyote, cottontail rabbit, and white-tailed jackrabbit. Small game mammals that are trapped include raccoon, beaver, muskrat, mink, and badger (Hoberg and Gause, 1992). A list of mammals commonly found in the reason is shown in Table 5.

Table 5. Characteristic Mammal Species of the Mixed Grass Prairie (Missouri Coteau) (Hagen 2005)

Badger	Northern grasshopper mouse	Red fox	Western harvest mouse
Coyote	Northern pocket gopher	Richardson's ground squirrel*	White tailed deer
Deer mouse	Olive-backed pocket mouse	Snowshoe hare	White-tailed jackrabbit
Meadow jumping mouse	Prairie vole	Striped skunk	
Meadow vole	Raccoon	Thirteen-lined ground squirrel	

* Species identified as a conservation priority by the North Dakota Game and Fish Department.

3.1.4 Reptiles and Amphibians

Reptiles and amphibians common within the region include toads, leopard frogs, chorus frogs, the tiger salamander, painted turtles and garter snakes (Hoberg and Gause, 1992). A more complete list of reptiles and amphibians commonly found in the region is listed below in Table 6.

Table 6. Characteristic Reptile and Amphibian Species of the Mixed Grass Prairie (Missouri Coteau) (Hagen 2005)

Bullsnake	Great plains toad	Plains spadefoot*	Western hognose snake*
Canadian toad*	Northern leopard frog	Smooth green snake*	Woodhouse's toad
Chorus frog	Plains garter snake	Tiger salamander	Yellowbelly racer
Common garter snake			

* Species identified as a conservation priority by the North Dakota Game and Fish Department.

Wildlife habitats within the project area can be categorized into open grassland and cropland habitat, rangeland habitat, and wetland habitat. The most abundant type of wildlife habitat in the project area is the open grassland and cropland habitat. These areas consist mostly of agricultural fields, field edges, and road ditches. Vegetative species include mostly smooth brome, goldenrods and wild rose in the road ditches and small grains and row crops in the fields. Wildlife species attracted to these areas include gray partridge, ring-necked pheasant, red fox, cottontail rabbit, and white-tailed jackrabbit.

Supplementing this habitat type are field and farmstead windbreaks that have been planted to reduce soil erosion in cropland areas and provide shelter for farms and feedlots. Species within the farmstead windbreaks vary with the most common species including ash, cottonwood, siberian elm, and caraganna (siberian peashrub). Field windbreaks contain fewer species including mostly siberian elm and green ash. These areas of woody vegetation provide cover and travel corridors for many wildlife species.

Rangeland habitat includes pasture, hayland, set-aside, and coulees. These areas are generally steeper in slope and are mostly used for cattle or hay production. Vegetative species includes shrubs and both native and nonnative herbaceous plants. Wildlife species attracted to these areas include white-tailed deer, mule deer, antelope, coyotes, and sharp-tailed grouse. The rangeland and wooded coulee habitat is present primarily in the north east part of the project area. Woody vegetation is sparse and mostly found on the north slopes in steeper topography. Species include buckbrush, buffaloberry, ash, boxelder, and aspen.

Wetland habitat includes deep marshes, shallow marshes and seasonally flooded basins. The deep marshes are usually not cropped, while the shallow marshes can be cropped or grazed in during drier periods. Marshes generally contain surface water for most of the growing season, while seasonally flooded basins are dry by early summer. Vegetation commonly found in the shallow and deep marshes are cattails, bulrushes, rushes, sedges, smartweeds, mints and grasses.

Seasonally flooded basins are often converted to agricultural production except during wet conditions. Vegetative species that are commonly encountered include smartweeds, wild millet, foxtail, ragweed and goosefoot. Wildlife species attracted to wetland habitats include ducks, geese, raccoon, beaver, muskrat, and mink. Wetland habitat is present throughout the project site.

US Fish and Wildlife Service easements are present throughout central North Dakota. These easements offer permanent protection for wetlands and grasslands. A number of areas at the project site are currently under a USFWS easement. USFWS wetland easements protect wetlands from draining and filling activities. The majority of the wetland easements are located in Glendale Township and the eastern part of Bryant Township. There are several parcels containing grassland easements located on the project site. They are in section 1 and 13 of Bryant Township, and sections 3, 4, 22, 35 and 36 of Glendale Township. There are no wind tower locations are located on grassland easement parcels, but 25 are located on wetland easement parcels (see Attachment 2). The wetland easements offer protection for the wetland areas only, while the upland (nonwetland) areas are not regulated.

3.1.5 Fish Habitat

Fish habitat is not present at the project site; however there are some water bodies that provide fish habitat in the region. The McKenna Lakes complex located just west of Napoleon offers some fishing opportunities for yellow perch and northern pike. Other water bodies offering fishing opportunities in the region include Beaver Lake and Rudolf Lake. Beaver Lake is part of Beaver Lake State Park which is a park facility managed by the North Dakota Parks and Recreation Department. Beaver Lake is located approximately ten miles south east of the project site. It is managed for yellow perch and northern pike. Rudolf Lake is located approximately eight miles east of the project site and contains walleye and yellow perch.

3.1.6 Wildlife Management Areas

The nearest National Wildlife Refuge (NWR) to the project site is the Long Lake National Wildlife Refuge located in Moffit, North Dakota. It consists of 22,310 acres located in Burleigh and Kidder Counties. It is located approximately 11 miles from the project site. Long Lake is an alkaline lake that is up to 2 miles wide and 16 miles long. The Refuge contains 22,300 acres, 16,000 of which are lake bottom. The remaining acres contain mixed-grass prairie grasslands, ravines, cultivated fields, small tree and shrub plantings, and seasonal wetland basins. The NWR provides significant breeding habitat for many species of birds, and also provides a rest area for spring and fall migrations.

3.2 Environmental Consequences

3.2.1 Proposed Action

Potential impacts to the wildlife in the Phase I area would be primarily a result of impacts to their habitat, and impacts to the bird species migratory routes. A Habitat Conservation Plan will be prepared for the LCWF if required by the USFS. The plan would include the impacts that may occur as a result of the Project and the measures that will be undertaken to monitor, minimize and mitigate such impacts.

4.0 Aquatic Resources

4.1 Affected Environment

4.1.1 Lakes

Surface waters in the project area consist of wetlands and shallow lakes. The Mc Kenna Lakes are located just a couple of miles west of the project area. The North and South Lakes along with some adjacent wetlands result in over 3,000 acres of surface water. These lakes are generally known as a resting place for migratory waterfowl. There are two small lakes located in the project area. The first lake is located in section 13 of Bryant Township and is approximately 73 acres in size. The second lake is in Sections 7, 8 and 14 in Starkey Township and is approximately 106 acres in size. Both the Mc Kenna Lakes and the project lakes are classified by the NWI as L2ABG – Lacustrine Littoral Aquatic Bed Intermittently Exposed basins. These types of basins are generally less than two meters (6.6 feet) in depth and contain surface water throughout the growing season.

4.1.2 Wetlands

There are numerous wetlands in this region (see Attachment 3) varying form large areas with big lakes to small temporary seasonal wetlands. A wetland is and area that is inundated or saturated by surface or ground water long enough to support vegetation typically adapted for life in saturated soil. The numerous smaller wetlands in this area provide more habitat and food for waterfowl than one large wetland of the same total average. A loss of these smaller wetlands would have a significant impact on waterfowl that migrate and breed in this region.

Numerous wetland areas also dot the project area. According to the National Wetland Inventory (NWI) wetlands comprise approximately 3,127 acres or 5.4% of the project area. Most are seasonally flooded basins (Palustrine Emergent Seasonally Flooded - PEMC). Other wetland types include temporarily flooded basins (Palustrine Emergent Temporarily Flooded - PEMA) and semipermanently flooded basins (Palustrine Emergent/Aquatic Bed Semipermanently Flooded - PEM/ABF). There are numerous smaller scattered throughout Glendale County and in the northeast part of Bryant Township. While the remaining parts of the project area contain fewer wetlands but they tend to be larger in size. There is also a complex of wetlands next to Beaver Creek at the south end of the project.

4.1.3 Rivers and Streams

Beaver Creek runs though the south end of the project site. It begins as an outlet to Beaver Lake located in Beaver Lake State Park and flows west to the Missouri River west of Linton.

4.2 Environmental Consequences

4.2.1 Proposed Action

Potential impacts to aquatic resources would primarily be a result of direct impacts due to the placement of the turbines and associated equipment; or due to stormwater runoff during construction activities and throughout operation of the LCWF. Direct impacts will be avoided as much as possible by placing the turbines such that the aquatic resources are avoided or minimally impacted. Stormwater pollution prevention plans will be prepared for the project area to address the effects of stormwater runoff during construction and throughout the operation life of the LCWF.

5.0 Rare, Threatened and Endangered Species

A request was submitted on March 19, 2008, to Mr. Jeffrey K. Towner of the USFWS in Bismarck, North Dakota for information on threatened and endangered species (see Attachment 4) that may be present in the project area. The USFWS responded by identifying whooping cranes (*Grus americana*) and piping plovers (*Charadrius melodus*) as species that are found in Logan County, North Dakota, (Towner, Jeffry K., 2008). The Whooping Crane is listed as endangered and the piping plover is listed as threatened.

5.1 Endangered Species

The only self-sustaining natural populations of whooping cranes migrate through western and central North Dakota counties during the spring and fall. They breed in Wood Buffalo National Park in Alberta and the Northwest Territories of Canada, and winter along the Texas coast.

Specific occurrences of whooping cranes at the project site were not identified; however whooping cranes have been documented using roosting habitat in the vicinity of the proposed project area. The project site is located within a 90-mile wide migration corridor (see Attachment 5) that has been identified in North Dakota, (Towner, Jeffry K., 2008).

5.2 Threatened Species

Critical habitat for the piping plover includes alkali wetlands, wetland areas devoid of vegetation and their upland areas adjacent to these types of wetlands. This species primarily nests on sandbars of the Missouri and Yellowstone Rivers, (Towner, Jeffry K., 2008). Occurrences of the piping plover were not identified by the USFWS at the project site or in the vicinity of the project.

5.3 Environmental Consequences

5.3.1 Proposed Action

Potential impacts to the threatened and endangered resources would primarily be a result of impacts to their habitat, and impacts to their migratory routes. A Habitat Conservation Plan will be developed for the LCWF that addresses the impacts that may occur as a result of the Project and the measures that will be undertaken to monitor, minimize and mitigate such impacts.

Attachment 1

Land Cover – Phase I

(See map book)

Attachment 2

US Fish and Wild Life Easements

(See map book)

Attachment 3

MWI Wetlands

(See map book)

Attachment 4

Threatened and Endangered Species – Phase I

(See map book)

Attachment 5

Whooping Crane Sightings

(See map book)

Attachment 6

Bird Survey Routes

(See map book)

Section B: Studies

a. Studies & Assessments
Physical

Physical Resources
Affected Environment and Environmental Consequences

1.0 Introduction

Just Wind, LLC is a Minnesota limited liability company formed to develop, partially own and manage a wind energy project in Logan County, North Dakota. The Owner of the project will be a wholly owned subsidiary of Just Wind, Logan County Wind Farm, LLC (LCWF). Phase I of the wind energy project will consist of 160 Siemens 2.3 wind turbine generators with a total nameplate capacity of 368 megawatts.

The Siemens wind turbine generators will be located in Bryant Township, Glendale Township and Starkey Township. The proposed project will include all associated transmission infrastructure, including an underground electrical collection system, telemeter monitoring equipment, and a new project substation with a power generation capacity of 500 megawatts. The development of the LCWF Project will also include the turbine access roads and other associated equipment required for the successful operation of the wind farm.

The proposed wind energy project will be developed on approximately 57,700 acres of suitable agricultural land in Logan County, near the town of Napoleon. The existing land use is compatible with the development of the wind energy project, as is the existing infrastructure including a 345 kV transmission line.

The physical resource information will include a general description of the physical setting, including the land cover types, and the site soils and geology. The groundwater resources and surface water resources will also be characterized for the area. In addition, the existing air quality for the area will be characterized based on published data and previous testing.

2.0 Land Cover Types

2.1 Affected Environment

The area for the proposed project includes a mix of cropland, pastureland, wooded areas, Natural Resources Conservation Reserve (NRCS) – Conservation Reserve Program (CRP) land, and a small urban area (see Attachment 1). The vast majority of the land is CRP-fallow cropland, or in small grains, hay, and sunflowers. The following tables provide a breakdown of the land cover types for the area per NRCS for Glendale, Bryant and Starkey Townships, and for the entire project area.

Table 1: Land Cover Types (NRCS) by Individual Townships

Land Cover Types	Glendale Township		Bryant Township		Starkey Township	
	Acres	Percentage	Acres	Percentage	Acres	Percentage
Urban	444	2.28%	1,040	5.43%	713	3.73%
Woods	21	0.11%	147	0.77%	182	0.95%
Water and Wetlands	1,494	7.67%	158	0.82%	244	1.28%
Pasture/Range/Non-Ag	1,993	10.23%	1,465	7.65%	396	2.07%
Fallow Cropland/CRP	4,020	20.63%	3,807	19.88%	4,815	25.19%
Clover/Wildflowers	6,820	35.01%	2,875	15.02%	2,891	15.13%
Crops (Corn, Soybeans, Hay, Sunflowers and Small Grains)	4,688	24.07%	9,656	50.43%	9,871	51.65%
Totals	**19,479**	**100.00%**	**19,149**	**100.00%**	**19,112**	**100.00%**

Table 2: Land Cover Totals (NRCS) by Combined Project Area

Land Cover Types	Project Totals	
	Acres	Percentage
Urban	2,198	3.81%
Woods	350	0.61%
Water and Wetlands	1,895	3.28%
Pasture/Range/Non-Ag	3,854	6.67%
Fallow Cropland/CRP	12,641	21.89%
Clover/Wildflowers	12,587	21.80%
Crops (Corn, Soybeans, Hay, Sunflowers and Small Grains)	24,216	41.94%
Totals	**57,740**	**100.00%**

Prime farmlands are listed by soil mapping units for Logan County. Some soils have limitations such as high water table or flooding, and may qualify as prime farmland if these limitations are overcome by management methods. Some soil associations are mapped as a complex of two or three soil types and only part of the complex may be listed as prime farmland. The following soil series are designated as prime farmland of statewide importance and include the Williams-Bowbells loams, the Willams loams, the Arnegard loam, the Hamerly loam, the Reeder-Arnegard loam, the Amor-Werner Loams, the Amor –Werner-Farnuf loams, Wildrose silty clay and gray silty clay loam. The prime farmland if drained soils include Marysland loam, Colvin silt loam, and the Hamerly-Tonka-Parnell complex Acreage of prime farmland was estimated for the entire project area using the NRCS soil data, and the USDA Soil Survey map for Logan County. Based on this information, approximately 17,875 acres of land is designated as prime farmland of statewide importance or prime farmland if drained.

