Minnesota Public Utilities Commission
Site Permit Application for a
Large Wind Energy Conversion System

Freeborn Wind Farm
Freeborn County, Minnesota
June 14, 2017
Docket No. IP6946 / WS-17-410

FREEBORN
WIND FARM

Freeborn Wind Energy LLC
c/o Invenergy LLC
One South Wacker Drive, Suite 1800
Chicago, IL 60606

Project Name: Freeborn Wind Farm
Project Location: Freeborn County, MN
Applicant: Freeborn Wind Energy LLC, c/o Invenergy LLC
Address: One South Wacker Drive, Suite 1800, Chicago, IL 60606

Authorized Representative: Dan Litchfield, Senior Manager, Project Development

Signature: Dan Litchfield
Phone: 312-582-1057
Email: DLitchfield@invenergyllc.com

TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

ACRONYMS

AADT	Annual Average Daily Traffic
ABBP	Avian and Bat Protection Plan
AM	Amplitude Modulation
AMA	Aquatic Management Area
APLIC	Avian Power Line Interaction Committee
AST	Aboveground Storage Tank
AWEA	American Wind Energy Association
BGEPA	Bald and Golden Eagle Protection Act
BMPs	Best Management Practices
BWSR	Minnesota Board of Water & Soil Resources
CFEC	Cannon Falls Energy Center
Ch.	Chapter
Cm	Centimeter
CO	Carbon monoxide
COD	Commercial Operation Date
CO_2	Carbon dioxide
CRP	Conservation Reserve Program
CWA	Clean Water Act
d/b/a	Doing business as
dB	Decibel
dB(A)	A-weighted decibel
°	Degree
DOC	Minnesota Department of Commerce
DOC EERA	Minnesota Department of Commerce Energy Environmental Review and Analysis
EBH	Environmental Bore Hole
ECPG	Eagle Conservation Plan Guidance
EMF	Electromagnetic fields
EQB	Minnesota Environmental Quality Board
ESA	Endangered Species Act
EWG	Exempt Wholesale Generator Certification
FAA	Federal Aviation Administration
FCAI	Freeborn County Arts Initiative
FCC	Federal Communications Commission
FEMA	Federal Emergency Management Agency
FM	Frequency Modulation
ft	Feet
GIA	Generator Interconnection Agreement
GIS	Geographic Information System
Hankard	Hankard Environmental, Inc.
Hz	Hertz
IEC	International Electrotechnical Commission

IPaC	Information for Planning and Consultation
ISO	International Organization for Standardization
KHz	Kilohertz
kV	Kilovolt
kW	Kilowatt
L_{10}	Sound pressure level exceeded 10 percent of the measurement period
L_{50}	Sound pressure level exceeded 50 percent of the measurement period
L_{90}	Sound pressure level exceeded 90 percent of the measurement period
L_{eq}	Continuous Equivalent Sound Pressure Level
LGU	Local Government Unit
LiDAR	Light Detection and Ranging
LWECS	Large Wind Energy Conversion System
m	Meter
m/s	Meters per second
MDH	Minnesota Department of Health
MISO	Midcontinent Independent System Operator
Minn. R.	Minnesota Administrative Rules
Minn. Stat.	Minnesota Statutes
MNDNR	Minnesota Department of Natural Resources
MnDOT	Minnesota Department of Transportation
MPCA	Minnesota Pollution Control Agency
MPUC	Minnesota Public Utilities Commission
MVA	Mega Volt-Amp
MW	Megawatt
Mwh	Megawatt hour
NA	Not Applicable
NAC	Noise Area Classification
NARUC	National Association of Regulatory Utility Commissioners
NASA MERRA	National Aeronautics and Space Administration Modern-Era Retrospective Analysis for Research and Applications
NGO	Non-Governmental Organization
NHD	National Hydrography Dataset
NHIS	Natural Heritage Information System
NLCD	National Land Cover Database
NO_x	Nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NRC	National Research Council
NRCS	Natural Resource Conservation Service
NRHP	National Register of Historic Places
NWI	National Wetlands Inventory
O&M	Operations and Maintenance
OSA	Office of the State Archaeologist
PEM	Palustrine Emergent Wetland
PFO	Palustrine Forested Wetland
Phase I ESA	Phase I Environmental Site Assessment

PM_{10}	Particulate matter
POI	Point of Interconnection
Project	Freeborn Wind Farm
PSA	Purchase and Sale Agreement
PSS	Palustrine Scrub-shrub Wetland
PWI	Minnesota Public Waters Inventory
RD	Rotor Diameter
RIM	Reinvest in Minnesota
ROW	Right-of-way
RPA	Route Permit Application
rpm	Rotations per minute
RV	Recreational Vehicle
SCADA	Supervisory Control and Data Acquisition
SCS	Site Characterization Study
SHPO	State Historic Preservation Office
SNA	Scientific and Natural Area
SODAR	Sonic Detection and Ranging
SO_x	Sulphur oxides
SO_2	Sulphur dioxide
SP	Site Permit
SPA	Site Permit Application
SPCC	Spill Prevention Control and Countermeasure
subd.	Subdivision
SWPPP	Storm Water Pollution Prevention Plan
TV	Television
USACE	United States Army Corps of Engineers
UCS	Union of Concerned Scientists
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geologic Service
VOC	Volatile organic compound
VSQG	Very Small Quantity Generator
WAB	Wind Access Buffer
WCA	Wetland Conservation Act
WCFZ	Worst Case Fresnel Zones
WECS	Wind Energy Conversion System
WEG	Wind Energy Guidelines
WMA	Wildlife Management Area
WPA	Waterfowl Production Area
WQC	Water Quality Certification

1.0 Applicant Information

Freeborn Wind Energy LLC (Applicant or Freeborn Wind), an affiliate of Invenergy LLC (Invenergy), plans to develop the up to 200 megawatt (MW) Freeborn Wind Farm to be located in Freeborn County, Minnesota, and Worth County, Iowa. Freeborn Wind respectfully submits this Site Permit Application (SPA) to the Minnesota Public Utilities Commission (Commission or MPUC) to construct and operate the up to 84 MW Minnesota portion of the Freeborn Wind Farm (the Project). The remaining portion of the Freeborn Wind Farm will be permitted, built, and operated in Iowa.

The Project is a large wind energy conversion system (LWECS), as defined in the Wind Siting Act (Minnesota Statutes [Minn. Stat.] Chapter [Ch.] 216F) with a Project boundary (Project Area) of approximately 26,273 acres in Freeborn County, Minnesota. Freeborn Wind will develop, design, and permit the Project. Freeborn Wind has entered into an agreement with Northern States Power Company d/b/a Xcel Energy (Xcel Energy) whereby Xcel Energy will acquire the Project after it is developed, and then subsequently construct, own, and operate it.

Freeborn Wind began development in 2008 with initial leasing activities and erected a meteorological tower in 2009. The Project is scheduled to begin construction in second quarter 2020, with an in-service and commercial operation date (COD) planned for the fourth quarter of 2020, pending Commission and related approvals. In a separate Route Permit Application (RPA), Freeborn Wind will also request Commission approval of the proposed approximately 7-mile-long 161 kilovolt (kV) transmission line from the Project Substation to the Point of Interconnection (POI) located at the existing Glenworth Substation just southeast of Glenville, Minnesota. Since the proposed 161 kV transmission line is approximately 7 miles in length, a separate RPA is required, according to Minn. Stat. Ch. 216E and Minnesota Administrative Rules (Minn. R.) Ch. 7850. The RPA will follow the SPA submittal to the Commission for the Project. Freeborn Wind has obtained a Generator Interconnection Agreement (GIA) with transmission owner ITC Midwest LLC and the Midcontinent Independent System Operator, Inc. (MISO). The Project’s queue position is J407.

Invenergy develops, builds, owns and operates large-scale power plants across four core technologies: wind (68 projects; 7,600 MW), natural gas (11 projects; 5,800 MW), solar (8 projects; 140 MW), and battery storage (6 projects; 88 MW). Invenergy projects are mainly located in the United States, with other projects located in Japan, Poland, Scotland, and Uruguay. Invenergy has a proven development track record of 102 large-scale projects with over 3,400 wind turbines placed in service and over 15,500 MW built.

In Cannon Falls, Minnesota, Invenergy operates the Cannon Falls Energy Center (CFEC), a 357 MW natural gas combustion turbine power plant. CFEC began operation in 2008 and provides natural-gas fired peaking power and all of the electricity generated is committed to Xcel Energy (see Minnesota Environmental Quality Board [EQB] Docket No. 04-85-OPPS). Freeborn Wind and Invenergy do not own or operate, or have financial interest in any other LWECS in Minnesota.

Freeborn Wind proposes to develop this Project to meet Minnesota state policies of locating energy facilities in an orderly manner compatible with environmental preservation and the efficient use of resources. The remaining portions of this SPA provide necessary information for the Commission and the Minnesota Department of Commerce (DOC) to review and approve the Project.

2.0 Certificate of Need

A Certificate of Need from the MPUC is required for all "large energy facilities," defined to include generators greater than 50 MW in size, unless a statutory exemption applies.[1] Freeborn Wind proposes to construct a LWECS of up to 84 MW in Minnesota; therefore, absent an exemption, a Certificate of Need would be required.

On September 21, 2016, Freeborn Wind entered into a Purchase and Sale Agreement (PSA) with Xcel Energy and Invenergy Wind Development North America LLC. Under this PSA, Xcel Energy will purchase the Project following permitting and prior to construction, and will construct, own, and operate the Project. On October 24, 2016, Xcel Energy filed an Initial Petition notifying the Commission of its selection of the PSA (the Initial Petition), along with several other wind energy projects Xcel Energy proposed to purchase and self-build.[2] On March 15, 2017, Xcel Energy filed a Supplemental Wind Petition seeking approval of 1,550 MW of wind energy, 750 MW of self-build wind (including the Project) and 800 MW of wind energy power purchase agreements.[3] As summarized in the Supplemental Wind Petition, Xcel Energy utilized the Commission-approved resource acquisition process approved by the Commission as part of its approval of Xcel Energy's last integrated resource plan.[4] Commission approval of Xcel Energy's Supplemental Wind Petition, including the PSA, is currently pending in MPUC Docket No. E002/M-16-777.

The Project was selected through a Commission-approved bidding process; therefore, under Minn. Stat. Ch. 216B.2422 subdivision (subd.) 5, it is exempt from the Certificate of Need requirements.[5]

---

[1] Minn. Stat. Ch. 216B.243 and 216B.2421.

[2] Xcel Energy's Petition, *In the Matter of the Petition of Xcel Energy for Approval of the Acquisition of Wind Generation from the Company's 2016-2030 Integrated Resource Plan*, MPUC Docket No. E002/M-16-777 (October 24, 2016).

[3] Xcel Energy's Supplement, *In the Matter of the Petition of Xcel Energy for Approval of the Acquisition of Wind Generation from the Company's 2016-2030 Integrated Resource Plan*, MPUC Docket No. E002/M-16-777 (March 15, 2017).

[4] *Id.* at 3-12. *See also* Order Approving Plan with Modifications and Establishing Requirements for Future Resource Plan Filings, *In the Matter of Xcel Energy's 2016-2030 Integrated Resource Plan*¸ MPUC Docket No. E002/RP-15-21 (January 11, 2017), Ordering Point 5.

[5] *See also* Comments of the Minnesota Department of Commerce, Division of Energy Resources, *In the Matter of the Petition of Xcel Energy for Approval of the Acquisition of Wind Energy*, MPUC Docket No. E002/M-16-777 (May 1, 2017), at p. 3 ("Since the Company is using a Commission-approved bidding process none of the projects selected in this proceeding require a certificate of need.")

3.0 State Policy

LWECS site permit applications are governed by the Wind Siting Act (Minn. Stat. Ch. 216F) and Minn. R. Ch. 7854. The Wind Siting Act also requires an application for an LWECS site permit to meet the criteria in Minn. Stat. Ch. 216E.03 subd. 7. This SPA provides information necessary to demonstrate compliance with these criteria and Minn. R. Ch. 7854. In addition, this SPA has been organized following the DOC Energy Facility Permitting Application Guidance for Site Permitting of Large Wind Energy Conversion Systems in Minnesota (Aug. 2010; LWECS Application Guidance).

LWECS are to be sited in an orderly manner compatible with environmental preservation, sustainable development and the efficient use of resources (Minn. Stat. Ch. 216F.03). As discussed in this SPA, Freeborn Wind is designing the Project to comply with the Commission's wind turbine setback and siting guidelines.

4.0 Project Description, Overview, and Public Outreach

4.1 Project Description and Overview

The Project is located in Freeborn County. The Project Area was selected based upon review and analysis of wind resources, economic considerations, landowner interest, availability of easements, access to transmission routes, interconnection of the Project to existing transmission facilities and lines, geographic features, and environmental resources. Overall, there has been positive landowner support for the Project and no critical environmental resource concerns have been identified during review of the Project. The Project is located in an area with strong wind resources and is situated near existing electric transmission infrastructure.

The Project Area is approximately 26,273 acres and includes areas where Freeborn Wind has negotiated, and continues to negotiate, easements with landowners for development of the Project. Negotiations are ongoing and not all landowners of parcels within the Project Area have executed agreements with Freeborn Wind. Freeborn Wind has revised the initial footprint of the Project Area numerous times, taking into account landowner involvement, regulatory agency and public comments, efficient and effective use of wind energy, minimization of environmental impacts, and applicable setback requirements. Of the 26,273 acres within the Project Area, 17,435 acres are currently under lease for the Project in Minnesota (see Section 7 for additional wind rights information).

Figure 1 shows the Project's location and Table 4.1-1 provides the townships and sections located within the Project Area in Minnesota.

Table 4.1-1: Sections within the Freeborn Wind Farm Project Boundary

County	Civil Township Name	Township	Range	Sections
Freeborn	Hayward	102	20	12, 13, 14, 15, 22, 23, 24, 25, 26, 35, 36
	London	101	19	13, 14, 19, 20, 21, 22, 23, 24, 27, 28, 29, 30, 31, 32, 33
	Oakland	102	19	7, 8, 9, 16, 17, 18, 19, 20, 21
	Shell Rock	101	20	1, 2, 8, 11, 12, 13, 14, 15, 16, 17, 21, 22, 23, 24, 25, 26, 27, 28, 35, 36

The Project is located in a predominately agricultural area of southcentral Minnesota; wind turbines and associated facilities are thus sited primarily on agricultural lands. The Project Area consists of approximately 91.6 percent cropland, 1.4 percent pasture/grassland, 0.5 percent aquatic/wetland/open water, 5.6 percent developed, and 0.9 percent introduced and semi-natural vegetation (U.S. Geological Survey, 2011).

The Project would include a nameplate wind energy capacity of up to 84 MW in Minnesota with up to 42 turbine sites. The remaining turbines would be located in Worth County, Iowa. Freeborn Wind proposes to use a combination of two turbine types for the Project: the Vestas V116 and V110, both of which are 2.0 MW models (see Section 5.2 for additional discussion of the turbine characteristics).

Permanent Project facilities include:

- wind turbines and associated equipment;
- gravel access roads to turbine sites and necessary modifications to existing roads;
- buried electric collection lines;
- an operations and maintenance (O&M) facility;
- a Project Substation;
- an overhead transmission line (connecting the Project Substation to the POI); and
- one permanent meteorological tower.

Temporary facilities for the Project include staging areas for construction of the Project (to be located in Iowa), a temporary batch plant area (to be located in Iowa), and improvements to public and private roads for delivery of materials and equipment. Temporary crane paths will be routed and used during construction of the Project.

4.2 Public Outreach

Freeborn Wind has been conducting public outreach for the Project since leasing began in 2008, but renewed outreach efforts in early 2016. Outreach efforts include meeting with individual landowners and landowner groups, regulatory agencies, local governmental units, and the general public to discuss the Project; identifying support or constraints for the Project; and gathering comments to address in Project planning, design, permitting, and operation. Additional resources were dedicated to the unique public outreach needs of the area through the engagement of a local public relations consultant in April 2017.

The following is a brief summary of stakeholder outreach efforts:

- Landowners – several landowner group meetings in 2016, including a holiday gathering and individual meetings with certain landowners, turbine and access road layout review in April 2017 and a pre-filing cookout on May 31, 2017.
- Regulatory Agencies – meetings and discussions with staff from the U.S. Fish & Wildlife Service (USFWS), U.S. Army Corps of Engineers (USACE), Minnesota Department of Commerce Energy Environmental Review and Analysis (DOC EERA), and Minnesota Department of Natural Resources (MNDNR).
- Local Governmental Units – meetings and discussions with Freeborn County representatives (County Commissioners, Administration, Highway Department, Environmental Services), as well as representatives of Shell Rock, London, Oakland, Hayward, and Riceland townships; Freeborn County Township Association; Albert Lea-Freeborn County Chamber of Commerce; Rotary Club of Albert Lea; Convention and Visitors Bureau; and Albert Lea Energy Forum.
- General Public – meetings with students and staff at Southwest Middle School in Albert Lea, meeting with technical instructor at Riverland Community College, presentation at the Freeborn pop-up art show, hosting a booth at the Freeborn County Fair, presentation to Wind on the Wires (a renewable energy advocacy organization), and presentation to social club members at the Bohemian Brick Hall located between Myrtle and Hayward.

Additionally, on March 31, 2017, Freeborn Wind sent letters to regulatory agencies and local governments to describe the Project, request comments, and provide an update on permitting status (see Appendix A for the mailing lists and sample notice letter). Freeborn Wind sent a second round of notice letters to local governments on April 17, 2017, to clarify that the Project Area is the proposed area within which Freeborn Wind is working to secure land for the Project.

Freeborn Wind also maintains a Project website (see www.freeborncountywind.com) as well as a Facebook account (see https://www.facebook.com/FreebornWindFarm/), which provide additional information about the Project and the ability for stakeholders to provide comments regarding the Project.

Freeborn Wind is using information obtained with this outreach to optimize and refine Project design, identify and resolve issues, and address concerns brought forward by stakeholders prior to submitting this SPA.

5.0 Project Design

5.1 Description of Layout

Freeborn Wind is taking into account landowner concerns and land use, regulatory, environmental, and cultural resources in the Project design and is optimizing identified wind resources based on these factors. This section provides additional detailed Project layout information (e.g., proposed turbine siting, topography, wind resources) and applicable setbacks. Micrositing for the Project was completed in early April 2017. A description of proposed turbines and towers is provided in Section 5.2. Electrical and fiber optic communication systems are described in Section 5.3.

5.1.1 General Setback Considerations

For the Project layout, Freeborn Wind implemented the wind energy conversion facility siting criteria outlined in the Commission's *Order Establishing General Wind Permit Standards*, Docket No. E,G999/M-07-1102 (January 11, 2008) (MPUC General Permit Standards) and Freeborn Wind's guidelines and best practices. Freeborn Wind also generally incorporated the siting criteria contained in Freeborn County's Renewable Energy Systems ordinance (Freeborn County Ordinance Ch. 26) (see Chapter 26). Where setbacks differ for the same feature, Freeborn Wind used the most stringent setback distance. Table 5.1-1 and Figure 2 illustrate Project setbacks.

Table 5.1-1: Wind Turbine Setbacks for the Project

Turbine Setbacks	Distance for Setback	Authority
Wind Access Buffer – Prevailing Wind Directions	5 x rotor diameter	PUC General Permit Standards; *see also* Freeborn County Ordinance Sec. 26-51
Wind Access Buffer – Non-Prevailing Wind Directions	3 x rotor diameter	PUC General Permit Standards; *see also* Freeborn County Ordinance Sec. 26-51
Residences	1,000 feet (ft), or the minimum distance required to meet the state noise standard of 50 dB(A), whichever is greater [1]	Freeborn Wind; *see also* Freeborn County Ordinance Sec. 26-51
	500 ft, or the minimum distance required to meet the state noise standard of 50 dB(A), whichever is greater	MPUC General Permit Standards

Table 5.1-1: Wind Turbine Setbacks for the Project

Turbine Setbacks	Distance for Setback	Authority
Municipality, residential zone, campgrounds, churches, and health care facilities	2,640 ft	Freeborn County Ordinance Sec. 26-51
High Voltage Transmission Lines & Low Voltage Transmission Lines	1.1 times the total turbine height (V116 total height is 453 ft, resulting in setback of 498 ft; V110 total height is 443 ft, resulting in setback of 487 ft)	Freeborn County Ordinance Sec. 26-51
Communication Towers	1.1 times the total turbine height (V116 total height is 453 ft, resulting in setback of 498 ft; V110 total height is 443 ft, resulting in setback of 487 ft)	Freeborn County Ordinance Sec. 26-51
Public Roads and Trails	Minimum 250 ft	PUC General Permit Standards
	1.1 times the total turbine height (V116 total height is 453 ft, resulting in setback of 498 ft; V110 total height is 443 ft, resulting in setback of 487 ft)	Freeborn County Ordinance Sec. 26-51
Railroads	1.1 times the total turbine height (V116 total height is 453 ft, resulting in setback of 498 ft; V110 total height is 443 ft, resulting in setback of 487 ft)	Freeborn County Ordinance Sec. 26-51
Noise Requirements	Distance must meet the state noise standard of 50 dB(A) [2]	Minnesota Pollution Control Agency (MPCA), Site Permit condition
Shadow Flicker Requirements	Shadow Flicker should not exceed 30 hours per year at residences[3].	Freeborn County Ordinance Sec. 26-51
Wetlands, USFWS Types III, IV, and V	3 x rotor diameter [4]	Freeborn County Ordinance Sec. 26-51
Public Conservation Lands[5]	3 x rotor diameter	Freeborn County Ordinance Sec. 26-51
Open Public Ditch	50 ft	Freeborn County Ordinance Sec. 26-51

Table 5.1-1: Wind Turbine Setbacks for the Project

Turbine Setbacks	Distance for Setback	Authority
Buried Public Drain Tile	30 ft	Freeborn County Ordinance Sec. 26-51

1 PUC General Permit Standards identify the minimum setback from residences as 500 ft, or the minimum distance required to meet the state noise standard of 50 dB(A), whichever is greater. Freeborn Wind follows the practice of siting turbines at least 1,000 ft from residences, unless other arrangements have been made with specific residents (while still complying with the MPCA's limit of the 50 dB(A) nighttime L50 noise level.

2 Noise standards are regulated by the MPCA under Minn. R. Ch. 7030. These rules establish the maximum night and daytime noise levels that effectively limit wind turbine noise to 50 dB(A). The MPCA standards require A-weighting measurements of noise; background noise must be at least 10 dB lower than the noise source being measured.

3 For detailed discussion regarding shadow flicker setbacks refer to Section 8.4.

4 For detailed discussion regarding wetland setbacks refer to Section 8.2.

5 Public Conservation Lands are also considered non-participating lands subject to the Wind Access Buffer under the Site Permit.

As noted previously, where setback distances differ, Freeborn Wind used the more restrictive setback. For example, Freeborn Wind is siting turbines at least 1,000 ft from residences (see Table 5.1-1) in all cases. Geographic Information System (GIS) analysis of the closest occupied residence to each turbine determined that the minimum distance from a turbine to the nearest residence in the Project was 1,126 ft. The average distance from the Project's turbines to the nearest home is 1,900 ft. Freeborn Wind's residential setbacks are sufficient to meet the 50 dB(A) noise level setback for the two Vestas turbine models under consideration for the Project (see also Section 8.3 for additional information on turbine noise data). As an additional example, Freeborn Wind also used a minimum setback of 499 ft (i.e., 1.1 times turbine height) from public roads, railroads, pipelines, and transmission lines.

5.1.2 Wind Access Buffer Setback

Implementation of a Wind Access Buffer (WAB) setback is intended to reduce disruption of the normal wind flow and protect the wind rights of non-participating landowners. It requires turbines to be setback from the property line of a nonparticipating landowner at least 5 rotor diameter (RD) in the prevailing wind direction and 3 RD in the non-prevailing wind direction. Similarly, the MPUC General Permit Standards require internal turbine spacing setbacks of at least 5 RD in the prevailing wind directions and 3 RD in the non-prevailing wind directions. Differing setbacks based on RD for the two turbines under consideration for the Project are included in Table 5.1-2.

Table 5.1-2: Representative Minimum Turbine Setback Distances by Turbine Model

Turbine Description [1]	RD (m/ft)	5 RD (m/ft)	3 RD (m/ft)	Total Height, Including Blades (m/ft)
Vestas V110	110 / 361	550 / 1,805	330 / 1,083	135 / 443
Vestas V116	116 / 381	580 / 1,902	348 / 1,141	138 / 453

1 Tower heights will be 80 m (263 ft).

To determine the prevailing and non-prevailing wind directions, Freeborn Wind derived a long-term 80 meter (m) wind distribution for the onsite meteorological tower identified as Tower 2330, which has collected wind data since March 2009. The collected data were adjusted to long-term conditions using industry-standard processes. The long-term reference used was National Aeronautics and Space Administration Modern-Era Retrospective Analysis for Research and Applications (NASA MERRA) wind data. The resulting wind distribution expresses the wind speed frequency across 12 directional sectors (a standard industry practice). The results of the onsite wind speed frequency are shown in Table 5.1-3.

Table 5.1-3: Site Wind Speed Frequency by Directional Sector

Directional Sector	Wind Angle Center	Frequency across all wind speeds
1	0	6%
2	30	4%
3	60	4%
4	90	5%
5	120	7%
6	150	13%
7	180	15%
8	210	7%
9	240	6%
10	270	7%
11	300	15%
12	330	12%

Based on its analysis, Freeborn Wind identified two prevailing wind directions. The first direction is centered at 180 degrees from north (meaning coming from due south) with a 30-degree (°) sector width (i.e., predominant wind direction begins at 165° and extends through 195°). The second direction is centered at 300° from north (meaning coming from west-northwest) with a 30° sector width (i.e., predominant wind direction begins at 285° and extends through 315°). The proposed setback from non-participating property lines is 5 times the turbine RD length from 345° to 15° from north and from 105° to 135° from north (downwind from the predominant wind directions), and 3 times turbine RD in all other wind directions. A visual representation of the proposed setback is pictured in Chart 1 below. The footprint of the WAB for a V110 is 305 acres and the V116 WAB is 339 acres. For comparative purposes, the existing V82 turbines installed elsewhere in Freeborn County have a WAB of only 169 acres in size. Accordingly, the WAB for Freeborn Wind results in much greater turbine spacing and a much lower turbine density, meaning that there will be significantly fewer turbines per square mile and per township in the Project than in the county's other wind energy project.

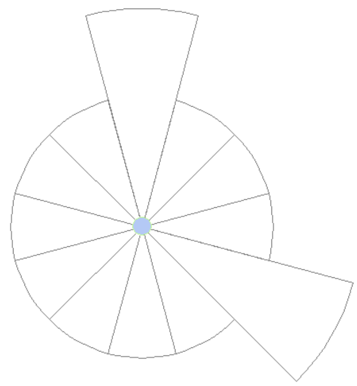

Chart 1: Proposed Wind Rights Setback

5.1.3 Additional Layout Considerations

Freeborn Wind provided the site layout that reflects its best effort to maximize the energy production of the Project in accordance with applicable setbacks and minimizing impacts to the land and surrounding community. Freeborn Wind selected the proposed turbine locations to minimize the potential land use and environmental impacts from the Project. While slight changes to turbine site locations may occur, Freeborn Wind expects the final layout will be very similar to the turbine site layout shown in this SPA. However, Freeborn Wind acknowledges that changes may occur as a result of the ongoing information gathering, landowner interaction, permitting processes, and additional micrositing activities. Table 5.1-4 provides the following turbine siting considerations that could impact the turbine layout and approximate schedule for determining these factors.

Table 5.1-4: Turbine Siting Considerations and Approximate Schedule

Issue	Approximate Schedule	Siting Consideration
Commission permitting process issue resolution		
Setbacks	Site Permit issuance date	Setbacks in this SPA are as proposed by Freeborn Wind and based upon the MPUC General Permit Standards and Freeborn Wind commitments.
Non-Commission permitting process issue resolution items (potentially resolved within the 6-month permitting timeline)		
Turbine type	Once final siting factors are assessed	The Project plans to use a combination of Vestas V110 and Vestas V116 turbines; locations of the two turbine models may be modified based on applicable setbacks and other considerations.

Table 5.1-4: Turbine Siting Considerations and Approximate Schedule

Issue	Approximate Schedule	Siting Consideration
Final leased land boundary	Once final lease and easement negotiations are complete with landowners	Freeborn Wind will not place turbines on unleased properties and will design layout to meet wind access buffer from unleased property lines.
Title clearance	After site control is complete	Freeborn Wind will site turbines on leased land that takes into account applicable existing Subordination, Non-Disturbance, and Attornment agreements and will secure consent forms from appropriate parties. Freeborn Wind will also insure all leased land interests through a title insurance policy. No turbines will be sited on non-participating landowner land.
Post Commission permitting process issue resolution		
Geotechnical analysis	After field surveys and turbine micrositing are complete	Geotechnical soil borings will be conducted at the location of final turbine sites to evaluate soil conditions and suitability to support turbine foundations.
Wetlands	For areas not already field delineated, remaining jurisdictional wetlands and waters within the construction limits of Project facilities will be delineated prior to construction. Applicable federal and state/local permits for unavoidable impacts will be obtained before construction activities begin in those jurisdictional areas.	Freeborn Wind will avoid or minimize permanent impacts to wetlands/waters, subject to state and federal jurisdiction, to the greatest extent possible.

Table 5.1-4: Turbine Siting Considerations and Approximate Schedule

Issue	Approximate Schedule	Siting Consideration
Cultural	Applicable areas with proposed ground disturbance will be surveyed for cultural resources before construction activities begin.	Cultural resources identified within the proposed construction areas and previously documented cultural resources in the Project Area will be avoided to the greatest extent possible. If avoidance is not practicable, additional investigation of the resource may be needed and further discussion with regulating agencies would be necessary prior to any direct impact to the resource occurring.

5.2 Description of Turbines and Towers

5.2.1 Wind Turbine Design and Operation

Wind turbine components are made up of the rotor (blades and hub), nacelle, tower, and foundation. The generator, gear boxes, controller, shafts, brake, generator cabling, hoist, generator cooling, and associated equipment are located within the nacelle. Turbine blades convert kinetic energy from wind into rotational energy. An anemometer and wind/weather vane, which monitor wind speed and direction, respectively, are located on top of the nacelle at the opposite end from the rotor.

The hub supports the blades and connecting rotor, yaw motors, mechanical braking system, and a power supply for emergency braking. An emergency power supply is also located within the hub that allows the mechanical brakes to work if power is lost. The three blades are composed of carbon fiber, fiberglass, and internal supports to be lightweight but strong. Lighting receptors are attached at the tip of each blade to safely conduct lightning strikes to ground.

The foundation and tower support the rotor and nacelle. Foundations for the towers are anticipated to be spread foundation design. The foundation above ground is approximately 13 ft in diameter. The tubular towers will be painted a non-glare white.

Electrical and communication cables and a control system are located at the base of the tower. Access to the turbine from the outside is through the bottom of the tower via a door equipped with a lock. A ladder is within the tower to access the top platform of the tower. Access to the nacelle from the top platform in the tower is by ladder. There are several electrical and mechanical safety, fire protection, first aid, escape, climbing, and work area features included within each turbine assembly for safe operation and maintenance of equipment.

During operation, the nacelle orientation can be adjusted by yaw motors to match wind speed direction to maximize energy generation and operational factors. Pitch motors rotate the blades to optimize blade angles in relation to wind speed. Mechanical force is transferred via the hub from the blades to the shaft connecting the hub to the gear box located within the nacelle. A mechanical brake located within the hub locks the blade rotor to prevent the blades from spinning during maintenance periods or when the turbine is out of service. The gear box adjusts shaft speeds to match the required generator speed.

The electricity produced by the generator is transmitted through insulated cables to a transformer located within the turbine nacelle that increases voltage to the collection system voltage of 34.5 kV.

5.2.2 Turbine Model Selection and Types

Freeborn Wind plans to use two turbine types for the Project: the Vestas V110 and the V116, both of which are rated at 2.0 MW of power production. While not finalized, the Project layout would be constructed with a combination of the two turbine types (preliminarily, 32 V116 turbines and 10 V110 turbines). V110s will be used where V116s will not fit due to the WAB or other siting constraints. V110s have also been strategically deployed to minimize sound levels at non-participating residences. Otherwise, the V110s will be clustered together for maintenance simplicity. Turbine locations are shown on Figure 3 and basic characteristics of the turbines are presented in Table 5.2-1.

Table 5.2-1: Wind Turbine Characteristics

Characteristic	Turbine Model	
	Vestas V110	Vestas V116
Nameplate capacity (kW)	2000	2000
Hub height (m)	80 (262.5 ft)	80 (262.5 ft)
Rotor Diameter (m)	110 (360.0 ft)	116 (380.6 ft)
Total height (m)[1]	135 (442.9 ft)	138 (452.8 ft)
Cut-in wind speed (m/s)[2]	3 (6.7 mph)	3 (6.7 mph)
Rated capacity wind speed (m/s)[3]	11 (24.6 mph)	10.5 (23.5 mph)
Cut-out wind speed (m/s)[4]	20 (44.7 mph)	20 (44.7 mph)
Maximum sustained wind speed(m/s)[5]	52.5 (117.4 mph)	50.8 (113.6 mph)
Wind Swept Area (m^2)	9,503 (102,289 ft^2)	10,563 (113,699 ft^2)
Maximum Rotor speed (rpm)	17.0	14.88

1 Total height = the total turbine height from the ground to the tip of the blade in an upright position.
2. Cut-in wind speed = wind speed at which turbine begins operation
3 Rated capacity wind speed = wind speed at which turbine reaches its rated capacity
4 Cut-out wind speed = wind speed above which turbine shuts down operation
5 Maximum sustained wind speed = wind speed up to which turbine is designed to withstand

5.2.2.1 Turbines

A brief summary of turbine characteristics is included in Table 5.2-1. These turbines were selected due to wind resource analysis, siting, setbacks, and availability of turbines for use in the Project. The Vestas V110 and V116 are similar turbines, except for the RD.

Both turbines have active yaw and pitch regulation and asynchronous generators; both use a bedplate drive-train design where all nacelle components are joined on common structures to improve durability. Both turbines can operate with adjusted cut-in speeds and full blade feathering. Both turbines have Supervisory Control and Data Acquisition (SCADA) communication technology to control and monitor the Project. SCADA allows automatic, independent operation and remote supervision, and simultaneous control of the wind turbines.

As Project owner and operator, Xcel Energy will enter into an operations, maintenance, and service arrangement with Vestas, the turbine manufacturer. The arrangement will be structured to provide timely and efficient O&M services. A computerized data network will provide detailed operating and performance information for each wind turbine. During operation, Xcel Energy will maintain a computer program and database for tracking each wind turbine's operational history.

Additional Vestas turbine features include:

- Rotor blade pitch regulation;
- Gearbox with three-step planetary spur gear system;
- Double fed three-phase asynchronous generator;
- A braking system for each blade and a hydraulic parking brake (disc brake);
- Yaw systems that are electromechanically driven;
- Force-flow bedplates (nacelle components joined on a common structure to improve durability);
- New gearbox bearing designs (improving reliability by reducing bending and thrust);
- Low noise trailing edges; and
- SCADA Controlled Generation Modulation.

5.2.2.2 Rotor

The rotor consists of the blades and hub. Three blades are mounted to the rotor hub. The hub is connected to the nacelle, which contains the gearbox, generator, brake, cooling system, and other electrical and mechanical systems.

5.2.2.3 Tower

The towers are tubular steel with a hub height of 80 m (263 ft). The turbine tower, where the nacelle is mounted, consists of three sections manufactured from certified steel plates. Welds are made with automatically controlled power welding machines and are ultrasonically inspected during manufacturing per American National Standards Institute specifications. All surfaces are sandblasted and multi-layer coated for protection against corrosion. Access to the turbine is through a lockable steel door at the base of the tower. Within the tower, access to the nacelle is provided by a ladder equipped with a fall arresting safety system.