Impacts to prime farmland will occur at the turbine locations and from the access roads. There are 54 turbines that are located on prime farmland and approximately 44-miles of access roads that cross prime farmland. This results in approximately one-third acre of prime farmland impacted by the turbines and 79.5 acres impacted by the access roads. As such, there are 80 acres of prime farmland impacted by the LCWF. This represents less than 0.50% of the prime farmland within the project area being impacted by the wind turbines and access roads.

2.2 Environmental Consequences

2.2.1 Proposed Action

The proposed action will have minimal impacts on the land cover types except in the immediate areas where the turbines, access roads and underground electrical collection system are located. These impacts will be localized and will not generally affect land use in the overall project areas.

3.0 Geology and Minerals

3.1 Affected Environment

Construction activities associated with the development of the LCWF have the potential to impact soils and other geologic resources. The impacts can occur locally during excavation and grading activities at the turbine locations, or regionally as a result of the construction of the required infrastructure and inter-connection to the nearby transmission line. The impacts may vary for the individual turbine locations based on the specific geology in the immediate vicinity of the wind turbines.

3.1.1 Geologic Setting

The geologic setting of North Dakota has been shaped by periods where warm seas covered the state to periods where glaciers shaped the landscape. The most recent ice age, approximately 25,000 years ago, was responsible for many of the physiographic features that are observed today. South Central North Dakota contains four different physiographic units. These include the Glaciated Plains, the Missouri Coteau, the Coteau Slope and the Missouri Slope Upland (Bluemle, 2000). These different regions contain both erosional and glacial landforms. The Missouri Escarpment divides the Glaciated Plains from the Coteau Slope and the Missouri Coteau.

Approximately the western third of Logan County is located within the Coteau Slope District of the Glaciated Missouri Plateau of the Great Plains. The Coteau Slope is the westward flowing region located on the east side of the Missouri River. It has a thin layer of glacial drift with few closed depressions with most of the drainage completely integrated and flowing westward to the Missouri River. The Missouri Coteau is located to the east and is characterized by a nonintegrated drainage with numerous closed depressions. The Coteau Slope in Logan County is further divided into subdistricts. These include the Napoleon Subdistrict, the Beaver Creek

Subdistrict, the Wishek Subdistrict and the Zeeland Subdistrict. The project area is located within the Napoleon Subdistrict. The Napoleon Subdistrict has the most remaining closed depressions with the least developed drainage patterns of the four subdistricts in Logan County. This subdistrict generally slopes westward towards the Missouri River; however, it still contains many closed basins that are characteristic of the Missouri Coteau.

3.1.2 Site Geology

Both bedrock and glacial deposits are observed in many areas of North Dakota. The glacial deposits are more recent compared to the bedrock (typically shale). The surface deposits at the project area are mapped as Quaternary age formation, of the Coleharbor group, formed by river deposits or glacier landforms. Bedrock geology formations are of the cretaceous age, primarily of the Hell Creek formation (Bluemle, 2000; see Attachment 2).

Lignite coal resources underlie much of the western two thirds of North Dakota. When these reserves lie close enough to the surface to be economically harvested they are considered strippable lignite resources. Strippable lignite resources have not been identified in Logan County (Bluemle, 2000). Oil production in North Dakota is currently limited to the western and north central parts of the state. Oil production facilities are not known to be active at the project site or in the surrounding area. Mineral deposits such as gemstones and gold are generally not considered an important economic resource in North Dakota. Deposits of these resources are not known within the project area.

3.1.3 Physiographic and Topographic Setting

The typical "prairie pothole" region of North Dakota is a result of the hummocky collapsed glacial topography that exists along the Missouri Coteau. The Missouri Coteau extends across the central part of the state of North Dakota generally from the northwest to the south central parts of the state. Although the project area is located in the Coteau Slope the project area contains undulating to rolling topography that is typical of collapsed glacial topography (see Attachment 3). This is particularly evident in the northeast portion of the project area.

Runoff from the project area flows westward and is part of the Missouri River Drainage Basin. The James River Drainage Basin begins a few miles to the east bringing runoff eastward to the James River. According to the County Soil Survey, slopes within the project area range from 0-3% to 9-15% with an average of 5%. Elevations within the project area are at approximately 2000 feet above mean sea level.

3.2 Environmental Consequences

3.2.1 Proposed Action

The geologic resources will generally not be affected by the proposed project. The proposed action will have minimal impacts on the geologic resources except in the immediate areas where the turbines, access roads and underground electrical collection system are located. These impacts will be localized and will not generally affect the geologic resources in the overall project areas. Lignite coal resources are not known to exist at the project site and oil production facilities do not exist within or adjacent to the area; as such, the project is not expected to alter or deplete these resources.

4.0 Groundwater Resources

4.1 Affected Environment

Groundwater resources for the LCWF Project would require an assessment of the Project needs versus local availability and specific uses relative to the project features. Additionally, groundwater characteristics would need to be identified including depth to groundwater, groundwater quality, and availability.

4.1.1 Regional Hydrogeologic Setting

Groundwater resources in Logan County can be obtained from aquifers from both the Quaternary age and the Cretaceous age. The Quaternary age aquifers are formed in glacial drift and tend to have the highest yields. The aquifers can yield 200 to 1,300 gallons per minute. A number of aquifers have been delineated by the North Dakota Geological Survey within Logan County. The Napoleon aquifer is located near the community of Napoleon, ND and is closest to the project site. The Streeter aquifer is a large aquifer located approximately 12 miles north east of Napoleon. The Streeter and Napoleon aquifers have the greatest potential for development within Logan County (Klausing, 1983).

4.1.2 Site Subsurface Conditions

The project area contains parts of the Napoleon aquifer. This aquifer is formed in glacial drift and is divided into two parts. These include the Napoleon buried-valley aquifer and the Napoleon outwash aquifer. The project area contains parts of the Napoleon outwash aquifer. The buried-valley aquifer contains the greater yield potential of the two with a potential yield of 1,000 to 1,500 gallons per minute. The outwash aquifer yields between 50 to 200 gallons per minute. USGS well data indicate that the groundwater gradient is essentially towards McKenna Lake (Klausing, 1983). This results in a westerly gradient for portions of the aquifer within the project area.

4.1.3 Groundwater Elevations

USGS observation well data indicate that water levels within the Napoleon outwash aquifer vary between 3 and 36 feet below the land surface and fluctuate on a seasonal basis. Generally the shallow groundwater levels are highest in early spring and at their lowest during the winter months (Klausing 1983).

4.2 Environmental Consequences

4.2.1 Proposed Action

Potential impacts to groundwater resources would be primarily a result of fuel spills from equipment during construction. However, stormwater pollution prevention plans (SWPPP's), should adequately address spills and runoff from the site during construction.

5.0 Surface Water Resources

5.1 Affected Environment

The surface water resources would need to be identified, both permanent and ephemeral surface water bodies, and assessed at the project level. Characteristics defined include water quality, water uses, and surface water runoff patterns

5.1.1 Climate and Precipitation

The climate in south central North Dakota is characterized by very warm summers and very cold winters. July and August are the hottest months with average high temperatures of 82 and 81 degrees Fahrenheit respectively at Napoleon, ND. January is the coldest month with an average low temperature of -2 degrees Fahrenheit (www.weather.com). Logan County has an average annual precipitation of approximately 17 inches. Most of the rainfall occurs in the months of June and July with average monthly precipitation levels of 3.20 and 2.88 inches respectively. Average snowfall for Logan County is approximately 30 inches (Jensen). The average number of frost free days in Logan County is 120 days (Jensen).

5.1.2 Surface Water Features

Surface waters in the project area consist of wetlands and shallow lakes. The Mc Kenna Lakes are located just a couple of miles west of the project area. The North and South Lakes along with some adjacent wetlands result in over 3,000 acres of surface water. These lakes are generally known as a resting place for migratory waterfowl. There are two small lakes located in the project area. The first lake is located in section 13 of Bryant Township and is approximately 73 acres in size. The second lake is in Sections 7, 8 and 14in Starkey Township and is approximately 106 acres in size. Both the Mc Kenna Lakes and the project lakes are classified by the NWI as L2ABG – Lacustrine Littoral Aquatic Bed Intermittently Exposed basins. These types of basins are generally less than two meters (6.6 feet) in depth and contain surface water throughout the growing season.

Numerous wetland areas also dot the project area. According to the National Wetland Inventory (NWI), wetlands comprise approximately 3,127 acres or 5.4% of the project area. Most are seasonally flooded basins (Palustrine Emergent Seasonally Flooded - PEMC). Other wetland types include temporarily flooded basins (Palustrine Emergent Temporarily Flooded - PEMA) and semipermanently flooded basins (Palustrine Emergent/Aquatic Bed Semipermanently Flooded - PEM/ABF). The following table provides a listing of the wetland types in the project area.

Table 3: Wetland Types in the Project Area

Wetland Type	Acreage	Percentage
PABF	74.9	2.4%
PABFX	19.4	0.6%
PEMA	692.4	22.1%
PEM/ABF	141.1	4.5%
PEMC	2,094.9	67.0%
PEMF	104.3	3.4%
Total	3,127.0	100.0%

5.1.3 Local Drainage Features and Runoff

Surface runoff from north of Highway 34 flows towards a number of closed basins and is stored within these depressions in the landscape. Surface runoff south of Highway 34 runs to the west flowing just south of the city of Napoleon towards the McKenna Lakes. An intermittent flowage begins southeast of Napoleon and flows northwest to the south basin of the McKenna Lakes. Most of the surface water from Starkey Township drains to intermittent flow areas and then into Beaver Creek, which flows west to the Missouri River.

5.1.4 Regional Runoff and Flooding

Surface runoff within the regions is generally westward to the Missouri River. However, many closed basins are also present capturing runoff and providing storage. Floodplain studies have not been completed within the project area. The nearest completed floodplain study is for the community of Napoleon, just west of the project area. Both 100-year and 500-year floodplains are delineated within the community of Napoleon (see Attachment 7).

5.1.5 Water Quality

The Clean Water Act (CWA) requires states to report to the Environmental Protection Agency on the quality of their waters approximately every two years. Section 303(d) of the CWA requires states to list waterbodies which are considered to have water quality problems. These waterbodies are termed "impaired" or "listed" waters. Beaver Creek, located in the southern part of the project is currently listed on the 2006 Section 303(d) list of impaired waters. Beaver Lake, located approximately 2 miles to the east of the project area is also on the impaired water list. Beaver Lake is as threatened due to excessive nutrients and Beaver Creek is not supporting recreational uses due to excessive levels of Total Fecal Coliform Bacteria (Dwelle 2006).

5.2 Environmental Consequences

5.2.1 Proposed Action

Potential impacts to surface water resources would be primarily a result of fuel spills from equipment and stormwater runoff during construction. However, stormwater pollution prevention (SWPP) plans should adequately address spills and runoff from the site during construction. While runoff from project will enter Beaver Creek, the project will not contribute Fecal Coliform, so no additional SWPP measures should be needed

6.0 Air Quality

6.1 Affected Environment

Air quality tends to change with time, as does the regulatory programs associated with emissions from identified sources. Given that wind power does not consume fossil-fuels for electric production; and the operation does not produce carbon dioxide, sulfur dioxide, mercury, particulates, or any other type of air pollutant; no air quality impacts are anticipated for the LCWF Project.

6.1.1 Winds

Generally wind speeds in North Dakota peak during late winter and early spring. Specifically the months of April and May have the highest average wind speeds across the state (Jensen). The average (mean) wind speed in Bismarck is 12.8 and 12.5 mile per hour for April and May respectively. The mean wind speed for Bismarck is 10.8 miles per hour (Jensen). The prevailing wind direction in Bismarck is from the north to northwest direction.

6.1.2 Air Quality

The air quality in the project area likely meets the North Dakota air quality standards. According to *Scorecard,* a pollution information site (www.scorecard.org), Logan County North Dakota ranks among the cleanest counties in the United States for air quality. The nearest North Dakota Department of Health (NDDH) air quality monitoring station is located in Bismarck, a distance of approximately 50 miles. Bismarck is one of ten sites that was sampled by the NDDH in 2006. There were no exceedances of either the state or federal ambient air quality standards measured at these sites in 2006 (Dwelle and Glatt, June 2007). The project site and the surrounding areas are rural with agriculture being the dominant land use. No obvious air quality concerns or contaminant sources are present. Spring and fall tillage of the agricultural fields may produce high levels of dust (particulates) depending on the local moisture conditions and wind speeds.

6.2 Environmental Consequences

6.2.1 Proposed Action

Potential air quality impacts would be limited to the construction activities of the Project. Dust and emissions from construction equipment will have temporary impacts to the local air quality. These temporary impacts are not expected to exceed North Dakota Air Quality Standards.

7.0 Soil Units

7.1 Affected Environment

Construction activities associated with the development of the LCWF have the potential to impact the soils in the area. The impacts can occur locally during excavation and grading activities at the turbine locations, or regionally as a result of the construction of the required infrastructure and inter-connection to the nearby transmission line. The impacts may vary for the individual turbine locations based on the specific soil types in the immediate vicinity of the wind turbines.

7.1.1 Soil Use and Productivity

Farming and Ranching are the main agricultural enterprises within the project corridor and are also the main use of the soil resources. In much of the rangeland the stands of grass are managed for beef cattle production. These prairie ecosystems now contain both native and introduced species. The most common crops grown in the region include durum wheat, spring wheat, corn, soybeans, barley, sunflowers, oats, safflower, flax, and grass-legume hay.

7.1.2 Soils

Soils in and around the project site consist of grassland soils that are typical of the Missouri Coteau and Coteau Slope (see Attachment 5). Native grasses for these soils consist of western wheat grass, blue gramma, green needlegrass, and needle-and-thread. In addition to the grasses some forbs and sedges would also have been present (National Cooperative Soil Survey). Soils in the project generally consist of well drained to excessively well drained soils formed in loamy alluvium and calcareous glacial till. In the northeast part of the project area the soil types are primarily Zahl-Williams loams. These soils are formed in calcareous glacial till and tend to have slopes of 6-15%. This soil type is very common throughout the Missouri Coteau. In the southwest part of the project area the soil types include mostly Bowdle-Lehr loams and the Wabek-Lehr complex. These soils types are formed in loamy alluvium and tend to have flatter slopes (1-6%). The depressions, however, do not contain well drained soils. Parnell silty clay loam is a poorly drained soil type that is present in most of the wetlands within the project. It comprises approximately two percent of the project area.

7.1.3 Prime Farmland Soil Units

Prime farmland, as described by the US Department of Agriculture, is:

> *land that has the best combination of physical and chemical characteristics for producing food, feed, forage, fiber, and oilseed crops, and is also available for these uses (the land could be cropland, pastureland, rangeland, forest land, or other land, but not urban built-up land or water). It has the soil quality, growing season, and moisture supply needed to economically produce sustained high yields of crops when treated and managed, including water management, according to acceptable farming methods.*
>
> *In general, prime farmlands have an adequate and dependable water supply from precipitation or irrigation, a favorable temperature and growing season, acceptable acidity or alkalinity, acceptable salt and sodium content, and few or no rocks. They are permeable to water and air. Prime farmlands are not excessively erodible or saturated with water for a long period of time, and they either do not flood frequently or are protected from flooding.*

Prime farmlands are listed by soil mapping unit for each county. In addition to the unit, some soils have limitations such as high water table or flooding, and may qualify for prime farmlands if these limitations are overcome by management methods. Also, in some cases a soil unit is mapped as a complex of two or three soil types. In many of these soil units, only part of the complex is listed as prime farmland. According the Logan County Soil Survey prime farmlands are not present in the project area. However some soil units are consider prime if a drainage system is in place to overcome wetness limitations. Prime farmlands within the project area are shown in Attachment 6.

Farmlands of Statewide Importance are lands that are nearly prime farmland in physical characteristics that can produce high yields of crops when managed according to acceptable farming methods. These lands are considered an important agricultural resource that does not meet the definition of Prime Farmlands. The project area contains a number of areas considered Farmland of Statewide Importance.

7.2 Environmental Consequences

7.2.1 Proposed Action

As stated previously, there are 54 turbines and 44 miles of access road that is located on prime farmland areas. The total area impacted represents less than 0.50% of the prime farmland that is present in the project area. The prime farmland soils will be disturbed during construction of the tower structures and the access roads. The result of the construction activities is that these areas will be taken out of agricultural production for a period extending through the life of the LCWF Project. These activities may permanently impact Farmlands of Statewide Importance and Prime Farmlands. Other impacts to soils may include soil erosion during construction. Construction impacts would be temporary in nature and will be addressed during the construction process. The implementation of the storm water pollution prevention plan (SWPPP) and the use of general construction best management practices should reduce soil erosion or other potential impacts that may occur in the project area during construction.

Attachment 1

Land Cover Types

(See map book)

Attachment 2

Bedrock Formations

(See map book)

Attachment 3

Topography

(See map book)

Attachment 4

Surface Water Features

(See map book)

Attachment 5

Soils

(See map book)

Attachment 6

Prime Farmland

(See map book)

Attachment 7

FEMA Q3 Data

(See map book)

Section B: Studies

a. Studies & Assessments
Social

Social Resources
Affected Environment and Environmental Consequences

1.0 Introduction

Just Wind, LLC is a Minnesota limited liability company formed to develop, partially own and manage a wind energy project in Logan County, North Dakota. The Owner of the project will be a wholly owned subsidiary of Just Wind, Logan County Wind Farm, LLC (LCWF). Phase I of the wind energy project will consist of 160 Siemens 2.3 wind turbine generators with a total nameplate capacity of 368 megawatts.

The Siemens wind turbine generators will be located in Bryant Township, Glendale Township and Starkey Township. The proposed project will include all associated transmission infrastructure, including an underground electrical collection system, telemeter monitoring equipment, and a new project substation with a power generation capacity of 500 megawatts. The development of the LCWF Project will also include the turbine access roads and other associated equipment required for the successful operation of the wind farm.

The proposed wind energy project will be developed on approximately 57,700 acres of suitable agricultural land in Logan County, near the town of Napoleon. The existing land use is compatible with the development of the wind energy project, as is the existing infrastructure including a 345 kV transmission line.

The social resource information will include a general description of the socioeconomic setting for the Phase I area. The land-use types will be characterized including human settlement, recreation, agricultural production, forestry production and cultural resources.

Logan County is one of 53 counties in North Dakota. The estimated population of Logan County, ND in 2006 was 1,999. This was a decrease of about 13 percent from the 2000 census (www.fedstats.gov accessed July 9, 2008). The total area of the county is 1,011 square miles including 18 square miles of water.

2.0 Agricultural Resources

According to the U.S. Department of Agriculture, Agricultural Statistics Service, Logan County had nearly 578,000 acres listed as farm land in 2002. This is about 91 percent of the total land in the county, although only part of that may be tilled in any given growing season.

2.1 Affected Environment

The average farm size in Logan County is 1,298 acres with 93 percent of them being operated by a family or individual. More than 303,000 acres of the land in the farms is classified as cropland by the 2002 North Dakota Census of Agriculture. Less than 1 percent of the land is irrigated, so the majority of crops are produced using dry-land methods, including small grains such as wheat. Livestock, poultry, and their products produce 74 percent of the total agricultural market value.

2.2 Environmental Consequences

The American Wind Energy Association has presented a document available on line at http://www.awea.org/pubs/documents/faq2002%20-%20web.pdf which is a summary of responses to frequently asked questions (FAQ's) about wind energy. In it, they discuss the amount of space occupied by a typical wind farm.

> *Wind farms may extend over a large geographical area, but their actual "footprint" covers only a very small portion of the land, making wind development an ideal way for farmers to earn additional income. In open, flat terrain, a utility-scale wind plant will require about 50 acres per megawatt of installed capacity. However, only 5% (2.5 acres) or less of this area is actually occupied by turbines, access roads, and other equipment--95% remains free for other compatible uses such as farming or ranching.*

This suggests that the access roads, foundations, power substations, and other equipment needed as part of the wind farm will not seriously hinder most aspects of agricultural activity. However it will require persons to maneuver around these added obstructions. Some agricultural related activities such as crop dusting and other forms of aerial application may have to be modified or curtailed to avoid injury or damage to the pilot, his equipment, or the wind turbines.

2.2.1 Proposed Action

The proposed actions will have minimal impacts on agricultural resources. Landowners that will be hosting wind-farm turbines have been informed of the limitations that will be imposed on their agricultural practices. Aerial-applications services companies have been made aware that their methods may need modification because of the safety hazard that will exist when the wind turbines are in place.

3.0 Land Use Types and Local Zoning

3.1 Affected Environment

The wind farm will be installed in a primarily agricultural of Logan County. The city of Napoleon and a golf course are located at the western edge of the wind farm. Many metropolitan areas are trying to change zoning laws to allow certain types of wind-based power-generation facilities in urban and residential areas, but that would not be applicable in this setting. Several resources were searched and no zoning restrictions were found that would limit the installation and operation of a wind farm in Logan County, North Dakota.

The search did turn up a reference that suggested some zoning-based restriction may be considered to address the possibility of uncontrolled operation of wind farms in Stutsman County, North Dakota. Stutsman County borders Logan County on the north. The president of

Just Wind, LLC was quoted in an article published in The Jamestown Sun (Jamestown, ND) on August 20, 2008 which stated:

> *Zoning regulations would define things like setbacks from residences, roads and property lines. The regulations would define where wind turbines could be constructed. "Without zoning it puts us at risk," [Jeff] Metzger [president of Just Wind] said. "So no one can come in and build a wind farm that interferes with us."*

This statement is referring to the need to establish zoning requirements that would control the density of wind turbines in and near a wind farm where no wind farm had existed previously. For more information see: http://www.jamestownsun.com/

3.2 Environmental Consequences

3.2.1 Proposed Action

The potential environmental consequences in this setting generally are negligible. Once the wind farm is in place it is unlikely to interfere with agricultural activities other than the footprint of the turbine towers and related infrastructure that will remove some farm land from productivity.

The town of Napoleon and the nearby golf course also will be minimally impacted other than a view of the wind turbines to the east. When the sun is low in the sky during and shortly after sunrise, the towers and rotating blades likely will cast a shadow on the town and some flickering of the sunlight eclipsed by the rotating blades may be observed.

4.0 Transportation

Various forms of transportation are available in the Napoleon area including a branch line of the Canadian Pacific Railroad, Highway 3 running north and south through Napoleon, and Highway 34 running east and west through Napoleon. Highway 3 connects with Interstate 94 about 26 miles north of the Napoleon. Highway 34 connects with U.S. Highway 83 about 25 miles west of Napoleon. Bismarck, the capitol of North Dakota, is about 1-1/2 hours drive to the northwest of Napoleon.

There are many independent trucking firms in the area, several of which run more than one vehicle. Courier services also are available. Bus service from Napoleon to major nearby cities is available, scheduled on selected days of the week. Napoleon has a municipal airport with a paved 3200 x 60-foot lighted runway located about 1-mile to the southeast of town.

Additional information is available at http://www.napoleonnd.com/transportation.htm (accessed on Sept. 4, 2008).

4.1 Affected Environment

Roadways, railroads, air traffic including private planes all may be affected. In this highly agricultural area, much of the local air traffic may be aerial applicators of agricultural chemicals.

4.2 Environmental Consequences

4.2.1 Proposed Action

Increased truck traffic is anticipated during construction and installation of the wind farm. Transportation of the large turbines, support towers, and rotors and blades likely will take considerable room on roadway rights of way. The construction related trucks will add to the density of large machinery using the local roadways. This will be in addition to the seasonal farm machinery use of the local roadways.

Once the wind farm is operational, little disruption of transportation should be experienced. However, the activities of aerial applicators of agricultural chemicals, which generally are seasonal in nature, may be altered or curtailed in the immediate vicinity of the wind farm.

5.0 Recreation

5.1 Affected Environment

The types of recreation that may be affected by the wind farm are primarily outdoors activities. These include hunting, fishing, hiking, camping, and various motorized sports. Since the project is in a rural area, it is common for farmsteads to recreate on their own property and share access with nearby landowners and acquaintances. That may include the types of recreational activities described above.

For persons without access to private land there are other recreational opportunities nearby. Beaver Lake State Park is located 17 miles southeast of Napoleon, and offers boating, canoeing, water skiing and fishing. McKenna Lake about 1 mile west of Napoleon also may offer recreational opportunities.

Other nearby attractions include the Lawrence Welk Home, the Whitestone Battlefield State Historic Site, and the Slade & Long Lake National Wildlife Refuges. These are a considerable distance from the wind farm and should not be affected by its presence.

Other types of recreation that might be affected by the presence of the wind farm are activities that take advantage of the wide-open spaces available in North Dakota. Aerial recreation including ballooning and hang gliding fit into this category. A number of Internet sites were searched including http://www.hotairballooning.com/balloon-rides/balloon-rides-67.php, and no local vendors of aerial recreational activities were found.

5.2 Environmental Consequences

5.2.1 Proposed Action

The wind farm generally is unlikely to interfere with the recreational activities described above. Some naturalists may be bothered by the site of wind farms as they may obstract their view, but this should be avoidable by viewing nature in a nearby location. Some bird hunting may be affected as hunters are distracted by moving blades as they aim at flying targets. A more likely consequence is damage to the wind-farm equipment by hunters.

6.0 Visual Resources

People have different perceptions of wind farms. Some people see them as an asset and appreciate or accept their presence. Other see them as a detriment that detracts from their enjoyment of the scenery.

6.1 Affected Environment

The town of Napoleon and local, but widely-dispersed rural residents of the area in and near the wind farms likely will experience views of the turbines. This will vary depending on a person's perspective (east, west, north, or south) relative to the wind farm.

6.2 Environmental Consequences

6.2.1 Proposed Action

It is unlikely that the visual disruption can be avoided. Any attempt to hide the turbines probably would not improve the view.

7.0 Noise

Wind turbines have often been cited as creating noise that is disturbing to observers.

7.1 Affected Environment

The areas within and near the wind farm all may be affected by the sound the units make while they are operating.

Wind turbines most commonly produce some broadband noise as their revolving rotor blades encounter turbulence in the passing air. Broadband noise is usually described as a "swishing" or "whooshing" sound. Some wind turbines (usually older ones) can also produce tonal sounds (a "hum" or "whine" at a steady pitch). This can be caused by mechanical components or, less commonly, by unusual wind currents interacting with turbine parts. This problem has been nearly eliminated in modern turbine design (See http://www.awea.org/pubs/factsheets/WE_Noise.pdf for more information).

7.2 Environmental Consequences

7.2.1 Proposed Action

While earlier models of wind turbines were very noisy, recent advancements have provided a great deal of improvement. The following table provided by the American Wind Energy Association illustrates that an operating wind farm at a distance of 750 to 1,000 feet is no noisier than a kitchen refrigerator or a moderately quiet room.