5.3 Description of Electrical and Fiber Optic Communication System

The Project will include up to 42 wind turbines with each rated at 2 MW for electric power generation of up to 84 MW. A transformer will be located within the nacelle of each turbine to increase voltage to 34.5 kV. Underground electrical collection lines and a fiber optic communication system will be installed between each turbine site and the Project Substation. The collection lines and fiber optic lines will be installed within the same trench; they will also be marked and access to them will be provided, as needed, via aboveground junction boxes.

The fiber optic line will provide communication between the wind turbines, Project Substation, Operations and Maintenance (O&M) facility, and the electrical grid. The Project Substation will have a fiber optic connection to the O&M building and a communication system to the grid operator. The collection lines will transmit wind generated power to the Project Substation.

Power transmitted to the Project Substation will be transformed (stepped up) to 161 kV, and then conveyed via an approximately 7-mile-long aboveground transmission line that connects the Project Substation to the POI. The POI is the existing Glenworth Substation, which is connected to an existing 161 kV transmission line (i.e., the electrical grid). The GIA specifies grid-to-Project communications by the interconnecting utility.

6.0 Description and Location of Associated Facilities

To support operation and maintenance of the Project, additional facilities will be constructed within the Minnesota and Iowa portions of the Project. Freeborn Wind proposes to construct the Project O&M facility, Project Substation, and 161 kV transmission line between the Project Substation and the POI in Minnesota. The 161 kV transmission line will be permitted under a RPA that will be submitted by Freeborn Wind to the Commission shortly after this SPA. Freeborn Wind is seeking Commission approval through the LWECS Site Permit for the following Project associated facilities:[6]

- Access roads;
- O&M facility;
- Project Substation;
- Permanent meteorological tower and associated weather collection data systems;
- Electric collection lines; and
- Fiber optic communication lines.

The O&M facility and Project Substation will be located adjacent to each other and will overall require approximately 12 acres of land within the Project Area. These facilities were sited to

[6] The temporary batch plant and staging/laydown areas needed during construction of the Project will be located within Iowa.

avoid and/or minimize, to the extent practicable, disturbance from installation of the collection system and fiber-optic communication system.

The Project Substation is located in the southern part of the Minnesota portion of the Project in an area roughly centered on the average location of the wind turbines for Minnesota and Iowa. Freeborn Wind evaluated running all of the collection to the POI, instead of stepping up to 161 kV at the Project Substation and utilizing the 161 kV transmission line. Impacts related to that alternative were greater, as it would require most of that 7-mile transmission path to be traversed by up to ten underground circuits, resulting in much greater temporary impact to farmland and drainage tile systems. Crossing the Shell Rock River with ten underground circuits would likewise have much more impact than one overhead transmission line. The width of such a corridor would also exceed current land control. Finally, electrical losses will be reduced with the overhead line compared to the underground option. Proposed locations of associated facilities are shown on Figure 3.

6.1 Collector Lines and Feeder Lines

The preliminary collection line electrical layout based on the proposed turbine locations is shown on Figure 3. The voltage of collection lines for the Project is 34.5 kV.

The approximate length of collection lines needed for the turbine layout included in the SPA is 57 miles. All collection lines will be installed underground via trenching, plowing, or directional bores, as needed. The collection lines will be installed as a network between turbine locations and the Project Substation site, which will raise the voltage to 161 kV.

Generally, the electrical collection lines will be buried in trenches. Where electrical collectors meet public road right-of-way (ROW), the power collection lines will either rise to become aboveground lines (if requested by the road authority or if shallow bedrock, sensitive environmental conditions, or conflicts with underground utility or other infrastructure are encountered) or will continue as underground lines. The collection lines will occasionally require an aboveground junction box when the lines from separate spools need to be spliced together, and these will be placed along field edges or in the ROW, as appropriate.

The conceptual electrical layout is shown on Figure 3.

6.2 Transmission and Project Substation

The Project Substation will receive power generated by all project turbines via underground lines. Two 34.5 kV to 161 kV transformers will transform the voltage to transmission level. Additional equipment within the Project Substation will include overhead bus and associated structures, circuit breakers, disconnect switches, relay panels, surge arresters, battery banks, a grounding system, and relaying, metering, and communication equipment.

The POI is the Glenworth Substation just southeast of Glenville, Minnesota. The Project has executed a GIA for queue position J407 with the MISO and the transmission owner, ITC Midwest. Work at the Glenworth Substation will include installing a fourth circuit breaker and terminal to the existing three breaker ring bus, and replacing the existing 161/69 kV transformer with a 150 Mega Volt-Amp (MVA) unit. Collection lines from the turbines would be installed to the Project Substation (see Figure 3). The Project Substation is proposed to be constructed adjacent to the O&M facility at the location indicated in Figure 3. Together, the footprint of the Project Substation and O&M facility site is planned to be approximately 12.2 acres, which would be enclosed with a chain link fence and equipped with lockable access gate. The substation will contain transformers, switch gear, metering, electrical control and communication systems, and other equipment required to transform wind generated power from the Project from 34.5 kV to 161 kV.

A proposed aboveground 161 kV transmission line would be constructed from the Project Substation to the POI at the existing Glenworth Substation as shown on Figure 3. The location of existing power lines entering and exiting the Glenworth Substation are also shown on Figure 3. No new access roads or other changes outside the existing Glenworth Substation fence line are anticipated from the Project. Freeborn Wind will obtain an RPA from the Commission for the proposed transmission line.

6.3 Additional Associated Facilities

As indicated previously, Freeborn Wind proposes to locate temporary staging and construction laydown yards and a concrete batch plant in Iowa for the Project in accordance with applicable requirements. Materials used for construction of the Project in Minnesota will be transported from the Iowa staging areas to the applicable construction sites. An O&M building will be constructed at the same site as the Project Substation and will provide access and storage for Project operations and maintenance. The building will be approximately 7,500 square ft and house the equipment to operate and maintain the Project. The building will be surrounded by an approximately 1.5 acre fenced-in gravel and paved area that is used for parking and storage. Freeborn Wind has proposed this location for the O&M building because it is centrally located to the turbines, minimizes transportation time to perform turbine maintenance, and is close to the Project Substation for maintenance and operational reasons.

The Project proposes to construct one permanent meteorological tower with the potential for a Sonic Detection and Ranging (SODAR) and/or a Light Detection and Ranging (LiDAR) unit(s). Two potential locations for the permanent meteorological tower or SODAR/LiDAR units are shown on Figure 3, but only one would be constructed.

6.4 Access Roads

The Project will include permanent all-weather gravel roads that provide access to the wind turbines. The primary function of the roads is to provide accessibility to the turbines for turbine maintenance crews. The roads will be low-profile to allow farm equipment to cross. Roads will initially be approximately 50 ft wide to accommodate transportation of heavy construction equipment; however, once the Project completes construction of the turbines, the roads will be reduced to a permanent width of 16 ft. Total access road length will be up to 13 miles.

The access road network was designed to efficiently serve the Project, limit and intelligently use public roads, incorporate landowner input to create the least interference with farming operations, and, where possible, actually improve farming operations by having a well-sited road that farmers can use for loading grain trucks during harvest and for other farm activities.

6.5 Permitting for Associated Facilities

A comprehensive listing of applicable permits and approvals are described in Section 11 of the SPA (see Table 11.1-1). Freeborn Wind will seek approval from the Commission, Freeborn County, and applicable townships, as required. To secure such approvals, Freeborn Wind will conduct all permits and approvals required either concurrently with or following issuance of the LWECS Site Permit. Concurrent with this SPA, Freeborn Wind will submit an RPA to the Commission for the proposed 161 kV transmission line that will connect the Project Substation to the planned POI.

7.0 Wind Rights

Since 2008, Freeborn Wind has been working with landowners to obtain appropriate land lease and wind easements/setback easement agreements to build the Project.

Depending upon the landowner and Project need, Freeborn Wind has secured necessary land rights from each participating landowner, which may vary from parcel to parcel. These rights include, but are not limited to the rights to construct wind turbines and Project facilities (e.g., O&M facility, Project Substation), and include access roads, collection lines, crane paths, rights to wind and buffer easements, transmission feeder lines in public road ROW, and rights to additional land, as needed, to mitigate environmental impacts.

Figure 4 shows the turbine layout, property lines within the Project Area, and location of leased lands for the Project. The total acreage of the Project Area within Minnesota is approximately 26,273 acres. As of filing this SPA, Freeborn Wind has approximately 17,435 acres of the 26,273 acres under lease within the Project Area (i.e., 66 percent).

All Project facilities will be sited on leased land. The current set of land agreements is sufficient to accommodate construction and operation of proposed facilities and required buffers, as well as allow for flexibility in siting turbines that may be needed to avoid natural resources, homes, and other sensitive features. Figure 3 depicts the Project facilities and underlying parcels required to site the Project following applicable setbacks.

8.0 Environmental Impacts

This section provides a description of the environmental conditions that exist within the Project Area. Consistent with Commission procedures on siting LWECS and with applicable portions of the Minnesota Power Plant Siting Act (Minn. Stat. Ch. 216E), various exclusion and avoidance criteria were considered in selecting the Project Area.

8.1 Demographics

8.1.1 Description of Resources

The Project Area is located in the southeastern portion of Freeborn County, Minnesota (see Figure 1). The Project components are distributed throughout Hayward, London, Oakland, and Shell Rock Townships. According to the 2010 United States Census, the population of Freeborn County was 31,255 (U.S. Census, 2010). In 2010, Freeborn County had 14,231 individual housing units available. Of these, 13,177 (92.6 percent) were occupied and 1,054 (7.4 percent) were vacant. The average household size was 2.39 persons per household.

A summary of the population demographics for Freeborn County and the individual townships included in the Project Area are provided in Table 8.1-1.

Table 8.1-1: Summary of Demographics in Project Vicinity

Jurisdiction	1990 Population	2010 Population	2015 Population	2010-2015 Population Increase (+) / Decrease (-)	1990-2015 Population Increase (+) / Decrease (-)	Number of Households: Occupied / Vacant	Average Household Size
Freeborn County	33,060	31,255	30,613	-2.6%	-7.5%	13,177 / 1,054	2.39
Hayward Township	459	381	379	-0.6%	-17.5%	155 / 12	2.45
Hayward (Hayward Township)	246	250	269	+7.6%	+9.3%	114 / 9	2.19
London Township	365	315	306	-2.9%	-16.2%	126 / 17	2.6
Myrtle (London Township)	77	48	54	+12.5%	-29.9%	26 / 10	1.85
Oakland Township	426	396	422	+6.5%	-0.9%	144 / 15	2.67
Shell Rock Township	476	427	438	+2.5%	-8.0%-	180 / 14	2.36
Glenville (Shell Rock Township)	775	643	586	-8.8%	-24.4%	278 / 12	2.31

The Project Area is located in southcentral Minnesota and is comprised predominantly of a rural residential population. At the county level, a majority of the population (22,539 or 72.1 percent) reside in municipal/urban centers. The remaining 8,716 (27.9 percent) reside in rural areas. For the four townships included in the Project Area, this pattern is reversed. According to the 2010

U.S. Census Data, the combined population of Hayward, London, Oakland, and Shell Rock townships is 2,460 (7.8 percent of Freeborn County). This total includes those individuals residing in municipalities (941 or 38.2 percent) and those living in rural areas (1,519 or 61.7 percent). The Project Area is situated entirely within the rural areas of Hayward, London, Oakland, and Shell Rock townships. None of the municipal centers located within the four townships (Hayward, Myrtle, London and Glenville) are included in the Project Area.

The population of Freeborn County has been declining for at least the past 25 years. In 1990, the reported population for Freeborn County was 33,060. As stated above, the 2010 population was reported at 31,255 and the 2015 population is estimated at 30,613. This represents an approximately 2.6 percent county population decline over the past 5 years and a cumulative county population decline of 7.5 percent since 1990. The City of Albert Lea experienced a population decline over the past 25 years with an overall population decline of 745 individuals, representing a 4 percent drop. The rate of the decline is approximately half of that exhibited in Freeborn County as a whole, indicating that the urban areas of Freeborn County are decreasing at a slower pace.

The four townships included within the Project Area experienced a comparable population decline since 1990; however, unlike the urban center of Albert Lea, the percentage of decline in three of the four townships is greater than that exhibited at the county level. This indicates that the rural township populations are declining more rapidly. Hayward Township exhibits the greatest decline at 17.5 percent. Oakland Township exhibits the smallest decline (relative to the other townships) at 0.9 percent.

Current densities within 5 miles of the Project Area range from 6.3 people per square mile in Deer Creek Township in Worth County, Iowa (south of the Project Area), to 34.6 people per square mile in Austin Township in Mower County, Minnesota (east of the Project Area). The average population density of the four townships included in the Project Area is 10.75 people per square mile.

A summary of the population densities for both the four Project Townships and the townships adjacent to the Project Area are provided in Table 8.1-2 below.

Table 8.1-2: Summary of Population Densities

Township, County, State	People per Square Mile	Location	Township/Range – Relative Position to Project Area
Hayward Township, Freeborn County, Minnesota	11.0	Project Township	102/20
London Township, Freeborn County, Minnesota	8.7	Project Township	101/19
Oakland Township, Freeborn County, Minnesota	11.0	Project Township	102/19
Shell Rock Township, Freeborn County, Minnesota	12.3	Project Township	101/20
Albert Lea Township, Freeborn County, Minnesota	30.5	Adjacent Township	102/21 - West

Table 8.1-2: Summary of Population Densities

Township, County, State	People per Square Mile	Location	Township/Range – Relative Position to Project Area
Austin Township, Mower County, Minnesota	34.6	Adjacent Township	102/18 - East
Bancroft Township, Freeborn County, Minnesota	29.1	Adjacent Township	103/21 - Northwest
Deer Creek Township, Worth County, Iowa	6.3	Adjacent Township	100/19 - South
Freeman Township, Freeborn County, Minnesota	13.9	Adjacent Township	101/21 - West
Grove Township, Worth County, Iowa	8.3	Adjacent Township	100/20 - South
Heartland Township, Worth County, Iowa	9.1	Adjacent Township	100/21 - Southwest
Lansing Township, Mower County, Minnesota	30.1	Adjacent Township	103/18 - Northeast
Lyle Township, Mower County, Minnesota	10.0	Adjacent Township	101/18 - East
Moscow Township, Freeborn County, Minnesota	14.9	Adjacent Township	103/19 - North
Otranto Township, Mitchell County, Iowa	10.2	Adjacent Township	100/18 - Southeast
Riceland Township, Freeborn County, Minnesota	12.1	Adjacent Township	103/20 - North

There is a total of 126 residences located within the Project Area (see Figure 3). A review of the demographic characteristics of the Project Area do not indicate that minority or low-income residents are concentrated in any portion of the Project. As currently designed, the Project components will not be constructed in areas occupied by any economic or ethnic minority populations.

8.1.2 Impacts

The construction and operation of the Project is not anticipated to displace any current residences or alter the demographic character of the Project Area.

8.1.3 Mitigative Measures

No mitigation efforts will be required as no impacts are anticipated.

8.2 Land Use

8.2.1 Local Zoning and Comprehensive Plans

A comprehensive plan is a guide for future development in the applicable local government's jurisdiction and generally includes policies, goals, and plans for private and public land and water use, transportation, and community facilities. The local government may then adopt zoning regulations that further the goals of the comprehensive plan and provide for orderly development, including governing the size, placement, density, and height of structures, as well as where certain uses can occur.

In developing the Project and preparing the SPA, Freeborn Wind reviewed local land use controls within and around the Project Area. The Project Area is within the jurisdiction of Freeborn County, which has adopted a comprehensive plan and a zoning code. Freeborn County's Comprehensive Land Use Policy Plan (Comprehensive Plan) is codified at Ch. 24 of the Freeborn County Code of Ordinances. The Comprehensive Plan "provide[s] a set of policies applied to specific areas… or to specific land uses…" that are "designed to guide the land use decisions for those areas and uses" (see Sec. 24-19[a]). With respect to agricultural areas, the Comprehensive Plan provides that "[a]reas identified as agricultural land should be managed in such a way as to preserve that use and prevent a decline of agricultural uses" (see Sec. 24-22[a][1] and also that "the intent of the 'A' Agricultural District is to protect agricultural and open land uses from the intrusion and premature development of uses not performing a function necessary to the agricultural use of the land or meeting the social, cultural or economic growth needs of the county" (see Sec. 24-22[d]). The Comprehensive Plan further specifies that lands within the Agricultural Districts are generally for agriculture use and farm dwellings, although "certain uses related to the needs of the people of the county" may be developed if they are "compatible with open land" (see Sec. 24-22[b]).

Freeborn Wind reviewed available local zoning and comprehensive plans within and adjacent to the Project Area, including Freeborn County, the cities of Hayward, Myrtle, and Glenville, and the four townships (Hayward, London, Oakland and Shell Rock). Table 8.1-3 lists the municipalities within and adjacent to the Project Area and applicable zoning and/or respective comprehensive plans, if any.

Table 8.1-3: Zoning Code and Comprehensive Plan Inventory for Local Governments within and Adjacent to the Project Area

Governing Body	Name of Plan	Year Adopted	Associated Regulations
Freeborn County	Code of Ordinances of Freeborn County, Minnesota (Ordinance No. 2015-02)	Dec. 1, 2015	Ch. 6 Buildings and Construction Ch. 12 Emergency Management and Services Ch. 14 Environment Ch. 24 Planning and Development Ch. 26 Renewable Energy Systems Ch. 28 Roads, Sidewalks, and Other Public Places
	Comprehensive Water Plan	2006	2011 Mid-Term Amendments (2006-2015) Amendment to Implementation (2016-2021)
City of Hayward (Hayward Township)	City Code of City of Hayward	2002	Title 4 Public Health and Safety Title 7 Public Ways and Property Title 9 Building Regulations Title 10 Zoning Regulations Title 11 Subdivision Regulations
City of Myrtle (London Township)	None Adopted	NA	NA
City of Glenville (Shell Rock Township)	None Adopted	NA	NA
Hayward Township	None Adopted	NA	NA [1]
London Township	None Adopted	NA	NA [1]
Oakland Township	None Adopted	NA	NA [1]
Shell Rock Township	None Adopted	NA	NA [1]

[1] While these townships have not adopted their own local code/ordinance or comprehensive plan, all are included in the 2015 Freeborn County Code of Ordinances.

Freeborn County's Code of Ordinances designates the Project Area generally as an Agricultural District. Thus, the proposed Project will not alter the land use or zoning classification of any parcels within the Project Area. In addition, Freeborn County's Renewable Energy Systems Ordinance regulates the installation and operation of renewable energy systems (including wind energy conversion systems). The Ordinance identifies commercial wind energy conversion systems (WECS) and meteorological towers as conditionally permitted uses in an Agricultural District (see Sec. 26-41). The Ordinance includes regulations relating to, among other things, turbine setbacks, environmental mitigation, and decommissioning. By its terms, the Ordinance applies only to systems that are not otherwise subject to siting and oversight by the MPUC (see Sec. 26-20); thus, it does not apply to the Project. Nonetheless, the Project has been designed to generally comply with this Ordinance.

It should be noted that in December 2015 Freeborn County extensively and comprehensively modified its Freeborn County Ordinance Ch. 26.[7] The previous ordinance applied to WECS with a total height of up to and including 200 ft, and was the minimum guideline for WECS exceeding 200 ft WECS in the following categories required a conditional use permit:

- WECS over 200 ft in height;
- WECS in installations of four or more towers;
- New WECS access points;
- WECS outside of a building site or an active agricultural site; and
- WECS with a combined nameplate capacity of 5,000 kilowatts (kW) or greater.

The previous ordinance also applied to all WECS with a combined nameplate capacity of up to 25 MW and it indicated projects 25 MW and greater are to be processed by the MPUC (see Sec. 14-1[3]). Setbacks were previously established for certain zoning areas (e.g., R-1, R-2, or R-H zones), buried public drain tiles and open public ditches, public roads, transmission lines, and communication towers, adjacent property lines, building sites with primary structures or active agricultural sites, and residences or within 0.5 mile of any municipality, excluding Albert Lea (see Sec. 14-3 and 14-6[8]). Waivers of certain setbacks were available in the previous ordinance. The previous ordinance contained other provisions regarding design and installation, operation, noise levels, public participation, liability insurance, and a decommissioning plan (see Sec. 14-[6] to [11]).

The current Freeborn County Ordinance Ch. 26 applies to renewable energy systems, including energy from sources that are not easily depleted such as moving water (hydro, tidal, and wave power), biomass, geothermal energy, solar energy, wind energy, and energy from solid waste treatment plants (see Sec. 26-24). Among other things, the current ordinance includes details regarding permitted, conditionally permitted, and not permitted uses for the categories of WECS (e.g., micro-WECS, non-commercial WECS, commercial WECS and meteorological towers) within applicable zoning districts (see Sec. 24-41). A summary of WECS general standards regarding setbacks is provided in Sec. 24-51, which applies to micro-WECS less than 100 ft hub height, non-commercial WECS 100 ft but less than 200 ft hub height, commercial equal to or greater than 200 ft hub height, and meteorological towers. Setback types include:

- Project boundary/property lines;
- Noise standard;
- Other ROW (e.g., railroads, power lines, recreational trails);
- Public conservation lands;

---

7 The previous ordinance was entitled Article 14 Wind Energy Conversion Systems (WECS) and was referred to as the “Freeborn Wind Energy Siting Ordinance” (established in April 1982). See http://www.co.freeborn.mn.us/Archive/ViewFile/Item/96.

- Wetlands – USFWS types III, IV, and V;
- Non-residential structures;
- Other existing WECS and internal turbine spacing;
- Public drainage ditches;
- Public drainage tiles;
- Dwellings on adjacent properties in R-H, R-1, and R-2 zones;
- Dwellings on adjacent properties in "A" zone;
- Dwellings on adjacent properties in PD, I, B-1, and B-2 zones; and,
- Municipalities, residential zones, campgrounds, churches, and health care facilities.

Where applicable, the above setbacks are expressed in either a set distance (e.g., 50 ft), a percentage of the total height of the turbine (e.g., 1.1 times the total height), or factor of the RD (e.g., 3 RDs). Additional setback requirements are provided for native prairie, sand and gravel operations, aviation (public and private airports), and substations, accessory facilities and power lines associated with the WECS (see Sec. 26-52.) The current ordinance contains additional provisions regarding safety design standards, tower configuration standards, abandonment and decommissioning, flicker analysis, additional standards for commercial WECS projects (preliminary acoustic studies, local emergency services notification, and pre-construction meeting), other applicable standards (other signage, power lines, waste disposal, orderly development, noise, electrical code and standards, and Federal Aviation Administration [FAA]), avoidance and mitigation of damages to public infrastructure (roads and drainage system), and interference with electromagnetic communications. The previous ordinance contained other provisions regarding design and installation, operation, noise levels, public participation, liability insurance, and a decommissioning plan (see Sec. 26-53 and 60).

In addition to the Freeborn County Ordinance Ch. 26, Freeborn County has adopted the Comprehensive Water Plan Amended to 2016 (Comprehensive Water Plan), which establishes priorities in actions related to water quality, water quantity, and special land uses and conditions that influence land and water resources. The Comprehensive Water Plan identifies specific natural resources and implementation actions to address priority concerns. Resources and concerns include aquifers, surface waters (lakes, shoreland, aquatic invasive species, and wetlands), soil and erosion, waste disposal and management (subsurface sewage treatment systems, feedlots, and solid waste), drainage, and municipal wastewater and stormwater. The Comprehensive Water Plan focuses on agricultural land uses since approximately 81 percent of productive land in Freeborn County is farmed or used for rotational animal pastures.

Specifically, the Comprehensive Water Plan provides information on eight Circular 39 Type Wetlands found in the National Wetland Inventory (NWI) of Freeborn County and approximate acreages of each type of wetland. Freeborn County Ordinance Sec. 26-51 requires a 3 RD setback from three types of wetlands (e.g., USFWS types III, IV, and V wetlands) (see Sec. 26-51). Based upon desktop review of the Project Area, several of these wetland types were identified within the Project Area in proximity to proposed turbine locations. In late April 2017, Freeborn Wind further assessed these specific wetlands by conducting wetland field delineations to confirm the desktop review. This delineation effort was limited to these specific areas in proximity to turbine locations and not the entire site. Further wetland delineations will be completed later. With the exception of three stock ponds (created for agricultural feed lot operations at a nearby farm), none of the wetlands were delineated as types III, IV, or V. The three stock ponds were determined to meet type III criteria and all three are located near Turbine 31. Accordingly, the proposed Project will not alter the land use or Comprehensive Water Plan designations on parcels within the Project Area.

None of the townships within the Project Area have adopted zoning regulations. Of the three cities in the vicinity of the Project (none of which are within the Project Area), only one (Hayward Township) has adopted zoning regulations. Hayward Township's Zoning Code generally applies only within its municipal boundaries (see Ch. 1-1-5) and Freeborn Wind is not aware of any orderly annexation agreements or other plans that would expand the city's zoning regulations into the Project Area.

Freeborn Wind will negotiate in good faith with Freeborn County and Hayward, London, Oakland, and Shell Rock townships to address local concerns related to development, road use, and drainage systems through a development, road use, and drainage agreement. The fundamental components of such agreements will be an objective standard of repair for public infrastructure, as well as adherence to local zoning and siting regulations in effect at the time of filing this SPA. Freeborn Wind has begun preliminary discussions with local officials and plans to enter into such agreements prior to the start of construction.

8.2.2 Conservation Easements

Conservation easements are voluntary legal agreements between a landowner and a land trust (or other qualified organization) in which the landowner, not some outside agency, places restrictions on the use of the property, to protect the natural values of the land. Conservation easements are sold or donated by a landowner to state, federal, or non-governmental organizations in perpetuity to meet conservation objectives. Conservation easements may or may not require public access as part of the easement agreement. The easements are flexible and tailored to meet a landowner's needs and vision for the land. The landowner retains ownership of the property and all rights and privileges for its use, except for the uses restricted under the easement.

The Minnesota Board of Water & Soil Resources (BWSR) administers the Reinvest in Minnesota (RIM) conservation easement program. The program is a critical component of the state's efforts to improve water quality by reducing soil erosion and phosphorus and nitrogen loading, and improving wildlife habitat and flood attenuation on private lands. Freeborn Wind reviewed available public data for conservation easements and identified one 4-acre RIM easement within the Project Area (see Figure 5). Note that several easements are shown on Figure 5, but because the easement parcel is so small and in the vicinity of the Shell Rock River, it is very hard to discern at the map scale. The Project will not impact this conservation easement.

Based on publicly available information (USGS Protected Areas Database, 2016), there are no USFWS wetland or grassland easements in the Project Area. Freeborn Wind also coordinated with the USFWS Windom Wetland Management District to confirm the absence of USFWS easements or fee-title properties in the Project Area. Similarly, there are no wetland bank easements in the Project Area (BWSR, 2017).

Freeborn Wind is reviewing land title records of participating parcels to identify any conservation easements that are not recorded in public databases on any properties within the Project Area. No other easements have been identified at this time. Should additional easements be identified, Freeborn Wind will review and determine whether the Project layout would be impacted.

8.2.3 Impacts

The Freeborn Wind Farm will positively impact the local economy by providing a diversified income stream for landowners, possible temporary jobs for local workers, and tax benefits to local governments. Agricultural use of the Project Area will be allowed to continue. The Project compliments current agricultural and other land uses within and nearby the Project Area, and does not conflict with applicable local zoning and/or comprehensive plan requirements.

Freeborn Wind will conduct wetland delineation within the entire Project Area to confirm the type of wetlands and assess applicable setbacks related to the delineated wetlands. The results of the wetland delineation will be submitted to the MPUC in a future supplemental filing. The Project is consistent with Freeborn County's Zoning and Comprehensive Water Plan. Freeborn Wind will also avoid Project activities within public or private conservation easement areas to the extent possible.

8.2.4 Mitigative Measures

Negative impacts to local zoning, comprehensive plans, and conservation easement lands are not expected from the Project; however, as previously stated, Freeborn Wind will negotiate in good faith with Freeborn County on an agreement to address local concerns regarding development, road use, and drainage issues. In the event that impacts to public easements do occur, Freeborn Wind will work with the MNDNR, USFWS, and/or other relevant authority to develop appropriate mitigation. Freeborn Wind will review its wetland delineation field review results and the proximity of proposed turbines to wetland types III, IV, and V to determine if any turbine locations may need to be adjusted to meet the county Ordinance's 3 RD setback. At this time, Turbine 31 is planned to be 2.9 RD away from type III wetlands along 880th Ave, which are believed to be old stock ponds. Though this does not explicitly comply with the Freeborn County Ordinance, Freeborn Wind believes there is good cause for an exception here for the following reasons:

- The county established a 3-RD (1,141 ft for the V116) setback from class III-V wetlands. Due to other siting restrictions, turbine 31 is sited 1,086 ft from a class III wetland. Therefore, turbine 31 would be placed only 55 ft closer to the wetland than permitted (over 95% compliant).
- Freeborn Wind hired an environmental consultant to conduct a formal wetland delineation and classification of the three wetlands within 1,020 ft of turbine 31 and they

were characterized as a small (combined 0.411 acre) man-made collection of stock ponds that would serve as very low-quality habitat for wildlife.

- Since wildlife would not likely be attracted to this pond, the placement of the turbine 24 ft closer to the pond is not expected to have an impact on wildlife.
- Strict compliance could be achieved by placing a V110 in this location, but the Project has a limited number of V110s and to site one here could mean removing one from another location, which would increase the sound level for homes near that other location. And while those nearby homes would still be below the statutory limit of 50 dB(A), the Applicant feels the best overall balance is achieved with the configuration of siting the turbine 1,020 ft from the man-made stock pond and a decrease in project sound levels for non-participating homes.

8.3 Noise

Wind turbines produce noise resulting primarily from the interaction of the blades with the atmosphere, as well as the cooling systems located outside of the nacelle. Noise from mechanical equipment located inside the nacelle is generally insignificant. The amount of noise produced by the blades is dependent on their rotational speed, and therefore maximum noise emissions occur at maximum rotation. Noise emissions will propagate outward from each turbine, and depending on atmospheric conditions, certain levels will be received on adjacent properties. Noise reaching adjacent properties must meet State of Minnesota statutory limits (see Minn. R. Ch. 7030.0040). The following discussion describes the results of a process conducted to demonstrate through measurements and modeling that, when constructed and operated, noise levels from the Project will meet the statutory limits at all times and under all conditions. The Project will be required to develop and execute a Noise Study Protocol and Report, in accordance with Guidance for Large Wind Energy Conversion System Noise Study Protocol and Report, Minnesota Department of Commerce, October 2012. For more information on noise levels, metrics, and terminology, refer to *A Guide to Noise Control in Minnesota* (Minnesota Pollution Control Agency [MPCA], 2015).

In Minn. R. Ch. 7030, Noise Pollution Control, noise level limits are established according to the land use activity at the location of the receiver. Land uses are divided into four categories called noise area classifications (NACs):

- NAC-1: Residential housing, religious activities, camping and picnicking areas, health services, hotels, educational services;
- NAC-2: Retail, business and government services, recreational activities, transit passenger terminals;
- NAC-3: Manufacturing, fairgrounds and amusement parks, agricultural and forestry activities; and
- NAC-4: Undeveloped and unused land.

A complete list of land uses and their associated NACs is given in Minn. R. Ch. 7030.0050, Noise Area Classification (NAC). The limits for each NAC are given in Minn. R. Ch. 7030.0040, Noise Standards, and are shown in Table 8.3-1. The limits are defined in terms of the level exceeded 50 percent of the time period of interest (L_{50}), which is 1 hour in this case, and expressed in units of A-weighted decibels (dB(A)). There is a separate limit expressed as the level exceeded 10 percent of the time period (L_{10}). These are called statistical noise levels. Also, commonly employed is the average noise level, which in acoustics is called the equivalent level (L_{eq}). The following noise modeling description relies on the noise source emission data provided by turbine manufacturers. All turbine manufacturers quantify their noise emissions using the International Electrotechnical Commission (IEC) 61400-11 standard. This standard requires the use of the L_{eq}, thus the models are technically based on that metric; however, for a continuously operating wind turbine over the time period of interest (1 hour), the L_{eq} and L_{50} are equivalent.

Table 8.3-1: State of Minnesota Noise Limits

Noise Area Classification	Daytime (7:00 am – 10:00 pm)		Nighttime (10:00 pm – 7:00 am)	
	1-Hour L_{10} (dB(A))	1-Hour L_{50} (dB(A))	1-Hour L_{10} (dB(A))	1-Hour L_{50} (dB(A))
1	65	60	55	**50**
2	70	65	70	65
3	80	75	80	75
4	None	None	None	None

Wind turbine L_{10} noise emissions are approximately 1 to 3 dB(A) higher than L_{50} emissions based on measurements conducted at operating wind farms. Thus, because the L_{10} limit is 5 dB(A) higher than that for the L_{50}, demonstrating or achieving compliance with the L_{50} standard guarantees compliance with the L_{10} standard. Furthermore, because turbines can operate 24 hours per day, the Project must be designed to meet the more restrictive nighttime limits. Thus, for NAC-1 receptors (mainly residences), which are of primary importance, compliance must be demonstrated with the 50-dB(A) nighttime L_{50} standard. Finally, per the MPUC *Order Establishing General Wind Permit Standards*, “the project must meet Minnesota noise standards (Minn. R. Ch. 7030) at all residential receivers (homes).” Because the limit is based on the use of the land, the residential limit is enforced at the house itself.

Based on a thorough field review of all land use in the Project Area, a total of 249 residences were identified, as were two churches, for a total of 251 NAC-1 receptors. Three NAC-2 land uses were identified, including two businesses and the London Town Hall. Wind turbine noise levels were predicted at each of these receptors, as described in the following subsection. The rest of the land use is agricultural, for which the nighttime noise limit is 75 dB(A). This level of noise is not reached even directly under or in front of a turbine, thus noise levels are in compliance on all lands used for agriculture and no further analysis was conducted. Figure 6 shows the locations of each of the 251 NAC-1 receptors and 3 NAC-2 receptors where noise levels were predicted. These locations include residences within approximately 2,000 m (1.2 miles) of any proposed turbine. Noise levels at more distant residences will be lower than those described herein.

8.3.1 Description of Resources

The *Application Guidance for Site Permitting of Large Wind Energy Conversion Systems in Minnesota* (MDOC, 2010) requires a description of ambient noise levels in the Project Area, as well as the prediction of Project noise levels at all residences located in the Project Area. This section describes the results of an ambient noise survey that was conducted in the spring of 2017, as well as the methods used to predict Project noise levels. The results of the predictions are described with the noise impacts in Section 8.3.2.

Ambient noise levels were measured in the Project Area in order to characterize the existing acoustic environment as it relates to wind turbine operations. The study was conducted in accordance with the National Association of Regulatory Utility Commissioners' (NARUC) document *Assessing Sound Emissions from Proposed Wind Farms & Measuring the Performance of Completed Projects (October 2011).* Wind turbine projects are unique in the field of environmental acoustics, in that operations are correlated with wind speed, which is correlated to ambient noise level. The nights when it is very calm and quiet will, in general, be the nights when the turbines do not operate. Nights of full operation will often have blustery winds at ground level, causing ambient noise levels to be louder due to the rustle of vegetation. There are times when upper level winds create full operation of the turbines, while ground winds (and therefore ambient noise levels) are relatively low. This is called the "critical" wind speed, and generally occurs at a wind speed of 7 meters per second (m/s) as measured at a reference height of 10 m above the ground.

The study consisted of first measuring ambient noise levels at representative locations, along with simultaneous measurement of hub-height wind speeds and ground wind speeds. Noise levels were measured continuously over a 2-week period at the five representative residences shown in Figure 6. The data were then sorted into daytime and nighttime categories, with the focus on nighttime due to the lower noise limits and potential for impacts to residents. Periods of precipitation were removed from the analysis, as were times when the noise levels were clearly not correlated to wind, including times when the wind was not blowing (and therefore the turbines would not be operating), times when noise levels were very high such as when a truck was passing by or a neighbor was mowing a lawn, and during equipment calibration checks.

The resulting ambient noise levels (10-minute L_{90}, dB(A)) were correlated with hub-height wind speeds normalized to a height of 10 m. A relationship curve fit was performed separately for each measurement site. Table 8.3-2 shows the observed ambient noise levels for three wind speeds: 3 m/s (approximate turbine cut-in), 7 m/s (critical wind speed), and 10 m/s (full turbine power and acoustic output). The values at 3 m/s represent calm conditions when turbines would be just beginning to operate, and as expected the ambient noise levels are relatively low (20 to 30 dB(A)). At the critical wind speed, ambient noise levels range from about 30 to 40 dB(A). At 10 m/s the turbines would be producing full acoustic emissions, and ambient noise levels range from about 45 to 50 dB(A).

Table 8.3-2: Observed Nighttime Ambient Noise Levels

Measurement Location	Measurement Period		Average 10-Min L_{90} (dB(A))		
	Start	Stop	3 m/s [1]	7 m/s [1]	10 m/s [1]
M1	3/21 17:00	4/05 14:40	30	41	50
M2	3/22 15:00	4/05 18:00	25	36	47
M3	3/22 11:00	4/06 12:50	23	29	44
M4	3/22 14:00	4/05 16:50	29	36	50
M5	3/23 10:00	4/05 8:40	28	33	51

[1] Hub-height wind speed normalized to 10 m height

Interstate 90 is audible in the northern portion of the Project Area and this is reflected in the levels at M1. M4 is both exposed to the ground-level wind and near a number of large trees that rustle in the wind. It is also near a major east-west travel route for the southern Project Area and experiences automobile and truck pass-bys. In general, average nighttime ambient noise levels in the Project Area range from approximately 30 to 50 dB(A) under wind conditions in which the turbines would operate at or near full acoustic output. This is a typical range of levels for rural locations in the United States (Hessler, 2011). A more detailed description of the ambient noise measurements can be found in Appendix B.

Noise levels expected at residences and other receptors from the Project were predicted using a proven system of measurements and analysis. Manufacturers measure the noise emissions from their turbines using standard methods (see IEC 61400-11). The propagation of noise emissions from each turbine to each residence is modeled via a widely used and studied method outlined in International Organization for Standardization (ISO) standard 9613-2 *Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation*. Most importantly, noise levels from operating turbines on other projects have been measured and the method validated. Measurements have shown that noise levels predicted using the methods described herein are the loudest ever expected to occur. They are representative of full turbine operations and atmospheric conditions conducive to sound propagation.

Table 8.3-3 lists the noise emission levels that were used on this Project. These are octave band sound power levels (dB) with a corresponding overall level dB(A). Two turbine types are being employed, with the longer-bladed V116-2.0 being approximately 2 dB(A) louder than the V110-2.0. The Project was modeled assuming all V116 units, except nine locations where V110 models should be employed to reduce sound to the degree practicable. The sound power level of the transformer at the Project Substation is representative of utility-scale transformers for wind installations. The model included the 2 transformers and all 42 turbines proposed for Minnesota, as well as the 52 northernmost turbines in Iowa to account for cumulative effects from them. Turbines located farther south in Iowa will not impact noise levels in Minnesota. The locations of the turbines and transformers modeled are shown in Figure 6.

Table 8.3-3: Source Sound Power Levels

Source	Octave Band Power Level (dB)									Overall Power Level (dB(A))
	31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	
V116-2.0	116.3	112.5	107.1	103.4	104.3	105.4	103.3	97.4	84.4	109.5
V110-2.0	116.3	113.3	109.5	105.1	103.3	102.9	101.0	94.6	80.5	107.6
Transformer	90.0	95.8	97.7	92.2	92.8	86.6	81.4	76.6	69.7	93.0

The software program SoundPLAN (Version 7.4) was used to implement the ISO 9613-2 noise propagation standard to predict the noise level at each residence from the combined operation of all turbines. A more detailed description of the noise modeling methods is provided in Appendix B. Each turbine was modeled as a point source at a hub height of 80 m, minimum atmospheric absorption was applied, no barriers were assumed, and the ground was assumed to be completely reflective (G = 0.0). Hankard Environmental Inc. (Hankard) has applied this methodology on previous projects and associated follow-up measurements have confirmed its validity. In fact, the method accurately predicts the very highest noise levels that are experienced at residences. These highest levels occur when all nearby turbines are operating at or near full capacity and atmospheric conditions are ideal for sound propagation. More specifically, this occurs when there is a temperature inversion present, or when the residence is downwind of the nearest turbines.

8.3.2 Impacts

The previously described modeling method was used to predict maximum noise levels from the full operation of the Project. The results are presented graphically in Figure 6, which shows noise level contours, or isopleths, that indicate where predicted noise levels equal 50 dB(A), 45 dB(A), and 40 dB(A). Table 8.3-4 lists the number of NAC-1 locations that fall into the following categories: greater than or equal to 50 dB(A), between 45 and 50 dB(A), between 40 and 45 dB(A), and below 40 dB(A). At no location are noise levels greater than 50 dB(A) under any condition. In fact, through the careful placement of turbines and the selective use of the quieter V110 turbines, noise levels are approximately 47 dB(A) or less at all non-participating residences. It should be noted that the noise levels shown in Figure 8 and listed in Table 8.3-4 are the maximum that are ever expected to occur. Noise levels will be less than those shown when the turbines are not operating near full capacity, are off, or when atmospheric conditions are less conducive to sound propagation.

Table 8.3-4: Number of NAC-1 Receivers in Each Noise Level Category

1-Hour L_{50} (dB(A))	NAC-1 Receivers
≥ 50	0
45 to 50	33
40 to 45	55
< 40	163

Also analyzed was the noise level of a single turbine, which is often what controls the noise level at residences closest to the Project. At a distance of 499 ft from the base of the tower, which is the minimum setback from roads and trails, noise levels from a Vestas V116-2.0 turbine would be a maximum of 56 dB(A). This is the noise level produced by a person talking in a normal indoor conversation. At the minimum distance of a turbine to a residence of 1,126 ft, a single V116-2.0 turbine would produce a maximum of 48 dB(A).

In previous LWECS site permit proceedings before the MPUC as well as those in other states, at local levels, and internationally, the issues of low frequency noise and infrasound have been debated. The following concerns have been raised: 1) low frequency noise and infrasound are produced by wind turbines, and 2) these emissions in particular are purportedly the cause of both annoyance and health effects, such as headaches, nausea, dizziness, and others. Over the past 10 years, a significant number of studies have been conducted on this subject by expert medical panels, acoustical consultants, and academic researchers.

Infrasound from wind turbines has been successfully and repeatedly measured by researchers in the United States (Walker, 2012), Germany (Ministry for the Environment, Climate and Energy of the Federal State of Baden-Wurttemberg, Germany, 2016), and Japan (Tachibana, 2014). It has been demonstrated that infrasound from wind turbines consists of energy at the blade pass frequency of approximately 1 hertz (Hz), and its harmonic components out to about 10 Hz; however, the levels are detectible by instruments only, and are not only below the threshold of human hearing but in fact multiple orders of magnitude below the threshold. The 2016 German study (which spanned 2 years and examined six wind turbines by different manufacturers and with different sizes, covering a power range from 1.8 to 3.2 MW) concludes that,

> Infrasound is caused by a large number of different natural and technical sources. It is an everyday part of our environment that can be found everywhere. Wind turbines make no considerable contribution to it. The infrasound levels generated by them lie clearly below the limits of human perception. There is no scientifically proven evidence of adverse effects in this level range.

The German study also found that levels of wind turbine infrasound are lower than or equivalent to that which would be experienced inside a moving car, at the beach due to waves, inside a house near an operating washing machine, or outside on a windy day. Similarly, the Ministry of the Environment of Japan's 2016 study *Investigation, Prediction, and Evaluation of Wind Turbine Noise in Japan* states that "super-low (below 20 Hz) frequency range components of wind turbine noise are at imperceptible levels. Therefore, wind turbine noise is not an issue caused by super-low frequency range."

Low frequency noise from wind turbines, from 20 to 200 Hz, is audible, but at levels that are generally less than those produced by other sources, such as traffic, wind, and other methods of power generation Hessler et al. (2011) recently concluded that, pending some additional research they feel is warranted, "no other infrasound or low frequency noise criteria are required beyond an acceptable A-weighted level". This is in contrast to the 2009 *Public Health Impacts of Wind Turbines* published by the Minnesota Department of Health (MDH), which consisted of a review of the literature available at that time. That report, which was a literature review, concluded that the Minnesota 50 dB(A) limit "appears to underweight the penetration of low frequency noise into dwellings." However, as Hessler and others have demonstrated, based on the substantial scientific evidence generated since 2009, regulating wind turbine noise using acceptable A-weighted limits is now considered appropriate.

Several studies have also examined the issue of health effects and whether or not they are produced by the low levels of infrasound and low frequency noise produced by wind turbines. A 2012 study conducted by the Massachusetts Department of Environmental Protection concludes that "none of the limited epidemiological evidence reviewed suggests an association between noise from wind turbines and pain and stiffness, diabetes, high blood pressure, tinnitus, hearing impairment, cardiovascular disease, and headache/migraine." In 2010, the Vermont Department of Health concluded that "there is no direct health effect from sound associated with wind turbine facilities." In 2015, Health Canada presented the results of a large-scale epidemiological study to address the issue of wind turbine noise and possible health effects. This is the most extensive direct health study ever conducted on this issue. While the study did find a correlation between wind turbine noise and annoyance, with regard to fatigue, tinnitus, vertigo, nausea, dizziness, cardiovascular diseases, and diabetes it found "the evidence for a causal association is largely lacking for these other effects."

In summary, the conclusion of modern wind turbine noise research is that infrasound and low frequency noise are produced by wind turbines and infrasound in particular has a distinct signature in the 1 to 10 Hz range. However, measured infrasound levels are orders of magnitude below the human hearing threshold and have not been shown to cause health effects. Low frequency noise from wind turbines can at times be audible at residences, but is adequately controlled by accepted A-weighted limits. Accordingly, the Project's compliance with the Minnesota state noise standard adequately minimizes potential impacts related to infrasound and low frequency noise.

8.3.3 Mitigative Measures

Though the primary turbine type in the Project is the Vestas V116-2.0, the installation of nine Vestas V110-2.0 units at strategic locations allows the Project to decrease sound levels at non-participating homes. The V110-2.0 units are approximately 2 dB(A) quieter than the V116-2.0.

The Applicant carefully considered placement of turbines and has designated the following to be sites for V110-2.0's: turbine numbers 18, 23, 29, 33, 34, 41, 42, 47 and 204 (in Iowa). In some cases, V110s were selected because the V116 would not fit due to property line setbacks, but in most of these cases, V110s were chosen strictly for their sound advantage and the resulting reductions in predicted dB(A) levels at adjacent homes. These changes brought noise levels down to approximately 47 dB(A) or less at all non-participating residences.

If changes are made to the turbine layout, number of turbines, or turbine type, the noise analysis should be updated and compliance again demonstrated. If needed, mitigative measures available to the Project to reduce noise levels at any given residence include:

- Negotiating agreements with residences;
- Siting of turbine(s) at greater distances;
- Siting of fewer nearby turbine(s);

- Use of low noise blades on select turbine(s); and
- Operation of select turbine(s) in low noise mode (reduced rotational speed and power output).

8.4 Visual Impacts

8.4.1 Existing Aesthetics

The topography of the Project Area is generally flat with elevations ranging from 1,174 to 1,307 ft (358 to 398 m) above sea level. Agricultural fields, farmsteads, and gently rolling topography visually describe the Project Area and the landscape is rural open space. Topography within the Project Area is shown on Figure 7.

Within the Project Area local vegetation is predominantly agricultural crops and heavily grazed pasture. Crops include corn, soybeans, small grains, and forage crops, which visually create a low uniform cover. A mix of deciduous and coniferous trees planted for windbreaks typically surrounds farmsteads. Generally, these forested areas are isolated groves or windrows established by the landowner/farmers to prevent wind erosion and to shelter dwellings. In the swales, there are occasional patches of native willows, cattails, sedges, and rushes.

The settlements in this area of Freeborn County are residences and farm buildings (inhabited and uninhabited) scattered along rural county roads. These structures are focal points in the dominant open space character of the vicinity.

8.4.2 Visual Impacts on Public Resources

Public lands and natural areas situated within and proximate to the Project are comparable to similar landscape features located in agricultural settings. Construction of wind turbines in agricultural settings have the potential to affect the aesthetic quality of the regional viewshed; however, the severity of the affect is dependent on the perspectives of the individual observers.

Some of the Project's proposed turbines will be observable from MNDNR-managed Wildlife Management Areas (WMAs), USFWS Waterfowl Production Areas (WPAs), and other local natural resource areas. There are 15 WMAs and 7 WPAs within 10 miles of the Project Area. Segments of the Freeborn County Snowmobile Trail system extend through the Project Area. Additional information regarding these resources is found in Section 8.7. Figure 5 identifies the various natural, recreational, and wildlife areas within and proximal to the Project. As stated previously, the severity of the visual affect will be dependent upon the perspective of the individual observer.

8.4.3 Visual Impacts on Private Lands and Homes

Construction and operation of wind turbines will alter the viewshed within and proximate to the Project Area. As stated in the previous section, the level of visual impact as either positive or negative will depend largely upon perceptions of observers; however, following construction activities, the presence of the facility will not alter the day-to-day human activity or traffic in the area. The Project Area will retain its rural and remote character. The turbines are compatible with the rural agricultural heritage of the area that often includes other high-profile facilities such as grain elevators and communication towers.

The FAA requires obstruction lighting of structures exceeding an elevation of 200 ft above average ground level because they are considered obstructions to air navigation (FAA, 2016). To mitigate the visual impact of such lighting, Freeborn Wind will use FAA guidance and standards when applying to the FAA for approval of a lighting plan that will light the project and will follow the approved plan to meet the minimum requirements of FAA regulations for obstruction lighting.

To address the occasional concern about the aesthetics of wind turbines, Freeborn Wind coordinated with local art non-profit Freeborn County Arts Initiative (FCAI) in November 2016 to stage a wind-themed art contest. About ten local artists got together at FCAI over a weekend and created wind-themed art works in different mediums. The work was displayed publicly for two weeks, and photos were shared on the Project's Facebook page. A favorite piece was chosen as the winner and purchased from the artist, and that and one other purchased piece were donated to the Freeborn County Historical Society for their 2017 fundraising auction (see https://www.facebook.com/pg/FreebornWindFarm/photos/?tab=album&album_id=326048081100471).

8.4.4 Shadow Flicker

Shadow flicker from wind turbines occurs when rotating wind turbine blades move between the sun and the observer. Shadow flicker is generally experienced in areas near wind turbines where the distance between the observer and wind turbine blade is short enough that shadows are not diffused by the atmosphere. When the blades rotate, this shadow creates a pulsating effect, known as shadow flicker. If the blade's shadow is passing over the window of a building, it will have the effect of increasing and decreasing the light intensity in the room at a low frequency, hence the term "flicker". This flickering effect can also be experienced outdoors, but the effect is typically less intense, and becomes less intense when farther from the wind turbine causing the flicker. The moving shadow of a wind turbine blade on the ground is similar to the effect one experiences when driving on a road when there are shadows cast across the road by an adjacent row of trees.

This flickering effect is most noticeable within approximately 1,000 m of the turbine and becomes more and more diffused as the distance increases. There are no uniform standards defining what distance from the turbine is regarded as an acceptable limit beyond which, the shadow flicker is considered to be insignificant. The same applies to the number of hours of flickering that is deemed to be acceptable, although the Freeborn County ordinance limits shadow flicker to 30 hours per year at non-participating homes.

Shadow flicker is typically greatest in the winter months when the angle of the sun is lower and casts longer shadows. The effect is also more pronounced around sunrise and sunset when the sun is near the horizon and the shadows are longer. A number of factors influence the amount of shadow flicker on the shadow receptors (residences). One consideration is the environment around the shadow receptor. Obstacles such as terrain, trees or buildings between the wind turbine and the receptor can significantly reduce or eliminate shadow flicker effects. Deciduous trees may block the shadow flickering effect to some degree, depending on the tree density, species present and time of year. Deciduous trees can lead to a reduction of shadow flicker during the summer when the trees are bearing leave; however, during the winter months, these trees are without their leaves and their impact on shadow flicker is not as significant. Coniferous trees tend to block shadowing year round.

For this study, no credit was taken for any potential shading effects from any type of trees or other obstacles that would reduce the number of shadow flickering hours at the structures.

Another consideration is the time of day when shadow flicker occurs. For example, it may be more acceptable for private homes to experience the shadow flickering during daytime hours when family members may be at work or school. Likewise, a commercial property would not be significantly affected if all the shadow flicker impact occurred before or after business hours.

The climate also needs be considered when assessing shadow flicker. In areas with a significant amount of overcast weather, there would be less shadow flicker. Also, if the wind is not blowing, the turbines would not be operational and therefore not creating shadow flicker.

The shadow flicker frequency was computed using the WindPro Modeling program (Version 3.1) using site-specific distribution of wind direction and sunshine probability (see Table 5.1.3 for wind direction distribution for shadow flicker model and Table 8.4-1 below for probability of sunshine).

Table 8.4-1: Probability of Sunshine Assumptions for Shadow Flicker Model

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sunshine Probability	53%	59%	57%	56%	62%	67%	74%	69%	62%	51%	37%	38%

8.4.5 Impacts

Shadow flicker frequency calculations for the Project were modeled for 254 residences (receptors). The results are presented graphically in Figure 8 and the Shadow Flicker Study Report for the Project, which contains additional details, is included in Appendix C. The maximum predicted shadow flicker impacts (hours:minutes per year) that occurred at a residence for the turbine layout are provided in Tables 8.4-2 and 8.4-3.

Table 8.4-2: Maximum Predicted Shadow Flicker Impacts for Participating Residents

Shadow Flicker Statistic	V116 (hours:minutes/year)
Maximum Shadow Flicker – Worst Case	100:57
Average Shadow Flicker – Worst Case	15:44
Maximum Shadow Flicker – Realistic Case	40:28
Average Shadow Flicker – Realistic Case	5:33

Table 8.4-3: Maximum Predicted Shadow Flicker Impacts for Non-Participating Residents

Shadow Flicker Statistic	V116 (hours:minutes/year)
Maximum Shadow Flicker – Worst Case	122:12
Average Shadow Flicker – Worst Case	9:10
Maximum Shadow Flicker – Realistic Case	45:23
Average Shadow Flicker – Realistic Case	3:07

This shadow flicker analysis was performed utilizing WindPro 3.1.617, which has the ability to calculate detailed shadow flicker maps across an entire area of interest or at site-specific locations using shadow receptors. The software program calculates the hours per year as well as the maximum minutes per day during which a given receptor could realistically expect to be exposed to shadow flicker from nearby wind turbines.

Simulated conditions for the worst-case scenario used the following criteria:

- There is constant sunshine;
- The turbines are consistently in operation;
- The wind direction orients the turbine rotors to an angle that is perpendicular to the sun-receptor sightline;
- There are no obstacles between the turbine and the receptor, such as tall structures, vegetative cover, or features of the surrounding terrain, that acts to block potential shadows; and
- Configurations of windows of the receptor structures are not considered in the computations.

The applied worst-case scenario model was refined to represent a less conservative and more accurate scenario by incorporating realistic features in the expected case scenario model:

- Wind direction – Wind data collected from the temporary meteorological towers located within the Project Area is entered into the model and used to adjust the turbine rotor blades accordingly and not uniformly aligned with the direction of the sun.
- Turbine operating hours – Wind data was incorporated to reflect the frequency of wind speeds that are sufficient to engage the turbine. It is understood that all turbines will not be in constant operation due to local wind velocities being outside of the turbine operation specifications. The anticipated amount of time the turbine is activated is multiplied by the number of minutes of shadow flicker.
- Actual sunshine hours – The hours of available sunshine are affected by numerous factors. Cloud cover, atmospheric fog or haze, time of day, and seasonality impact the amount and direction of sunshine. Monthly average sunshine probabilities are taken from the National Climatic Data Center Comparative Climatic Data. For the shadow flicker analysis, the Minneapolis, Minnesota station was chosen because it is the closest station in the database.

Combining these mitigating factors supports a less conservative, more "realistic" scenario. The goal of the realistic scenario is to produce interpretations that more closely represent actual expected results that includes a significant reduction in shadow flicker hours per day or per year as compared to the worst-case scenario. By including these factors in the model, however, it is possible to model results that are actually lower than those compared to actual results in the field. This is due to differences in annual averages.

At a distance of 1,000 ft or greater (the Project minimum setback for residences), receptors will typically experience shadow flicker only when the sun is low in the sky, and only when the factors described above are present. If a receptor does experience shadow flicker, it most likely will be only during a few days per year from a given turbine, and for a total of only a fraction (typically less than 1 percent) of annual daylight hours.

Shadow flicker from the proposed turbines is not harmful to the health of photosensitive individuals, including those with epilepsy. The frequency of shadow flicker due to wind turbines is a function of the rotor speed and number of blades and it is 0.75 Hz (i.e., 0.75 flickers per second) or less. The V116's maximum operational speed is 14.88 rotations per minute (rpm). Each revolution would yield three "flickers"; thus, 14.88 revolutions per minute times 3 flickers per revolution times 60 seconds per minute equals 0.75 flickers per second. The Epilepsy Foundation has determined that generally, the frequency of flashing lights most likely to trigger seizures is between 5 and 30 flashes per second (Epilepsy Foundation, 2013).

8.4.6 Mitigative Measures

Freeborn Wind will work to either avoid or minimize visual impacts of the Project. Freeborn Wind will work with landowners, community stakeholders, and interested parties to identify concerns related to Project aesthetics and to address potential visual impacts through Project design or siting efforts. Freeborn Wind proposes the following mitigation measures to address potential visual impacts:

- Existing roads will be used to the greatest extent possible during construction to limit the number of new roads required to be built within the Project Area;
- Existing roads will be used to the greatest extent possible during the operation and maintenance of the Project to limit the number of new roads required to be built within the Project Area;
- Access roads established for the wind facility will be located to limit the amount of construction grading required and facilitate erosion control;
- Areas disturbed during construction or during operation and maintenance efforts will be restored back to cropland or otherwise reseeded with appropriate native seed mixes;
- Collector cables will be buried to a depth to both protect the collection system and minimize the quantity of aboveground facilities within the Project Area;
- Turbines will not be located within biologically sensitive areas, including WMAs, WPAs, wetlands, or native prairie;
- All turbines will be uniform in color;

- Turbines will be illuminated to meet the minimum FAA requirements for obstruction lighting of wind turbine projects (e.g., reduce number of lights on turbines and synchronized red strobe lights); and
- Freeborn Wind will include details of its lighting plan prior to construction at the time 7460-1 Forms are submitted to the FAA for final approval.

Freeborn Wind will consider the results of the shadow flicker analysis when siting wind turbines in order to minimize potential impacts to all area residents. The mitigation of shadow flicker issues will be addressed as they are brought to the attention of the Applicant by a resident who believes they are experiencing more flicker than had been anticipated and modeled here. Mitigation efforts will be considered for each individual circumstance of shadow flicker and may include:

- Communication with adjacent landowners on when shadow flicker is possible and how to minimize shadow flicker effects;
- Installation of indoor screening, such as curtains or blinds in windows, where appropriate and reasonable;
- Providing exterior screening, such as a vegetation buffer or awnings over windows, where appropriate and reasonable; and
- Turbine Control Software programmed to shut down a specific turbine or turbines for an appropriate amount of time to reduce flicker to below 30 hours per year at each home.

8.5 Public Services and Infrastructure

8.5.1 Description of Resources

The Project is located in a sparsely populated, predominantly rural and agricultural area in southcentral Minnesota. Public services supporting rural residences and farmsteads within the Project Area include transportation/roadways, electric and telephone/telecommunications.

The largest city in the Project vicinity is Albert Lea, which is located approximately 5 miles west of the northwestern corner of the Project. The City of Albert Lea has its own police and fire departments. Three incorporated cities (Glenville, Hayward, and Myrtle) and one unincorporated village (London) are located within 5 miles of the Project Area. These communities receive public services from Freeborn County.

The Project is expected to have minimal effect on existing services and infrastructure of the area. Construction and operation of the Project will be in accordance with associated federal, state, and local permits and laws, as well as industry construction and operation standards and best practices. The Project is designed to have manageable temporary effects on the existing infrastructure during Project construction and operation. Because only minor impacts are expected, extensive mitigation measures are not anticipated. The following sections describe specific impacts that may occur to public services and infrastructure and how they will be mitigated.

8.5.2 Roads

8.5.2.1 Description of Resources

Existing roadway infrastructure in and around the Project Area consists of county and township roads that generally follow section lines, with private unpaved farmstead driveways and farming access roads. Interstate Highway 90 provides the main access to nearby communities and runs east-west along the northern boundary of the Project. Various county and township roads (two-lane paved and gravel roads) provide access to the proposed site. In the agricultural areas, many landowners use private, single-lane farm roads and driveways on their property. A listing of roads, their classification (federal, state, county, or township) and existing traffic volumes on the area's state, and county roads and highways are documented in Tables 8.5-1 and 8.5-2.

Table 8.5-1: Miles of Roads in the Project Area

Road Type	Miles in the Project Area
Federal	0
State	0
County State Aid Highway	17.3
County	6.1
Township	35.4
Total	**58.8**

Of the roads within or adjacent to the Project Area, Interstate Highway 90 has the highest Annual Average Daily Traffic (AADT) count at 12,100 vehicles per day, as reported by the Minnesota Department of Transportation (MnDOT) (2015). In comparison, the functional capacity of a two-lane paved rural highway in the area is in excess of 5,000 vehicles per day. Other roadways in the vicinity of the Project have AADTs ranging from 2,450 to as few as 80 cars per day in the center of the Project Area on County Road 7.

Table 8.5-2: Average Annual Daily Traffic for Roads in the Project Vicinity

Roadway Segment Description	Existing Annual Average Daily Traffic
Interstate 90 between CR46 and Mower Freeborn Rd	12,100
US 65 between Glenville and CR1	2,450
CR19 between CR26 and CR34	375
CR13 between CR26 and CR30	520
CR1 between CR1 and CR30	940
CR30 between CR19 and CR13	420
CR30 between CR13 and CR1	375
CR7 between CR26 and CR30	80

8.5.2.2 Impacts

During Project construction, it is anticipated that there will be some temporary impacts on public roads within the Project Area. Roads will be affected by the normal use of vehicles employed to deliver Project components, construction materials and equipment to and from Project locations. Specific routes may also be impacted by the temporary expansion of road widths and/or intersections to facilitate the safe and efficient delivery of Project facility components and associated construction equipment.

During construction, it is anticipated that the local roads may experience an increase in daily traffic of between 250 and 275 trips per day. As stated above, the functional capacity of a two-lane paved rural highway is in excess of 5,000 vehicles per day. A majority of the area roadways within or proximal to the Project have AADTs currently well below capacity, the additional 250 to 275 vehicle trips during construction would be perceptible, but comparable to traffic loads experienced during peak planting and harvest periods.

Construction vehicle access to the Project will be served by either Interstate 90 or U.S. Highway 65, which connect to county roads throughout the Project Area. Specific additional truck routes will be determined by the Project location or activity requiring delivery. Additional operating permits will be obtained for oversized truck movements. Transportation of equipment and materials associated with the construction of wind projects involves oversized and/or overweight loads and road use that is not consistent with normal traffic in the Project Area.

Following construction, maintenance crews will drive through the Project Area to monitor and maintain the wind facility. It is not anticipated that operation, maintenance and repair activities will adversely impact normal traffic in the Project Area. Traffic control measures and coordination with local authorities will be implemented to ensure public health and safety is protected with respect to the Project.

8.5.2.3 Mitigative Measures

Turbines will be setback from the edge of public road rights-of-way a minimum of 499 ft as required to ensure safety for travelers. Prior to construction, Freeborn Wind will coordinate with the applicable local and state road jurisdictional authorities to ensure that the increased traffic and additional weights being applied to area roads are acceptable, and to obtain all relevant permits for access and utility installation. Freeborn Wind will work with the cities and townships in Freeborn County and MnDOT, as necessary, regarding access road locations, roadway concerns, ROW work (if any), and setbacks during construction of the Project. Freeborn Wind will also work closely with the landowners in the placement of access roads to minimize land use disruptions during construction and operation of the Project to the extent possible.

Designated haul-roads will be reviewed with the local authority having jurisdiction and Freeborn Wind will negotiate in good faith to execute a comprehensive road use agreement that will be used to identify suitable travel routes, traffic control measures, methods for evaluating, monitoring and restoring roads, and mitigation measures to ensure roads used for oversize/overweight loads are properly identified, monitored and stabilized. Construction-related impacts are further described in Section 10.

Freeborn Wind will ensure that the general contractor communicates with the relevant road authorities throughout the construction process, particularly regarding the movement of equipment on roads and the terms of the potential road agreement.

8.5.3 Telecommunications

8.5.3.1 Description of Resources

Telephone service in the area is provided to farmsteads, rural residences and businesses by BeMobile, CenturyLink, Jaguar Communications, Sprint Communications Company L.P, Verizon Communications, and Winnebago Cooperative Telecom Association.

8.5.3.2 Impacts

Construction and operation of the Project are not expected to impact telephone or internet service to or within the Project Area. Prior to construction, a utility locate service will be contacted to locate underground utilities so they can be avoided.

8.5.3.3 Mitigative Measures

At this time, no impacts are anticipated to telephone service. Should inadvertent impacts to these systems arise, Freeborn Wind will work to remedy service interruptions on a case-by-case basis.

8.5.4 Communications Systems

8.5.4.1 Description of Resources

<u>Microwave Beam Paths</u>

On behalf of Freeborn Wind, Comsearch completed an evaluation of licensed non-federal government microwave beam paths in the vicinity of the Project Area and determined that there are 36 microwave beam paths that intersect the Project Area in the east and central portions of the Project. Comsearch calculated a Worst Case Fresnel Zone (WCFZ), which is considered the mid-point of a full microwave path and the location of the widest Fresnel zone. The microwave path and WCFZ buffer are depicted on Figure 9 and in the Comsearch Licensed Microwave Report (see Appendix D).

<u>AM/FM Radio</u>

On behalf of Freeborn Wind, Comsearch analyzed amplitude modulation (AM) and frequency modulation (FM) radio broadcast stations whose service could potentially be affected by the proposed Freeborn Wind Project. Comsearch found five database records for AM stations within approximately 30 kilometers (18.6 miles) of the Project. These records represent stations KAUS and KQAQ (both daytime and nighttime operations) broadcasting from Austin, Minnesota, and KATE broadcasting from Albert Lea, Minnesota. Comsearch determined that there were 25 records for FM stations within a 30-kilometer radius of the Project Area. Twenty-three (23) of these stations are currently licensed and operating, 10 of which are low-power or translator stations that operate with limited range. A listing of the nearest AM and FM stations are provided in the attached AM and FM Radio Report (see Appendix D).

Fixed Land Mobile Stations

As a result of the communication tower study, Comsearch found 43 database records for Land Mobile stations within approximately 30 kilometers (18.6 miles) of the Project. A listing of the identified Land Mobile stations is provided in the attached Communication Tower Study (Appendix D).

8.5.4.2 Impacts

Microwave Beam Paths

Comsearch conducted a Licensed Microwave Study for Freeborn Wind. The Comsearch study concludes that as long as the turbines (including blade radius) are located outside of the identified Fresnel zone, there should be no impact to the microwave beam path by the Project.

AM/FM Radio

As described in the Comsearch study, the exclusion distance for AM broadcast stations varies as a function of the antenna type and broadcast frequency. For directional antennas, the exclusion distance is calculated by taking the lesser of 10 wavelengths or 3 kilometers. For non-directional antennas, the exclusion distance is simply equal to 1 wavelength. Potential problems with AM broadcast coverage are only anticipated when AM broadcast stations are located within their respective exclusion distance limit from wind turbine towers. The closest AM station to the Project, KAUS, is more than 3 kilometers from the nearest turbine. As there were no stations found within 3 kilometers of the Project, which is the maximum possible exclusion distance based on a directional AM antenna broadcasting at 1000 kilohertz (KHz) or less, the Project should not impact the coverage of local AM stations.

The coverage of FM stations is generally not susceptible to interference caused by wind turbines, especially when large objects, such as wind turbines, are sited in the far field region of the radiating FM antenna in order to avoid the risk of distorting the antenna's radiation pattern. Impacts to FM broadcast signals are expected to be minimal if Project turbines are sited in the "far-field regions" of the individual broadcast antenna and a line-of-site connection between the antenna and receivers is maintained. The 'far-field region" for FM antennas is a minimum distance of 450 m (1,476 ft) from the radio antenna. As currently designed the closest wind turbine is approximately 1,080 m (3,544 ft) distant from the KNSE antenna and is of sufficient distance to limit potentially impact to the broadcast signal.

Fixed Land Mobile Stations

A change in coverage of fixed land mobile stations associated with wind turbine installation is not expected by the Project. Land Mobile sites, such as emergency response, public safety, and local government communications, are typically unaffected by the presence of wind turbines.

The frequencies of operation for these services have characteristics that allow the signal to propagate through wind facilities.

8.5.4.3 Mitigative Measures

Microwave Beam Paths

Freeborn Wind has sited the Project's turbines in a manner that avoids identified microwave beam paths and communication systems. Freeborn Wind will not operate the wind project so as to cause microwave, radio, or navigation interference contrary to Federal Communications Commission (FCC) regulations or other law.

AM/FM Radio

Because there are no AM/FM radio stations operating in close enough proximity to the Project that would typically cause impacts to reception, no mitigation is proposed at this time. Should issues arise, Freeborn Wind will work closely with area stations in regards to mitigation options.

Fixed Land Mobile Stations

In the unlikely event a land mobile licensee believes their coverage has been compromised by the presence of the Project, there are options to improve signal coverage through optimization of a nearby base station or adding a repeater site. Utility towers, meteorological towers, or even the turbine towers within the wind Project Area can serve as the platform for a land mobile base station or repeater sites.

8.5.5 Television

8.5.5.1 Description of Resources

Freeborn Wind evaluated the off-air television (TV) stations where service could potentially be affected by the Project. Off-air stations are TV broadcasters that transmit signals that can be received directly on a TV receiver from terrestrially located broadcast facilities. Freeborn Wind identified all off-air TV stations within 80 miles (130 kilometers) of the Project Area. However, the TV stations that are most likely to provide off-air coverage to the Project Area will be those stations at a distance of 50 miles (80 kilometers) or less. There are six stations within approximately 50 miles of the Project. All of the stations identified are currently licensed and operating.

8.5.5.2 Impacts

Construction of wind turbines has the potential to impact TV reception as a result of an obstruction in the line of sight between residents relying on digital antennas for TV reception and the TV station antennas; however, based on the low number of full-power TV channels available in the immediate vicinity of the Project Area, it is unlikely that off-air TV stations are the primary mode of TV service for the local communities. Signal scattering could still impact certain areas currently served by the TV stations, especially those that would have line-of-sight to at least one wind turbine but not to a respective station antenna. TV cable service, where available, and direct broadcast satellite service are more likely the dominant modes of service delivery.