Source/Activity Indicative noise level	dB (A)
Threshold of hearing	0
Rural night-time background	20-40
Quiet bedroom	35
Wind farm at 350m	35-45
Car at 40mph at 100m	55
Busy general office	60
Truck at 30mph at 100m	65
Pneumatic drill at 7m	95
Jet aircraft at 250m	105
Threshold of pain	140

Source: The Scottish Office, Environment Department, Planning Advice Note, PAN 45, Annex A: Wind Power, A.27. Renewable Energy Technologies, August 1994. Cited in "Noise from Wind Turbines," British Wind Energy Association, http://www.britishwindenergy.co.uk/ ref/noise.html .

Some sound produced by operation of the wind turbines is unavoidable. The turbines will be located at least 1000 feet away from an occupied building to minimize any noise-related disturbance.

8.0 Social and Economic Values

8.1 Affected Environment

8.1.1 Population and Demographics

The estimated population of Logan County, ND in 2006 was 1,999, which translates to about 2 people per square mile. This was a decrease of about 13 percent from the 2000 census (www.fedstats.gov accessed July 9, 2008). More than 99 percent of the population was classified as non-Hispanic white. The most common first ancestry was German (75%) and Norwegian (7%). Half of the population was between the ages of 19-64 years. By gender, the population was split at about 51 percent female and about 49 percent male. There were 1,207 housing units in Logan County in 2006.

8.1.2 Employment

The top 2 classes of workers in Logan County were employees working for private companies followed by self-employed workers in their own not-incorporated business. The most common industry for male workers was agriculture, followed by construction, educational services, repair and maintenance, finance and insurance, and farm product raw material merchant wholesalers. The most common industry for females was health care, educational services, agriculture, finance and insurance, accommodation and food services, and social assistance.

8.1.3 Income

In 2005, the personal per capita income in Logan County was $34,403. This compares to $31,357 for the state of North Dakota (www.fedstats.gov accessed July 9, 2008). The unemployment rate reported was 3.1 percent. Full time and part time employment was reported at 1,529 persons.

8.1.4 Public Services and Facilities

Logan County and the City of Napoleon have a variety of businesses that support the predominantly agricultural-based economy. Along with those are public and social services that provide a supporting infrastructure that ranges from maintenance of roads to public safety and education.

Napoleon has a mayor-council form of government with each member elected for 4-year terms, a police department, a volunteer fire department, and an ambulance service fully equipped with all volunteers trained in accordance with state standards. The fire department and ambulance are interconnected with state radio and law enforcement agencies. Logan County also has a Sheriff's office.

The Napoleon Public School is fully accredited with 230 students in grades k-12. It has a state of the art computer-networking setup. Extracurricular activities include band, choir, football, wrestling, boys and girls basketball, boys and girls track, girls volleyball, speech, drama, and golf.

Napoleon has a medical clinic serviced by the staff of Wishek Community Hospital which is located 25 minutes southeast of the town. It has six churches, many non-profit charitable organizations, a golf country club with a 9-hole grass-green golf course. The Napoleon City Park has a heated swimming pool with a tubular slide, tennis and basketball court, sand volleyball, and horse shoes. The park also has twelve camping sites, a heated bath house complete with showers, a playground with up to date equipment, and 3 picnic shelters with roofs over them. Napoleon also has a baseball/softball complex, a 4-lane bowling facility, trapshooting grounds, and the Logan County Historical Society.

8.1.5 Property Values

The home-ownership rate in Logan County in 2000 was about 86 percent. The median value of an owner-occupied home was $30,200.

According to the 2002 Census of Agriculture, 91 percent of Logan County was classified as farm land. The average size of a farm in Logan County was 1,298 acres and the average value including buildings was $323,440.

8.2 Environmental Consequences

8.2.1 Proposed Action

The influx of people and financial resources expected as a result in installation, operation, and maintenance of the proposed wind farm are likely to benefit the social and economic resources of Logan County. Additional services will be needed to support staff working on the facilities. Because the wind farm will pay taxes and other fees to local governments as well as providing additional income to local landowners, the financial resources should be available to support expanded services.

9.0 Cultural Resources

Trefoil Cultural and Environmental Heritage performed a Class III Cultural Resources Survey for the for the *Just Wind* Wind Farm in accordance with the North Dakota State Historic Preservation Office (NDSHPO). A Class III survey is an intensive field inventory of cultural resources and archaeological sites that have surface indications in an entire target area.

9.1.1 Historical Resources

Trefoil contacted the NDSHPO and learned that the area where the wind farm will be installed had not previously been inventoried. The NDSHPO was not aware of any cultural or historical sites that would be affected by the wind farms.

Nine historic sites were identified during the Class III Survey. The current project layout for the wind turbines includes locations adjacent to these sites. The access roads and cable locations in these areas will require minor adjusting so the final layout will avoid all historic sites.

Four prehistoric sites were identified in the Project Area. All of these sites are represented by a small concentration of lithic materials, predominately knife river flint. Subsurface testing indicates no intact soils at any of the sites, and no further investigation is recommended. The current project layout avoids all these sites.

Twenty isolated finds were recorded in the project area during the Class III Survey. One of the sites represents possible historic activity, and the remaining nineteen sites represent possible prehistoric activity. Isolated finds included four or fewer artifacts representing a very limited occurrence of past activity. All the isolated finds locations were tested for additional buried archaeological material, and all such tests were negative. The isolated finds are not substantial enough to warrant any significant modifications to the project layout.

The Logan County Historical Society located at the west edge of Napoleon includes several historical buildings with antique household items and clothing, antique farm machinery, and other historical items. However, it provides no indication whether it has information about historical sites in the area of the proposed wind farm.

9.1.2 Archeological Resources

In addition to reviewing historical documents that were readily obtainable, Trefoil performed a visual inspection in a 200 x 200 meter area around the sites where turbines were to be installed. These surveys identified six archeological sites that were documented for subsequent investigation. The immediate result is that the turbines sited near these archeological features were relocated to a different area. The features identified included rock walls or other evidence of historic farmsteads, cairns (a mound of stones erected as a memorial or marker), and collections of historic farm implements. Trefoil also recommended performing similar surveys where access roads will be located.

9.1.3 Native American Resources

A review of available data bases and other resources that might provide information about Native American activities in the wind farm area was conducted by Trefoil. These resources did not reveal any sites that had any particular cultural significance. Trefoil also contacted 19 Native-American groups that may have interest in the area. Richard Rothaus (Trefoil Cultural and Environmental Heritage, oral communication Sept. 4, 2008) conveyed that 3 affiliated tribes had expressed interest in the findings in the wind farm area and requested to be informed when any additional information is discovered.

9.2 Environmental Consequences

9.2.1 Proposed Action

Although evidence of historical sites in the area is sparse, there does not appear to be anything that is significant enough to interfere with planned installation and operation. The locations of the proposed for turbine installation were moved when possible sites of archeological significance were identified, so no further action should be warranted. It is possible that excavation will reveal sites having archeological significance that previously had not been identified, but those will be dealt with as encountered. Indications from Trefoil are that the area was never heavily settled for a long enough period to result in artifacts that have important cultural significance.

Section B: Studies

a. Studies & Assessments

Avian & Bat Species

DISCUSSION OF AVIAN AND BAT SPECIES

Avian Species

There are approximately 163 species of birds that live and nest in North Dakota during the breeding seasons of spring and summer. Table 2 lists the birds and shows the frequencies based on information from the *Birds of North Dakota Field Checklist*, compiled by Chad Grondahl, NDGF. In addition, the Patuxent Wildlife Research Center, a biological research center of the United State Geological Survey (USGS) has conducted bird surveys throughout the United States. Two of the survey routes, Lake George and Braddock, are located in close proximity to the project area. The Lake George route is located to the north of the project area, approximately 7 miles away, while the Braddock route is approximately 11 miles to the west. Table 1 also lists bird counts along the Lake George and Braddock survey route.

Table 1: Avian Species Sighting Frequencies

	Estimated Frequencies				Counts	
Species	**Spring**	**Summer**	**Fall**	**Winter**	**Lake George***	**Braddock***
[1] (Nelson's) Sharp-tailed sparrow	U	F	U		0.23	0.27
Alder flycatcher	R	R	R		1.84	4.82
[2] American avocet	C	C	C		0.13	2.91
[1] American bittern	F	F	F		1.58	0.73
American coot	Ab	Ab	Ab		7.55	4.55
American crow	C	F	C	R	1.61	11
American goldfinch	F	F	F	U	8	7.36
American kestrel	C	F	C	R	0.52	0.27
American Redstart	C	C	C			
American robin	Ab	C	Ab	R	4.61	11.73
[1] American white pelican	U	C	U		8.1	13
American wigeon	C	U	C	R	1.84	1.55
[1] Baird's sparrow	F	F	F		13.23	2.09
[2] Bald Eagle	U	R	U	R		
Bank swallow	C	C	Ab		2.81	6.73
Barn swallow	Ab	Ab	Ab		18.16	32.18
Belted kingfisher	F	F	F	R		0.18
[1] Black tern	C	C	Ab		4.26	0.91
Black-and-white warbler	F	F	F			
[2] Black-billed cuckoo	F	F	U		1.61	0.82
Black-billed magpie	F	C	C	F		
Black-capped chickadee	F	F	F	F	0.03	
Black-crowned night-heron	F	C	F		1.48	3.36
Black-headed grosbeak	F	F	F			
Blue jay	F	F	F	U	0.13	0.45
Blue-winged teal	Ab	Ab	Ab		17.23	23.27
[2] Bobolink	F	F	F		21.65	30.91
Brewer's blackbird	C	F	C	O	2.68	1.55
Broad-winged hawk	U	F	U			

Species	Estimated Frequencies				Counts	
	Spring	Summer	Fall	Winter	Lake George*	Braddock*
Brown thrasher	F	F	F		4.94	6.36
Brown-headed cowbird	C	C	U		100.61	112
Bufflehead	F	R	F	O		0.55
2 Burrowing owl	U	F	U		0.03	0.18
California gull	F	F	F	O	0.74	
Canada goose	Ab	F	Ab	R	10.26	3.27
2 Canvasback	F	F	C	O	1.16	6
Cattle egret	R	R	R		1.19	
Cedar waxwing	F	F	F	U	0.19	0.91
1 Chestnut-collared longspur	C	Ab	C		70.35	58
Chestnut-sided warbler	F	R	F			
Chimney swift	C	F	F			
Chipping sparrow	F	F	F		0.03	0.91
Clay-colored sparrow	C	Ab	C			17.18
Cliff swallow	Ab	Ab	Ab		1.81	178.09
Common grackle	Ab	Ab	Ab	R	60.65	117.36
Common merganser	F		F	U		
Common nighthawk	C	U	C		0.35	0.27
Common snipe	C	U	C		6.84	9.36
Common tern	U	F	U			0.73
Common yellowthroat	C	C	C			20.55
2 Dickcissel	U	F	U		6.35	1.64
Double-crested cormorant	F	F	F		3.68	13.45
Downy woodpecker	F	F	F	F	0.1	0.09
Eared grebe	C	C	C		2.23	13.18
Eastern bluebird	F	F	U		0.35	0.09
Eastern kingbird	C	C	Ab		35.13	37.64
Eastern wood-pewee	C	C	C			
European Starling	F	F	F	F	9.1	5.82
1 Ferruginous hawk	F	C	F		3.74	1.18
Forster’s tern	U	F	U		1.13	0.18
Franklin’s gull	Ab	C	Ab		3.39	24.55
Gadwall	C	C	C	O	15.68	28.82
2 Golden eagle	F	F	F	F		
1 Grasshopper sparrow	C	C	C		40.94	42
Gray catbird	C	F	C		0.74	0.55
Gray partridge	C	C	C	C	0.58	0.73
Great blue heron	F	F	F		0.19	0.27
Great crested flycatcher	F	F	F			
Great egret	R	R	U		0.03	
Great horned owl	F	F	F	F	0.29	0.91
2 Greater prairie-chicken	U	U	U	U		
Green-winged teal	F	U	C		0.97	0.55
Hairy woodpecker	F	F	F	F		0.09
Hooded merganser	U	F	U			

	Species	Estimated Frequencies				Counts	
		Spring	Summer	Fall	Winter	Lake George*	Braddock*
1	Horned Grebe	F	F	F			
	Horned lark	Ab	Ab	Ab	U	41.77	141.45
	House sparrow	C	C	C	C	22.68	95.27
	House wren	C	C	F		3.61	8.09
	Indigo bunting	F	F	F			
	Killdeer	C	C	C		15.87	23.36
	Lapland longspur	Ab		Ab	U		
1	Lark bunting	Ab	Ab	Ab		137.55	90.82
	Lark sparrow	F	F	F			
	Lazuli bunting	C	C	C			
2	Le Conte's sparrow	U	F	U		0.16	0.09
	Least flycatcher	C	C	C		2.23	1.09
	Lesser scaup	Ab	U	Ab	O	3.77	2.36
2	Loggerhead shrike	U	F	U		1.06	0.55
	Mallard	Ab	C	Ab	U	26	40.09
1	Marbled godwit	F	F	U		9.48	15.18
	Marsh wren	F	C	F		5.94	26.09
	Mountain bluebird	F	F	U			
	Mourning dove	Ab	C	Ab	R	53.19	101.82
	Mourning warbler	F	F	F			
	Northern flicker	C	C	C	R	1.42	1.73
	Northern goshawk	R	O	R	R		
2	Northern harrier	C	F	C	R	2.35	2.91
	Northern oriole (Baltimore)	F	F	F		1.81	1.64
2	Northern pintail	Ab	C	Ab	O	6.65	9.09
	Northern rough-winged swallow	F	F	F		0.29	0.09
	Northern shoveler	C	C	C		7.65	10.09
	Northern waterthrush	F	F	F			
	Orchard oriole	F	F	R		6.35	7.64
	Ovenbird	F	F	F		0.03	
	Pied-billed grebe	F	F	F		2.61	2.73
	Pine siskin	F	R	F	U		
2	Piping plover	U	U	U			
	Purple martin	F	F	F			0.18
	Red crossbill	U	R	U	U	1	
	Red-eyed vireo	C	C	C		0.03	0.18
2	Redhead	C	C	C	O	3.42	8
2	Red-headed woodpecker	F	F	F		0.03	
	Red-tailed hawk	C	F	C	R	2.03	2.18
	Red-winged blackbird	Ab	Ab	Ab	R	154.48	330.82
	Ring-billed gull	C	C	C	R	6.1	9.45
	Ring-necked duck	U	F	F		0.03	
	Ring-necked pheasant	C	C	C	C	1.87	42.55
	Rock dove	C	C	C	C	0.35	1
	Rock wren	U	F	U			