8.5.5.3 Mitigative Measures

If interference to a residence's or business's TV service is reported, Freeborn Wind will work with affected parties to determine the cause of interference and, when necessary, reestablish TV reception and service. Freeborn Wind plans to address post-construction TV interference concerns on a case-by-case basis. If TV interference is reported to Freeborn Wind, project representatives will:

- Review results of the report to assess whether impacts are likely Project-related;
- Meet with landowner and local communication technician to determine the current status of their TV reception infrastructure;
- Discuss with the landowner the option of 1) installing a combination of high gain antenna and/or a low noise amplifier at Freeborn Wind’s sole expense, or 2) entering into an agreement for Freeborn Wind to provide a monetary contribution equal to the cost of comparable satellite TV services at the residence;
- Freeborn Wind will test option 1, and if it restores landowner’s TV reception to pre-windfarm-operations performance, will consider the matter closed;
- If Project-related interference remains an issue, Freeborn Wind will propose an agreement that reimburses the landowner for the costs of comparable satellite TV services and will remove the antenna and amplifier equipment, unless it was initially installed to serve multiple households; and
- If Freeborn Wind and the landowner are unable to reach an agreement to resolve interference-related issues, Freeborn Wind will report the concern as an unresolved complaint and defer to the MPUC’s dispute resolution process to resolve the matter.

Freeborn Wind recognizes that some impacts to TV service within the Project Area may occur, but these impacts are likely to be minimal based on the findings of the off-air TV analysis. The Applicant is committed to operating the facility in a manner that does not adversely impact TV reception. Should issues arise following construction of the Project, Freeborn Wind will work with the affected residents in a timely manner to determine the cause of the interference and establish acceptable reception.

8.5.6 Other Infrastructure and Services

8.5.6.1 Railroad

The Cedar River Railroad traverses the central portion of the Project in a generally east-west direction near County Road 13. The Union Pacific Railroad is located immediately west of the western edge of the Project and parallel to U.S. 65 on the west side of the highway.

8.5.6.2 Pipelines

There is an Alliance natural gas pipeline that traverses the northern portion of the Project in a northwest to southeast direction. There is also a Kinder Morgan oil pipeline in the same ROW. Turbines will be carefully sited at least 1.1 times the tip height away from the identified pipelines; consequently, impacts to pipelines are not expected and therefore no mitigation measures have been proposed.

8.5.6.3 Electrical Services

There are currently three utility electric transmission lines within the Project Area. There is an Alliant 161 kV transmission line that runs east-west through the northern portion of the Project between 190th Street and 200th Street. In the southwestern portion of the Project, an Alliant 69 kV line travels north-south approximately 0.5 mile west of 820th Street. Also in the southwestern portion of the Project, a Dairyland Power 69 kV line traverses a small portion of the Project along 140th Street heading west immediately out of the Glenworth Substation. The Glenworth Substation is the POI and located along U.S. 65 at the western edge of the Project. There are no additional substations in the Project Area. Turbines have been sited at least 1.1 times the tip height from existing transmission lines.

Limited and short-term impacts to the electrical service may be experienced where coordinated short-term outages occur when high clearance construction equipment needs to cross areas with overhead distribution and/or transmission lines. Outages associated with project transmission interconnection may also be required. Freeborn Wind and local service providers will work closely to ensure outages are planned and coordinated with local residents and other impacted users.

8.5.6.4 Water Supply and Sanitary Service

Homes and farmsteads in the Project Area typically utilize onsite water wells and septic systems for individual household water and sanitary needs. Construction and operation of the Project are not anticipated to affect water supply or sanitary service of existing residents. As discussed in Section 4.1, during construction a temporary batch plant will be installed in Iowa and any water needed to make concrete will be obtained in Iowa under applicable local and state permit/ approval requirements.

A water supply well is being planned for the O&M facility, which will be permitted and installed in accordance with applicable Minnesota law and MDH requirements (MDH, 2015). Freeborn Wind will also coordinate closely with individual landowners to ensure that water supply and sanitary facilities near the Project are identified prior to construction and avoided.

It is not anticipated that the Project will require the appropriation of surface water or permanent dewatering. Temporary dewatering may be required during construction for specific turbine foundations and/or electrical trenches. Water use during construction may occur to provide dust control, which would be trucked in, as well as water for concrete mixes (to be prepared in Iowa), and other construction purposes.

8.5.6.5 Impacts

Turbines were setback 1.1 times tip height from both railroads, pipelines, and transmission lines. Project collection lines will cross the Cedar River Railroad. Freeborn Wind will work with the railroad and pipeline companies on crossing agreements for collection lines and cranes.

No other impacts are anticipated to these infrastructure or services. Freeborn Wind will coordinate with pipeline companies and other electric utility services before and during construction to fully understand infrastructure and safety concerns and to avoid and prevent possible conflicts or impacts.

8.5.6.6 Mitigative Measures

If temporary dewatering is required during construction activities, discharge of dewatering fluid will be conducted under the requirements of the National Pollutant Discharge Elimination System (NPDES) permit and Storm Water Pollution Prevention Plan (SWPPP) which will be developed for this Project.

8.6 Cultural and Archaeological Resources

8.6.1 Description of Resources

The Minnesota State Historic Preservation Officer (SHPO) and the Office of the State Archaeologist (OSA) were contacted in March 2017 to initiate Project coordination. Cultural resource specialist staff at Merjent, Inc., on behalf of Freeborn Wind, conducted a literature review based on the Project Area and a 1-mile buffer. In Minnesota, the Project is located within the Southeast Riverine (Region 3) archaeological sub-region, which includes Dodge, Fillmore, Goodhue, Houston, Mower, Olmsted, Wabasha, and Winona counties, and portions of Dakota, Freeborn, Rice, and Waseca counties. The region continues into the adjacent corners of Wisconsin and Iowa (Anfinson, 1990). Archaeological resource sites are numerous in this region according to an overview entitled *Model: A Predictive Model of Pre-contact Archaeological Site Location for the State of Minnesota Final Report*, specific section entitled "Minnesota's Environment and Native American Culture History" by Gibbon, Johnson, and Hobbs (2002).

Merjent, Inc. collected data from the SHPO in St. Paul, Minnesota regarding known cultural resources information resulting from previous professional cultural resources surveys and reported archaeological sites and architecture inventory resources. Data collection included gathering records of sites within the Project Area and a 1-mile Study Area centered on the Project Area boundary. The standard 1-mile Study Area is used to gather valuable information regarding the location of previously identified cultural resources and cultural resources surveys. This information is then used to identify site types that may be encountered and landforms or areas that have a higher potential for containing significant cultural resources. Collected data includes archaeological site files, architecture inventory files, and previous cultural resources studies and reports.

The literature review revealed that no previously documented archaeological sites are located within the Project Area (see Figure 10); however, research did identify the presence of one previously reported archaeological site within the surrounding 1-mile buffer in Minnesota. Site 21FE0024, the Esse Mounds site, is identified as a prehistoric (possible Middle Woodland) burial mound site. It has not been formally evaluated for the National Register of Historic Places (NRHP). As the site is located external to the Project Area it will not be impacted by proposed construction. No additional evaluation efforts will be required.

A total of 17 previously reported architecture inventory resources are present within the 1-mile Study Area. Of these, four of the inventoried resources are located within the Project Area (see Table 8.6-1 and Figure 10). Nearly every type of property category is represented within the listing of previously inventoried resources, including domestic, commerce, industry, government, education, religion, funerary, recreation and culture, agricultural processing, health care, and transportation. Approximately one-quarter of the previously reported resources are located in Myrtle near the central portion of the Project Area (see Table 8.6-1 and Figure 10). Further, the majority of the resources (89 percent) have not been evaluated for the NRHP. Of the two resources that have been evaluated, one (FE-HRD-002) is listed on the NRHP and the other (FE-SHE-006) is considered to be eligible for listing in the NRHP.

Table 8.6-1: Previously Reported Architecture Resources within the 1-Mile Study Area

County	Architecture Inventory Number	Property Name	Address	Property Category	Property Type	NRHP Eligibility	Within Project Area (Y/N)
Freeborn	FE-GLE-001	Glenville Creamery	1st Street SE & River Road	Agricultural Processing	Creamery	Unevaluated	N
Freeborn	FE-GLE-004	Glenville Methodist Episcopal Church	211 1st Avenue	Religion	Church	Unevaluated	N
Freeborn	FE-HRD-001	Petran Farms	off County Road 46	Agriculture	Farmstead	Unevaluated	N
Freeborn	FE-HRD-002	Lodge Zare Zapadu No. 44	off County Highway 30	Social	Meeting Hall	Eligible; Listed	Y
Freeborn	FE-HRD-006	Bohemian Wood Hall (razed)	off County Road 30	Social	Meeting Hall	Unevaluated	Y
Freeborn	FE-LON-001	District School No. 51	SW corner County Highway 13 & County Highway 34	Education	School	Unevaluated	N
Freeborn	FE-LON-003	District School No. 125	off County Highway 1	Education	School	Unevaluated	N
Freeborn	FE-LON-004	Deer Creek Lutheran Church	off County Highway 32	Religion	Church	Unevaluated	N
Freeborn	FE-LON-005	Creamery	off County Highway 32	Agricultural Processing	Creamery	Unevaluated	Y
Freeborn	FE-MYR-001	Myrtle Railroad Depot	off County Highway 13	Transportation	Train Depot	Unevaluated	N
Freeborn	FE-MYR-002	School	Albert Street	Education	School	Unevaluated	N
Freeborn	FE-MYR-003	School	Albert Street	Education	School	Unevaluated	N

Table 8.6-1: Previously Reported Architecture Resources within the 1-Mile Study Area

County	Architecture Inventory Number	Property Name	Address	Property Category	Property Type	NRHP Eligibility	Within Project Area (Y/N)
Freeborn	FE-MYR-004	Myrtle Post Office	NW corner Main Street & 1st Avenue	Government	Post Office	Unevaluated	N
Freeborn	FE-MYR-005	Myrtle Museum	Main Street	Domestic	Residence	Unevaluated	N
Freeborn	FE-OAK-001	Trondhjem Norwegian Evangelical Lutheran Church	off County Road 11	Religion	Church	Unevaluated	N
Freeborn	FE-SHE-003	District School No. 100	off County Highway 13	Education	School	Unevaluated	Y
Freeborn	FE-SHE-006	U.S. Highway 65 State line Marker	off U.S. Highway 65	Transportation	Marker	Considered Eligible Finding	N

There are four architecture resources located within the Project Area: FE-HRD-002, FE-HRD-006, FE-LON-005 and FE-SHE-003 (Figure 10). The first property, FE-HRD-002, the Lodge Zare Zapadu No. 44, was entered into the NRHP on March 20, 1986. According to the inventory form, it is a Bohemian Brick hall which was the last of three fraternal lodge buildings which served as social and recreational centers for a community of immigrants from the Bohemian provinces of what was then Austria-Hungary who settled, beginning in 1854-6 and continuing into the 1870s and 1880s, in the border area where Hayward, London, Shell Rock and southern Oakland townships meet in Freeborn County. The building's management has entered into a Good Neighbor Agreement with the Project, demonstrating their acceptance of the Project.

The second property, FE-HRD-006, the Bohemian Wood Hall, also is a fraternal lodge hall; according to the inventory form, the building has been razed. The third property, FE-LON-005, is a creamery located in London Township; the NRHP eligibility of the property has not been evaluated. The final property, FE-SHE-003, is the District School #100 located in Shell Rock Township; the NRHP eligibility of the property has not been evaluated. The sizable number of previously recorded architecture inventory resources were identified within the 1-mile Study Area, indicating a strong historic European American presence in the Project Area.

8.6.2 Impacts

Archaeological resources may be impacted directly during the construction of a wind energy facility. Construction within the turbine footprint, cable trenching, access roads, and borrow areas could impact unknown archaeological resources. In addition, construction of turbines or other protruding structures may impact viewshed integrity from existing architecture inventory resources.

8.6.3 Mitigative Measures

The Project Area has potential to contain archaeological resources. These archaeological resources would most likely be located on or near elevated landforms and areas near permanent water sources. Freeborn Wind will conduct a Phase I archaeological resources inventory and work cooperatively with SHPO and OSA.

The archaeological resources inventory will focus on areas proposed for Project construction, including wind turbine locations, associated access roads, electrical cable routes, and other construction elements. These investigations will be conducted by a professional archaeologist meeting the Secretary of the Interior's Standards for Archaeology as published in Title 36 Code of Federal Regulations Part 6. Survey strategies (pedestrian and/or shovel probing and/or deep testing) for the archaeological resource inventory will depend on surface exposure and the characteristics of the landforms proposed for development. After receiving the proposed turbine, access road, and electrical cable layouts, archaeologists will design an appropriate survey strategy for archaeological resources. This proposed survey strategy will be shared with SHPO to gather their input on the methodology prior to completing the study. It is anticipated that the Phase I Archaeological Survey will be conducted during early spring or late fall 2018, when ground surface visibility is optimum for visual survey.

If archaeological resources are identified during the survey, an archaeologist will identify the location and record Universal Transverse Mercator coordinates so that Project construction layout can consider the location and adjust construction plans. If Project construction plans cannot be adjusted, further investigation of the resource may be needed and further coordination with SHPO and possibly OSA will be required if human remains may be present. This additional investigation would be described and documented on a case by case basis. The results of the investigation will be compiled and documented in a report or reports and shared with SHPO.

As for architectural resources, we have a Good Neighbor Agreement with the owners of the Brick Hall. As the wood hall has been razed and the two other sites are not listed, no mitigation is anticipated.

8.7 Recreation

8.7.1 Description of Resources

Recreation opportunities in Freeborn County include hiking, biking, boating, fishing, camping, swimming, cross country skiing, snowmobiling, hunting, and nature viewing. Figure 10 shows the locations of state parks, Aquatic Management Areas (AMAs), Scientific and Natural Areas (SNAs), WMAs, state game refuges, snowmobile trails, state trails, WPAs, in the Project vicinity.

There is one state park in the Project vicinity: Myre-Big Island State Park is located approximately 2.5 miles west of the northwest corner of the Project and includes portions of Albert Lea Lake. The park contains wet lowlands, oak savanna, grasslands, and a maple/ basswood forest. Recreational opportunities include hiking, camping, canoeing, and bird watching.

Minnesota's WMAs are managed to provide wildlife habitat, improve wildlife production, and provide public hunting and trapping opportunities. These MNDNR lands were acquired and developed primarily with hunting license fees. WMAs are closed to all-terrain vehicles and horses because of potential detrimental effects on wildlife habitat. The Shell Rock WMA is located adjacent to the Project Area on the western border and west of US 65. WMAs located within 10 miles of the Project Area boundary are included in Table 8.7-1.

Table 8.7-1: Wildlife Management Areas within 10 Miles of the Project Area Boundary

Distance from Project Area Boundary (mi)	WMA Name	General Location	WMA Area (acres)
Adjacent	Shell Rock WMA	Adjacent	48
1.6	Panicum Prairie WMA: Shell Rock Unit	Southwest	192
2.3	Red Cedar River WMA	East	72
2.5	Panicum Prairie WMA: Grass Lake Unit	Southwest	854

Table 8.7-1: Wildlife Management Areas within 10 Miles of the Project Area Boundary

Distance from Project Area Boundary (mi)	WMA Name	General Location	WMA Area (acres)
3.8	Carex WMA	Northeast	332
4.3	Schrafel WMA	Northeast	32
5.4	Lyle-Austin WMA	East	115
7.2	Schottler WMA	East	164
7.8	Ann & Leo Donahue WMA	West	112
8.4	Upper Twin Lake WMA	West	14
8.8	Lena Larson WMA	East	171
8.9	Ramsey Mill Pond WMA	Northeast	394
9.3	Magaksica WMA	West	169
9.6	Wo Wacintanka WMA	North	557
9.9	Mentel WMA	East	25

SNAs are areas designated to protect rare and endangered species habitat, unique plant communities, and significant geological features that possess exceptional scientific or educational values. There are no SNAs within 10 miles of the Project Area.

The MNDNR acquisition of riparian shoreline parcels called AMAs ensures that critical fish and wildlife habitat will be conserved, non-boat public access to water resources will always be available, and habitat can be developed on previously disturbed areas. There are two AMAs within 10 miles of the Project Area: the Juglans Woods AMA is located 2.9 miles west of the Project surrounding the Shell Rock River and within the Albert Lea Game Refuge, and the Cedar River AMA is located 6 miles east of the Project along the Cedar River on the south side of the city of Austin.

There are two state game refuges within 10 miles of the Project Area: the Albert Lea Game Refuge is located in and around Myre-Big Island State Park approximately 2.5 miles west of the northwest corner of the Project Area, and the Moscow State Game Refuge is located approximately 2.5 miles northeast of the Project (see Figure 5). Hunting and trapping is allowed on public parcels in these game refuges, including small game and deer by firearms and archery (Minn. R. Ch. 6230.0400). However, the primary purpose of these game refuges is to provide protection to waterfowl; therefore, no waterfowl hunting is permitted within the refuge. The game refuges may be open or closed at the discretion of the MNDNR commissioner.

There are approximately 18 miles of snowmobiles trails in the Project Area. These generally follow 840th Avenue north/south and the abandoned rail road line that runs east/west (see Figure 5).

The Blazing Star State Trail runs from Albert Lea Lake in Albert Lea through Myre-Big Island State Park. Currently, six miles are constructed between the City of Albert Lea and Myre-Big Island State Park. This trail also connects to Albert Lea's city trail system. Another 1.5 miles are built between the city of Hayward and Township Rd 290. Once the trail reaches Austin, it will connect to Austin's city trail system, as well as the Shooting Star State Trail. When completed, the Blazing Star State Trail will connect Albert Lea and Austin via Big Island State Park and Hayward.

State water trails provide recreation opportunities for canoeing, boating, fishing, and wildlife viewing. The Shell Rock River State Water Trail is partially within the western portion of the Project Area (see Figure 5). This water trail travels 20 miles through central Freeborn County to the Iowa border. The Cedar River State Water Trail is located approximately 2.5 miles east of the Project in Mower County and travels approximately 20 miles from Lansing south to the Iowa border.

WPAs are federal lands managed to protect breeding, forage, shelter, and migratory habitat for waterfowl or wading birds, such as ducks, geese, herons, and egrets. WPAs provide opportunities or viewing wildlife and intact ecosystems. There are no WPAs within the Project Area; WPAs located within 10 miles of the Project Area boundary are shown in Table 8.7-2. Note that many WPAs include multiple parcels. The distance from the Project Area is to the closest parcel; the WPA area includes acreage of all parcels.

Table 8.7-2: Waterfowl Production Areas within 10 Miles of the Project Area Boundary

Distance from Project Area Boundary (mi)	WPA Name	General Location	WPA Area (acres)
4.2	Turtle Creek WPA	Northeast	155
5.1	Lost Lake WPA	Northeast	101
5.9	Goose Lake WPA	Northwest	167
6.1	Arlen Schamber Legacy WPA	Northeast	43
6.5	Goose Creek WPA	West	663
8.1	Twin Lake WPA	West	272
9.3	Elk Creek WPA	Southwest	129

8.7.2 Impacts

The Project will avoid all AMAs, SNAs, WMAs, WPAs, and state trails. Recreational impacts will generally be visual, affecting individuals using public lands in the Project vicinity. See Section 8.4 for additional discussion of visual impacts and proposed mitigative measures. Visual impacts will be most evident to visitors using any WMA, AMA, WPA, state trail, or snowmobile trail within 5 miles of the Project.

8.7.3 Mitigative Measures

Project turbines and facilities will not be located within public parks, trails, WMAs, AMAs, or WPAs. Turbines will be set back from public lands based on a minimum of the 3 RD by 5 RD setbacks form all non-leased properties per MPUC siting guidelines (MPUC, 2008).

8.8 Public Health and Safety

The operation of wind farms (or LWECS) provide benefits to the environment and health of the regional community. Throughout their operational life-cycle, LWECS operations emit the smallest amount of greenhouse gasses compared to other energy generation methods (see Table 8.8-1) by replacing energy generated by fossil fuels. Wind energy production also eliminates emission of sulphur oxides (SO_x), nitrogen oxides (NO_x), particulate matter (PM_{10}), and mercury, as well as drastically reduces water consumption.

Table 8.8-1: Comparison of Carbon Dioxide Emissions by Generation Source

Generation Source	Pounds CO_2 / kilowatt-hour
Coal	1.4 – 3.6
Natural Gas	0.6 – 2.0
Hydroelectric	0.1 – 0.5
Geothermal	0.1 – 0.2
Solar	0.07 – 0.2
Wind	0.02 – 0.04

The American Wind Energy Association (AWEA) (2016) estimates that in 2015 the operation of wind energy farms in the United States reduced the amount of carbon dioxide (CO_2) emissions by 132 million metric tons. In 2015, SO_x and NO_x reductions due to operation of wind farms were 176,000 metric tons and 106,000 metric tons, respectively (AWEA 2016).

Tables 8.8-2 and 8.8-3 provide the estimated amount of air pollutant emission that may be reduced if a comparable coal-fired and natural gas fired generating facilities in Minnesota were replaced by the anticipated base energy production values of the Project referenced in Section 10.9.2. The air emission metrics are based on data compiled from eGRID (USEPA, 2017) database and NREL (Deru, 2007) for the existing generation capacity within the State of Minnesota.

Table 8.8-2: Potential Coal-Fired Generation Emission Reductions

Emission Component	Tons per Year	Tons per 30-Year Operation
CO_2	370,928	11,127,828
NO_x	290	8,712
SO_2	323	9,690
PM_{10}	95	2,856
VOC	12	354
CO	133	3,998

Table 8.8-3: Potential Natural Gas-Fired Generation Emission Reductions

Emission Component	Tons per Year	Tons per 30-Year Operation
CO_2	152,120	4,563,606
NO_x	61	1,838
SO_2	9	283
PM_{10}	72	2,174
VOC	12	354
CO	133	3,998

Replacing fossil fuel generation with renewable sources also has a significant positive impact on health and healthcare costs. Studies conducted by the Union of Concerned Scientists (UCS) have determined that the decrease in pollutant emissions from fossil fuels is linked to a reduction of early mortality, a loss of workdays, and overall healthcare costs. That same study estimates that healthcare costs in the United States related to impacts from fossil fuels in 2015 ranged between $361 and $886 billion (UCS, 2017). In 2015, the greenhouse gas emission reductions resulting from wind generation is estimated to have reduced health costs by $7.3 billion (AWEA, 2016).

8.8.1 Electromagnetic Fields and Stray Voltage

8.8.1.1 Description of Resource

Electromagnetic fields (EMF) are electric and magnetic fields present around electrical devices. Electric fields are caused from voltage or electrical charges and magnetic fields are due to the flow of electricity or current that travels along transmission lines, power collection lines, substation transformers, house wiring, electrical appliances, etc. The intensity of the electric field is related to the voltage of the line and the intensity of the magnetic field is related to the current flow through the conductors (e.g., wires). EMF occurs both indoors and outdoors; however, no discernible health impacts from power lines have been identified in previous studies (NIEH, 1999).

The proposed 161 kV interconnection transmission line would originate at the Project Substation to be located adjacent to the O&M facility. Wind turbine generators and associated interconnection cables will be setback from residences in excess of state standards, where EMF will be at background levels.

Stray voltage is a natural phenomenon that results from low levels of electrical current flowing between two points that are not directly connected. Where distribution lines have been shown to contribute to stray voltage on farms, the electric distribution system directly serving the farm or the wiring on a farm was directly serving the farm, or the wiring on a farm was directly under and parallel to the transmission line. These factors are considered in design and installation of transmission lines and can be readily mitigated. Problems related to distribution lines are also readily managed by correctly connecting and grounding electrical equipment.

8.8.1.2 Impacts

The question of whether or not exposure to magnetic fields potentially causes biological responses or even health effects continues to be the subject of research and debate even though the general consensus is that electric fields pose no risk to humans. EMF from underground electrical collection lines dissipates close to the lines because they are installed below ground within insulated shielding. The electrical fields around the lines are negligible and the small magnetic field directly above the lines dissipates within 20 ft on either side of the installed cable, based on engineering analysis. EMF associated with the transformers within the nacelle dissipates within 500 ft, so the 1,000-foot turbine setback from residences will be adequate to avoid any EMF exposure to homes.

To address stray voltage, electrical systems, including farm systems and utility distribution systems, must be adequately grounded to the earth to ensure continuous safety and reliability, and to minimize this current flow. Potential impacts from stray voltage can result from a person or animal coming in contact with neutral-to-earth voltage. Stray voltage does not cause electrocution and is not related to ground current, EMF, or earth currents. Stray voltage is a particular concern for dairy farms because it has the potential to impact operations and milk production. Problems are usually related to the distribution and service lines directly serving the farm or the wiring on a farm affecting confined farm animals.

8.8.1.3 Mitigative Measures

Freeborn Wind is dedicated to siting turbines and associated facilities to avoid impacts with dairy farmers within the Project Area. The Project will design, construct and operate all electrical equipment and devices, including turbines, transformers, collection lines, transmission lines, and associated electrical equipment, in accordance with applicable codes, manufacturer specifications, and required setbacks. Because no impacts due to electromagnetic fields (EMF) or stray voltage are anticipated, no mitigation is proposed.

8.8.2 Air Traffic

8.8.2.1 Description of Resource

There are six airports within 20 miles of the Project Area (see Table 8.8-1). The nearest airport is the Northwood Municipal Airport, located approximately 3.6 miles south of the Project Area in Worth County, IA.

Table 8.8-1: Airports within 20 Miles of the Project Site

Airport Name	City	County, State	Distance [1]	Runway Information [2]	Runway Elevation (feet) [3]
Albert Lea Municipal Airport	Albert Lea	Freeborn, MN	7.9 W/NW of Project	Asphalt, good	1,261

Table 8.8-1: Airports within 20 Miles of the Project Site

Airport Name	City	County, State	Distance [1]	Runway Information [2]	Runway Elevation (feet) [3]
Mayo Clinic Health System Heliport - Albert Lea [4]	Albert Lea	Freeborn, MN	7.7 W of Project	Helipad H1	70 x 70 ft
Austin Municipal Airport	Austin	Mower, MN	8.9 miles E/NE of Project	Concrete, good	1,233.5
St. Olaf Hospital Heliport [4]	Austin	Mower, MN	7.0 miles NE of Project	Helipad H1	50 x 50 ft
Northwood Municipal Airport	Northwood	Worth, IA	3.6 miles S of Project	Turf, fair	1,226
Lake Mills Municipal Airport	Lake Mills	Winnebago, IA	15.1 SW of Project	Turf, fair	1,260

1 Distance in miles from the nearest portion of the Freeborn Wind Farm Project Area.
2 Runway surface type and condition.
3 Elevation in feet at the highest point on the centerline of the useable landing surface. Measured to the nearest foot with respect to mean sea level.
4 The heliports listed here are private

8.8.2.2 Impacts

The closest airport to the Project is the Northwood Municipal Airport, located approximately 3.6 miles south of the Project Area. Freeborn Wind will coordinate with the Northwood Municipal Airport, the FAA, and applicable state authorities prior to construction to understand potential impacts.

In addition to commercial flights associated with the above airports at distance from the Project, air traffic may be present near the Project Area for agricultural field crop dusting. Crop dusting is usually conducted during the day by highly maneuverable airplanes or helicopters. Installing wind turbine towers, aboveground transmission lines, or other associated aboveground facilities in active croplands would create a potential for collisions with crop-dusting aircraft. However, aboveground transmission lines are expected to be routed along edges of fields, roadways or other existing linear infrastructure, similar to existing distribution lines. The proposed turbines would be visible from a distance and lighted according to FAA guidelines.

It is anticipated that the FAA review of the Project will result in a “No Hazard” issuance determination because Freeborn Wind has prescreened the Project Area with consultant Aviation Systems Incorporated and has designed the turbine layout to receive No Hazard determinations. Both turbines and meteorological towers will have lighting to comply with applicable FAA requirements.

8.8.2.3 Mitigative Measures

Setbacks to airport facilities must be in accordance with MNDOT Department of Aviation and FAA requirements. Further, the Applicant will appropriately mark and light the turbines to comply with FAA requirements. The Applicant will notify local airports about the Project and new towers in the area to reduce the risk to crop dusters. Freeborn Wind will coordinate with landowners within and proximal to the Project regarding crop dusting activities. Permanent meteorological towers will be freestanding with no guy wires. Temporary meteorological towers had supporting guy wires which were marked with alternating red and white paint at the top and colored marking balls on guy wires for increased visibility.

8.8.3 Safety and Security

8.8.3.1 Description of Resource

The Project is located in an agricultural, rural setting. Freeborn Wind is coordinating with applicable emergency and non-emergency response staff for the area, such as local law enforcement agencies, 911 services, fire departments, and ambulance services. Construction and operation of the Project is anticipated to have minimal impacts on the security and safety of local residents and the general public.

8.8.3.2 Impacts

Construction and operation of the Project is not anticipated to have any significant impact to security and safety of the local population. Current turbine technology, proactive maintenance, and regular facility inspections have reduced the risk to insignificant rates.

In the event that emergency services are needed at local residences during construction, construction activities will be stopped and relocated so that emergency vehicles may have unfettered access the emergency site.

8.8.3.3 Mitigative Measures

Freeborn Wind will coordinate with regional air ambulance, sheriff’s offices, and fire services, to develop a safety plan during construction and operations of the Project. The Applicant will provide information about the Project and to answer any questions first response teams may have regarding Project plans and details.

As discussed in other segments of this SPA, the following security measures will be enacted to reduce personal injury or property damage:

- All Project related facilities will be equipped with sufficient security measures during construction and operation of the Project. These measures may include temporary and/or permanent fencing, warning signs, and secure locks on equipment and wind power facilities;
- Security gates and fences will be constructed at locations deemed necessary by Freeborn Wind at the request of landowners;
- Construction and operation staff safety training will be provided;
- Regular maintenance and inspections will be conducted to assess potential blade failures and minimizing the potential for blade throw; and
- Large setbacks are being used from roads, property lines, homes, and other infrastructure. These distances mitigate potential damage from any unusual and unlikely tower collapses or blade failures.

8.9 Hazardous Materials

8.9.1 Description of Resources

The Project Area is primarily rural and used for agriculture. Potential hazardous materials within the Project Area may be associated with agricultural activities and material uses, including herbicides, pesticides, petroleum products (fuel and lubricants), solid and liquid waste disposal, water supply wells (domestic and agricultural). Farmstead facilities may also contain lead-based paint, asbestos (shingles, insulation, etc.), and polychlorinated biphenyls (in electrical transformers). Trash and farm equipment dumps are also common in rural settings and are present in the Project Area.

Freeborn Wind conducted a preliminary review of the MPCA "What's in My Neighborhood?" database to identify state listed sites that may have environmental impacts. Review of this information indicates the following designated sites are located within the Project Area:

- 35 feedlot sites;
- 12 tank sites;
- 5 construction stormwater permit sites;
- 4 hazardous waste (small to minimal quantity generators) sites;
- 3 multiple activities sites;
- 2 leak sites;
- 1 air permit site; and
- 1 wastewater discharge site.

The above-listed sites will be avoided by the Project. Operation of the Project turbines will include use of petroleum products including gear box oil (either mineral based or synthetic based upon manufacturer and application), hydraulic fluid, and gear grease. The turbines will be regularly serviced and any waste fluids that are generated with this service will be managed and disposed of (if needed) or recycled in compliance with applicable waste disposal laws and regulations.

8.9.2 Impacts

Freeborn Wind will conduct a Phase I Environmental Site Assessment (ESA) in accordance with ASTM E 1527-13 (Phase I ESA). The Phase I ESA will identify known recognized environmental conditions or historical recognized environmental conditions that may require additional action prior to or during construction. The Phase I ESA will be conducted prior to construction to locate and avoid hazardous waste sites.

During construction of the Project, some solid and fluid wastes will be generated from construction activities. These wastes will be properly contained and disposed of following applicable state and local requirements.

During operation of the Project, turbine hydraulic oils and lubricants will be contained within the wind turbine nacelle and within service vehicles. The turbine transformers in the nacelle are the dry type. The Project will monitor fluids during maintenance at each turbine and transformer. A small volume of hydraulic oil, lube oil, grease, and cleaning solvent will be stored in the O&M building. When fluids are replaced, the used products will be handled according to applicable regulations and disposed of or recycled through an approved waste disposal firm.

8.9.3 Mitigative Measures

Because any potential hazardous waste sites identified will be avoided by the Project, no mitigative measures are necessary. Any wastes, fluids, or pollutants that are generated during construction and operation of the Project will be handled, processed, treated, stored, and disposed of in accordance with Minn. R. Ch. 7045 and local requirements.

8.10 Land-Based Economies

8.10.1 Agriculture/Farming

8.10.1.1 Description of Resources

The majority of the Project Area is agricultural cropland (see Figure 11). Cultivated land comprises approximately 24,058.7 acres (91.6 percent) of the Project Area. Pasture land comprises approximately 95.3 acres (0.4 percent) of the Project Area.

Grain, oilseed and dry bean and pea crops are grown throughout Freeborn County and represent 69 percent of the agricultural market for the County. Raising livestock and dairy farming are major sources of income, representing a combined 31 percent of the county agricultural market. Within the Project Area, the trend has been toward fewer individual farms and an increase in farms of greater acreage (U.S. Department of Agriculture [USDA], 2012). Converting cropland to the Conservation Reserve Program (CRP) and the RIM program is another source of farm income. CRP and RIM lands are cropland planted to conservation grasses and legumes to protect and improve the soil with limited harvesting or pasturing allowed on CRP land. CRP land is enrolled for 10-year periods, whereas RIM conservation easements are permanent.

Approximately 32 percent of the soil within the Project Area is prime farmland. The USDA Natural Resource Conservation Service (NRCS) identifies prime farmland as land that has the best combination of both physical and chemical characteristics for the production of food, livestock feed and forage, fiber, and oilseed crops and is available for these agricultural uses. Important farmlands consist of prime farmland, unique farmland, and farmland of statewide or local importance (U.S. Department of Agriculture, 2016).

8.10.1.2 Impacts

The construction and operation of the Project will not significantly impact the current agricultural land use or character of the area.

Small portions of land will be removed from agricultural production at turbine locations and along proposed access roads (less than 1 acre per turbine). Individual landowners will be able to continue to plant crops and graze livestock up to the turbine pads. In some instances, agricultural practices may be impacted by creating altered maneuvering areas for agricultural equipment around turbine structures and access roads, but access roads have been designed with landowner input for minimal agricultural impact. For example, access roads are placed along fencelines wherever possible, and if they do go through fields, they are generally oriented in parallel with farming directions. In many cases, access roads are longer than absolutely necessary so as to minimize agricultural impact via selection of a route that minimizes agricultural equipment maneuvering changes.

If construction activities are executed outside of winter months, temporary impacts to agriculture fields may occur. These temporary impacts may include limited planting opportunity, crop damage, drain tile damage, and soil compaction.

Only 32 percent of the soil within the Project Area is considered prime farmland. The loss of agricultural land to the construction of the wind farm will reduce the amount of land that can be cultivated. Approximately 0.1 percent of the Project Area will be converted to non-agricultural land use. Similarly, approximately 8.5 acres (less than 0.1 percent) will be converted out of prime farmland. This will not significantly alter crop production in the Project Area or Freeborn County.

Negotiations with property owners have produced land agreements mutually agreeable to both parties that address agricultural impacts such as crop damage, soil compaction, and drain tile repairs. Drain tile will be repaired according to the agreement between Freeborn Wind and the owner of any damaged tile. Freeborn Wind will strive to avoid impacts to CRP land and RIM lands.

Stray voltage is a natural phenomenon that is the result of low levels of electrical current flowing between two points that are not directly connected. Electrical systems, including farm systems and utility distribution systems, must be adequately grounded to the earth to ensure continuous safety and reliability, and to minimize this current flow. Potential effects from stray voltage can result from a person or animal coming in contact with neutral-to-earth voltage. Stray voltage does not cause electrocution and is not related to ground currents, EMF, or earth currents. Stray voltage is a particular concern for dairy farms because it can impact operations and milk production. Problems are usually related to the distribution and service lines directly serving the farm or the wiring on a farm affecting confined farm animals. In those instances where distribution lines have been shown to contribute to stray voltage, the electric distribution system directly serving the farm or the wiring on a farm was directly under and parallel to the transmission line. These circumstances are considered in installing transmission lines and can be readily mitigated. Problems related to distribution lines are also readily managed by correctly connecting and grounding electrical equipment. The Applicant recognizes that this issue may occur, and is committed to siting turbines and power lines to avoid conflicts with dairy farms in the Project Area.

8.10.1.3 Mitigative Measures

Only areas occupied by turbines, Project substation, O&M facility, and access roads will be removed from crop production. All land surrounding the constructed facilities can still be farmed. The permanent loss of up 33.3 acres of agricultural land will not result in the loss of any agriculture-related jobs or any net loss of income. Revenue lost from the removal of land from agricultural production will be more than offset by lease payments to landowners hosting the Project facilities. As a result of land payments to landowners hosting facilities and landowners without facilities but with wind rights agreements, significant new agricultural income will enter the county from the Project.

Freeborn Wind will coordinate with property owners to identify features on their property, including drain tile, which can be avoided. Freeborn Wind recognizes that the excavation and heavy equipment associated with construction may cause damage to known or unknown drain tiles. In the event that there is damage to drain tile as a result of construction activities or operation of the Project, Freeborn Wind will work with affected property owners to repair the damaged drain tile in accordance with the easement agreements between Freeborn Wind and the landowners.

Freeborn Wind will avoid or minimize impacts to mapped CRP and RIM lands. If CRP land is impacted, Freeborn Wind will work with the landowner and the NRCS to remove the impacted portion of the enrolled parcel from the CRP program. There will be no impacts to RIM land; therefore, no mitigation will be necessary.

8.10.2 Forestry

8.10.2.1 Description of Resources

According to the MNDNR Division of Forestry (MNDNR, 2016a) commercial or industrial forestry resources are not located within the Project Area. Local forested land within the Project Area is generally associated with homes in the form of shelterbelts or woodlots and gallery forests along the water courses. These, however, are not considered economically significant forest resources.

8.10.2.2 Impacts

Shelterbelts and woodlots associated with residential areas will not be impacted during construction or operation of the Project. No commercial or industrial quality forestry resources are located within the Project Area.

8.10.2.3 Mitigative Measures

No forestry resource mitigation efforts will be required as no impacts to forestry resources are anticipated.

8.10.3 Mining

8.10.3.1 Description of Resources

Sand and gravel resources are regularly exploited in areas dominated by glacial till and outwash deposits. Many of the pits are inactive, abandoned, or their use is limited to the landowner. Based on MnDOT County Pit Maps and topographic maps, there are no active gravel pits located within the Project Area (MnDOT, 2016).

8.10.3.2 Impacts

Negative impacts to mining are not anticipated.

8.10.3.3 Mitigative Measures

No impacts to mining resources are anticipated. No mitigation will be necessary.

8.11 Tourism

8.11.1 Description of Resources

The majority of tourism marketing in Freeborn County focuses on promoting destinations and attractions located in the City of Albert Lea, located approximately 6 miles northwest of the Project Area. Efforts promoting tourism activities in other portions of Freeborn County focus on public facilities, such as Myre-Big Island State Park and the Blazing Star Trail (linking Myre-Big Island State Park and Albert Lea) (Albert Lea Convention and Visitors Bureau, 2017).

Recreational Vehicle (RV) and bus tours are present in the area and these tourists have been receptive to tours of the existing wind farm in the county.

8.11.2 Impacts

All facilities associated with the Project will be located on private lands. No impacts to public recreational facilities or tourism-related activities are anticipated. Setbacks from recreational facilities, public amenities, and non-participating properties will negate direct impacts and minimize indirect impacts.

8.11.3 Mitigative Measures

No tourism mitigation efforts are anticipated as no impacts to tourism activities are expected.

8.12 Local Economies

8.12.1 Description of Resources

According to the U.S. Census Bureau (U.S. Census, 2010), the largest industries employing residents of Freeborn County are: 1) education, health care and social assistance services (23.2 percent), 2) manufacturing (19.1 percent), and 3) retail trade (12.9 percent).

The 2015 per capita income for Freeborn County was $26,494. Hayward Township has a per capita income level higher than that of the county at $35,450 while London Township exhibits a comparably elevated per capita level of $37,486. Oakland Township has a relatively lower per capita income level at $31,917 compared to Hayward and London Townships, but is still above the county average. Shell Rock Township has a per capita income level of $23,627, which is the only township of the four included in the Project Area with a lower per capita level than the county. The per capita income level appears to correlate with relative poverty levels for the county. Hayward, London, and Oakland townships have a lower percentage of poverty rate (2.8 percent, 2.1 percent, and 1.7 percent respectively) than Freeborn County's rate of 8.3 percent. Shell Rock Township, however, has a higher percentage of poverty than the other three townships at 3.5 percent, but is still below the county level.

The Project provides citizens of the county, landowners, and farmers with opportunities for new economic opportunities from the generation of wind energy.

8.12.2 Tax Payments and Property Values

8.12.2.1 Tax Payments

Long-term beneficial impacts to the county's tax base as a result of the construction and operation of the Project will contribute to improving the local economy. In addition to the creation of jobs and personal income, the Project will pay a Wind Energy Production Tax to the local units of government of $1.20 per megawatt hours Mwh of electricity produced, resulting in an annual tax payment of approximately $9,400 per turbine per year, or up to $397,000 per year if all 42 turbines are able to be constructed.

8.12.2.2 Property Values

Project facilities will be sited and constructed predominantly on leased agricultural lands owned by participating landowners being compensated for the use of their property, yielding increased valuations on the farmland due to the harvest of electricity along with traditional agricultural products that underpin the value of the land.

8.12.3 Impacts

8.12.3.1 Tax Payments

It is anticipated that local contractors and suppliers will be engaged during construction. Wages and salaries paid in Freeborn County will contribute to personal income of the region. Additional household income will be generated for residents in the county and state by corollary payments made by the Applicant during development, construction and operation of the proposed facility as well as state and local taxes throughout the life of the Project. Purchase of equipment, fuel, supplies, and other services and materials will benefit local economies.

Local wind energy production tax payments are split 80 percent to Freeborn County and 20 percent to the host township. Local townships can benefit from this new tax revenue to fund their services, particularly road maintenance, and the Project will assist in this regard. Elsewhere in Freeborn County, a Hartland Township Supervisor has reported that township generates almost half of its annual income from wind energy and uses that revenue to fund road maintenance, among other things, resulting in benefits for all township residents.

8.12.3.2 Property Values

The Project provides opportunities to landowners and farmers for increased agricultural profitability and a more diverse source of income. Wind energy generation provides a long-term, annual benefit to participating landowners. Landowners having turbines or other Project facilities on their land, as well as those who have leased their wind rights to the Project, will receive a royalty or lease payment annually for the life of the Project.

As all Project facilities will be located on leased lands it is anticipated that there will be no unmitigated impacts to the property values of participating landowners. Concerns regarding adverse impacts to property values of non-participating landowners adjacent or proximal to wind farm developments have been expressed to the Applicant. Freeborn Wind completed a market impact analysis of the Project and determined that there is no credible data indicating property values are adversely impacted due to proximity to wind farm developments (see Appendix E). The results of the Project market impact analysis mirror the findings of a nationwide study that reviewed the sale of over 50,000 home sales in nine separate states and found that sale prices/ property values were not impacted by wind development actions (Hoen et al., 2013).

8.12.4 Mitigative Measures

8.12.4.1 Tax Payments

Socioeconomic impacts associated with the Project will be positive. The construction and operation of the Project will provide an increase in wages and purchases made at local businesses and an increase in the counties' tax base.

8.12.4.2 Property Values

No negative impacts on property values within or near the Project are anticipated. Participating landowners will be compensated for the use of their property. Non-participating properties are not expected to see any impacts to their values, partially because the SPA will be adhering to required setbacks from homes as well as strict restrictions on potential nuisances such as sound and shadow flicker.

8.13 Topography

8.13.1 Description of Resources

The Project is located in the Oak Savanna subsection of the MNDNR's Ecological Classification System (MNDNR, 2009). The Oak Savanna subsection is a series of end moraines that acted to limit the spread of prairie fires from the west and did not support the establishment of hardwood forests from the east. The result was the development of an oak savanna interspersed with areas of tallgrass prairie and maple-basswood forest. The topography of the subsection consists of rolling plains derived of loess-mantled ridges overlying till and bedrock. In the Project Area, elevations range from 1,174 ft to 1,307 ft (349 meters to 398 m) above sea level. An elevation map of the Project Area is shown on Figure 7.

8.13.2 Impacts

No impacts to topography are anticipated. Wind turbines and access roads will not require significant modification to the existing topographic features.

8.13.3 Mitigative Measures

No mitigative measures are necessary as no impacts are anticipated.

8.14 Soils

8.14.1 Description of Resources

Ten soil associations are found within the Project Area (Table 8.14-1 and Figure 12). A soil association has a distinctive pattern of soils, relief, and drainage. Each is a unique natural landscape consisting of one or more major soils and other minor soils. The association is named after its major soils.

Table 8.14-1 Soil Associations in Project Area

Soil Association	Area (acres)
Webster-Nicollet-Clarion-Canisteo (s1750)	4,083
Webster-Nicollet-Lester (s1752)	452
Kenyon-Floyd-Clyde (s1759)	707
Lester-Hamel (s3504)	2,197
Mayer-Estherville-Biscay (s3510)	14
Webster-Estherville-Dickinson (s3616)	764
Muskego-Caron-Blue Earth variant-Blue Earth (s3618)	2,366
Moland-Merton-Maxcreek-Canisteo (s3619)	12,689
Waukee-Udolpho-Marshan-Hayfield-Fairhaven (s3626)	662
Newry-Maxcreek-Havana-Blooming (s3631)	2,338
Total	**26,273**

The Webster-Nicollet-Clarion-Canisteo Association – Webster soils are silty clay loam on a concave slope of about 1 percent gradient in a cultivated field. Webster soils are very deep, poorly drained, moderately permeable soils formed in glacial till or local alluvium derived from till on uplands. Nicollet soils are clay loam on a 2 percent plane slope in a cultivated field. Nicollet soils are very deep, somewhat poorly drained soils that formed in calcareous loamy glacial till on till plains and moraines. Clarion soils are loams on a convex upland with a slope of 4 percent, in a cultivated field. Clarion soils are very deep, moderately well drained soils on uplands formed in glacial till. Canisteo soils are clay loam, on a nearly level to slightly convex slope, on a ground moraine, in a cultivated field. Canisteo soils are very deep, poorly and very poorly drained soils that formed in calcareous, loamy till or in a thin mantle of loamy or silty sediments and the underlying calcareous, loamy till. These soils are on rims of depressions, depressions and flats on moraines or till plains (USDA, 2016).

The Webster-Nicollet-Lester Association – Webster and Nicollet soils are described above. Lester soils are loams, on a convex slope of about 9 percent, on a ground moraine, in a cultivated field. Lester soils are very deep, well drained soils that formed in calcareous, loamy till. These soils are convex slopes on moraines and till plains (USDA, 2016).

The Kenyon-Floyd-Clyde Association – Kenyon soils are loams, on a convex, south-facing ridge top with a slope of 3 percent, in a cultivated field. Kenyon soils are very deep, moderately well drained soils formed in 30 to 75 centimeters (cm) of silty or loamy sediments and the underlying till. These soils are on interfluves and side slopes on dissected till plains. Floyd soils are loams, on a southwest-facing slope of about 3 percent, in a bluegrass pasture. Floyd soils are very deep, somewhat poorly drained soils formed in 75 to 150 cm of loamy sediments and in the underlying till. These soils are on concave foot slopes adjacent to upland drainageways on dissected till plains. Clyde soils are silty clay loams, on an east-facing, concave slope of 1 percent, in a pasture. Clyde soils are very deep, poorly and very poorly drained soils formed in 75 to 150 cm of loamy glacial outwash or erosional sediments and the underlying loamy till. These soils are on nearly level positions, swales and concave drainageways on interfluves on dissected till plains (USDA, 2016).

The Lester-Hamel Association – Lester soils are described above. Hamel soils are loams with a 2 percent concave slope on a glacial moraine in a cultivated field. Hamel soils are very deep, poorly drained and somewhat poorly drained soils that formed in slope colluvium and glacial till on moraines. These soils have moderately slow permeability (USDA, 2016).

The Mayer-Estherville-Biscay Association – Mayer soils are loams, with a slightly convex slope of less than 1 percent, on a glacial outwash plain, in a cultivated field. Mayer soils are very deep, poorly and very poorly drained soils that formed in 50 to 100 cm of a loamy mantle and the underlying sandy and gravelly glacial outwash. These soils are on concave or slightly convex positions on glacial outwash plains, till plains, and stream terraces. Estherville soils are sandy loam, on a plane slope of about 1 percent, on a glacial outwash plain, in a cultivated field. Estherville soils are very deep, somewhat excessively drained soils that formed in 25 to 50 cm of loamy sediments over sandy and gravelly outwash. These soils are on outwash plains, stream terraces, valley trains, and kames on moraines. Biscay soils are loam, on a level slope, on an outwash plain, in a cultivated field. Biscay soils are very deep, poorly drained and very poorly drained soils that formed in 50 to 100 cm of loamy glacial outwash and the underlying calcareous sandy and gravelly glacial outwash. These soils are on concave or slightly convex positions on glacial outwash plains, till plains, valley trains, stream terraces and flood plains (USDA, 2016).

The Webster-Estherville-Dickinson Association – Webster and Estherville soils are described above. Dickinson soils are fine sandy loam, on a convex slope of 3 percent, in a cultivated field. Dickinson soils are very deep, well drained soils formed in glacial or alluvial deposits that have been reworked by wind. These soils are on uplands and on treads and risers on stream terraces in river valleys (USDA, 2016).

The Muskego-Caron-Blue Earth Association – Muskego soils are muck - on a slope of less than 1 percent in a cultivated field. Muskego soils are very deep, very poorly drained soils formed in herbaceous organic material over sedimentary peat on glacial lake plains, flood plains, and till plains. Caron soils are muck with a plane level slope in a large bog in a rolling glacial moraine; pastured. Caron soils are deep very poorly drained organic soils that formed in a layer of organic soil material and in underlying coprogenous earth. These soils are in bogs in glacial moraines. They have moderate and moderately rapid permeability in the organic soil material and moderately slow permeability in the underlying coprogenous earth. Blue Earth soils are mucky silty clay loam, on a plane level slope in the bottom of a former postglacial lake, in a cultivated field. Blue Earth soils are very deep, very poorly drained soils that formed in 75 to more than 200 cm of coprogenous earth and the underlying loamy till, lacustrine sediments, or outwash of Late Wisconsin glaciation. These soils are on plane or slightly concave slopes in former lake basins in moraines, flood plains, and lake plains (USDA, 2016).

The Moland-Merton-Maxcreek-Canisteo Association – Moland soils are silt loam, on a convex, east-facing slope of 5 percent, in a cultivated field. Moland soils are very deep, well drained soils that formed in 35 to 60 cm of silty or loamy sediments and the underlying calcareous, loamy glacial till. These soils are on convex slopes on ground moraines. Merton soils are silt loam, on a linear slope of 2 percent, in a cultivated field. Merton soils are very deep, somewhat poorly drained soils that formed in 35 to 60 cm of silty or loamy sediments and the underlying calcareous, loamy glacial till. These soils are on linear and slightly convex slopes on ground moraines. Max Creek soils are silty clay loam, on a linear slope of less than 1 percent, in a cultivated field. Max Creek soils are very deep, poorly and very poorly drained soils that formed in 65 to 102 cm of loess or silty sediments and the underlying calcareous, loamy glacial till. These soils are on linear or concave slopes on ground moraines. Canisteo soils are described above (USDA, 2016).

The Waukee-Udolpho-Marshan-Hayfield-Fairhaven Association – Waukee Soils are loam, on a north-facing, convex slope of about 1 percent, on a stream terrace, in a cultivated field. Waukee soils are very deep, well drained soils that formed in 50 to 100 cm of loamy alluvium or outwash and in the underlying sandy to gravelly alluvium or outwash. These soils are on treads and risers on stream terraces in river valleys and in outwash areas. Udolpho soils are silt loam, on a linear slope of 1 percent, in a cultivated field. Udolpho soils are very deep, poorly drained and very poorly drained soils that formed in 50 to 102 cm (20 to 40 inches) of silty or loamy sediments and the underlying sandy and gravelly outwash. These soils are on linear or concave slopes on outwash plains, valley trains, stream terraces, and glaciated uplands. Marshan soils are silty clay loam, on a plane slope on a terrace along a small stream in a cultivated field. Marshan soils are very deep, poorly and very poorly drained soils that formed in 50 to 100 cm of loamy sediments and the underlying sandy and gravelly outwash. Marshan soils are on plane or slightly concave positions along narrow drainageways on outwash plains, valley trains, and stream terraces. Hayfield soils are loam, on a linear slope of less than 1 percent, in a cultivated field. Hayfield soils are very deep, somewhat poorly drained soils that formed in 50 to 100 cm of silty or loamy sediments and the underlying sandy and gravelly outwash. These soils are on linear or concave slopes on outwash plains, valley trains, treads and risers on stream terraces, and glaciated uplands. Fairhaven soils are silt loam, on a nearly level slope, on an outwash plain, in a cultivated field. Fairhaven soils are very deep, well drained soils formed in 50 to 100 cm of loamy sediments and the underlying calcareous sandy and gravelly glacial outwash. The Fairhaven soils are on stream terraces, outwash plains, and valley trains (USDA, 2016).

The Newry-Maxcreek-Havana-Blooming Association – Newry soils are silt loam, on a linear slope of 2 percent, in a cultivated field. Newry soils are very deep, moderately well drained soils that formed in 35 to 60 cm of silty or loamy sediments and the underlying calcareous, loamy glacial till. These soils are on linear and slightly convex slopes on ground moraines. Max Creek soils are described above. Havana soils are silt loam with a plane slope of less than 1 percent on a ground moraine, cultivated field. Havana soils are deep poorly drained soils that formed in a mantle of loess or loamy sediments and loamy calcareous glacial till on ground moraines. These soils have moderately slow permeability. Blooming soils are silt loam, on a convex, south-facing slope of 4 percent, in a cultivated field. Blooming soils are very deep, well drained soils that formed in 35 to 60 cm of silty or loamy sediments and the underlying calcareous, loamy glacial till. These soils are on convex slopes on ground moraines and end moraines (USDA, 2016).

8.14.2 Impacts

Construction of wind turbines and associated Project facilities will increase the potential for soil erosion or compaction during construction. In some locations, some prime farmland may be converted from conventional agricultural uses to wind energy generation use. The Project will convert up to 33.3 acres out of cropland for Project facilities (turbines, access roads, Project Substation, and O&M facility). See Section 8.10.1 for a discussion of impacts to prime farmland.

8.14.3 Mitigative Measures

A NPDES permit application to discharge stormwater from construction facilities will be acquired by the Applicant from the MPCA. Best Management Practices (BMPs) will be used during construction and operation of the Project to protect topsoil and adjacent resources and to minimize soil erosion. Practices may include containment of excavated material, protection of exposed soil, and stabilization of restored material. A SWPPP will be developed prior to construction that will include BMPs such as silt fencing, revegetation plans, and management of exposed soils to prevent erosion. Following completion of construction, all impacted property not required for continuing operations of the Project facilities will be restored to a reasonably similar condition to its original condition. Reclamation efforts will include restoration actions to eliminate areas of soil compaction and to replace removed topsoil to its original location. Except for de minimus amounts that are removed as a consequence of construction, topsoil shall not be removed from the property without the consent of the landowner.

8.15 Geologic and Groundwater Resources

8.15.1 Description of Resources

8.15.1.1 Surficial Geology

Surficial geology of the Project Area consists of glacial deposits associated with the Des Moines Lobe. The drift cover of the Project Area is composed predominantly of a mixture of sand, silt and clay materials with varying quantities of pebbles, cobbles, and boulders. The glacial deposits are mantled over the underlying bedrock structures and range in thickness from 50 to 200 ft. The thickness variability is the result of topographic surface of the underlying bedrock structures (Quade and Rongstad, 1991).

8.15.1.2 Bedrock Geology

The bedrock underlying the glacial material in the Project Area consists of series sandstone, shale, and carbonate deposits dating from the Late Cambrian to Early Ordovician (see Figure 13). This bedrock consists of materials deposited in shallow marine environments that covered this portion of southern Minnesota 500 million years ago. The lithological features of the bedrock in the Project Area is relatively uniform as a result of the consistent nature of the geologic processes in the region (Quade and Rongstad, 1991).

8.15.1.3 Aquifers

Groundwater in Freeborn County is derived from four bedrock aquifer systems. The Project Area is situated completely within the Cedar Valley-Maquoketa-Galena aquifer system. This aquifer is composed of carbonate rocks, limestone or dolomite with some quartz sands and shale units (Quade and Rongstad, 1991).

8.15.2 Impacts

Impacts to geologic and groundwater resources are not anticipated. Water supply needs will be quite limited and wells will not be impacted. The proposed O&M facility water requirements will be satisfied with a new well.

8.15.3 Mitigative Measures

Construction and operation of the Project will not impact existing water wells as turbines and associated facilities will be set back from occupied structures according to applicable state and county standards.

8.16 Surface Water and Floodplain Resources

8.16.1 Description of Resources

Surface water and floodplain resources for the Project Area were identified by reviewing U.S. Geological Survey (USGS) topographic maps, Minnesota Public Waters Inventory (PWI) maps, and other resources. The Project Area occurs within the vicinity of the Lower Mississippi River Basin in the Shell Rock River and Cedar River watersheds (MNDNR, 2016c) (see Figure 14). There are streams and county ditches in the Project Area. Figure 14 shows the locations of surface waters, federal Clean Water Act (CWA) 303(d) impaired waters, Minnesota PWI waters, Minnesota's update to the National Wetlands Inventory (NWI) wetlands, and trout streams within the Project vicinity, all of which were downloaded from the Minnesota Geospatial Commons.

8.16.1.1 Minnesota Public Waters Inventory

Public waters are all waterbasins and watercourses that meet the criteria set forth in Minn. Stat Ch. 103.G.005, subd. 15 that are identified on PWI maps authorized by Minn. Stat., Ch. 103G.201 (MNDNR, 1984). Public water wetlands include all type III, type IV, and type V wetlands (as defined in USFWS Circular No. 39, 1971 edition) that are 10 acres or more in size in unincorporated areas or 2.5 acres or more in size in incorporated areas. There is one PWI wetland, three PWI watercourses, and one PWI ditch in the Project Area (see Table 8.16-1).

Table 8.16-1: Public Waters Inventory within the Project Area

PWI Type	PWI Feature Name
PWI Watercourse	Shell Rock River (24024a)
	Peter Lund Creek
	Unnamed Stream (24011a)
PWI Ditch	Unnamed Stream
PWI Wetland	Unnamed

Most waterbodies (65 percent) in the Project Area are classified as county ditches.

8.16.1.2 Impaired Waters

CWA Section 303(d) requires each state review, establish, and revise water quality standards for all surface waters within the state. Waters that do not meet their designated beneficial uses because of water quality violations are considered impaired. There are two impaired waters within the Project Area: Shell Rock River and Woodbury Creek. The Shell Rock River is listed as having the following impairments: fecal coliform, aquatic macroinvertebrate bioassessments, fishes bioassessments, dissolved oxygen, turbidity, and pH. Woodbury Creek is listed as having impairments for fecal coliform (MPCA, 2016).

8.16.1.3 Wildlife Lakes in and Adjacent to Project Area

The MNDNR commissioner may formally designate lakes for wildlife management under the authority of Minnesota Statutes 97A.101 subd. 2. This designation allows the MNDNR to temporarily lower lake levels periodically to improve wildlife habitat and regulate motorized watercraft and recreational vehicles on the lake. (MNDNR, 2014). There are no designated wildlife lakes in the Project Area. The nearest wildlife lake is Upper Twin Lake located approximately 8.5 miles west of the Project Area.

8.16.1.4 Federal Emergency Management Agency Floodplains within Project Area

There are 100-year floodplains associated with the Shell Rock River, Deer Creek, and unnamed streams in the Project Area (see Figure 15).

8.16.2 Impacts

The Project will not require the appropriation of surface water or permanent dewatering. Temporary dewatering may be required during construction for specific turbine foundations and/or electrical trenches.

Project facilities will be designed to avoid impacts on surface water resources to the extent practicable. Wind turbines will be built in uplands to avoid impacts to surface waters and wetland; however, Project facilities, such as collection lines, access roads, crane paths, and the Project Substation will impact land, and therefore potentially impact surface water runoff in the

Project Area. Ground disturbing construction activities may also cause sedimentation; however, these impacts are expected to be minimal.

There are no turbines sited within Federal Emergency Management Agency (FEMA) floodplains; however, the access roads to Turbines 28, 33, and 34 will cross floodplains but are not anticipated to increase the flood stage level or reduce the flood storage capacity. Additionally, temporary workspace associated with these turbines will be within a floodplain. These temporary impacts will be restored to preconstruction grades and elevations.

8.16.3 Mitigative Measures

Turbines will be sited on the relatively high elevation portions of the Project Area to maximize the wind resource, thereby likely avoiding surface waters and floodplains, which tend to be at lower elevations. Access roads and the Project Substation will be designed to minimize impacts on surface waters and floodplains. Temporary impacts associated with crane paths will also be minimized. Installation of electrical collection cables is expected to avoid impacts by boring under surface water features, as necessary.

BMPs will be used during construction and operation of the Project to minimize soil erosion, protect topsoil, and protect surface waters and floodplains from direct and indirect impacts. These may include containing excavated material, protecting exposed soil, using silt fences, stabilizing restored material, and revegetating disturbed areas with non-invasive species.

If Project facilities will impact Waters of the United States, Minnesota's PWI, or 100-year floodplains, Freeborn Wind will work with the appropriate agencies to apply for the necessary permits. Access roads constructed adjacent to streams and drainages will be designed in such a manner that runoff from the upper portions of the watershed can flow unrestricted to the lower portion of the watershed. A SWPPP will be prepared and an NPDES permit will be obtained prior to Project construction. Project activities will avoid crossings of streams and wetlands to the extent possible. Any permanent crossing will be permitted by the appropriate agencies (MNDNR, Local Government Unit [LGU], under the Wetland Conservation Act [WCA], and/or USACE).

8.17 Wetlands

8.17.1 Description of Resources

Wetlands within the Project Area were first analyzed using public databases, including several years of aerial photography: 1991, 2003, 2004, 2006, 2008, 2009, 2011, 2012, and 2015 (Google Earth, 2017); NWI (MNDNR, 2017; USFWS NWI, 2016), PWI (see Minn. Stat. Ch. 103G.201 2016), hydric soils data (USDA NRCS, 2016), topographic maps (USGS, 2016), and USGS National Hydrography Dataset (NHD) (USGS NHD, 2016). These databases identify lakes, streams, rivers, and canals. Onsite assessments were also conducted in April 2015 and November 2016 to confirm the presence or absence of mapped wetlands as well as the extent of wet or saturated features that were visible from public roads (see Appendix F). There are few isolated wetlands throughout the Project Area; however, most wetlands identified in the public databases are associated with streams (see Figure 16). Wetlands classified in the NWI and their acreage within the Project Area are presented in Table 8.17-1.

Table 8.17-1: NWI Wetlands and Acreage within the Project Area

NWI Type		Acreage
Palustrine Freshwater Emergent (PEM)	PEM1A	148.2
	PEM1Af	71.4
	PEM1Ax	0.5
	PEM1B	7.8
	PEM1C	26.6
	PEM1F	14.7
	PEM1Fx	0.8
	Subtotal	**269.9**
Palustrine Forested Wetland (PFO)	PFO1A	71.6
	PFO1B	5.3
	PFO1C	4.1
	PFO1Cx	0.4
	Subtotal	**81.4**
Palustrine Scrub-shrub Wetland (PSS)	PSS1A	25.4
	PSS1B	1.2
	PSS1C	1.5
	Subtotal	**28.1**
Freshwater Pond/Riverine	PABF	0.8
	PUBF	2.7
	PUBFx	6.4
	PUBH	1.7
	R2UBH	13.7
	Subtotal	**25.3**
Wetland Total		**404.7**

There is a total of 404.7 acres of NWI wetlands in the Project Area (1.5% of Project Area). Two-thirds (269.9 acres) of the mapped wetlands are PEM wetlands. Approximately 20 percent (81 acres) of the wetlands are mapped as PFO, which are primarily associated with the Shell Rock River. The remaining 14 percent of wetlands are mapped as PSS wetlands (28.1 acres) and freshwater pond or riverine wetlands (25.3 acres). There is one PWI wetland located within the Project Area, which also overlaps the NWI wetland.

8.17.2 Impacts

As noted in Section 8.16.2, turbines will be sited in upland areas to maximize the wind resource and as such, are likely to avoid wetlands and surface waters, which are typically at lower elevations. Based on the current site design, there are no expected wetland impacts from turbines or the Project Substation/O&M facility. Not only will project infrastructure avoid wetlands, but all turbines have been sited at least 1,000 ft from Class III-IV wetlands (Shaw and Fredine, 1956). Access roads may impact 0.1 acre of PEM wetlands. All mapped water features will be field verified following the USACE Wetlands Delineation Manual (1987) and final impact calculations will be based on the final site design and delineations. Additionally, after the field verification of wetlands, Project facilities may undergo minor shifts so as to avoid wetland features whenever possible. Access roads and the Project Substation will be designed to avoid wetland impacts to the extent practicable. Temporary impacts associated with crane paths will also be minimized. Installation of underground electric cables is expected to avoid impacts by boring under PWI features as necessary. Wherever practical, Freeborn Wind will also parallel collection lines with crane paths to minimize temporary impacts to wetlands.

8.17.3 Mitigative Measures

The layout has been designed to avoid and minimize wetland impacts. Furthermore, formal wetland delineations will be completed prior to construction. Wetlands will be avoided to the extent possible during the construction and operations phases of the Project. If wetland impacts cannot be avoided, Freeborn Wind will submit a permit application to the USACE for dredge and fill within Waters of the United States under Section 404 of the CWA, to the LGU for Minnesota WCA coverage and the MPCA for Water Quality Certification (WQC) under Section 401 of the CWA prior to construction.

Freeborn Wind will mitigate direct or indirect wetland impacts during construction and operation by protecting topsoil, minimizing soil erosion, and protecting adjacent wetland resources. Other practices may include containing excavated material, protecting exposed soils, using silt fences, stabilizing restored material, and revegetating disturbed areas with non-invasive species. As noted above, turbines have been sited at least three rotor diameters from Class III-IV wetlands, except in the one instance mentioned previously (see Section 8.2.4 for more information).

8.18 Vegetation

8.18.1 Description of Resources

8.18.1.1 Land Cover

According to the 2011 National Land Cover Database (NLCD), the majority (91.6 percent) of the Project Area consists of cultivated croplands (i.e., agriculture) and developed areas (5.6 percent) (see Table 8.18-1 and Figure 11). Corn and soybean are the most common crops. Deciduous forest comprises one percent of the Project, mostly associated with farmsteads and the Shell Rock River. Herbaceous land cover comprises 1 percent of the Project Area. Emergent herbaceous wetlands, hay/pasture, woody wetlands, and open water all comprise less than 1 percent of the Project Area. The remaining land cover types all comprise less than 0.1 percent of the Project Area. Note that the NLCD dataset is based off aerial photography and likely underestimates the wetlands in the Project Area. The water resources-specific datasets described in Section 8.17.1 are more accurate.

Table 8.18-1: National Land Cover Types in the Project Area

Land Cover	Area (acres)	Percent of Project Area
Cultivated Crops	24,059	91.6%
Developed, Open Space	1,336	5.1%
Grassland/herbaceous	252	1.0%
Deciduous Forest	253	1.0%
Developed, Low Intensity	117	0.4%
Hay/pasture	95	0.4%
Emergent Herbaceous Wetlands	86	0.3%
Developed, Medium Intensity	23	0.1%
Woody Wetlands	20	0.1%
Open Water	18	0.1%
Barren Land	10	< 0.1%
Evergreen Forest	2	< 0.1%
Developed, High Intensity	1	< 0.1%
Total	**26,273**	**100%**

8.18.1.2 Native Prairie and Native Plant Communities

The DOC and MNDNR define native prairie as grasslands that have never been tilled and contain floristic qualities representative of prairie habitat (MNDNR, 2011). Therefore, planted grasslands such as CRP, which are typically planted in previously tilled fields, are not considered native prairie. However, agricultural grasslands such as pasture and hayfields may be considered native prairie if the land has not previously been tilled. The MNDNR's 2011 guidance recommends that all grasslands, including hayfields, pastures, and fallow lands be evaluated as potentially harboring native prairie. MNDNR maintains maps of native prairie, but not all native prairie have been identified and mapped so there may be unmapped areas. Therefore, Freeborn Wind conducted in-field native prairie evaluations in September 2015 and November 2016 (see Appendix F). Note that these assessments were completed for a larger Study Area than the Project Area included in this SPA.

The native prairie evaluations included both a desktop assessment and field visit to ground-truth and verify potential prairie and/or previously tilled grasslands. Based on the desktop and field reviews, potential native prairie land cover (grassland that does not appear to have been previously tilled) occurs in the Project Area in a small percentage (1.2 percent). The majority of grasslands, both previously tilled and previously untilled, documented in the Project were agricultural grasslands (i.e., hayfields and pastures) consisting of fields of hay/alfalfa, pastures composed of cool season (i.e., non-native) grasses, and lightly grazed pastures largely consisting of weedy/nuisance vegetation.

As an avoidance measure, the Project Area has been modified to exclude two of the larger patches of potential native prairie (not previously plowed) in T101N R20W Section 30 and

T102N R20W Section 17. The remaining potential native prairie in the current Project Area is primarily grass-lined waterways and grassy buffer/filter strips that are typical in agricultural landscapes, which have been mapped and will be avoided during construction and operation of the Project. These areas are typically not tilled, may be mowed, and provide filtration to water resources or water conveyance in heavy rain events.

MNDNR also maps native prairie, native plant communities, and railroad ROW prairie. The Project Area has been refined so as to exclude all MNDNR mapped native prairie, native plant communities, and railroad ROW prairie. Table 8.18-2 provides the acreage of native prairie identified in the Project Area. Based on Freeborn Wind field surveys, there are 467.9 acres of potential native prairie in the Project Area.

Table 8.18-2: Potential Native Prairie in the Project Area

Source	Acres	Percent of Project Area
MNDNR Native Prairie	0	0%
Freeborn Wind – Potential Native Prairie (not previously plowed)	339.2	1.3%
Freeborn Wind – Potential Native Prairie (previously plowed)	128.7	0.5%
Total Native Prairie	**467.9**	**1.8%**[1]

[1] Total Project Area is 26,273 acres

MNDNR also maps sites of biodiversity significance. A site's biodiversity rank is based on the presence of rare species populations, the size and condition of native plant communities within the site, and the landscape context of the site. There are four biodiversity significance ranks: outstanding, high, moderate, and below:

- "Outstanding" sites contain the best occurrences of the rarest species, the most outstanding examples of the rarest native plant communities, and/or the largest, most ecologically intact or functional landscapes.
- "High" sites contain very good quality occurrences of the rarest species, high-quality examples of rare native plant communities, and/or important functional landscapes.
- "Moderate" sites contain occurrences of rare species, moderately disturbed native plan communities, and/or landscapes that have strong potential for recovery of native plant communities and characteristic ecological processes.
- "Below" sites lack occurrences of rare species and natural features or do not meet Minnesota Biological Survey standards for outstanding, high, or moderate rank. These sites may include areas of conservation value at the local level, such as habitat for native plants and animals, corridors for animal movement, buffers surrounding higher-quality natural areas, areas with high potential for restoration of native habitat, or open space.