Species	Estimated Frequencies				Counts	
	Spring	Summer	Fall	Winter	Lake George*	Braddock*
Rose-breasted grosbeak	C	C	C		0.06	
Ruddy duck	C	C	C		1.84	29.27
Ruffed grouse	F	F	F	F		
Rufous-sided towhee	F	C	U	O		
Sandhill crane	F	R	Ab			
Savannah sparrow	Ab	C	Ab		12.32	
Say's phoebe	U	U	U		0.16	0.09
Scarlet tanager	F	F	F		1.52	5.09
[2] Sedge wren	U	F	U			
Sharp-shinned hawk	F	U	F	O		
[2] Sharp-tailed grouse	C	C	C	C	0.87	0.73
[2] Short-eared owl	F	F	F	U	0.58	0.64
Song sparrow	C	C	C	O	0.87	5
Sora	C	C	C		2.45	2.27
Spotted sandpiper	U	U	U			0.64
[1] Sprague's pipit	U	F	F		0.58	0.18
[1] Swainson's hawk	C	C	C		4.16	3.55
Swamp sparrow	U	U	U			0.09
Tree swallow	C	F	F		1.45	2.55
Tundra swan	C		C			
Turkey Vulture	U	F	U			0.09
[1] Upland sandpiper	F	F	F		19.1	20.55
Veery	U	C	U			
Vesper sparrow	F	C	F	O	4.77	11.73
Virginia rail	F	F	F		0.06	0.36
Warbling Vireo					1.87	1
Western grebe	F	C	U		2.29	29.73
Western kingbird	C	C	Ab		47.45	61
Western meadowlark	Ab	Ab	Ab	R	166.48	179.36
White-breasted nuthatch	F	F	F	F		
White-faced ibis	O	O	O		0.1	
White-throated sparrow	C	U	C	R		
[3] Whooping crane	R		R			
Wild turkey	F	F	F	F	0.45	
[1] Willet	F	F	U		2.58	5.45
Willow flycatcher	F	F	F		1.84	4.82
[1] Wilson's phalarope	C	C	C		5.94	15.18
Wood duck	U	F	F		0.32	
[1] Yellow rail	R	R	R			
Yellow-bellied sapsucker	U	F	U			
Yellow-breasted chat	F	F	F			
Yellow-headed blackbird	Ab	Ab	Ab	R	85.74	191.64
Yellow-rumped warbler	Ab	U	Ab			

*These numbers reflect the abundance of the species near the survey route during the breeding season. They are averages of the total counts along the route for the period 1989-1998. The abundance estimate represents the number of birds that a very good birder would encounter in about 2.5 hours of roadside birding in the area near the BBS route.

[1] Level I species as defined by the North Dakota Game and Fish Department

[2] Level II species as defined by the North Dakota Game and Fish Department

[3] Level III species as defined by the North Dakota Game and Fish Department

Ab -ABUNDANT; a species that occurs in very large numbers and is easily observed.

C -COMMON; a species that occurs in large numbers.

F -FAIRLY COMMON; a species that occurs in moderate numbers.

U -UNCOMMON; a species that occurs in low numbers.

R -RARE; a species that occurs yearly somewhere in the state, but in very low numbers.

O -OCCASIONAL; a rare species that occurs at intervals of 3 - 5 years.

In addition to the birds that nest in North Dakota, there are approximately 60 species that migrate through the state in the spring and/or fall. A list of these birds is shown in Table 2.

Table 2: Migrating Avian Species

American tree sparrow	Eastern phoebe	Long-billed dowitcher	Ruby-crowned kinglet
Baird's sandpiper	Field sparrow	Magnolia warbler	Ruby-throated hummingbird
Bay-breasted warbler	Fox sparrow	Merlin	Semipalmated plover
Blackburnian warbler	Golden-crowned kinglet	Nashville warbler	Semipalmated sandpiper
Blackpoll warbler	Gray-cheeked thrush	Orange-crowned warbler	Smith's longspur
Black-throated green warbler	Greater white-fronted goose	Osprey	Snow bunting
Bohemian waxwing	Greater yellowlegs	Palm warbler	Solitary sandpiper
Bonaparte's gull	Harris' sparrow	Pectoral sandpiper	Stilt sandpiper
Brown creeper	Hermit thrush	Peregrine falcon	Swainson's thrush
Buff-breasted sandpiper	Herring gull	Poor-will	Tennessee warbler
Canada warbler	Hudsonian godwit	Purple finch	Water pipit
Common loon	Least sandpiper	Red-breasted merganser	Western tanager
Common redpoll	Lesser golden plover	Red-necked grebe	White-crowned sparrow
Dark-eyed junco	Lesser yellowlegs	Ross' goose	Wilson's warbler
Dunlin	Lincoln's sparrow	Rough-legged hawk	Yellow-bellied flycatcher

The *Birds of North Dakota Field Checklist* also lists approximately 71 additional species whose primary range of territory does not include North Dakota, but may be seen on occasion every few years. These birds are not included in the remaining discussion due because they are typically not found in the area.

The USFWS identified the whooping crane and piping plovers as species that are found in Logan County, North Dakota, (Towner, Jeffry K., 2008). The Whooping Crane is listed as endangered and the piping plover is listed as threatened. While the Whooping Cranes sightings have occurred up to 90 miles on either side of the Missouri River, the majority of them were within 50 miles. The nearest sighting to the project area was approximately 14 miles away.

Critical habitat for the piping plover includes alkali wetlands, wetland areas devoid of vegetation and their upland areas adjacent to these types of wetlands. This species primarily nests on sandbars of the Missouri and Yellowstone Rivers, (Towner, Jeffry K., 2008). Occurrences of the piping plover were not identified by the USFWS at the project site or in the vicinity of the project.

While there are over 200 species of birds that could potentially be found in the project area, it is not considered prime habitat land. Approximately 70% of the land is agriculture or pastoral land. Less than 1% of the land is forested, and less than 4% is water or wetlands. In addition, there are no waterfowl production areas located in the project area. The nearest major water body is Lake McKenna, located approximately one mile to the west. The Missouri River is approximately 40 miles west of Napoleon.

The National Wind Coordinating Committee (NWCC) completed a study comparing mortality of birds from wind farms with avian deaths caused by other man-made structures. The report state that: "Based on current estimates, windplant related avian collision fatalities probably represent from 0.01% to 0.02% of the annual avian collisions fatalities in the United States." Wind farms that have had relatively high instances of avian fatalities have occurred because the turbines were located in migratory paths. The primary migratory path in the area is along the Missouri River, and as stated previously, is approximately forty miles west of Napoleon.

In summary, one may conclude that avian collision fatalities occurring at the LCWF will likely be close to or less than the averages observed (0.01% to 0.02% of all avian fatalities) at other wind farms due to the lack of suitable habitat in the project area and distance from the main migration routes.

Bat Species

There are five species of bats with ranges that include the project area, that are shown in Table 3.

Table 3: Bat Species	
Big brown bat	Northern myotis
Hoary bat	Silver-haired bat
Little brown bat	

There are many factors that are not understood regarding bat mortality caused by wind turbines. A study by the University of Alberta found that 46% of the dead bats killed at a wind energy facility in southwestern Alberta did not show external injuries (Baerwald, Erin 2008). Of the total dead bats, a portion of them were necropsied in the field. Of the bats that were necropsied, 57% showed indications of internal haemorrhaging but no external injuries. The study concluded that the bats were not killed by direct collision with the turbine blades, but by pulmonary barotrauma, the lung damage caused by rapid pressure changes. The study theorized that when the bats flew into the low pressure areas caused by the turbine blades, the air in their lungs expanded too rapidly, causing the lungs to rupture. This study is the first to document barotrauma as a significant cause of bat mortality at wind farms. In contrast, a monitoring study conducted at the Buffalo Ridge Wind resource area in Minnesota in 2000 indicated that most of the dead bats found had trauma injuries consistent with collision with the turbine blades. While this study did not examine the bats for pulmonary barotrauma, there were physical indications that blunt trauma was the largest factor in their death.

Other factors have been correlated with bat mortality include weather conditions, migration and proximity to habitat, but the exact relationships are not understood. Most studies have indicated that like the birds, bat mortality due to wind turbines is small, particularly when compared to mortality caused by other man-made objects. However there are still many factors that are not understood that have caused higher than expected bat mortalities at some wind farms.

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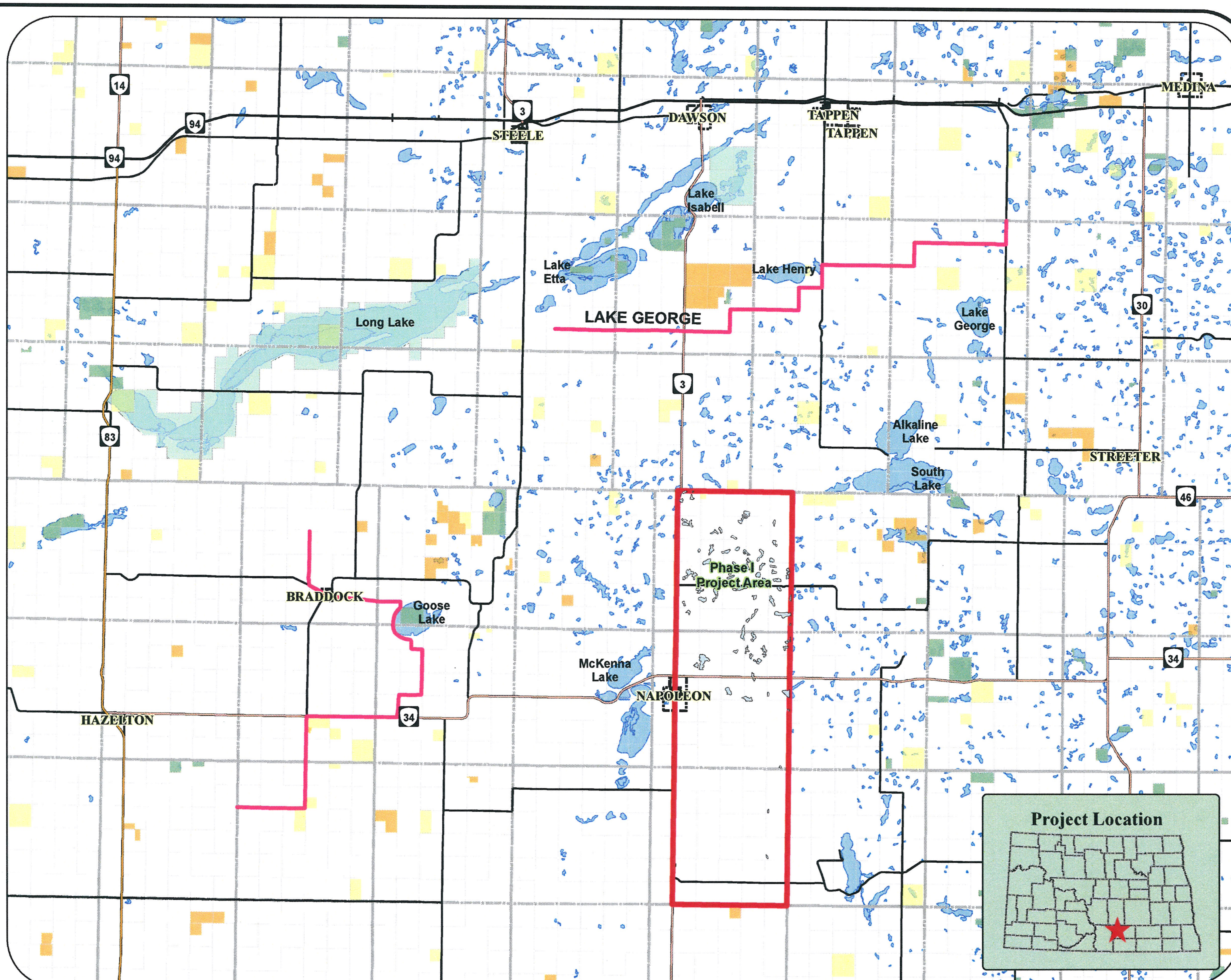
Bird Survey Route

- Bird Survey Route
- Ponds_Lakes_PhaseI
- Phase I Project Boundary
- Township Line
- Section Line

US Fish & Wildlife

- Waterfowl Production Area
- US Fish and Wildlife Service
- ND Land Department
- ND Game & Fish
- Ponds Lakes and Large Rivers



Data downloaded from the ND GIS Data Hub.
Bird Survey Routes from the North American Breeding Bird Survey.