Table 8.18-3 presents the Minnesota Biological Survey's Sites of Biodiversity Significance that occur in the Project Area and their biodiversity significance rank (see Figure 10). There are no outstanding or high sites of biodiversity significance in the Project Area. There is one moderate site on the western border of the Project associated with U.S. Highway 65. There are also two sites mapped below these criteria totaling 74 acres in the Project Area.

Table 8.18-3: Sites of Biodiversity Significance within the Project Area

Site of Biodiversity Significance	Number of Sites in the Project Area	Acres
Below	2	74
Moderate	1	5.8
High	0	0
Outstanding	0	0
Total	**3**	**79.8[1]**

[1] The total Project area is 26,273 acres

Records of rare plants are discussed in Section 8.20.

8.18.2 Impacts

Vegetation will be removed for the installation of turbine foundations, access roads, the project substation, and O&M facilities. Based on land cover data and confirmed during turbine siting, most turbines will be sited in plowed crop fields that are typically planted to row crops. Access roads in the agricultural landscape are expected to impact crop fields, and potentially grassed areas associated with ditches and roadsides. Impacts to woodlots are not expected. Depending on the final layout, up to 33.3 acres of cropland will be permanently removed from agricultural production. Looking at the entire project boundary and all land types, approximately 0.1 percent (38.2 acres) will be permanently converted to sites for wind turbines, access roads, and facilities. After construction is complete, the temporary workspaces surrounding access roads and turbines will be able to be farmed, grazed, or otherwise managed as they were prior to installation of the wind farm. Temporary vegetation impacts will be associated with crane paths, the installation of the underground collection system, and contractor staging and laydown areas. With ground disturbance and equipment deliveries from different geographic regions, Freeborn Wind will work together with all Project construction parties entering the Project Area to control and prevent the introduction of invasive species. To the extent practicable, direct permanent and temporary impacts to natural areas, including wetlands and native prairies, will be avoided and minimized.

Table 8.18-4 provides a summary of estimated permanent impacts to vegetation. The amount of vegetation that will be removed as a result of the Project will be determined once the site layout is finalized, but the vast majority is anticipated to be crop land. Temporarily disturbed areas will be reseeded to blend with existing vegetation. Avoidance and minimization of impacts to native prairies and wetlands will reduce impacts to those vegetated areas.

Table 8.18-4: Summary of Estimated Permanent Impacts to Vegetation (acres)

Facility	Cultivated Crops	Deciduous Forest	Developed	Total
Turbines	1.9	0	0	**1.9**
Access Roads	22.8	0.1	1.2	**24.1**
Project Substation + O&M Facility	8.6	0	3.6	**12.2**
Total Project Impacts	**33.3**	**0.1**	**4.8**	**38.2**
Total within Project Area	**24,059**	**253**	**1477**	

8.18.3 Mitigative Measures

The Project has been designed to avoid any permanent or temporary impacts to native prairie, native plant communities, and railroad ROW prairies; Freeborn Wind-identified potential native prairie (both previously plowed and not previously plowed); and all sites of biodiversity significance, regardless of rank.

The following measures will be used to avoid and minimize potential impacts to higher quality vegetation types and vegetation in general during siting, construction, and operation of the Project to the extent practicable:

- Freeborn Wind conducted a preconstruction inventory of the Project Area for existing conservation lands such as WMAs and WPAs, which may harbor higher quality habitats, and wetlands, native prairie, and forests. The preconstruction inventories have varying level of detail with the most specific detail in the vicinity of construction (see Appendix G);
- Exclude established WMAs, SNAs, state parks, WPAs, and other recreation areas from consideration for Project facilities;
- Freeborn Wind will avoid impacts to MNDNR mapped native prairie, native plant communities, railroad ROW prairies, sites of biodiversity significance, and Freeborn Wind identified potential prairie;
- Avoid disturbance of wetlands during construction and operation of the Project. If jurisdictional wetland impacts are proposed, Freeborn Wind will obtain applicable wetland permits;
- Minimize impacts to existing trees;
- Prepare a construction SWPPP and obtain a NPDES Permit; and
- Use BMPs during construction and operation of the Project to protect topsoil and adjacent resources and to minimize soil erosion. Best practices will be used during construction and operation of the Project to minimize soil erosion, protect topsoil, and protect surface waters and floodplains from direct and indirect impacts. These may include containing excavated material, protecting exposed soil, using silt fences, stabilizing restored material, and re-vegetating disturbed areas with non-invasive species.

8.19 Wildlife

While this section describes wildlife in general, particular attention is given to birds and bats and the guidelines used to assess potential impacts to these animals from wind energy development.

8.19.1 Description of Resources

8.19.1.1 USFWS Land-Based Wind Energy Guidelines

On March 23, 2012, the USFWS issued the Land-Based Wind Energy Guidelines (WEG) (USFWS, 2012). These voluntary guidelines provide a structured, scientific process for addressing wildlife conservation concerns at all stages of land-based wind energy development. They also promote effective communication among wind energy developers and federal, state, and local conservation agencies and tribes. The WEG provides a tiered approach for assessing potential impacts to wildlife and their habitats. The tiered approach is an iterative decision-making process for collecting information in increasing detail, quantifying the possible risks of proposed wind energy projects to wildlife and habitats, and evaluating those risks to make siting, construction, and operation decisions. Subsequent tiers refine and build upon issues raised and efforts undertaken in previous tiers. At each tier, a set of questions is provided to help the developer identify potential problems associated with each phase of a project, and to guide the decision process. The tiered approach is designed to assess the risks of project development by formulating questions that relate to site-specific conditions regarding potential species and habitat impacts. The tiers are outlined briefly as:

- Tier 1: Preliminary evaluation or screening of sites (landscape-level screening of possible project sites; generally based on readily available public information);
- Tier 2: Site characterization (comprehensive characterization of one or more potential project sites; generally based on consulting with the appropriate agencies/authorities and one or more reconnaissance level site visits by a wildlife biologist);
- Tier 3: Field studies to document site wildlife conditions and predict project impacts (site-specific assessments at the proposed project site; quantitative and scientifically rigorous studies [e.g., acoustical monitoring, point count avian surveys, raptor nest surveys, lek surveys]);
- Tier 4: Post-construction mortality studies (to evaluate direct fatality impacts); and
- Tier 5: Other post-construction studies (to evaluate direct and indirect effects of adverse habitat impacts, and assess how they may be addressed; not done for most projects [e.g., post-construction displacement and/or use studies, curtailment effectiveness studies])

This tiered approach allows developers to determine whether they have sufficient information, whether and/or how to proceed with development of a project, or whether additional information gathered at a subsequent tier is necessary to make those decisions. The WEGs acknowledge that wind energy developers who voluntarily adhere to these guidelines undertake a robust level of wildlife impact analysis, and have a shared responsibility with the USFWS to ensure that the scientific standards of the guidelines are upheld and used to make wise development decisions.

It is important to note that not all of the five tiers are recommended or necessary for all projects.

8.19.1.2 Results of Tier 1 and 2

A Tier 1 preliminary site evaluation and Tier 2 site characterization study (SCS) were initially completed for the Project in Spring 2015 and were later expanded to include new areas being considered for development in Fall 2016 (see Appendix G). The study was based on a comprehensive desktop review of existing data including published technical literature, field guides, public datasets, site visits, agency correspondence and meetings with MNDNR and/or USFWS on March 3 and May 12, 2015; January 13 and May 5, 2016; and January 24, February 28, and April 11, 2017. Based on early agency coordination and the initial Project Area, Tier 3 studies were initiated in 2015. The boundary has since been revised multiple times to avoid and create distance from higher quality wildlife habitats in the Project vicinity. The answers to the questions posed in the USFWS WEG are based on the Project Area included in this SPA; the SCS reports in Appendix G reference a larger Study Area.

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

Based on land cover data, most of the Project Area (91.6 percent) is in active agricultural production. There are no MNDNR mapped native prairie, railroad ROW prairies, or native plant communities in the Project Area. There are also no wildlife managed lands including WMAs and WPAs in the Project Area. The Project Area has been designed to avoid these higher quality habitats. There are four Natural Heritage Information System (NHIS) records within or intercepting the Project Area (see Section 8.20.1 for more information). These include one record of a wet prairie terrestrial community, one record of wild sweetwilliam (*Phlox maculata*; vascular plant listed as special concern), one record of cowbane (*Oxypolis rigidior*; vascular plant on the MNDNR watchlist), and one record of western prairie fringed orchid (*Platanthera praeclara*; vascular plant federally listed as endangered and state listed as threatened). Additionally, based on the USFWS Information for Planning and Consultation (IPaC), the federally threatened northern long-eared bat (*Myotis septentrionalis*) may occur in Freeborn County. To avoid impacts to foraging bats, all turbines are sited at least 1,000 ft from suitable bat foraging habitat, as recommended by USFWS. There is no USFWS-designated critical habitat in Freeborn County.

IPaC lists 23 species of migratory birds of particular conservation concern that may utilize or stop over in Freeborn County. Bald and golden eagles are also federally protected under the Bald and Golden Eagle Protection Act (BGEPA) and are known to occur in Freeborn County. The Shell Rock River intersects a small portion of the western edge of the Project Area where the substation will be located. This area contains some of the only suitable bald eagle nesting and foraging habitat in the Project Area. Freeborn Wind committed to USFWS that it would build fewer than 4 turbines within 0.5 mile of the Shell Rock River to reduce impacts to wildlife, and it ultimately only sited one turbine 0.6 mile from the Shell Rock River, and the rest are more than 1 mile or greater from the river to minimize impacts. Finally, in its February 21, 2017 letter, MNDNR identified two avoidance areas that contain an increased amount of habitat that may concentrate birds and bats. Freeborn Wind is avoiding both avoidance areas.

Does the landscape contain areas where development is precluded by law or designated as sensitive according to scientifically credible information? Examples of designated areas include, but are not limited to: areas of scientific importance; areas of significant value; federally-designated critical habitat; high-priority conservation areas for Non-Governmental Organizations (NGOs); or other local, state, regional, federal, tribal, or international organizations.

There are no protected areas or designated critical habitat in the Project Area. The Shell Rock River may be considered a feature of significant value, though all turbines are sited to the east of the river so they are not placed between nesting habitat and the river, where eagles and other raptors may forage. The Project Area originally abutted Albert Lea Lake, though project infrastructure is now sited approximately 4 miles east of the lake to minimize impacts to birds and other wildlife that may utilize the area around the lake. The Project Area has been refined throughout development to create more distance between project infrastructure and sensitive features.

Are there plant communities of concern present or likely to be present at the site(s)?

As previously noted, the majority of the Project Area is cultivated crops (91.6 percent). There are 6 acres of moderate Sites of Biodiversity Significance (all associated with U.S. Highway 65 ROW) and 74 acres of Site of Biodiversity Significance below the minimum threshold. As mentioned above, there are no MNDNR-mapped native prairies, native plant communities, or railroad ROW prairies in the Project Area. Freeborn Wind also conducted native prairie evaluations for the Project, which included desktop assessments followed by field reviews to identify potential native prairie (not previously plowed and containing certain floristic qualities). Most of these areas were found to lack floristic qualities associated with native prairie habitat (i.e., native plant communities). Based on native prairie field assessments for the Project in 2015 and 2016, there will be no impacts to MNDNR mapped native prairie, native plant communities, railroad ROW prairies, sites of biodiversity significance, or Applicant-identified potential prairie.

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

Freeborn Wind found that there are no NHIS records of maternity roosts or hibernacula within the Project Area or 5 miles of the Project Area. The nearest documented bat hibernaculum is Mystery Cave, located approximately 40 miles to the east of the Project. The distance from this hibernaculum to the Project Area indicates a very low probability of swarming activity in association with this cave during the fall migration period and any activity during winter hibernation. There are no known congregation areas for species of concern in the Project Area. NHIS records identified a colonial waterbird nesting area within 5 miles of the Project, located at Myre-Big Island State Park (see Section 8.20.1). However, this record is dated before 2004. There are also no active eagle nests located within the Project Area. Based on 2017 eagle nest surveys, there is one active and occupied bald eagle nest within two miles of the Project Area on the Shell Rock River; there are two additional active and occupied bald eagle nests within five miles of the Project: one on the Cedar River and one near Albert Lea Lake. Freeborn Wind has conducted several studies on native prairie, raptors and eagle nests, bat habitat and activity, and avian use (see Sections 8.18.1 and 8.19.1.2).

Using best available scientific information, has the developer or relevant federal, state, tribal, and/or local agency independently demonstrated the potential presence of a population of a species of habitat fragmentation concern? If not, the developer need not assess impacts of the proposed project on habitat fragmentation.

Since vegetation and tree clearing will be limited on site, Freeborn Wind has not identified any species of habitat fragmentation concern. The MNDNR recommended avoidance of certain wooded areas to avoid impacts to foraging and nesting habitat. Freeborn Wind committed to avoiding these areas. Since these areas will be avoided, neither the USFWS nor MNDNR have identified that there would be the potential to impact species of habitat fragment concern. The Project Area is predominately cultivated crops and the Project layout will avoid sites of biodiversity significance, mapped native prairie, and sensitive habitat.

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

The list of birds observed during preconstruction surveys in the Project Area during January 2015 to March 2016 is included in Appendix F. Avian use surveys are also ongoing through September 2017. No federally or state-listed threatened or endangered species were observed in the Project Area. Seven sensitive species were observed during large bird surveys (see Avian Use Report in Appendix F). These include four state special concern species (American white pelican, Franklin's gull, trumpeter swan, and peregrine falcon, which is also a USFWS bird of conservation concern), bald and golden eagles (both protected by the BGEPA), and one federal watch list species (American golden plover). As noted previously, the USFWS IPaC lists the northern long-eared bat as a species known to occur in Freeborn County and Freeborn Wind has sited the turbines at least 1,000 ft from suitable bat foraging habitat as recommended by USFWS. Neither the March 18, 2015 or the February 21, 2017 MNDNR letters reference particular bird or bat species of concern.

8.19.1.3 Tier 3 Studies

Freeborn Wind initiated several Tier 3 studies in 2015 in a Study Area (see Table 8.19-1) that was larger than the current Project Area to allow for flexibility in siting turbines away from high value resource areas. Freeborn Wind conducted raptor nest surveys, bat acoustic studies, and avian use studies in 2015 to 2017. Freeborn Wind continues to conduct avian use and raptor nest surveys in 2017 in compliance with the WEG and USFWS' Eagle Conservation Plan Guidance (ECPG). Reports from these studies are included in Appendix F and results of avian and bat studies are summarized in detail in the Avian and Bat Protection Plan (ABPP). Freeborn Wind has continued to coordinate with both USFWS and MNDNR and share the results of these studies as they have become available. During an April 11, 2017 meeting with MNDNR, the agency indicated that the modified Project Area and layout, which avoided high quality bat habitat, negated the need for any additional acoustic bat surveys that were mentioned in the February 21, 2017 MNDNR letter.

Table 8.19-1 Summary of Tier 3 Studies at Freeborn Wind Project

Survey	Dates
Tier 1/Tier 2 Site Characterization Study	Spring 2015 and updated November 2016
Native Prairie Evaluations	September 2015 and November 2016
Wetland Evaluations	April 2015 and November 2016
Raptor Nest Surveys	March 2015, March 2016, and April 2017
Eagle Nest Monitoring	April – August 2015
Avian Use Surveys	January 2015 – March 2016 and October 2016 – September 2017

8.19.1.4 Eagle Conservation Plan Guidance

Wind energy developers and wildlife agencies have recognized a need for specific guidance to help make wind energy facilities compatible with eagle conservation and the laws and regulations that protect eagles. The USFWS has developed the ECPG, Module 1 – Land-based Wind Energy, Version 2 (USFWS, 2013a). The ECPG provides a framework for development that assesses historical information on eagle use or eagle habitat in the geographic region and project area, potential habitat features, presence of known important eagle use areas, presence of foraging areas in a proposed project site, and eagle use in the Project Area.

Freeborn Wind conducted raptor nest surveys in 2015, 2016, and 2017, which included identification of bald eagle and other raptor nests (see Appendix F). The 2015 raptor nest survey was conducted in March 2015 for the then Study Area and 10-mile buffer. The survey did not identify any bald eagle nests in the Project Area, but there were two active, occupied bald eagle nests along the Shell Rock River and two additional active and occupied bald eagle nests approximately 9 miles west-southwest of the Project on a lake in Worth County, Iowa and 10 miles northwest of the Project. There was one potential bald eagle nest occupied by a great horned owl near Albert Lea Lake. Additionally, two red-tail hawk nests were identified in the Project Area.

In 2016, Freeborn Wind conducted an eagle nest survey of the Study Area and 2-mile buffer to determine the status of the three active or potential eagle nests identified during 2015 and to identify any new eagle nests. The two active eagle nests identified in 2015 along the Shell Rock River were also active in 2016; the eagle nest occupied by a great horned owl from 2015 was inactive in 2016. Additionally, no new eagle nests were identified in 2016.

A 2017 raptor nest survey was conducted for an expanded Study Area and 10- mile buffer. The final report for this recent work is forthcoming; however, preliminary results confirm the two eagle nests along the Shell Rock River are occupied and active in 2017. No new eagle nests were identified in the Project Area.

In addition to raptor and eagle nest surveys, Freeborn Wind also conducted eagle nest monitoring to identify eagle flight paths of the two occupied active nests along the Shell Rock River. Nest monitoring was conducted during April – August 2015 and found eagle use concentrated near the Shell Rock River; no flight paths were recorded towards or in the Project Area.

Large bird use surveys, which include observations of eagles and other large raptors, were conducted at 18 locations within the Project Area during January 2015 to March 2016 (see Appendix F). Large bird use surveys are also ongoing at 33 additional locations from October 2016 through September 2017. The results of the 2016 to 2017 surveys will be available after completion of the surveys and data analysis. The lowest eagle use was recorded in the summer; the highest eagle use was recorded during the 2016 winter, when eagles may not have migrated as far south as previous winters due to mild temperatures, instead staying in Minnesota rather than moving further south to Iowa or northern Missouri.

8.19.1.5 Birds

Various migratory and resident bird species utilize the Project Area as part of their life cycle (see Appendix F). Migratory birds may use the Project Area for resting, foraging, or breeding activities for only a portion of the year. Resident bird species occupy the Project throughout the year. As indicated above, Freeborn Wind conducted several avian studies to document avian use in the Study Area. Results of these studies are summarized in the ABPP (see Appendix H); however, it should be noted that the avian community characterized by these studies is consistent with those reported at other wind farms in southern Minnesota and northern Iowa during preconstruction studies. Additionally, no federally or state-listed species have been observed in the Project Area.

In addition to the preconstruction avian use surveys conducted at the Project, preconstruction avian use study results from other wind energy facilities in the region are informative for assessing regional trends in avian use and species composition. In general, these studies show that common, disturbance-tolerant passerine species are the most-observed species at wind energy facilities in predominantly agricultural landscapes (Derby et al., 2011b; Stantec, 2012; Westwood Professional Services, 2012; Black Oak Wind and Getty Wind Company, 2012; Gasper, 2013). The results of the preconstruction avian use surveys for the Project are consistent with the patterns documented in the regional studies, as well as consistent with the historical knowledge of avian use patterns and behavior in the Midwest and at wind energy facilities throughout the country.

8.19.1.6 Mammals

Many different species of mammal may occur in the Project Area and use the food and cover available from agricultural fields, pasture, farm woodlots, and wetland areas.

There are seven bat species present in Minnesota, four of which are listed as state special concern: big brown bat (*Eptesicus fuscus*), little brown bat (*Myotis lucifigus*), northern long-eared bat, and tri-colored bat (*Perimyotis subflavus*). As previously mentioned, the northern long-eared bat is also federally listed as threatened. Freeborn Wind conducted a bat acoustic study from April 14 to November 14, 2015 (see Appendix F). Freeborn Wind also completed a desktop northern long-eared bat habitat analysis to determine potential summer roosting habitat and commuting/travel habitat (see the ABPP in Appendix H and Figure 10). All turbines have been sited more than 1,000 ft from suitable foraging habitat as recommended by USFWS.

8.19.1.7 Reptiles and Amphibians

Reptile and amphibian species that may be present in the Project Area include turtles, frogs, and snakes. The species may utilize pasture areas, wetlands, and grasslands. There is one NHIS record of a state-listed threatened species (Blanding's turtle) within 5 miles of the Project, but not in the Project Area. Wetland habitat comprises less than 2 percent of the Project Area. Freeborn Wind does not expect impacts to this species or any additional federally or state listed reptiles or amphibians.

8.19.1.8 Insects

There are many species of insects and pollinators that may utilize the Project Area. Typically, these species inhabit native prairie. The Project has been designed to avoid mapped and field verified potential prairie, and therefore, have no impact on insect species.

8.19.2 Impacts

8.19.2.1 Birds

The potential for habitat fragmentation impacts is low because the Project is sited on a previously disturbed landscape. Agriculture is the dominant land cover type within the Project Area, particularly where turbines and facilities will be located.

The Project has the potential to cause displacement of some bird species from the Project Area due to increased human activity or the presence of tall structures, though clearing of habitat will be minimal. Many of the most-observed bird species within the Project Area were common, disturbance-tolerant species, similar to the results of surveys at other wind energy facilities in the region (Derby et al., 2011b; Stantec, 2012; Westwood Professional Services, 2012; Black Oak Wind and Getty Wind Company, 2012; Gasper, 2013). Shorebirds and waterfowl using saturated depressions within croplands in the Project Area as stopover habitat during spring migration may be more sensitive to displacement by Project turbines, as displacement of these bird types has been reported at wind facilities in Europe (Winkelman, 1990; Pedersen and Poulsen, 1991; Spaans et al., 1998; Fernley et al., 2006). However, shorebirds and waterfowl are likely to prefer habitat along the Shell Rock River and on Albert Lea Lake, limiting displacement effects. Given that most lands within the Project Area are already disturbed and subject to human activity related to farming, and because most of the birds observed were common, disturbance-tolerant species, displacement effects are expected to be minimal.

Project operation may result in avian mortality from collision with the Project's turbines or other structures. Based on the results of post-construction monitoring at similar facilities located on agricultural landscapes in southern Minnesota and northern Iowa and, given the lack of unique ecological features within the Project Area that would attract birds, estimated bird carcass rates at the Project would be expected to be within the range or lower than those reported from studies at other wind facilities in the region (see Table 8.19-2). At Freeborn, no single species or group is expected to experience a disproportionate amount of estimated mortality or impacts of a magnitude to affect the local or migratory population, as reflected in studies completed by Erickson et al. (2014).

Table 8.19-2: Annual Bird Carcass Rate Results from Post-construction Monitoring Studies in Southern Minnesota and Northern Iowa

Project Name	State	Estimated Bird Carcasses/ Megawatt/Year	Source
Barton I and II	IA	5.50	Derby et al., 2011a
Buffalo Ridge (Phase I; 1996)	MN	4.14	Johnson et al., 2000
Buffalo Ridge (Phase I; 1997)	MN	2.51	Johnson et al., 2000
Buffalo Ridge (Phase I; 1998)	MN	3.14	Johnson et al., 2000
Buffalo Ridge (Phase I; 1999)	MN	1.43	Johnson et al., 2000
Buffalo Ridge (Phase II; 1998)	MN	2.47	Johnson et al., 2000
Buffalo Ridge (Phase II; 1999)	MN	3.57	Johnson et al., 2000
Buffalo Ridge (Phase III; 1999)	MN	5.93	Johnson et al., 2000
Elm Creek	MN	1.55	Derby et al., 2010b
Elm Creek II	MN	3.64	Derby et al., 2012
Moraine II	MN	5.59	Derby et al., 2010c
Pioneer Prairie I (Phase II)	IA	0.27	Chodachek et al., 2012
Top of Iowa 2003	IA	0.42	Jain, 2005
Top of Iowa 2004	IA	0.81	Jain, 2005
Winnebago	IA	3.88	Derby et al., 2010d
Lakefield 2012	MN	2.75	Westwood, 2013
Lakefield 2014	MN	1.07	Westwood, 2015

The Project is located immediately east of Albert Lea Lake and Shell Rock River, which are important aquatic habitat features on the landscape and concentrate use by waterfowl and shorebird species, potentially including some sensitive species, during migration and winter. Waterfowl constituted the most commonly recorded large-bird subtype during the large-bird use study (see Appendix F). However, waterfowl and shorebird carcass rates at wind energy projects have been low, even in areas of high use. Generally, waterfowl and shorebird carcass rates have shown to be insignificant at wind facilities, as compared to the rate of use or incidence of these groups (Erickson et al., 2002).

The proximity to Albert Lea Lake and Shell Rock River may increase the potential for bald eagles to use the Project Area, particularly during winter. The presence of bald eagle nests within 16 kilometers (10 miles) of the Project Area may increase the potential for bald eagles to use the Project Area during the nesting season. However, eagle nest monitoring of two nests along the Shell Rock River indicated most bald eagle activity is focused along the Shell Rock River corridor and flights to and from the direction of the Project are not common during the nesting season (Appendix F). Avian use studies found that eagle use of the Project Area was highest in winter (and more eagle minutes were recorded in February and March than in any other month) and the greatest concentration of eagle activity occurred between the Project Area and Albert Lea Lake (see Appendix F).

Through its coordination with the USFWS, Freeborn Wind has committed to setbacks from Albert Lea Lake and the Shell Rock River, both of which provide bald eagle habitat. Freeborn Wind has exceeded the agreed-to minimum setbacks from these water features. Since eagle use was higher around Albert Lea Lake, the Applicant agreed not to site turbines within one mile of Albert Lea Lake. The closest turbine was ultimately sited over four miles from this water feature to minimize impacts to eagles. Freeborn Wind also agreed to at least a half mile setback from the Shell Rock River for up to four turbines and all remaining turbines set back at least one mile. There are no turbines sited within 0.5 mile of the Shell Rock River and only one is within 1 mile (0.6 mile away).

No federally listed as endangered or threatened bird species were observed within the Project Area during preconstruction surveys, and it is very unlikely that the Project would impact a federally listed bird species. The federally listed piping plover may stopover at Albert Lea Lake and its associated wetland complex during migration; however, the species is not known to concentrate in large numbers at inland stopover sites (see Appendix G) and, as described above, shorebirds, such as the piping plover, have been shown to have low carcass rates at wind facilities in the United States (Erickson et al., 2001, 2002; NRC, 2007).

8.19.2.2 Bats

Construction and decommissioning activities are not expected to require the removal of trees or old buildings, making it unlikely that roosting bats would be disturbed or incur mortalities. Turbines are sited at least 1,000 ft from foraging and roosting bat habitat to limit impact to all bats during construction and operation. The closest known hibernaculum is also 40 miles from the Project Area, limiting potential for impacts to bats during fall swarming.

All seven bat species known to occur in Minnesota may migrate through the Project Area; however, bat habitat within the Project Area is limited to small groves of trees and fencerows near homesteads and the riparian corridors along a few small streams with fringe wetlands. Outbuildings and other anthropogenic structures may be used as roosting habitat by some species. Cultivated crops also may provide marginal foraging habitat for bat species adapted to use such habitat.

Bat carcasses at wind energy facilities in the United States have mostly occurred in the swarming and migration seasons, typically between mid-July and mid-September (Howe et al., 2002; Johnson et al., 2003; Kerlinger et al., 2007; BHE Environmental, 2010). Post-construction monitoring studies at other wind facilities in southern Minnesota also have reported a similar pattern, with most bat carcasses occurring during the fall migration season and consisting primarily of eastern red bats and hoary bats, both migratory tree bat species (Chodachek et al., 2014).

The preconstruction acoustic study for the Project (see Appendix F) recorded activity by low frequency bats (which include hoary bats) and high frequency bats (which include eastern red bats) at all detectors. Activity of both groups was highest in summer (June 1 to July 15), followed by the fall migration period (July 30 to October 14). Therefore, estimated bat carcass rates at the Project would be expected to be within the range reported from studies at other wind facilities in the region (see Table 8. 19-3). Activity of both groups decreased as wind speeds at the Project increased, and as temperatures at the Project decreased.

Table 8.19-3: Annual Bat Carcass Rate Results from Post-construction Monitoring Studies in Southern Minnesota and Northern Iowa

Project Name	State	Estimated Bat Carcasses/ Megawatt/Year	Source
Barton I and II	IA	1.85	Derby et al., 2011a
Big Blue	MN	6.33	Chodachek et al., 2014
Buffalo Ridge (Phase I; 1999)	MN	0.74	Johnson et al., 2000
Buffalo Ridge (Phase II; 1998)	MN	2.16	Johnson et al., 2000
Buffalo Ridge (Phase II; 1999)	MN	2.59	Johnson et al., 2000
Buffalo Ridge (Phase III; 1999)	MN	2.72	Johnson et al., 2000
Buffalo Ridge (Phase II; 2001/Lake Benton I)	MN	4.35	Johnson et al., 2004
Buffalo Ridge (Phase II; 2002/Lake Benton I)	MN	1.64	Johnson et al., 2004
Buffalo Ridge (Phase III; 2001/Lake Benton II)	MN	3.71	Johnson et al., 2004
Buffalo Ridge (Phase III; 2002/Lake Benton II)	MN	1.81	Johnson et al., 2004
Crystal Lake II	IA	7.42	Derby et al., 2010a
Elm Creek	MN	1.49	Derby et al., 2010b
Elm Creek II	MN	2.81	Derby et al., 2012
Grand Meadow	MN	3.11	Chodachek et al., 2014
Moraine II	MN	2.42	Derby et al., 2010c
Oak Glen	MN	3.09	Chodachek et al., 2014
Pioneer Prairie I (Phase II)	IA	10.06	Chodachek et al., 2012
Top of Iowa 2003	IA	7.16	Jain, 2005
Top of Iowa 2004	IA	10.27	Jain, 2005
Winnebago	IA	4.54	Derby et al., 2010d
Lakefield 2012	MN	19.87	Westwood, 2013
Lakefield 2014	MN	20.19	Westwood, 2015

The Project is located within the range of the federally listed northern long-eared bat, and individuals may occur within the Project Area during spring through fall migration. Based on the Project's location relative to the nearest known northern long-eared bat hibernaculum (see

Section 8.19.1), northern long-eared bats are not expected to occur in the Project Area during the fall swarming period or during the winter when they are hibernating. Additionally, Freeborn Wind has designed the layout to site turbines at least 1,000 ft from wooded habitat that northern long-eared bats, and other bat species, utilize for roosting and foraging, which is consistent with the USFWS northern long-eared bat guidance (USFWS, 2014). Note that wooded habitat in the Project is conservative and includes woodlots around farmsteads, shelterbelts, and the riparian corridor associated with the Shell Rock River (see Figure 10). Under the final 4(d) rule published January 14, 2016 (Title 81 Code of Federal Regulations Part 1900), incidental take of the northern long-eared bat from the operation of utility-scale wind-energy turbines is not prohibited (see the ABPP footnote in Section 1.4.1 for more information).

8.19.3 Mitigative Measures

Freeborn Wind has or will implement the following measures to the extent practicable to help avoid potential impacts to wildlife in the Project Area during turbine siting, project construction, and operation:

- The Project's location in a previously disturbed landscape avoids the following habitat features: 1) habitats associated with any federally listed wildlife or plant species, 2) bird movement corridors, 3) landscape features that attract raptors, 4) bat hibernacula or maternity/nursery colonies, and 5) concentrated bird and/or bat use areas;
- Native habitat (including native prairie, forested habitat, and wetlands) will be avoided during Project infrastructure siting and previously disturbed lands (including existing roadways) will be used, where practical, to avoid wildlife habitat fragmentation;
- As recommended in the USFWS' Northern Long-Eared Bat Interim Guidance (USFWS, 2014), all turbines will be sited more than 305 m (1,000 ft) from the edge of connected patches of forested habitat to avoid potential impacts to northern long-eared bats during the summer;
- Turbine towers will be designed and constructed to discourage bird nesting and wildlife attraction by being un-guyed, tubular towers;
- The Project will employ slow-rotating, upwind rotors;
- Aviation hazard lighting will be minimized to FAA requirements and strobed, minimum-intensity red lights will be installed on Project turbines, as recommended by the FAA and in the WEG (USFWS, 2012) to avoid attracting birds or bats;
- Hoods/shields will be installed on exterior lights at the O&M building and substation to minimize skyward light;
- Turbine doors will not have exterior lights installed at the entrance;
- To the extent practicable, the underground communication cables and power collection system will be buried along the access roads in trenches extending from each of the turbines to the Project's 34.5/161 kV substation; lines will be buried along both private and public rights-of-way;

- In the event that the 34.5 kV electrical collection lines require overhead construction, the structures will be designed and constructed in accordance with the Avian Power Line Interaction Committee's (APLIC) suggested practices to minimize potential electrocution risk to perching birds (APLIC, 2006); and
- Prepare and implement an ABPP during construction and operation of the Project. A draft ABPP is attached to this SPA as Appendix H. This ABPP includes minimization and avoidance measures to avian and bat species during construction and operation of the Project. The ABPP has been developed in a manner that is consistent with the guidelines and recommendations of the WEGs. It includes construction practices and design standards, operational practices, permit compliance, and construction and operations worker training.
- The Project turbines can be programmed to be locked or feathered at wind speeds up to the manufacturer's standard cut-in speed, from one-half hour before sunset to one-half hour after sunrise, from April 1 to October 31 of each year of operation through the life of the project, and be equipped with the appropriate operating software to allow for modification of the operating cut-in speed if deemed necessary to reduce avian/bat impacts.

8.20 Rare and Unique Natural Resources

8.20.1 Description of Resources

8.20.1.1 Threatened and Endangered Species

The MNDNR maintains an NHIS database through their Natural Heritage Program and Nongame Research Program, which is the most complete source of data on Minnesota's rare, endangered, or otherwise significant plant and animal species, plant communities, and other rare natural features (MNDNR, 2016b). NHIS data show that there is one state listed endangered plant record that intersects the Project Area – the western prairie fringed orchid, which is also federally listed as threatened (see Table 8.20-1). This record was last observed in 1939 along a railroad north of the Project and is likely no longer present. There is also a special concern plant species and watchlist plant species within the Project. There are documented occurrences of one reptile and seven mussels within 5 miles of the Project Area that are state-listed endangered or threatened; however, none of these records are within the Project Area and none of these species have been observed during field surveys (see Table 8.20-1). In addition, there are 13 species of special concern (1 bird, 2 fish, 3 mussels, and 7 plants) that do not have a legal status but are being tracked by the MNDNR, have been documented within 5 miles of the Project Area. Lastly, there are two colonial waterbird nesting sites outside the Project Area and associated with Albert Lea Lake.

As part of its NHIS database, the MNDNR also maps rare and unique plant communities. These records may represent relatively rare habitats (e.g., prairie) or high quality or good examples of more common plant communities (e.g., wet meadow). While most native plant communities have no legal protection in Minnesota, these areas have the potential to contain undocumented populations of rare plant species, which may be protected under Minnesota's state endangered species law. Many of these native communities also provide essential habitat for rare species of fauna, such as those listed in Table 8.20-1.