N W E S

0 1 2 4 6 8 Miles

Bird Survey Routes					
Scale: AS SHOWN	Drawn by: KZS	Checked by:	Project No.: 5192-000	Date: 09/02/08	Sheet:

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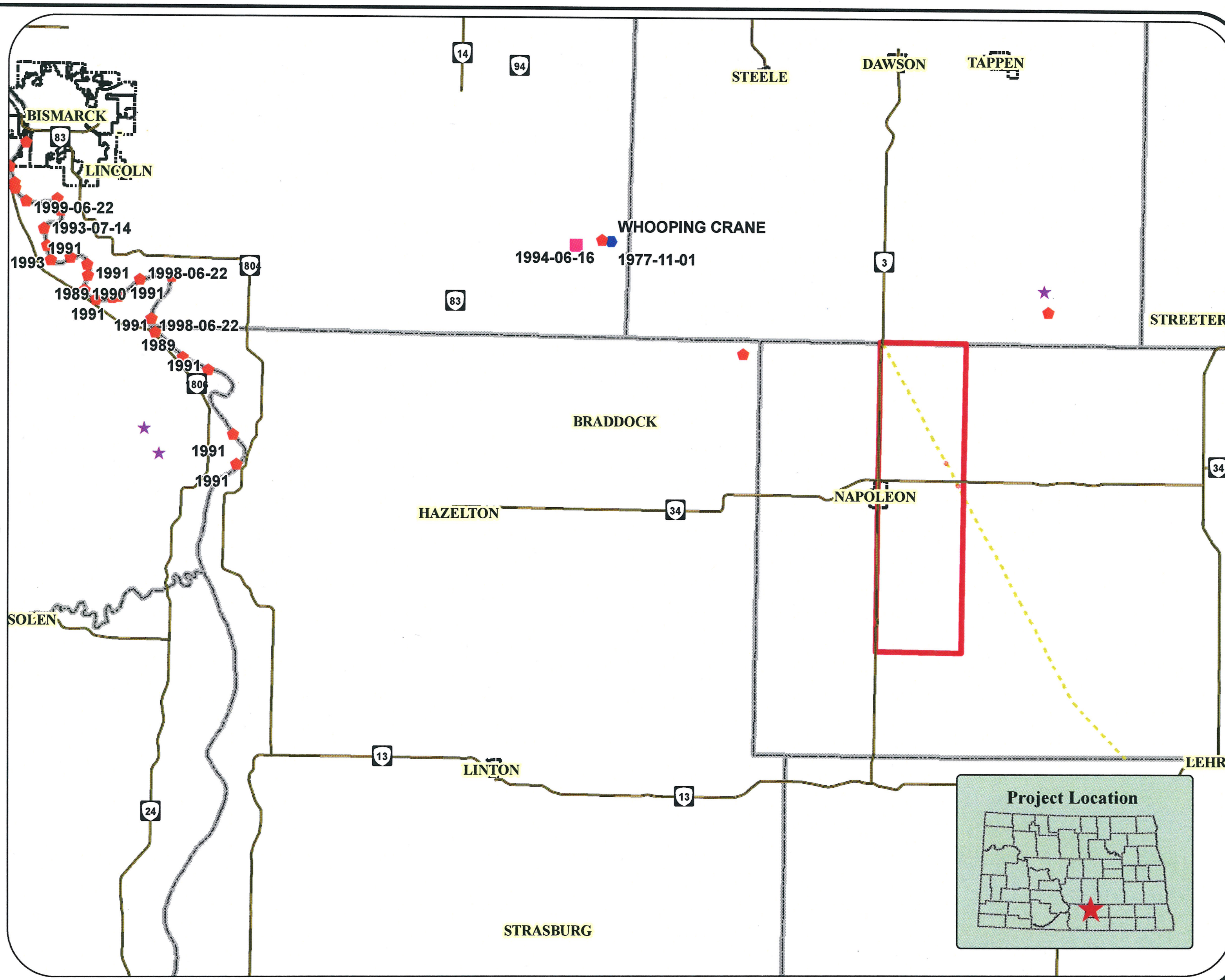
Threatened & Endangered Species Map Phase I



COMMON TERN
PIPING PLOVER
WHOOPING CRANE

Species of Concern

Animal
Plant
State Highway
Phase I Project Boundary
Existing 345kv Transmission Line
Railroad
Corporate Boundary

Base map data downloaded from the ND GIS Data Hub.
Natural Heritage Species of Concern are part of the North Dakota Natural Heritage Inventory provided by the North Dakota Parks & Recreation Department.
Background is 2006 USDA-FSA Aerial Photography.

N
W E
S

0 3.5 7 14 Miles

Threatened & Endangered Species Map - Phase I					
Scale: AS SHOWN	Drawn by: KZS	Checked by:	Project No.: 5192-000	Date: 07/3/08	Sheet:

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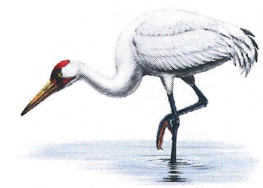
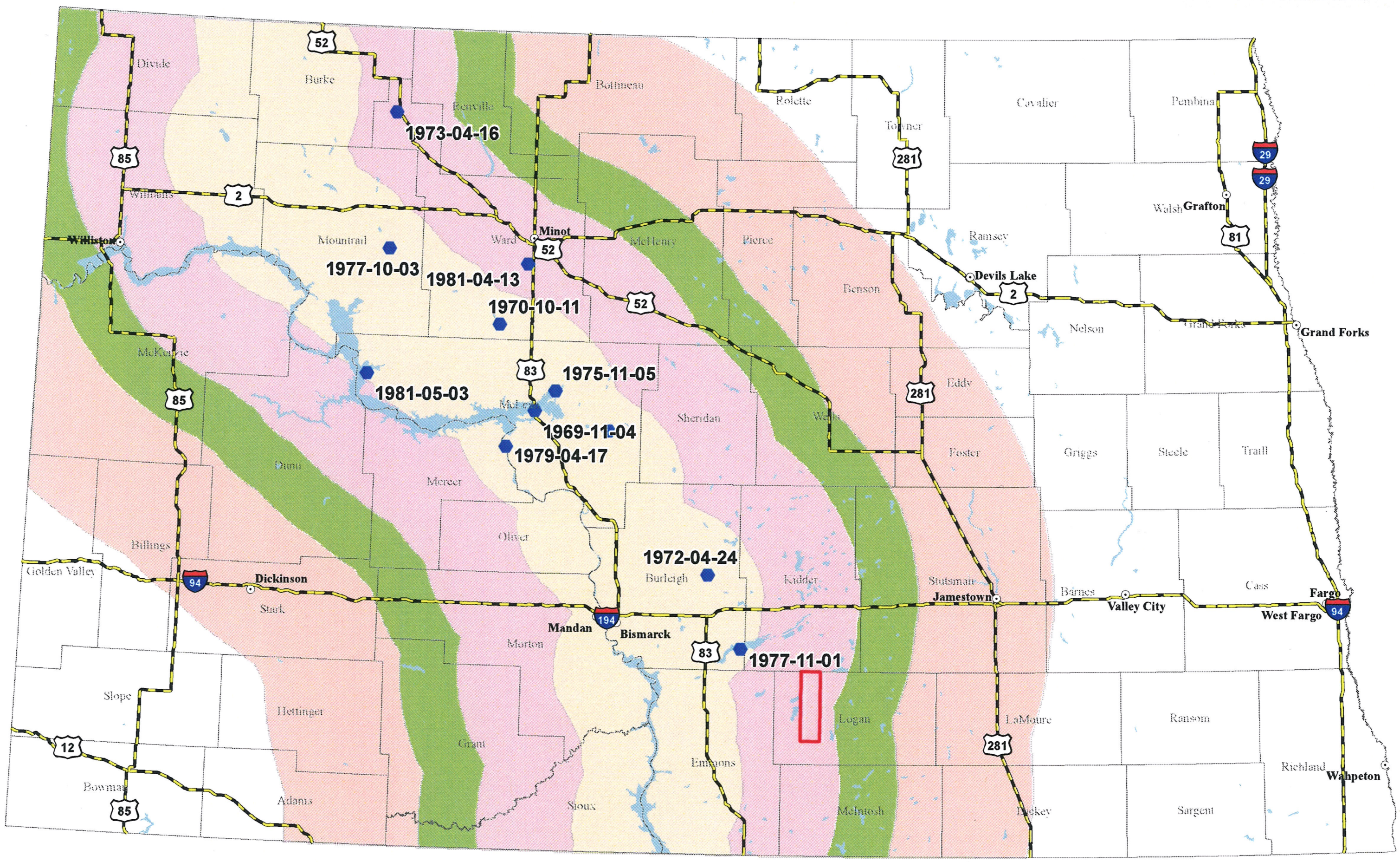
Selected Percentages of Whooping Crane Sightings

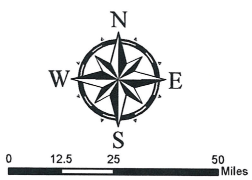
Major Roads
County Boundaries
Percent Whooping Crane Sightings
Approx 50% (40 mile corridor)
Approx 75% (95 mile corridor)
Approx 85% (120 mile corridor)
Approx 95% (180 mile corridor)
Phase I Project Boundary

Last time Observed

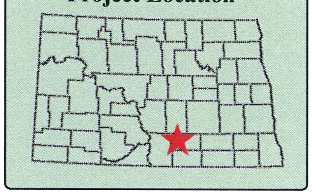
WHOOPING CRANE







Project Location



Data downloaded from the ND GIS Data Hub.
Sightings Through Spring 2007

Selected Percentages of Whooping Crane Sightings					
Scale: AS SHOWN	Drawn by: KZS	Checked by:	Project No.: 5192-000	Date: 09/03/08	Sheet:

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analogous to forward and backward mutation at the individual level; and the intensity of selection for other traits such as oogamy that may cause uniparental inheritance secondarily. None of these parameters is known for any organism.

In fact, all of these factors must be considered in order to achieve a complete explanation for the relative frequencies of uniparental and biparental inheritance of organelle genes. Moreover, the explanation must be sought in a phylogenetic context in which the ancestral state of the organisms can be reconstructed. It may be more fruitful to analyze the evolution of mechanisms of uniparental inheritance (organelle exclusion from the zygote, selective silencing, and so on) as opposed to patterns. Given the complexity of the task, it will almost certainly be necessary to treat one limited group of organisms at a time, and combine them into successively larger trees to achieve more general explanations, or more likely, to show that the evolutionary consequences of uniparental inheritance vary from one group to another, just as the mechanisms vary.

It should be clear from this Primer that uniparental inheritance is a quantitative trait with many different underlying mechanisms; moreover it is potentially subject to any or all of the evolutionary forces of mutation, random genetic drift, and selection within and between species. Unraveling the evolutionary history, causes, and consequences of the trait will almost certainly be much more difficult than we thought, and should provide many years of good scientific fun.

Further reading

Birky, C.W. Jr. (2001). The inheritance of genes in mitochondria and chloroplasts: Laws, mechanisms, and models. Proc. Nat. Acad. Sci. USA *35*, 125–148.

Lynch, M., and Blanchard, J.L. (1998). Deleterious mutation accumulation in organelle genomes. Genetica *102*, *103*, 29–39.

Piganeau, G., Gardner, M., and Eyre-Walker, A. (2004). A broad survey of recombination in animal mitochondria. Mol. Biol. Evol. *21*, 2319–2335.

Piganeau, G., and Eyre-Walker, A. (2004). A reanalysis of the indirect evidence for recombination in human mitochondrial DNA. Heredity *92*, 282–288.

Xu, J. (2005). The inheritance of organelle genes and genomes: patterns and mechanisms. Genome *48*, 951–958.

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Barotrauma is a significant cause of bat fatalities at wind turbines

Erin F. Baerwald, Genevieve H. D'Amours, Brandon J. Klug and Robert M.R. Barclay

Bird fatalities at some wind energy facilities around the world have been documented for decades, but the issue of bat fatalities at such facilities — primarily involving migratory species during autumn migration — has been raised relatively recently [1,2]. Given that echolocating bats detect moving objects better than stationary ones [3], their relatively high fatality rate is perplexing, and numerous explanations have been proposed [1]. The decompression hypothesis proposes that bats are killed by barotrauma caused by rapid air-pressure reduction near moving turbine blades [1,4,5]. Barotrauma involves tissue damage to air-containing structures caused by rapid or excessive pressure change; pulmonary barotrauma is lung damage due to expansion of air in the lungs that is not accommodated by exhalation. We report here the first evidence that barotrauma is the cause of death in a high proportion of bats found at wind energy facilities. We found that 90% of bat fatalities involved internal haemorrhaging consistent with barotrauma, and that direct contact with turbine blades only accounted for about half of the fatalities. Air pressure change at turbine blades is an undetectable hazard and helps explain high bat fatality rates. We suggest that one reason why there are fewer bird than bat fatalities is that the unique respiratory anatomy of birds is less susceptible to barotrauma than that of mammals.

As with any airfoil, moving wind-turbine blades create zones of low pressure as the air flows over them. Animals entering these low pressure areas may suffer barotrauma. To test the decompression hypothesis, we collected hoary (*Lasiurus cinereus*) and silver-haired bats (*Lasionycteris noctivagans*) killed at a wind energy facility in south-western Alberta, Canada, and examined them for external and internal injuries.

Of 188 bats killed at turbines the previous night, 87 had no external injury that would have been fatal, for example broken wings or lacerations (Table 1). Of 75 fresh bats we necropsied in the field, 32 had obvious external injuries, but 69 had haemorrhaging in the thoracic and/or abdominal cavities (Table 1). Twenty-six (34%) individuals had internal haemorrhaging and external injuries, whereas 43 (57%) had internal haemorrhaging but no external injuries. Only six (8%) bats had an external injury but no internal haemorrhaging.

Among 18 carcasses examined with a dissecting microscope, ten had traumatic injuries. Eleven bats had a haemothorax, seven of which could not be explained by a traumatic event. Ten bats had small bullae — air-filled bubbles caused by rupture of alveolar walls — visible on the lung surface (Figure 1A). All 17 bats examined histologically had lesions in the lungs consistent with barotrauma (Table 1), with pulmonary haemorrhage, congestion, edema, lung collapse and bullae being present in various proportions (Figure 1). In 15 (88%), the main lesion was pulmonary haemorrhage, which in most cases was most severe around the bronchi and large vessels.

Although the pressure reduction required to cause the type of internal injuries we observed in bats is unknown, pressure differences as small as 4.4 kPa are lethal to Norway rats (*Rattus norvegicus*) [6]. The greatest pressure differential at wind turbines occurs in the blade-tip vortices which, as with airplane wings, are shed downwind from the tips of the moving blades [7]. The pressure drop in the vortex increases with tip speed, which in modern turbines turning at top speed varies from 55 to 80 m/s. This results in pressure drops in the range of 5–10 kPa (P. Moriarty, personal communication), levels sufficient to cause serious damage to various mammals [6].

Barotrauma helps explain the high fatality rates of bats at some

Table 1. Injuries observed in bats killed at wind turbines in south-western Alberta, Canada.

	L. cinereus	*L. noctivagans*	*Other species*	*Total*
No external injury	38% (103)	55% (77)	75% (8)	46% (188)
Internal haemorrhage	90% (48)	96% (26)	100% (1)	92% (75)
Pulmonary lesions	100% (6)	100% (8)	100% (3)	100% (17)

Internal haemorrhage was detected by visual examination of dissected carcasses, while pulmonary lesions were detected using stained histological sections. Numbers in parentheses are sample sizes.

wind energy facilities. Even if echolocation allows bats to detect and avoid turbine blades, they may be incapacitated or killed by internal injuries caused by rapid pressure reductions they can not detect.

Birds are also killed at wind turbines, but at most wind energy facilities fewer birds than bats are killed [8], and barotrauma has not been suggested as a cause of bird fatalities. This may be explained partly by differences in the respiratory anatomy and susceptibility to barotrauma of birds and bats. Bats have large lungs and hearts, high blood oxygen-carrying capacity, and blood-gas barriers thinner than those of terrestrial mammals [9]. These flight adaptations suggest that bats are particularly susceptible to barotrauma. Although birds have even thinner blood-gas barriers, they have compact, rigid lungs with unidirectional ventilation and a cross-current blood-gas relationship, as opposed to mammals which have large pliable lungs with the blood-gas relationship in a uniform pool in the pulmonary alveoli [9,10]. In addition, the pulmonary capillaries of birds are exceptionally strong compared to those of mammals, and do not change as much in diameter when exposed to extreme pressure changes [10]. Bats' large pliable lungs expand when exposed to a sudden drop in pressure, causing tissue damage, whereas birds' compact, rigid lungs do not.

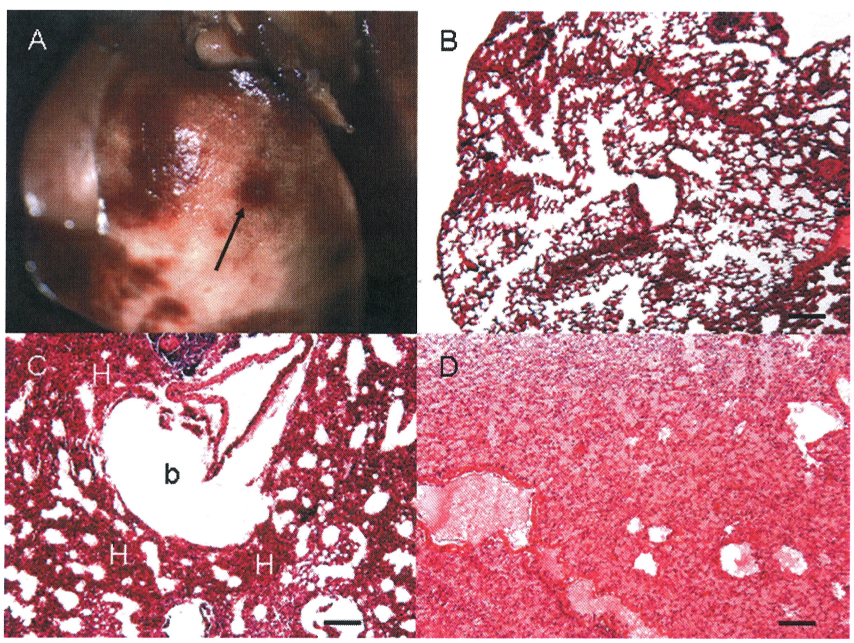

Figure 1. Pulmonary barotrauma in bats killed at wind turbines.

(A) Formalin-fixed *L. noctivagans* lung with multifocal hemorrhages and a ruptured bulla with hemorrhagic border (arrow). Histological sections of bat lungs stained with hematoxylin and eosin (100X). (B) Normal lung of an *L. noctivagans*. (C) Lung of *Eptesicus fuscus* found dead at a wind turbine with no traumatic injury. There is extensive pulmonary hemorrhage (H), congestion, and bullae (b). (D) Lung of *L. cinereus* found dead at a wind turbine with a fracture of the distal ulna and radius. 90% of the alveoli and airways are filled with edema. Bar = 100 μm.

Supplemental data
Supplemental data are available at http://www.current-biology.com/cgi/content/full/18/16/R695/DC1

Acknowledgments
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References

1. Kunz, T.H., Arnett, E.B., Erickson, W.P., Hoar, A.R., Johnson, G.D., Larkin, R.P., Strickland, M.D., Thresher, R.W., and Tuttle, M.D. (2007). Ecological impacts of wind energy development on bats: questions, research needs, and hypotheses. Front. Ecol. Environ. *5*, 315–324.
2. Arnett, E.B., Brown, K., Erickson, W.P., Fiedler, J., Hamilton, B.L., Henry, T.H., Jain, A., Johnson, G.D., Kerns, J., Kolford, R.R., *et al.* (2008). Patterns of fatality of bats at wind energy facilities in North America. J. Wildl. Manag. *72*, 61–78.
3. Jen, P.H.S., and McCarty, J.K. (1978). Bats avoid moving objects more successfully than stationary ones. Nature *275*, 743–744.
4. Dürr, T., and Bach, L. (2004). Bat deaths and wind turbines - a review of current knowledge, and of the information available in the database for Germany. Bremer Beiträge für Naturkunde und Naturschutz *7*, 253–264.
5. von Hensen, F. (2004). Gedanken und Arbeitshypothesen zur Fledermausvertr glichkeit von Windenergieanlagen. Nyctalus *9*, 427–435.
6. Dreyfuss, D., Basset, G., Soler, P., and Saumon, G. (1985). Intermittent positive-pressure hyperventilation with high inflation pressures produces pulmonary microvascular injury in rats. Am. Rev. Respir. Dis. *132*, 880–884.
7. Bertin, J.J., and Smith, M.L. (1997). Aerodynamics for Engineers (New Jersey: Prentice Hall).
8. Barclay, R.M.R., Baerwald, E.F., and Gruver, J.C. (2007). Variation in bat and bird fatalities at wind energy facilities: assessing the effects of rotor size and tower height. Can. J. Zool. *85*, 381–387.
9. Maina, J.N., and King, A.S. (1984). Correlations between structure and function in the design of the bat lung: a morphometric study. J. Exp. Biol. *111*, 43–61.
10. West, J.B., Watson, R.R., and Fu, Z. (2007). Major differences in the pulmonary circulation between birds and mammals. Respir. Physiol. Neurobiol. *157*, 382–390.

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Section B: Studies

c. Permits

Environmental Permits

Agency	Type of Approval	Time Table	Schedule	Notes
Federal Permits and Approvals				
USFWS	Compatibility Analysis of Disturbed Grassland Easements	60-90 days	N/A	Just Wind is avoiding Grassland Easements.
	Compatibility Analysis of Disturbed Wetland Easement	30 days	N/A	Just Wind is avoiding Disturbed Wetland Easement
	Special Use Permit for Wetland Easements	5-30 days	N/A	Just Wind is avoiding Wetland Basins Easements
	Special Use Permit for Grassland Easements	5-30 days	N/A	Just Wind is avoiding Grassland Easements
	Right of Way Permit	180-365 days	N/A	Just Wind is avoiding Grassland Easements. construction
State of North Dakota Approvals and Permits				
Public Services Commission	Certificate of Site Compatibility		N/A	September 2008
SHPO	Section 106 Compliance Approval	30 days	Class III Survey Report to SHPO: 09/2008	If needed. Section 106 Compliance Approval is required if there is federal involvement in the Project. Need for approval is not anticipated at this time.
Local Permits and Approvals				
Logan County				05/12/2008

Construction Permits – Wind Facility

Agency	Type of Approval	Time Table	Schedule	Notes
		Federal Approvals		
FAA	Form 7460-1, Notice of Proposed Construction	60 days	03/01/2009-05/01/2009	Notice and approval are required for structures over 200 feet in height. FAA approval of lighting and marking of turbines is required prior to erection of tower.
FAA	Form 7460-2, Part 1, Notice of Actual Construction or Alteration	No response from FAA	After Construction of Turbines	File final construction as-built information with FAA
		State of North Dakota		
North Dakota Department of Health	Notice of Intent (NOI) – NPDES General Permit for Storm Water discharges associated with Construction Activity	30 days	10/01/2008-11/01/2008	Required for disturbance of over 1 acre of land. Must prepare a Storm Water Pollution Prevention Plan (SWPPP). Required prior to commencement of construction.
North Dakota Highway Patrol	Overheight/Overweight Permit	30 days	03/2009-04/2009	Permit required for hauling construction equipment and materials on State Highways.
North Dakota Department of Transportation	Road Approach/Access Permit	90 days	10/01/2008-01/01/2009	Permit required for construction of access roads from State Highways.
		Local Permits		
Logan County	Haul Road Agreement	30 days	10/01/2008-11/01/2008	Permit required for hauling construction equipment and materials on County Roads.
Logan County	Utility Permit	30 days	10/01/2008-11/01/2008	Permit required for utility crossings on Country road ROW

Section D: Location

a. Exclusion Areas

Exclusion Area Criteria

Exclusion Area	Present within Project Site?	Proposed Buffer	Section Addressed
Designated or registered national areas: parks; memorial parks; historic sites and landmarks; natural landmarks; historic districts; monuments; wilderness areas; wildlife areas; wild, scenic, or recreational rivers; wildlife refuges; & grasslands	None		**Data 1** D 5 **Supplemental Map:** Exclusion Area Map
Designated or registered state areas: parks; forests; forest management lands; historic sites; monuments; historical markers; archaeological sites; grasslands; wild, scenic, or recreational rivers; game refuges; game management areas; management areas; and nature preserves	None		**Data 1** D 5 **Supplemental Map:** Exclusion Area Map
County parks and recreational areas; municipal parks; parks owned or administered by other governmental subdivisions; hardwood draws; and enrolled woodlands	None		**Data 1** D 5 **Supplemental Map:** Exclusion Area Map
County parks and recreational areas; municipal parks; parks owned or administered by other governmental subdivisions; hardwood draws; and enrolled woodlands	None		**Data 1** D 5 **Supplemental Map:** Exclusion Area Map
Prime farmland and unique farmland, as defined by the land inventory and monitoring division of the soil conservation service, United States department of agriculture, in 7 C.F.R. part 657; provided, however, that if the Commission finds that the prime farmland and unique farmland that will be removed from use for the life of the facility is of such small acreage as to be of negligible impact on agricultural productions, such exclusion shall not apply		Approximately 80 acres of the 17,875 acres of Prime Farmland will be altered due to the LCWF Project. This represents less than 0.50 % of the Prime Farmland in the Project Area.	**Data 1** **B: Physical Resources** **Data 1** D 5 **Supplemental Map:** Exclusion Area Map
Irrigated land	None		**Data 1** D 5 **Supplemental Map:** Exclusion Area Map

Exclusion Area	Present within Project Site?	Proposed Buffer	Section Addressed
Areas critical to threatened or endangered animal or plant species	None	No areas critical to threatened and endangered species have been identified in the Project Area.	**Data 2** **B: Biological Resources** **Data 1** D 5 **Supplemental Map:** Exclusion Area Map
Areas where animal or plant species that are unique or rare to this state would be irreversibly damaged	None	No unique or rate areas have been identified in the Project site - are working with USFWS and ND Game and Fish Dept. to avoid potential impacts.	**Data 2** **B: Physical Resources** **Data 1** D 5 **Supplemental Map:** Exclusion Area Map

Section D: Location

b. Avoidance Area

Avoidance Area Criteria

Avoidance Area	Present within Project Site?	Proposed Buffer	Section Addressed
Historical resources which are not designated as exclusion areas	None		**Data 1** **B: Class III Cultural Resource Inventory** **Data 1** D 5 **Supplemental Map:** Avoidance Area Map
Areas within the city limits of a city or the boundaries of a military installation	None	The closet turbine is located 2,500 ft from the city limits of the community of Napoleon	**Data 1** D 5 **Supplemental Map:** Avoidance Area Map
Areas within known floodplains as defined by the geographical boundaries of the hundred-year flood	None		**Data 2** **B: Physical Resources** **Data 1** D 5 **Supplemental Map:** Avoidance Area Map
Areas that are geologically unstable	None		**Data 2** **B: Physical Resources** **Data 1** D 5 **Supplemental Map:** Avoidance Area Map
Woodlands and wetlands	None		**Data 2** **B: Physical Resources** **Data 1** D 5 **Supplemental Map:** Avoidance Area Map
Areas of recreational significance which are not designated as exclusion areas	None		**Data 1** D 5 **Supplemental Map:** Avoidance Area Map

Setback Distances for Wind Turbines

Just Wind will develop a site layout that optimizes wind resource while minimizing the impact on land resources and any potentially sensitive areas.

Just Wind has complied with and exceeded Logan County established setbacks for Occupied Structures & Facilities, Public Roads, Above Ground Communications, Electrical Lines, and Wind Energy Facility Perimeter.

Logan County zoning allows for above ground collection however; Just Wind has chosen to place the collection system underground. This will reduce potential for having a single point of failure, thereby lessening the chance of a lightning strike or icing creating an interruption of production output.