Table 8.20-1: NHIS Records within 5 Miles of the Project Area

Type	State Status	Scientific Name	Common Name	No. of NHIS Records within the Project Area	No. of NHIS Records within 5 Miles of Project Area Boundary	Year of Most Current Observation
Bird	SPC	*Progne subis*	Purple Martin	0	1	2009
Fish	SPC	*Notropis nubilus*	Ozark Minnow	0	2	2014
	SPC	*Lythrurus umbratilis*	Redfin Shiner	0	2	2003
Reptile	THR	*Emydoidea blandingii*	Blanding’s Turtle	0	1	2010
Mussel	END	*Plethobasus cyphyus*	Sheepnose	0	1	1999
	THR	*Actinonaias ligamentina*	Mucket	0	1	1998
	THR	*Alasmidonta marginata*	Elktoe	0	1	1999
	THR	*Elliptio dilatata*	Spike	0	1	1999
	THR	*Lasmigona costata*	Fluted-shell	0	2	1999
	THR	*Quadrula metanevra*	Monkeyface	0	1	1999
	THR	*Venustaconcha ellipsiformis*	Ellipse	0	1	1999
	SPC	*Ligumia recta*	Black Sandshell	0	1	1998
	SPC	*Lasmigona compressa*	Creek Heelsplitter	0	1	1999
	SPC	*Pleurobema sintoxia*	Round Pitgoe	0	1	1999
Plant	END	*Platanthera praeclara*	Western Prairie Fringed Orchid	1	0	1939
	THR	*Valeriana edulis var. ciliata*	Edible Valerian	0	3	2010
	THR	*Asclepias sullivantii*	Sullivant's Milkweed	0	6	2009
	THR	*Napaea dioica*	Glade Mallow	0	1	2010
	THR	*Asclepias hirtella*	Prairie Milkweed	0	1	2009
	THR	*Carex jamesii*	James’ Sedge	0	1	2015

Table 8.20-1: NHIS Records within 5 Miles of the Project Area

Type	State Status	Scientific Name	Common Name	No. of NHIS Records within the Project Area	No. of NHIS Records within 5 Miles of Project Area Boundary	Year of Most Current Observation
	SPC	*Baptisia lactea var. lacteal*	White Wild Indigo	0	1	2008
	SPC	*Cypripedium candidum*	Small White Lady's-slipper	0	3	2014
	SPC	*Sanicula trifoliata*	Beaked Snakeroot	0	1	1989
	SPC	*Phlox maculata*	Wild Sweetwilliam	1	1	2009
	SPC	*Eryngium yuccifolium*	Rattlesnake Master	0	4	2009
	SPC	*Arisaema dracontium*	Green Dragon	0	1	2010
	SPC	*Gymnocladus dioica*	Kentucky Coffee Tree	0	1	2009
	W	*Oxypolis rigidior*	Cowbane	1	1	2008
Other	NA	Animal Assemblage – Colonial Waterbird Nesting Site		0	2	2010

Source: MNDNR NHIS Data, 2016

Based on NHIS data (different than MNDNR mapped native prairie or native plant communities), there is one wet prairie (southern) within the Project Area and one dry sand-gravel oak savanna (southern) terrestrial communities within 5 miles of the Project. See Section 8.18.1 for a discussion on other native prairie and native plant communities. No Project infrastructure will be sited near the communities.

Based on USFWS IPaC results, there is one federally listed threatened or endangered species known to occur in Freeborn County: the northern long-eared bat (see Section 8.19.1.3 and the ABPP in Appendix H).

8.20.2 Impacts

Based on preconstruction site assessments, the Project Area is primarily cropland. There is one NHIS record of a federal and state-listed plant species (western prairie fringed orchid) that intercepts the Project boundary; however, the record is from 1939 and it is likely that the precision of the record is low, resulting in a larger polygon. This record is likely associated with a railroad ROW prairie north of the Project. No other records of threatened or endangered species occur in the Project Area. As discussed in Section 8.18, turbines, access roads, the Project Substation, and the O&M facility have been sited to avoid mapped native prairie, native plant communities, railroad ROW prairie, site-specific potential prairie, and sites of biodiversity significance. Furthermore, Freeborn Wind has designed the Project to site turbines at least 1,000 ft from northern long-eared bat habitat. Freeborn Wind will avoid rare and unique resources to the extent practicable.

8.20.3 Mitigative Measures

Freeborn Wind will implement the following measures to avoid potential impacts to federal and state-listed species and rare or sensitive habitat in the area during site selection for the wind turbines and access roads and the subsequent Project development, construction and operation:

- Avoid or minimize disturbance of individual wetlands and waterbodies during construction;
- Avoid or minimize placement of turbines, access roads, and the Project Substation within high quality native prairie; and
- Continue to coordinate with the USFWS and MNDNR as the Project layout is developed.

9.0 Site Characterization

9.1 Site Wind Characteristics

Freeborn Wind has conducted detailed site wind characterization studies and analysis over the past seven years for the Project and had two temporary meteorological towers monitoring weather data in the Project Area. While high quality wind resources guided site selection, other factors, including environmental concerns, relative interest from communities and landowners, and access to cost effective transmission, contributed to selection of the Project Area. Given surrounding wind resource development and analysis conducted by Freeborn Wind, this furthers maximum use of Minnesota’s wind resource in a cost-effective manner.

In addition to Freeborn Wind's own wind resource studies since 2008, other studies have been done including the United States Department of Energy and the DOC studies in Minnesota initiated in 1982, and the 2014 National Renewable Energy Laboratory Wind Integration National Dataset (that provides modeled wind resource and power production data for over 100,000 grid points across the continental United States (Draxl et al., 2015). Predicted wind speeds are included in model data at hub heights of 80 and 100 m above ground level. Near the Project Area, the mean annual wind speed at 80 m (263 ft) above ground level is predicted to be 7.6 m/s.

9.1.1 Interannual Variation

Interannual variation is the expected variation in wind speeds from one year to the next. It is calculated by dividing the standard deviation of annual average wind speeds by the long-term average wind speed. Wind speed fluctuates continuously, and as a result, the power from a wind turbine or plant varies. The meteorological data collected within the Project Area was analyzed and yielded a 2.1 percent interannual variation in wind speed, or 0.16 m/s. The maximum annual average wind speed recorded was 7.8 m/s; the minimum annual average wind speed recorded was 7.3 m/s.

9.1.2 Seasonal Variation

Seasonal variation is represented by the shift in wind speeds from one month to the next. Table 9.1-1 presents estimated average seasonal variation based on long-term correlations with on-site data. The months of November through May are expected to generally have the highest wind speeds, while the months of June through October are expected to have the lowest wind speeds.

Table 9.1-1: Average Wind Speed

Month	Wind Speed (m/sec)
January	8.1
February	8.1
March	8.2
April	8.8
May	8.1
June	7.0
July	6.1
August	6.0
September	7.2
October	7.7
November	8.1
December	7.9
Annual Average	**7.6**

9.1.3 Diurnal Conditions

Diurnal variation occurs through the shift in day and nighttime weather patterns. The below Chart 2 shows expected variation in wind speeds at the Project Area. On average, the wind speeds are 8.2 m/s between 6 pm and 6 am, and 7.4 m/s between 6 am and 6 pm.

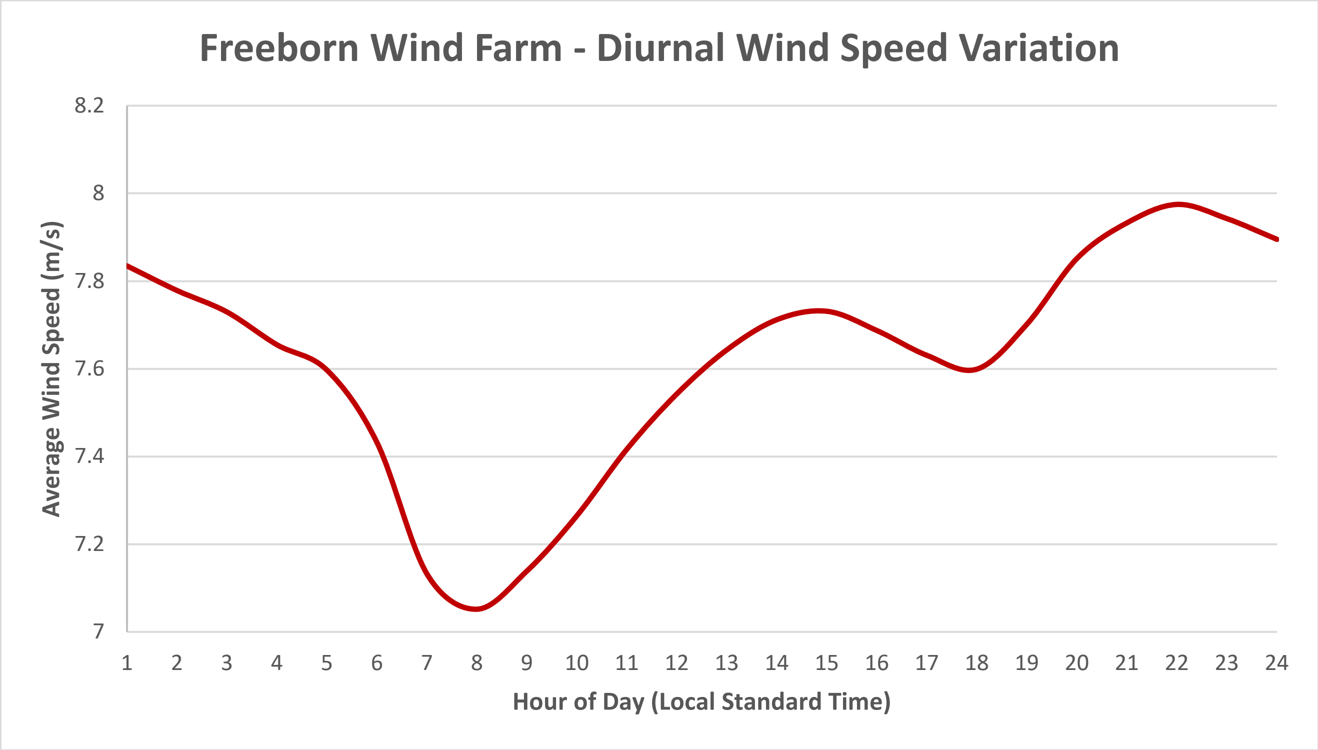

Chart 2: Diurnal Wind Speed Variation

9.1.4 Atmospheric Stability

One way to characterize atmospheric stability is quantifying the lateral fluctuation of the wind. The lateral fluctuation is calculated by taking the standard deviation of wind direction fluctuation. Stable values are considered between 0 and 2.5, moderately stable between 2.5 and 7, neutral between 7 and 9, moderately unstable between 9 and 15, and very unstable is greater than 15° (Slade, 1968). Project atmospheric stability of monitored meteorological tower sites at the 52-m level is 6°, or moderately stable.

9.1.5 Hub Height Turbulence

Hub height turbulence (Turbulence Intensity) is the measured standard-deviation of wind speed over an hour, divided by the mean for the same time period. For 15 m/s wind speeds, the average TI at 60 m is 9.6 percent. For 15 m/s wind speeds, the characteristic TI is 12.0 percent.

9.1.6 Extreme Wind Conditions

Maximum hourly wind speed at Freeborn Wind meteorological tower sites measured 28.2 m/s. Site extreme wind events for a one-year event will likely be 26.7 m/s. Table 9.1-2 provides the 20- through 100-year maximum means and gusts for the Project Area based on the data collected by the two meteorological towers at the Project Area. To extrapolate from the 8-year data record at the Project Area to the longer periods, a Gumbel distribution was fitted to the observed maximum wind speeds in each year of the Project data record (Harris, 1999). The result is a plot of the wind speed versus the probability of exceedance; the return period is the inverse of the probability of exceedance (i.e. a 1 percent probability of exceedance translates to a 100-year return period).

Table 9.1-2: Extreme Wind Events at 60m

Period (yr)	Extreme Wind Speed (m/s)	
	10-min Means	Gust
20	27.4	35.4
25	27.8	35.9
50	29.0	37.5
100	30.3	39.0

9.1.7 Wind Speed Frequency Distribution

The following Chart 3 indicates wind speed frequency distribution calculated from 10-minute measured data, vertically extrapolated to the 80-m hub height. A majority of the winds occur between 4 m/sec and 10 m/sec. The characteristics of this distribution are consistent with wind regimes observed elsewhere in Minnesota.

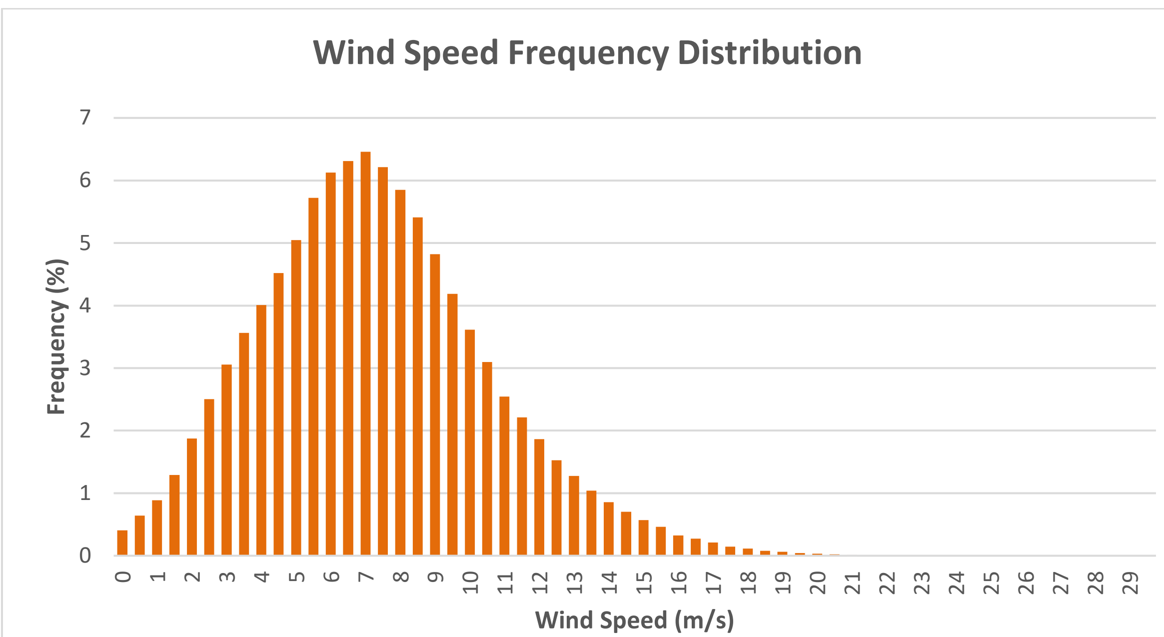

Chart 3: Wind Speed Frequency Distribution

9.1.8 Wind Variation with Height

Wind shear is the relative change in wind speed as a function of height. Wind shear is calculated using a power function based upon the relative distance from the ground. The general equation used for calculating wind shear is $S/S_o = (H/H_o)^{\alpha}$, where S_o and H_o are the speed and height of the lower level and α is the power coefficient. The power coefficient can vary greatly due to terrain roughness and atmospheric stability. The power coefficient will also change slightly with variation in height. The vertical variation with height, or shear coefficient, based on the 50- to 60-m levels at the Project's meteorological tower site with 8 years of data, is approximately 0.19.

9.1.9 Spatial Wind Variation

Using wind speed data collected from the onsite meteorological towers and numerical wind modeling software, the spatial variation in wind speeds was calculated across the Project Area. This means estimating what the wind speeds are at different locations within the Project Area. The range of expected annual average wind speeds at hub height spans from a low of 7.4 m/s to a high of 7.7 m/s.

9.1.10 Wind Rose

As part of the previously mentioned studies, Freeborn Wind prepared a wind rose, in 12 directions, which is illustrated in Chart 4. The wind rose graphically represents wind speeds based on the direction the wind comes from and the frequency from each direction. The following chart shows a composite wind rose from the two Freeborn Wind meteorological towers.

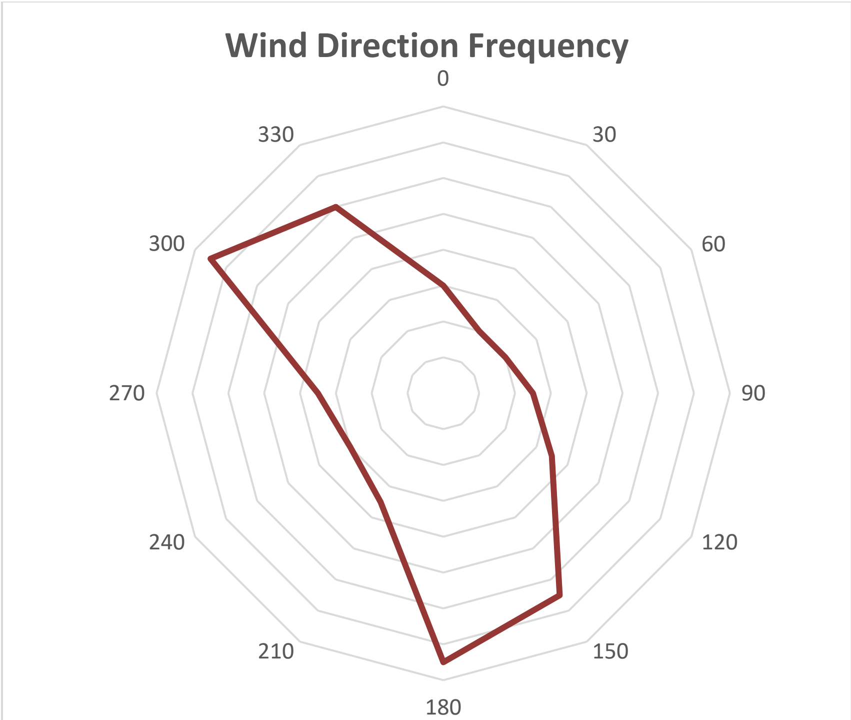

Chart 4: Wind Rose

9.1.11 Other Meteorological Conditions

9.1.11.1 Average and Extreme Weather Conditions

Minnesota has a continental-type climate and is subject to frequent outbreaks of continental polar air throughout the year, with occasional Arctic outbreaks during the cold season. Occasional periods of prolonged heat occur during summer, particularly in the southern portion of Minnesota, when warm air pushes northward from the Gulf of Mexico and the southwestern United States. Pacific Ocean air masses that move across the Western United States produce comparatively mild and dry weather at all seasons.

Freeborn Wind reviewed long term average temperatures and precipitation from the Midwest Regional Climate Center (2016) Albert Lea Station (USC00210075) located approximately 3 to 4 miles west of the Project Area. Average minimum temperatures in the Project Area range from 5.3 degrees Fahrenheit in January to 61.8 degrees in July; average maximum temperatures range from 23.0 degrees in January to 82.1 degrees in July. Average precipitation in the Project Area ranges from 0.7 inch in February to 4.7 inches in June.

Extreme weather events, such as thunderstorms, wind storms, tornadoes, hail, heavy snow and ice, extreme cold, heat waves, flash floods/floods, heavy rain, lightning, and drought occur in the Project Area.

The State of Minnesota experiences approximately 15 to 20 tornadoes per year (NOAA, National Climatic Data Center, 2013). National Climatic Data Center records in and near the Project Area include 104 thunderstorms, 11 high wind events, and 48 tornadoes from 1950 to 2010. The annual frequency of thunderstorm days is about 45 days in southern Minnesota. Such storms are usually of short duration and localized, leading to damage in small geographic areas. Wind turbines are built to withstand hail and lightning, but are not designed to survive tornado-force winds of over 89 m/s (200 mph).

Turbines under consideration for this Project are capable of withstanding most of the extreme weather conditions that occur in the area. All turbines being considered have lightning protection systems, turbine blades that “feather” into the prevailing wind direction during high wind events to minimize the risk of damage, and turbines that shut down above the cut-out wind speed (generally 20 m/s).

During winter, there is potential for icing events to result in ice accumulation on turbine blades with variable frequency. Although the turbines are not equipped with specific ice-sensing equipment, the turbine will stop turning if significant ice accumulation causes an imbalance, or a mismatch between expected energy generation for a given wind speed and actual energy generation – the difference being attributable to deformation of the airfoil due to ice formation. These mechanical safeguards and turbine setbacks mitigate the potential hazard associated with ice throw, and minimize the potential that ice thrown from turbine blades could reach public roads and residences. Ice throw is not expected to be a hazard for the Project.

9.2 Location of Other Wind Turbines within 20 Miles of Project Boundary

Freeborn Wind reviewed the USGS Energy Resources Program data (Diffendorfer et al., 2017), State of Iowa, and other publicly available data to identify existing wind turbines in the vicinity of the Project. This review indicates eight wind farms are located within 20 miles of the Project Area: two in Minnesota and six in Iowa. The location of these wind farms is indicated on Figure 17. The Applicant has also included locations for all potential turbines in the Iowa portion of the Freeborn Wind Farm on this map. A summary of these wind farms is included in Table 9.2-1.

Table 9.2-1: Wind Farms within 20 Miles of the Project Boundary

Name of Wind Farm	Location	Distance from Project (mi) and Direction	Generation Capacity (MW)	Number of Turbines and Turbine Size (MW)
Barton	Worth Co., IA	5 miles S	160	80 / 2
Windwalkers	Worth Co., IA	8 miles S	1.6	1 / 1.6
Top of Iowa III	Worth Co., IA	10 miles SW	29	18 / 1.65
Top of Iowa II	Worth Co., IA	11 miles SW	80	40 / 2
Top of Iowa I	Worth Co., IA	12 miles SW	40	89 / 0.9
Bent Tree	Freeborn Co., MN	12 miles NW	200	122 / 1.65
Windvision	Mitchell Co., IA	16 miles SE	0.9	1 / 0.9
Oak Glen	Steele Co., MN	17 miles N	44	24 / 1.8

Within 20 miles of the Project Area, there are 461 identified wind turbines, with 172 of them located in Minnesota. Freeborn Wind also performed a search across Freeborn County for wind energy projects that are not built but for which LWECS Site Permit Applications have been submitted to the Commission. Beyond the Shell Rock Wind Farm (case 11-195), no others were identified according to this review (Minnesota DOC, Energy Facility Permitting, 2017).

10.0 Project Construction

10.1 Roads and Infrastructure

Area roadways will be accessed by a variety of small to large construction vehicles during Project construction. Once the Project is constructed, only small-to-medium sized vehicles will access local roadways to perform routine maintenance on turbines and associated facilities. Heavy equipment will occasionally return to the site if large turbine components need to be repaired or exchanged. Freeborn Wind estimates that the maximum construction workforce at the project will create approximately 250 to 275 additional trips per day on local roadways during peak construction. It is anticipated that total trips per day will decrease substantially following turbine installation.

Because of the size of the equipment to be installed, and the turning radii of the delivery trucks, some local roadways may require upgrades to improve drivability and access. This typically includes widening select intersections to allow for the long delivery trucks to turn, and upgrading road surfaces by grading or the addition of gravel. The degree to which existing roadways will require upgrading for the project remains under evaluation by Freeborn Wind. Pavement reinforcement will be dependent on the time of year, but will be returned to pre-construction condition at the conclusion of the Project. All proposed upgrades will be coordinated in advance with Freeborn County and township authorities.

10.2 Access Roads

The permanent aggregate access roads will be approximately 16 ft wide and consist of geotextile fabric and relatively uniformly graded aggregate base or other equivalent material as determined by the Freeborn Wind's geotechnical investigation. To the extent practical based on existing grades and the requirement to facilitate proper drainage, the finished elevation of the access roads will be level with existing grade so as to minimize impacts to farming activities. Freeborn Wind will not construct access roads on natural slopes steeper than two horizontal over one vertical (2:1). While constructing the access roads, Freeborn Wind will strip and stockpile the topsoil for site restoration in a manner that will allow Freeborn Wind to integrate permanent construction into contours of the existing grade to preserve drainage to what existed prior to construction. As needed, culverts or field drain tile inlets will be provided by Freeborn Wind to prevent the ponding of water as a result of the construction of the roads. If fish can pass through culverts prior to construction, post-construction their ability to pass through shall be maintained. Freeborn Wind will maintain access roads throughout the construction of the wind farm, including snow removal and erosion control/repair.

10.3 Associated Facilities

10.3.1 Operation and Maintenance Facility

An O&M building may be constructed on the site for access and storage for project maintenance and operations. The buildings for O&M are typically less than 7,500 square ft and will have an adjacent parking lot and storage area. Freeborn Wind anticipates that a new well will provide water service for the O&M facility, and that on-site septic system will provide for sanitary needs.

10.3.2 Project Substation

The Project Substation will consist of switch gear, metering, transformers, electrical control and communications systems, and other high voltage equipment needed to transform the electricity generated by the Project from 34.5 kV to 161 kV. Final specification of the substation will be determined by the agreements the Project has with MISO, as well as the transmission owner. The Project Substation will be approximately 5 acres in size including the graded area which may be larger than the area actually fenced.

The Project Substation will collect and interconnect approximately ten underground cable feeders in a straight bus configuration. The underground feeders will interconnect up to 100 2.0

MW wind turbines at 34.5 kV, with up to 42 of the turbines being in Minnesota and subject to this permit proceeding. The Project Substation will also consist of circuit breakers and switches required for the protection and control of the wind turbines and a main power transformer to step up the 34.5 kV output to 161 kV so that it may interconnect to Glenworth Substation. The controls and protective relays for the collection system breakers, transformer and the tie to Glenworth, as well as communication equipment, will be located in a control house located within the collector Project Substation.

10.3.3 Collector Lines and Feeder Lines

The approximate length of collection lines needed for the turbine layout included in the SPA is 57 miles. All collection lines will be installed underground via trenching, plowing, or directional bores, as needed. The collection lines will be installed as a network between turbine locations and the Project Substation site, which will raise the voltage to 161 kV.

Generally, the electrical collection lines will be buried in trenches. Where electrical collectors meet public road right-of-way (ROW), the power collection lines will either rise to become aboveground lines (if requested by the road authority or if shallow bedrock, sensitive environmental conditions, or conflicts with underground utility or other infrastructure are encountered) or will continue as underground lines. The collection lines will occasionally require an aboveground junction box when the lines from separate spools need to be spliced together, and these will be placed along field edges or in the ROW, as appropriate.

10.3.4 Laydown and Staging Areas

A centralized laydown yard will be established within the Iowa portion of the overall Freeborn Wind Farm boundary to house construction trailers, provide parking to the construction staff and store materials to be used during construction. This will be conducted in accordance with Iowa requirements.

10.3.5 Meteorological Towers

Freeborn Wind also proposes to install one permanent meteorological tower to maintain the performance of the Project, conform to grid integration requirements and validate wind turbine power curves. Two locations have been selected though only one tower will be built. Both locations are far enough from proposed wind turbines to be able to accurately capture the free-flowing wind. The permanent meteorological tower will be connected to the Project's communication system with a fiber optic line.

10.3.6 Crane Paths

Generally, cross-country or cross-field routes are utilized for the large erection cranes, as opposed to utilizing the local road system because the existing local road systems were not designed and built with this SPA in mind; typically, public road subgrade materials are not thick enough to handle the crane weight and typical local roads, bounded by ditch systems, utilities, etc., are not wide enough to handle the wide track crawlers that are used. Rather than create excessive damage to existing roads or necessitate relocating poles (and subsequently extending the ROW), it is lower impact and more efficient for the cranes to travel through the fields and perform de-compaction as needed. If the cranes are travelling on frozen ground, de-compaction may not be needed.

Depending upon soil conditions and time of year, crane paths are generally prepared by utilizing a bulldozer or grader to blade off the topsoil to expose firmer layers of underlying clay, till, or rock to a depth necessary to achieve greater bearing capacity than may be available with the topsoil conditions. In most cases, satisfactory bearing is achieved in 12 inches. In the event that soil conditions do not improve at such depths, localized matting can be used during crane walks. For dry or frozen conditions, no work may be required to prepare crane paths; however, in wet conditions or other such conditions that may pose very soft soil conditions, sections of wood matting will be rotated through part or the entire course of the walk.

Additional stone may be brought in to support crane movement when blading the existing material aside is not practical. This might occur at ditch crossings or when travelling next to an existing access road where the material adjacent to the road is not suitable. Typically in those cases, after removing the topsoil and piling it adjacent to the area, larger (3- to 4-inch) stone will be placed along the bottom of the route and topped with 0.75 to 1 inch maximum of well graded gravel. For ditch crossings, temporary culverts may be added to allow for through-flow in a rain event. If fish can pass through culverts prior to construction, post construction their ability to pass through shall be maintained.

Crane paths are typically 32 ft wide (a common main erection crane on wind farm sites, the Manitowoc 16000 has a track width of 29 ft).

Additional material is typically not imported for the crane paths so removing these paths is simply a matter of bulldozing the previously windrowed material evenly back across the areas from which it was removed. After replacing and leveling the material, rippers or plows are run through the affected area (crane path and where windrows existed) to de-compact material back to its original farmed density.

In circumstances where additional stone is brought in and put down for crane walks, all added stone and culverts are removed and the topsoil, which had been removed and piled aside, is returned to its original condition and de-compacted, as applicable.

10.4 Turbine Site Location

10.4.1 Foundation Design

This Project will incorporate a spread footing foundation which is comprised of a footing and a pedestal to support each wind turbine assembly. The footing portion is octagonal and spreads out below grade approximately 55 ft in diameter. Its depth is approximately 8 ft. The pedestal portion is a concrete cylinder rising approximately 3 ft above the foundation. The anchor bolt cage for the spread footing foundation consists of steel tie rods within PVC sleeves. At the top and bottom of the cage are embedment rings which hold the tie rods in alignment. The anchor bolt cage extends from the bottom of the footing through the top of the pedestal providing anchors for the turbine tower.

The excavation of soil will be performed in separate stages to minimize comingling between soil strata. For example, in areas where black dirt overlays clay or rock, the top layer will be removed and stockpiled on one side of the foundation site prior to excavating the underlying material. This underlying soil is then removed with an excavator and placed into a separate pile around the excavation.

Foundations are constructed by identifying and rerouting drainage tiles out of the excavation area; excavating a hole; pouring a mud mat of lean concrete; placing reinforcing steel; installing the tower mounting system (anchor bolt cage); placing concrete forms; and pouring concrete into the excavation.

Upon completion of the foundation and sub-grade grounding, backfilling is done by reverse process by which it was taken out. Material excavated from the deepest section of the foundation holes would be the first material replaced back into the hole, with the final fill being the topsoil that was initially removed. All subgrade material replaced back in the hole is placed in 12- to 18-inch lifts and is compacted with sheepsfoot rollers between successive lifts. Unless specifically requested to beneficially use the material, all spoils excavated from a foundation hole are placed back into the same hole from which they originated. Excess material displaced by the turbine foundation is feathered in around the base of the foundation to tie the pedestal in to the existing contours. Any materials which cannot be properly replaced, compacted, and graded will be removed and transported to a licensed disposal facility.

10.4.2 Tower

The towers are conical tubular steel with a hub height of 80 m (262 ft). The towers consist of three sections manufactured from rolled steel plates welded together along with thick flanges for bolting the sections together. All surfaces are multi-layer coated for protection against corrosion. Access to the turbine is through a lockable steel door at the base of the tower. Access to the nacelle is provided by a ladder equipped with a fall-arresting safety system.

10.5 Post-construction Cleanup and Site Restoration

During construction, additional areas will be temporarily impacted. Activities causing temporary impacts are associated with the widening of access roads for equipment transport, installation of turbine foundations, installation of underground electrical collector and communication cables, and for staging and support purposes. At the completion of construction activities, all temporarily disturbed areas will be graded back to natural contours, de-compacted, and seeded as needed. Erosion control practices will be maintained until seeded areas are stabilized. New gravel roads that are to be kept for ongoing operation and maintenance access will be corrected of any deterioration due to the construction process. Freeborn Wind is committed to cleaning up construction debris and restoring temporarily impacted areas to the extent practicable, and to the satisfaction of landowners.

10.6 Operation of Project

Xcel Energy will manage operations, maintenance, and service of the Project and its related facilities either through subcontractors or internal staff. The Project will have full time staff of technicians, a supervisor, and others as necessary to conduct scheduled maintenance activities and non-scheduled repairs. When site staff are not present, on-call technicians will be available to perform repairs in a timely manner.

10.6.1 Project Control, Management, and Service

10.6.1.1 General Maintenance Duties

Onsite service and maintenance activities include routine inspections, regular preventive maintenance on all turbines and related facilities, and unscheduled maintenance and repair on the wind turbines, electrical power systems, and communications systems.

10.6.1.2 Maintenance Schedule

Wind turbine and transmission facility maintenance schedules and required outage duration are based on equipment manufacturer's recommendations and Xcel Energy's experience operating this type of facility. Wind turbine scheduled maintenance includes a first service inspection, which is performed one to three months after the turbines have been engaged. Following the first service inspection, turbines will be serviced bi-annually. When possible, turbine maintenance will be performed during periods of low wind so as to not sacrifice energy production. Scheduled maintenance will be phased so that minimal turbines will be offline at any time. During turbine commissioning and initial commercial operation, turbines will be inspected on-site daily to see that they are operating properly. Following the "break-in" period during the initial commercial operation date, the turbines will be remotely monitored on a continuing basis with planned service and maintenance at routine intervals recommended by the turbine manufacturer.

O&M staff will address both scheduled and unscheduled major maintenance on the wind project, including repairs, replacement of parts and removal of failed parts. The O&M technicians will be equipped with the necessary tools and instruments for routine service, repairs, and Project/site operational control. Turbine maintenance will be performed as an ongoing function during the life of the Project. Transformer and other substation maintenance will be accomplished on an annual basis and will be scheduled during low or no wind periods. Components of the interconnection owned by the transmission owner will be maintained by the transmission owner under the interconnection agreement.

Civil maintenance will include maintaining Project structures, as well as access roads, drainage systems, and other facilities. Maintenance will be required for site facilities and transmission facilities. Site facilities (e.g., roads, drainage, fences) will be maintained as needed and scheduling will be adjusted based on local use and environmental conditions.

Other maintenance activities include cooperation with the local governmental agencies dealing with environmental concerns, including the management of lubricants, solvents, and other hazardous materials, and the implementation of appropriate security methods. Project access roads will also be maintained to facilitate site access including snow removal and regrading as necessary.

10.7 Costs

10.7.1 Capital and Operational Costs

The total Freeborn Wind Farm installed capital costs are estimated to be approximately $300 million, including wind turbines, associated electrical and communication equipment and systems, and access roads. The Minnesota portion of the Project would be approximately $126 million for operations and maintenance costs, and administrative costs are estimated to be approximately $7 to 8 million per year in total and $3 million per year for the Minnesota portion of the Project.

10.7.2 Site and Design Dependent Costs

Site and design dependent costs will be driven primarily by site-specific subsurface conditions. This will determine access road design, turbine foundation design, turbine array layout, difficulty of working underground and electrical collection system cost.

10.8 Schedule

10.8.1 Land Acquisition

Land acquisition for the project began in 2008 and by 2009, over 30,000 acres had been secured for lease. Unfortunately, the project was not able to be permitted and constructed during this time, and project leases began to expire in 2015 and 2016. A robust effort at renewing leases began in fall 2016, as well as seeking leases in new areas just beyond the original project footprint. Freeborn Wind has continued to acquire wind rights leases and also collection/ transmission easements in 2017.

10.8.2 Sale of Power

Invenergy began discussing the Project with Xcel Energy in early 2016 and entered into a PSA in September 2016. The Freeborn Wind Farm will be developed and then sold to Xcel for eventual construction and operations. Xcel Energy identified a need for additional wind energy in its latest Integrated Resource Plan.

10.8.3 Equipment Procurement, Manufacture, and Delivery

Freeborn Wind is in the process of procuring turbines for the Project. Turbine deliveries could commence in early 2020.

10.8.4 Construction

Freeborn Wind will manage the primary contractors performing onsite Project construction. The construction will take approximately eleven months to complete. The construction will include turbine installation, access roads construction, electrical and communication work, and restoration.

10.8.5 Construction Financing

Upon securing all regulatory approvals for the Project, Xcel Energy will finance the Project on balance sheet.

10.8.6 Permanent Financing

Permanent financing will be provided with the Xcel Energy's internal funds or a combination of internal funds and third-party debt and equity capital.

10.8.7 Expected Commercial Operation Date

Freeborn Wind anticipates that the Project would begin commercial operation in the fourth quarter of 2020. The commercial operations date is dependent on several factors including weather, permitting, and other development activities.