Setback Type	Minimum Distance	Just Wind Distance
Wind Energy Facility Perimeter	2.5 times the rotor diameter (303.73 ft) = 760 feet	800 feet
Rural Residential Zone	1.25 times the total height or 750 feet whichever is greater	1000 feet
Occupied Residence	1.25 times the total height or 750 feet whichever is greater	1000 feet
Property Lines	200 feet	250 feet
Minimum Ground Clearance/Electrical Lines	The blade tip of any Wind Turbine shall, at its lowest point, have ground clearance of no less than seventy-five (75) feet.	110 feet
Large Wetland Complexes	N/A	N/A
USFWS Waterfowl Production Area (WPA)	N/A	N/A
Road ROW	200 feet	250 feet
Transmission Line	200 feet	250 feet

Section D: Location

c. Selection Criteria

Selection Criteria

Selection Criteria	Potential Adverse Effects	Section Addressed
The impact upon agriculture:		
Agricultural production	The proposed Development is compatible with existing land use plans. Approximately 64 acres of land in the Development site will be removed from its current use for the development, construction, operation and maintenance of the wind power plant. Agricultural activity and wildlife grazing is anticipated to occur between the wind turbines	**Data 1** D. 6.
Family farms and ranches	No turbines will be placed within 1000 feet of family homes. Land area lost to the construction of access roads and turbines and aesthetic impacts are the potential adverse effects to family farms; however, wind lease payments to farmers provide a supplemental income minimizing the effect	Logan County Zoning Ordinance
Land which the owner demonstrates has soil, topography, drainage, and an available water supply that cause the land to be economically suitable for irrigation	No owner has expressed concerns related to economically suitable irrigation on their land where impacts are expected.	N/A
Surface drainage patterns and ground water flow patterns	No impacts to surface drainage patterns or groundwater flow patterns anticipated.	**Data 1** D 6 **Data 2** B a Physical
The agricultural quality of the cropland No impacts to the agricultural quality of the cropland are anticipated.	If compaction of soils occurs during Construction. Just Wind will work with the landowners to alleviate the compaction.	**Data 1** D
The impact upon the availability and adequacy of:		
Law enforcement	No impacts are anticipated. Extra tax revenue will support increased demand on such services.	**Data 2** B a Social
School systems and education programs	No adverse effects are expected.	**Data 2** B a Social
Governmental services and facilities	Governmental services and facilities will not be impacted	**Data 2** B a Social
General and mental health care facilities	General and mental health care facilities will not be impacted	NA
Recreational programs and facilities	No impacts are anticipated	**Data 2** B a Social
Transportation facilities and networks	During construction an increase in vehicle trips per day is anticipated. During facility operation no significant impacts are anticipated	**Data 1** D 6

Selection Criteria	Potential Adverse Effects	Section Addressed
Retail service facilities	No adverse impacts anticipated.	**Data 2** B a Social
Utility services	Just Wind will utilize station service from the local electrical utility. Kem Electric will suggest appropriate configurations for the electrical system, and Just Wind will cooperate with their recommendations to prevent negative impacts to the transmission system.	
The impact upon:		
Local institutions	No impacts are anticipated.	**Data 2** B a Social
Noise sensitive land uses	The noise sensitive land uses within the Project site are the residences near turbine locations. As long as no turbines are sited within 1000 feet of a sensitive land use for the 2.3 MW turbines noise levels will not exceed the allowable 45 dBA standard.	**Data 1** D. 6. **Data 2** B a Social
Rural residences and businesses	No turbines will be placed within 1000 feet of family homes	**Data 1** D. 6.
Aquifers	No impacts are anticipated.	**Data 2** B a. Biological
The impact upon:		
Human health and safety	If mitigative measures are implemented as discussed in Section D and maintenance schedules are met, no impacts to human health and safety are anticipated	**Data 2** B a. Social **Data 1** D 6.
Animal health and safety	No impacts to livestock are anticipated from operation of the facility. Based on biological surveys there is a potential for small numbers of avian and bat collisions with the turbines for the Project, but the impact is expected to be minimal. Mitigative measures in turbine siting will minimize the potential for these impacts. Just Wind will conduct post-construction monitoring for avian and bat species.	**Data 2** B a. Avian B a. Biological
Plant life	The proposed action will have minimal impacts on the vegetation except in the immediate areas where the turbines are located. These impacts will be localized and will not have significant impacts to the overall project areas. Approximately 64 acres will be taken out of production for project use.	**Data 2** B a. Biological
Temporary and permanent housing	Temporary housing will be utilized during construction. No adverse impacts are anticipated.	**Data 2** B a Social

Selection Criteria	Potential Adverse Effects	Section Addressed
Temporary and permanent skilled and unskilled labor	No adverse effects are anticipated.	**Data 2** B a Social
The cumulative effect of the location of the facility in relation to existing and planned facilities and other industrial development	No impacts are anticipated to existing and planned facilities and other industrial development	**Data 2** B a Social

Energy Conversion Facility Siting Criteria (69-06-08-01)

The Public Service Commission has established criteria that guide and govern the site of an energy conversion facility. These criteria are divided into four categories: exclusion areas, avoidance areas, selection criteria, and policy criteria.

1.0 Exclusion Areas

Exclusion Areas are geographical areas that are excluded from consideration for locating an energy conversion facility, and will include a buffer area to protect the integrity of the area. Specific exclusion areas are as follows.

1.1 Designated or registered national: parks, memorial parks, historic sites and landmarks, natural landmarks, monuments, and wilderness areas.

None were found within the Project Area (refer to the Map Book for the Exclusion Area Maps).

1.2 Designated or registered state: parks, historic sites, monuments, historical markers, archaeological sites, and nature preserves.

None were found within the Project Area (refer to the Map Book for the Exclusion Area Maps).

1.3 County parks and recreational areas, municipal parks, parks owned or administered by other government subdivisions.

None were found within the Project Area (refer to the Map Book for the Exclusion Area Maps).

1.4 Prime farmland and unique farmland, as defined by the land inventory and monitoring division of the soil conservation service.

Prime farmland is listed by soil mapping unit and was estimated for the entire project area using the NRCS soil data and the USDA soil survey map for Logan County. Based on this information, there are approximately 17,875 acres designated as prime farmland in the Project Area. Based on the current layout for the wind turbines and access roads, approximately 80 acres of prime farmland will be altered by the LCWF. This represents less than 0.50% of the prime farmland within the Project Area.

1.5 Irrigated Land

None were found within the Project Area (refer to the Map Book for the Exclusion Area Maps).

1.6 Areas critical to the life stages of threatened or endangered animal or plant species.

Federally listed species in Logan County include the Whooping Crane and the Piping Plover. Although the Whooping Crane migrates through the state and may frequent the area on a seasonal basis, the nearest sighting of a Whooping Crane to the Project Area was approximately 16 miles northwest and it occurred in January 1977 (see Map Book for Whooping Crane Migratory Path and Sightings).

Although the Piping Plover breeding range includes North Dakota and more nests have been found in North Dakota than any other state, habitat characteristic of the Piping Plover was not identified in the Project Area (USGS, 2000; North Dakota Natural Heritage Species of Concern).

Long-term adverse impacts are not expected to threaten and endangered species due to the LCWF Project (refer to the Map Book for the Exclusion Areas and the T&E Species Map).

1.7 Areas where animal or plant species that are unique or rare to this state would be irreversibly damaged.

According to the North Dakota Parks and Recreation Department, there are no occurrences of rare or unique species listed in the Project Area or in Logan County (refer to the Map Book for the Exclusion Areas and the T&E Species Map).

2.0 Avoidance Areas

Avoidance areas are those geographical areas that are avoided from consideration for locating an energy conversion facility unless it can be demonstrated that there is no reasonable alternative; and that the impacts from the facility can be managed effectively with any adverse impacts being avoided. A buffer zone of a reasonable width to protect the integrity of the area will be included. The specific avoidance areas are as follows.

2.1 Historic resources that are not specifically designated as exclusion or avoidance areas.

A Class III Cultural Resources Inventory of the LCWF Project Area was performed by Richard Rothaus, PhD. The Inventory included a surface survey of approximately 1,975 acres, 230 shovel tests to examine for the presence of cultural artifacts, and 170 soil probes to check for buried soils that may contain archaeological materials. Based on the Class III Inventory, the following was identified.

2.1.1 Four prehistoric sites were identified in the Project Area. All of these sites are represented by a small concentration of lithic materials, predominately knife river flint. Subsurface testing indicates no intact soils at any of the sites, and no further investigation is recommended. The current project layout avoids all these sites.

2.1.2 Nine historic sites were identified during the survey. The current project layout for the wind turbines includes locations adjacent to these sites. The access roads and cable locations in these areas will require minor adjusting so the final layout will avoid all historic sites.

2.1.3 Twenty isolated finds were recorded in the Project Area. One of the sites represents possible historic activity, and the remaining nineteen sites represent possible prehistoric activity. Isolated finds included four or fewer artifacts representing a very limited occurrence of past activity. All the isolated finds locations were tested for additional buried archaeological material, and all such tests were negative. The isolated finds are not substantial enough to warrant any significant modifications to the project layout.

(Refer to the Map Book for the Avoidance Area Maps).

2.2 Areas within the city limits of a city or the boundaries of a military installation.

The closet wind turbine to the corporate limits of Napoleon is 2,500 feet. There are no military installations in the Project Area (refer to the Map Book for the Avoidance Area Maps).

2.3 Areas within known floodplains as defined by the geographical boundaries of the 100-year flood.

The Project Area for the LCWF Project is not located in the 100-year floodplain boundaries (refer to the Map Book for the Avoidance Area Maps).

2.4 Areas that are geologically unstable.

None were found within the Project Area for the LCWF Project (refer to the Map Book for the Avoidance Area Maps).

2.5 Areas designated as woodlands or wetlands.

Numerous wetland areas occur within the Project Area. According to the National Wetland Inventory, wetlands comprise approximately 3,127 acres or 5.4% of the Project Area. Most of the wetlands are seasonally flooded basins (PEMC – Palustrine Emergent Seasonally Flooded). Based on the current layout for the wind turbines and access roads, approximately 38 acres of wetland area will be altered by the LCWF. This represents less than 1.25% of the wetlands within the Project Area.

There are no woodland areas identified in the Project Area.

Please refer to the Map Book for the Avoidance Area Maps.

2.6 Areas of Recreational Significance with are not designated as exclusion areas.

None were found within the Project Area for the LCWF Project (refer to the Map Book for the Avoidance Area Maps).

3.0 Selection Criteria

Selection criteria refers to those factors that were considered by the applicant when locating the facilities inclusive of the construction and operation of those facilities. Any adverse effects resulting from the LCWF will be an acceptable minimum, and those effects will be managed and maintained as such.

3.1 Agricultural Impacts

Agricultural production will be affected in areas where wind turbines or access roads become inconvenient for work with large equipment. The Just Wind staff has worked diligently with landowners to minimize any impacts to their agricultural production. Landowners will be compensated for the wind turbines and associated access roads that are sited on their property.

3.2 Public, commercial, and government facilities; transportation and utility services

The Just Wind staff has worked diligently with local public and governmental officials to avoid or minimize impacts to any facilities during construction and operation of the LCWF Project.

The closest wind turbine to the community of Napoleon is 2,500 feet.

3.3 Impacts to local institutions, land use, residences, businesses, human health and safety, animal health and safety and plant life

The Just Wind staff has worked diligently with state and local officials, and residences to minimize any impacts to the area resulting from the construction and operation of the LCWF Project. Human health and safety issues have been addressed, as well as impacts to the plant and animal communities.

Rural residences are located throughout the Project Area. Just Wind has established the minimum setback distance from occupied structures and facilities, public roads and above ground communications and electrical lines; of 1,000 feet.

Please refer to Section B of the Supplemental Information for additional discussion regarding impacts and effects of the construction and operation of the LCWF Project.

4.0 Policy Criteria

Policy Criteria refers to those benefits that the Project will bring to the local area and to the State of North Dakota.

The proposed LCWF Project consisting of 160 wind turbines with a nameplate capacity of 368 megawatts that will provide electrical energy from a renewal resource for an initial term of 25 years. The economic benefits to the local community, to the landowners, and to the State of North Dakota will be manifested in the creation of jobs and the production of a renewal energy that will have far reaching social and economic impacts.

Please refer to Section A and the supplemental information for Section B for additional discussion regarding the social and economic benefits of the LCWF Project.

Section D: Location

d. Policy Criteria

Policy Criteria

POLICY CRITERIA

Per Section 69-06-08-01-4, the Commission may give preference to an applicant that will maximize benefits that result from the adoption of the following policies and practices, and in a proper case may require the adoption of such policies and practices.

Policy Criteria	Suitable Policy or Practice of Applicant	Section Addressed
Recycling of the conversion byproducts and Effluents	None	N/A
Energy conservation through location, process, and design	Just Wind is developing the site to maximize the energy output. Just Wind will develop a site layout that optimizes wind resources while minimizing the impact on land resources and any potentially sensitive areas.	**Data 1** D
Training and utilization of available labor in this state for the general and specialized skills required	Just Wind will use local labor to the extent feasible and is currently employing 13 Napoleon community members.	
Use of a primary energy source or raw material located within the state	The energy generated at the site will utilize the wind resources of the state of North Dakota.	**Data 1** C 1
Non-relocation of residents	No residents will be relocated as a result of the Project.	**Data 1** D 6
The dedication of an area adjacent to the facility to land uses such as recreation, agriculture, or wildlife management	The Project will not interfere with adjacent land uses, as none of these are applicable in our project area.	**Data 1** D 6 **Supplemental Map:** Avoidance Area Map **USFSW** Easement Map
Economies of construction and operation	Just Wind will utilize local contractors to the extent feasible.	**Data 1** C 3 **Data 2** A Siemens
Secondary uses of appropriate associated facilities for recreation and enhancement of wildlife	None N/A	N/A
Use of citizen coordinating committees	Just Wind will continue to work with landowners of properties for the Project	

Policy Criteria	Suitable Policy or Practice of Applicant	Section Addressed
A commitment of a portion of the energy produced for use in this state	Just Wind is in the final stages of negotiating a long-term Power Purchase Agreements with WAPA.	**Data 1** C 1
Labor relations	No labor relations will be affected.	N/A
The coordination of facilities	Existing facilities and facility corridors were considered in the location of the wind farm and the associated facilities.	**Data 2** B a, b, c
Monitoring of impacts	Just Wind is working with Houston Engineering to develop a plan for monitoring impacts to soil, and avian species during and following construction. Potential impacts to the threatened and endangered resources would primarily be a result of impacts to their habitat, and impacts to their migratory routes. A Habitat Conservation Plan will be developed for the LCWF that addresses the impacts that may occur as a result of the Project and the measures that will be undertaken to monitor, minimize and mitigate such impacts.	**Data 2** B a Biological