10.9 Energy Projections

10.9.1 Proposed Array Spacing for Wind Turbines

Wind turbines will be placed on lands in the Project Area that are leased by Freeborn Wind. The turbines will be installed in relatively high elevation areas to access the best wind resource in the Project Area. The Proposed internal array spacing for the Project's turbines is a minimum of 3 RD in a crosswind spacing (non-prevailing direction) and a minimum of 5 RD in a downwind spacing (prevailing direction). The internal turbine spacing is dependent upon the selected equipment and the site topography. Freeborn Wind developed the Project to maximize the wind resource and minimize array wake losses.

10.9.2 Base Energy Projections

Freeborn Wind Farm will have a nameplate generation capacity of up to 200 MW and a net capacity factor of between 45 to 52 percent. Freeborn Wind estimates an average annual output of between approximately 788,000 and 911,000 Mwh. The 84 MWs in Minnesota would generate between 331,000 and 382,000 Mwh per year. Annual energy production output will depend on final design, site specific features, and annual variability in the wind resource. Gross to net calculations take into account, among other factors, energy losses in the electrical collection system, mechanical availability, array losses, and system losses. An industry-wide estimate of energy losses ranges from fifteen to twenty percent (15 to 20 percent) of maximum output.

10.10 Decommissioning and Restoration

10.10.1 Anticipated Life of the Project

Freeborn Wind estimates the service life of the Project to be approximately 30 years. This estimate is based on industry experience in the ownership and operation of this type of facility.

10.10.2 Cost to Decommission

Project decommissioning has not yet been determined. The Applicant will create a thorough decommissioning cost estimate prior to construction begins as part of a decommissioning plan.

10.10.3 Method of Ensuring Funds Will Be Available for Decommissioning and Restoration

Sufficient funds will be set aside to fund Project decommissioning and site restoration efforts following the cessation of Project operation. These funds will be supplemental to the extent that the salvage value of Project facilities do not cover final decommissioning costs. Availability of funds will be discussed in the decommissioning plans.

10.10.4 List of Decommissioning and Restoration Activities

Upon termination of landowner agreements, Freeborn Wind will remove the remaining improvements on individual properties and will, to the extent practicable, restore the properties to their approximate original condition prior to the installation of the improvements. Freeborn Wind will bear the financial responsibility for the restoration and will be completed within 12 months, and in general accordance with the requirements of Minn. R. Ch. 7854.0500, subd. 13.

Decommissioning efforts will include the removal of above-ground wind facilities (wind turbine hub/nacelles, blades, towers, foundations, cables, roads, and other associated facilities). Foundations will be removed to a depth of 48 inches below current grade. Access roads will be removed unless affected landowners provide written notice that all or segments of the Project access road may remain. Any disturbed surfaces resulting from decommissioning activities shall be graded, reseeded, and restored as nearly as possible to their preconstruction condition.

The Project requests the right to re-evaluate decommissioning alternatives at the end of the LWECS Site Permit term and to update decommissioning costs to more accurately reflect decommissioning costs. The Project further requests the right to re-apply for an LWECS Site Permit and continue operation of the Project following the expiration of the original LWECS Site Permit.

11.0 Identification of Other Permits

Freeborn Wind identified known or potentially required permits and approvals for the Project and lists them in Table 11.1-1. Freeborn Wind will be responsible for conducting applicable environmental and engineering reviews, and, with cooperation and consultation with Xcel Energy, will obtain permits, licenses, and approvals needed subsequent to, and as conditioned upon, issuance of the LWECS Site Permit from the Commission. In the event a potential approval is not later determined to be required for the Project, it will be removed from this list.

Table 11.1-1: Permits and Approvals

Regulatory Authority	Permit/Approval
Federal Approvals	
U.S. Army Corps of Engineers	Wetland Delineation Approvals
	Jurisdictional Determination
	Federal Clean Water Act Section 404 and Section 10 Permit(s)
U.S. Fish & Wildlife Service	Review for threatened & endangered species
	Wetland and easement permits
	Tier 1 preliminary site evaluation
	Tier 2 site characterization
	Tier 3 field studies and impact prediction
	Eagle conservation plan
	Avian and bat protection plan
U.S. Environmental Protection Agency (Region 5) (USEPA) in coordination with the Minnesota Pollution Control Agency (MPCA)	Spill Prevention Control and Countermeasure (SPCC) Plan
	Phase I Environmental Site Assessment (Phase I ESA)
Lead Federal Agency (National Historic Preservation Act)	Federal Section 106 Review (Class I Literature Review / Class III Cultural Field Study)
Federal Aviation Administration	Notice of Proposed Construction or Alteration (Determination of No Hazard - Form 7460-1)
	Notice of Actual Construction or Alteration (Form 7460-2)
Department of Defense	Federal airways and airspace review near military bases
U.S. Department of Transportation – Federal Highway Administration	Utility line crossing license/approval
Federal Communications Commission	Non-federally licensed microwave study
U.S. Department of Commerce – National Telecommunications & Information Administration	NTIA communications study / determination of impacts & studies which may be needed
U.S. Department of Agriculture	Conservation / Grassland / Wetland Easement & Reserve Program releases and consents

Table 11.1-1: Permits and Approvals

Regulatory Authority	Permit/Approval
Federal Energy Regulatory Commission	Exempt wholesale generator certification (EWG)
	QF certification
	Market-based rate authorization
Federal Emergency Management Agency	Flood plain designation
State of Minnesota Approvals	
Minnesota Public Utilities Commission	Site Permit (SP) for Large Wind Energy Conversion System (LWECS)
	Route Permit (RPA) for electric transmission line
Minnesota State Historic Preservation Office (SHPO)	Cultural and historic resources review and review of State and National Register of Historic Sites and Archeological Survey
Minnesota Pollution Control Agency	Section 401 Water Quality Certification
	National Pollutant Discharge Elimination System Permit (NPDES) – MPCA General Stormwater Permit for Construction Activity
	Very Small Quantity Generator (VSQG) License – Hazardous Waste Collection Program
	Aboveground Storage Tank (AST) Notification Form (see also USEPA/MPCA SPCC requirement above)
Minnesota Department of Health	Environmental Bore Hole (EBH)
	Well Construction Notification
	Plumbing Plan Review
Minnesota Department of Natural Resources	License to Cross Public Lands and Water
	Native Prairie Protection Plan
	Endangered species consultations
	Biological surveys
	General permit for water appropriations (construction dewatering)
	Well construction preliminary assessment
	Public Waters Work Permit
Minnesota Board of Water and Soil Resources	Wetland Conservation Act (WCA) approval

Table 11.1-1: Permits and Approvals

Regulatory Authority	Permit/Approval
Minnesota Department of Transportation	Utility Accommodation Permit on Trunk Highway ROW
	Oversize/Overweight Permit for State Highways
	Access/Driveway Permit for MNDOT roads
	Tall Structure Permit
Minnesota Department of Labor and Industry	Electrical plan review, permits, & inspections
Local Approvals	
Freeborn County	ROW permits
	Development, road use and public drainage agreement, to be negotiated in good faith to ensure an objective standard of repair for public infrastructure and adherence with local regulations as of the filing of this SPA.
	Crossing permits
	Driveway permits for access roads
	Oversize/overweight permit for County roads
	Wetland Conservation Act (WCA) approvals
Freeborn County Soil and Water Conservation District	Wetland Conservation Act (WCA) approvals
Townships (Hayward, London, Oakland, and Shell Rock)	ROW permits, crossing permits, driveway permits for access roads, oversize/overweight permits for township roads
Shell Rock River Watershed District	Erosion control, land/water alteration, wetlands/floodplains, and pollution control approvals
Other	
Midcontinent Independent System Operator (MISO)	Turbine Change Study
	Generator Interconnection Agreement

12.0 References

Albert Lea Convention and Visitors Bureau. 2017. Web site address: http://albertleatourism.org/ (accessed 3/27 – 3/31/2017).

American Wind Energy Association (AWEA). 2016. $7.3 billion in public health savings seen in 2015 from wind energy cutting air pollution. Article available on-line at: http://www.awea.org/MediaCenter/pressrelease.aspx?ItemNumber=8634 (Accessed 6/1/2017).

Anfinson, Scott F. 1990. Archaeological Regions in Minnesota and the Woodland Period. In The Woodland Tradition in the Western Great Lakes: Papers Presented to Elden Johnson, edited by G. E. Gibbon, pp. 135-166. University of Minnesota Publications in Anthropology No. 4. University of Minnesota, Minneapolis.

Avian Power Line Interaction Committee (APLIC). 2006. Suggested Practices for Avian Protection on Power Lines: The State of the Art in 2006. Public Interest Energy Research Program (PIER) Final Project Report CEC-500-2006-022. Edison Electric Institute, APLIC, and the California Energy Commission. Washington D.C. and Sacramento, California.

BHE Environmental, Inc. (BHE). 2010. Post-Construction Bird and Bat Mortality Study: Cedar Ridge Wind Farm, Fond Du Lac County, Wisconsin. Interim Report prepared for Wisconsin Power and Light, Madison, Wisconsin. Prepared by BHE Environmental, Inc. Cincinnati, Ohio. February 2010.

Black Oak Wind, LLC, and Getty Wind Company, LLC. 2012. Black Oak and Getty Wind Avian and Bat Protection Plan. Updated July 9, 2012. 34 pp.

Chodachek, K., C. Derby, D. Bruns Stockrahm, P. Rabie, K. Adachi, and T. Thorn. 2014. Bat Fatality Rates and Effects of Changes in Operational Cut-in Speeds at Commercial Wind Farms in Southern Minnesota - Year 1: July 9 - October 31, 2013. Prepared for Minnesota Department of Commerce, St. Paul, Minnesota. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismarck, North Dakota, and Minnesota State University Moorhead, Moorhead, Minnesota. May 23, 2014. Available online at: http://mn.gov/commerce/energyfacilities/documents/MNDOC,%20Bat%20Fatality%20Study%20Year%201,%205.23.14.pdf

Chodachek, K., C. Derby, M. Sonnenberg, and T. Thorn. 2012. Post-Construction Fatality Surveys for the Pioneer Prairie Wind Farm I Llc Phase Ii, Mitchell County, Iowa: April 4, 2011 – March 31, 2012. Prepared for EDP Renewables, North America LLC, Houston, Texas. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismarck, North Dakota. August 27, 2012.

Cryan, P. M. 2008. Mating Behavior as a Possible Cause of Bat Fatalities at Wind Turbines. Journal of Wildlife Management 72(3): 845-849. doi: 10.2193/2007-371.

Cryan, P. M. and A. C. Brown. 2007. Migration of Bats Past a Remote Island Offers Clues toward the Problem of Bat Fatalities at Wind Turbines. Biological Conservation 139: 1-11. doi:10.1016/j.biocon.2007.05.019.

Derby, C., K. Chodachek, and K. Bay. 2010a. Post-Construction Bat and Bird Fatality Study Crystal Lake Ii Wind Energy Center, Hancock and Winnebago Counties, Iowa. Final Report: April 2009- October 2009. Prepared for NextEra Energy Resources, Juno Beach, Florida. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismarck, North Dakota. June 2, 2010.

Derby, C., K. Chodachek, K. Bay, and A. Merrill. 2010b. Post-Construction Fatality Surveys for the Elm Creek Wind Project: March 2009- February 2010. Prepared for Iberdrola Renewables, Inc. (IRI), Portland, Oregon. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismarck, North Dakota.

Derby, C., K. Chodachek, K. Bay, and A. Merrill. 2010c. Post-Construction Fatality Surveys for the Moraine Ii Wind Project: March - December 2009. Prepared for Iberdrola Renewables, Inc. (IRI), Portland, Oregon. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismarck, North Dakota.

Derby, C., K. Chodachek, K. Bay, and A. Merrill. 2010d. Post-Construction Fatality Surveys for the Winnebago Wind Project: March 2009 - February 2010. Prepared for Iberdrola Renewables, Inc. (IRI), Portland, Oregon. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismarck, North Dakota.

Derby, C., K. Chodachek, K. Bay, and S. Nomani. 2011a. Post-Construction Fatality Surveys for the Barton I and Ii Wind Project: Iri. March 2010 - February 2011. Prepared for Iberdrola Renewables, Inc. (IRI), Portland, Oregon. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismarck, North Dakota. Version: September 28, 2011.

Derby, C., T. Thorn, and K. Bay. 2011b. Wildlife Baseline Studies for the Big Blue Wind Energy Project, Faribault County, Minnesota. Interim Report November 2010 - August 2011. Prepared for Pinnacle Engineering. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismarck, North Dakota.

Derby, C., K. Chodachek, and M. Sonnenberg. 2012. Post-Construction Fatality Surveys for the Elm Creek Ii Wind Project. Iberdrola Renewables: March 2011-February 2012. Prepared for Iberdrola Renewables, LLC, Portland, Oregon. Prepared by Western EcoSystems Technology, Inc. (WEST), Bismarck, North Dakota. October 8, 2012.

Deru, M. and P. Torcellini. 2007. Source Energy and Emission Factors for Energy Use in Buildings. Technical report NREL/TP-550-38617. National Renewable Energy Laboratory, United States Department of Energy.

Diffendorfer, J.E., Compton, Roger, Kramer, Louisa, Ancona, Zach, and Norton, Donna, 2017, Onshore industrial wind turbine locations for the United States (ver. 1.2, January 2017): U.S. Geological Survey Data Series 817, https://doi.org/10.3133/ds817. ISSN 2327-638x (online).

Draxl, C.; Hodge, B. M.; Clifton, A.; McCaa, J. 2015. The Wind Integration National Dataset (WIND) Toolkit. Applied Energy (151); pp. 355-366.

Epilepsy Foundation. 2013. Photosensitivity and Seizures. Available on-line at: http://www.epilepsy.com/learn/triggers-seizures/photosensitivity-and-seizures. (Accessed April, 2017).

Erickson, W. P., G. D. Johnson, D. P. Young, D. Strickland, R. Good, M. Bourassa, K. Bay, and K. Sernka. 2002. Synthesis and Comparison of Baseline Avian and Bat Use, Raptor Nesting and Mortality Information from Proposed and Existing Wind Developments. Technical report prepared for Bonneville Power Administration, Portland, Oregon by WEST, Inc., Cheyenne, Wyoming. December 2002. http://www.bpa.gov/Power/pgc/wind/Avian_and_Bat_Study_12-2002.pdf.

Erickson, W. P., G. D. Johnson, M. D. Strickland, D. P. Young, Jr., K. J. Sernka, and R. E. Good. 2001. Avian Collisions with Wind Turbines: A Summary of Existing Studies and Comparisons to Other Sources of Bird Collision Mortality in the United States. National Wind Coordinating Collaborative (NWCC) Publication and Resource Document. Prepared for the NWCC by WEST, Inc., Cheyenne, Wyoming. August 2001.

Erickson, W. P., M. M. Wolfe, K. J. Bay, D. H. Johnson, and J. L. Gehring. 2014. A Comprehensive Analysis of Small Passerine Fatalities from Collisions with Turbines at Wind Energy Facilities. PLoS ONE 9(9): e107491. doi: 10.1371/journal.pone.0107491.

Federal Aviation Administration (FAA). 2016. Obstruction Marking and Lighting (AC No. 70/7460-1L). October 8, 2016. Available on-line at: https://www.faa.gov/documentLibrary/media/Advisory_Circular/AC_70_7460-1L_Change_1_Obstruction_Marking_and_Lighting_10062016.pdf.

Fernley, J., S. Lowther, and P. Whitfield. 2006. A Review of Goose Collisions at Operating Wind Farms and Estimation of the Goose Avoidance Rate. Unpublished report. West Coast Energy, Hyder Consulting and Natural Research.

Freeborn County. 2015. Freeborn County Code of Ordinances. Available on-line at: https://www.municode.com/library/mn/freeborn_county/codes/code_of_ordinances (Accessed March 2017).

Freeborn County. 2006. Freeborn County Comprehensive Water Plan 2006-2015. http://www.co.freeborn.mn.us/DocumentCenter/Home/View/1315. (Accessed April 2017).

Gasper, B.R. 2013. Memo dated March 4, 2013, to M. Peterson, EDF Renewable Energy, Minneapolis, Minnesota, Re: Spring and Fall 2012 Avian Point County Survey, Stoneray Wind Project. Burns & McDonnell Engineering Company, Inc., Kansas City, Missouri. 14 pp.

Germany 2016. Low-frequency Noise incl. Infrasound from Wind Turbines and Other Sources, Ministry for the Environment, Climate and Energy of the Federal State of Baden-Wuerttemberg Germany, September 2016.

Gibbon, Guy E., C. M. Johnson and E. Hobbs. 2002 Minnesota's Environment and Native American Culture History. Electronic document available online at: http://www.mnmodel.dot.state.mn.us/chapters/chapter3.html.

Gomberg, J and E. Schweig. "Earthquake Hazard in the Heart of the Homeland: U.S. Geological Survey Fact Sheet FS-131-02." http://pubs.usgs.gov/fs/fs-131-02/fs-131-02.pdf. October 2002. (Accessed 3/28/2017).

Google Earth. 2017. Image data. Google Earth 7.1.8.3036. Copyrighted by Google Inc.

Gruver, J., M. Sonnenberg, K. Bay, and W. Erickson. 2009. Post-Construction Bat and Bird Fatality Study at the Blue Sky Green Field Wind Energy Center, Fond Du Lac County, Wisconsin July 21 - October 31, 2008 and March 15 - June 4, 2009. Unpublished report prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. December 17, 2009.

Harris, R.I., 1999. Improvements to the method of independent storms. J. Wind Eng. Ind. Aerodyn. 80, 1–30.

Health Canada. Understanding the Evidence: Wind Turbine Noise, The Expert Panel on Wind Turbine Noise and Human Health. Council of Canadian Academies. April 2015.

Hessler, David M. 2011. Best Practices Guidelines for Assessing Sound Emissions from Proposed Wind Farms and Measuring the Performance of Completed Projects. Report prepared for the Minnesota Public Utilities Commission and Measuring the Performance of Completed Projects. Report prepared for the Minnesota Public Utilities Commission. National Association of Regulatory Utility Commissioners, Washington, DC.

Hoen, Ben, Jason P. Brown, Thomas Jackson, Ryan Wiser, Mark Thayer and Peter Cappers. 2013. A Spatial Hedonic Analysis of the Effects of Wind Energy Facilitieis on Surrounding Property Values in the United States. Environmental Energy Technologies Division, Ernest Orlando Lawrence Berkeley National LaboratoryBerkeley, California. Available online at: https://emp.lbl.gov/sites/all/files/lbnl-6362e.pdf.

Howe, R. W., W. Evans, and A. T. Wolf. 2002. Effects of Wind Turbines on Birds and Bats in Northeastern Wisconsin. Prepared by University of Wisconsin-Green Bay, for Wisconsin Public Service Corporation and Madison Gas and Electric Company, Madison, Wisconsin. November 21, 2002. 104 pp.

International Electrotechnical Commission (IEC). 2012. International Standard IEC 64100-11:2012, Wind turbines – Part 11: Acoustic noise measurement techniques, Edition 3.0. Available for purchase at https://webstore.iec.ch/publication/5428.

International Organization for Standardization (ISO). 1996. International Standard ISO 9613-2:1996, Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation. Available for purchase at https://www.iso.org/standard/20649.html. (Accessed April 2017).

Jain, A. 2005. Bird and Bat Behavior and Mortality at a Northern Iowa Windfarm. M.S. Thesis. Iowa State University, Ames, Iowa.

Japan 2016. Investigation, Prediction, and Evaluation of Wind Turbine Noise in Japan, Kimura et al, August 2016.

Johnson, G. D., W. P. Erickson, M. D. Strickland, M. F. Shepherd, and D. A. Shepherd. 2000. Final Report: Avian Monitoring Studies at the Buffalo Ridge Wind Resource Area, Minnesota: Results of a 4-Year Study. Final report prepared for Northern States Power Company, Minneapolis, Minnesota, by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. September 22, 2000. 212 pp. http://www.west-inc.com.

Johnson, G. D., W. P. Erickson, M. D. Strickland, M. F. Shepherd, D. A. Shepherd, and S. A. Sarappo. 2003. Mortality of Bats at a Large-Scale Wind Power Development at Buffalo Ridge, Minnesota. The American Midland Naturalist 150: 332-342.

Johnson, G. D., M. K. Perlik, W. P. Erickson, and M. D. Strickland. 2004. Bat Activity, Composition and Collision Mortality at a Large Wind Plant in Minnesota. Wildlife Society Bulletin 32(4): 1278-1288.

Kerlinger, P., R. Curry, A. Hasch, and J. Guarnaccia. 2007. Migratory Bird and Bat Monitoring Study at the Crescent Ridge Wind Power Project, Bureau County, Illinois: September 2005 - August 2006. Final draft prepared for Orrick Herrington and Sutcliffe, LLP. May 2007.

Kunz, T. H., E. B. Arnett, B. M. Cooper, W. P. Erickson, R. P. Larkin, T. Mabee, M. L. Morrison, M. D. Strickland, and J. M. Szewczak. 2007a. Assessing Impacts of Wind-Energy Development on Nocturnally Active Birds and Bats: A Guidance Document. Journal of Wildlife Management 71(8): 2449-2486. Available online at: http://www.batsandwind.org/pdf/Assessing%20Impacts%20of%20wind-energy%20development%20on%20bats%20and%20birds.pdf.

Kunz, T. H., E. B. Arnett, W. P. Erickson, A. R. Hoar, G. D. Johnson, R. P. Larkin, M. D. Strickland, R. W. Thresher, and M. D. Tuttle. 2007b. Ecological Impacts of Wind Energy Development on Bats: Questions, Research Needs, and Hypotheses. Frontiers in Ecology and the Environment 5(6): 315-324. Available online at: https://www.bu.edu/cecb/files/2009/12/kunzbats-wind07.pdf.

Massachusetts 2012. Wind Turbine Health Impact Study, Report of Independent Expert Panel, Massachusetts Department of Environmental Protection, January 2012.

Midwest Regional Climate Center. 2016. Annual Climate Summary by Month. http://mrcc.isws.illinois.edu/CLIMATE/Station/Annual/AnnualSummary.jsp.

Minnesota Administrative Rules, Chapter 7070, Noise Pollution Control. https://www.revisor.leg.state.mn.us/rules/?id=7030. (Accessed April 2017).

Minnesota Board of Water & Soil Resources (BWSR). 2017. Wetland Banking Tool. http://maps.bwsr.state.mn.us/banking/. (Accessed June 2017)

Minnesota Department of Commerce (DOC) – Energy Facility Permitting. 2017. eDocket Search. https://www.edockets.state.mn.us/EFiling/edockets/searchDocuments.do?method=showeDocketsSearch&showEdocket=true&userType=public.

Minnesota Department of Commerce (DOC), Office of Energy Security – Energy Facilities Permitting. 2010. Application Guidance for Site Permitting of Large Wind Energy Conversion Systems in Minnesota. https://mn.gov/commerce/energyfacilities/documents/LWECS_APP_Guide_AUG2010.pdf. (Accessed April 2017).

Minnesota Department of Health (MDH). 2009. Public Health Impacts of Wind Turbines, Minnesota Department of Health, Environmental Health Division, May 2009.

Minnesota Department of Natural Resources (MNDNR). 1984. Public Waters Inventory (PWI) Maps. http://www.dnr.state.mn.us/waters/watermgmt_section/pwi/maps.html (Accessed March/April 2017).

Minnesota Department of Natural Resources (MNDNR). 2009. Ecological Classification System Map. http://www.dnr.state.mn.us/ecs/index.html. (Accessed March 2017).

Minnesota Department of Natural Resources (MNDNR). 2011. Guidance for Commercial Wind Energy Projects. October 1, 2011. 20 pp. Information available at: http://files.dnr.state.mn.us/publications/ewr/dnr_wind_energy_project_guidance_2011.pdf.

Minnesota Department of Natural Resources (MNDNR). 2014. Designated Wildlife Lakes in Minnesota. http://files.dnr.state.mn.us/fish_wildlife/wildlife/shallowlakes/shallow_lakes_list.pdf. (Accessed April 17, 2017).

Minnesota Department of Natural Resources (MNDNR), Division of Forestry. 2016. Minnesota's Forest Resources 2015. MNDNR St. Paul, MN.

Minnesota Department of Natural Resources (MNDNR). 2016a. Licensed Natural Heritage Information System data to Merjent (License Agreement 750), current as of June 14, 2016.

Minnesota Department of Natural Resources (MNDNR). 2016b. Minnesota's Watershed Basins. Accessed April 17, 2017 from http://www.dnr.state.mn.us/watersheds/map.html.

Minnesota Department of Natural Resources (MNDNR). 2017. National Wetland Inventory Update for Minnesota. https://gisdata.mn.gov/dataset/water-nat-wetlands-inv-2009-2014. Accessed April 2017.

Minnesota Department of Transportation (MnDOT). 2015. 2015 Publication Traffic Volumes – Freeborn County. http://www.dot.state.mn.us/traffic/data/maps/trunkhighway/2015/counties/freeborn.pdf. (Accessed April 20, 2017).

Minnesota Department of Transportation (MnDOT). 2016. Aggregate Source Information System Map. http://www.dot.state.mn.us/materials/asis_GE.html. (Accessed March 2017).

Minnesota Environmental Quality Board (EQB). 2017. Cannon Falls Energy Center - https://www.eqb.state.mn.us/cannon-falls-energy-center. (Accessed April 20, 2017).

Minnesota Pollution Control Agency (MPCA). 2015. A Guide to Noise Control in Minnesota – Acoustical Properties, Measurement, Analysis, and Regulation. https://www.pca.state.mn.us/sites/default/files/p-gen6-01.pdf. (Accessed April 2017).

Minnesota Pollution Control Agency (MPCA). 2016. Draft 2016 Impaired Waters List. https://www.pca.state.mn.us/water/minnesotas-impaired-waters-list. (Accessed April 17, 2017).

Minnesota Public Utilities Commission (MPUC). 2008. Order Establishing General Wind Permit Standards.

https://mn.gov/commerce/energyfacilities/documents/19302/PUC%20Order%20Standards%20and%20Setbacks.pdf. (Accessed April 2017).

Minnesota Rural Electric Association, Minnesota Power, Xcel Energy, Otter Tail Power Company, Minnesota Farm Bureau, Minnesota Farmers Union, Cooperative Network, Minnesota Municipal Utilities Association, Minnesota Department of Labor and Industry, and the Minnesota Department of Agriculture (sponsoring organizations). September 2015. Minnesota Stray Voltage Guide. http://www.minnesotastrayvoltageguide.com/wp-content/uploads/2015/10/MN_StrayVoltageGuide_HR.pdf. (Accessed April 19, 2017).

Minnesota Statutes Section 103G.201. 2016. 2016 Minnesota Statutes; Water; Chapter 103g - Waters of the State; Section 103g.201 - Public Waters Inventory. Available online at: https://www.revisor.leg.state.mn.us/statutes/?id=103G.201.

Mixon, K.L., J. Schrenzel, D. Pile, R. Davis, R. Doneen, L. Joyal, N. Kestner, M. Doperalski, and J. Schladweiler. 2014. Avian and Bat Survey Protocols for Large Wind Energy Conversion Systems in Minnesota. Minnesota Department of Natural Resources. New Ulm, Minnesota. 41 pp.

National Association of Regulatory Utility Commissioners (NARUC). 2011. Assessing Sound Emissions from Proposed Wind Farms & Measuring the Performance of Completed Projects. http://pubs.naruc.org/pub/536DE04F-2354-D714-5179-F709E98A8093. (Accessed April 2017).

National Institute of Environmental Health (NIEH) Sciences EMF-RAPID Program Staff, 1999. NIEHS Report on Health Effects from Exposure to Power Line Frequency Electric and Magnetic Fields. Research Triangle Park, NC.

National Research Council (NRC). 2007. Environmental Impacts of Wind-Energy Projects. National Academies Press. Washington, D.C. www.nap.edu.

NOAA. National Climatic Data Center. *Storm Events Database*. 2013. http://www.ncdc.noaa.gov/stormevents/.

Ornithological Council, The. 2007. Critical Literature Review: Impact of Wind Energy and Related Human Activities on Grassland and Shrub-Steppe Birds. Prepared for the National Wind Consulting Council. Literature Review by S. Mabey and E. Paul. October 2007.

Quade, Henry and John Rongstad. 1991. Freeborn County Geologic Atlas. Water Resources Center, Mankato State University. Mankato, Minnesota.

Rienecker, M.M., M.J. Suarez, R. Gelaro, R. Todling, J. Bacmeister, E. Liu, M.G. Bosilovich, S.D. Schubert, L. Takacs, G.-K. Kim, S. Bloom, J. Chen, D. Collins, A. Conaty, A. da Silva, et al. (2011), MERRA: NASA's Modern-Era Retrospective Analysis for Research and Applications. J. Climate, 24, 3624-3648.

Shaffer, J. A. and D. H. Johnson. 2008. Displacement Effects of Wind Developments on Grassland Birds in the Northern Great Plains. Presented at the Wind Wildlife Research Meeting VII, Milwaukee, Wisconsin. Wind Wildlife Research Meeting VII Plenary. October 28-29, 2008.

Shaffer, J. A., D. H. Johnson, and D. A. Buhl. 2012. Avoidance of Wind Generators by Breeding Grassland Birds. Poster presented at the 5th North American Ornithological Conference, August 14 - 18, Vancouver, Canada.

Shaw, S.P. and C.G. Fredine. 1956. Wetlands of the United States (FWS Circular 39).

Slade, D. H. (1968). Meteorology and Atomic Energy. U.S. Atomic Energy Commission, Div. TeCh. Info., Oak Ridge, TN.

Spaans, A., L. van der Bergh, S. Dirksen, and J. van der Winden. 1998. Windturbines En Volgles: Hoe Hiermee Om Te Gaan? (Wind Turbines and Birds: Can They Co-Exist?). De Levende Naturr 99(3): 115-121.

Stantec. 2012. Bird and Bat Conservation Strategy, EcoHarmony West Wind Energy Project, Fillmore County, Minnesota. November 2012. Prepared for Gamesa Energy USA LLC, Minneapolis, Minnesota. Prepared by Stantec. Available online at: https://www.edockets.state.mn.us/EFiling/edockets/searchDocuments.do?method=showPoup&documentId={38FADF90-B842-4DA0-B138-9CE228CB48E2}&documentTitle=201211-80341-09.

Tachibana 2014. Outcome of Systematic Research on Wind Turbine Noise in Japan. Tachibana. November 2014.

Union of Concerned Scientists (UCS). 2017. Benefits of Renewable Energy Use. Article available at: http://www.ucsusa.org/clean-energy/renewable-energy/public-benefits-of-renewable-power#.WS2vlBGGM5s (Accessed 6/1/2017).

U.S. Army Corps of Engineers (USACE). 1987. Corps of Engineers Wetlands Delineation Manual. https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/16/nrcs143_020653.pdf.

U.S. Census. American Fact Finder. 2010. Web site address: https://factfinder.census.gov/faces/nav/jsf/pages/community_facts.xhtml. (Accessed March 2017).

U.S. Department of Agriculture (USDA), Natural Resource Conservation Service (NRCS). 2016. Official Soil Series Descriptions. Soil Survey Staff. http://soils.usda.gov/technical/classification/osd/index.html. (Accessed March 2017).

USDA, National Agricultural Statistics Service. 2012. 2012 Census of Agriculture – County Profile – Freeborn County, Minnesota. (Accessed March 2017).

U.S. Environmental Protection Agency (USEPA). 2017. Emissions & Generation Resource Integrated Database (eGRID2014) V.2. Revised release 2/27/2017. Data available on-line at: https://www.epa.gov/energy/emissions-generation-resource-integrated-database-egrid (Accessed 6/1/2017).

U.S. Energy Information Administration (EIA). 2017. State Energy Profiles. Data available on-line at: https://www.eia.gov/state/ (Accessed 6/1/2017).

U.S. Geological Survey (USGS). 2011. National Gap Analysis Program Land Cover Data – Version 2. http://gapanalysis.usgs.gov/gaplandcover/data/download/. (Accessed March 2017).

USGS. 2016. ArcGIS Rest Services Directory. Streaming data. The National Map, USGS. Last updated September 2016. Data from: https://basemap.nationalmap.gov/arcgis/rest/services.

USGS National Hydrography Dataset (NHD). 2016. USGS NHD Extracts: Iowa and Minnesota. Accessed October 2016. Information available online at: http://nhd.usgs.gov/; State data available online at: ftp://nhdftp.usgs.gov/DataSets/Staged/States/FileGDB/HighResolution/.

USGS Protected Areas Database (PAD). 2016. Protected Areas of the United States. Edition 1.4. https://gapanalysis.usgs.gov/PADUS/.

U.S. Fish and Wildlife Service (USFWS). 2011. Indiana Bat Section 7 and Section 10 Guidance for Wind Energy Projects. Revised October 26, 2011. Available online at: http://www.fws.gov/midwest/endangered/mammals/inba/pdf/inbaS7and10WindGuidanceFinal26Oct2011.pdf.

USFWS. 2012. U.S. Fish and Wildlife Service Land-Based Wind Energy Guidelines. https://www.fws.gov/ecological-services/es-library/pdfs/WEG_final.pdf (Accessed April 2017).

USFWS. 2013a. Eagle Conservation Plan Guidance. Module 1 - Land-Based Wind Energy. Version 2. Division of Migratory Bird Management, USFWS. April 2013. Available online at: https://www.fws.gov/migratorybirds/pdf/management/eagleconservationplanguidance.pdf.

USFWS. 2014. Northern Long-Eared Bat Interim Conference and Planning Guidance. USFWS Regions 2, 3, 4, 5, and 6. January 6, 2014. Available online at: http://www.fws.gov/northeast/virginiafield/pdf/NLEBinterimGuidance6Jan2014.pdf.

USFWS National Wetlands Inventory (NWI). 2016. NWI Data Mapper. Updated October 13, 2016. Fort Snelling, Minnesota. Wetlands Mapper: http://www.fws.gov/wetlands/Data/Mapper.html.

Vermont 2010. Potential Impact on the Public's Health from Sound Associated with Wind Turbine Facilities, Vermont Department of Health, October 2010.

Walker 2012. A Cooperative Measurement Survey and Analysis of Low Frequency and Infrasound at the Shirley Wind Farm in Brown County Wisconsin, Walker et al, December 2012.

Westwood Professional Services. 2012. Avian and Bat Protection Plan: Including Bird and Bat Conservation Strategies and an Eagle Conservation Plan, New Era Wind Project, Goodhue County, Minnesota. Prepared for New Era Wind Farm, LLC, Goodhue, Minnesota. Prepared by Westwood Professional Services, Eden Prairie, Minnesota. November 1, 2012. Available online: https://www.edockets.state.mn.us/EFiling/edockets/searchDocuments.do?method=showPoup&documentId={06CF40E5-6EA0-4A8C-9DD1-2631B35BAD99}&documentTitle=201211-80312-02.

Westwood Professional Services. 2013. 2012 Avian and Bat Fatality Monitoring Lakefield Wind Project Jackson County, Minnesota. https://www.edockets.state.mn.us/EFiling/edockets/searchDocuments.do?method=showPoup&documentId={0975A27A-BF4E-4C0A-A687-13921C2B58EF}

Westwood Professional Services. 2015. 2014 Avian and Bat Fatality Monitoring Lakefield Wind Project, Jackson County, Minnesota. https://www.edockets.state.mn.us/EFiling/edockets/searchDocuments.do?method=showPoup&documentId={692D3147-C6D7-41DE-A8B3-EA7381C45948}&documentTitle=20154-109264-01

Winkelman, E. 1990. Impact of the Wind Park near Urk, Netherlands, on Birds: Bird Collision Victims and Disturbance of Wintering Fowl. International Ornithological Congress 20: 402-403.